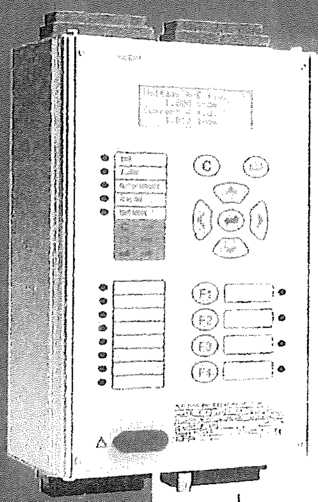
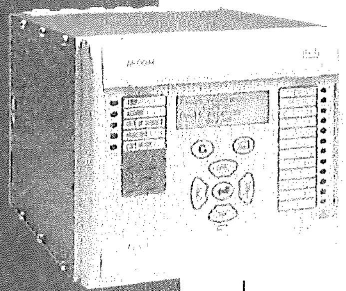
AUTOMATION & INFORMATION SYSTEMS

MiCOM P13x

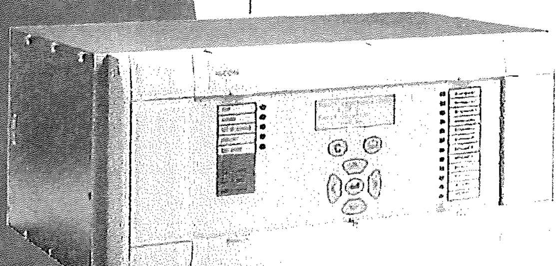
Feeder Management Relays



compact P130C



modular P132



The time-overcurrent protection devices of the MiCOM P13x range are designed for selective short-circuit protection, ground fault protection and overload protection. They can be applied in all types of medium- and high-voltage systems.

The broad spectrum of protection functions enables the user to cover a wide range of applications in the protection of cables and overhead lines, transformers and motors. In addition, numerous control functions are available. Thanks to the provision of four setting groups, the P13x devices are readily adapted to varying conditions in system operation.

The intuitive user interface as well as the various communication interfaces allow simple and comprehensive setting as well as access to readings from extensive recordings. Numerous integrated communication protocols provide interfacing to almost any kind of substation control or SCADA system.

Furthermore the integrated InterMiCOM protection interface provides direct end-to-end communication between two protection devices.

The particularly flat compact case of the P130C as well as the standard 19" modular case of the P132 with a user-selected number of plug-in modules provide a flexible solution for easy integration of the devices into the substation. Both case variants are available for flush mounting and wall-surface mounting.

Customer Benefits

- 1A/5A software setting
- Two communication interfaces (for SCADA and RTU)
- InterMiCOM protection interface

T&D

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APPLICATION

Overcurrent protection devices MiCOM P13x provide a wide range of protection functions.
For the different requirements in system protection the integrated functions follow the availability of CT and VT inputs (order options). As a result the preferred applications are as follows:

> P130C with VT:
  Voltage and Frequency Protection

> P130C with CT and VT:
  Directional Time-Overcurrent Protection

> P132 with CT:
  Non-Directional Time-Overcurrent Protection

> P132 with CT and VT:
  Directional Time-Overcurrent Protection

GLOBAL FUNCTIONS

The following global functions are generally available in all devices:

> Parameter subset selection
  (4 alternative setting groups)

> Metering

> Operating data recording

> Overload recording incl. overload data acquisition

> Ground fault recording
  incl. ground fault data acquisition

> Fault recording of all CT/VT inputs and binary events
  incl. fault measurands (e.g. fault location).

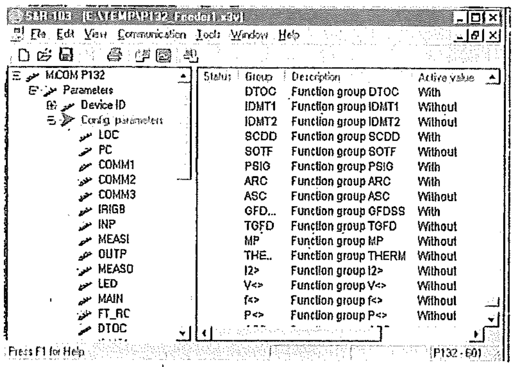
Functions Overview			P130C with VT	P130C with CT/VT	P132 with CT	P132 with CT/VT
50/51 P,Q,N	DTOC	Definite-time o/c protection, three stages, phase-selective	-	x	x	x
51 P,Q,N	IDMT resp. IDMT1	Inverse-time o/c protection, single-stage, phase-selective	-	x	x	x
51 P,Q,N	IDMT2	Inverse-time o/c protection, single-stage, phase-selective	-	-	x	x
67	SCDD	Short-circuit direction determination	-	x	-	x
50/27	SOTF	Switch on to fault protection	-	x	x	x
85	PSIG	Protective signaling	-	x	x	x
79	ARC	Auto-reclosure control (3-pole)	-	x	x	x
25	ASC	Automatic synchronism check	-	-	-	option
67N	GFDSS	Ground fault direction determination	-	x	-	x
67N	TGFD	Transient ground fault direction determination	-	-	-	option
37/48/49/ 49LR/50S/66	MP	Motor protection	-	x	x	x
49	THERM	Thermal overload protection	-	x	x	x
46	I2>	Unbalance protection	-	x	x	x
27/59 P,Q,N	V<>	Over-/Undervoltage protection	x	x	-	x
81	f<>	Over-/Underfrequency protection	x	x	-	x
32	P<>	Directional power protection	-	x	-	x
50BF/62	CBF	Circuit breaker failure protection	-	x	x	x
30/74	MCMOM	Measuring-circuit monitoring	x	x	x	x
	LIMIT	Limit value monitoring	-	x	x	x
	LOGIC	Programmable logic	x	x	x	x
	DEV	Control and monitoring of up to 3 switchgear units	-	-	option	option
	ILOCK	Interlocking logic	-	-	option	option
	COMMx	2 comm. interfaces, IRIG-B, protection comm. interface InterMiCOM	option	option	option	option
	INP / OUTP	Binary inputs / output relays (maximum number)	2 / 8	2 / 8	40 / 30	40 / 30
	MEASI / MEASO	Analog I/O (2x 20 mA outputs, 20 mA input, RTD inputs)	-	-	option	option

MiCOM P13x provide a wide range of protection functions.

MAIN FUNCTIONS

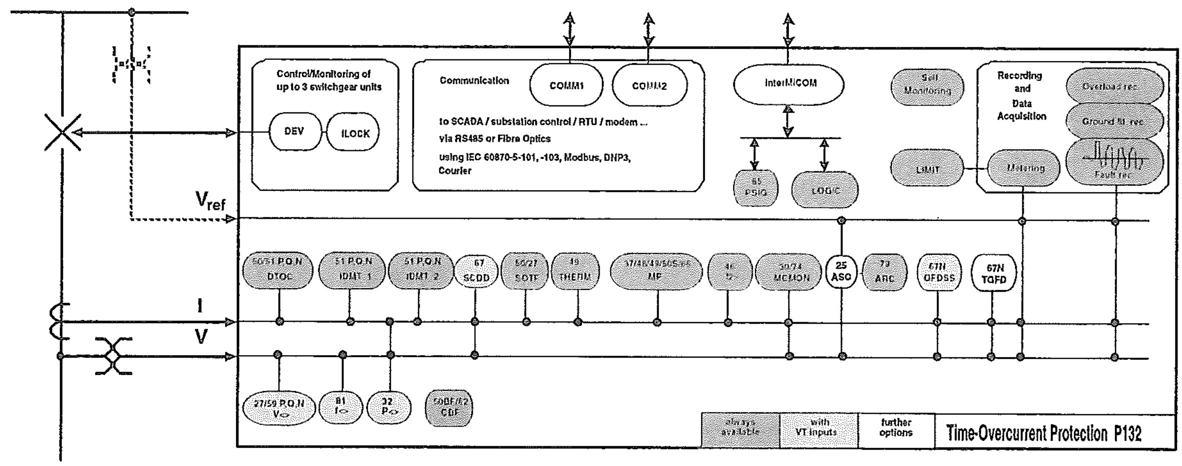
Main functions are autonomous function groups and can be individually configured or disabled to suit a particular application. Function groups that are not required and have been disabled by the user are masked completely (except for the configuration parameter) and functional support is withdrawn from such groups.

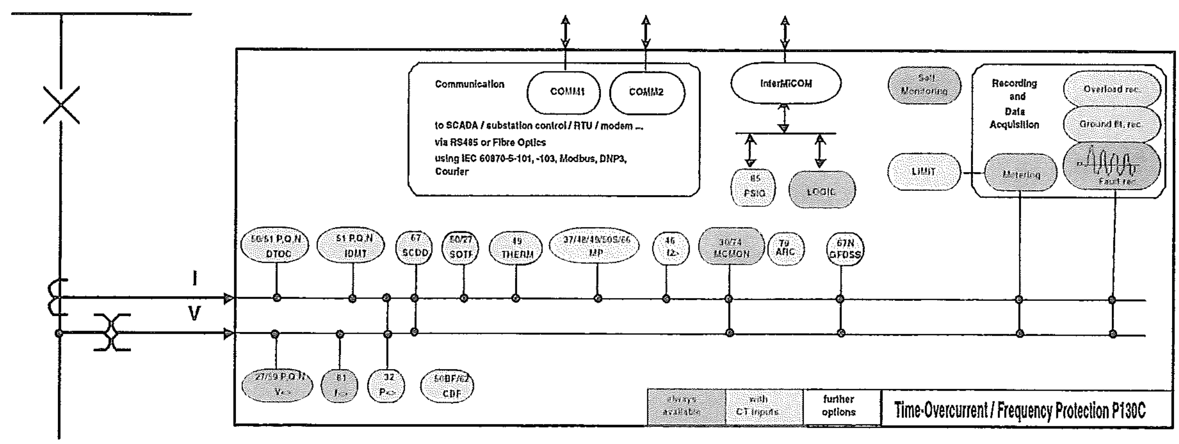
This concept permits an extensive scope of functions and universal application of the device in a single design version, while at the same time providing for a clear and straight-forward setting procedure and adaptation to the protection and control task under consideration.



Simple Function Selection by Mouseclick

FUNCTION DIAGRAMS





(Description of ANSI code nos. see Functions Overview)

TIME-OVERCURRENT PROTECTION

For the overcurrent protection of the three phase currents, the residual current and the negative-sequence current the P13x provide **definite time** overcurrent protection and **inverse time** overcurrent protection with a **multitude** of tripping characteristics.

The operate values of all overcurrent stages can **dynamically changed** (e.g. under cold load pickup conditions). Additionally, some of the phase and negative-sequence current stages can be **stabilized under inrush conditions** if desired.

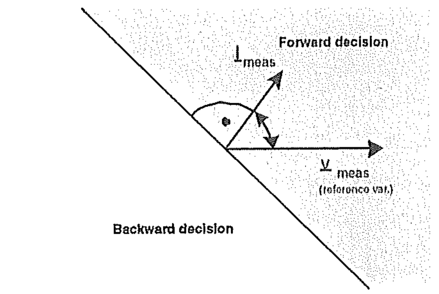
The residual and negative-sequence current stages affect the general starting signal. This effect can be suppressed if desired.

TRIPPING TIME CHARACTERISTICS

No.	Tripping time characteristic (k = 0.01...10.00)	Constants and formulae (t in s) a	b	c	R
0	Definite Time			$t = k$	
	Per IEC 255-3			$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1}$	
1	Normally inverse	0.14	0.02		
2	Very inverse	13.50	1.00		
3	Extremely inverse	80.00	2.00		
4	Long time inverse	120.00	1.00		
	Per ANSI/IEEE C37. 112	Trip			Release
5	Moderately inverse	0.0515	0.0200	0.1140	4.85
6	Very inverse	19.6100	2.0000	0.4910	21.60
7	Extremely inverse	28.2000	2.0000	0.1217	29.10
	Per ANSI	Trip			Release
8	Normally inverse	8.9341	2.0938	0.17966	9.00
9	Short time inverse	0.2663	1.2969	0.03393	0.50
10	Long time inverse	5.6143	1.0000	2.18592	15.75
		$t = k \cdot \left[\frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1} + c\right]$		$t = k \cdot \frac{R}{\left(\frac{I}{I_{ref}}\right)^2 - 1}$	
	Not per standard				
11	RI-type inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$			
	Not per standard				
12	RXIDG-type inverse	$t = k \cdot \left(5.8 - 1.35 \cdot \ln\frac{I}{I_{ref}}\right)$			

DIRECTIONAL CHARACTERISTICS IN SHORT CIRCUIT DIRECTION DETERMINATION

Meas. system	Starting	Variables selected for measurement I_{meas}	V_{meas}	Characteristic angle αP or αN
P	A	I_A	$V_{BC} = V_{BN} - V_{CN}$	+45°
	B	I_B	$V_{CA} = V_{CN} - V_{AN}$	+45°
	C	I_C	$V_{AB} = V_{AN} - V_{BN}$	+45°
	A-B	I_A	$V_{BC} = V_{BN} - V_{CN}$	+60°
	B-C	I_C	$V_{AB} = V_{AN} - V_{BN}$	+30°
	C-A	I_C	$V_{AB} = V_{AN} - V_{BN}$	+60°
	A-B-C	I_C	$V_{AB} = V_{AN} - V_{BN}$	+45°
G	GF	I_N	$V_{NG} = 1/3 \cdot (V_{AN} + V_{BN} + V_{CN})$	-90°...+90° (adjustable)



SHORT-CIRCUIT DIRECTION DETERMINATION

Due to the short-circuit direction determination function, the P13x can be used as directional time-overcurrent protection devices. For the individual overcurrent stages the user can select whether the stage shall be forward-directional, backward-directional or non-directional. Direction determination is performed in separate measuring systems for the phase current and residual current elements, respectively.

MiCOM P13x for rapid and selective fault clearance in your power system.

SWITCH ON TO FAULT PROTECTION

Closing of a circuit breaker might inadvertently lead to a short-circuit fault due to a maintenance ground clamp not yet removed, for example. The function 'switch on to fault protection' provides for an **undelayed protective tripping** during a settable time after a manual close command has been issued.

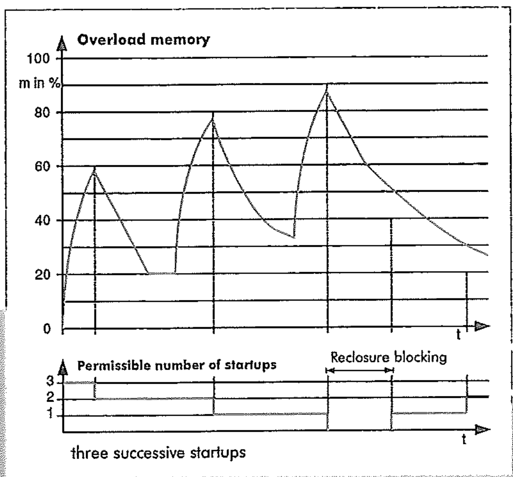
MOTOR PROTECTION

For the protection of directly switched h.v. induction motors with thermally critical rotor, the following specially matched protection functions are provided:

> Recognition of operating mode
> Rotor overload protection using a thermal motor replica
> Choice of reciprocally quadratic or logarithmic tripping characteristic
> Inclusion of heat dispersion processes in the rotor after several startups
> Separate cooling periods for rotating and stopped motors
> Startup repetition monitoring with reclosure blocking
> Control logic for heavy starting and protection of locked rotor

Using the optional RTD inputs, direct monitoring of the temperature of the stator windings and the bearings can be set up with the P132.

OVERLOAD MEMORY AND STARTUP COUNTER



THERMAL OVERLOAD PROTECTION

P13x provide thermal overload protection for lines, transformers and stator windings of h.v. motors. The highest of the three phase currents serves to track a first-order thermal replica according to IEC 255-8. For the P132 the temperature of the cooling medium can be taken into account in the thermal replica using the optional RTD inputs or the optional 20 mA input.
The user has a choice of using a thermal replica on the basis of either relative or absolute temperature.

OVER-/UNDERVOLTAGE PROTECTION

The over- and undervoltage protection allows the multi-stage evaluation of directly measured and internally calculated voltages.

OVER-/UNDERFREQUENCY PROTECTION

The four-stage frequency protection can be operated as pure over- and underfrequency monitoring as well as combined with differential frequency gradient monitoring (df/dt) for system decoupling applications or with medium frequency gradient monitoring ($\Delta f/\Delta t$) for load shedding applications.

DIRECTIONAL POWER PROTECTION

The directional power protection monitors the active and reactive power limits and detects power drop and reversal of direction.

GROUND-FAULT DIRECTION DETERMINATION

For the determination of the ground-fault direction in isolated or Peterson-coil compensated power systems two proven methods are provided:

> **Wattmetric method** (analysis of steady-state signals)
> **Transient method** (analysis of transient signals) (optional).

AUTO-RECLOSING CONTROL

The auto-reclosing control (ARC) operates in three-phase mode. ARC cycles with one high-speed reclosing (HSR) and multiple (up to nine) subsequent time-delay reclosings (TDR) may be configured by the user.

AUTOMATIC SYNCHRONISM CHECK

This option for the P132 can be used in conjunction with automatic or manual (re)closure and the close command of the optional control function. In non-radial networks this ensures that reclosure will proceed only if the synchronism conditions are met.

PROTECTIVE SIGNALING

Protective signaling can be used in conjunction with short-circuit direction determination. For this purpose the protection devices must be suitably connected by pilot wires or the optional protection interface InterMiCOM on both ends of the line section to be protected.
For protection devices on the infeed side of radial networks, teleprotection can also be controlled without the short-circuit direction determination function.

CONTROL

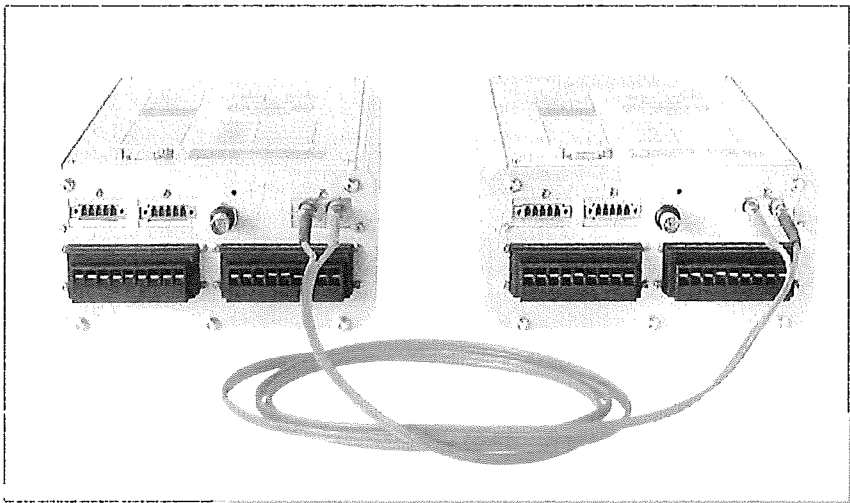
The optional control functions of the P132 are designed for the **control of up to three electrically operated switchgear units** equipped with electrical check-back signaling located in the bay of a medium-voltage substation or a non-complex high-voltage substation. The switchgear units can be controlled via binary inputs or the optional communication interface.

PROTECTION INTERFACE INTERMICOM

Optional InterMiCOM allows high performance permissive and blocking type **unit protection** to be configured, plus transfer of any digital status information between line ends. **Intertripping** is supported too, with channel health monitoring and cyclic redundancy checks (CRC) on the received data for maximum message security.

InterMiCOM provides **eight end-to-end signal bits**, assignable to any function within a MiCOM relay's programmable logic.

Default failsafe states can be set in case of channel outage.



InterMiCOM with Compact Devices

Proven protection with advanced communication and comfortable data handling.

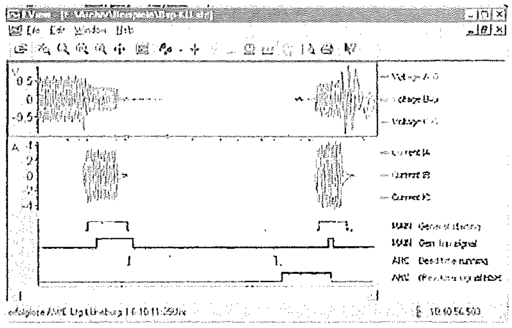
INFORMATION INTERFACES

Information exchange is done via the local control panel, the PC interface and **two** optional **communication interfaces.**

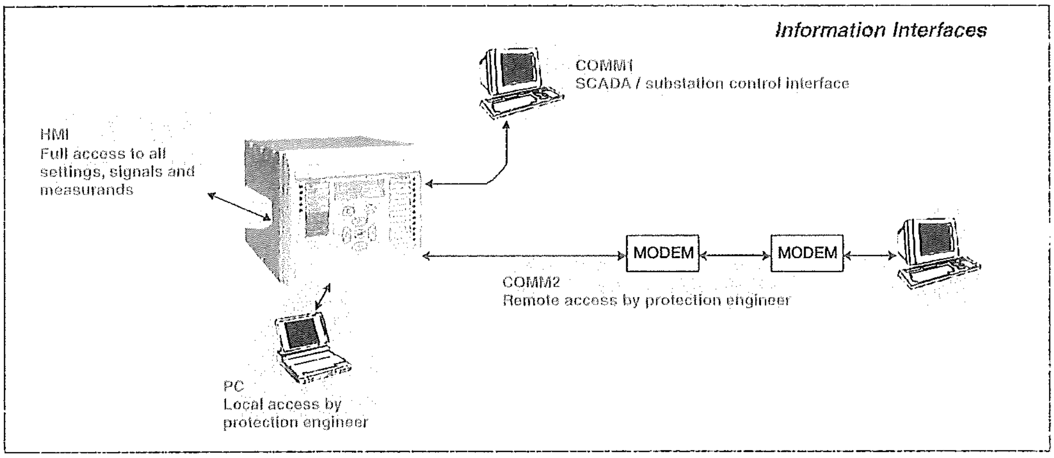
One of the communication interfaces conforms to IEC 60870-5-103, IEC 60870-5-101, DNP 3.0, Modbus and Courier and is intended for integration with substation control systems.

The 2nd communication interface conforms to IEC 60870-5-103 and is intended for central settings or remote access.

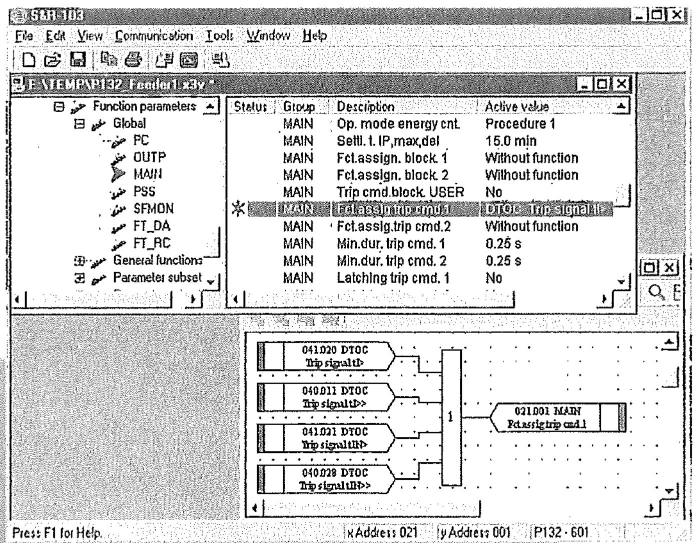
Clock synchronization can be achieved using one of the protocols or using the IRIG-B signal input.



One Record per Fault
(incl. oscillography, SOE, Fault Measurands)



Just one Setting File



Device Track Record
>> **PS 451 / PM 481:** first multi-functional, numerical time-overcurrent devices launched in 1991, more than 14000 devices installed.
>> **PS 441:** first directional time-overcurrent device in compact case design, more than 9000 devices installed since 1994.
>> **PS 4x2:** numerical time-overcurrent devices with extended functionality, more than 4000 devices installed since 1998.
>> **PS 4x2 MiCOM Design:** Adaption of the PS 4x2 to the MiCOM range design, launched in 2001.
>> **MiCOM P13x:** Complete integration of the PS 4x2 into the MiCOM range, extended functionality and realization of a 'compact-solution' in the MiCOM family.

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MiCOM P130C

Directional overcurrent and Frequency Protection

Version -301 -401 -601

Technical Manual

P130C/EN M/C11
(AFSV.12.09340 EN)

⚠ Warning

When electrical equipment is in operation, dangerous voltage will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use, or improper use may endanger personnel and equipment and cause personal injury or physical damage.

Before working in the terminal strip area, the device must be isolated. Where stranded conductors are used, wire end ferrules must be employed.

Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing.

For this reason only qualified personnel may work on or operate this device.

Qualified Personnel

are individuals who

- ☐ are familiar with the installation, commissioning, and operation of the device and of the system to which it is being connected;
- ☐ are able to perform switching operations in accordance with safety engineering standards and are authorized to energize and de-energize equipment and to isolate, ground, and label it;
- ☐ are trained in the care and use of safety apparatus in accordance with safety engineering standards;
- ☐ are trained in emergency procedures (first aid).

Note

The operating manual for this device gives instructions for its installation, commissioning, and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate AREVA technical sales office and request the necessary information.

Any agreements, commitments, and legal relationships and any obligations on the part of AREVA, including settlement of warranties, result solely from the applicable purchase contract, which is not affected by the contents of the operating manual.

ALSTOM

Transmission & Distribution
Schutz- und Schaltanlagenleittechnik

Konformitätserklärung
Declaration of Conformity

Wir
We

ALSTOM Energietechnik GmbH
Schutz- und Schaltanlagenleittechnik
(Name des Anbieters / supplier`s name)

Lyoner Str. 44-48
D-60528 Frankfurt
(Anschrift / address)

Diese Konformitätserklärung entspricht der Europäischen Norm EN 45014 "Allgemeine Kriterien für Konformitätserklärungen von Anbietern". Die Grundlage der Kriterien sind internationale Dokumente, insbesondere ISO bzw. IEC-Leitfaden 22, 1982, "Information on manufacturer's declaration of conformity with standards or technical specifications".

This Declaration of Conformity conforms to the European Standard EN 45014, "General criteria for supplier's declaration of conformity." The basis for the criteria has been found in international documentation, particularly in ISO/IEC Guide 22, 1982, "Information on manufacturer's declaration of conformity with standards or technical specifications".

erklären in alleiniger Verantwortung, daß das Produkt
declare under our sole responsibility that the product

Gerichtete Überstromzeit- und Frequenzschutzeinrichtung
Directional Time-Overcurrent and Frequency Protection Device

P130C

alle Ausführungen
all versions

auf das sich diese Erklärung bezieht, mit den folgenden Normen oder den normativen Dokumenten übereinstimmt:
to which this declaration relates is in conformity with the following standards or normative documents:

DIN EN 60255-6, November 1994
DIN EN 61010 Teil 1, März 1994

Gemäß den Bestimmungen der Richtlinien / Following the provisions of Directives

89/336/EWG, Elektromagnetische Verträglichkeit
mit allen Änderungen bis einschließlich 93/68/EWG
89/336/EEC, EMC Directive, with all amendments up to and including 93/68/EEC

73/23/EWG, Elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen
mit allen Änderungen bis einschließlich 93/68/EWG
73/23/EEC, Low Voltage Directive, with all amendments up to and including 93/68/EEC

Frankfurt am Main, 10.7.2003
(Ort und Datum der Ausstellung / Place and date of issue)

Hauser Ferling

(Name und Unterschrift der Befugten / name and signature of authorized person)

DET NORSKE VERITAS
CERTIFICATION FRANCE

QUALITY SYSTEM CERTIFICATE

Certificate Nr 0059-2002-FR-COFRAC-QUA

This is to certify that the Quality System of

ALSTOM T&D Protection & Control Business

FRANCE : LATTES - LEVALLOIS – VILLEURBANNE

GERMANY : FRANKFURT – HEILIGENHAUS – DRESDEN

ITALY : SAN PELLEGRINO - BERGAMO

UNITED KINGDOM : STAFFORD

has been found to conform to the Quality System Standard

ISO 9001 Ed. 2000 – NF IN ISO 9001 Ed. 2000

This certificate is valid for the following product or service ranges

DESIGN, DEVELOPMENT, PRODUCTION, SALES AND SERVICING OF PROTECTION, CONTROL AND MEASUREMENT EQUIPMENTS AND SYSTEMS FOR GENERATION, TRANSMISSION AND DISTRIBUTION SYSTEMS.

Date and Place :
Marseille, 2002-01-10
This certificate is valid from : 2002-01-10
For Comité de la Marque of DET NORSKE VERITAS CERTIFICATION FRANCE

Jacques MANGON

President

cofrac
CERTIFICATION D'ENTREPRISES & DE PERSONNELS
4 - 009 / 96

This certificate and Annexe are valid until : 2005-01-10
For DET NORSKE VERITAS CERTIFICATION FRANCE

Lucien BANCEL

General Manager

A lack of fulfilment of condition as set out in the appendix may render this certificate invalid.

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Contents
(continued)

1 Application and Scope

The P130C time-overcurrent protection devices provide selective short-circuit protection, ground fault protection, and overload protection in high-voltage systems. The multitude of protection functions incorporated into the devices enable the user to cover a wide range of applications in the protection of cable and line sections, transformers and motors. The systems can be operated as impedance-grounded, resonant-grounded, or isolated-neutral systems.

unctions

The P130C time-overcurrent protection devices have the following general functions:

- ❑ Four-pole measurement (A, B, C, N)
- ❑ Definite-time overcurrent protection, three stages, phase-selective
- ❑ Inverse-time overcurrent protection, single-stage, phase-selective
- ❑ Short-circuit direction determination
- ❑ Switch on to fault protection
- ❑ Protective signaling
- ❑ Auto-reclosing control (three-pole)
- ❑ Ground Fault Direction Determination Using Steady-State Values
- ❑ Motor protection
- ❑ Thermal overload protection
- ❑ Unbalance protection
- ❑ Time-voltage protection
- ❑ Over-/underfrequency protection
- ❑ Power directional protection
- ❑ Circuit breaker failure protection
- ❑ Measuring-circuit monitoring
- ❑ Limit value monitoring
- ❑ Programmable Logic

The user can select all general functions individually for inclusion in the device configuration or cancel them as desired. By means of a straightforward configuration procedure, the user can adapt the device flexibly to the scope of protection required in each particular application. The unit's powerful, freely configurable logic also makes it possible to accommodate special applications.

Global functions

In addition to the features listed above, as well as comprehensive self-monitoring, the following global functions are available in the P130C:

- ❑ Parameter subset selection
- ❑ Operating data acquisition (for support during commissioning, testing and operation)
- ❑ Operating data recording (time-tagged signal logging)
- ❑ Overload data acquisition
- ❑ Overload recording (time-tagged signal logging)
- ❑ Ground fault data acquisition
- ❑ Ground fault recording (time-tagged signal logging)
- ❑ Fault data acquisition
- ❑ Fault recording (time-tagged signal logging together with fault value recording of the three phase currents, the residual current as well as the three phase-to-ground voltages)

Design

The P130C is compact in design. The printed circuit boards are housed in a robust aluminum case and electrically interconnected via ribbon cables. The P130C has a multifunctional case design that is equally well suited to either wall surface mounting or flush panel mounting due to its reversible terminal blocks and adjustable mounting bracket.

Inputs and outputs

The P130C has the following inputs and outputs:

- □ 4 current-measuring inputs
- □ 3 voltage-measuring inputs
- □ 2 binary signal inputs (optical couplers) with user-definable function assignment
- □ 8 output relays with user-definable function assignment

The nominal currents and nominal voltages of the measuring inputs in the P130C can be set.

The nominal voltage range of the optical coupler inputs is 24 to 250 V DC without internal switching. The auxiliary voltage for the power supply can be switched internally from 110 to 250 V DC, 100 to 230 V AC to the range 24 to 60 V DC.

All output relays are suitable for both signals and commands.

Local control and display:

- ☐ Local control panel
- ☐ 17 LED indicators, 12 of which allow freely configurable function assignment
- ☐ PC interface
- ☐ One or two communication interfaces for connection to a substation control system (optional)
- ☐ One InterMiCOM guidance interface designed for real-time signal transmission between two MiCOM devices

Information is exchanged through the local control panel, the PC interface, or the optional communication interfaces.

One channel of the communication interfaces is designed to conform either to international standard IEC 60870-5-103 or to IEC 870-5-101, MODBUS, DNP 3.0 or Courier. The second channel is designed to conform to international standard IEC 60870-5-103. The P130C can be integrated into a substation control system through the communication interfaces.

The P130C can be ordered as standard model (with current transformers) or as frequency protection model (without current transformers). These models differ in the number of function groups available to the user.

	Current Transformers	CT fitted	CT not fitted
ARC:	Auto-reclosing control	X	
CBF:	Circuit breaker failure protection	X	
COMM1:	"Logical" communication interface 1	X	X
COMM2:	"Logical" communication interface 2	X	X
COMM3:	"Logical" communication interface 3	X	X
DTOC:	Definite-time overcurrent protection	X	
DVICE:	Device	X	X
FT_DA:	Fault data acquisition	X	X
FT_RC:	Fault recording	X	X
f<>:	Frequency protection	X	X
F_KEY	Function Keys	X	X
GF_DA:	Ground fault data acquisition	X	
GF_RC:	Ground fault recording	X	
GFDSS:	Ground fault direction determination using steady-state values	X	
I2>:	Unbalance protection	X	
IDMT:	Inverse-time overcurrent protection	X	
INP:	Binary input	X	X
LED:	LED indicators	X	X
LIMIT:	Limit monitoring	X	
LOC:	Local control panel	X	X
LOGIC:	Logic	X	X
MAIN:	Main function	X	X
MCMON:	Measuring-circuit monitoring	X	X
MP:	Motor protection	X	
MT_RC:	Monitoring signal recording	X	X
OL_DA:	Overload data acquisition	X	
OL_RC:	Overload recording	X	
OP_RC:	Operating data recording	X	X
OUTP:	Binary and analog output	X	X
P<>:	Power directional protection	X	
PC:	PC link	X	X
PSIG:	Protective signaling	X	
PSS:	Parameter subset selection	X	X
SCDD:	Short-circuit direction determination	X	
SFMON:	Self-monitoring	X	X
SOTF:	Switch on to fault protection	X	
THERM:	Thermal overload protection	X	
V<>:	Time-voltage protection	X	X

2 Technical Data

2.1 Conformity

Applicable to P130C Version - 301 - 401 - 601

›n of conformity

(Per Article 10 of EC Directive 72/73/EC.)
The product designated 'P130C Directional Overcurrent Protection and Frequency Protection Device' has been designed and manufactured in conformance with the European standards EN 60255-6 and EN 60010-1 and with the 'EMC Directive' and the 'Low Voltage Directive' issued by the Council of the European Community.

2.2 General Data

'evice data

Design
Multifunctional case design suitable for either wall surface mounting or flush panel mounting

Installation Position
Vertical ± 30°.

Degree of Protection
Per DIN VDE 0470 and EN 60529 or IEC 529.
IP 51.

Weight
Approx. 4 kg

Dimensions and Connections
See dimensional drawings (Chapter 4) and terminal connection diagrams (Chapter 5 and Appendix C).

Terminals

PC Interface (X6):
DIN 41652 connector, type D-Sub, 9-pin.

Communication Interface:	
Optical fibers (X7, X8 and X31, X32):	F-SMA fiber-optic connection per IEC 874-2 orDIN 47258 or ST® fiber-optic connection (ST® is a registered trademark of AT&T Lightguide Cable Connectors)
or	
Leads (X9, X10 and X33):	M2 threaded terminal ends for wire cross-sections up to 1.5 mm².
IRIG-B Interface (X11):	BNC plug

Other Inputs and Outputs:
M4 threaded terminal ends, self-centering with wire protection for conductor cross sections from 0.5 to 6 mm^2 or 2 × 2.5 mm^2.

Creepage Distances and Clearances
Per EN 61010-1§ and IEC 664-1.
Pollution degree 3, working voltage 250 V,
overvoltage category III, impulse test voltage 5 kV.

2.3 Tests

2.3.1 Type Tests

Type tests

Electromagnetic compatibility (EMC)

All tests per EN 60255-6§ or IEC 255-6.

Interference Suppression
Per EN 55022§ or IEC CISPR 22, Class A.

1 MHz Burst Disturbance Test
Per IEC 255 Part 22-1§ or IEC 60255-22-1, Class III.
Common-mode test voltage: 2.5 kV
Differential test voltage: 1.0 kV
Test duration: > 2 s
Source impedance: 200 Ω

Immunity to Electrostatic Discharge
Per EN 60255-22-2§ or IEC 60255-22-2, severity level 3.
Contact discharge, single discharges: > 10
Holding time: > 5 s
Test voltage: 6 kV
Test generator: 50 to 100 MΩ, 150 pF / 330 Ω

Immunity to Radiated Electromagnetic Energy
Per EN 61000-4-3§ and ENV 50204,§ severity level 3.
Antenna distance to tested device: > 1 m on all sides
Test field strength, frequency band 80 to 1000 MHz: 10 V / m
Test using AM: 1 kHz / 80 %
Single test at 900 MHz AM 200 Hz / 100 %

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§ For this EN, ENV or IEC standard, the DIN EN, DINV ENV or DIN IEC edition, respectively, was used in the test.

Electrical Fast Transient or Burst Requirements
Per EN 61000-4-4[§] or IEC 60255-22-4, severity levels 3 and 4.
Rise time of one pulse: 5 ns
Impulse duration (50% value): 50 ns
Amplitude: 2 kV / 1 kV or 4 kV / 2 kV
Burst duration: 15 ms
Burst period: 300 ms
Burst frequency: 5 kHz or 2.5 kHz
Source impedance: 50 Ω

Surge Immunity Test

Per EN 61000-4-5[§] or IEC 61000-4-5, insulation class 4.
Testing of circuits for power supply and unsymmetrical or symmetrical lines.
Open-circuit voltage, front time / time to half-value: 1.2 / 50 µs
Short-circuit current, front time / time to half-value: 8 / 20 µs
Amplitude: 4 kV
Pulse frequency: > 5 / min
Source impedance: 12 / 42 Ω

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
Per EN 61000-4-6[§] or IEC 61000-4-6, severity level 3.
Test voltage: 10 V

Power Frequency Magnetic Field Immunity
Per EN 61000-4-8[§] or IEC 61000-4-8, severity level 4.
Frequency: 50 Hz
Test field strength: 30 A / m

Alternating Component (Ripple) in DC Auxiliary Energizing Quantity
Per IEC 255-11.
12 %.

Voltage Test
Per DIN EN 61010 or IEC 255-5.
2 kV AC, 60 s.
Direct voltage (2.8 kV DC) must be used for the voltage test of the power supply inputs.
The PC interface must not be subjected to the voltage test.

Impulse Voltage Withstand Test
Per IEC 255-5.
Front time: 1.2 µs
Time to half-value: 50 µs
Peak value: 5 kV
Source impedance: 500 Ω

al robustness

Vibration Test
Per EN 60255-21-1[§] or IEC 255-21-1, test severity class 1.
Frequency range in operation: 10 to 60 Hz, 0.035 mm and 60 to 150 Hz, 0.5 g
Frequency range during transport: 10 to 150 Hz, 1 g

Shock Response and Withstand Test, Bump Test
Per EN 60255-21-2§ or IEC 255-21-2, test severity class 1.
Acceleration: 5 g / 15 g
Pulse duration: 11 ms

Seismic Test
Per EN 60255-21-3,§ test procedure A, class 1.
Frequency range:
5 to 8 Hz, 3.5 mm / 1.5 mm, 8 to 35 Hz, 10 / 5 m/s^2, 3 x 1 cycle

2.3.2 Routine Tests

All tests per EN 60255-6§ or IEC 255-6
and DIN 57435 Part 303.

Voltage Test
Per IEC 255-5.
2.5 kV AC, 1 s.
Direct voltage (2.8 kV DC) must be used for the voltage test of the power supply inputs.
The PC interface must not be subjected to the voltage test.

Additional Thermal Test
100% controlled thermal endurance test, inputs loaded.

2.4 Environmental Conditions

Environment

Temperatures
Recommended temperature range: -5°C to +55°C (23°F to 131°F)
Limit temperature range: -25°C to +70°C (-13°F to 158°F)

Humidity
≤ 75 % relative humidity (annual mean),
56 days at ≤ 95 % relative humidity and 40°C (104°F), condensation not permissible.

Solar Radiation
Direct solar radiation on the front of the device must be avoided.

2.5 Inputs and Outputs

nent inputs

Current
Nominal current: 1 and 5 A AC (adjustable).
Nominal consumption per phase: < 0.1 VA at I_{nom}
Load rating:
continuous: 4 I_{nom}
for 10 s: 30 I_{nom}
for 1 s: 100 I_{nom}
Nominal surge current: 250 I_{nom}

Voltage
Nominal voltage V_{nom}: 50 to 130 V AC (adjustable)
Nominal consumption per phase: < 0.3 VA at V_{nom} = 130 V AC
Load rating: continuous 150 V AC

Frequency
Nominal frequency f_{nom}: 50 Hz and 60 Hz (adjustable)
Operating range: 0.95 to 1.05 f_{nom}.
Frequency protection: 40 to 70 Hz

'nal inputs

Nominal auxiliary voltage $V_{in,nom}$: 24 to 250 V DC.
Operating range: 0.8 to 1.1 $V_{in,nom}$ with a residual ripple of up to 12 % $V_{in,nom}$

Operate value / Release Value (as per order)
Standard variant 18V:
$V_{op} \geq$ 19 V DC
$V_{rel} \leq$ 14 V DC

Special variant 90 V:
(60% to 70% of voltages in the range $V_{in,nom}$: 125 to 150 V DC)
$V_{op} \geq$ 100 V DC
$V_{rel} \leq$ 80 V DC

Special variant 155 V:
(60% to 70% of voltages in the range $V_{in,nom}$: 220 to 250 V DC)
$V_{op} \geq$ 180 V DC
$V_{rel} \leq$ 130 V DC

Power Consumption per Input:
Standard variant 18V:
V_{in} = 19 to 110 V DC: 0.5 W ± 30 %,
V_{in} > 110 V DC: $V_{in,nom} \cdot$ 5 mA ± 30 %.

Special variants 90 V and 155 V:
$V_{in,nom} \cdot$ 5 mA ± 30 %.

'ays

Rated voltage: 250 V DC, 250 V AC
Continuous current: 5 A
Short-duration current: 30 A for 0.5 s
Making capacity: 1000 W (VA) at L/R = 40 ms
Breaking capacity: 0.2 A at 220 V DC and L/R = 40 ms
4 A at 230 V AC and cos φ = 0.4

2.6 Interfaces

Local control panel

Input or output:
Via 7 keys and an LCD display consisting of 4 x 20 characters and 4 freely configurable function keys

State and fault signals:
17 LED indicators (5 permanently assigned, 12 freely configurable)

PC interface

Transmission rate: 300 to 115,200 baud (adjustable)

Communication interfaces

The communication unit can have three communication channels – depending on the version. Channels 1 and 3 are designed for wire connection or fiber-optic connection, whereas Channel 2 is intended for wire connection only.
For "logical" communication interface 1, interface protocols based on IEC 60870-5-103, IEC 870-5-101, MODBUS, or DNP 3.0 can be set. "Logical" communication interface 2 can only be operated using the interface protocol based on IEC 60870-5-103. "Logical" communication interface 3 is intended for real-time signal transmission between two MiCOM devices (peer-to-peer link, "InterMiCOM" interface).

<u>Wire Leads</u>
Per RS 485 or RS 422, 2 kV isolation
Distance to be bridged:
Point-to-point connection: max. 1200 m
Multipoint connection: max. 100 m

	Transmission Rate	Transmission Protocol
Order ext. No. -910 (one channel available)	300 to 19 200 baud (adjustable)	IEC 60870-5-103
Order ext. No. -921 (two channels available)	300 to 64 000 baud (adjustable)	Can be set by user for one channel
Order ext. No. -951 (InterMiCOM)	600 to 19 200 baud (adjustable)	

[1)] Distance to be bridged given identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation.

Plastic Fiber Connection
Optical wave length: typically 660 nm
Optical output: min. –7.5 dBm
Optical sensitivity: min. -20 dBm
Optical input: max. -5 dBm
Distance to be bridged:[1] max. 45 m

	Transmission Rate	Transmission Protocol
Order ext. No. -910 (one channel available)	300 to 38 400 baud (adjustable)	IEC 60870-5-103
Order ext. No. -922 (two channels available)	300 to 64 000 baud (adjustable)	Can be set by user for one channel
Order ext. No. -952 (InterMiCOM)	600 to 19 200 baud (adjustable)	

Glass Fiber Connection G 50/125
Optical wavelength: typically 820 nm
Optical output: min. -19.8 dBm
Optical sensitivity: min. -24 dBm
Optical input: max. -10 dBm
Distance to be bridged:[1] max. 400 m

Glass Fiber Connection G 62.5/125
Optical wavelength: typically 820 nm
Optical output: min. -16 dBm
Optical sensitivity: min. -24 dBm
Optical input: max. -10 dBm
Distance to be bridged:[1] max. 1400 m

Glass Fiber Connection G 50/125 or G 62.5/125

	Transmission Rate	Transmission Protocol
Order ext. No. -910 (one channel available)	300 to 38 400 baud (adjustable)	IEC 60870-5-103
Order ext. No. -924 (two channels available)	300 to 64 000 baud (adjustable)	Can be set by user for one channel
Order ext. No. -955 (InterMiCOM)	600 to 19 200 baud (adjustable)	

'erface

B122 format
Amplitude-modulated signal
Carrier frequency: 1 kHz
BCD-coded dating information

[1] Distance to be bridged given identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation.

2.7 Information Output

Counters, measured data, and indications: see "Address List."

2.8 Settings

Typical characteristic data

Main Function
Minimum output pulse for trip command: 0.1 to 10 s (adjustable)
Output pulse for close command: 0.1 to 10 s (adjustable)

Definite-Time and Inverse-Time Overcurrent Protection
Operate time inclusive of output relay (measured variable from 0 to 2-fold operate value): ≤ 40 ms, approx. 30 ms
Reset time (measured variable from 2-fold operate value to 0): ≤ 40 ms, approx. 30 ms
Starting resetting ratio: approx. 0.95

Short-Circuit Direction Determination
Nominal acceptance angle for forward decision: ± 90°
Resetting ratio forward/backward recognition: ≤ 7
Base point release for phase currents: 0.1 I_{nom}
Base point release for phase-to-phase voltages: 0.002 V_{nom} at V_{nom} = 100 V
Base point release for residual current: 0.01 I_{nom}
Base point release for neutral displacement voltage: 0.015 to 0.6 $V_{nom}/\sqrt{3}$ (adjustable)

Time-Voltage Protection
Operate time including output relay (measured variable from nominal value to 1.2-fold operate value or measured variable from nominal value to 0.8-fold operate value):
≤ 40 ms, approx. 30 ms
Reset time (measured variable from 1.2-fold operate value to nominal value or measured variable from 0.8-fold operate value to nominal value): ≤ 45 ms, ca. 30 ms
Resetting ratio of the starting:
Approx. 0.95 for operate values > 0.6 V_{nom} or $V_{nom}/\sqrt{3}$
Approx. 1.05 for operate values < 0.6 V_{nom} or $V_{nom}/\sqrt{3}$

2.9 Deviations

2.9.1 Deviations of the Operate Values

s

'Reference Conditions'
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

'Deviation'
Deviation relative to the setting under reference conditions.

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Operate values I_{neg}, V_{neg}
Deviation: ± 3°

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Phase and Residual Current Stages
Deviation: ± 5 %

Negative-Sequence System Stages
Deviation: ± 5 %

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Deviation: ± 10°

tection and
verload protection
time)

Deviation ± 7.5 % when I/I_{ref} = 6

e pr tion

Deviation: ± 5 %

age protection

Operate Values
Deviation: ± 5 % (or ± 1 % referred to the nominal value)

lerfrequency

Operate Values
Deviation: ± 3 % (or ± 1 % referred to the nominal value)

ectional

Operate Values P<>, Q<>
Deviation: ± 5 %

Ground fault direction determination using steady-state values

Operate Values V_{NG}>, $I_{N,act}$, $I_{N,reac}$, I_N>
Deviation: ± 3 %

Sector Angle
Deviation: 1°

2.9.2 Deviations of the Timer Stages

Definitions

'Reference Conditions'
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C or 68°F, and nominal auxiliary voltage $V_{A,nom}$.

'Deviation'
Deviation relative to the setting under reference conditions.

Definite-time stages

Deviation: ± 1% + 10 ms

Inverse-time stages

Deviation where I ≥ 2 I_{ref}: ± 5 % +10 to 25 ms
For IEC characteristic 'extremely inverse' and for thermal overload protection: ± 7.5 % + 10 to 20 ms

2.9.3 Deviations of Measured Data Acquisition

Definitions

'Reference Conditions'
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

'Deviation'
Deviation relative to the corresponding nominal value under reference conditions.

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Measuring Input Currents
Deviation: ± 1 %

Measuring Input Voltages
Deviation: ± 0.5 %

Internally Formed Resultant Current and Negative-Sequence System Current
Deviation: ± 2 %

Internally Formed Neutral Displacement Voltage and Voltages of Positive- and Negative-Sequence Systems
Deviation: ± 2 %

Active and Reactive Power / Active and Reactive Energy
Deviation: approx. ± 2 % of the measured value for cos $\varphi = \pm 0.7$
Deviation: approx. ± 5 % of the measured value for cos $\varphi = \pm 0.3$

Load angle
Deviation: ± 1°

Frequency
Deviation: ± 10 mHz

ı acquisition

Short-Circuit Current and Voltage
Deviation: ± 3 %

Short-Circuit Impedance, Reactance, and Fault Location
Deviation: ± 5 %

'ock

With free running internal clock:
Deviation: < 1 min/month

With external synchronization (with a synchronization interval ≤ 1 min):
Deviation: < 10 ms

With synchronization via IRIG-B interface: ± 1 ms

2.10 Recording Functions

Organization of the Recording Memories

Operating data memory

Scope: All signals relating to normal operation; from a total of 1024 different logic state signals (see "Operating Data Memory" in the Address List)
Depth: The 100 most recent signals

Monitoring signal memory

Scope: All signals relating to self-monitoring; from a total of 1024 different logic state signals (see "Monitoring Signal Memory" in the Address List)
Depth: Up to 30 signals

Overload memory

Number: The 8 most recent overload events
Scope: All signals relating to an overload event; from a total of 1024 different logic state signals (see "Overload Memory" in the Address List)
Depth: 200 entries per overload event

Ground fault memory

Number: The 8 most recent ground fault events
Scope: All signals relating to a ground fault event; from a total of 1024 different logic state signals (see "Ground Fault Memory" in the Address List)
Depth: 200 entries per ground fault event

Fault memory

Number: The 8 most recent fault events

Scope for signals:
All signals relating to a fault event; from a total of 1024 different logic state signals (see "Fault Memory" in the Address List)

Scope for fault values:
Sampled data for all measured currents and voltages

Depth for signals:
200 entries per fault event

Depth for fault values:
Max. number of periods per fault set by the user;
820 periods in total for all faults, that is
16.4 s (for f_{nom} = 50 Hz) or 13.7 s (for f_{nom} = 60 Hz)

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Resolution of the Recorded Data

Time resolution: 1 ms

Time resolution: 20 sampled values per period

Dynamic range:	100 I_{nom}
Amplitude resolution:	6.1 mA r.m.s. at I_{nom} = 1 A
	30.5 mA r.m.s. at I_{nom} = 5 A

Dynamic range:	16 I_{nom}
Amplitude resolution:	0.98 mA r.m.s. at I_{nom} = 1 A
	4.9 mA r.m.s. at I_{nom} = 5 A

Dynamic range:	150 V AC
Amplitude resolution:	9.2 mV r.m.s

2.11 Power Supply

Nominal auxiliary voltage $V_{A,nom}$:
100 to 250 V DC /100 to 230 V AC and 24 to 60 V DC (internal switching)

Operating range for direct voltage:
0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 12 % $V_{A,nom}$
Operating range for alternating voltage: 0.9 to 1.1 $V_{A,nom}$

Nominal consumption:	
Initial position, approx.:	8 W
Active position, approx.:	10 W

Start-up peak current:	< 3 A for duration of 0.25 ms
Stored energy time:	≥ 50 ms for interruption of $V_A \geq$ 220 V DC

2.12 Dimensioning of Current Transformers

The following equation is used for dimensioning a current transformer for the offset maximum primary current:

$$V_{sat} = (R_{nom} + R_i) \cdot n \cdot I_{nom} \geq (R_{op} + R_i) \cdot k \cdot I'_{1,max}$$

where:

V_{sat}: saturation voltage
$I'_{1,max}$: non-offset maximum primary current, converted to the secondary side
I_{nom}: rated secondary current
n: rated overcurrent factor
k: over-dimensioning factor
R_{nom}: rated burden
R_{op} actual connected operating burden
R_i: internal burden

The current transformer can then be dimensioned for the minimum required saturation voltage V_{sat} as follows:

$$V_{sat} \geq (R_{op} + R_i) \cdot k \cdot I'_{1,max}$$

Alternatively, the current transformer can also be dimensioned for the minimum required rated overcurrent factor n by specifying a rated power P_{nom} as follows:

$$n \geq \frac{(R_{op} + R_i)}{(R_{nom} + R_i)} \cdot k \cdot \frac{I'_{1,max}}{I_{nom}} = \frac{(P_{op} + P_i)}{(P_{nom} + P_i)} \cdot k \cdot \frac{I'_{1,max}}{I_{nom}}$$

where

$$P_{nom} = R_{nom} \cdot I^2_{nom}$$
$$P_{op} = R_{op} \cdot I^2_{nom}$$
$$P_i = R_i \cdot I^2_{nom}$$

Theoretically, the current transformer could be dimensioned for lack of saturation by inserting in the place of the required overdimensioning factor k its maximum:

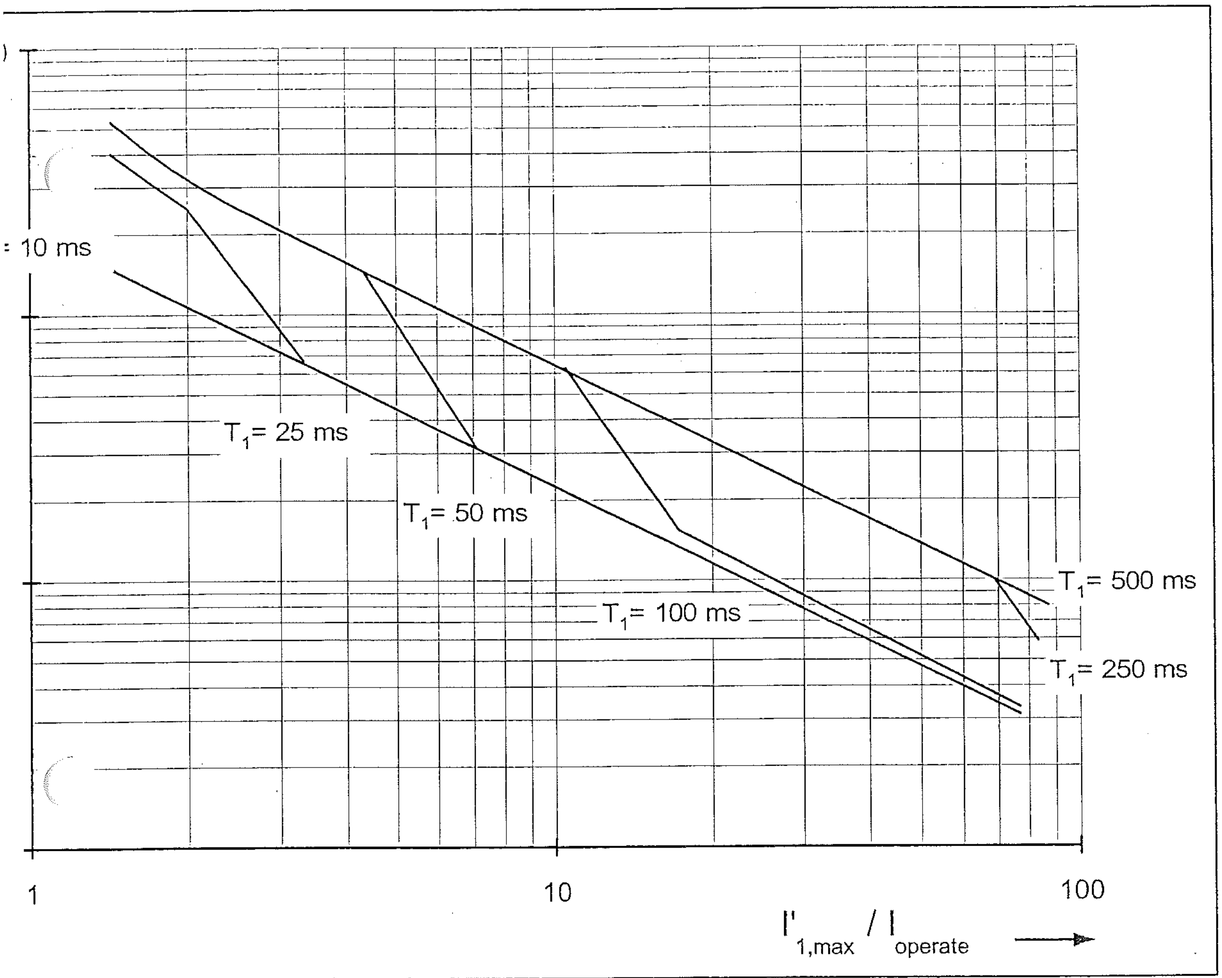
$$k_{max} \approx 1 + \omega T_1$$

where:

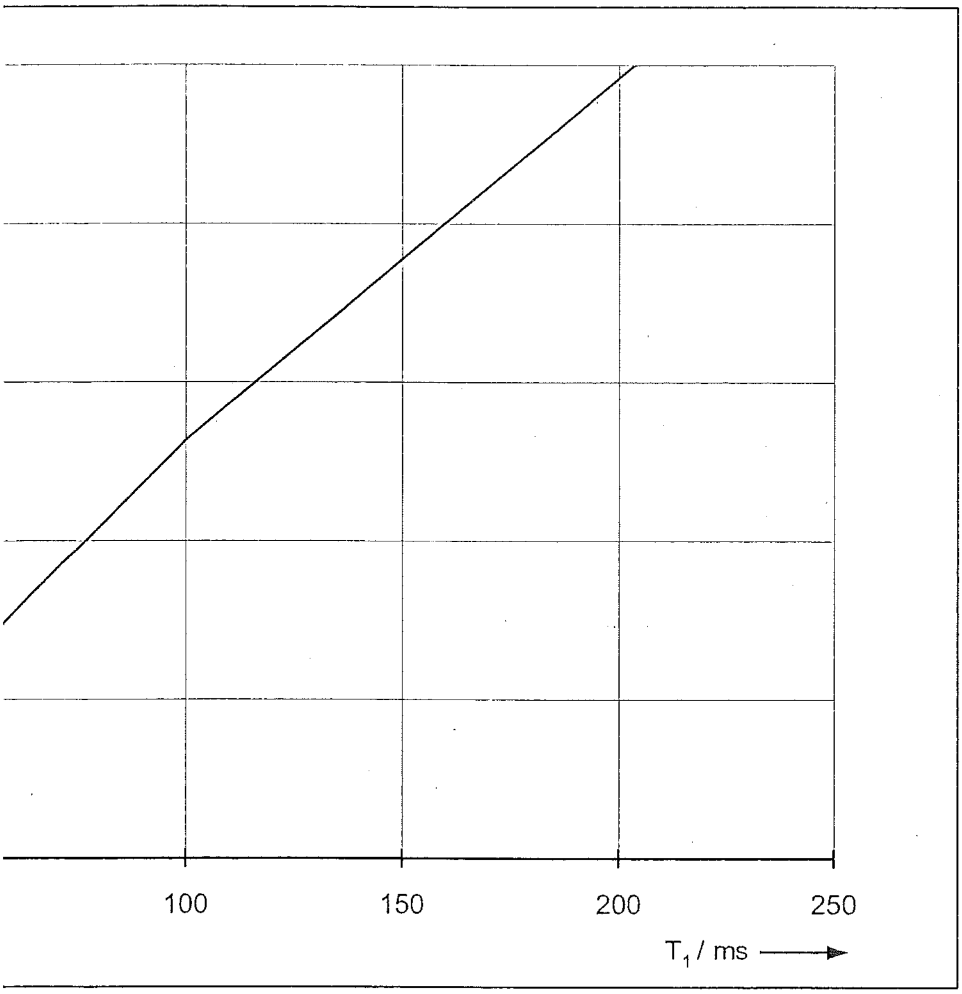
ω : system angular frequency
T_1: system time constant

However, this is not necessary. Instead, it is sufficient to dimension the overdimensioning factor k such that the normal behavior of the analyzed protective function is guaranteed under the given conditions.

If the P130C is to be used for definite-time overcurrent protection, then the overdimensioning factor k that must be selected is a function, first of all, of the ratio of the maximum short-circuit current to the set operate value and, secondly, of the system time constant T_1. The overdimensioning factor that is needed can be read from the empirically determined curves in Figure 2-1. When inverse-time maximum current protection is used, the overdimensioning factor can be taken from Figure 2-2.



red overdimensioning factor for definite-time overcurrent protection where fnom= 50 Hz

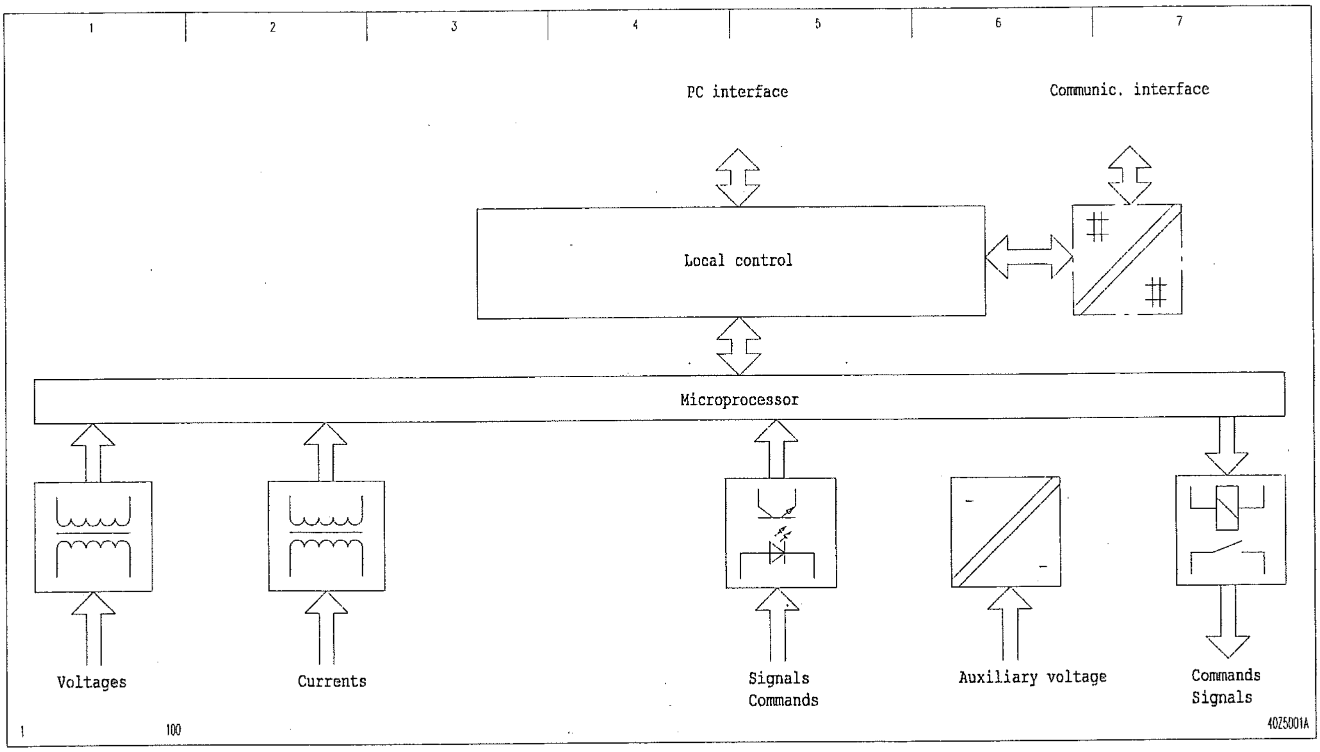


r inverse-time maximum current protection where fnom= 50 Hz

3 Operation

3.1 Modular Structure

The P130C, a numeric device, is part of the MiCOM P 30 family of devices. Figure 3-1 shows the basic hardware structure of the P130C.



3-1 Basic hardware structure

The external analog and binary quantities – electrically isolated – are converted to the internal processing levels by input transformers and optical couplers. Commands and signals generated by the device internally are transmitted to external destinations via floating contacts. The external auxiliary voltage is connected to the power supply unit which provides the auxiliary voltages that are required internally.

3.2 Operator-Machine Communication

The following interfaces are available for the exchange of information between operator and device:

- □ Integrated local control panel
- □ PC interface
- □ Communication interface

All setting parameters and signals as well as all measured variables and control functions are arranged within the branches of the menu tree following a scheme that is uniform throughout the device family. The main branches are:

'Parameters' branch

This branch carries all settings, including the device identification data, the configuration parameters for adapting the device interfaces to the system, and the function parameters for adapting the device functions to the process. All values in this group are stored in non-volatile memory, which means that the values will be preserved even if the power supply fails.

'Operation' branch

This branch includes all information relevant for operation such as measured operating data and binary signal states. This information is updated periodically and consequently is not stored. In addition, various control parameters are grouped here, for example those for resetting counters, memories and displays.

'Events' branch

The third branch is reserved for the recording of events. Therefore all information contained in this group is stored. In particular, the start/end signals during a fault, the measured fault data, and the sampled fault records are stored here and can be read out at a later time.

Settings and signals are displayed either in plain text or as addresses, in accordance with the user's choice. The Appendix documents the settings and signals of the P130C in the form of an 'address list'. This address list is complete and thus contains all settings, signals and measured variables used with the P130C.

The configuration of the local control panel also permits the installation of Measured Value 'Panels' on the LCD display. Different Measured Value Panels are automatically displayed for specific system operating conditions. Priority increases from normal operation to operation under overload conditions, operation during a ground fault, and finally to operation following a short circuit in the system. Thus the P130C provides the measured data relevant for the prevailing conditions.

' *Panel*

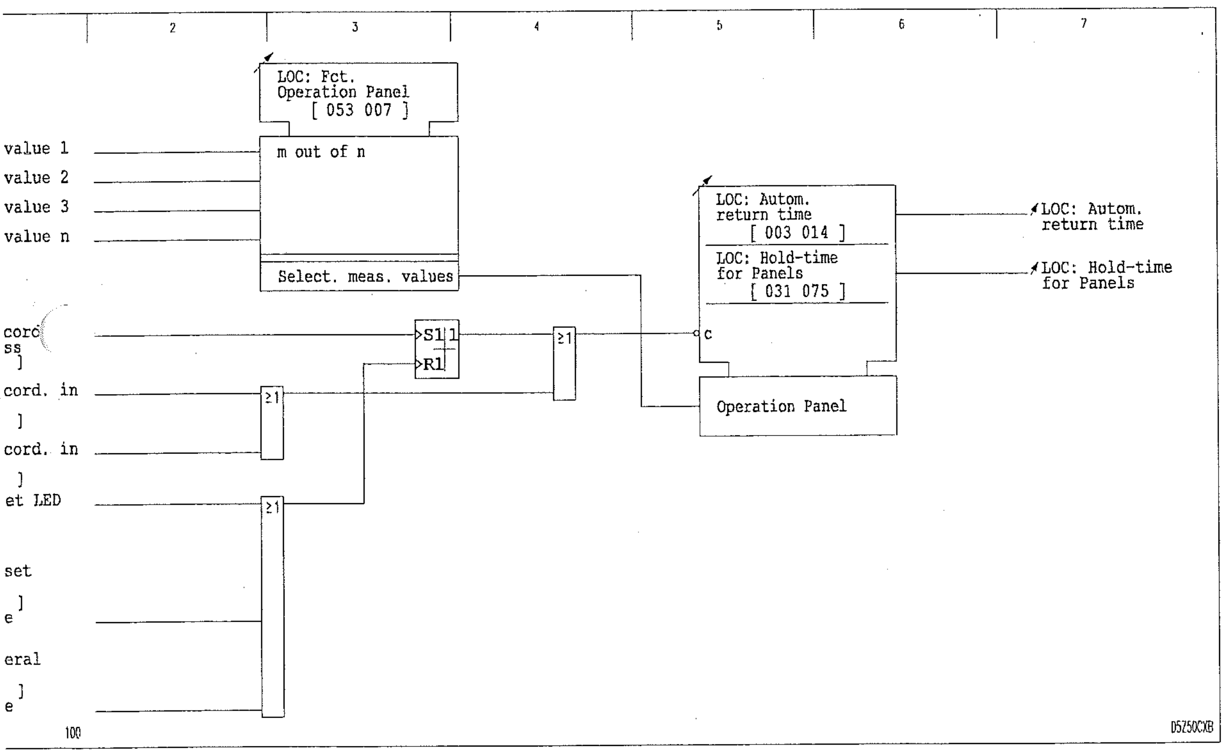
3.3 Configuring the Measured Value Panels (Function Group LOC)

The P130C provides Measured Value Panels that display the measured values relevant at a given time.

During normal power system operation, the Operation Panel is displayed. When an event occurs, the display switches to the appropriate Event Panel – provided that measured values have been selected for the Event Panels. In the event of an overload event or a ground fault, the display will automatically switch back to the Operation Panel at the end of the event. In the event of a fault, the Fault Panel remains active until the LED indicators or the fault memories are reset.

The Operation Panel is displayed after the set return time has elapsed, provided that at least one measured value has been configured.

The user can select the measured operating values that will be displayed on the Operation Panel by setting an 'm out of n' parameter. If more measured values are selected for display than the LCD display can accommodate, the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-time for Panels or when the appropriate keys on the local control panel are pressed.

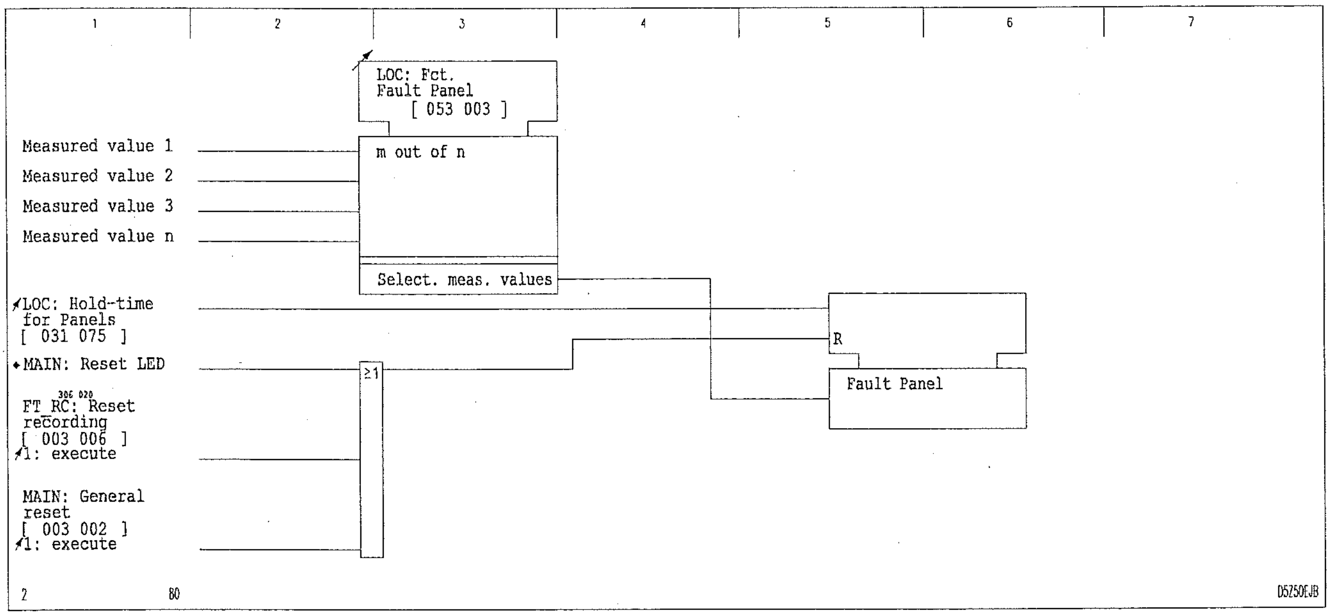


)peration Panel

Fault Panel

The Fault Panel is displayed in place of another data panel when there is a fault, provided that at least one measured value has been configured. The Fault Panel remains on display until the LED indicators or the fault memories are reset.

The user can select the measured fault values that will be displayed on the Fault Panel by setting an 'm out of n' parameter. If more measured values are selected for display than the LCD display can accommodate, the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-time for Panels or when the appropriate keys on the local control panel are pressed.

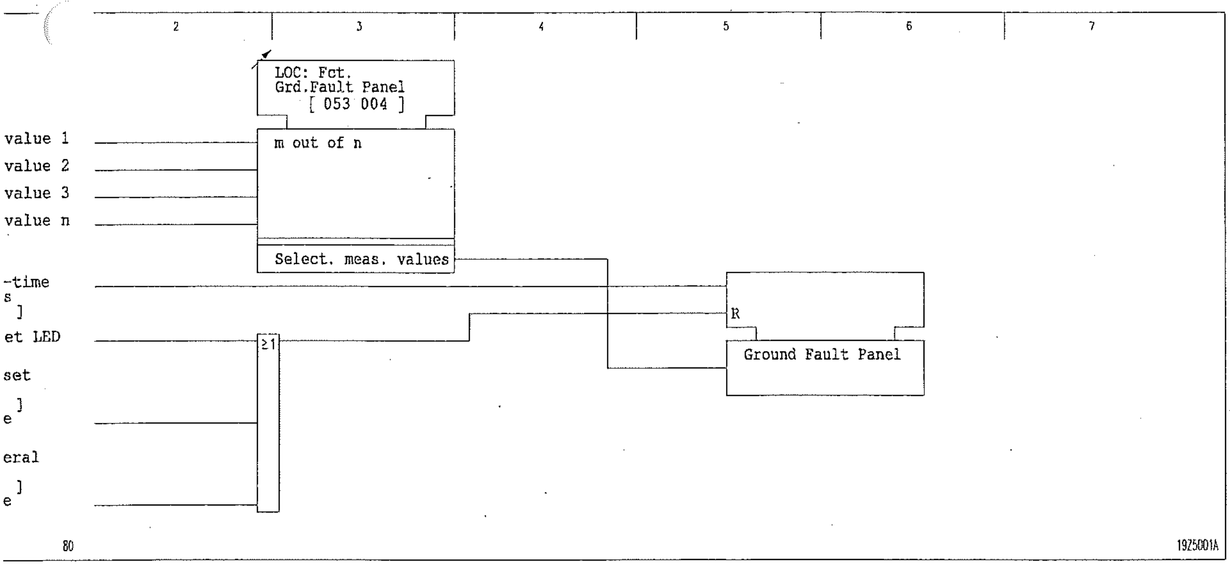


3-3 *Fault Panel*

ault Panel

The Ground Fault Panel is automatically displayed in place of another data panel when there is a ground fault, provided that at least one measured value has been configured. The Ground Fault Panel remains on display until the ground fault ends, unless a fault occurs. In this case, the display switches to the Fault Panel.

The user can select the measured values that will be displayed on the Ground Fault Panel by setting an 'm out of n' parameter. If more measured values are selected for display than the LC display can accommodate, the display will switch to the next set of values at intervals defined by the setting LOC: Hold-time for Panels or when the appropriate keys on the local control panel are pressed.

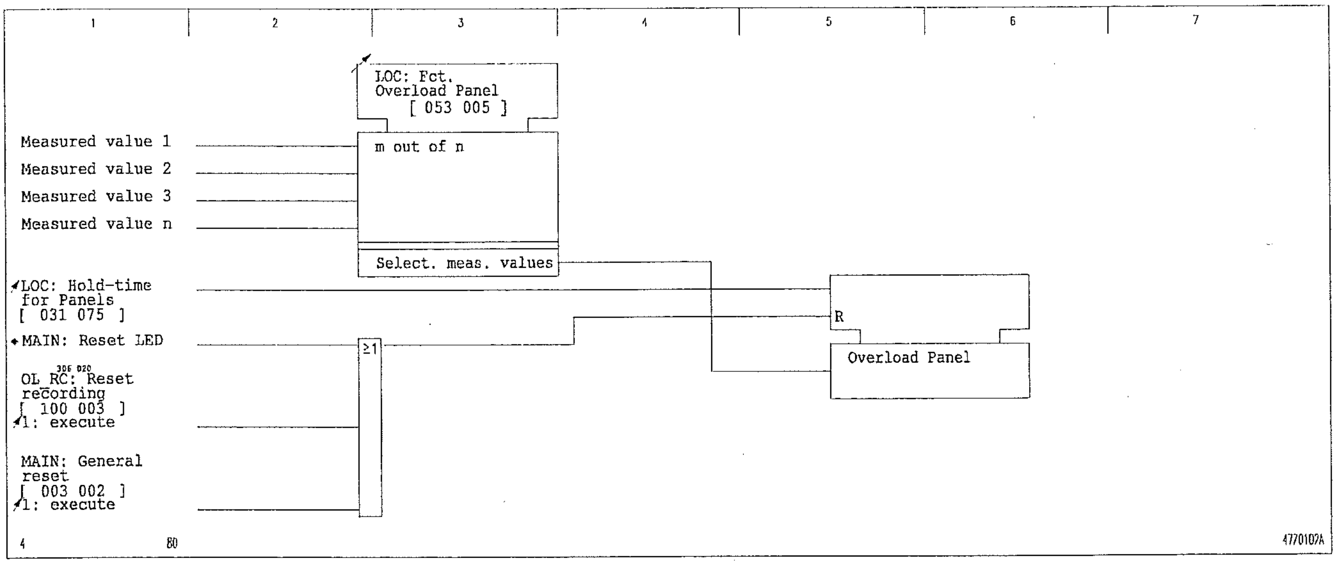


ɜroι ¯ault Panel

Overload Panel

The Overload Panel is automatically displayed in place of another data panel when there is an overload, provided that at least one measured value has been configured. The Overload Panel remains on display until the overload ends, unless a fault occurs. In this case, the display switches to the Fault Panel.

The user can select the measured values that will be displayed on the Overload Panel by setting an 'm out of n' parameter. If more measured values are selected for display than the LCD display can accommodate, the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-time for Panels or when the appropriate keys on the local control panel are pressed.



3-5 *Overload Panel*

3.4 Serial Interfaces

The P130C has a PC interface as a standard component. The communication unit is optional and can have one or two communication channels – depending on the design version. Communication between the P130C and the control station's computer is through the communication unit. Setting and readout are possible through all P130C interfaces.

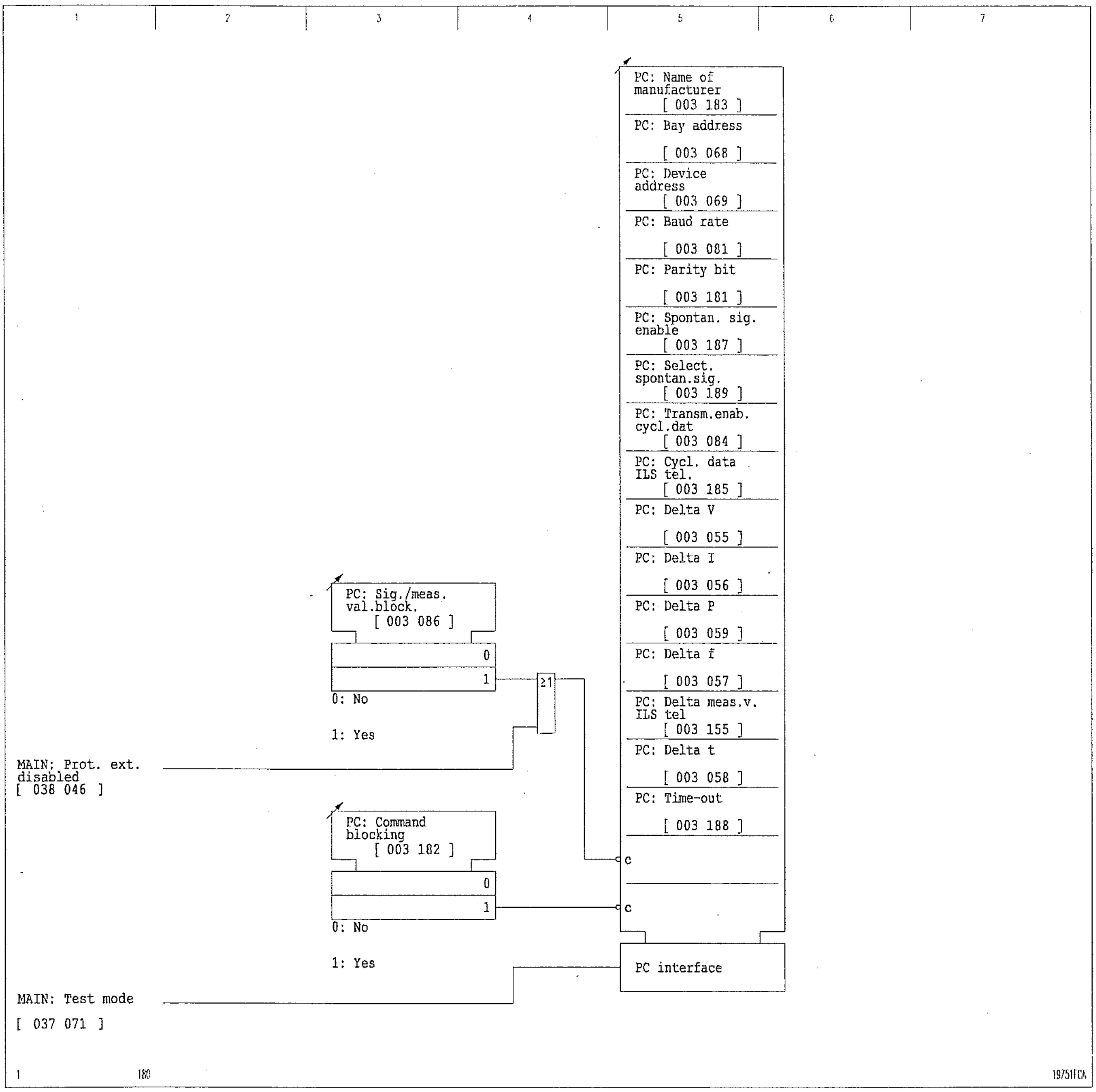
If the communication unit with two communication channels is installed, settings for two "logical" communication interfaces will be available. The settings for "logical" communication interface 1 (COMM1) can be assigned to physical communication channels 1 or 2 (see section entitled 'Main Functions'). If the COMM1 settings have been assigned to communication channel 2, then this means that the settings for "logical" communication interface 2 (COMM2) will automatically be active for communication channel 1. Communication with the P130C via communication channel 2 is only possible when the PC interface is inactive. As soon as communication occurs through the PC interface, communication channel 2 is "dead".

If tests are run on the P130C, the user is advised to activate the test mode so that the PC or the control system will evaluate all incoming signals accordingly (see section entitled 'General Functions').

3.4.1 PC Interface (Function Group PC)

Communication between the device and a PC is through the PC interface. In order for data transfer between the P130C and the PC to function, several settings must be made in the P130C.

An operating program is available as an accessory for P130C control (see Chapter 13).



3-6 *PC interface settings*

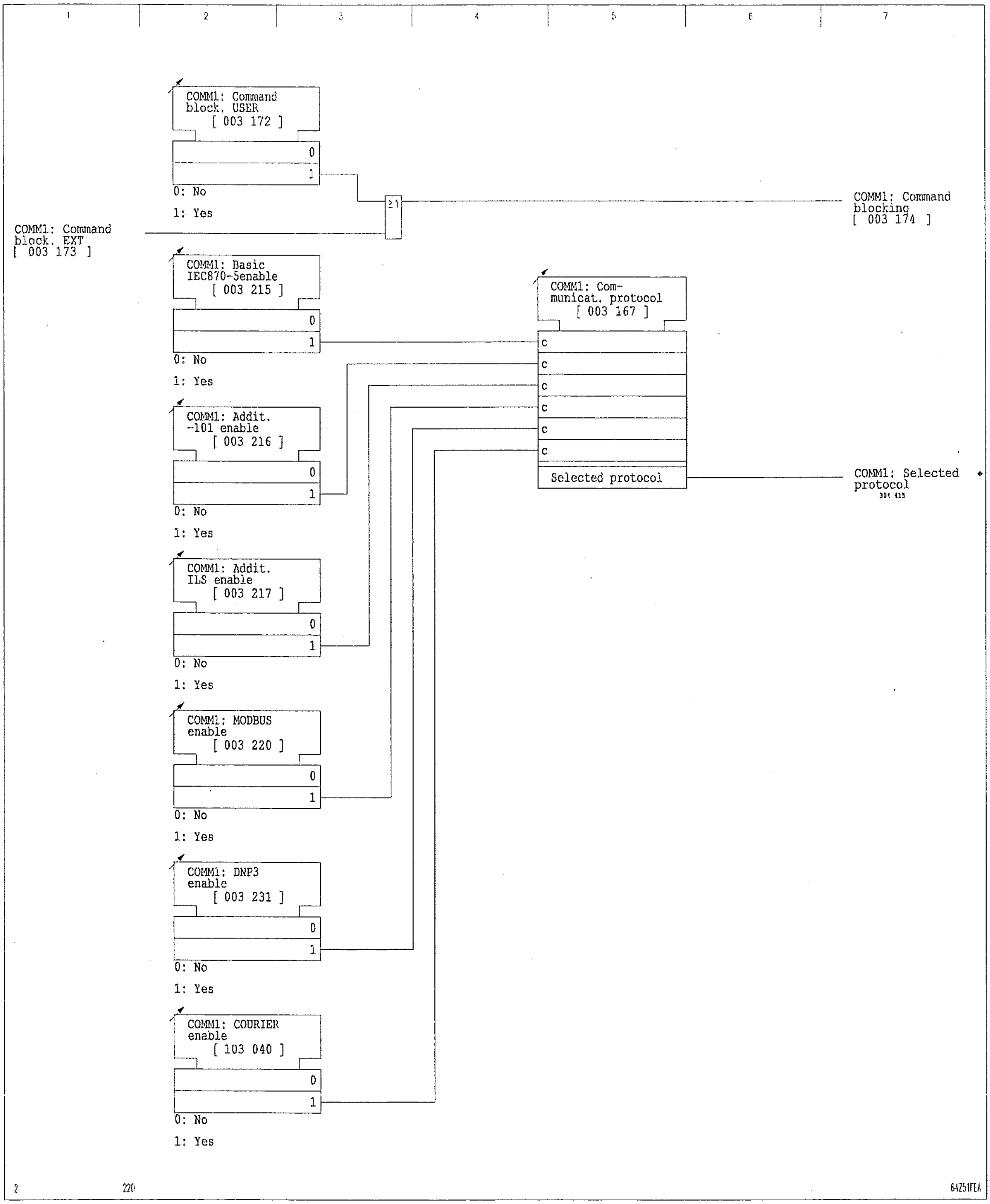
3.4.2 "Logical" Communication Interface 1 (Function Group COMM1)

Depending on the design version of the communication unit (see Technical Data), several interface protocols are available. The protocol as per IEC 60870-5-103 is supported for all versions. The following user-selected interface protocols are available for use with the P130C:

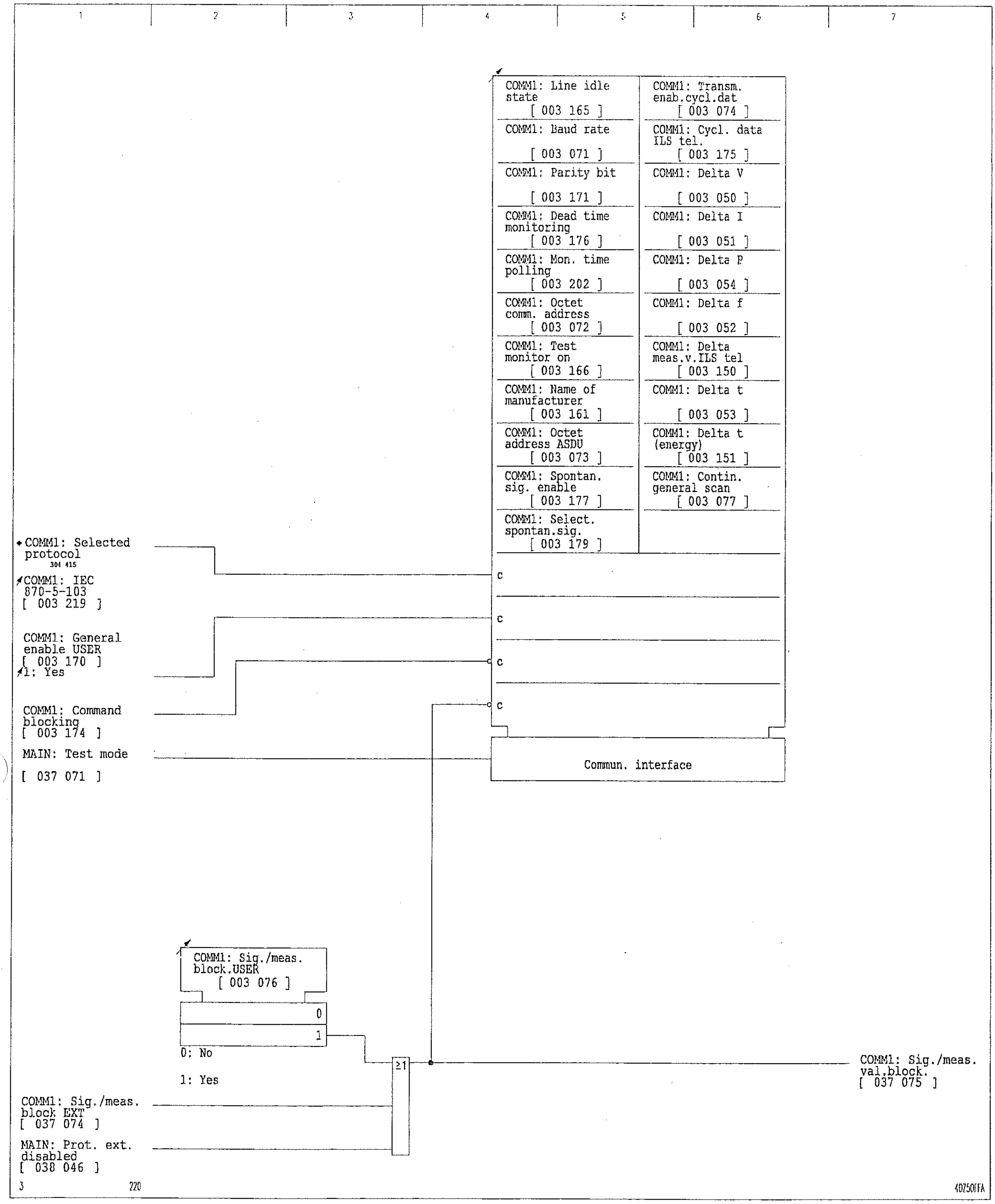
- IEC 60870-5-103, "Transmission protocols - Companion standard for the informative interface of protection equipment,' first edition, 1997-12 (corresponds to VDEW / ZVEI Recommendation, "Protection communication companion standard 1, compatibility level 2," February 1995 edition) with additions covering control and monitoring
- IEC 870-5-101, "Telecontrol equipment and systems - Part 5: Transmission protocols - Section 101 Companion standard for basic telecontrol tasks," first edition 1995-11
- ILS-C, internal protocol of AREVA
- MODBUS
- DNP 3.0
- COURIER

In order for data transfer to function properly, several settings must be made in the P130C.

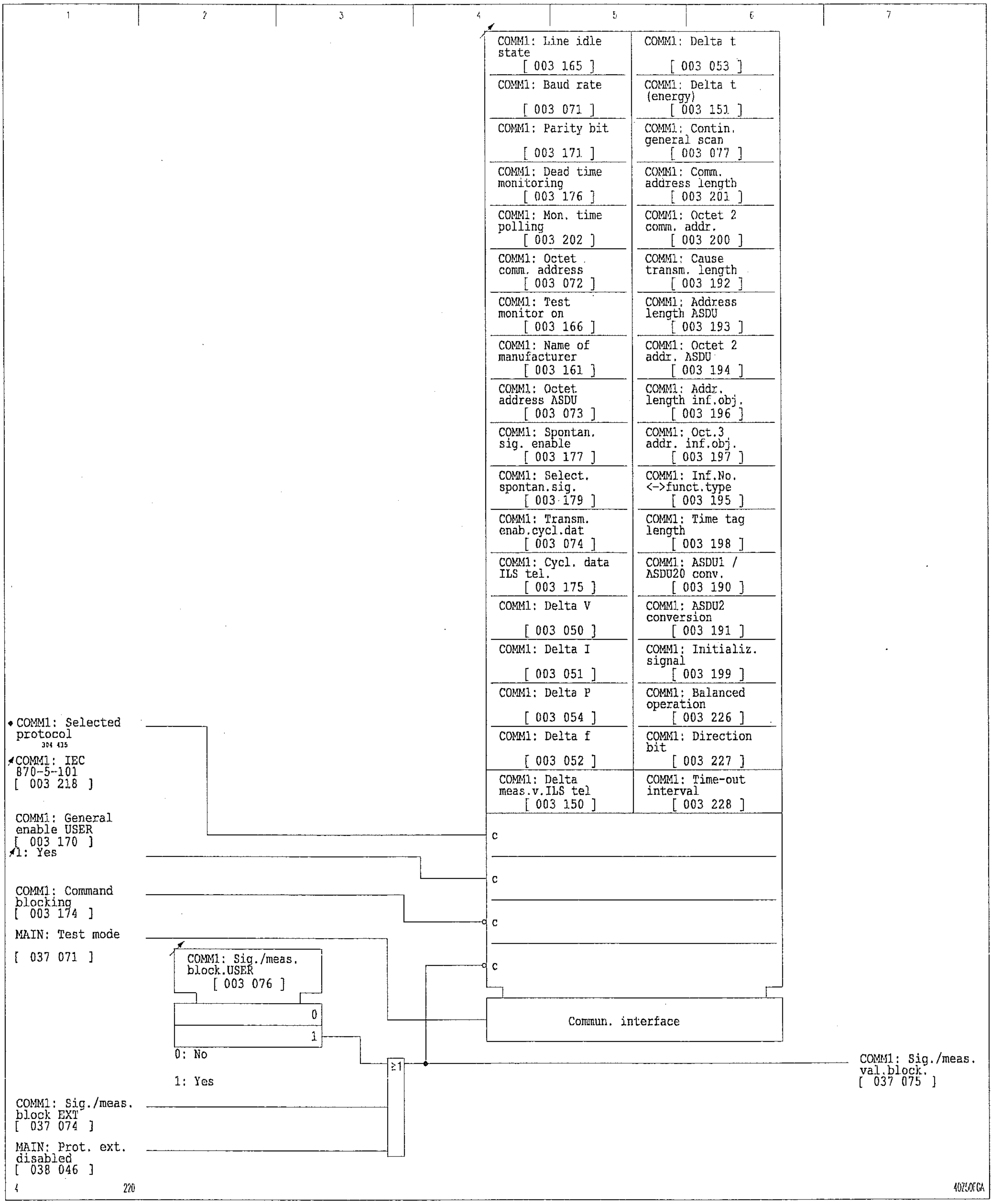
The communication interface can be blocked through a binary signal input. In addition, a signal or measured-data block can also be imposed through a binary signal input.



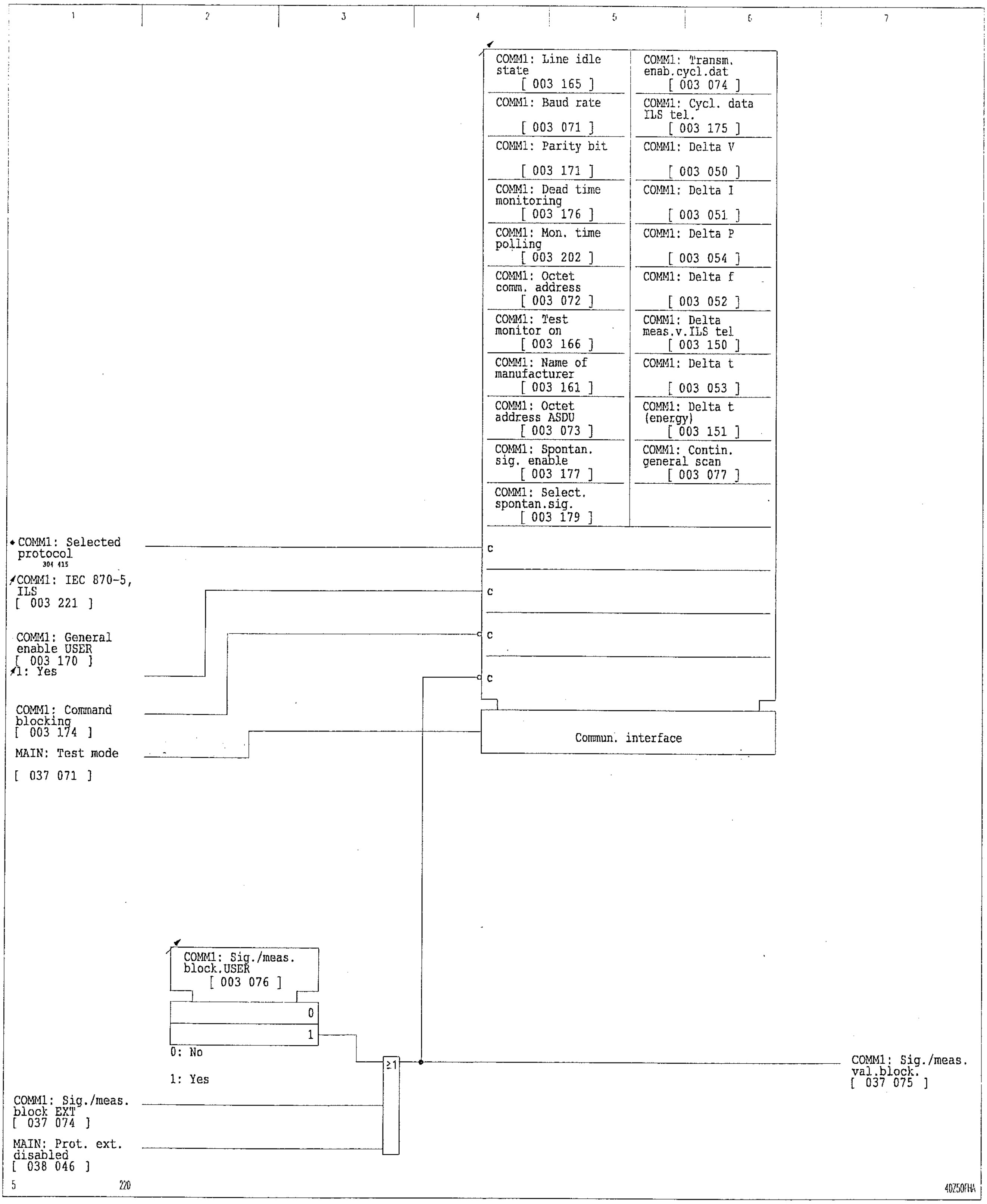
3-7 *"Logical" communication interface 1: selecting the interface protocol*



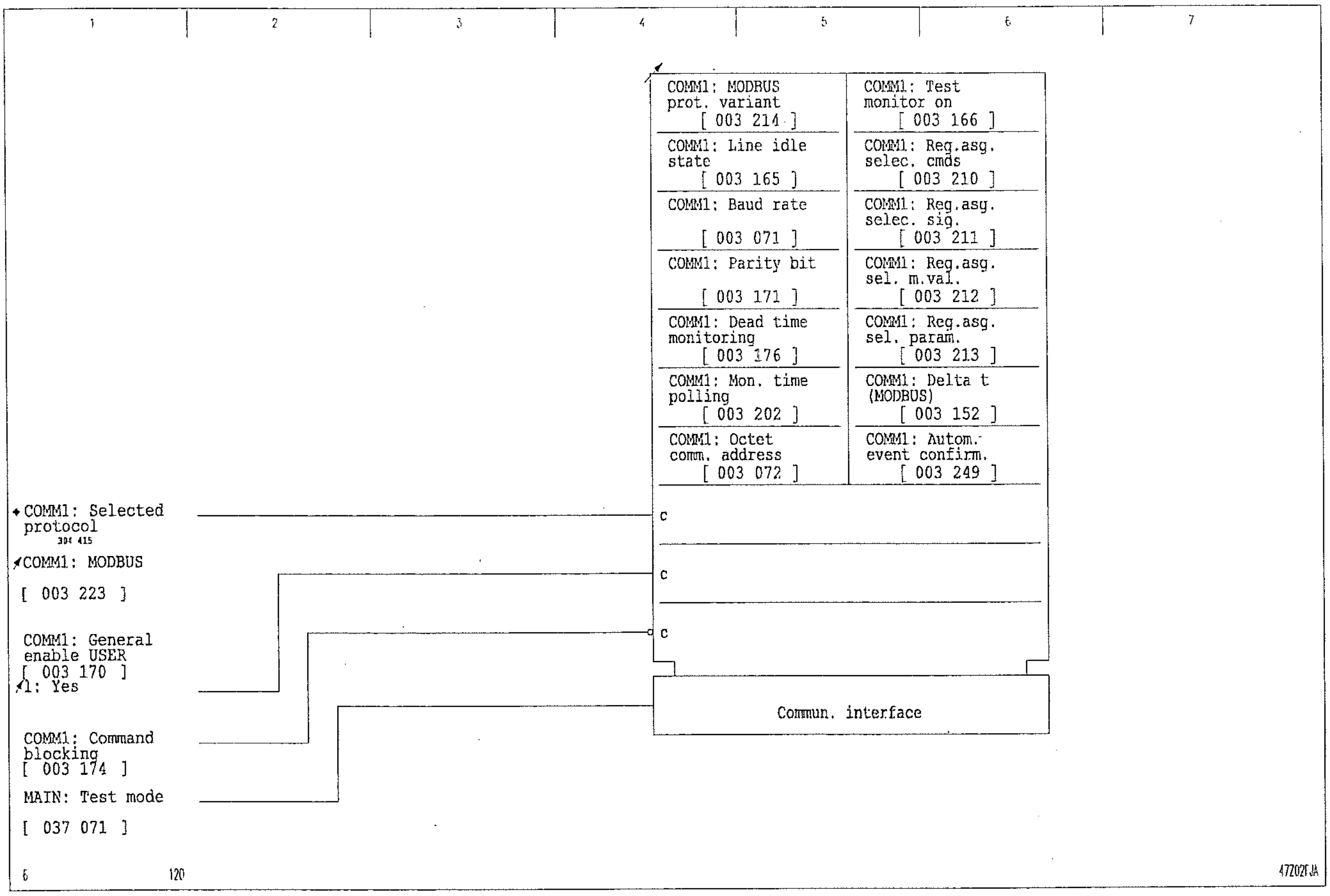
3-8 *"Logical" communication interface 1: settings for the IEC 60870-5-103 interface protocol*



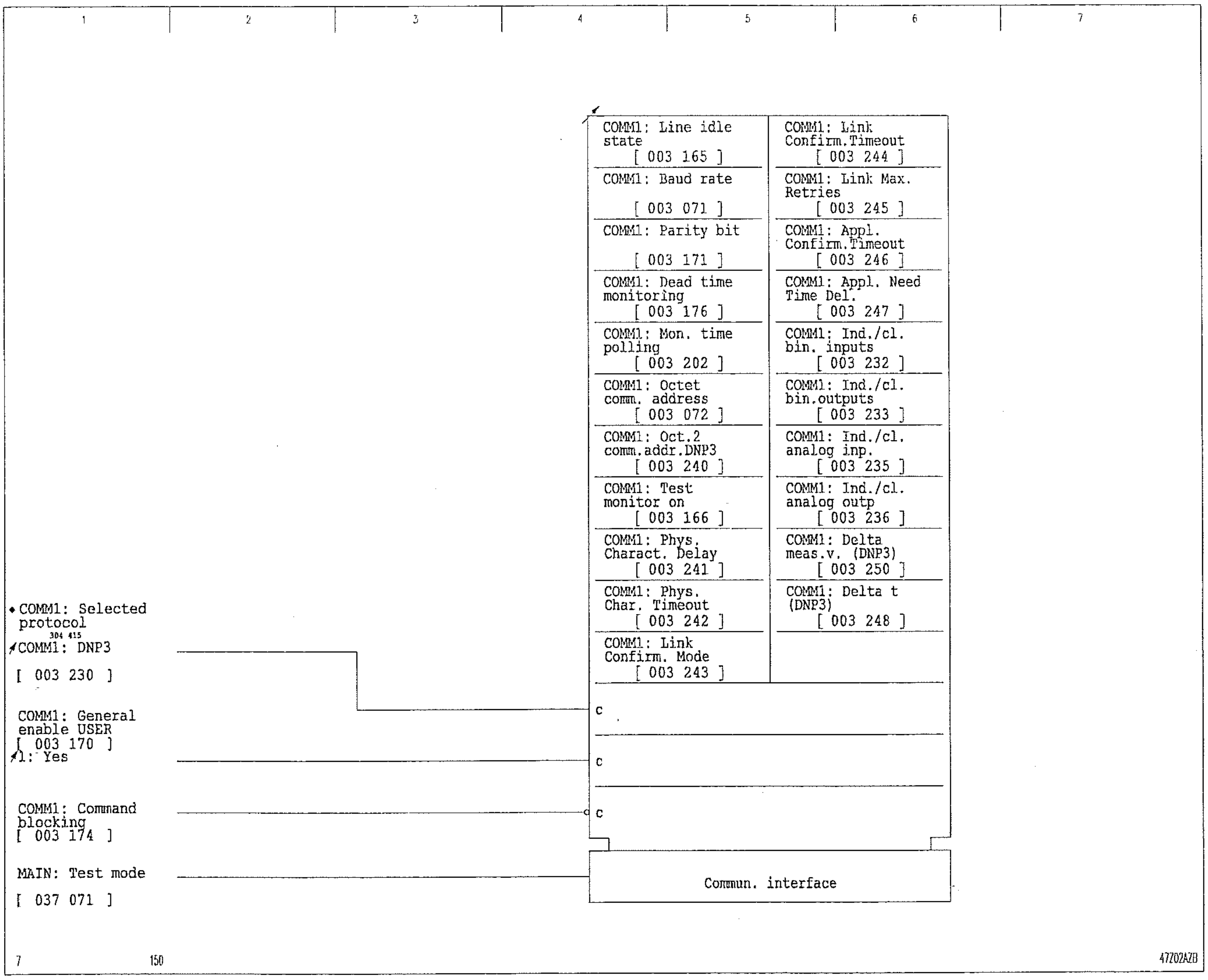
3-9 *"Logical" communication interface 1: settings for the IEC 870-5-101 interface protocol*



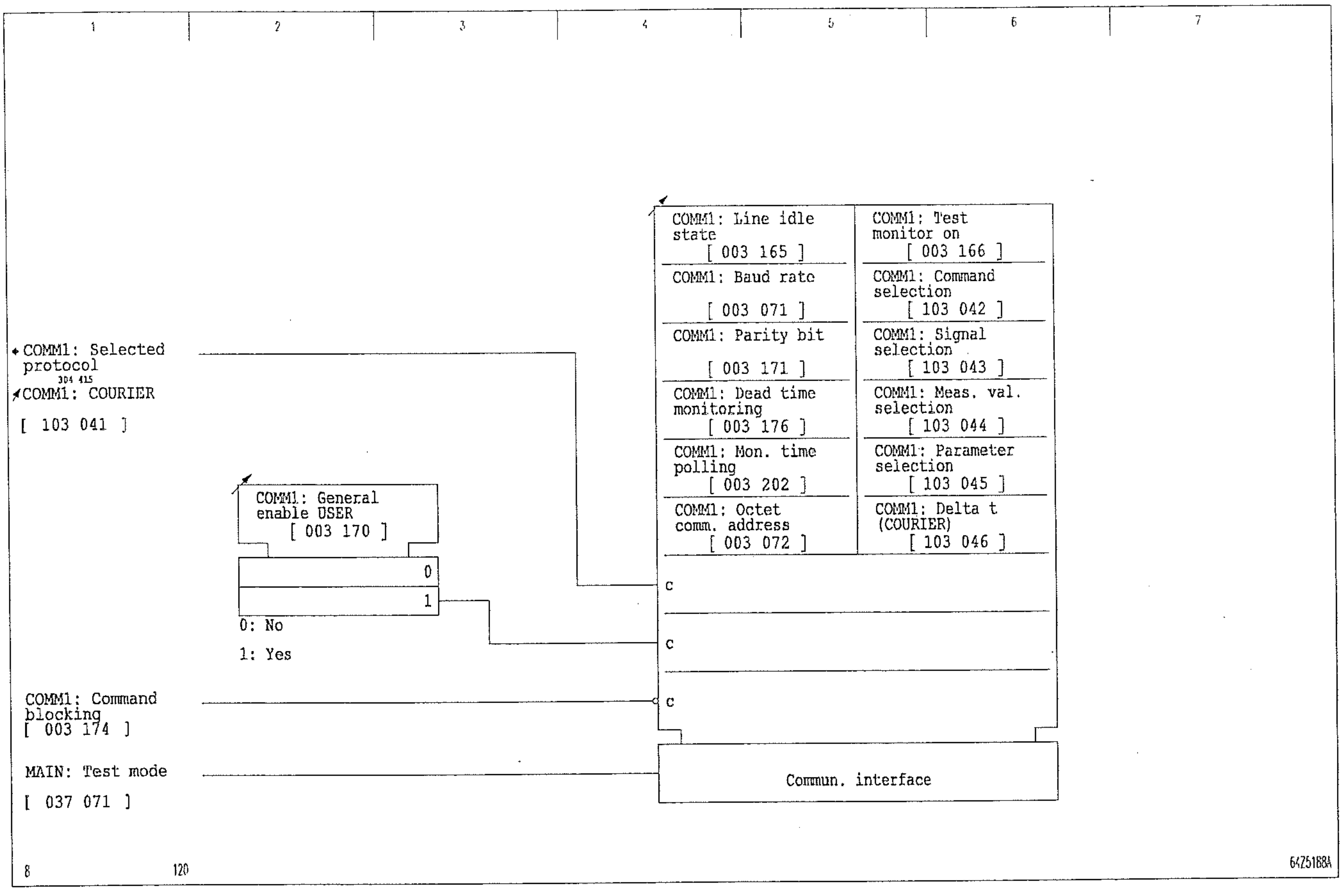
3-10 *"Logical" communication interface 1: settings for the ILS_C interface protocol*



3-11 "Logical" communication interface 1: settings for the MODBUS protocol



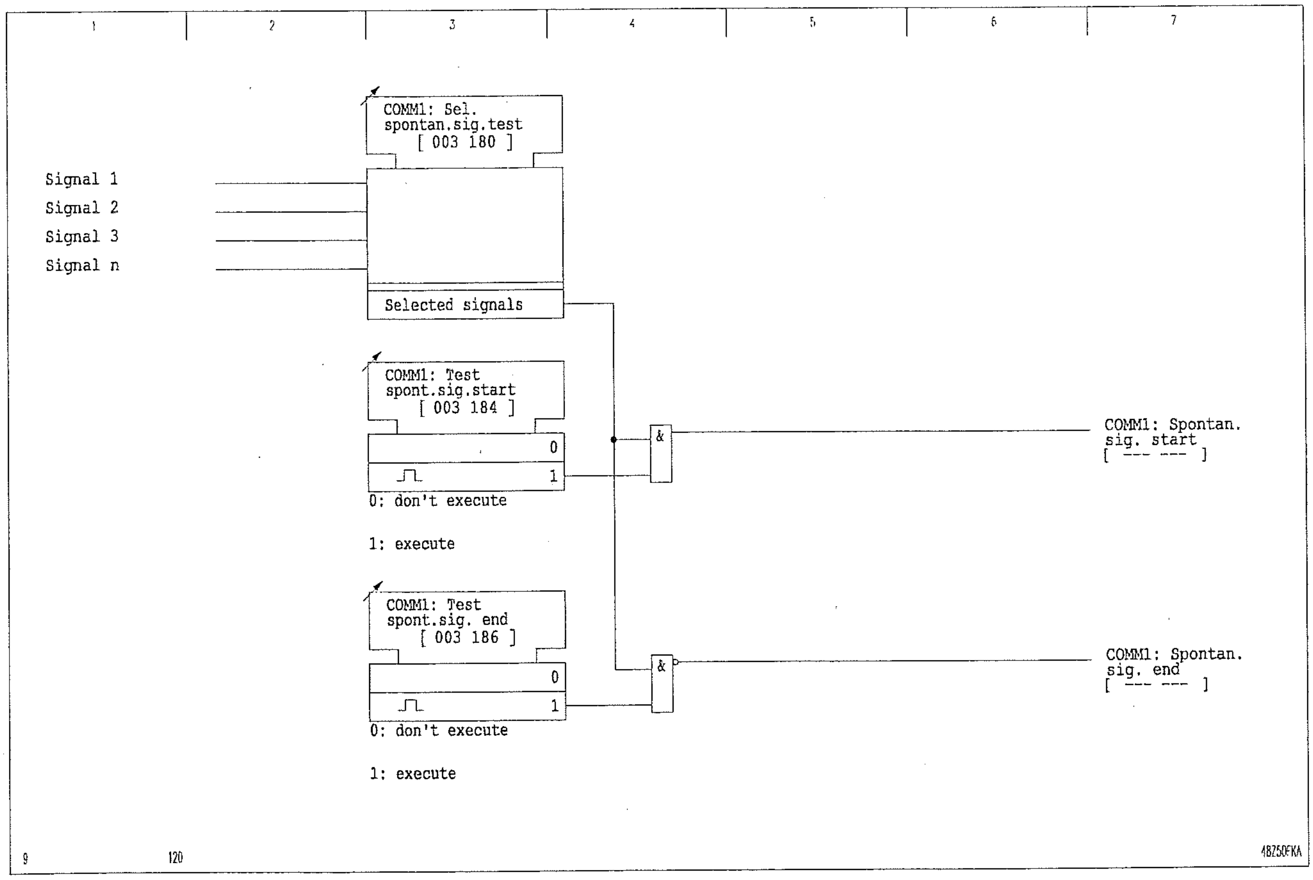
3-12 *"Logical" communication interface 1: settings for DNP 3.0*



3-13 *"Logical" communication interface 1: settings for the COURIER interface protocol*

Checking spontaneous signaling

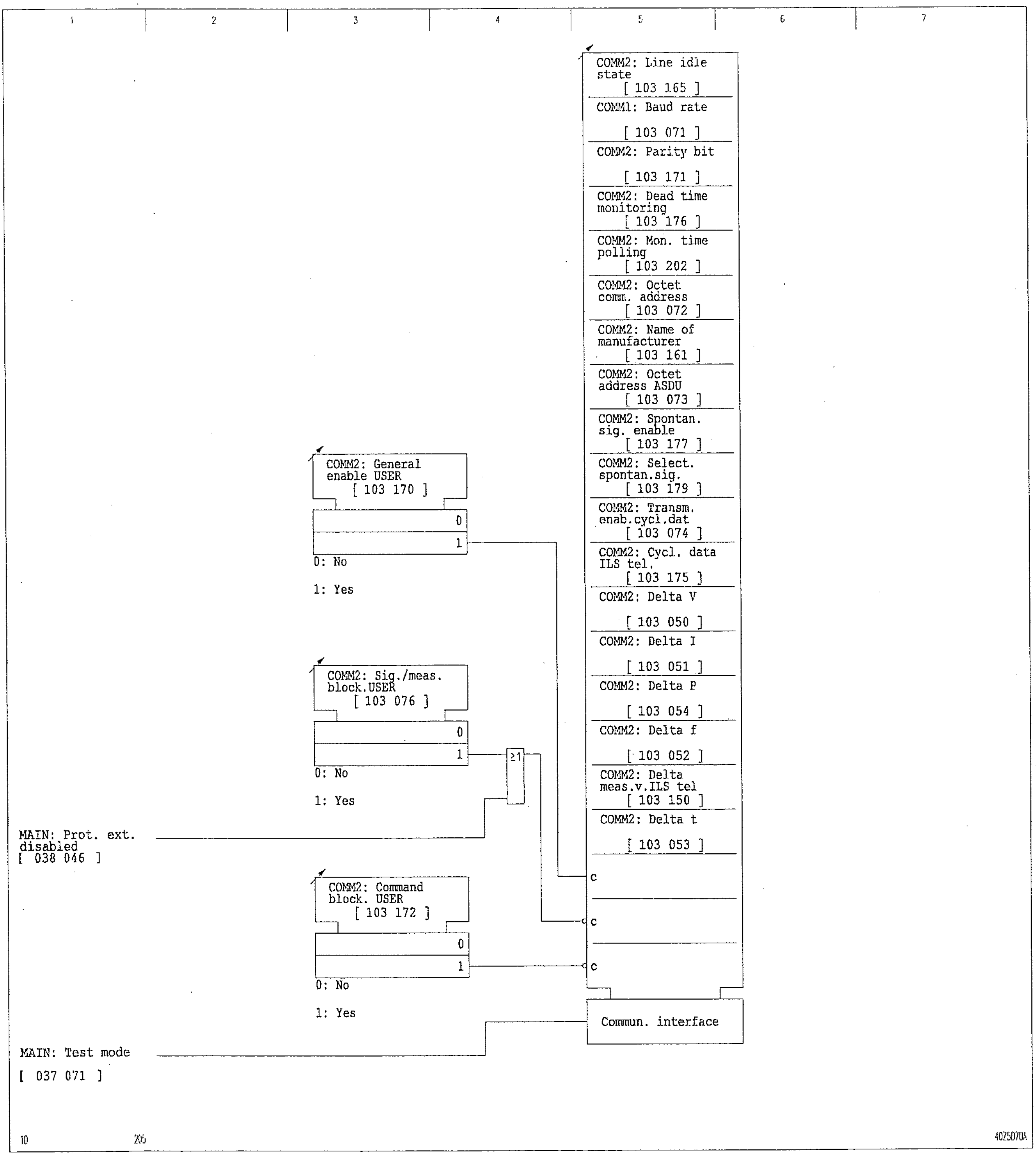
For interface protocols per IEC 60870-5-103, IEC 870-5-101 or ILS-C, there is the option of selecting a signal for testing purposes. This transmission of this signal to the control station as 'sig. start' or 'sig. end' can then be triggered via the local control panel.



3-14 Checking spontaneous signaling

3.4.3 "Logical" Communication Interface 2 (Function Group COMM2)

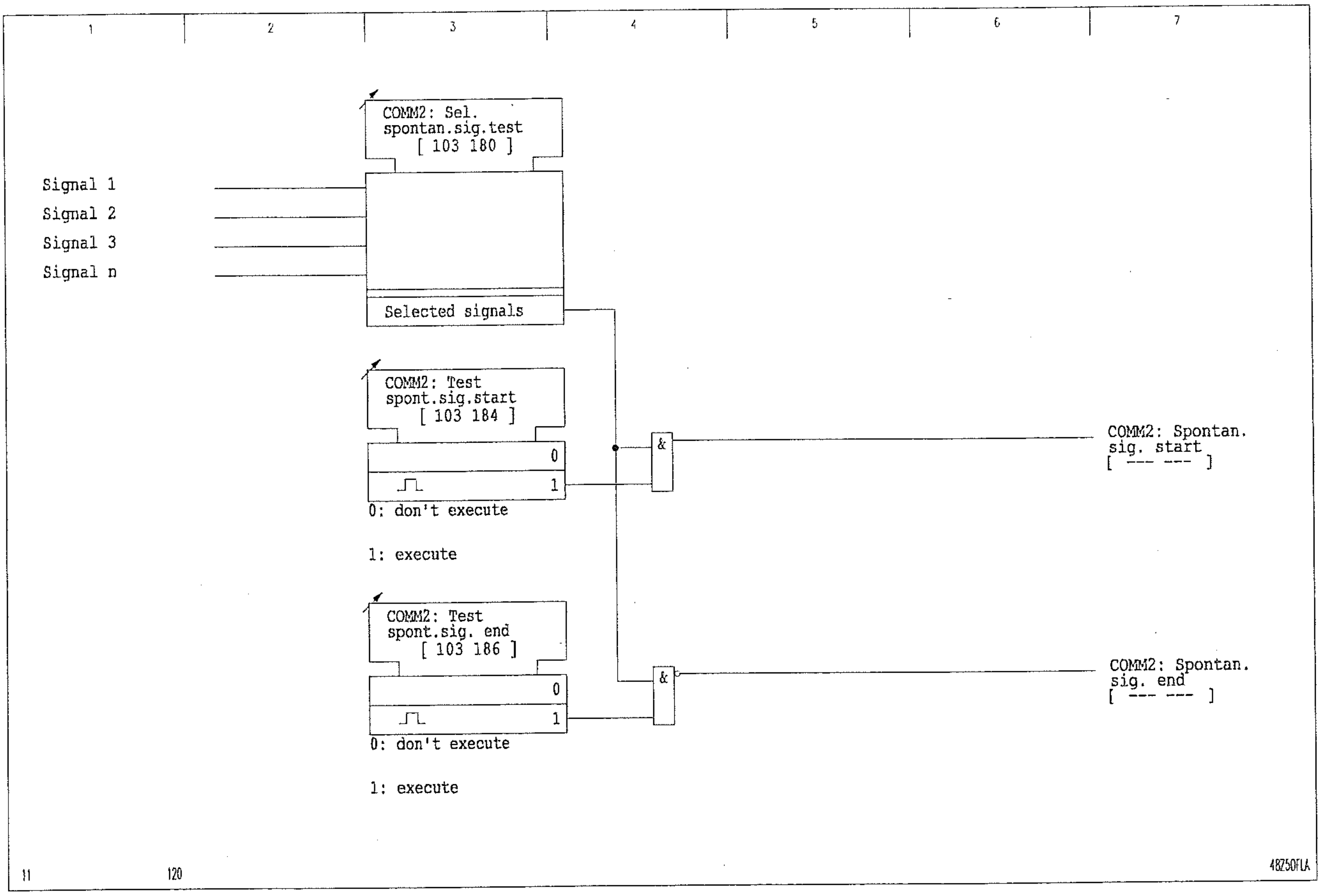
"Logical" communication interface 2 supports the IEC 60870-5-103 interface protocol. In order for data transfer to function properly, several settings must be made.



3-15 *Settings for "logical" communication interface 2*

Checking spontaneous signaling

There is the option of selecting a signal for testing purposes. This transmission of this signal to the control station as 'sig. start' or 'sig. end' can then be triggered via the local control panel.



3-16 *Checking spontaneous signaling*

3.4.4 "Logical" Communication Interface 3 (Function Group COMM3)

Application and Scope

"Logical" communication interface 3 provides a digital communication link between two MiCOM devices for the exchange of up to 8 binary protection signals. While "logical" communication interfaces 1 and 2 are intended for data acquisition and remote access, "logical" communication interface 3 is a "guidance interface" designed for real-time signal transmission (the "InterMiCOM" interface). The primary application resides in the exchange of signals associated with the PSIG (protective signaling) function. However, the InterMiCOM interface can also be employed for the transmission of any other binary signals internal or external to the device.

Hardware options

COMM3 is designed as asynchronous, full-duplex communication interface for the following transmission options.

Direct link without any ancillary equipment:

- Glass fiber (e.g. via 2 x G62.5/125 up to max. 1.4 km)
- Twisted pair (RS 422 up to max. 1.2 km)

Use of ancillary transmission equipment:

- Fiber-optic module (e.g. OZD 485 BFOC-1300 / Hirschmann up to max. 8/14/20 km)
- Universal modem (e.g. PZ 511 via twisted pair 2x2x0.5 mm up to max. 10 km)
- Voice frequency modem (e.g. TD-32 DC / Westermo up to max. 20 km)

Digital network:

- Asynchronous data interface of a primary multiplexing equipment

Enabling

In order to use InterMiCOM, communication interface COMM3 has to be included in the device configuration by way of the setting COMM3: Function group COMM3. This setting parameter is only visible if the relevant optional communication module is fitted. After configuration of COMM3, all addresses associated with this function group (setting parameters, binary state signals etc.) become visible.
The function group can then be enabled or disabled at COMM3: General enable USER.

Telegram configuration

The communication baud rate can be set (at COMM3: Baud rate) so as to meet the transmission channel requirements. Source address (COMM3: Source address) and receiving address (COMM3: Receiving address) can be set to differing values to prevent InterMiCOM communication internal to the device.

Using the InterMiCOM interface, eight independent binary signals can be transmitted in each direction. For the assignment of functions to the send signals (COMM3: Fct. assignm. send 1, ...), any signal from the "Binary Outputs" selection table can be selected. For the receive signals (COMM3: Fct. assignm. rec. 1, ...), any signal from the "Binary Inputs" selection table can be chosen.

For each receive signal, an individual operating mode can be set (COMM3: Oper. mode receive 1, ...) thus defining the required checks for accepting the received binary signal. The 8 signals are divided into two groups with differing choices for the operating mode. The operating mode selected for the telegram check defines the relative weighting of the conflicting target characteristics "Speed", Security" and Dependability" as required for specific protection schemes.

- Binary signals 1 to 4:
  Choice of *Blocking* or *Direct intertrip* for the operating mode.

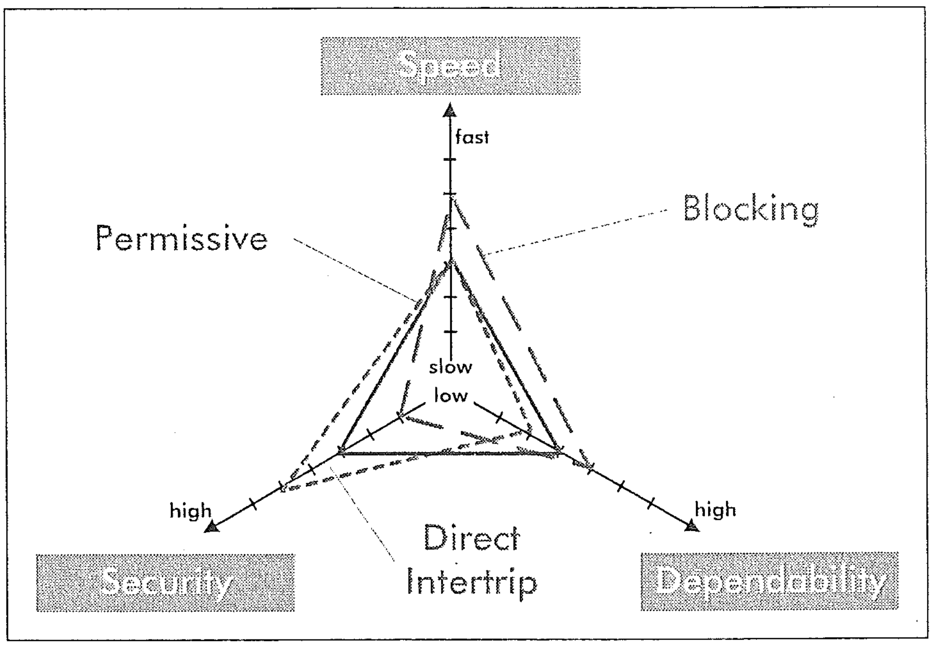
- Binary signals 5 to 8:
  Choice of *Permissive* or *Direct intertrip* for the operating mode.

EN 60834-1 classifies command based teleprotection schemes into 3 categories according to their specific requirements. The following settings for the operating modes are recommended for compliance with the requirements for the individual teleprotection schemes:

- Direct transfer trip or intertripping:
  - Preference: Security.
  - Implication: No spurious pickup in the presence of channel noise.
  - Recommended setting: Operating mode *Direct intertrip* (groups 1 to 4 or 5 to 8).

- Permissive teleprotection scheme:
  - Preference: Dependability.
  - Implication: Maximum probability of signal transmission in the presence of channel noise.
  - Recommended setting: Operating mode *Permissive* (groups 5 to 8).

- Blocking teleprotection scheme:
  - Preference: Speed.
  - Implication: Fast peer-to-peer signal transfer.
  - Recommended setting: Operating mode *Blocking* (groups 1 to 4).

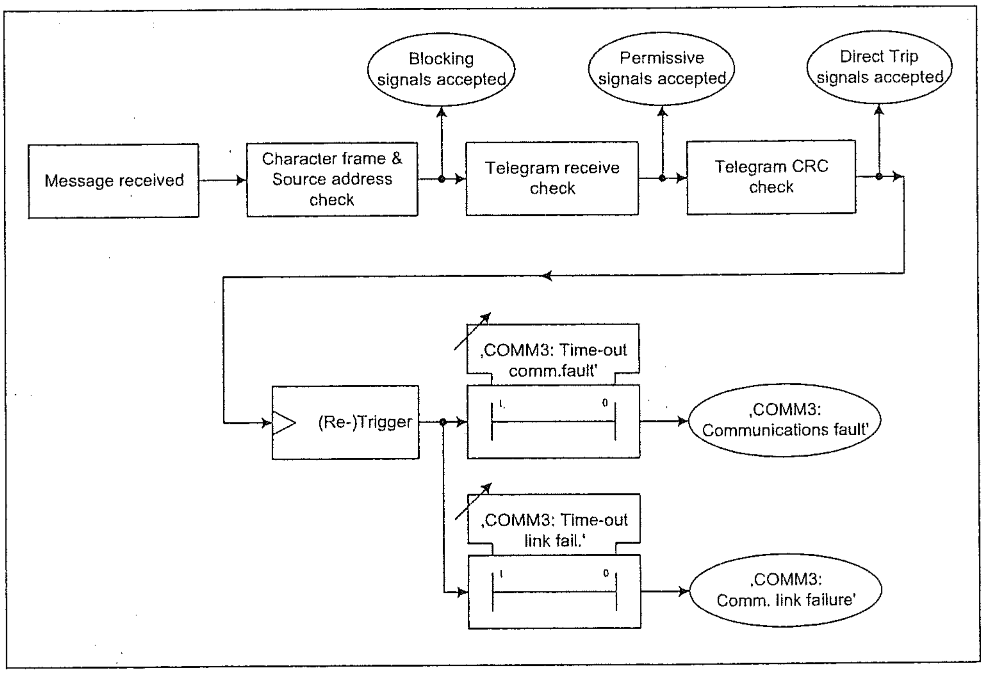


3-17 Comparison of the operating modes

Communication monitoring

Timer stage COMM3: Time-out comm.fault is used for monitoring the transmission channel. This timer is retriggered whenever a 100% valid telegram is received. The wide setting range allows adaptation to the actual channel transmission times. This is particularly important for time-critical schemes such as the blocking scheme. After this timer stage has elapsed, alarm signals COMM3: Communications fault and SFMON: Communic.fault COMM3 are issued and the received signals are set to their user-defined default values (COMM3: Default value rec. 1, ...), thus ensuring that the relay protection logic will continue to operate in a pre-determined failsafe way. When the InterMiCOM interface is used in connection with the PSIG (protective signaling) function, the alarm signals can be configured to the corresponding PSIG input signals using the COMM3: Sig.asg. comm.fault setting.

COMM3: Time-out link fail. is used to determine a persistent failure of the channel. After this timer stage has elapsed, alarm signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are raised. These can be mapped to give the operator a warning LED or contact, to indicate that maintenance attention is required.



3-18 *Message processing and communication monitoring*

Supervision of communication link quality

For each received message, InterMiCOM carries out a syntax check and updates the proportion of corrupted messages within the last 1000 received messages. These ratio results are provided as continuously updated values (COMM3: No. tel. errors p.u.) and as maximum value (COMM3: No.t.err.,max,stored). The user may declare the percentage of corrupted messages that can be allowed compared to total messages transmitted (COMM3: Limit telegr. errors), before an alarm is raised (COMM3: Lim.exceed.,tel.err. and SFMON: Lim.exceed.,tel.err.). All corrupted messages are counted (COMM3: No. telegram errors). This counter as well as the stored maximum ratio of corrupted messages can be reset via COMM3: Reset No. tel.errors.

Commissioning tools

The actual values of send and receive signals can be read from the device as physical state signals (COMM3: State send 1, ... and COMM3: State receive 1, ...). In addition, InterMiCOM provides two test facilities for commissioning of the protection interface.

For the loop back test, the send output is directly linked back to the receive input of the same device. The test can be triggered via COMM3: Loop back test. The device then sends the bit pattern (set as equivalent decimal number at COMM3: Loop back send) for the preset time COMM3: Hold time for test. Only for this test, the source address is set to "0", a value that is not used for regular peer-to-peer communication.

While the hold time is running, the test result can be checked by reading out the measured operating data values COMM3: Loop back result and COMM3: Loop back receive. Once the hold time has expired, the loop back test is terminated and InterMiCOM reverts to the normal sending mode (i.e. sending the updated values of the configured send signals, using the set source address).

Thus in case of communication problems, the loop back test can be used to verify or to exclude a device malfunction. The transmission channel including the receiving device can be checked manually by setting individual signals (COMM3: Send signal for test) to user-defined test values (COMM3: Log. state for test). After triggering the test via COMM3: Send signal, test, the preset signal is sent with the preset value for the set hold time COMM3: Hold time for test. The 7 remaining signals are not affected by this test procedure and are sent with their updated values. During this time, the received signal can be checked from the receiving device, e.g. by reading the physical state signal. Once the hold time has expired, the test mode is reset automatically and the updated values of all 8 signals are transmitted again.

3.5 Time Synchronization via the IRIG-B Interface (Function Group IRIGB)

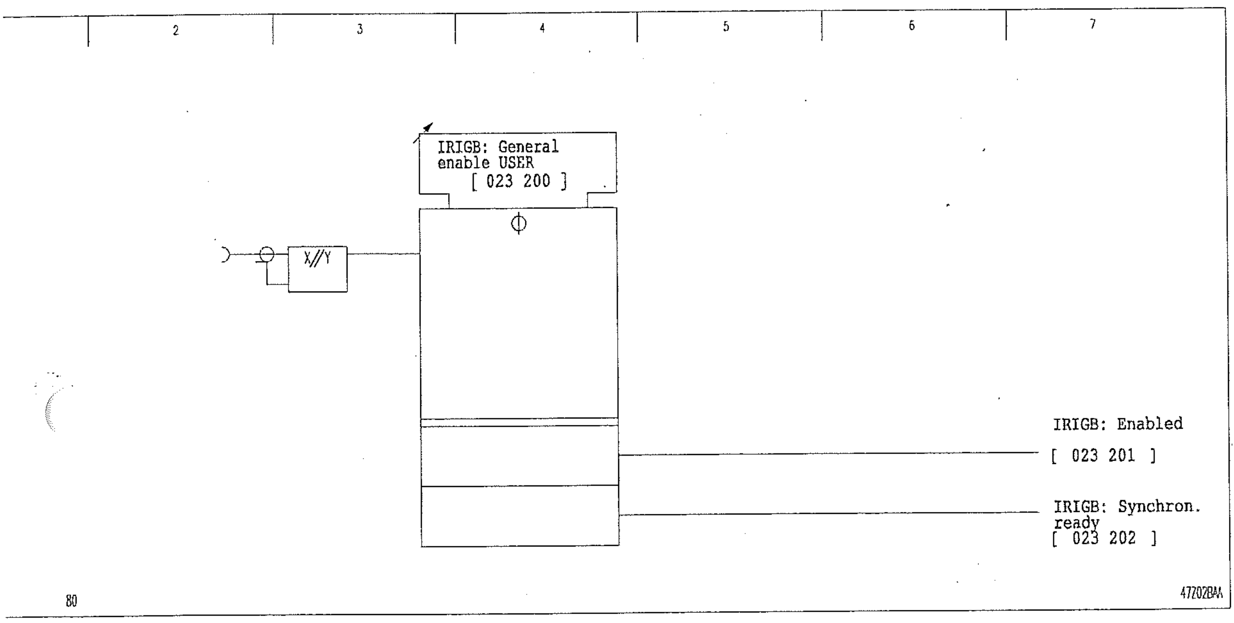
If a GPS receiver with an IRIG-B connection is available, for example, then the internal clock in the P130C can be synchronized to GPS time through the optional IRIG-B interface. The user must keep in mind that the IRIG-B signal contains only one piece of information about the date (the day as numbered since the beginning of the year). On the basis of this piece of information about the date, the P130C calculates the current date (DD.MM.YY) based on the year set in the P130C.

and enabling the 'erface

The IRIG-B interface can be disabled or enabled from the local control panel.

syr nize

Once the IRIG-B interface has been enabled and is receiving a signal, the P130C checks the received signal for plausibility. Non-plausible signals are rejected by the P130C. If a correct signal is not received by the P130C continuously, then the synchronization function is no longer ready.



RIG-B interface

3.6 Configurable Function Keys (Function Group F_KEY)

The P130C has four freely configurable function keys. Figure 3-20 illustrates their operation using function key F1 as an example. This function key is not enabled unless the associated password F_KEY: Password funct. key1 has been entered first. Once the password has been entered, the function key remains active for no longer than the set time F_KEY: Return time fct.keys. Thereafter, the function key is disabled until the password is entered again. The same rules apply to function keys F2, F3 and F4.

Configuring the function keys with a single function

A single function can be assigned to each function key by selecting a logic state signal (except LOC: Trig. menu jmp x EXT) via F_KEY: Fct. assignm. Fx (Fx: F1, F2, F3 or F4). The selected signal will then be triggered in the P130C whenever the relevant function key is pressed.

Configuring the function keys using menu jump lists

Instead of a single function, a menu jump list can be assigned to each function key by selecting the entry LOC: Trig. menu jmp x EXT (x: 1 or 2) at F_KEY: Fct. assignm. Fx (Fx: F1, F2, F3 or F4). Repeated pressing of the relevant function key will then sequentially trigger the functions of the selected menu jump list.

The two menu jump lists are composed via LOC: Fct. menu jmp list x (x: 1 or 2). Up to 16 functions can be selected, including setting parameters, event counters and /or event recordings.

Configuring the read key

At LOC: Fct. read key up to 16 functions can be selected from the same list as for LOC: Fct. menu jmp list x. Repeated pressing of the read key will then sequentially trigger the selected functions.

Operating mode of the function keys

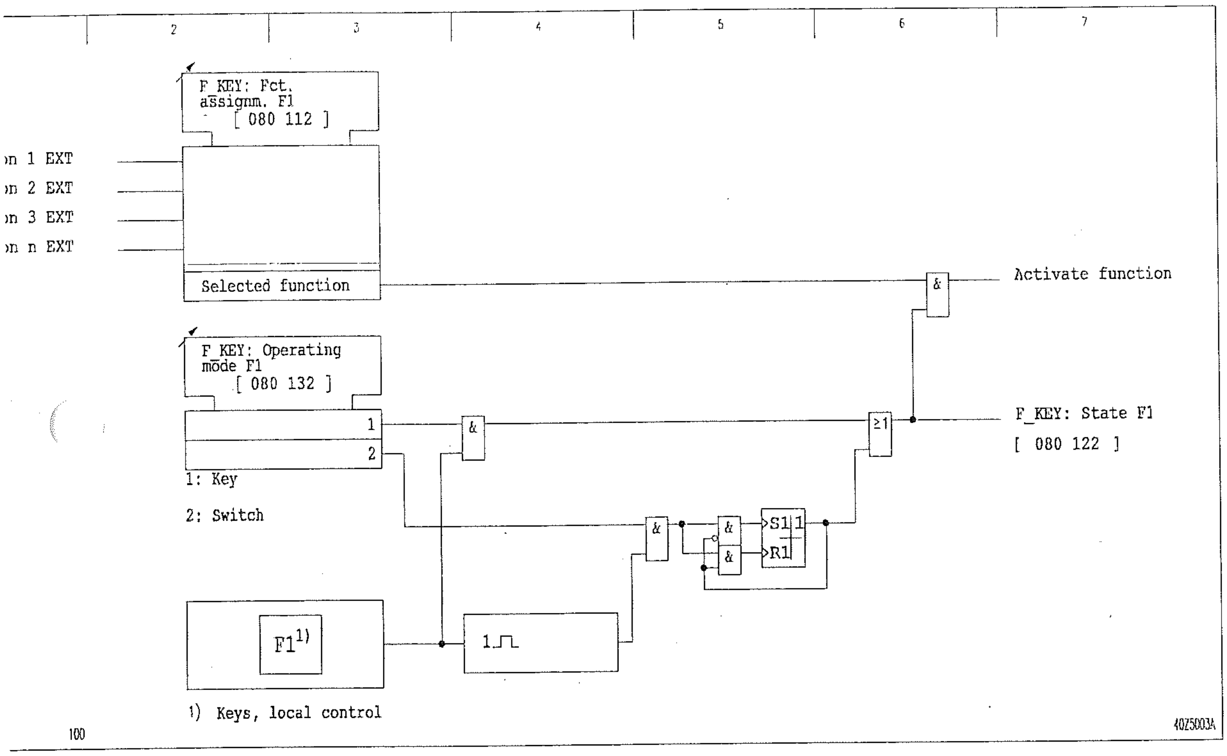
For each function key, the user can define an operating mode.

- *Key* mode: The selected function is active while the function key is being pressed.
- *Switch* mode: The status of the selected function will change between 'enabled' *(On)* and 'disabled' *(Off)* whenever the function key is pressed.

The switching state of the function key can be displayed.

Key response

If the backlighting of the LCD display is switched off, pressing a function key or the read key will initially result in switching on the backlighting. Pressing the key a second time will then trigger the selected function (as for the other keys).



Configuration and operating mode of the function keys. The associated function can be a single function or a menu jump list.

3.7 Configuration and Operating Mode of the Binary Inputs (Function Group INP)

The P130C has optical coupler inputs for processing binary signals from the system. The functions that will be activated in the P130C by triggering these binary signal inputs are defined by the configuration of the binary signal inputs. The trigger signal must persist for at least 30 ms in order to be recognized by the P130C.

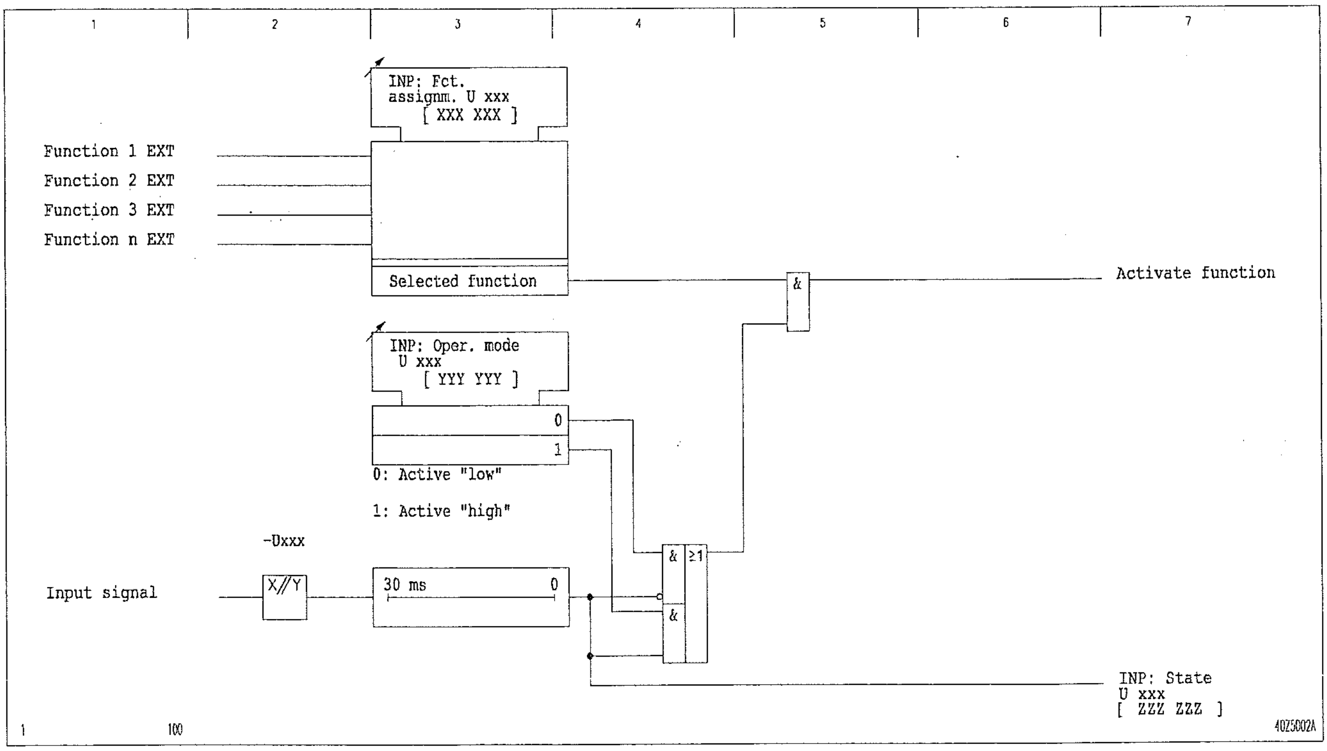
Configuring the binary inputs

One function can be assigned to each binary signal input by configuration. The same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

In this manual, we assume that the required functions (marked 'EXT' in the address description) have been assigned to binary signal inputs by configuration.

Operating mode of the binary inputs

The operating mode for each binary signal input can be defined. The user can specify whether the presence (active 'high' mode) or the absence (active 'low' mode) of a voltage should be interpreted as the logic '1' signal. The display of the state of a binary signal input – 'low' or 'high' – is independent of the setting for the operating mode of the signal input.



3-21 *Configuration and operating mode of the binary signal inputs*

3.8 Configuration, Operating Mode, and Blocking of the Output Relays (Function Group OUTP)

The P130C has output relays for the output of binary signals. The binary signals to be issued are defined by configuration.

tion of the output

One binary signal can be assigned to each output relay. The same binary signal can be assigned to several output relays by configuration.

mode of the ays

The user can set an operating mode for each output relay. The operating mode determines whether the output relay will operate in an energize-on-signal (ES) mode or normally-energized (NE) mode and whether it will operate in latching mode.

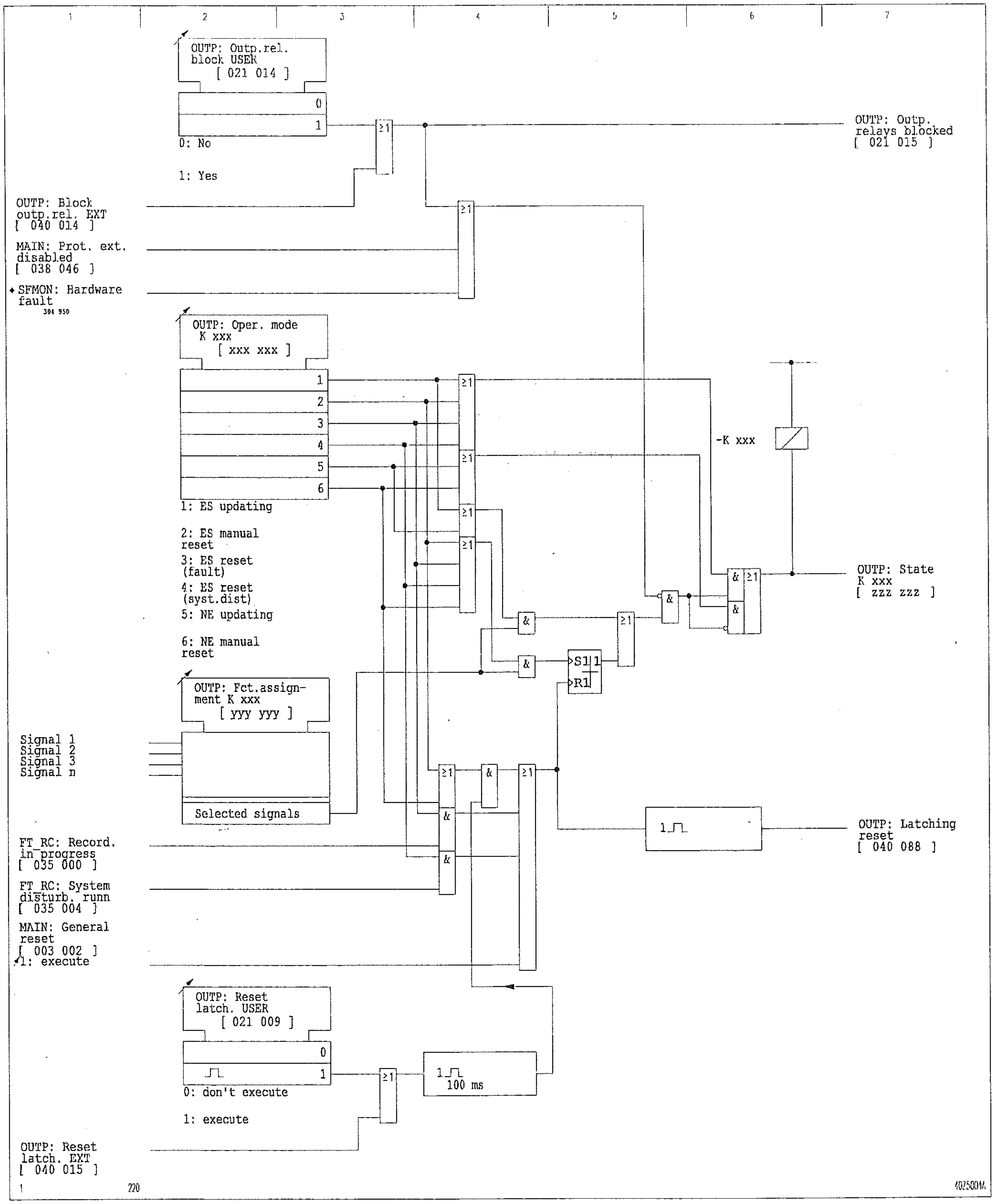
Depending on the I/O module under consideration, the output relays have either make contacts, changeover contacts or both (see the Terminal Connection Diagrams in the Appendix). For relays with make contacts, the energize-on-signal (ES) mode corresponds to normally-open operation. The normally-energized (NE) mode means that the polarity of the driving signal is inverted, such that a logic "0" maintains the relay normally-closed. For relays with changeover contacts, these more common descriptions are not applicable.

Latching is disabled manually from the local control panel or through an appropriately configured binary signal input either at the onset of a new fault or at the onset of a new system disturbance, depending on the operating mode selected.

he output relays

The P130C offers the option of blocking all output relays from the local control panel or by way of an appropriately configured binary signal input. The output relays are likewise blocked if the device is disabled via appropriately configured binary inputs. In such cases, the relays are treated according to their operating mode. They are not triggered if they are in energize-on-signal (ES) mode; only relays in normally-energized (NE) mode are triggered.
An exception is made for those relays that have the signals SFMON: Warning (relay) or MAIN: Blocked/faulty assigned to them. Thereby the blocking is indicated correctly.
(The signal MAIN: Blocked/faulty is coupled to the activation of the LED labeled 'OUT OF SERVICE'.)

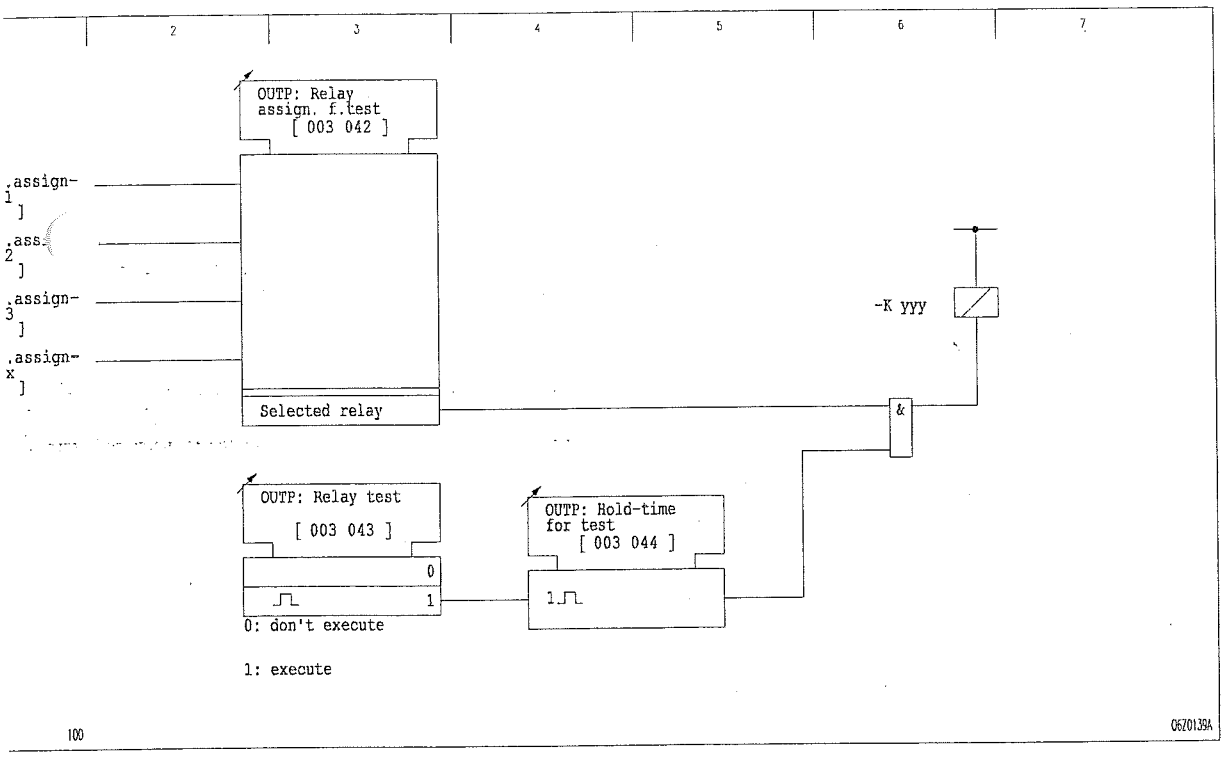
If, on the other hand, a serious hardware error has been detected by the self-monitoring function (see the error messages leading to blocking according to Chapter 10) then all output relays are reset whatever the set operating mode or signal configuration.



3-22 *Configuration, setting the operating mode, and blocking the output relays*

ˈe output relays

For testing purposes, the user can select an output relay and trigger it via the local control panel. Triggering persists for the duration of the set hold time.



ˈesting the output relays

3.9 Configuration and Operating Mode of the LED Indicators (Function Group LED)

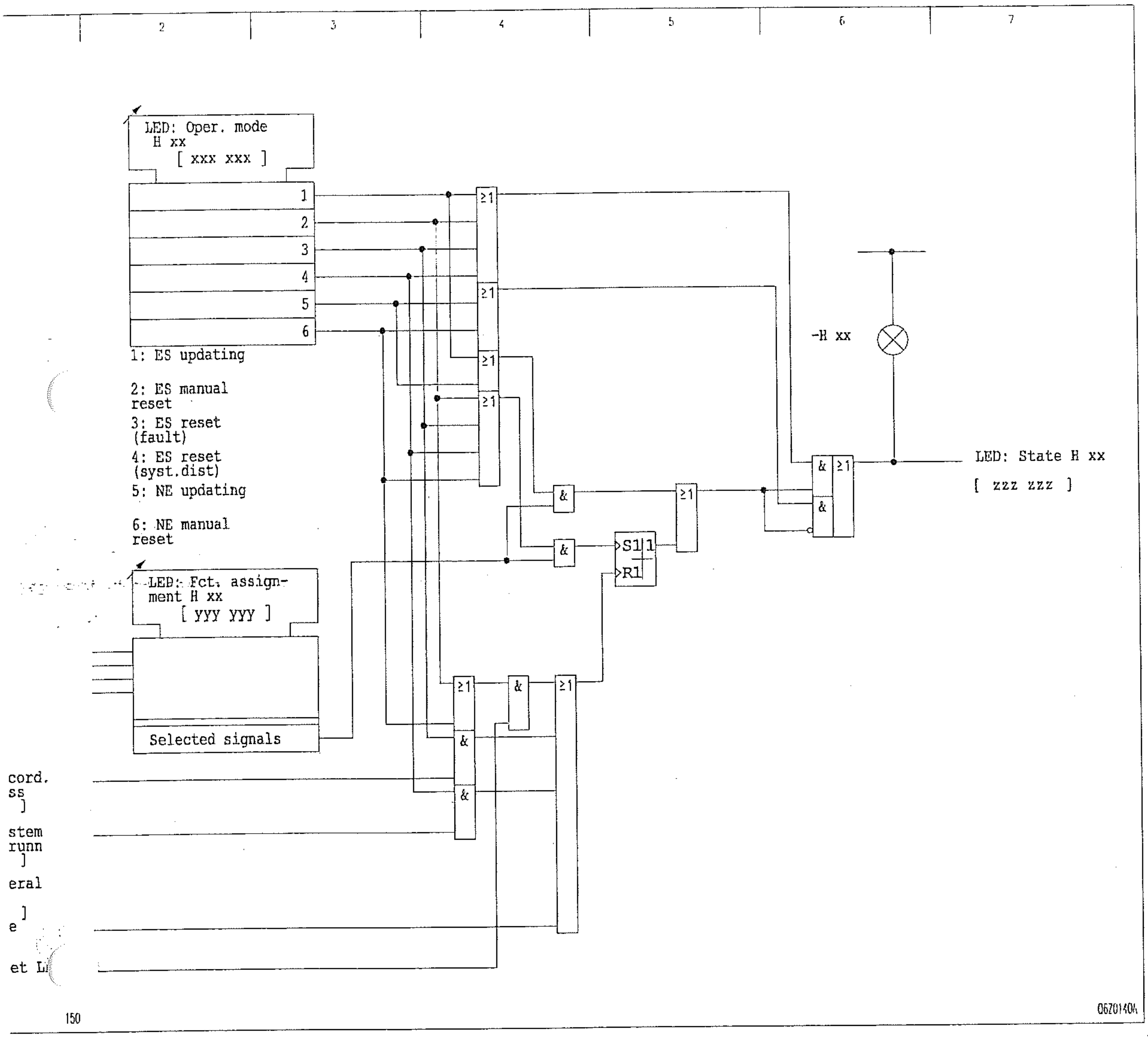
The P130C has 17 LED indicators for the indication of binary signals. Five of the LED indicators are permanently assigned to functions. The other LED indicators are freely configurable.

Configuring the LED indicators

One binary signal can be assigned to each of the freely configurable LED indicators. The same binary signal can be assigned to several LED indicators by configuration.

Operating mode of the LED indicators

The user can set an operating mode for each LED indicator – with the exception of the first one. The operating mode determines whether the LED indicator will operate in an energize-on-signal arrangement (ES, 'open-circuit principle') or normally energized arrangement (NE, 'closed-circuit principle') and whether it will operate in latching mode. Latching is disabled manually from the local control panel or through an appropriately configured binary signal input (see section entitled 'Main Functions of the P130C') either at the onset of a new fault or at the onset of a new system disturbance, depending on the operating mode selected.



Configuration and operating mode of the LED indicators

3.10 Main Functions of the P130C (Function Group MAIN)

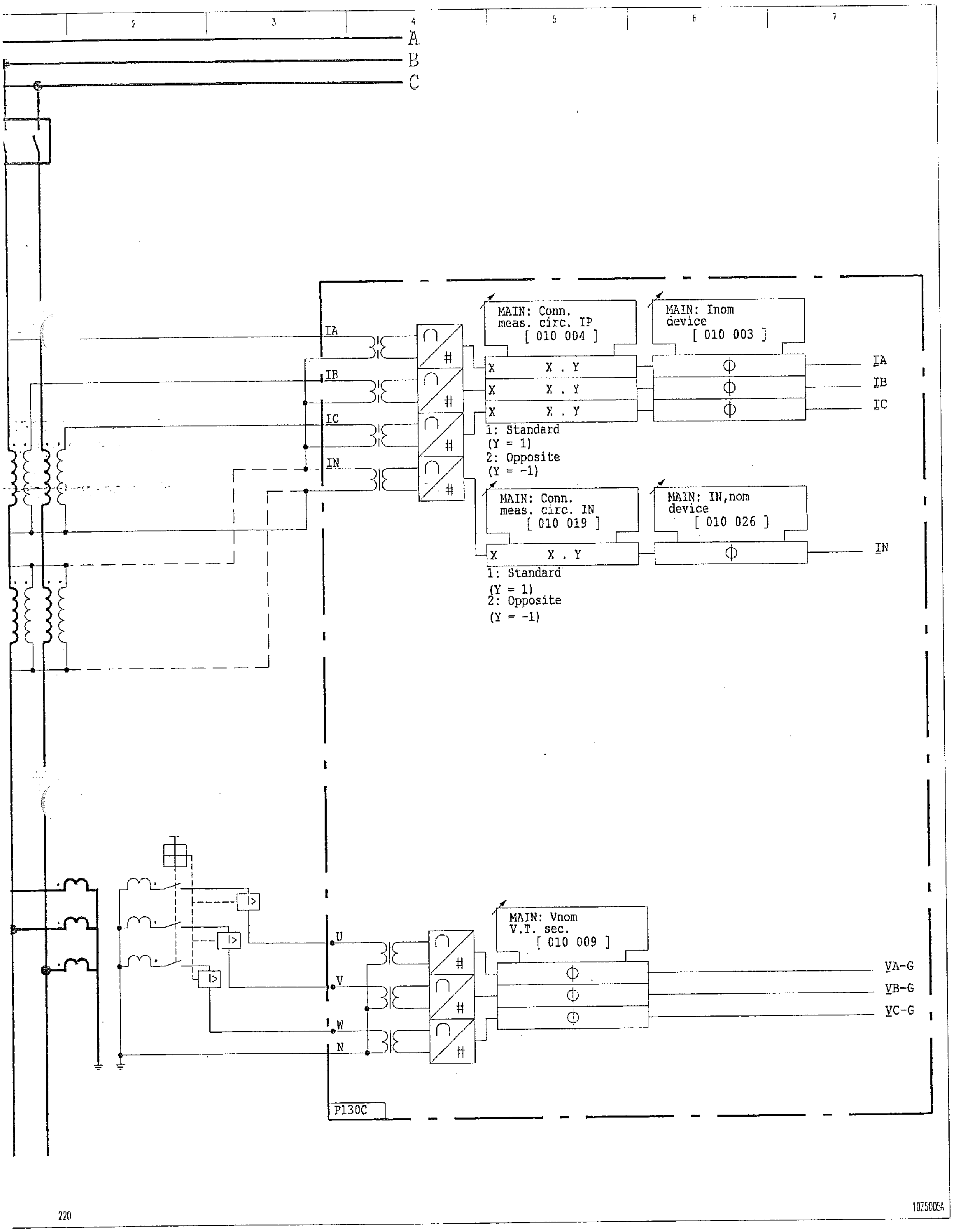
3.10.1 Conditioning the Measured Variables

The secondary phase currents of the system transformers are fed to the P130C. The measured variables are – electrically isolated – converted to normalized electronics levels. Air-gap transformers are used in the phase current path to suppress aperiodic signal components. The analog quantities are digitized and are thus available for further processing.

Settings that do not refer to nominal quantities are converted by the P130C to nominal quantities. For this purpose, the user must set the secondary nominal currents and nominal voltages of the system transformers.

The connection arrangement of the measuring circuits must be set in the P130C. Figure 3-25 shows the standard connection. The phase of the digitized currents is rotated 180° by this setting.

If the P130C is to operate with the GFDSS function (ground fault direction determination using steady-state values), current transformer T4 needs to be connected to a current transformer in Holmgreen connection (dashed lines in Figure 3-25) or to a window-type current transformer.



:on(1 the P130C measuring circuits. For the frequency protection model, the current transformers are not included.
Whe .ng P1-P2 and S1-S2 identifications for the terminal polarity of CT's, the dot shown identifies the P1 and S1 terminals.)

3.10.2 Operating Data Measurement

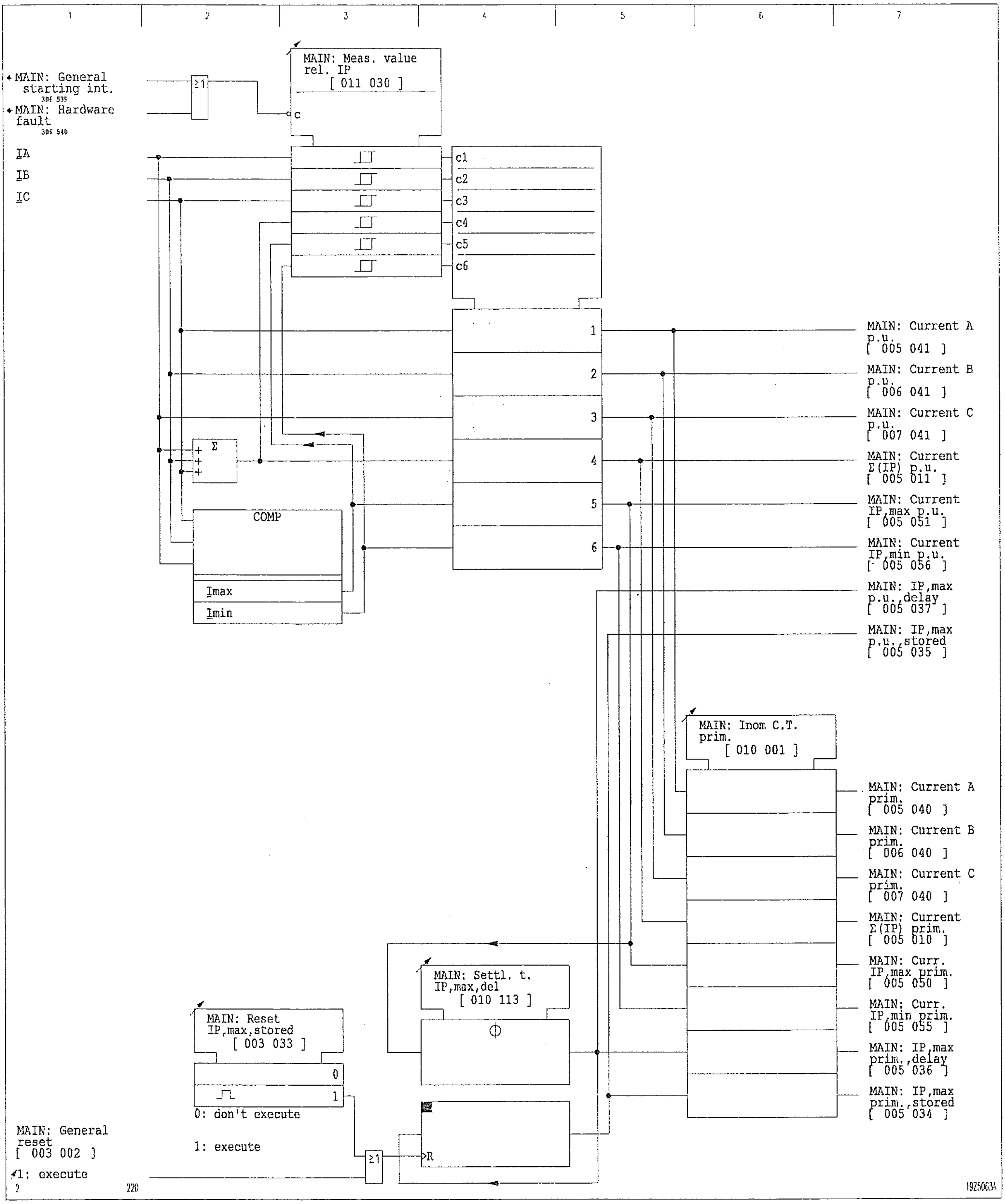
The P130C has an operating data measurement function for the display of currents and voltages measured by the P130C; quantities derived from these measured values are also displayed. Set minimum thresholds must be exceeded in order for measured values to be displayed. If these minimum thresholds are not exceeded, '*not measured*' is displayed in place of a value. The following measured variables are displayed:

- Phase currents for all three phases
- Maximum phase current
- Minimum phase current
- Delayed and stored maximum phase current
- Residual current measured by the P130C at the T 4 transformer
- Phase-to-ground voltages
- Sum of the three phase-to-ground voltages
- Phase-to-phase voltages
- Maximum phase-to-phase voltage
- Minimum phase-to-phase voltage
- Active and reactive power
- Active power factor
- Load angle φ in all three phases
- Phase relation between calculated and measured residual current
- Frequency
- Active and reactive energy output and input

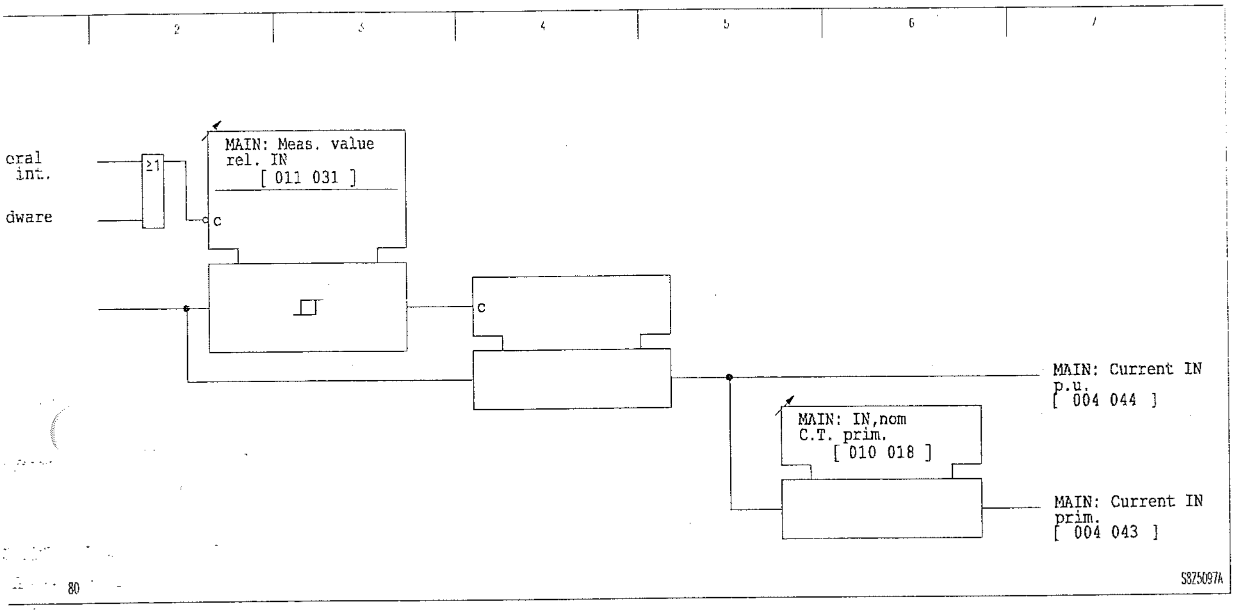
The measured data are updated at 1 s intervals. Updating is interrupted if a general starting state is present or if the self-monitoring function detects a hardware fault.

current values

The measured current values are displayed both as per-unit quantities referred to the nominal quantities of the P130C and as primary quantities. In order for values to be displayed as primary values, the primary nominal current of the system transformer needs to be set in the P130C.



3-26 *Measured operating data - phase current*



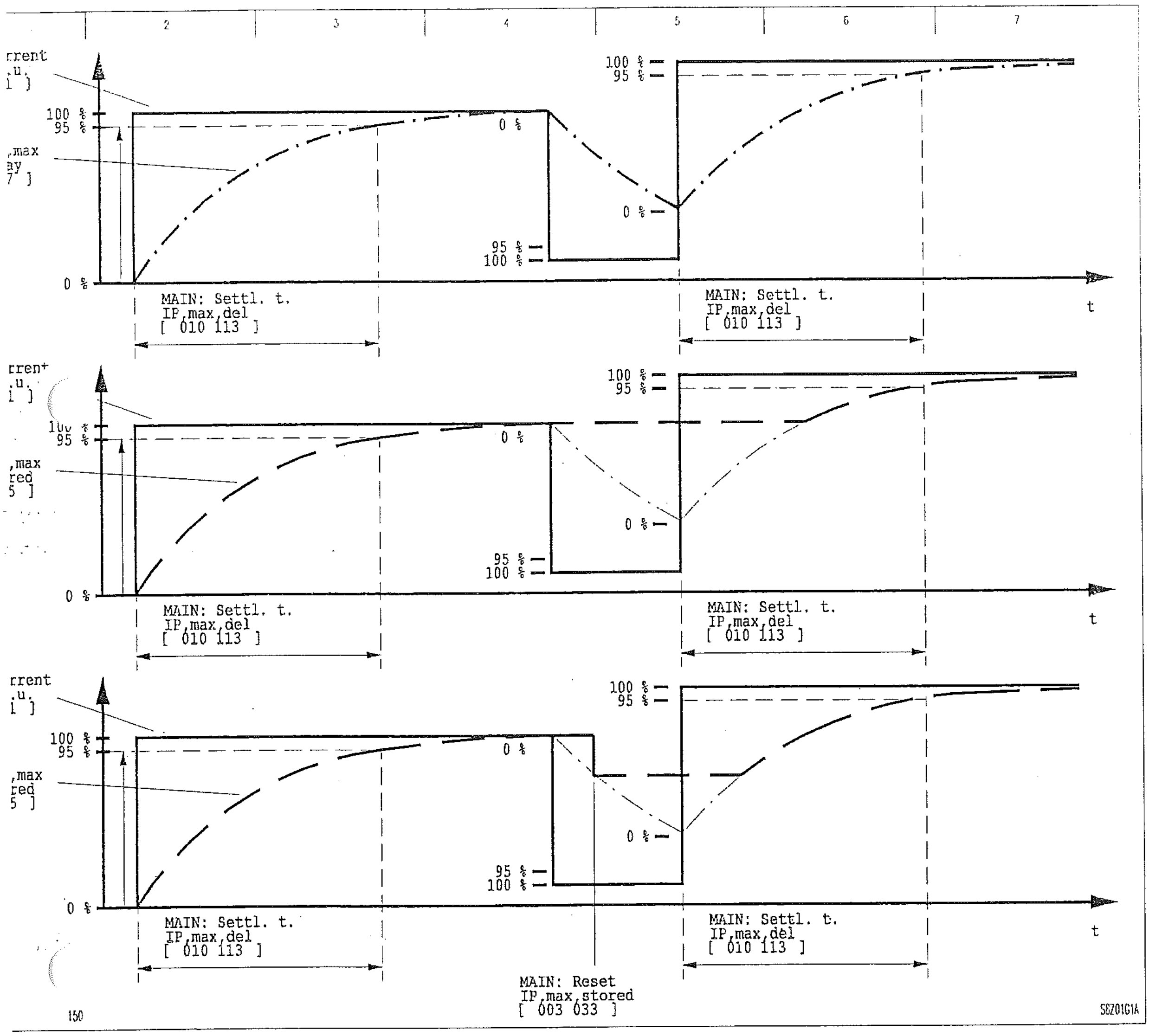
/leasured operating data - residual current

Delayed maximum phase current display

The P130C offers the option of delayed display of the maximum value of the three phase currents. The delayed maximum phase current display is an exponential function of the maximum phase current $I_{P,max}$ (see upper curve in Figure 3-28). At MAIN: Settl. t. IP,max,del the user can set the time after which the delayed maximum phase current display will have reached 95 % of maximum phase current $I_{P,max}$.

Stored maximum phase current display

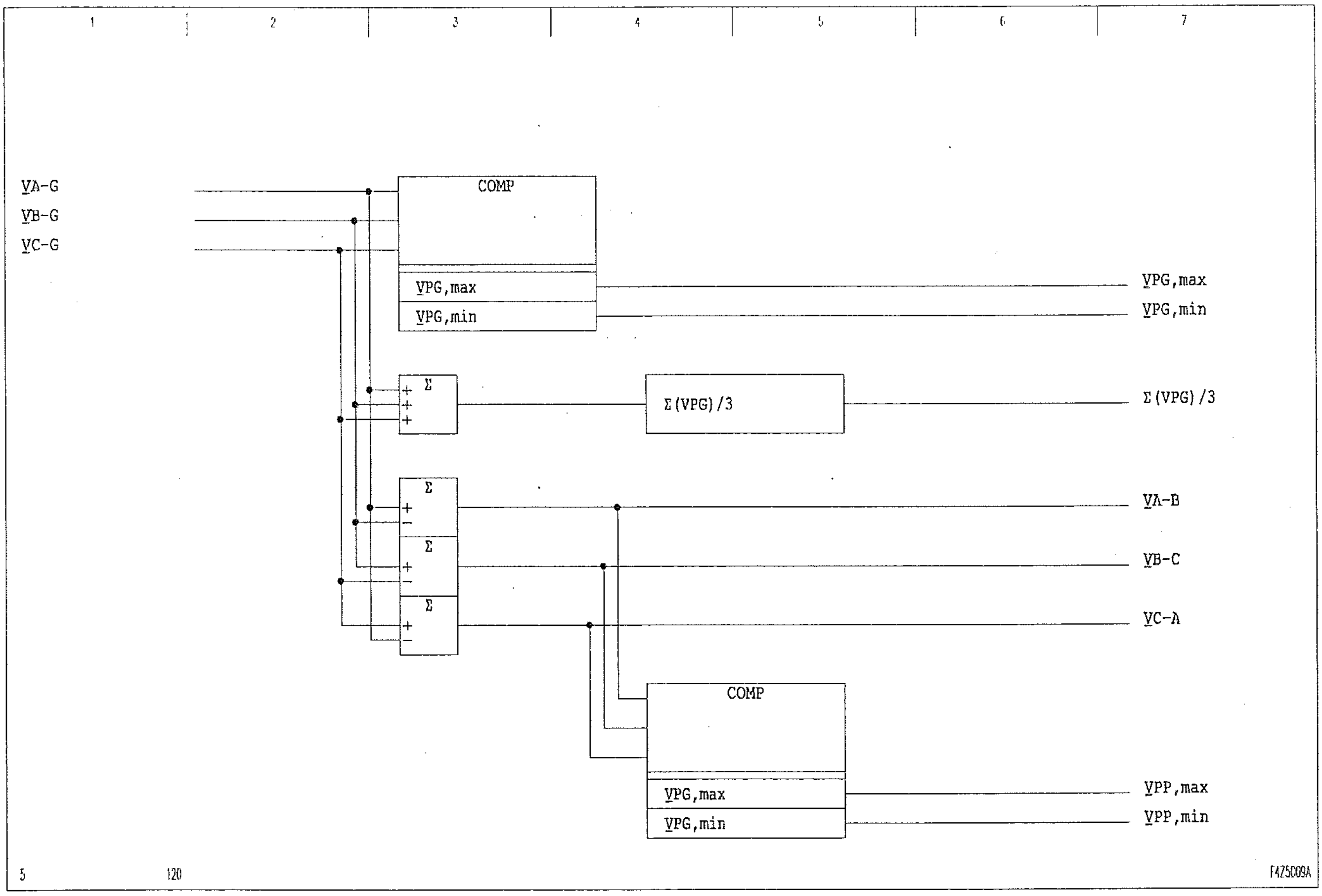
The stored maximum phase current follows the delayed maximum phase current. If the value of the delayed maximum phase current is declining, then the highest value of the delayed maximum phase current remains stored. The display remains constant until the actual delayed maximum phase current exceeds the value of the stored maximum phase current (see middle curve in Figure 3-28). At MAIN: Reset IP,max,stored the user can set the stored maximum phase current to the actual value of the delayed maximum phase current (see lower curve in Figure 3-28).



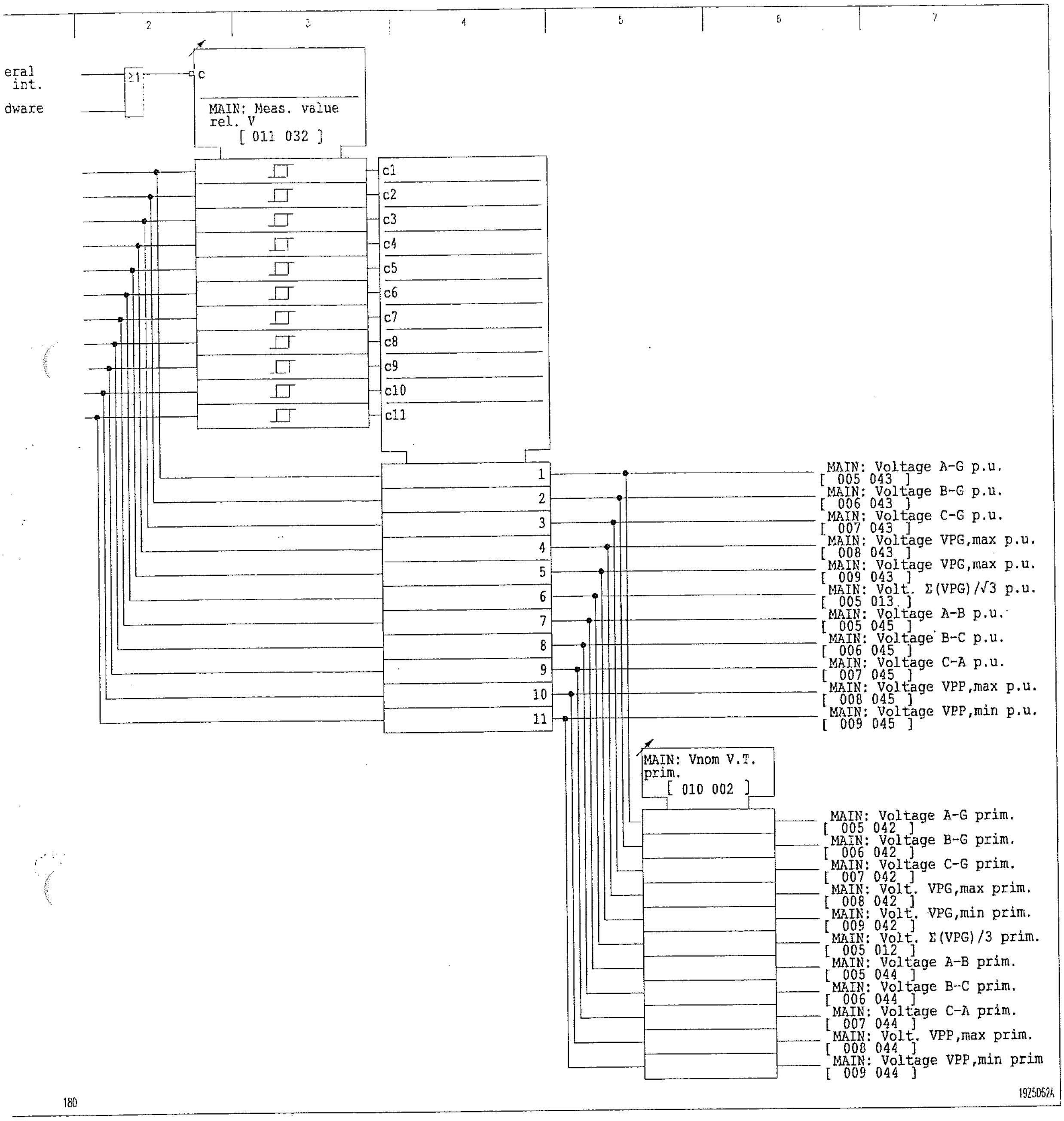
Operation of delayed and stored maximum phase current display

Measured voltage values

The measured voltage values are displayed both as per-unit quantities referred to the nominal quantities of the P130C and as primary quantities. In order for values to be displayed as primary values, the primary nominal voltage of the system transformer needs to be set in the P130C.



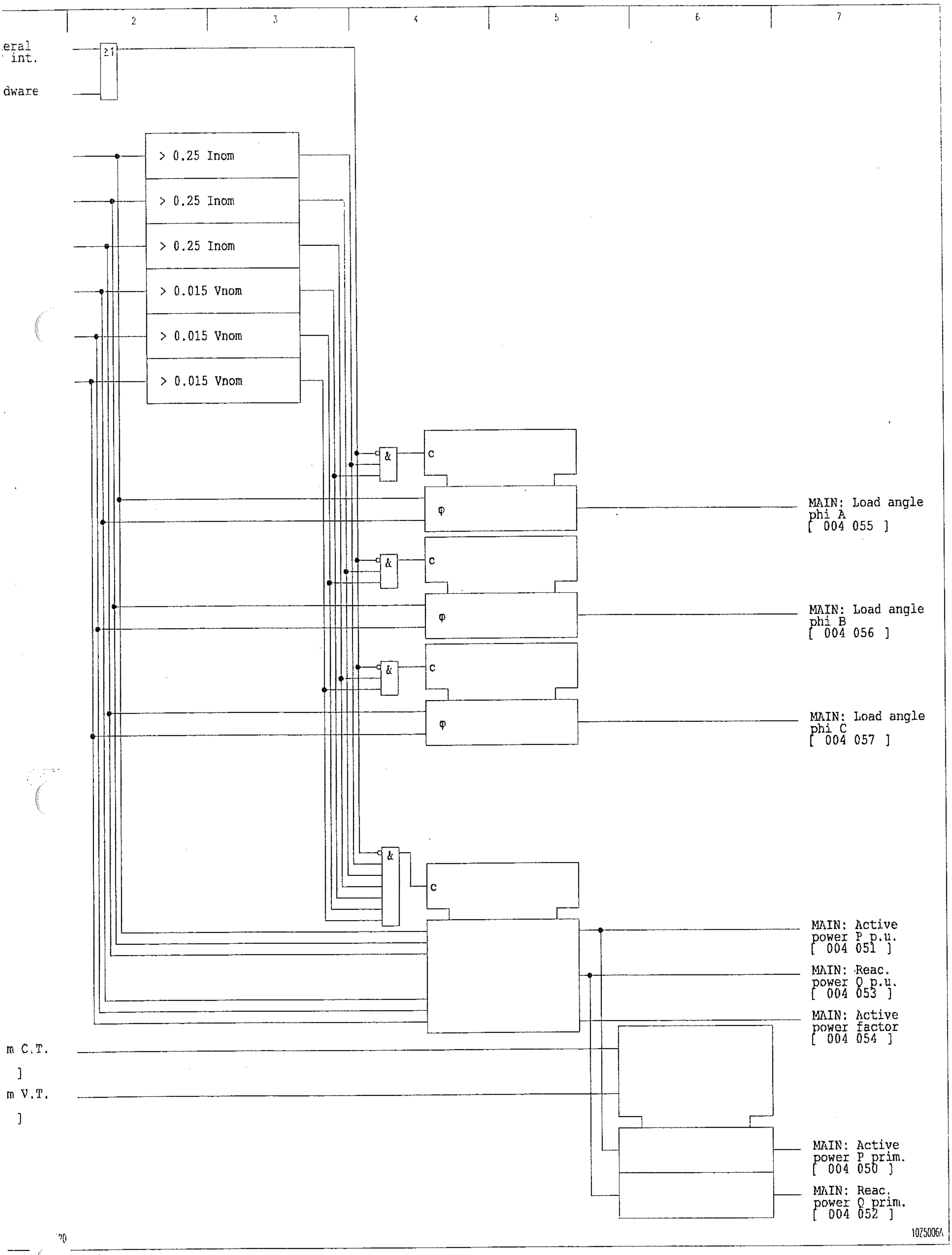
3-29 *Determining the minimum and maximum phase-to-ground and phase-to-phase voltages*



leasured operating data - phase-to-ground and phase-to-phase voltages

Measured values for power, active power factor, and angle

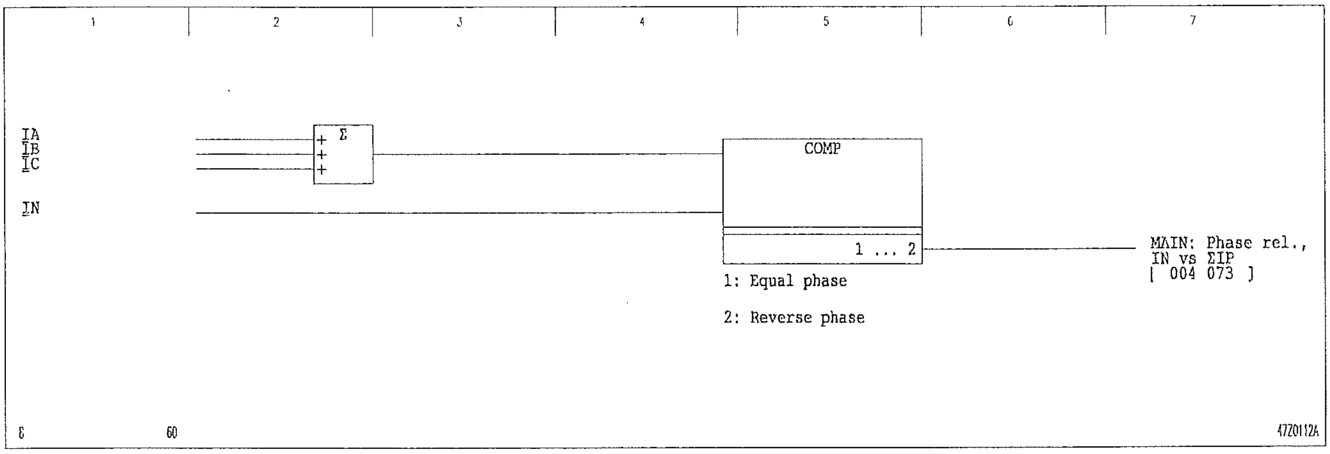
The active and reactive power and the active power factor are determined when currents and voltages in all three phases exceed minimum thresholds.



Measured operating data - power, active power factor, and angle

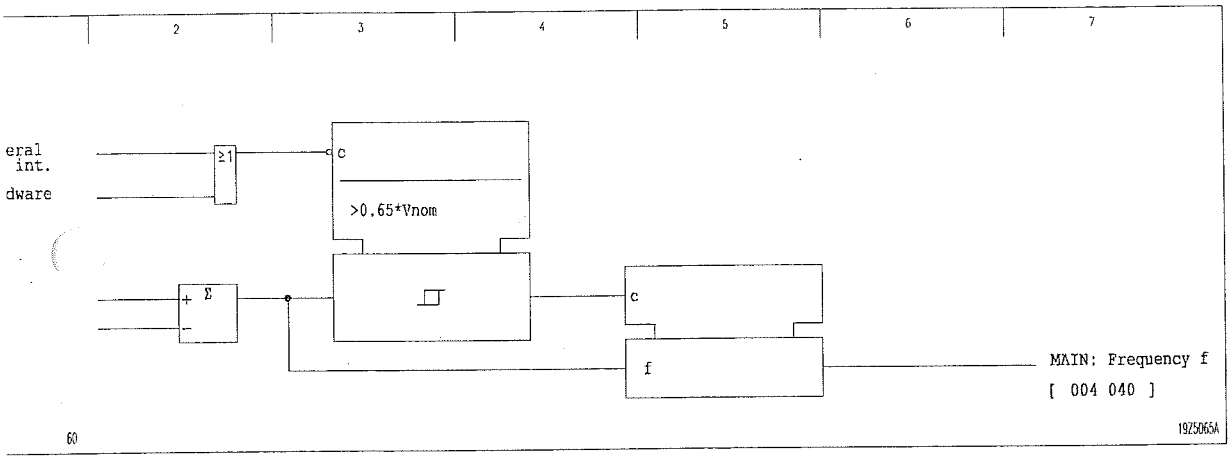
Phase relation I_N

The P130C checks to determine whether the phase relations of calculated residual current and measured residual current agree. If the phase displacement between the two currents is ≤ 45°, then the indication '*Equal phase*' is displayed.



3-32 Phase relation between calculated and measured residual current y

The P130C determines the frequency from voltage V_{A-B}. The voltage needs to exceed a minimum threshold of 0.65 V_{nom} in order for frequency to be determined.



requency measurement

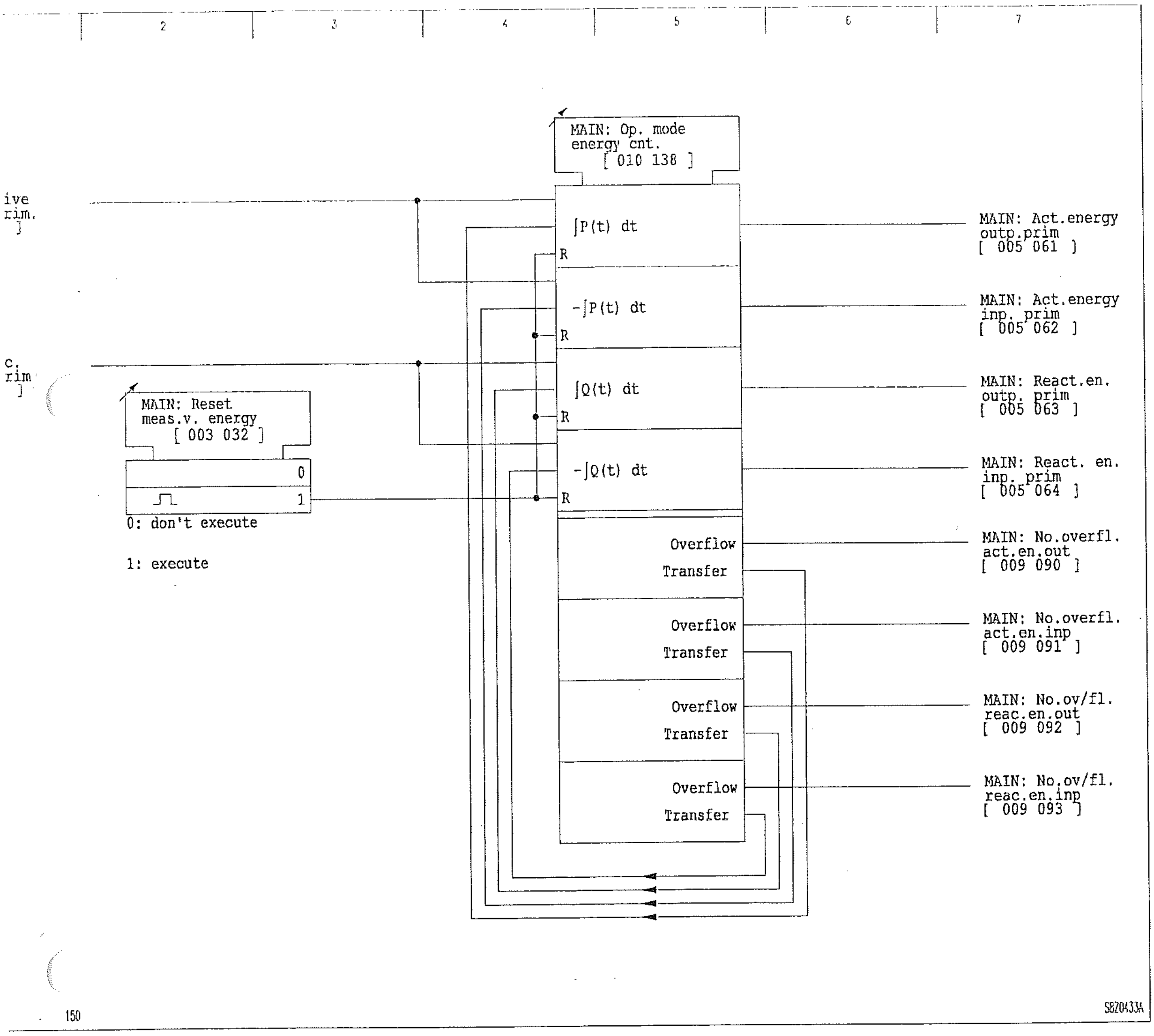
Active and reactive energy output and input

The P130C determines the active and reactive energy output and input based on the primary active or reactive power.

The user can choose between two procedures for the determination of the active and reactive energy. If procedure 1 is selected, active and reactive energy are determined every 2 s (approximately). If procedure 2 is selected, active and reactive energy are determined every 100 ms (approximately) thus achieving higher accuracy. Whenever the maximum value of 655.35 MWh or 655.35 Mvar h is exceeded, a counter is incremented and the determination of the energy output recommences. The value that exceeded the range is transferred to the new cycle.

^The total energy is calculated as follows:

Total energy = number of overflows * 655.35 + current count

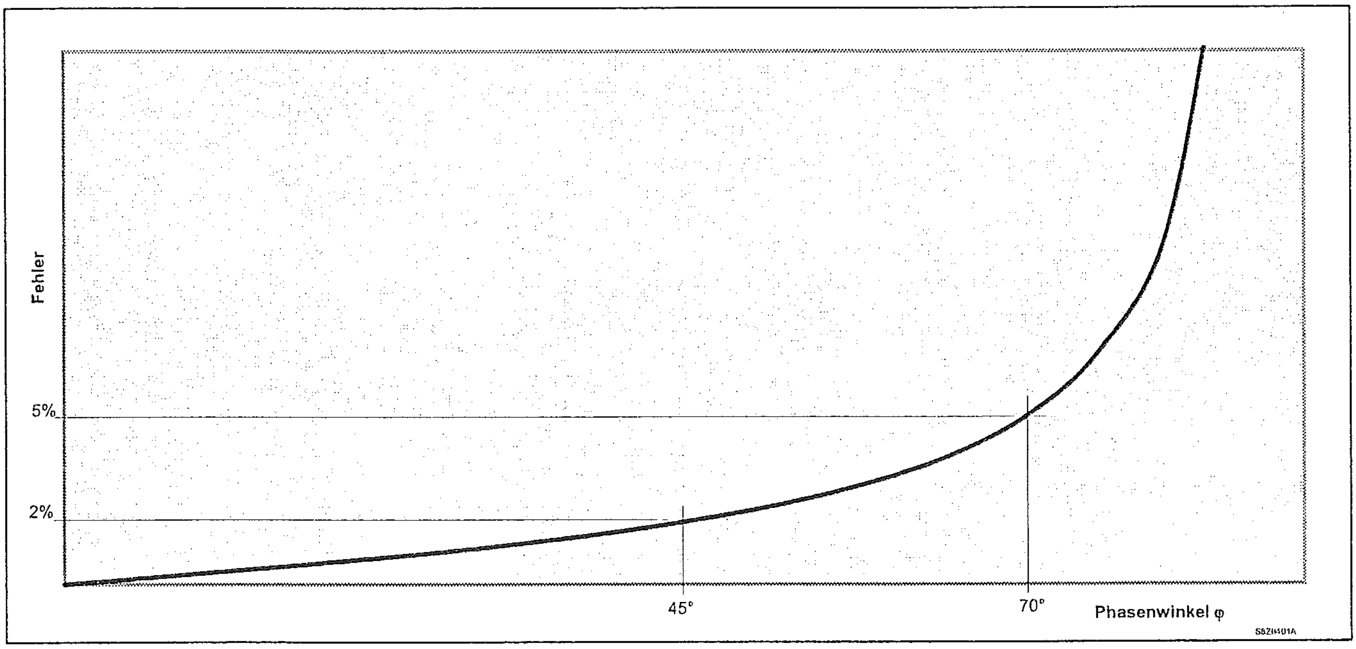


Determining the active and reactive energy output and input

Selection of the procedure for the determination of the energy output

Procedure	Characteristics	Applications
1	□ Determination of the active and reactive energy every 2 s (approximately) □ Reduced system loading	□ Constant load and slow load variations (no significant load variations within 1 second) □ Phase angles below 70° (cos φ > 0.3).
2	□ Determination of the active and reactive energy every 100 s (approximately) □ Higher system loading	□ Fast load variations □ Phase angles below 70° (cos φ > 0.3).

The maximum phase-angle error of the P139 is 1°. For high phase angles, an error of measurement needs to be taken into account. This error increases with the phase angle as shown in the following diagram.



3-35 *Error of measurement in the determination of energy output resulting from the phase-angle error of the P130C*

Error of measurement:

Approx. ± 2 % of the measured value for cos φ = ± 0.7

Approx. ± 5 % of the measured value for cos φ = ± 0.3

For phase angles in excess of 70° or when the error of measurement resulting from the maximum phase-angle error is not acceptable, external counters should be used to determine the energy output.

i a device

3.10.3 Configuring and Enabling the Protection Functions

The user can adapt the unit to the requirements of a specific high-voltage system by configuring the device functions. By including the desired device functions in the configuration and canceling all others, the user creates an individually configured unit appropriate for the specific application. Parameters, signals and measured values of canceled device functions are not displayed on the local control panel. Functions of general applicability such as operating data recording (OP_RC) or main functions (MAIN) cannot be canceled.

The following conditions must be met before a device function can be canceled or removed:

- The device function must be disabled.
- None of the functions of the device function to be canceled may be assigned to a binary input.
- None of the signals of the device function must be assigned to a binary output or an LED indicator.
- None of the functions of the device function to be canceled may be selected in a list parameter setting.

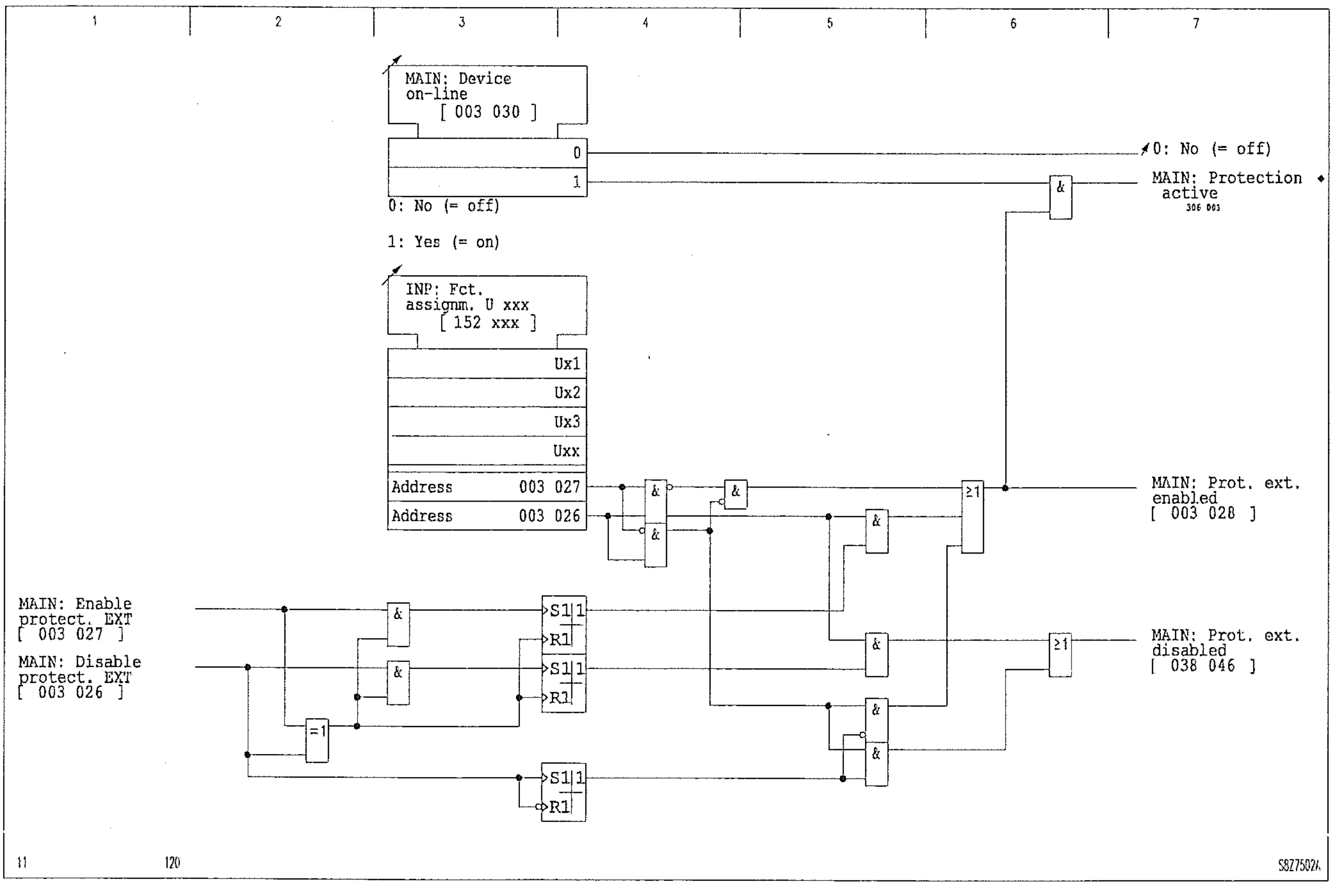
If the above conditions are met, proceed through the Configuration Parameters branch of the menu tree to access the setting parameters relevant for canceling device functions. If you wish to cancel the LIMIT function group, for example, access the setting parameter `LIMIT: Function group LIMIT` and set its value to *Without*. Should you wish to re-include the LIMIT function in the device configuration, access the same setting parameter and set the value to *With*.

The device function to which a parameter, a signal, or a measured value belongs is defined by the function group descriptor such as 'LIMIT'. In the descriptions of the device functions in the following sections of this manual, the device function being described is presumed to be included in the configuration.

Enabling or disabling a device function

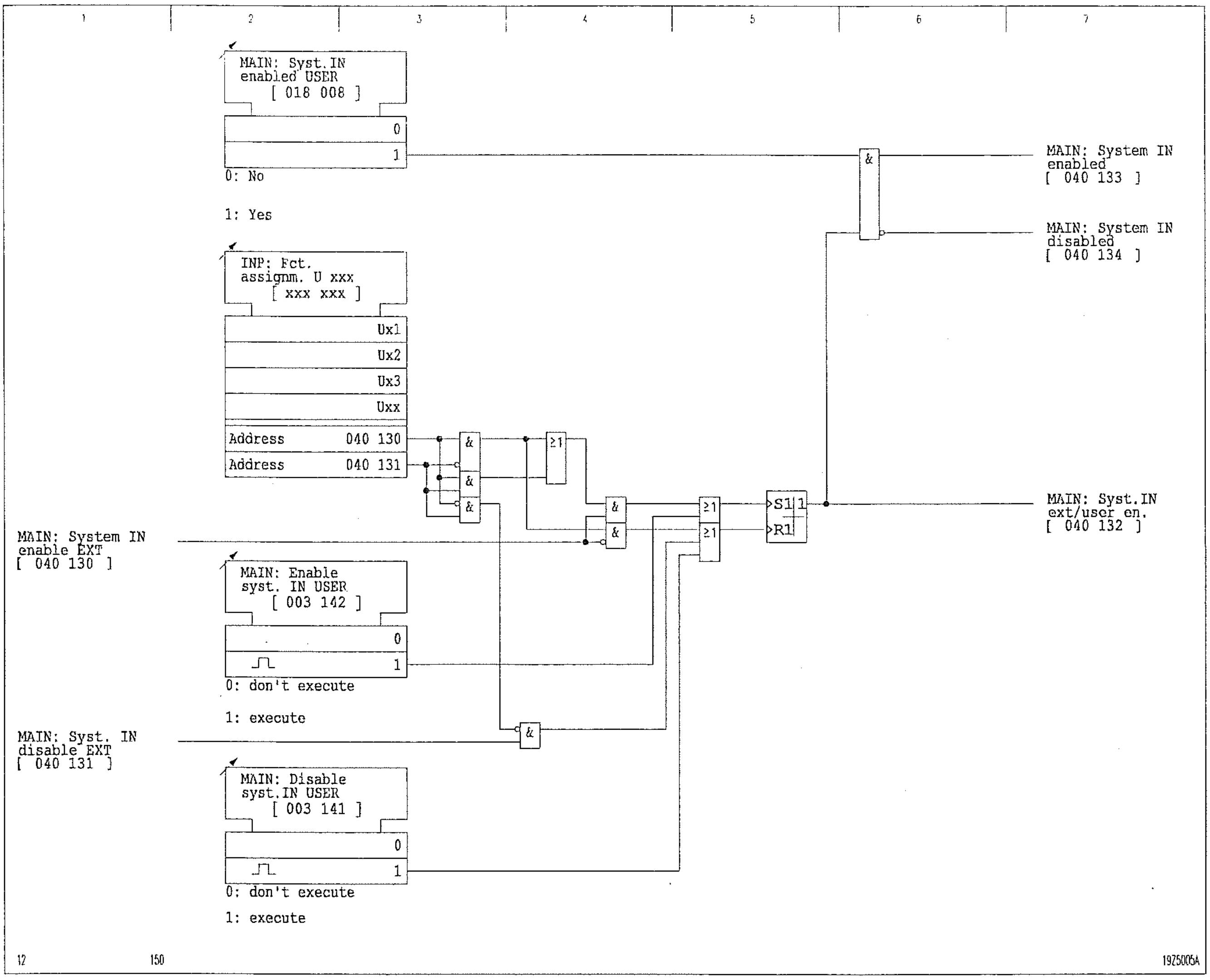
Besides canceling device functions from the configuration, it is also possible to disable protection via a function parameter or binary signal inputs. Provided that the binary signal inputs MAIN: Disable protect. EXT and MAIN: Enable protect. EXT functions are both configured, the protection functions can be disabled or enabled through these. If the triggering signals of the binary signal inputs are implausible – as for example when they both have a logic value of '1', then the last plausible state remains stored in memory. If only MAIN: Disable protect. EXT is assigned to a binary signal input, the protection functions will be disabled by a positive edge of the input signal; they will be enabled by a negative edge. When only one or neither of the two functions is configured, this is interpreted as 'Protection externally enabled'.

Note: If the protection function is disabled via the binary signal input that is configured for MAIN: Disable protect. EXT, then there is no MAIN: Blocked/faulty signal.
(The signal MAIN: Blocked/faulty is coupled to the activation of the LED labeled 'OUT OF SERVICE').



3-36 *Enabling or disabling a device function* *ɔr disabling the urrent systems of :/IDMT protection*

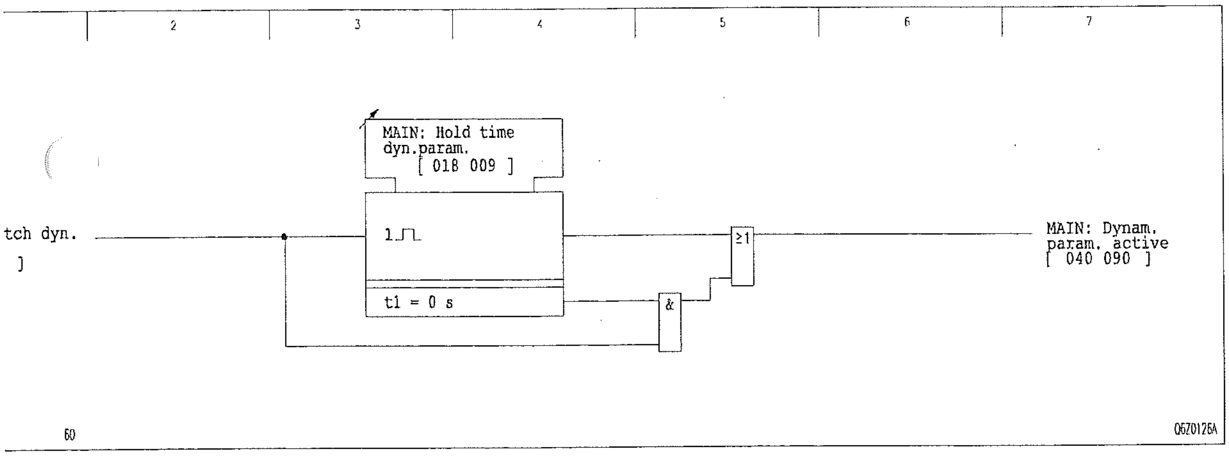
The function can be disabled or enabled from the integrated local control panel or through appropriately configured binary signal inputs. Whether the enabling of the residual current systems of the DTOC/IDMT protection by one of these two means is effective depends on the setting at MAIN: Syst.IN enabled USER. Enabling from either the integrated local control panel or through binary signal inputs is equally effective. If only MAIN: System IN enable EXT is assigned to a binary signal input, the residual current measuring systems of the DTOC/IDMT protection will be enabled by a positive edge of the input signal; they will be disabled by a negative edge. If only MAIN: System IN disable EXT is assigned to a binary signal input, a signal present at this input will have no effect.



3-37 *Enabling or disabling the residual current systems of the DTOC/IDMT protection*

3.10.4 Activation of Dynamic Parameters

For several of the protection functions, it is possible to switch for the duration of the set hold time to other settings - the "dynamic parameters" – through an appropriately configured binary signal input. If the hold time is set to 0 s, the switching is effective while the binary signal input is being triggered.



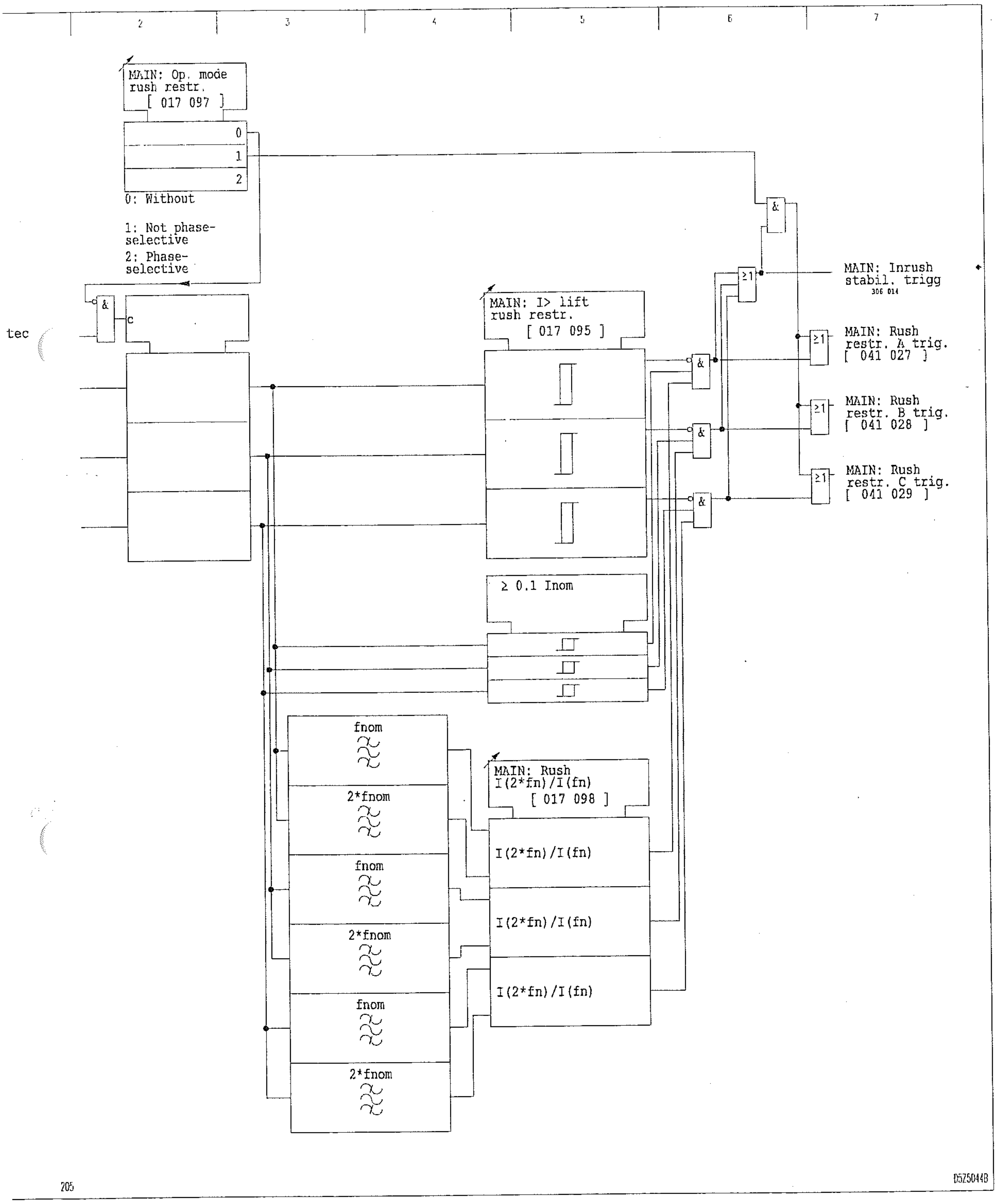
\ctivation of dynamic parameters

3.10.5 Inrush Stabilization (Harmonic Restraint)

The inrush stabilization function detects high inrush current flows that occur when transformers or machines are connected. The function will then block the following functions:

- The phase current starting of definite-time overcurrent protection (DTOC)
- The phase current starting and the negative-sequence current starting of inverse-time overcurrent protection (IDMT)

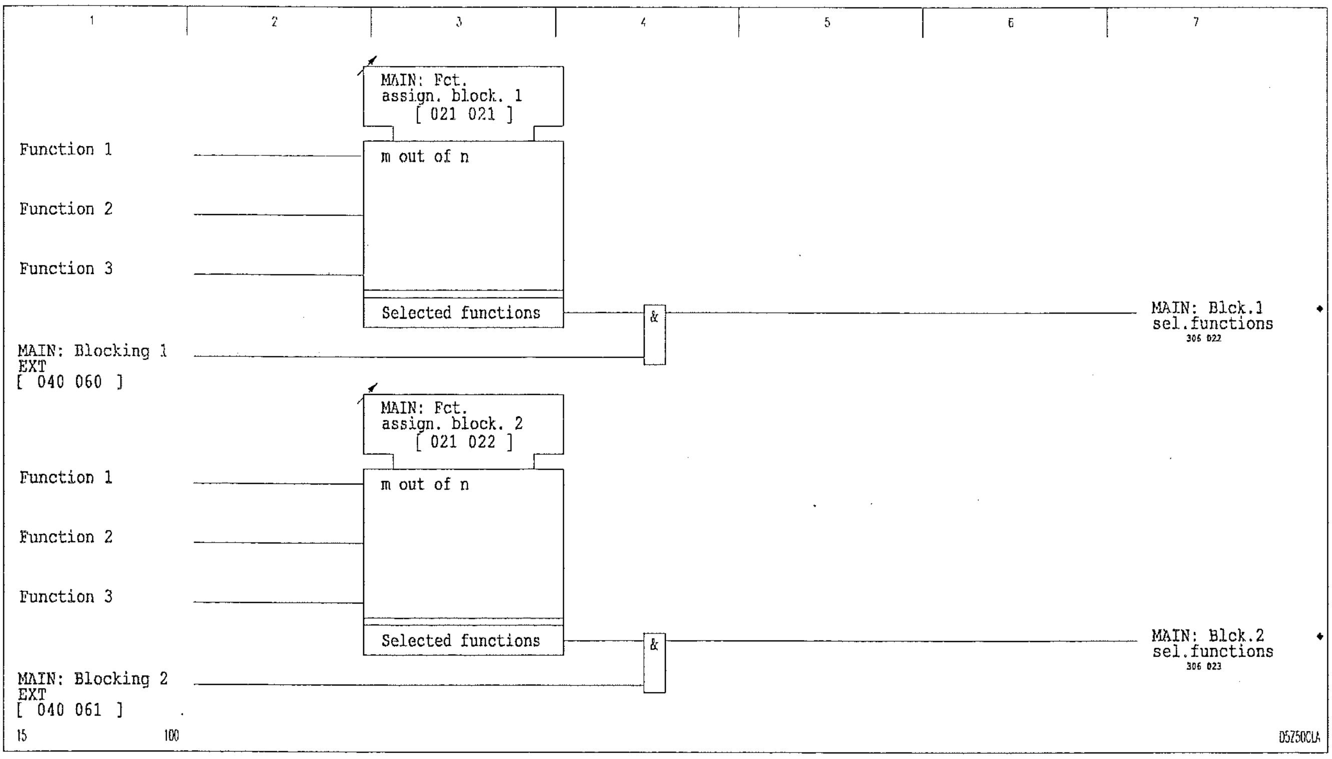
The inrush stabilization function identifies an inrush current by evaluating the ratio of the second harmonic current components to the fundamental wave. If this ratio exceeds the set threshold, then the inrush stabilization function operates. Another settable current trigger blocks inrush stabilization if the current exceeds this trigger. By setting the operating mode, the user determines whether inrush stabilization will operate phase-selectively or across all phases.



nrush stabilization (harmonic restraint)

3.10.6 Multiple Blocking

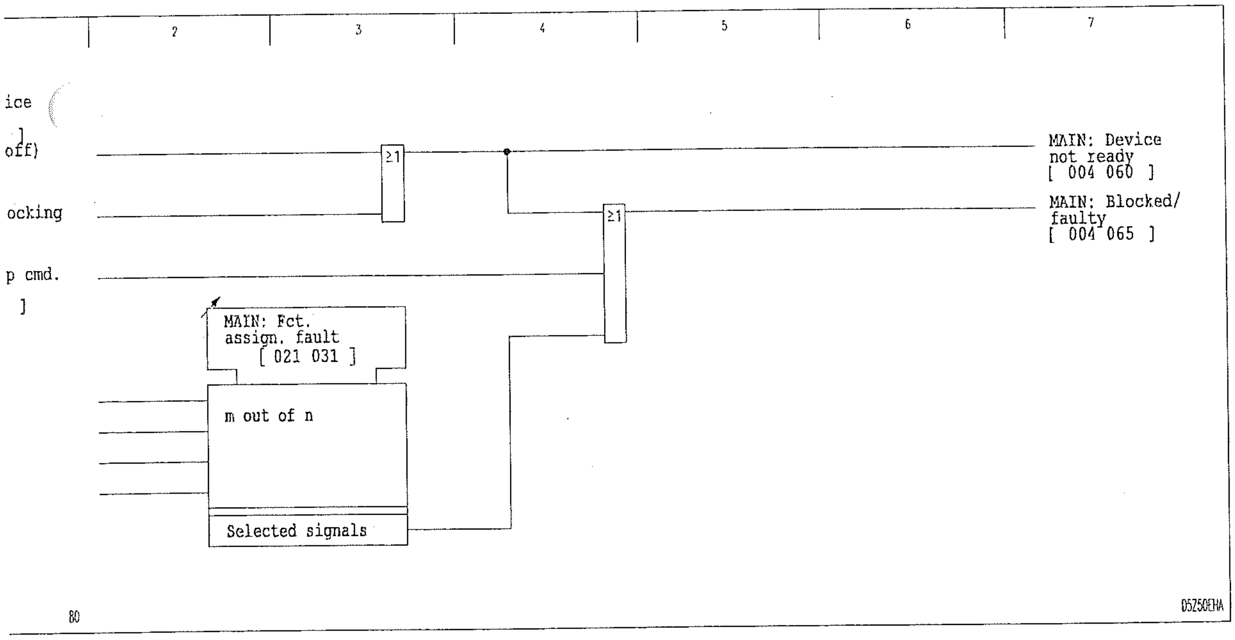
Two multiple blocking conditions may be defined by selecting 'm out of n' parameters. The items available for selection are found in the Address List. In this way the functions defined by the selection can be blocked by way of an appropriately configured binary signal input.



3-40 Multiple blocking

3.10.7 Blocked / Faulty (OUT OF SERVICE)

If the protection functions are blocked, this condition is signaled by a steady light from yellow LED indicator H 2 on the local control panel and also by a signal through the output relay configured for MAIN: Blocked/faulty. In addition, the user can select the functions that will produce the MAIN: Blocked/faulty signal by setting an 'm out of n' parameter. (The signal MAIN: Blocked/faulty is coupled to the activation of the LED labeled 'OUT OF SERVICE').



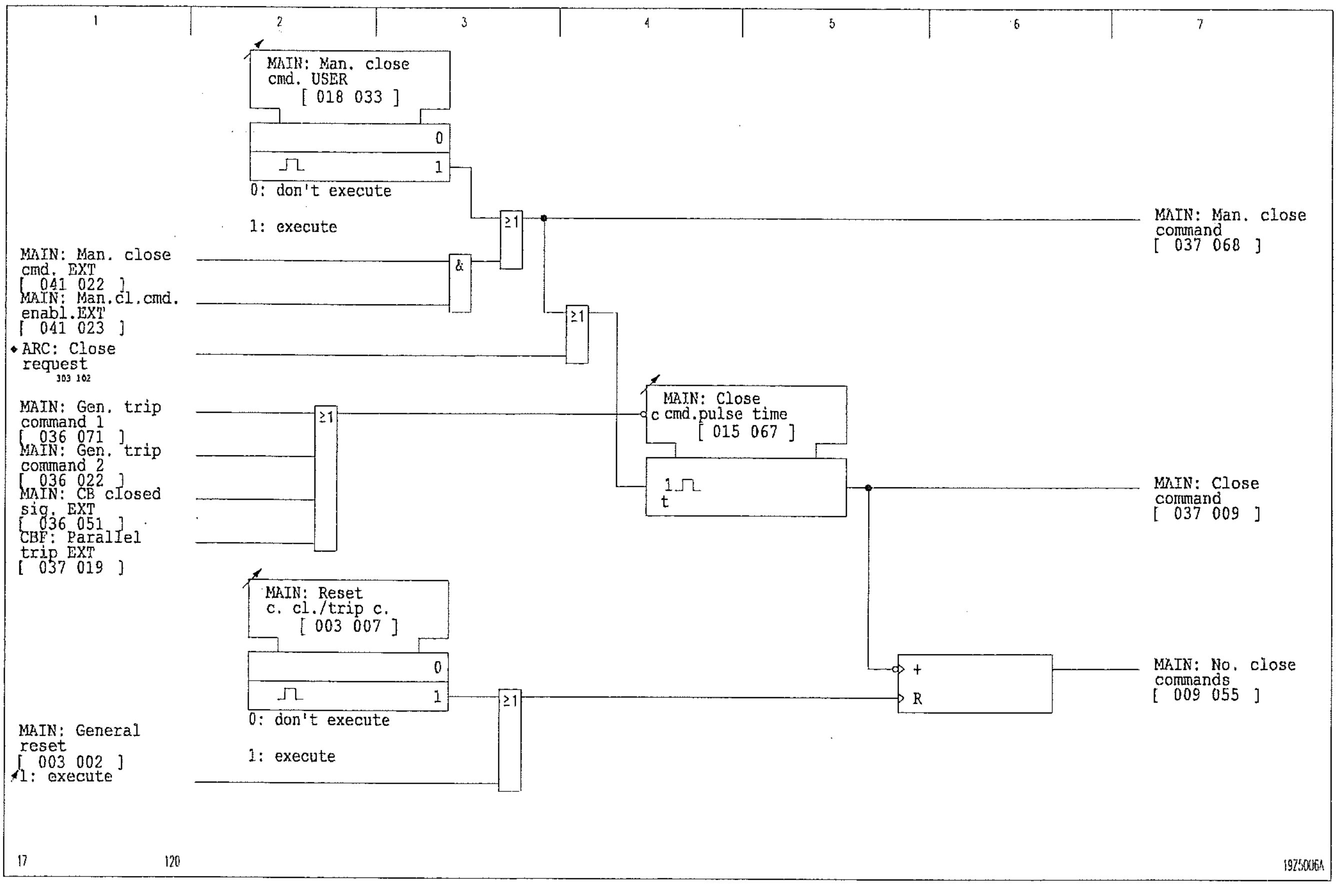
Block--/faulty' signal

3.10.8 Close Command

The circuit breaker can be closed by the auto-reclosing control function (ARC) integrated into the P130C, from the integrated local control panel, or via an appropriately configured binary signal input. The close command via local control panel or binary signal input is only executed if there is no trip command and no trip has been issued by a parallel protection device. Moreover, the close command is not executed if there is a "CB closed" position signal. The duration of the close command may be adjusted by a setting.

Close command counter

The close commands are counted. The counter may be reset either individually or together with the trip command counters.

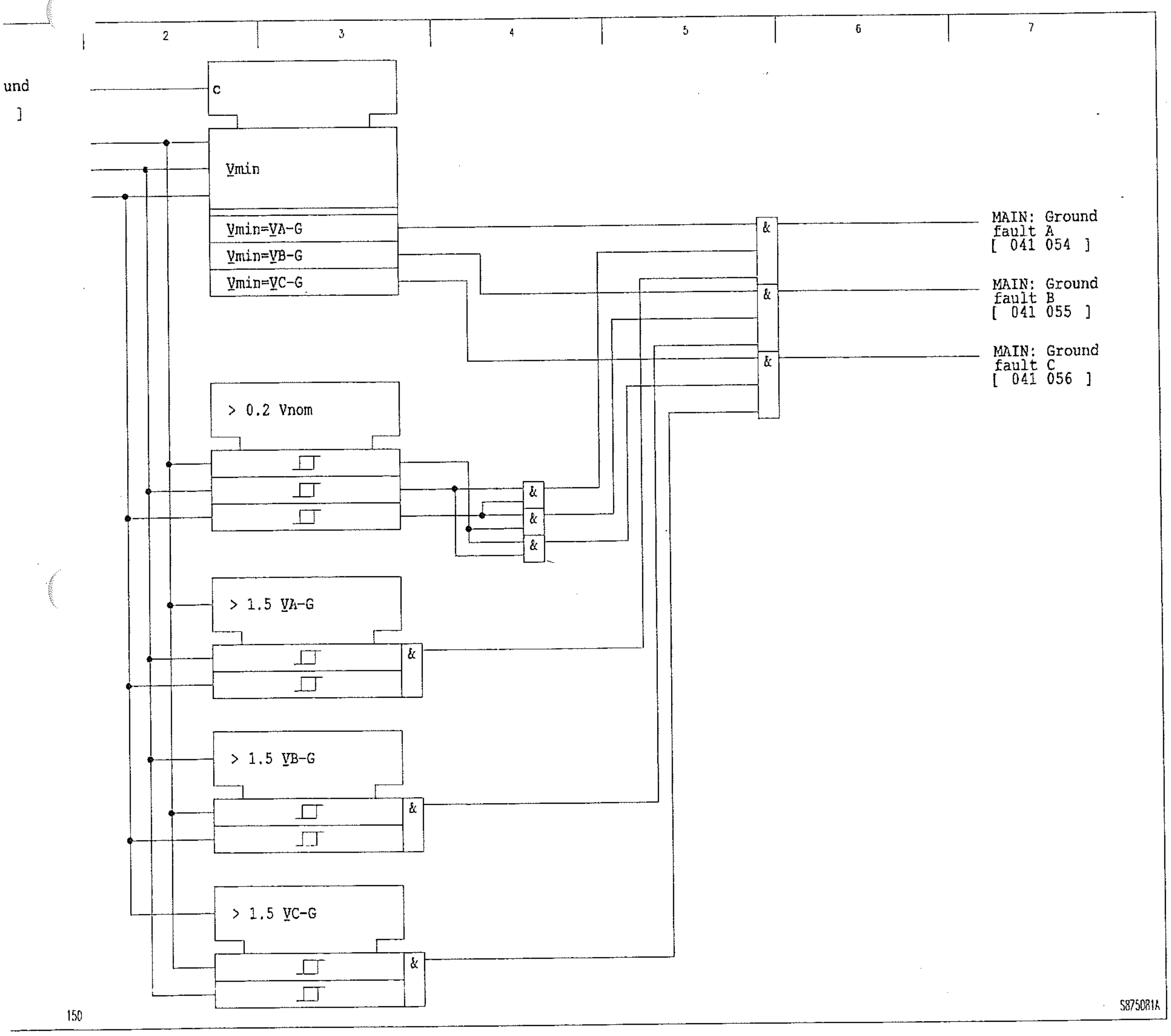


3-42 *Close command*

3.10.9 Ground Fault Signaling

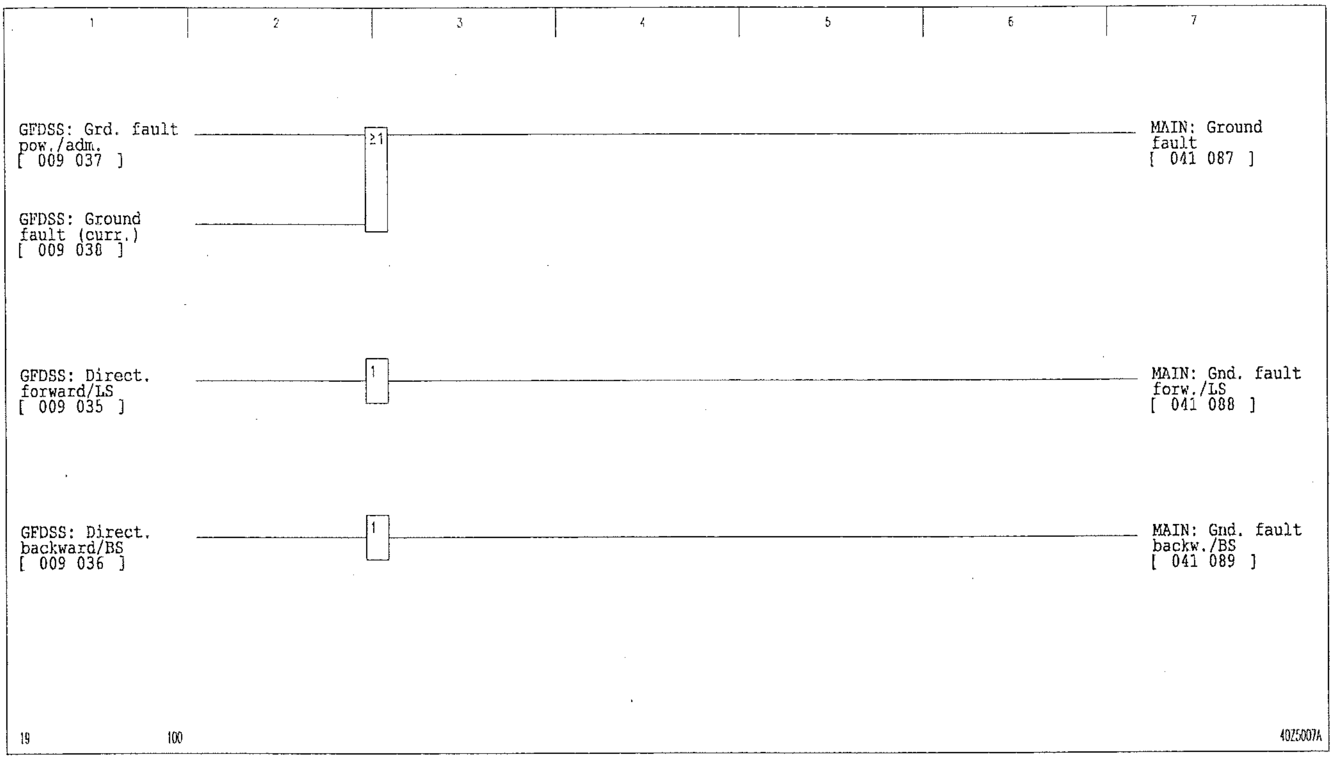
If a ground fault has been detected by either the GFDSS function (ground fault direction determination by steady-state values), the P130C analyzes the phase-to-ground voltages and identifies the phase where the ground fault is located.

During a ground fault, the P130C determines the lowest phase-to-ground voltage and checks to determine if the two other phase-to-ground voltages exceed the threshold of 0.2 V_{nom}. In addition, the two higher phase-to-ground voltages must exceed the lowest phase-to-ground voltage by a factor of 1.5. If these conditions are met, a ground fault signal is issued for the phase with the lowest phase-to-ground voltage.



Phase-selective ground fault signaling

Ground fault signals generated either by ground fault direction determination using steady-state values (GFDSS) are grouped together to form multiple signals.



3-44 Multiple ground fault signals

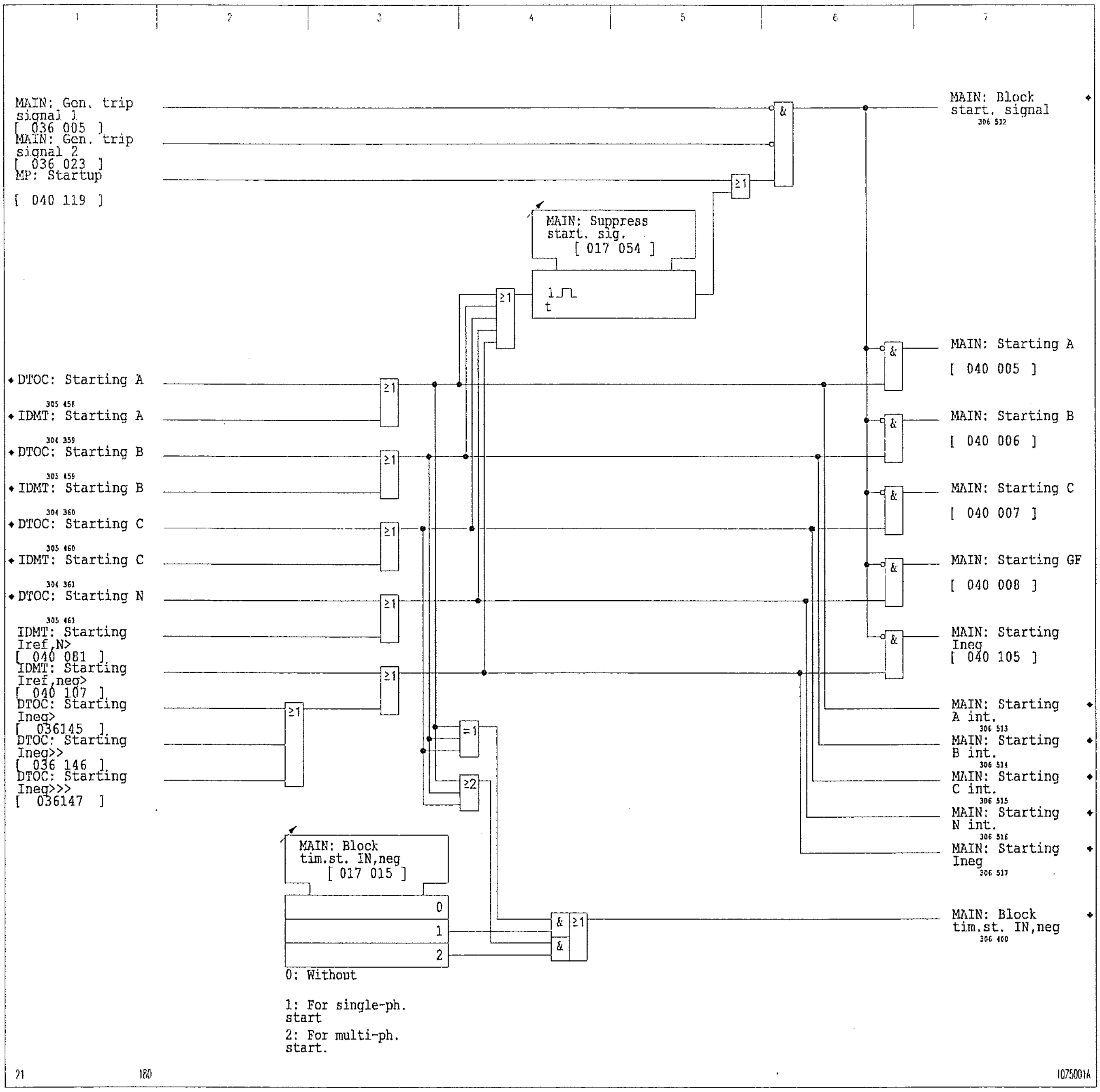
3.10.10 Starting Signals and Tripping Logic

lective starting

Common phase-selective starting signals are formed from the internal phase-selective starting signals of definite-time overcurrent protection and of inverse-time overcurrent protection.

An adjustable timer stage is started by the phase-selective starting signals and by the signals of residual current starting and negative-sequence system starting. While the timer stage is elapsing, the starting signals are blocked. The starting signals are blocked directly by motor protection if the startup of a motor has been detected. Blocking is ineffective if a trip signal is present.

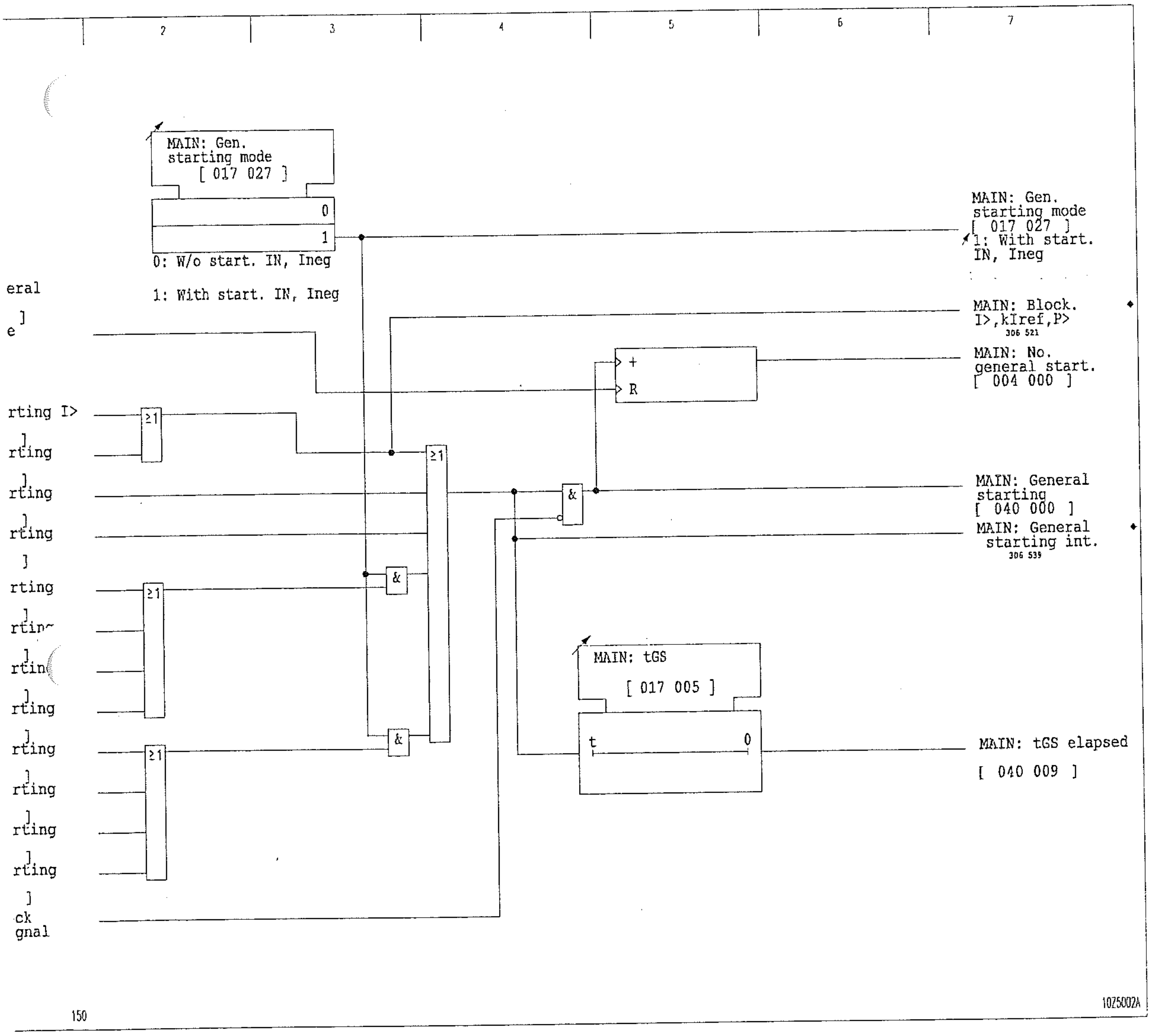
The operate delays of the residual current and negative-sequence current stages of the DTOC and IDMT protection functions can be blocked for a single-pole or multipole starting (depending on the setting).



3-45 *Phase-selective starting signals*

tarting

The general starting signal is formed from the starting signals of the DTOC and IDMT protection functions. A setting governs whether the residual current stages and the negative-sequence current stage will be involved in forming the general starting signal. If the operate signal of a residual current stage and the negative-sequence current stage does not cause a general starting (due to the setting) then the associated operate delays will be blocked. As a result, a trip command can not be issued by residual current and negative-sequence current stages.



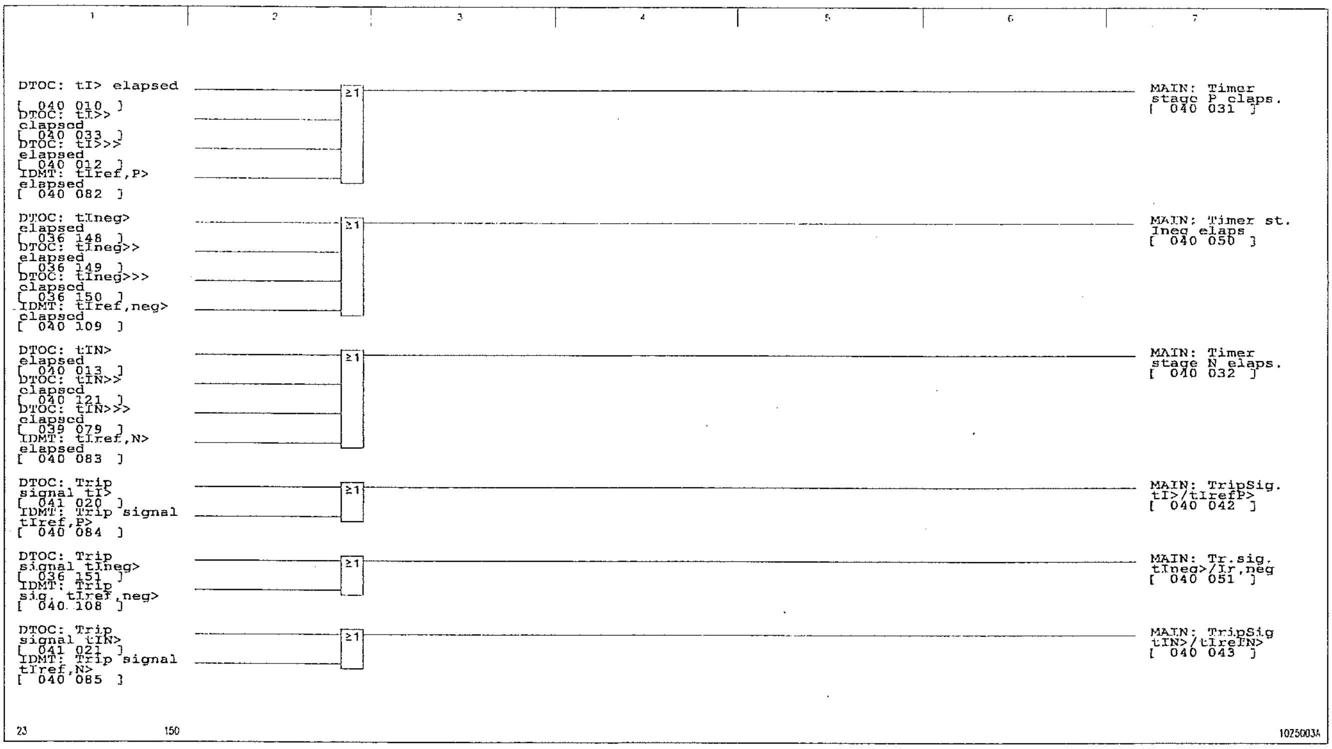
Ɜeneral starting

ıf general starting

The number of general startings is counted.

Multiple signaling of the DTOC and IDMT protection functions

The trip signals generated by DTOC and IDMT protection are grouped together to form multiple signals.



3-47 *Multiple signaling of the DTOC and IDMT protection functions* *nand*

The P130C has two trip commands. The functions to effect a trip can be selected by setting an 'm out of n' parameter independently for each of the two trip commands. The minimum trip command time may be set. The trip signals are present only as long as the conditions for the signal are satisfied.

of the trip s

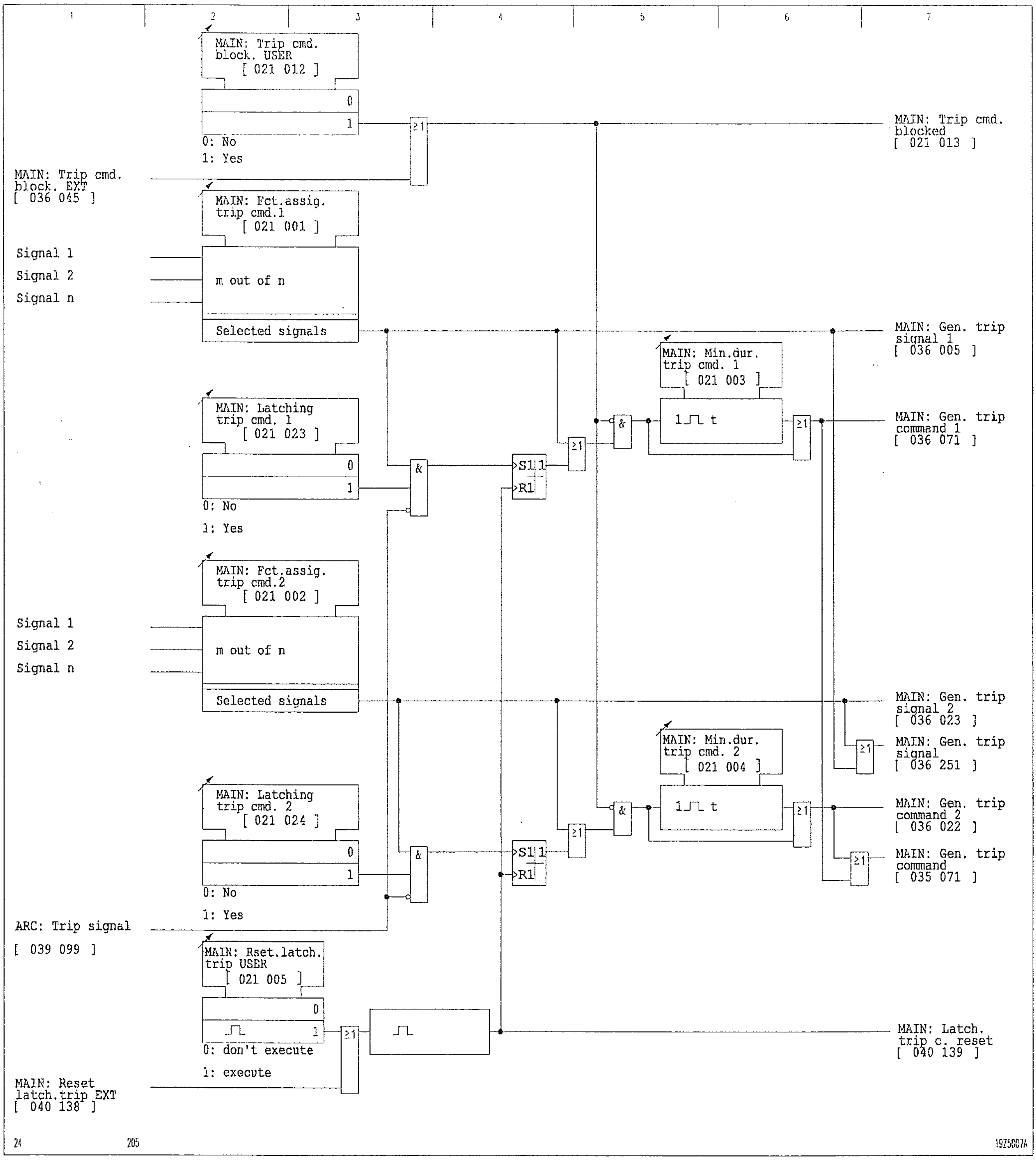
For each of the two trip commands, the user can specify by way of the appropriate setting whether it will operate in latching mode. If the latching mode is selected, the trip command persists until it is reset from the local control panel or via an appropriately configured binary signal. Latching is ineffective if a trip command has been issued by the ARC function.

he s

The trip commands may be blocked from the integrated local control panel or through an appropriately configured binary signal input. Blocking is effective for both trip commands. The trip signals are not affected by blocking. If the trip commands are blocked, this will be indicated by a steady light at yellow LED indicator H 2 on the local control panel and by an output relay configured for 'Blocked/faulty'.

f trip commands

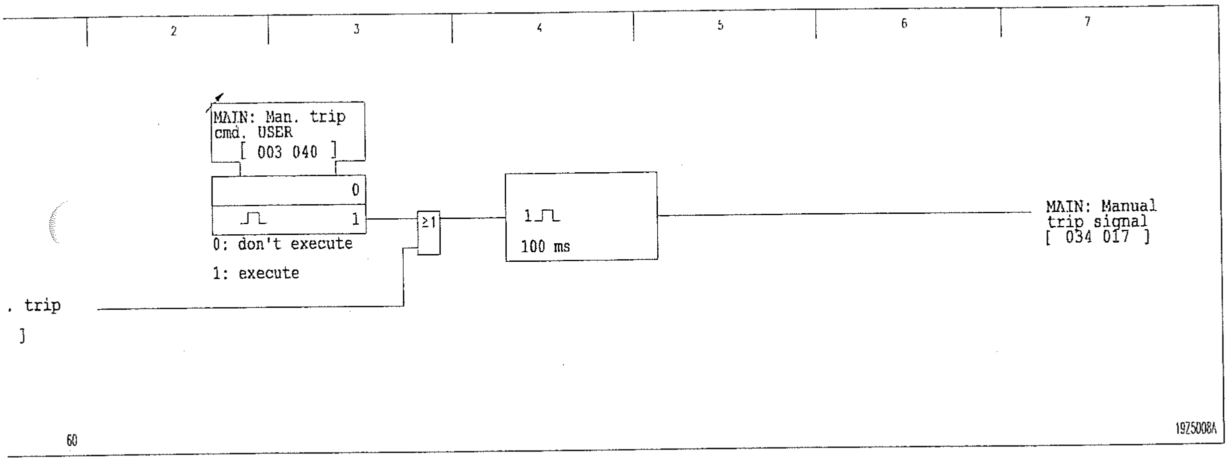
The trip commands are counted. The counters can be reset either individually or as a group.



3-48 *Forming the trip commands*

:p command

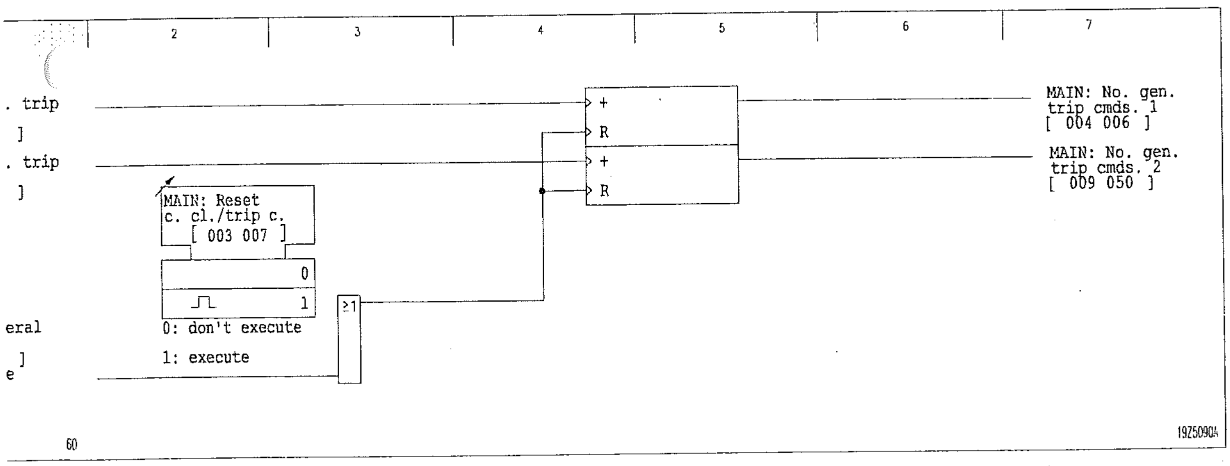
A manual trip command may be issued via the local control panel or a signal input configured accordingly. It is not executed, however, unless the manual trip is included in the selection of possible functions to effect a trip.



/anual trip command

nand counter

The trip commands are counted. The counters can be reset either individually or as a group.

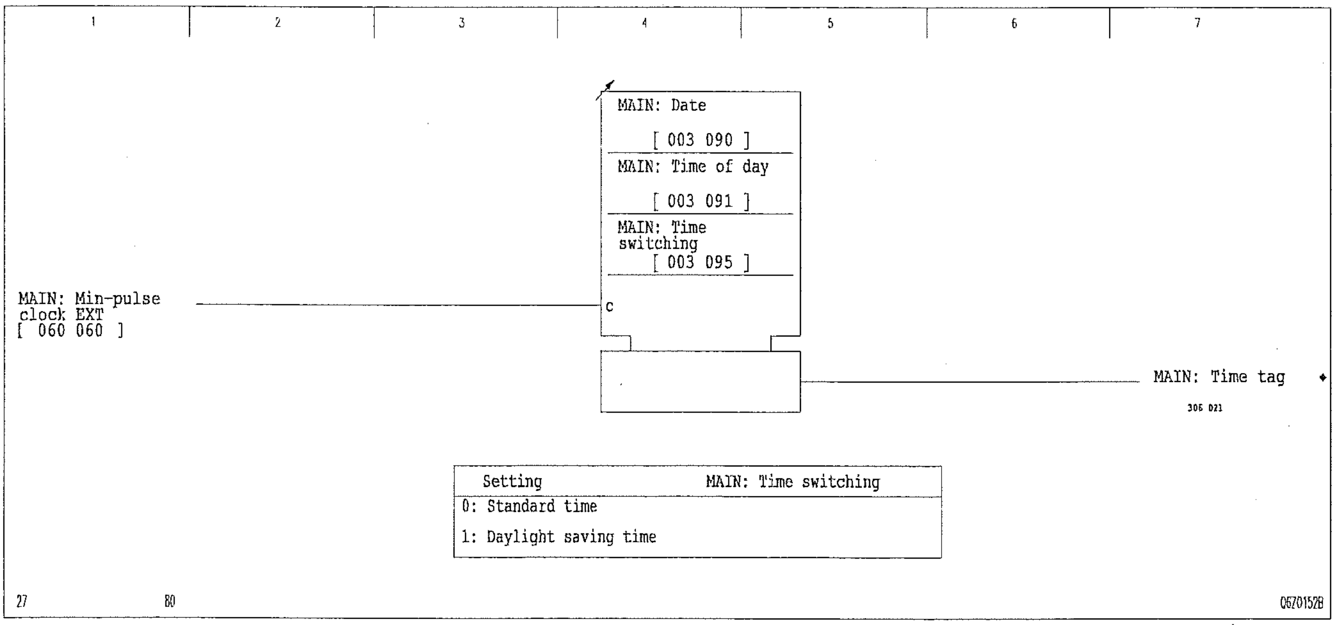


'rip command counter

3.10.11 Time Tagging and Clock Synchronization

The data stored in the operating data memory, the monitoring signal memory, and the event memories are tagged with date and time of day. For correct time tagging, the date and time need to be set in the P130C.

The time of different devices may be synchronized by a pulse through an appropriately configured binary signal input. The P130C evaluates the rising edge. In this way, the clock is set to the next full minute, rounding up or down. If several start/end signals occur (bouncing of a relay contact), the last edge is evaluated.



3-51 *Date and time setting and clock synchronization*

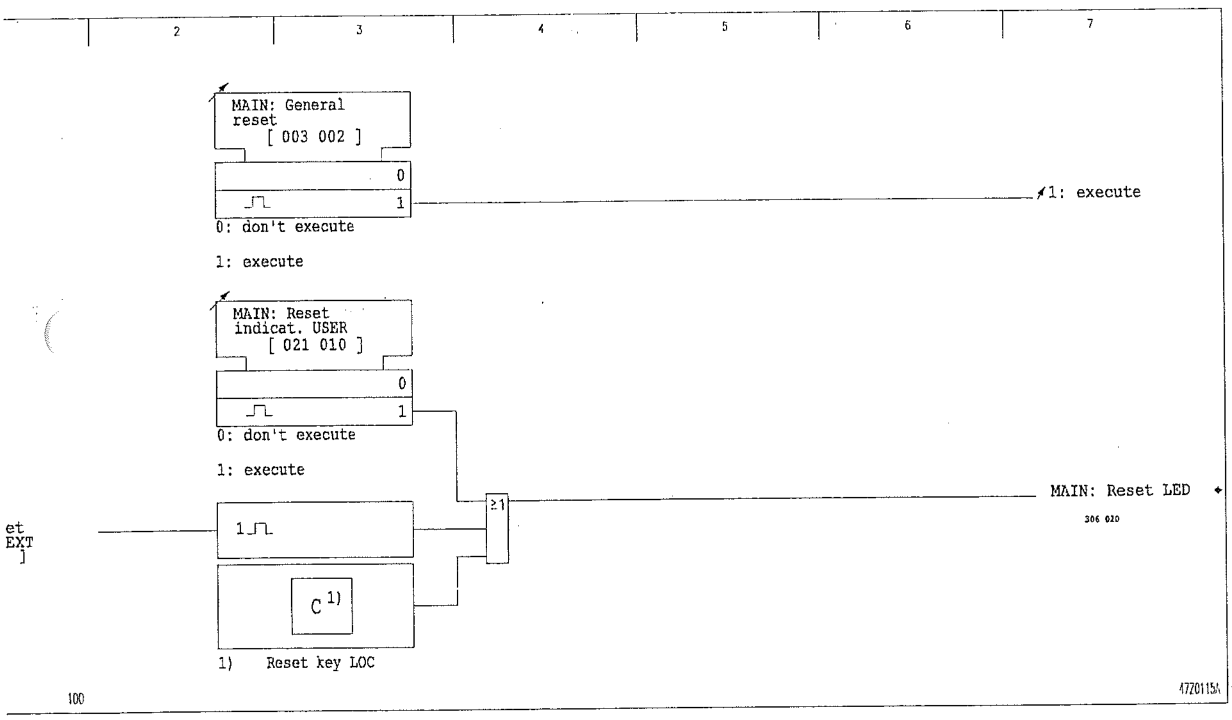
3.10.12 Resetting Mechanisms

Stored data such as event logs, measured fault data, etc., can be cleared in a number of different ways. The following mechanisms are available:

- Automatic resetting of the event signals indicated by LED indicators (provided that the LED operating mode has been set accordingly) and of the display of measured fault data on the local control panel whenever a new event occurs.
- Resetting of LED indicators and measured fault data on the local control panel by pressing the clear key (C) located on the panel.
- Selective resetting of a particular memory type (only the fault memory, for example) from the local control panel or through appropriately configured binary signal inputs
- General reset

In the first two cases listed above, only the displays on the local control panel are cleared but not the internal memories such as the fault memory.

In the event of a cold restart, namely simultaneous failure of both internal battery and power supply, all stored signals and values will be lost.

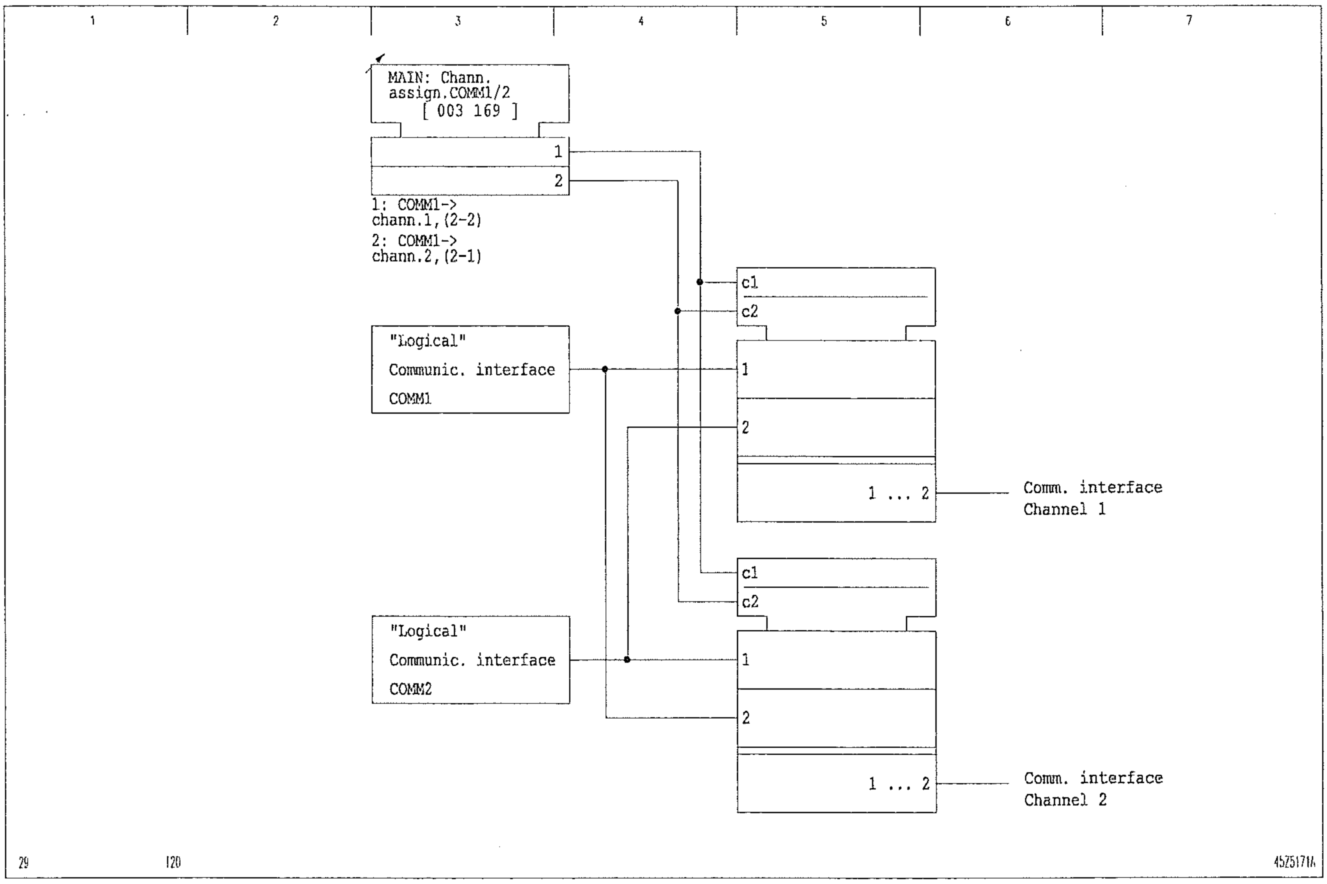


ᴲeneral reset, LED reset, and measured fault data reset from the local control panel

3.10.13 Assignment of the "Logical" Communication Interfaces to the Physical Communication Channels

Depending on the design version of communication module A, one or two communication channels are available (see "Technical Data"). The "logical" communication interfaces COMM1 and COMM2 can be assigned to these physical communication channels.

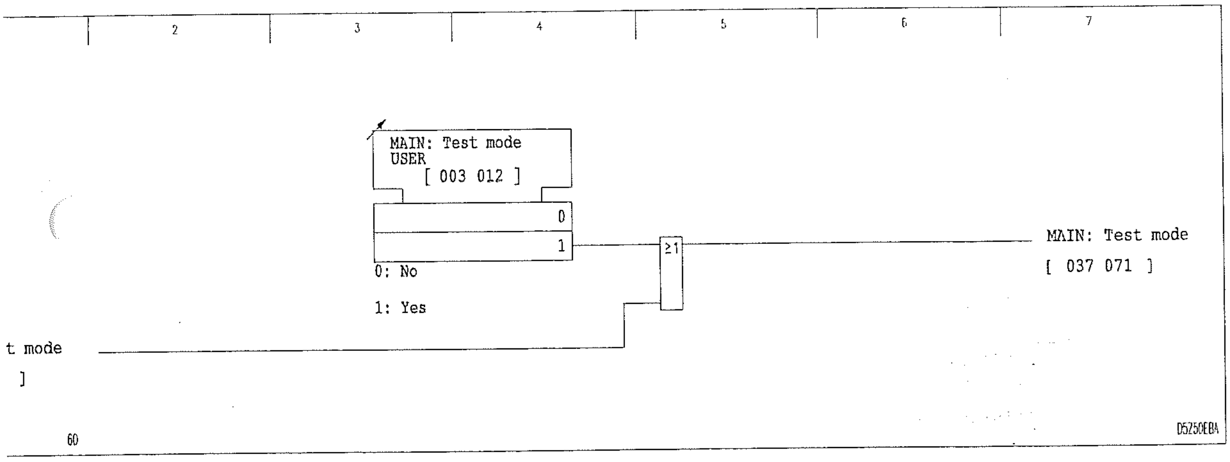
If the COMM1 "logical" communication interface has been assigned to communication channel 2, then this means that the settings for "logical" communication interface 2 (COMM2) will automatically be active for communication channel 1. Communication with the P130C via communication channel 2 is only possible when the PC interface is inactive. As soon as communication occurs through the PC interface, communication channel 2 is "dead".



3-64-a *Assignment of the "logical" communication interfaces to the physical communication channels*

3.10.14 Test Mode

If tests are run on the P130C, the user is advised to activate the test mode so that all incoming signals via the serial interfaces will be identified accordingly.



Setting the test mode

3.11 Parameter Subset Selection (Function Group PSS)

The P130C allows the user to pre-set four independent parameter subsets. The user can switch between parameter subsets during operation without interrupting the protection function.

Selecting the parameter subset

The control path that will determine the active parameter subset (function parameter or binary signal input) can be selected via the function parameter PSS: Control via USER or the external signal PSS: Control via user EXT. Depending on the selection made, the parameter subset will be selected either in accordance with the pre-set function parameter PSS: Param. subs. sel. USER or as a function of external signals. The parameter subset that is active at any given time can be determined by scanning the logic state signals PSS: Actual param.subset or PSS: PSx active.

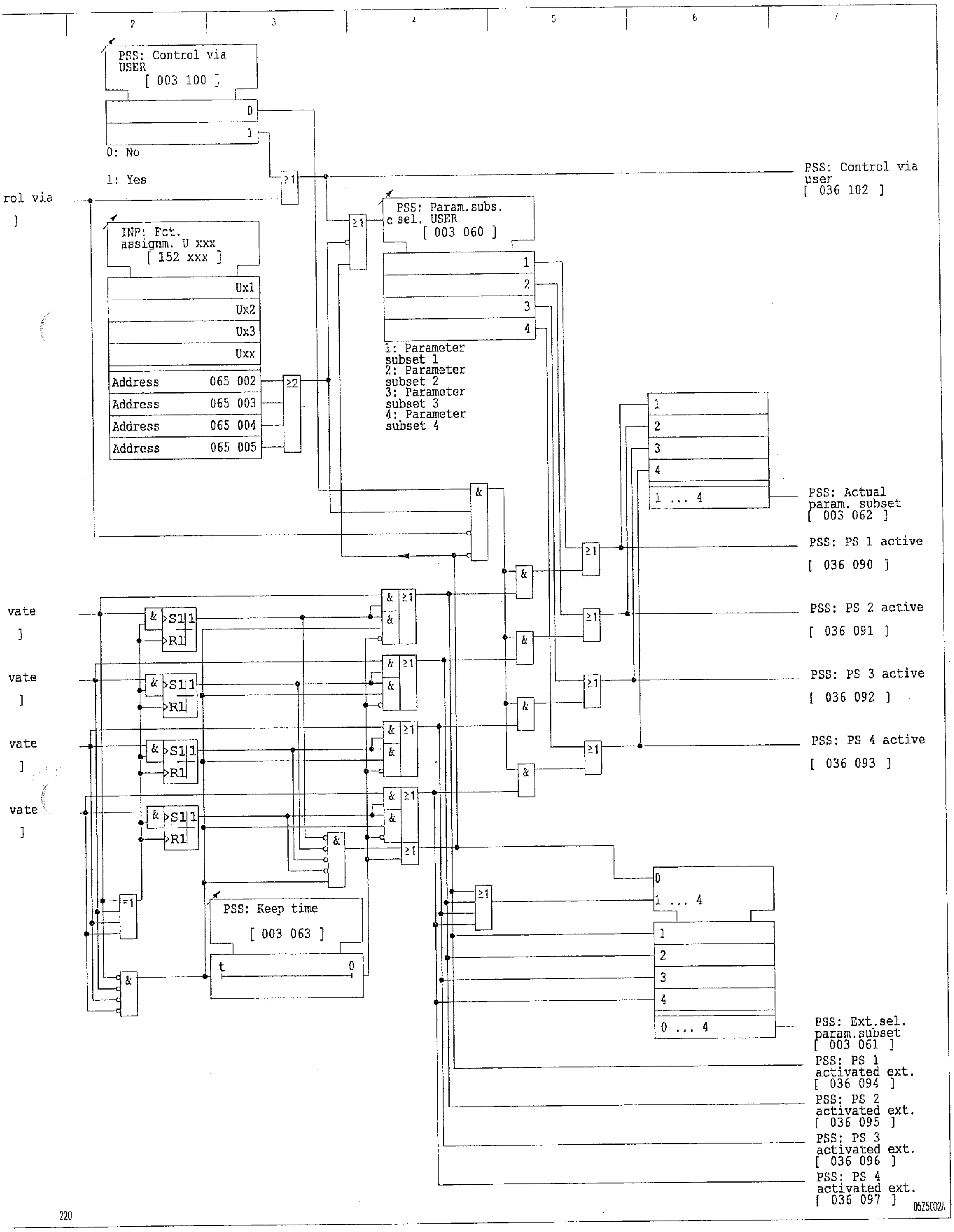
Selecting the parameter subset via binary inputs

If the binary signal inputs are to be used for parameter subset selection, then the P130C first checks to determine whether at least two binary inputs are configured for parameter subset selection. If this is not the case, then the parameter subset selected via the function parameter will be active. The P130C also checks to determine whether the signals present at the binary signal inputs allow an unambiguous parameter subset selection. This is true only when just one binary signal input is set to a logic value of '1'. If more than one signal input is set to a logic value of '1', then the parameter subset previously selected remains active. Should a dead interval occur while switching between parameter subsets (this is the case if all binary signal inputs have a logic value of '0'), then the stored energy time is started. While this timer stage is running, the previously selected parameter subset remains active. As soon as a signal input has a logic value of '1', the associated parameter subset becomes active. If, after the stored energy time has elapsed, there is still no signal input with a logic value of '1', the parameter subset selected via a function parameter becomes active.

If, after the supply voltage is turned on, no logic value of '1' is present at any of the binary signal inputs selected for the parameter subset selection, then the parameter subset selected via a function parameter will become active once the stored energy time has elapsed. The previous parameter subset remains active while the stored energy timer stage is running.

Parameter subset selection may also occur during a starting condition. When subset selection is handled via binary signal inputs, a maximum inherent delay of approximately 100 ms must be taken into account.

Settings for which only one address is given in the following sections are equally effective for all four parameter subsets.



\ctiv('he parameter subsets

3.12 Self-Monitoring (Function Group SFMON)

Comprehensive monitoring routines in the P130C ensure that internal faults are detected and do not lead to malfunctions.

Tests during startup

After the supply voltage has been turned on, various tests are carried out to verify full operability of the P130C. If the P130C detects a fault in one of the tests, then startup is terminated. The display shows which test was running when termination occurred. No control actions can be carried out. A new attempt to start up the P130C can only be initiated by turning the supply voltage off and then on again.

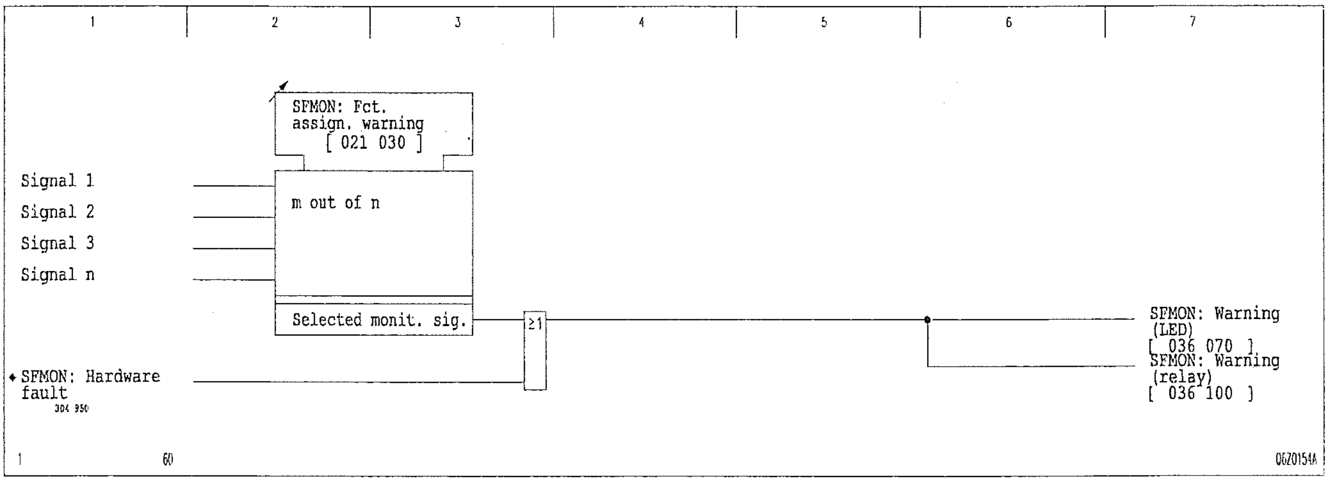
Cyclic tests

After startup has been successfully completed, cyclic self-monitoring tests will be run during operation. In the event of a positive test result, a specified monitoring signal will be issued and stored in a non-volatile memory – the monitoring signal memory – along with the assigned date and time (see also Monitoring Signal Recording).

The self-monitoring function monitors the built-in battery for any drop below the minimum acceptable voltage level. If the associated monitoring signal is displayed, then the battery should be replaced within a month, since otherwise there is the danger of data loss if the supply voltage should fail. Chapter 11 gives further instructions on battery replacement.

Signaling

The monitoring signals are also signaled via the output relay that is configured for SFMON: Warning. The output relay operates as long as an internal fault is detected.



3-56 *Monitoring signals*

sponse

The response of the P130C is a function of the type of monitoring signal. The following responses are possible:

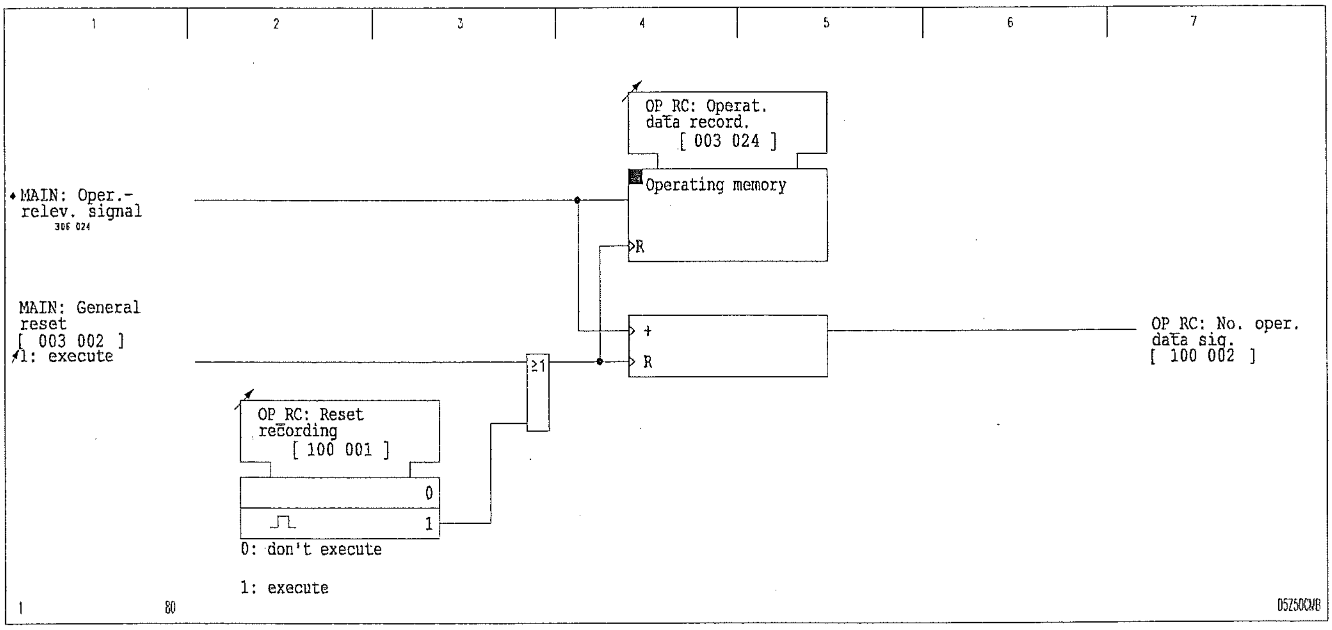
- Signaling Only
  If there is no malfunction associated with the monitoring signal, then only a signal is issued, and there are no further consequences. This situation exists, for example, when internal data acquisition memories overflow.
- Selective Blocking
  If a fault is diagnosed solely in an area that does not affect the protective functions, then only the affected area is blocked. This would apply, for example, to the detection of a fault on the communication module or in the area of the PC interface.
- Warm Restart
  If the self-monitoring function detects a fault that might be eliminated by a system restart – such as a fault in the hardware –, then a procedure called a warm restart is automatically initiated. During this procedure, as with any startup, the computer system is reset to a defined state. A warm restart is characterized by the fact that no stored data and, in particular, no setting parameters are affected by the procedure. A warm restart can also be triggered manually by a control action. During a warm restart sequence, both the protective functions and communication through serial interfaces will be blocked. If the same fault is detected after a warm restart has been triggered by the self-monitoring system, then the protective functions remain blocked, but communication through the serial interfaces will usually be possible again.
- Cold Restart
  If a corrupted parameter subset is diagnosed during the checksum test, which is part of the self-monitoring procedure, then a cold restart is carried out. This is necessary because the unit cannot identify which parameter in the subset is corrupt. A cold restart causes all internal memories to be reset to a defined state. This means that all device settings are also erased after a cold restart. The settings that then apply are the underlined values given in the column headed 'Range of Values' in the Address List (see Appendix). In order for a safe initial state to be established, the default values have been selected so that the protective functions are blocked. Both the monitoring signal that triggered the cold restart and the signal indicating parameter loss are entered in the monitoring signal memory.

3.13 Operating Data Recording (Function Group OP_RC)

For the continuous recording of processes in system operation as well as of events, a non-volatile ring memory is provided. The operationally relevant signals, each fully tagged with date and time at signal start and signal end, are entered in chronological order. The signals relevant for operation include control actions such as function disabling and enabling and triggers for testing and resetting. The onset and end of events in the system that represent a deviation from normal operation such as overloads, ground faults, or short-circuits are also recorded. The operating data memory can be cleared.

Counter for signals relevant to system operation

The signals stored in the operating data memory are counted.



3-57 Operating data recording and counter for signals relevant to system operation

3.14 Monitoring Signal Recording (Function Group MT_RC)

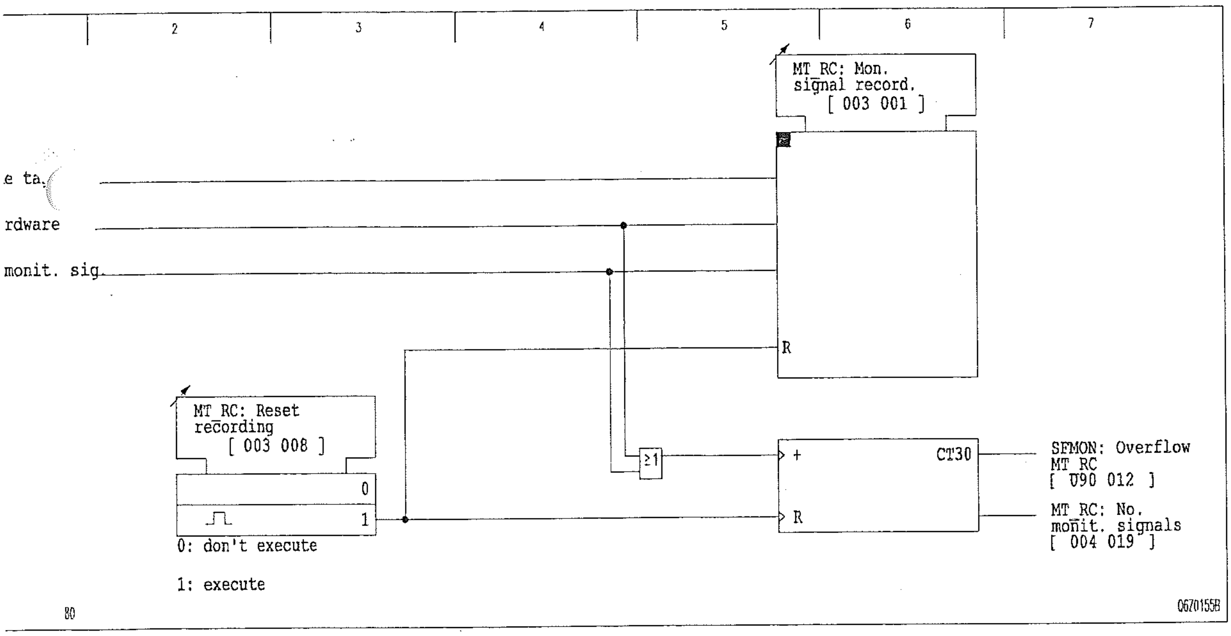
The monitoring signals generated by the self-monitoring function are recorded in the monitoring signal memory. A listing of all possible entries in this monitoring signal memory is given in the address list (see Appendix). The memory depth allows for a maximum of 30 entries. If more than 29 monitoring signals occur without interim memory clearance, the SFMON: Overflow MT_RC signal is entered as the last entry. Monitoring signals prompted by a hardware fault in the unit are always entered in the monitoring signal memory. Monitoring signals prompted by a peripheral fault can be entered into the monitoring signal memory, if desired. The user can select this option by setting an 'm out of n' parameter (see Self-Monitoring).

If at least one entry is stored in the monitoring signal memory, this fact is signaled by the red LED indicator H 3 on the local control panel. Each new entry is indicated by a flashing light.

The monitoring signal memory can only be cleared manually by a control action. Entries in the monitoring signal memory are not even cleared automatically if the corresponding test in a new test cycle has a negative result. The contents of the monitoring signal memory can be read from the local control panel or through the PC or communication interface. The time and date information assigned to the individual entries can be read out through the PC or communication interface or from the local control panel.

g signal counter

The number of entries stored in the monitoring signal memory is displayed on the monitoring signal counter (MT_RC: No. monit. signals).

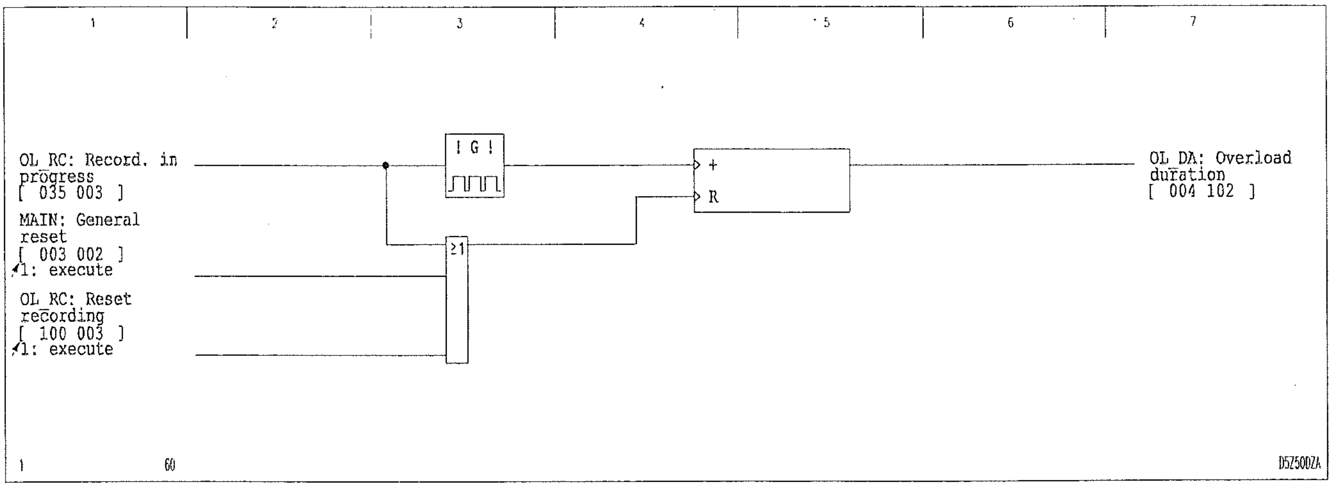


Monitoring signal recording and the monitoring signal counter

3.15 Overload Data Acquisition (Function Group OL_DA)

Overload duration

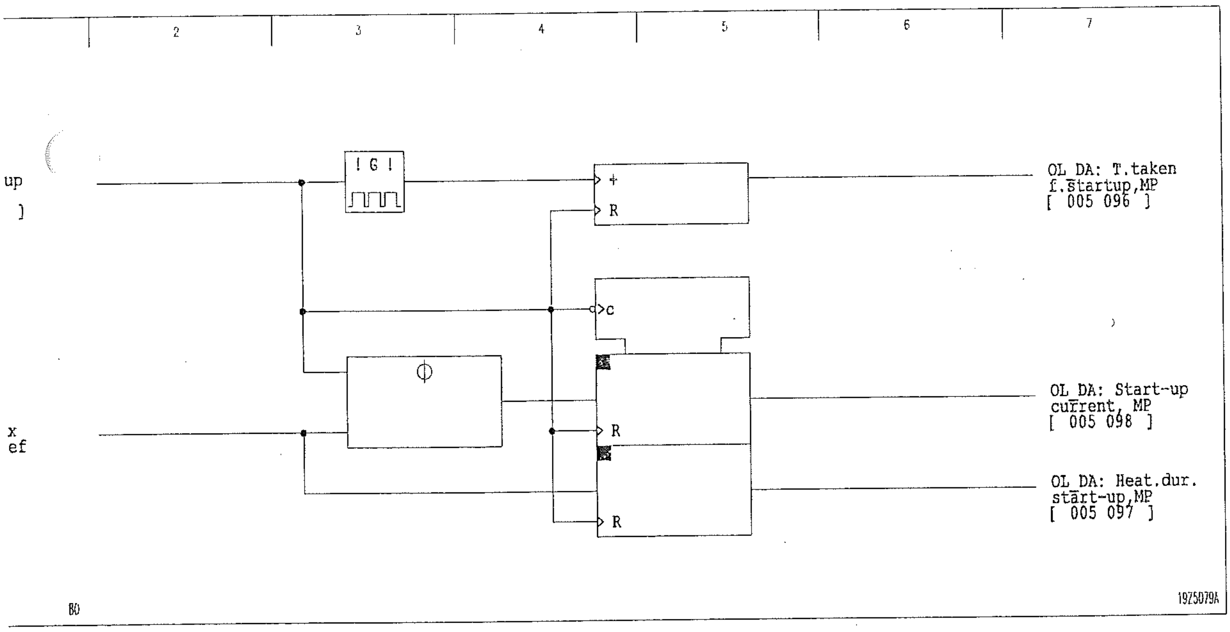
In the event of an overload, the P130C determines the overload duration. The overload duration is defined as the time between the start and end of the OL_RC: Record. in progress signal.



3-59 *Overload duration*

n of measured data by the motor function

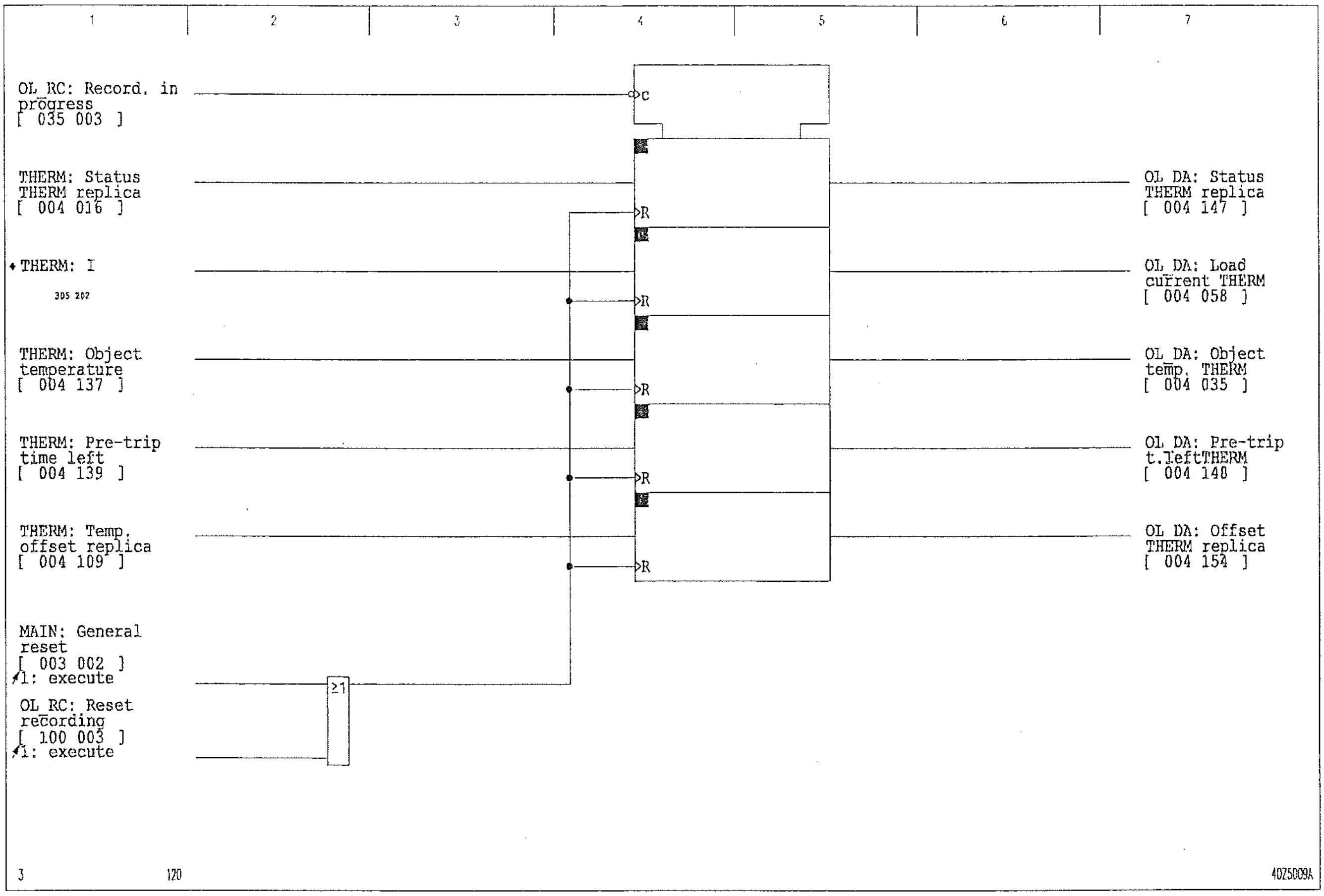
During motor startup, the measured data for the startup time, the maximum startup current and the startup heating are determined and stored at the end of the startup process.



Measured overload data of the motor protection function

Acquisition of the measured overload data of thermal overload protection

The measured overload data are derived from the measured operating data of the thermal overload protection function. They are stored at the end of the overload event.



3-61 Measured overload data of thermal overload protection

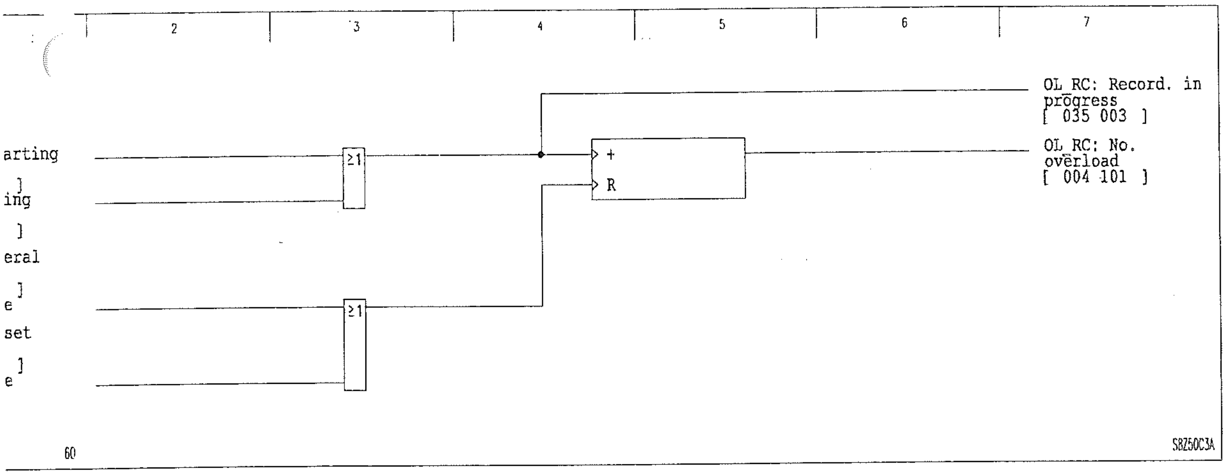
3.16 Overload Recording (Function Group OL_RC)

ⅴerload recording

An overload exists and therefore overload recording begins if a starting signal is issued by either the motor protection function (MP: Starting k*Iref>) or the thermal overload protection function (THERM: Starting k*Iref>).

overload events

Overload events are counted and identified by sequential number.



ɔounting overload events

Time tagging

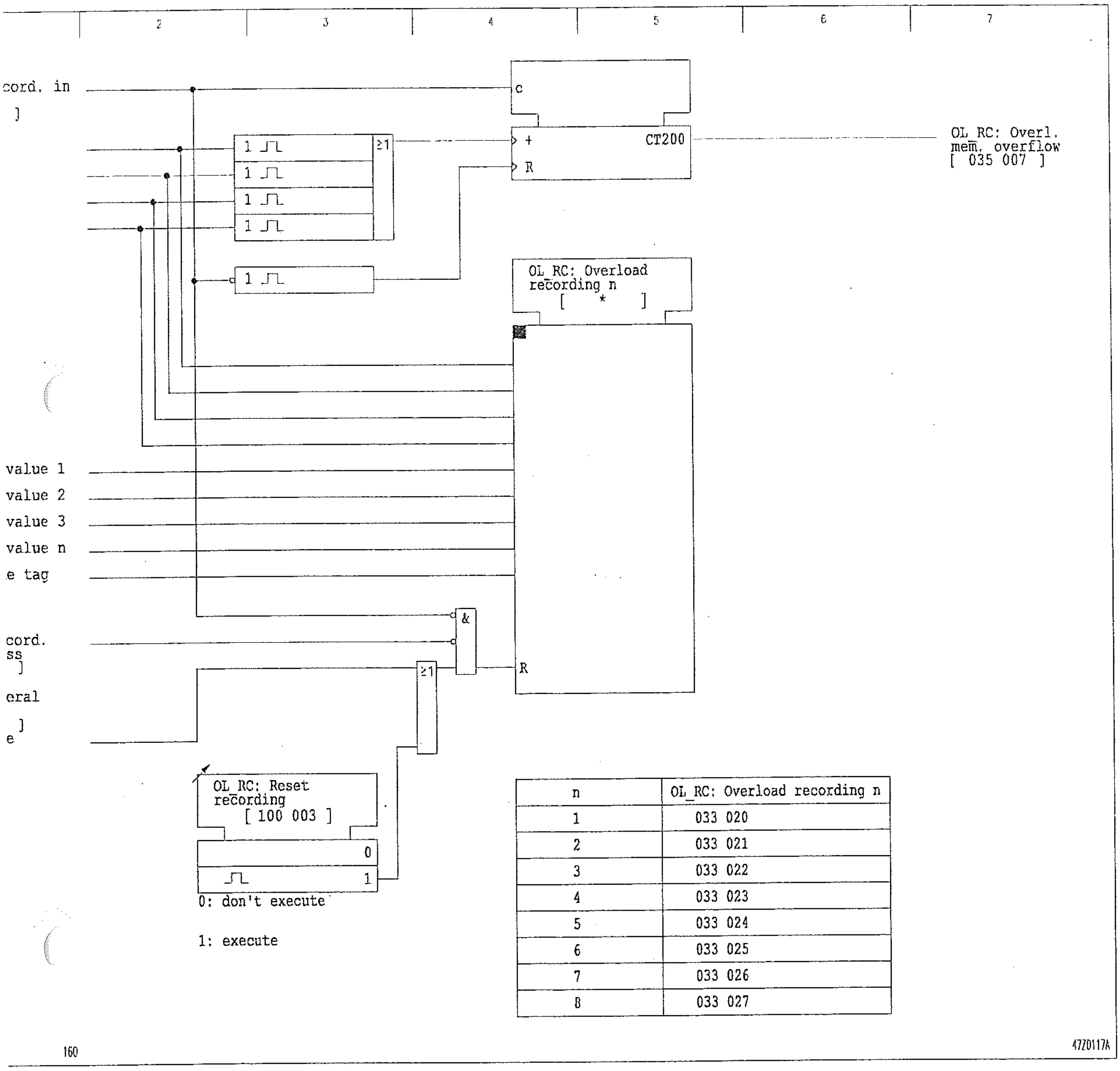
The date that is assigned to each overload event by the internal clock is stored. An overload event's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to an overload event when the event begins can be read out from the overload memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the overload) that is assigned to the signals can be retrieved from the overload memory or through the PC or communication interfaces.

Overload logging

Protection signals during an overload event are logged in chronological order with reference to the specific event. A total of eight overload events, each involving a maximum of 200 start or end signals, can be stored in the non-volatile overload memories. After eight overload events have been logged, the oldest overload log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single overload event, then OL_RC: Overl. mem. overflow will be entered as the last signal.

In addition to the signals, the measured overload data are also entered in the overload memory.

The overload logs can be read from the local control panel or through the PC or communication interfaces.



n	OL_RC: Overload recording n
1	033 020
2	033 021
3	033 022
4	033 023
5	033 024
6	033 025
7	033 026
8	033 027

)verload memory

3.17 Ground Fault Data Acquisition (Function Group GF_DA)

In the event of a ground fault, the P130C acquires the following measured ground fault data:

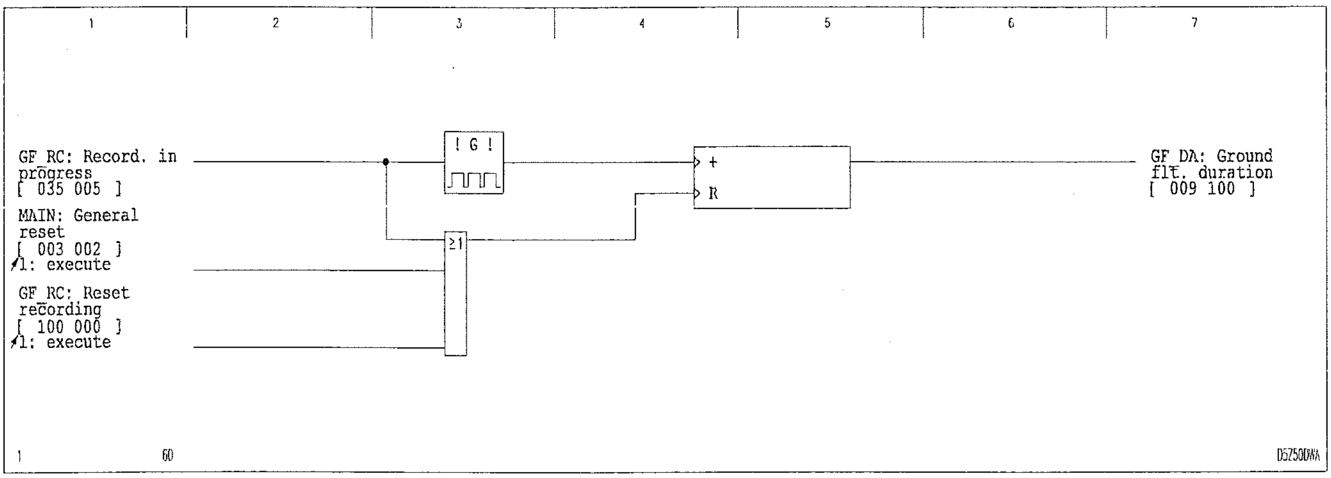
- Duration of the ground fault recording
- When the GFDSS function (ground fault direction determination using steady-state values) is enabled:
  - Ground fault duration determined by steady-state power, steady-state current or admittance evaluation
  - Neutral-point displacement voltage V_{NG} determined by steady-state power or admittance evaluation
  - Residual current I_N
  - Active component of residual current determined by steady-state power evaluation
  - Reactive component of the residual current determined by steady-state power evaluation
  - Filtered residual current determined by steady-state current evaluation
  - Admittance, conductance and susceptance if the admittance evaluation mode is enabled

Resetting the measured ground fault data

After the reset key 'C' on the local control panel is pressed, the ground fault data value is displayed as '*Not measured*'. However, the values are not erased and can continue to be read out through the PC and communication interfaces.

Duration of the ground fault recording

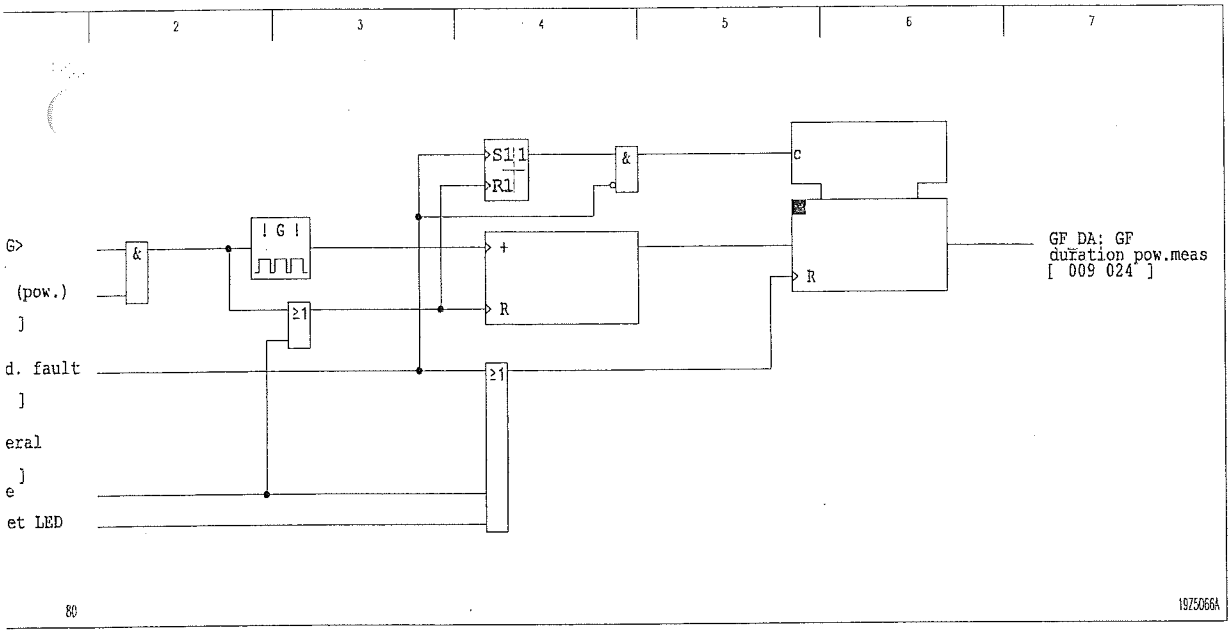
The ground fault duration is defined as the time between the start and end of the OL_RC: Record. in progress signal.



3-64 *Duration of the ground fault recording* ıult duration

3.17.1 Measured Ground Fault Data from Steady-State Power Evaluation

Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: VNG>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: VNG> has operated at least for the set time GFDSS: tVNG>. After GFDSS: tVNG> has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



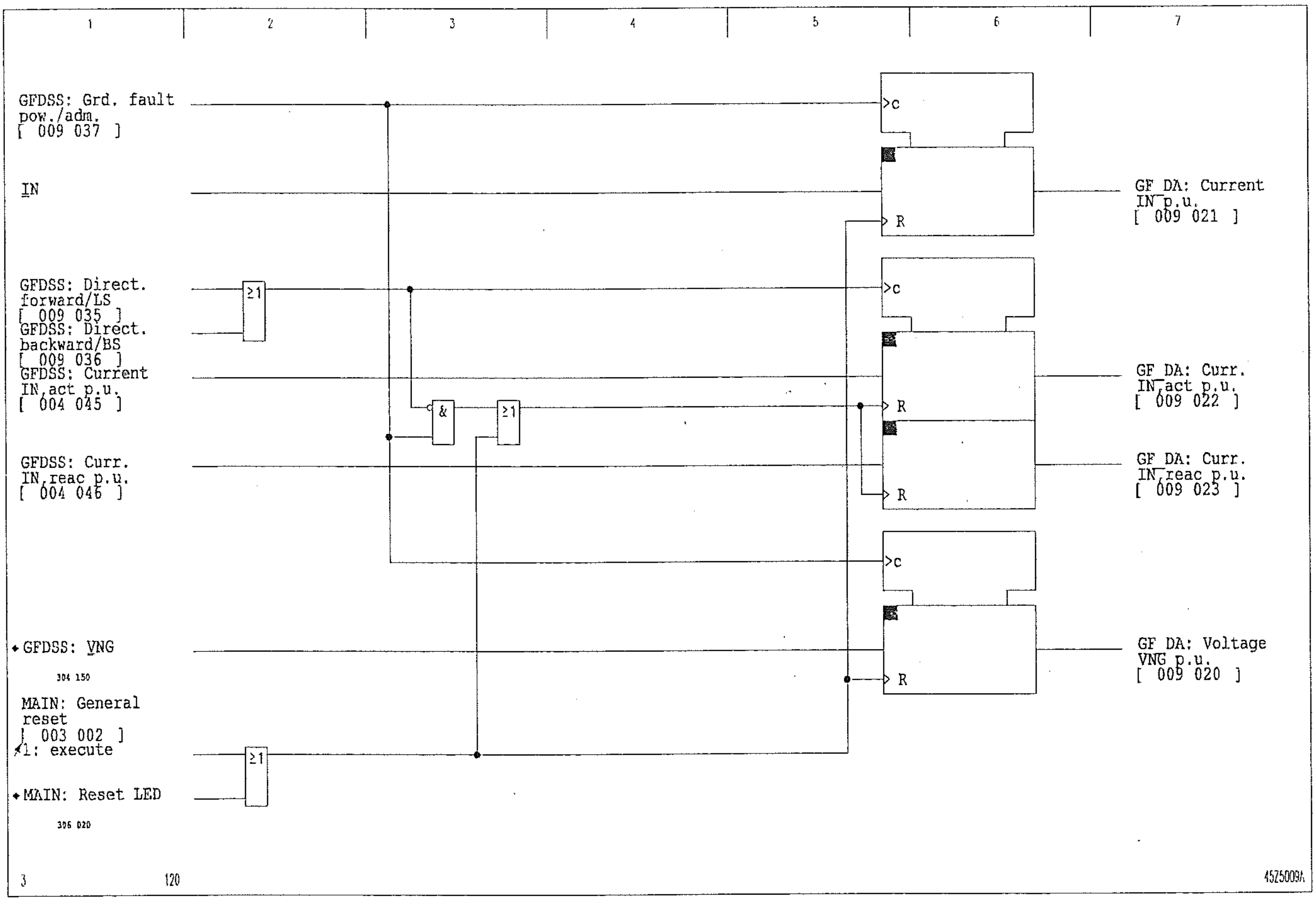
/leasurement and storage of ground fault duration, steady-state power evaluation

Residual current

The residual current that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory. In addition, the active or reactive component of the residual current at the time of the direction decision output is also stored. All measured data are output as per-unit quantities referred to the nominal current I_{nom} of the device.

Neutral displacement voltage

The neutral displacement voltage that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory.

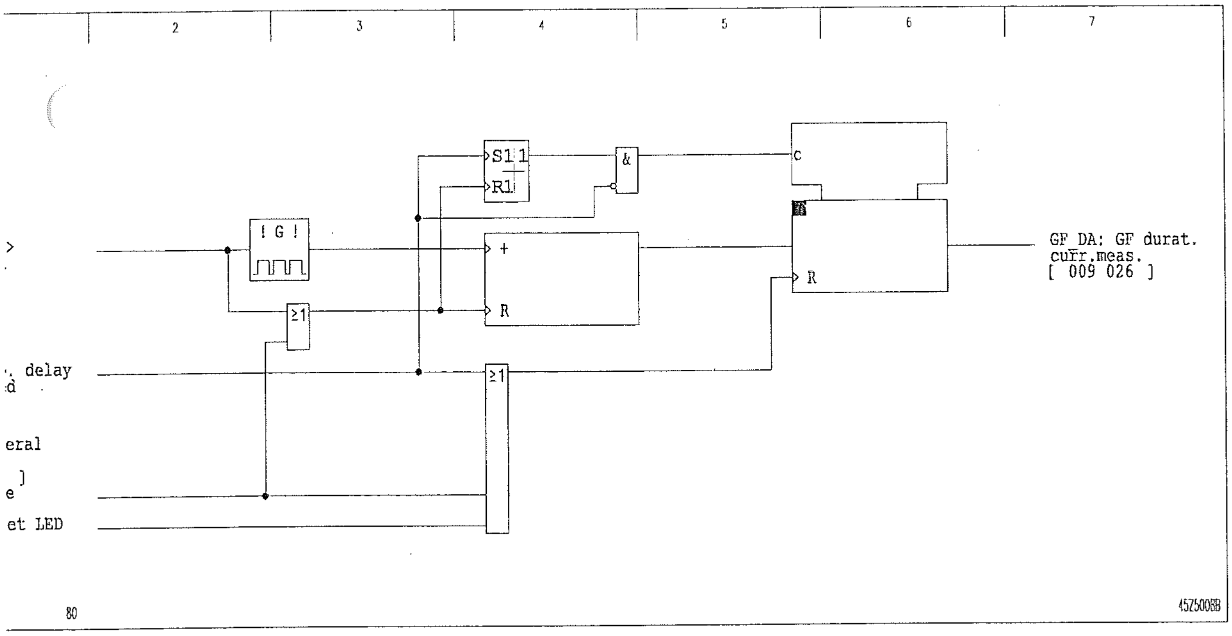


3-66 *Residual current and neutral-displacement voltage for steady-state power evaluation*

3.17.2 Measured Ground Fault Data from Steady-State Current Evaluation

ult duration

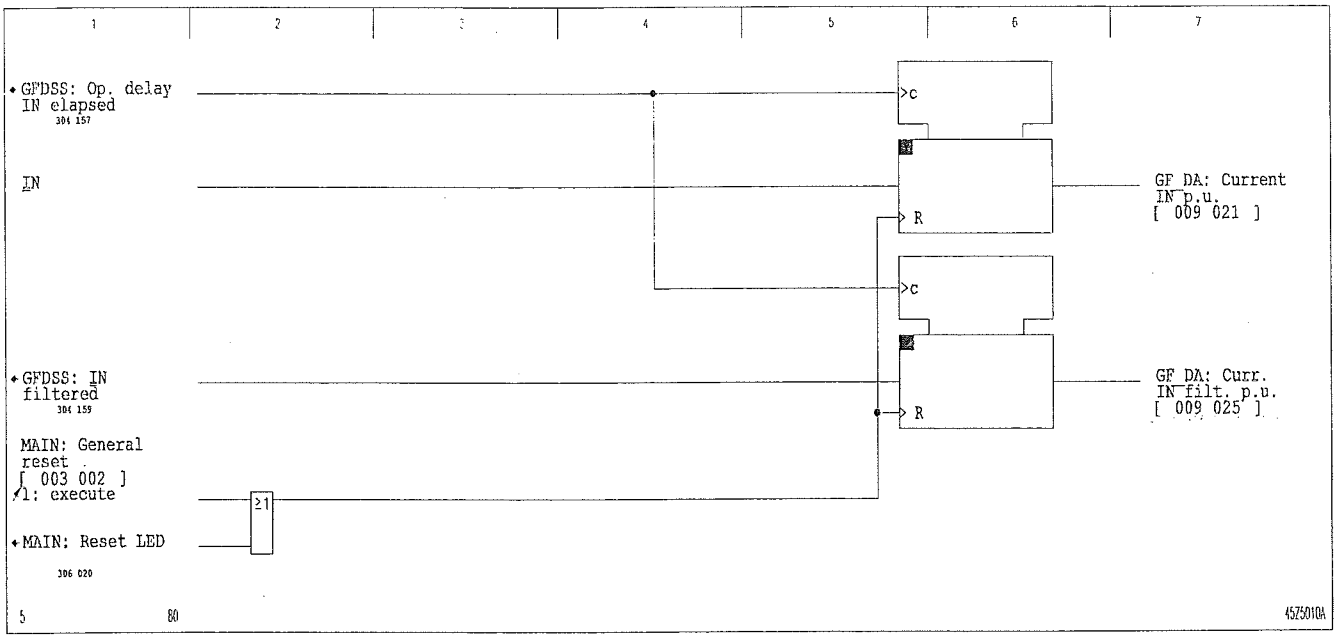
Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: IN>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: IN> has operated at least for the duration of the set operate delay (GFDSS: Operate delay IN). After the operate delay has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



leasurement and storage of ground fault duration, steady-state current evaluation

Residual current

Both the unfiltered and the filtered residual current at the time when the operate delay GFDSS: Operate delay IN elapses are stored.

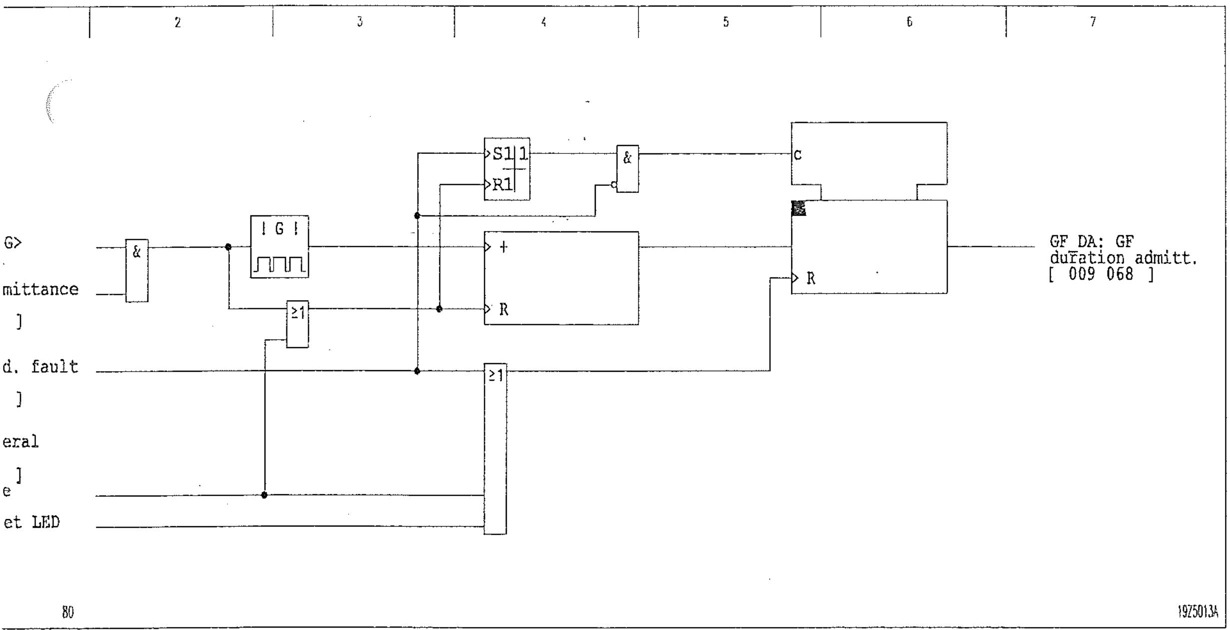


3-68 Filtered residual current determined by steady-state current evaluation

3.17.3 Measured Ground Fault Data from Admittance Evaluation

ult duration

Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: VNG>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: VNG> has operated at least for the set time GFDSS: tVNG>. After GFDSS: tVNG> has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



leasurement and storage of ground fault duration, admittance evaluation mode

Acquisition of admittance, conductance and susceptance

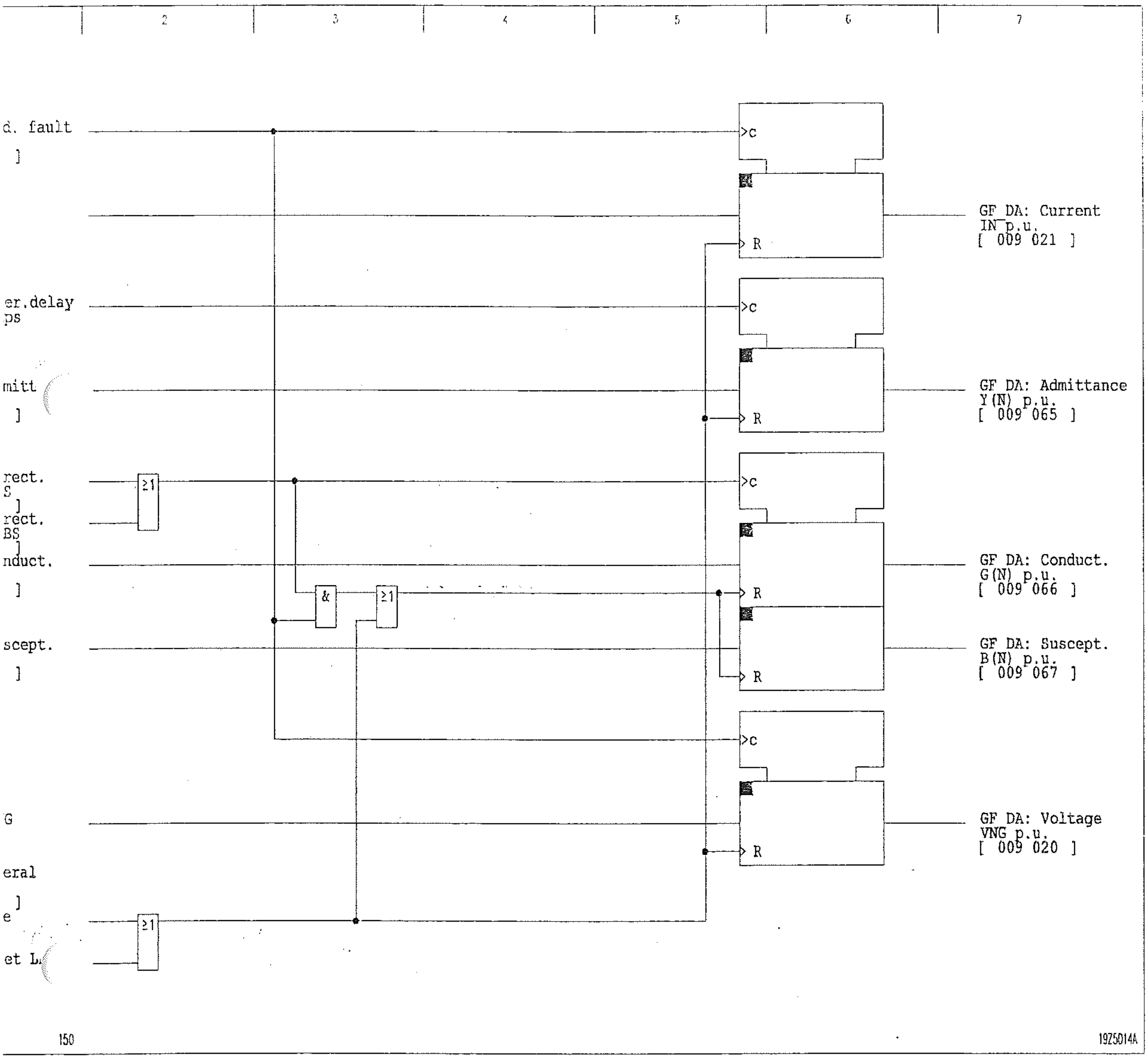
Conductance and susceptance are stored at the time when the direction decision is issued. The acquisition of the admittance data value is carried out at the time when timer stage GFDSS: Operate delay Y(N)> elapses.

Residual current

The residual current that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory. The measured data value is output as per-unit quantity referred to the nominal current I_{nom} of the device.

Neutral displacement voltage

The neutral displacement voltage that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory.



ured ground fault data for the admittance evaluation mode

3.18 Ground Fault Recording (Function Group GF_RC)

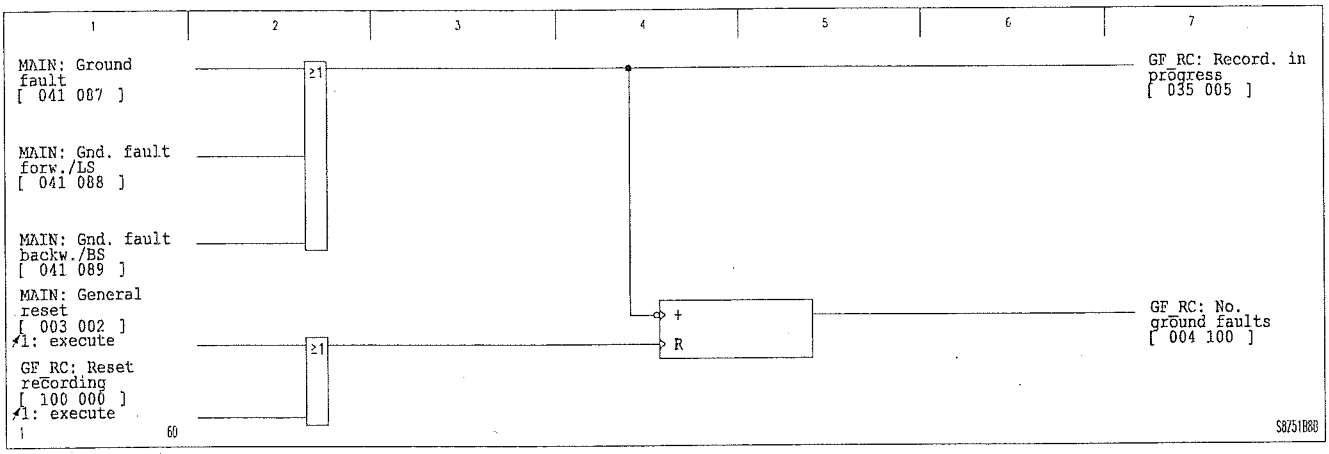
Start of ground fault recording

A fault exists, and therefore fault recording begins, if at least one of the following conditions is met:

- A ground fault has been detected by the GFDSS function (ground fault direction determination using steady-state values).
- A ground fault has been detected by transient ground fault direction determination.

Ground fault counting

The ground faults are counted and identified by sequential number.



3-71 *Ground fault counting*

ıing

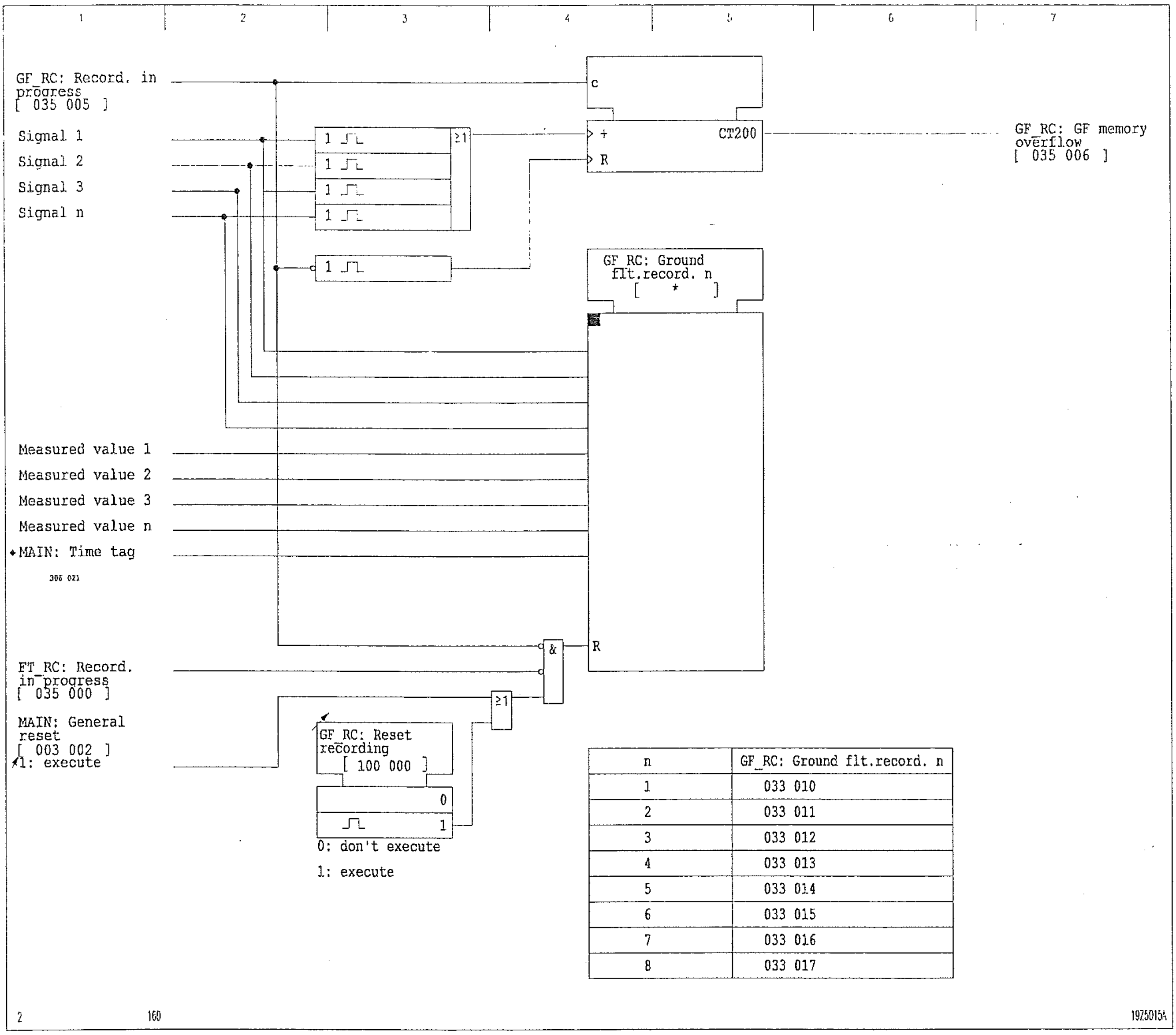
The date that is assigned to each ground fault by the internal clock is stored. A ground fault's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to a ground fault event when the event begins can be read out from the ground fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the ground fault event) that is assigned to the signals can be retrieved from the ground fault memory or through the PC or communication interfaces.

ıult logging

Protection signals issued during a ground fault are logged in chronological order with reference to the specific ground fault. A total of eight ground fault logs, each involving a maximum of 200 start or end signals, can be stored in the non-volatile ground fault memories. After eight ground faults have been logged, the oldest ground fault log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single ground fault, then `GF_RC: GF memory overflow` will be entered as the last signal.

In addition to the signals, the measured ground fault data are also entered in the ground fault memory.

The ground fault recordings can be read from the local control panel or through the PC or communication interfaces.



n	GF_RC: Ground flt.record. n
1	033 010
2	033 011
3	033 012
4	033 013
5	033 014
6	033 015
7	033 016
8	033 017

3-72 *Ground fault memory*

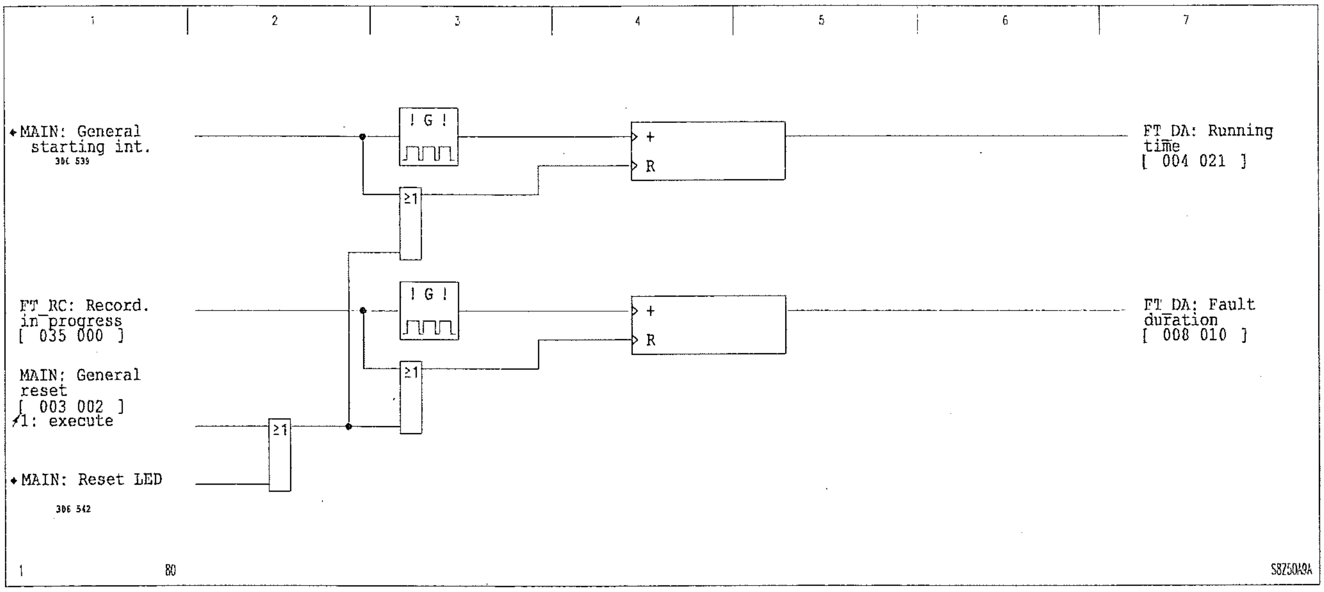
3.19 Fault Data Acquisition (Function Group FT_DA)

When there is a fault in the system, the P130C collects the following measured fault data:

- Running time
- Fault duration
- Fault current (short-circuit current)
- Fault voltage (short-circuit voltage)
- Short-Circuit Impedance
- Fault reactance (short-circuit reactance) in percent of line reactance and in Ω
- Fault angle
- Fault distance
- Ground fault current
- Ground fault angle
- Fault location in %
- Fault location in km

Running time and fault duration

The running time is defined as the time between the start and end of the general starting signal that is generated within the P130C, and the fault duration is defined as the time between the start and end of the `FT_RC: Record. in progress` signal.



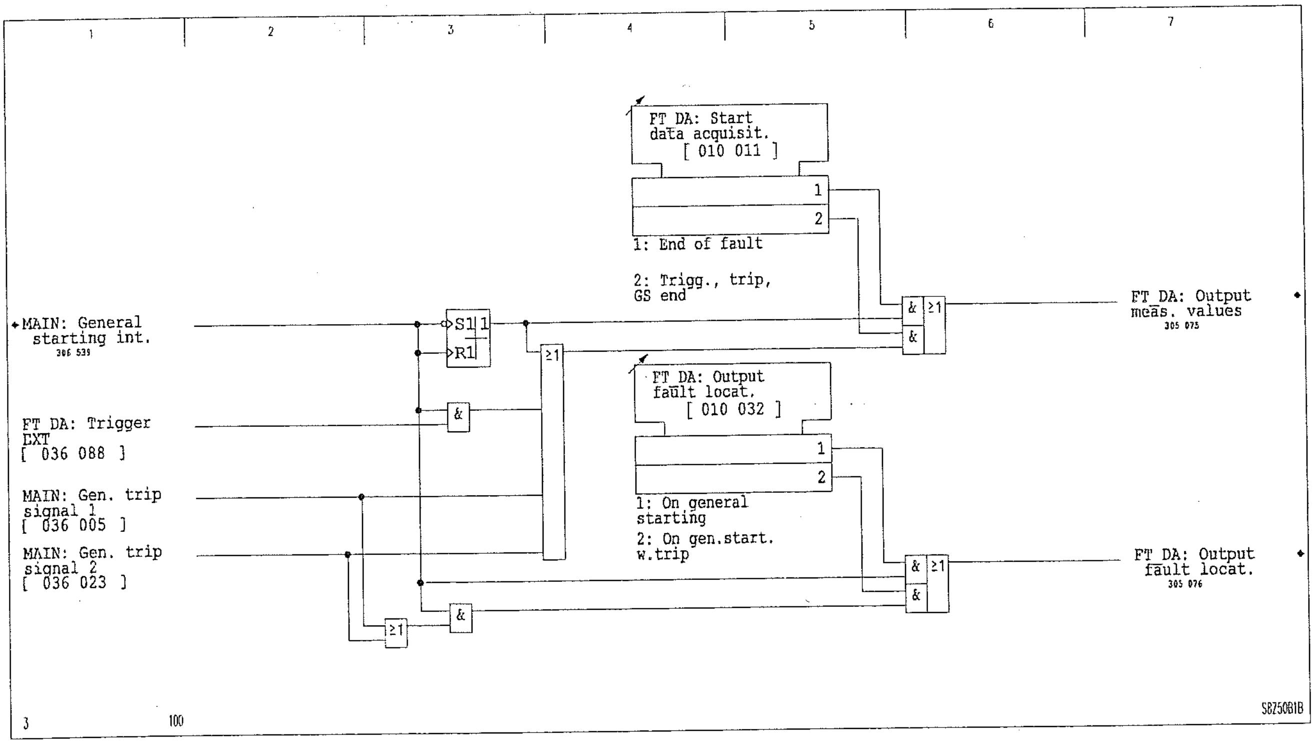
3-73 Running time and fault duration

Fault data acquisition time

The `FT_DA: Start data acqu.` setting governs the point during a fault at which the measured fault data are acquired. The following settings are possible:

- *End of fault*
  Acquisition at the end of the fault.
- *Trigg./Trip/GS end*
  Acquisition at one of the following points:
  - Triggering of an appropriately configured binary signal input during a general starting state
  - Issue of a general trip signal
  - End of a general starting state

Output of fault location occurs – depending on the setting – either when there is a general starting signal or when there is both a general starting signal and a simultaneous general trip signal.

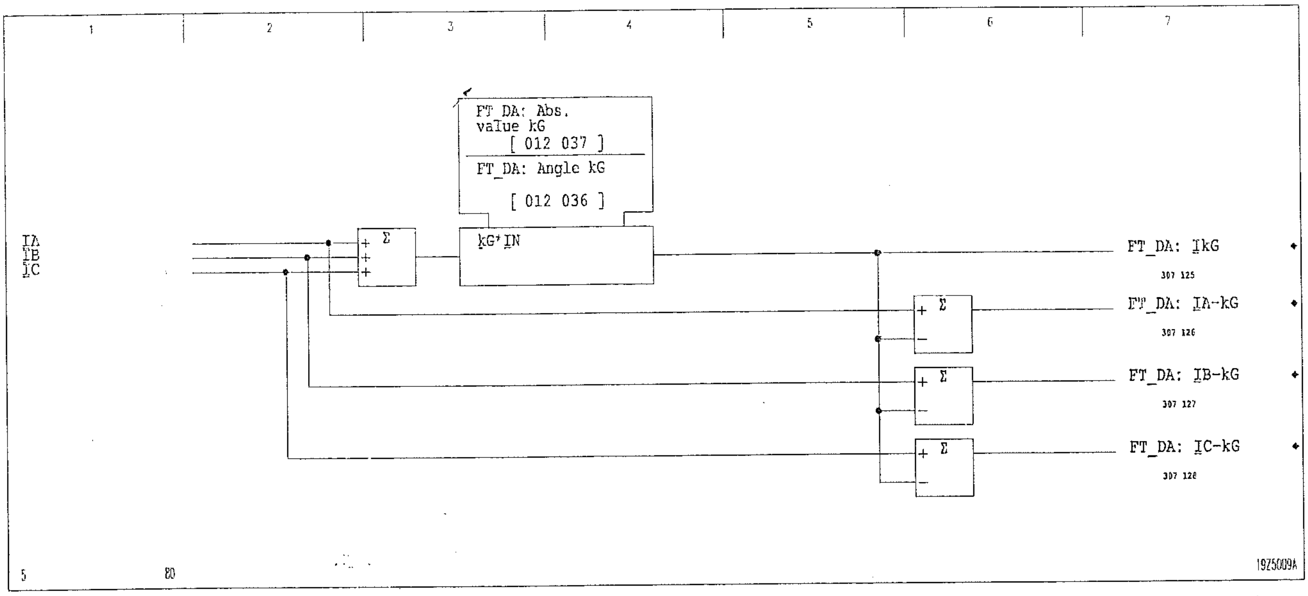


3-74 *Enabling of measured fault data acquisition and fault location output*

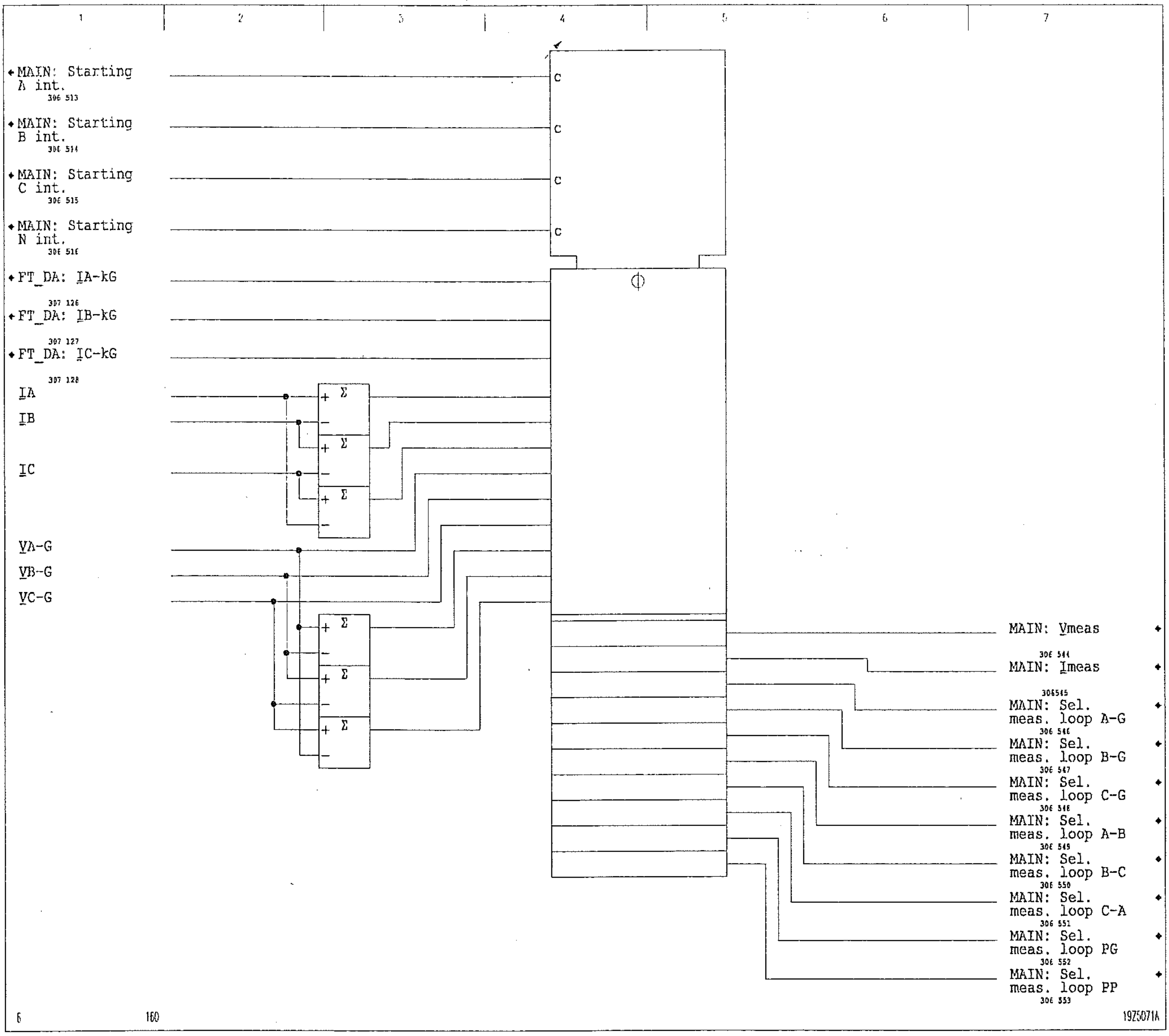
Fault data acquisition

The P130C selects a measuring loop based on the phase-selective starting decision. The short-circuit impedance (fault impedance) and fault direction are determined from this measuring loop's voltage and current. In the case of single-pole starting with ground fault detection, the currents corrected by the ground factor are selected as measured variables. In the case of three-phase starting, either grounded or ungrounded, the minimum voltage of the phase-to-phase voltages and the associated phase-to-phase current are selected as measured variables.

Fault Detection	Variables Selected for Measurement
IA	IA-kG / VA-G
IB	IB-kG / VB-G
IC	IC-kG / VC-G
IA-G	IA-kG / VA-G
IB-G	IB-kG / VB-G
IC-G	IC-kG / VC-G
IA-B	IA-B / VA-B
IB-C	IB-C / VB-C
IC-A	IC-A / VC-A
IA-B-G	IA-B / VA-B
IB-C-G	IB-C / VB-C
IC-A-G	IC-A / VC-A
IA-B-C	IP-P(min) / VP-P (min)
IA-B-C-G	IP-P(min) / VP-P (min)



3-75 *Formation of currents corrected by ground factor*



3-76 *Selection of measured variables for fault data acquisition*

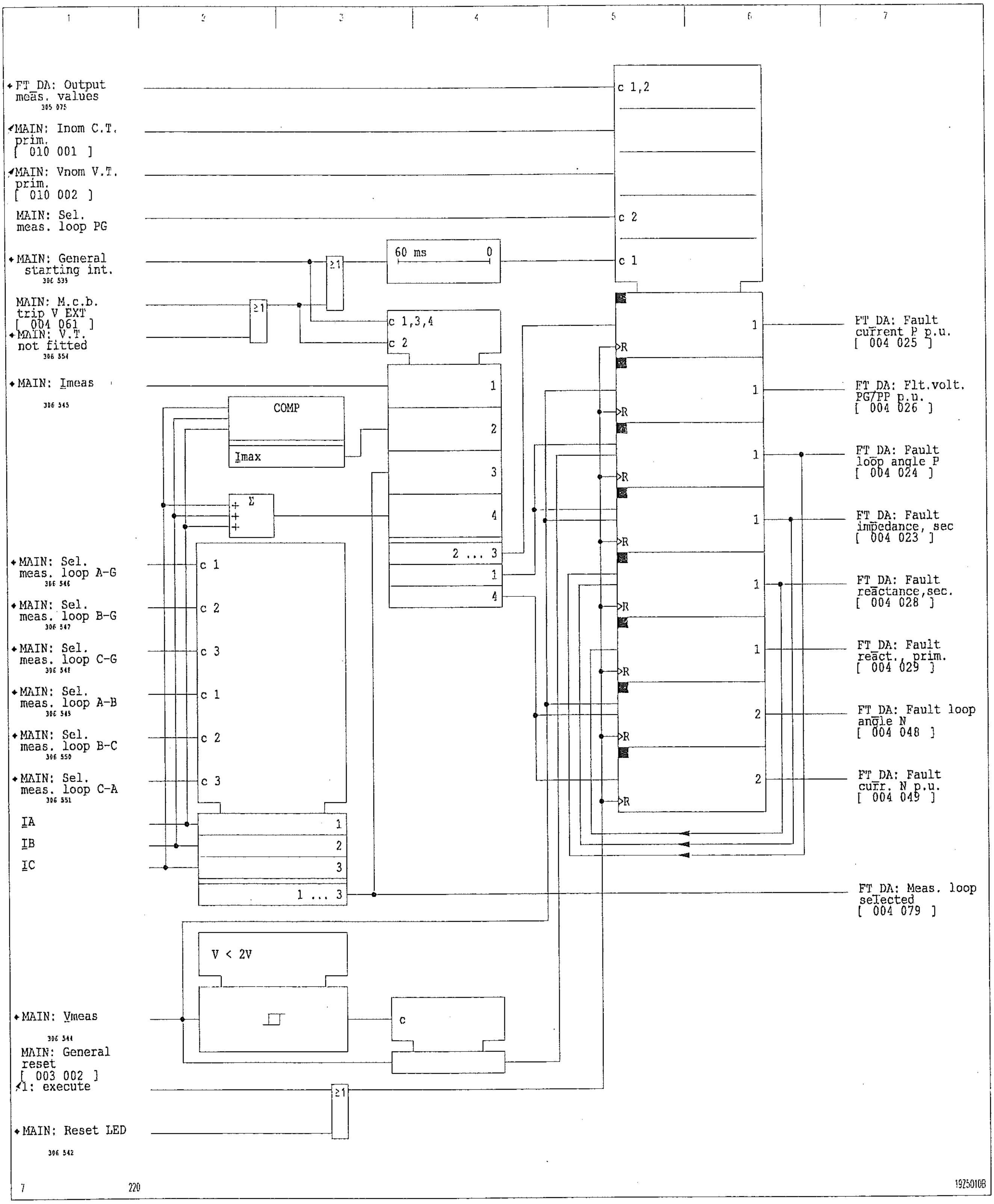
The fault must last for at least 60 ms so that the fault data can be determined.

The fault data are determined using the measured variables $\underline{I}_{meas}$ and $\underline{V}_{meas}$ selected by measured variable selection, if the fault is detected by fault data acquisition. One phase current is selected as the fault current in accordance with the measuring loop selected. In the case of multi-phase starting this is the current of the leading phase in the cycle. The primary fault reactance is calculated from the per-unit fault reactance using the nominal data for the set primary current and voltage transformers.

The ground fault data are only determined if a phase-to-ground loop has been selected for measurement in conjunction with the fault data acquisition function. The geometric sum of the three phase currents is displayed as the ground fault current. The ground fault angle is the phase displacement between ground fault current and selected measuring voltage.

If there is an m.c.b. trip signal or the transformer module is not fitted with a voltage transformer, then only fault current is determined. The maximum phase current is displayed.

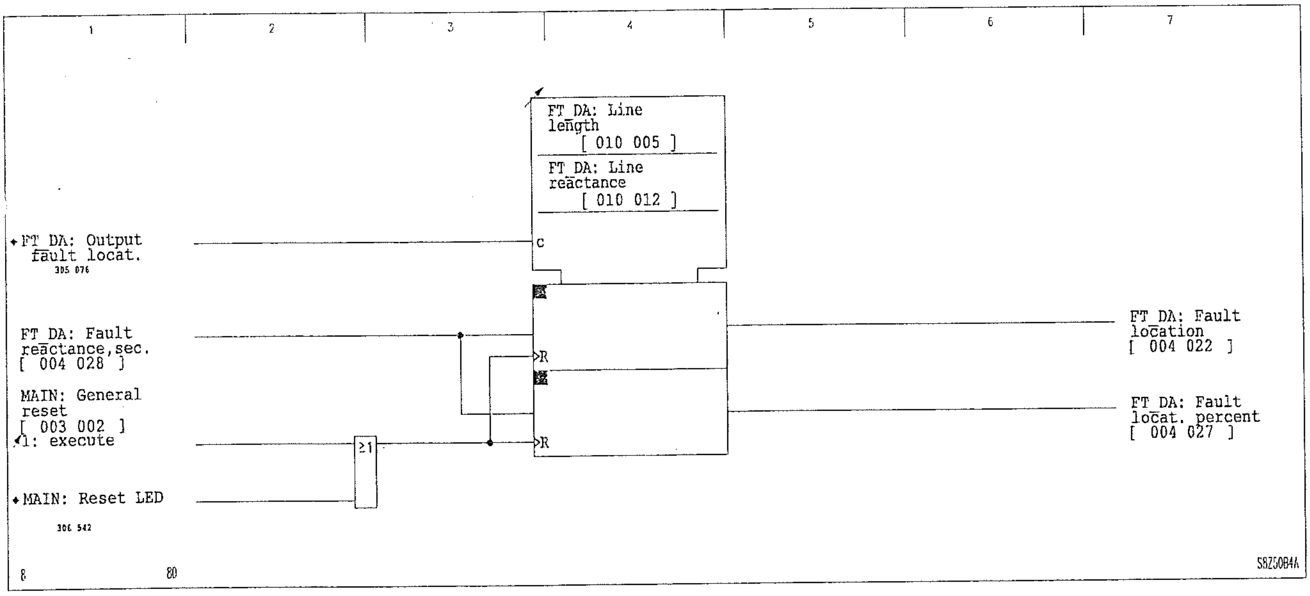
Fault current and voltage are displayed as per-unit quantities referred to I_{nom} and V_{nom}. If the measured or calculated values are outside the acceptable measuring range, the '*Overflow*' indication is displayed.



3-77 *Acquisition of fault data (short-circuit data)*

Acquisition of fault location

In order for the fault location to be determined in percent of line length and in km, the user must enter two settings in the P130C the value of the line reactance that corresponds to 100% of the line section being monitored and the value of the corresponding line length in km.



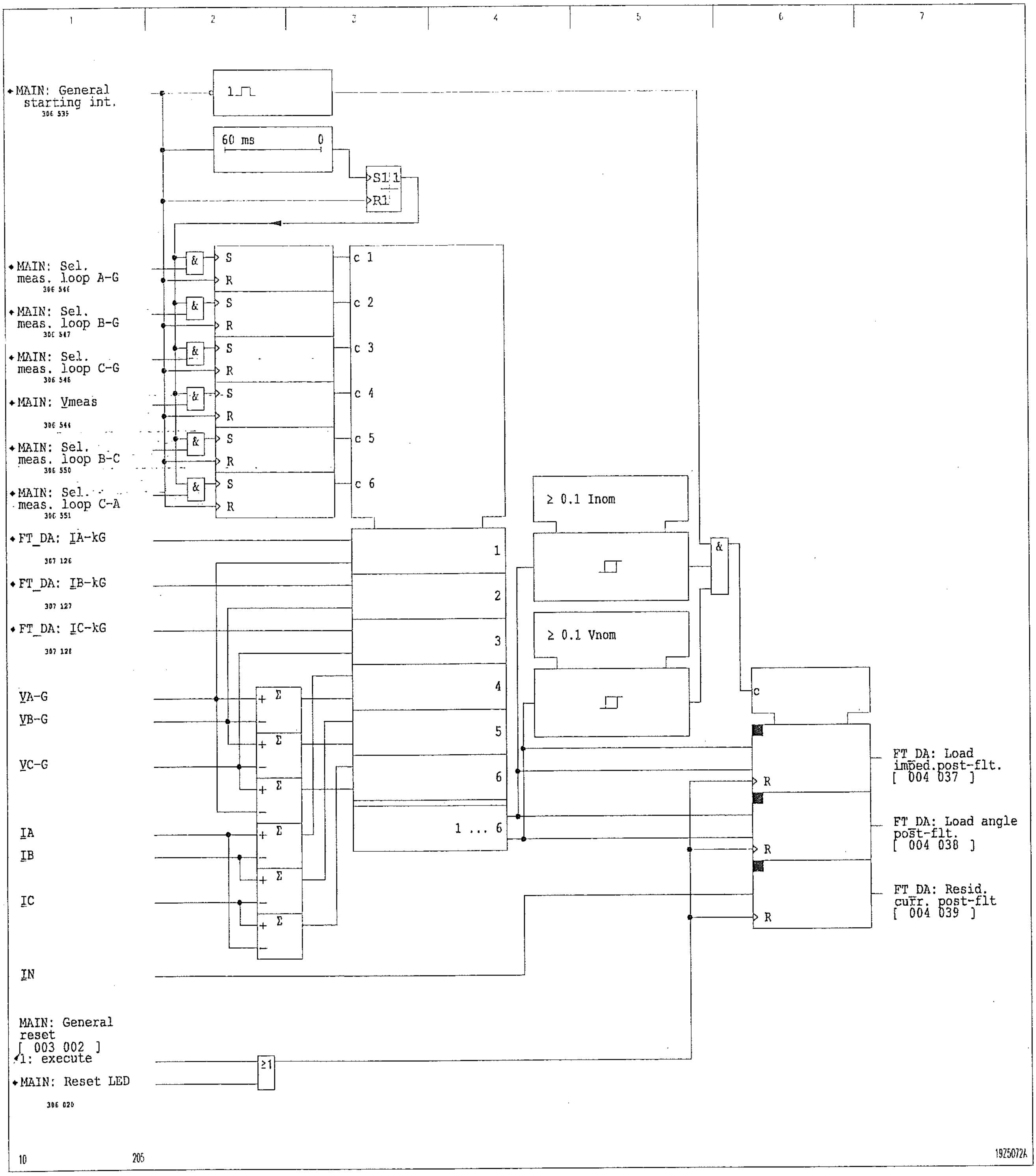
3-78 *Acquisition of fault location*

Acquisition of load data

In addition to fault data and fault location, the following load data are determined when the general starting signal drops out:

- Load impedance
- Load angle
- Residual current

The same measuring loop used to determine fault impedance is used to determine load impedance and load angle. The load current and the voltage must exceed the thresholds 0.1 I_{nom} and 0.1 V_{nom}, respectively, in order for the load data to be determined. If the thresholds are not reached or if the general starting signal does not last as long as 60 ms, the display '*Not measured*' appears.



3-79 *Acquisition of load data*

Fault data reset

After the reset key 'C' on the local control panel is pressed, the fault data value is displayed as '*Not measured*'. However, the values are not erased and can continue to be read out through the PC and communication interfaces.

3.20 Fault Recording (Function Group FT_RC)

Start of fault recording

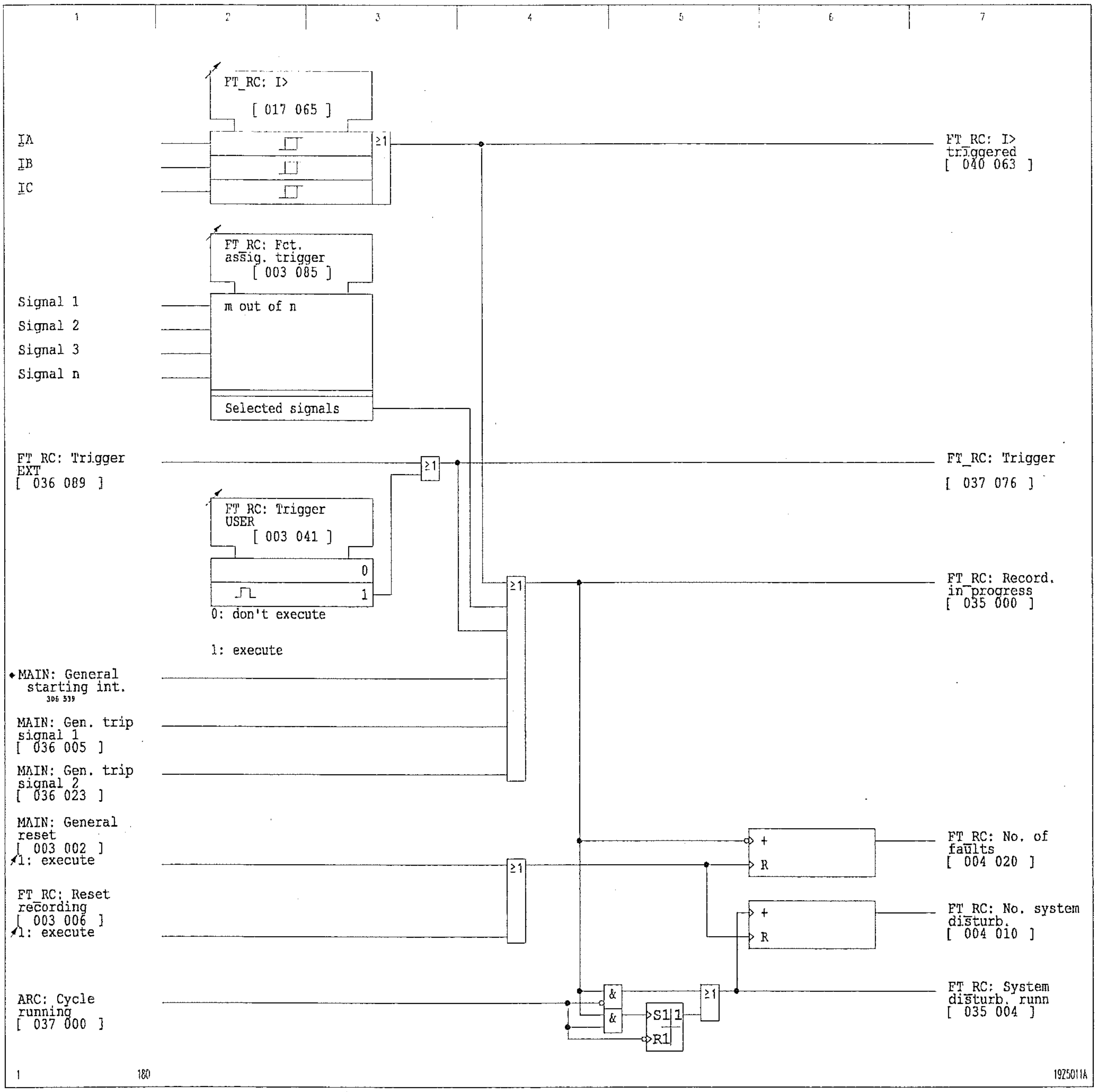
A fault exists, and therefore fault recording begins, if at least one of the following signals is present:

- MAIN: General starting
- MAIN: Gen. Trip signal 1
- MAIN: Gen. trip signal 2
- FT_RC: Trigger
- FT_RC: I>

In addition, the user can set an 'm out of n' parameter in order to configure signals whose appearance will trigger fault recording.

Fault counting

Faults are counted and identified by sequential number.



3-80 *Start of fault recording and fault counter*

Time tagging

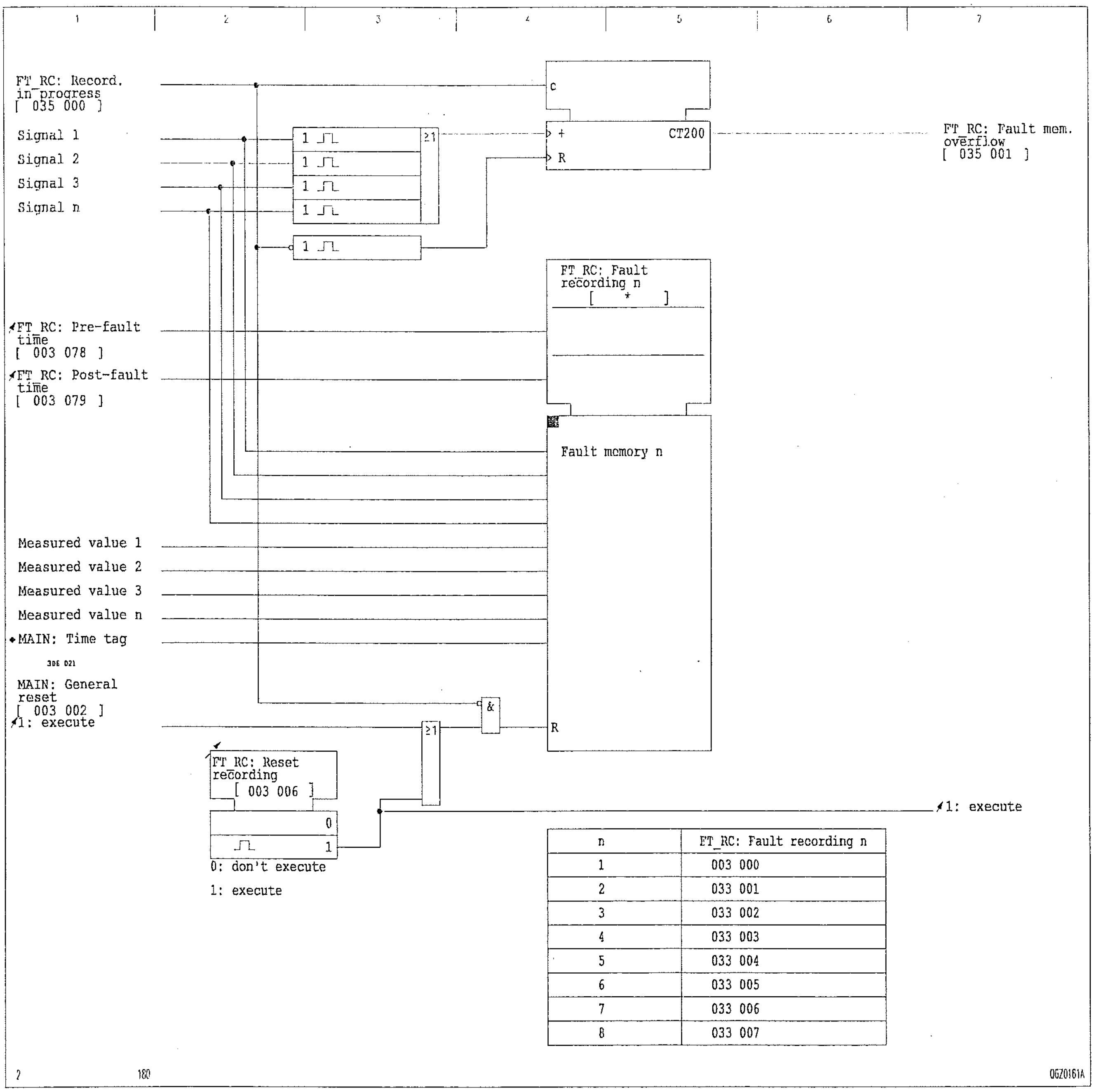
The date that is assigned to each fault by the internal clock is stored. A fault's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to a fault when the fault begins can be read out from the fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the fault) that is assigned to the signals can be retrieved from the fault memory or through the PC or communication interfaces.

Fault recordings

Protection signals during a fault, including the signals during the settable pre-fault and post-fault times, are logged in chronological order with reference to the specific fault. A total of eight faults, each involving a maximum of 200 start or end signals, can be stored in the non-volatile fault memories. After eight faults have been recorded, the oldest fault recording will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single fault, then `FT_RC: Fault mem. overflow` will be entered as the last signal. If the time and date are changed during the pre-fault time, the signal `FT_RC: Faulty time tag` is generated.

In addition to the fault signals, the measured fault data are also entered in the fault memory.

The fault recordings can be read from the local control panel or through the PC or communication interfaces.



n	FT_RC: Fault recording n
1	003 000
2	033 001
3	033 002
4	033 003
5	033 004
6	033 005
7	033 006
8	033 007

3-81 *Fault memory*

Fault value recording

The following analog signals are recorded:

- □ Phase currents
- □ Phase-to-ground voltages
- □ Residual current, measured by the P130C at the T 4 transformer

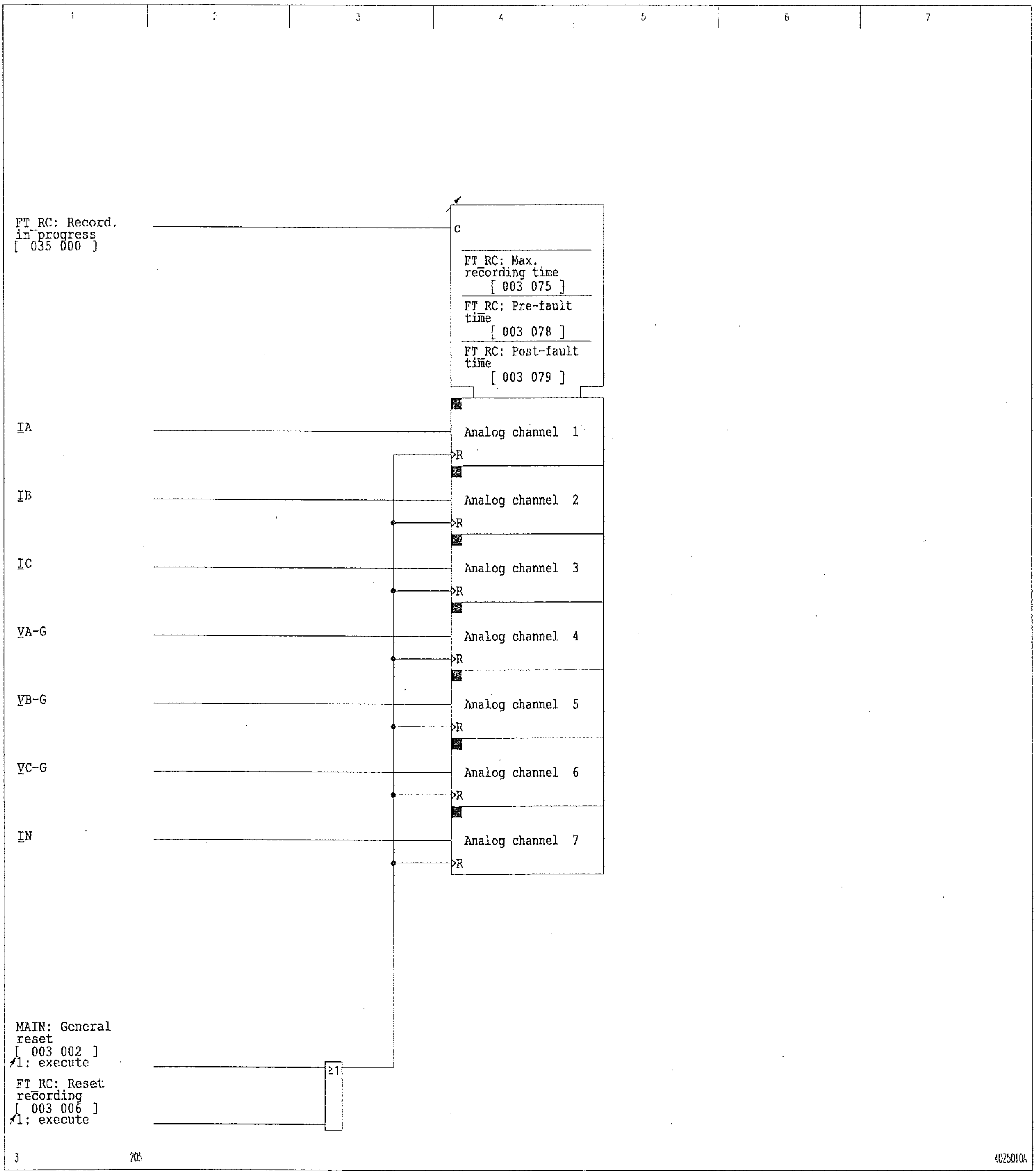
The signals are recorded before, during and after a fault. The times for recording before and after the fault can be set. A maximum time period of 16.4 s is available for recording. This period can be divided among a maximum of eight faults. The maximum recording time per fault can be set. If a fault, including the set pre-fault and post-fault times, lasts longer than the set maximum recording time, then recording will terminate when the set maximum recording time is reached.

The pre-fault time is exactly adhered to if it is shorter than the set maximum recording time. Otherwise; the pre-fault time is set to the maximum recording time minus a sampling increment, and the post-fault time is set to zero.

If the maximum recording time of 16.4 s is exceeded, the analog values for the oldest fault are overwritten, but not the binary values. If more than eight faults have occurred since the last reset, then all data for the oldest fault are overwritten.

The analog data of the fault record can only be read out through the PC or communication interfaces.

When the supply voltage is interrupted or after a warm restart, the values of all faults remain stored.



3-82 Fault value recording

3.21 Definite-Time Overcurrent Protection (Function Group DTOC)

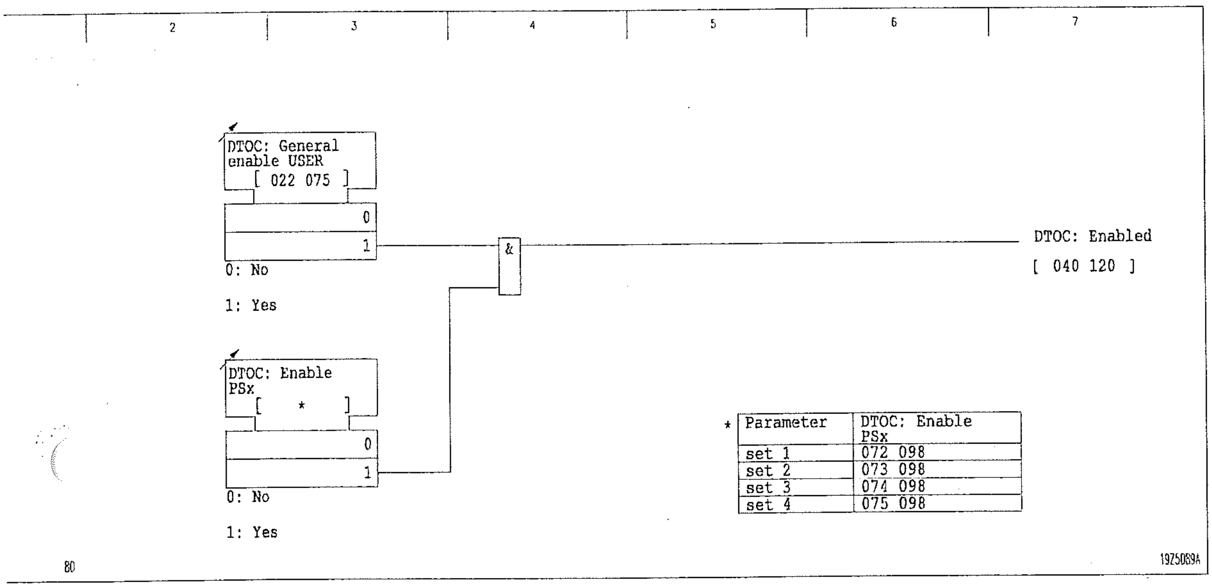
A three-stage definite-time overcurrent protection function (DTOC protection) is implemented in the P130C. Two separate measuring systems are available for this purpose:

- Phase currents system
- Residual currents system

Either the short-circuit direction determination function or the auto-reclosing control may intervene in the functional sequence of the DTOC function.

or e... bling
ote...

DTOC protection can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.



Disabling or enabling DTOC protection

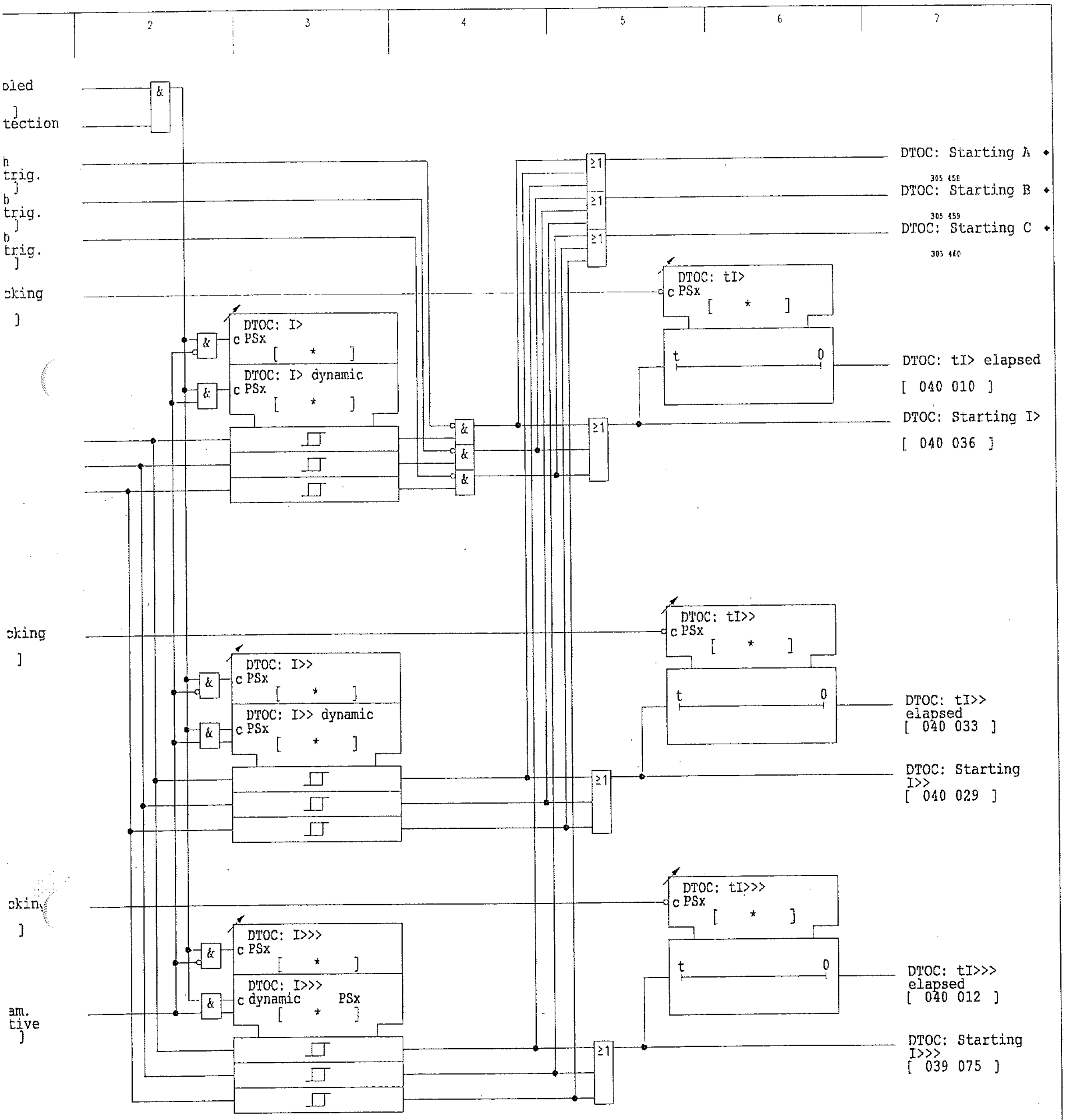
Phase current stages

The three phase currents are monitored by the P130C with three-stage functions to detect when they exceed the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" thresholds are active when no hold time is running. If the current exceeds the set thresholds in one phase, timer stages are started. Once these stages have elapsed, a signal is issued. The timer stages may be blocked via appropriately configured binary signal inputs.

When the inrush stabilization function (see: 'Main Functions of the P130C') is triggered, the 1st stage of the DTOC function is blocked.

The trip signals of all phase current stages are blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

The trip signals of the DTOC function can be blocked by the short-circuit direction determination function (stages I> and I>> only). Depending on the settings for the short-circuit direction determination function, the trip signal of stages I> or I>> may be enabled.



* Parameter	DTOC: I> PSx	DTOC: I> dynamic PSx	DTOC: I>> PSx	DTOC: I>> dynamic PSx
set 1	017 000	017 080	017 001	017 084
set 2	073 007	073 032	073 008	073 033
set 3	074 007	074 032	074 008	074 033
set 4	075 007	075 032	075 008	075 033

* Parameter	DTOC: I>>> PSx	DTOC: I>>> dynamic PSx	DTOC: tI> PSx	DTOC: tI>> PSx	DTOC: tI>>> PSx
set 1	017 002	017 085	017 004	017 006	170 007
set 2	073 009	073 034	073 019	073 020	073 021
set 3	074 009	074 034	074 019	074 020	074 021
set 4	075 009	075 034	075 019	075 020	075 021

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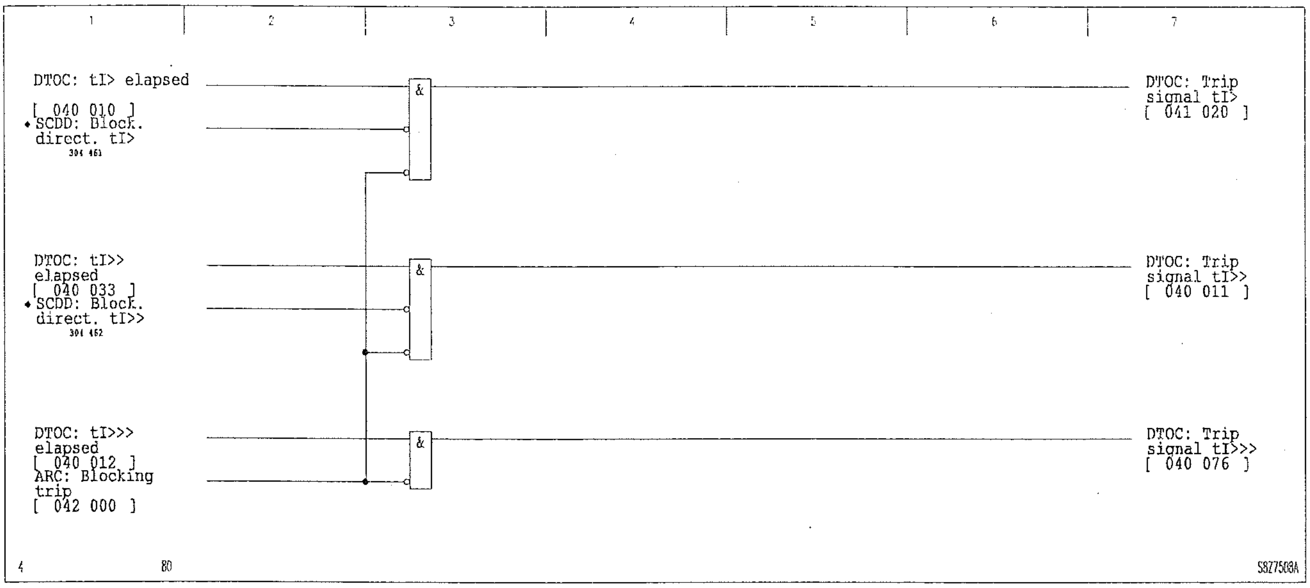
Phas ent stages



3-85 *Trip signals of the DTOC phase current stages* *sequence current*

The P130C calculates the negative-sequence current from the three phase currents according to one of the following formulas. The rotary field direction setting is taken into account.

Clockwise rotating field:

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left|\left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C\right)\right|$$

Anticlockwise rotating field:

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left|\left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C\right)\right|$$

$$\underline{a} = e^{j120°}$$

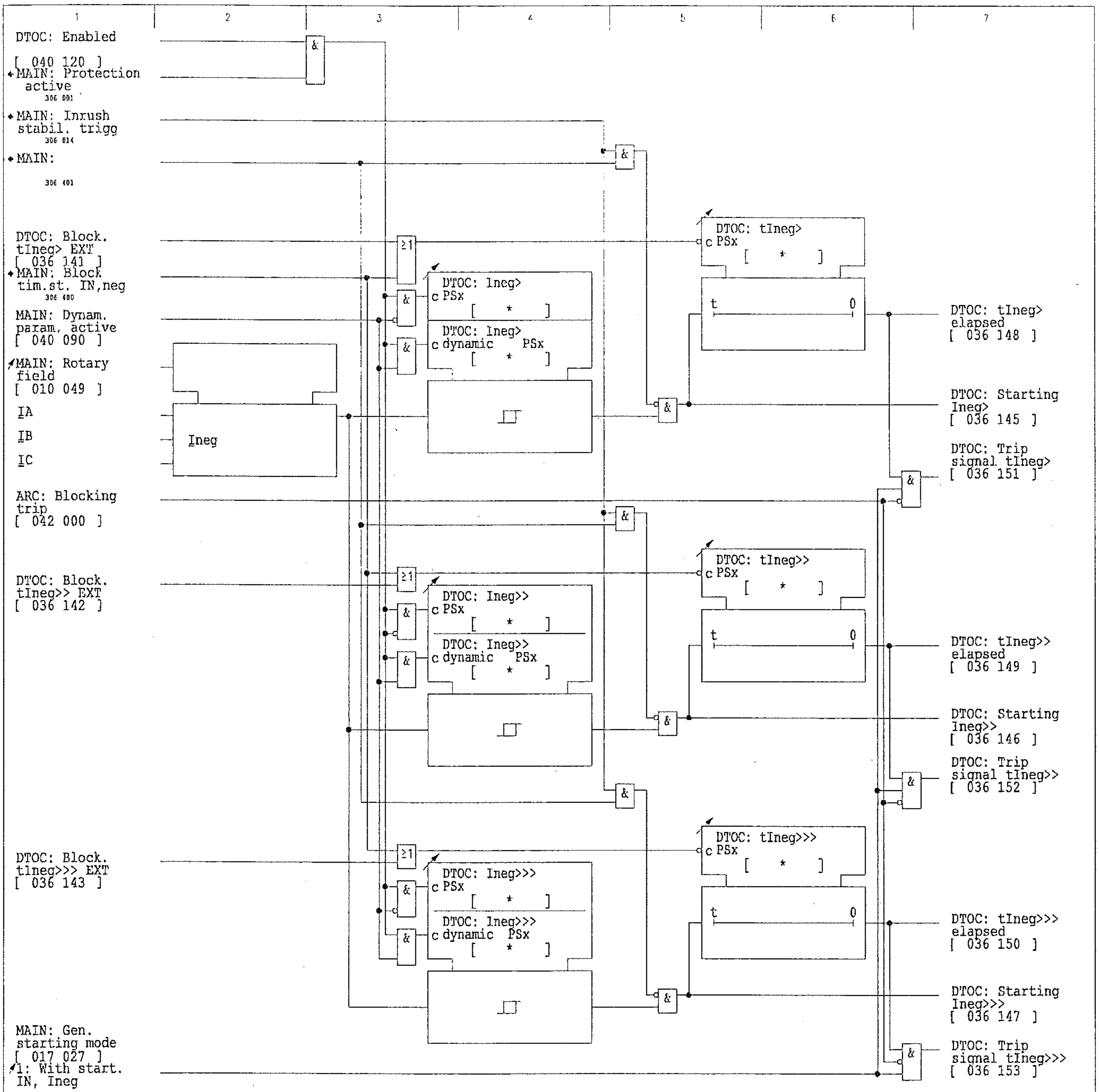
$$\underline{a}^2 = e^{j240°}$$

The negative-sequence current is monitored by the P130C with three-stage functions to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" thresholds are active when no hold time is running. If the current exceeds the set thresholds, timer stages are started. Once these stages have elapsed, a signal is issued. The timer stages may be blocked via appropriately configured binary signal inputs.

When the inrush stabilization function (see: 'Main Functions of the P130C') is triggered, the negative-sequence current stage is blocked.

If short-circuit direction determination is enabled, then the trip signal issued by the DTOC negative-sequence current stage is always non-directional.

The trip signal of the negative-sequence current stage is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.



* Parameter	DTOC: Ineg> PSx	DTOC: Ineg> dynamic PSx	DTOC: Ineg>> PSx	DTOC: Ineg>> dynamic PSx
set 1	072 011	076 200	072 012	076 201
set 2	073 011	077 200	073 012	077 201
set 3	074 011	078 200	074 012	078 201
set 4	075 011	079 200	075 012	079 201

* Parameter	DTOC: Ineg>>> PSx	DTOC: Ineg>>> dynamic PSx	DTOC: tIneg> PSx	DTOC: tIneg>> PSx	DTOC: tIneg>>> PSx
set 1	072 013	076 202	072 023	072 024	072 025
set 2	073 013	077 202	073 023	073 024	073 025
set 3	074 013	078 202	074 023	074 024	074 025
set 4	075 013	079 202	075 023	075 024	075 025

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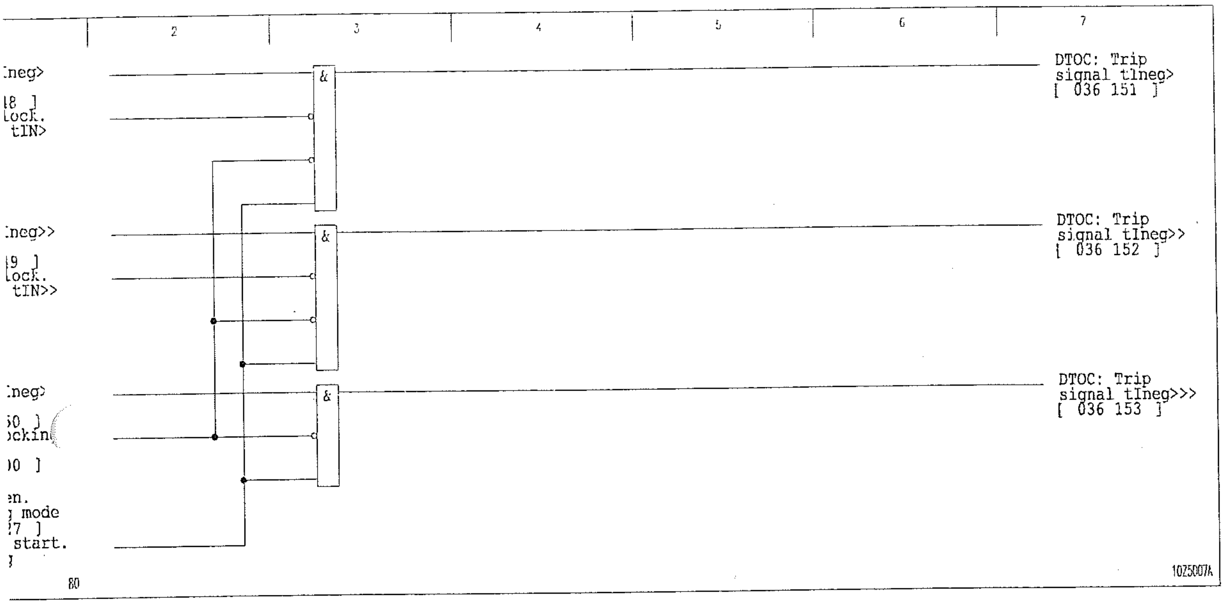
3-86 Negative-sequence current stages



ignals of the DTOC negative-sequence current stages

Enabling or disabling the residual current systems of DTOC protection

The residual current systems of DTOC protection can be disabled or enabled from the local control panel or via binary signal inputs.

Residual current stages

The residual current is monitored with three-stage functions to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" thresholds are active when no hold time is running. If the residual current exceeds the set thresholds, timer stages are started. Once these stages have elapsed, a signal is issued.

The timer stages may be blocked via appropriately configured binary signal inputs. Furthermore, the timer stages can – depending on the setting - be blocked automatically for single-pole or multi-pole startings.

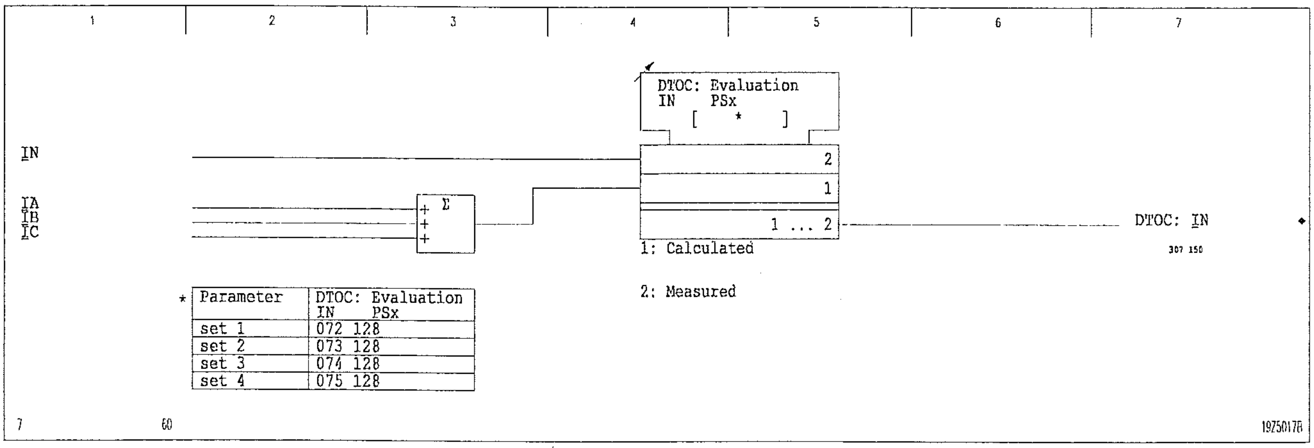
The trip signals of the residual current stages are not enabled unless the operating mode of the general starting is set to *With start. IN, Ineg.*

The trip signals of all residual current stages are be blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

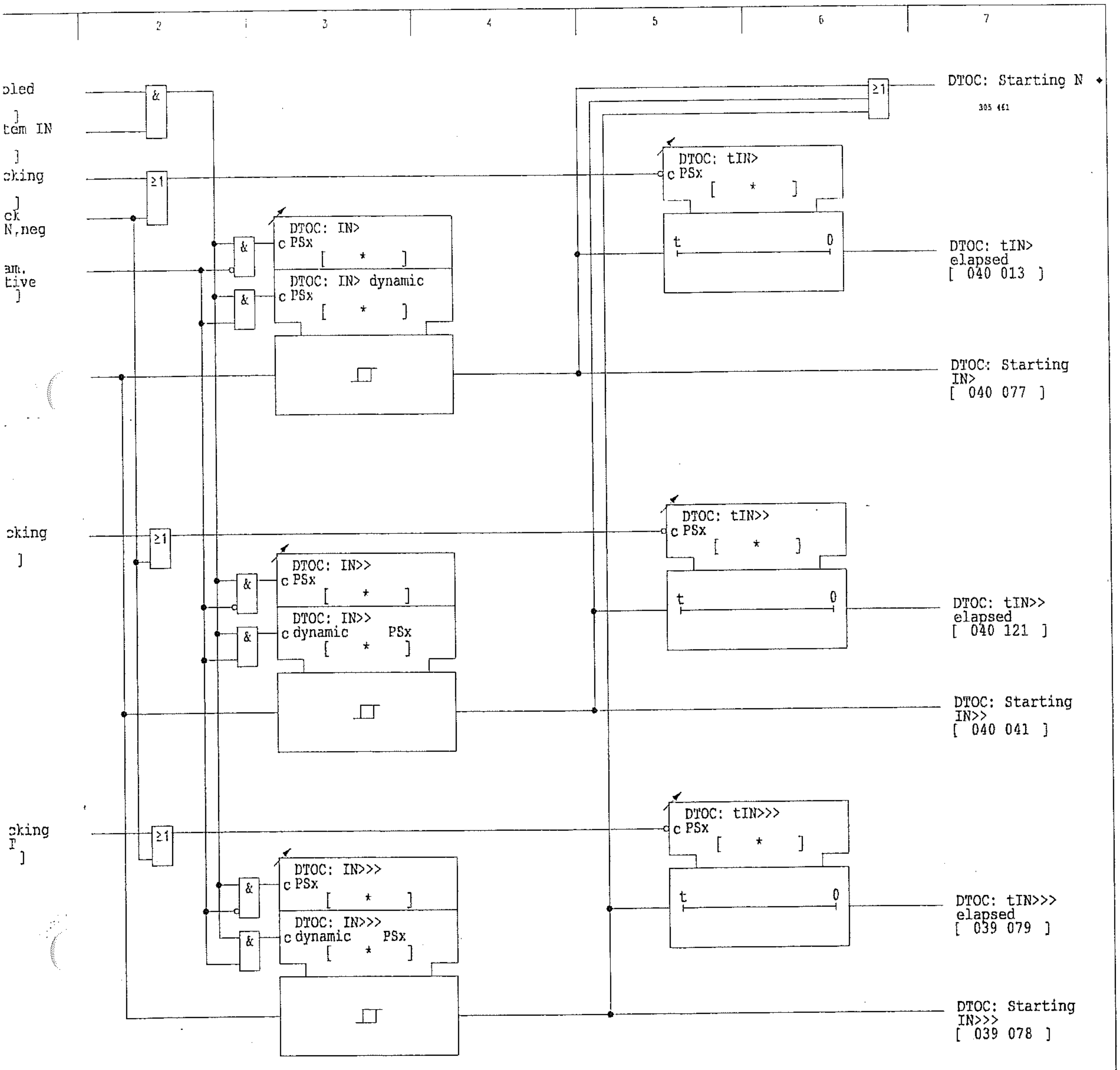
The trip signals of the DTOC function can be blocked by the short-circuit direction determination function (stages IN> and IN>> only). Depending on the settings for the short-circuit direction determination function, the trip signal of stages IN> or IN>> may be enabled.

Selecting the measured variable

A setting specifies which current will be used by the P130C as the residual current: either the residual current calculated from the three phase currents or the residual current measured at the fourth transformer.



3-88 *Selecting the measured variable*



* Parameter	DTOC: IN> PSx	DTOC: IN> dynamic PSx	DTOC: IN>> PSx	DTOC: IN>> dynamic PSx
set 1	017 003	017 081	017 009	017 086
set 2	073 015	073 035	073 016	073 036
set 3	074 015	074 035	074 016	074 036
set 4	075 015	075 035	075 016	075 036

* Parameter	DTOC: IN>>> PSx	DTOC: IN>>> dynamic PSx	DTOC: tIN> PSx	DTOC: tIN>> PSx	DTOC: tIN>>> PSx
set 1	017 018	017 087	017 008	017 010	170 019
set 2	073 017	073 037	073 027	073 028	073 029
set 3	074 017	074 037	074 027	074 028	074 029
set 4	075 017	075 037	075 027	075 028	075 029

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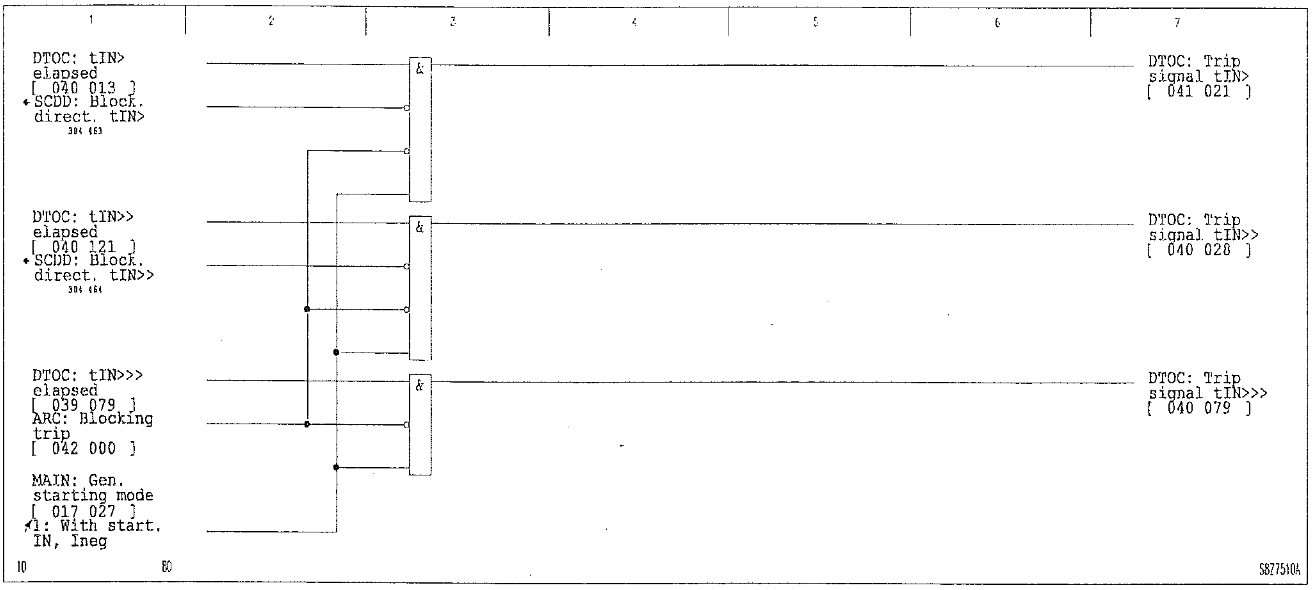
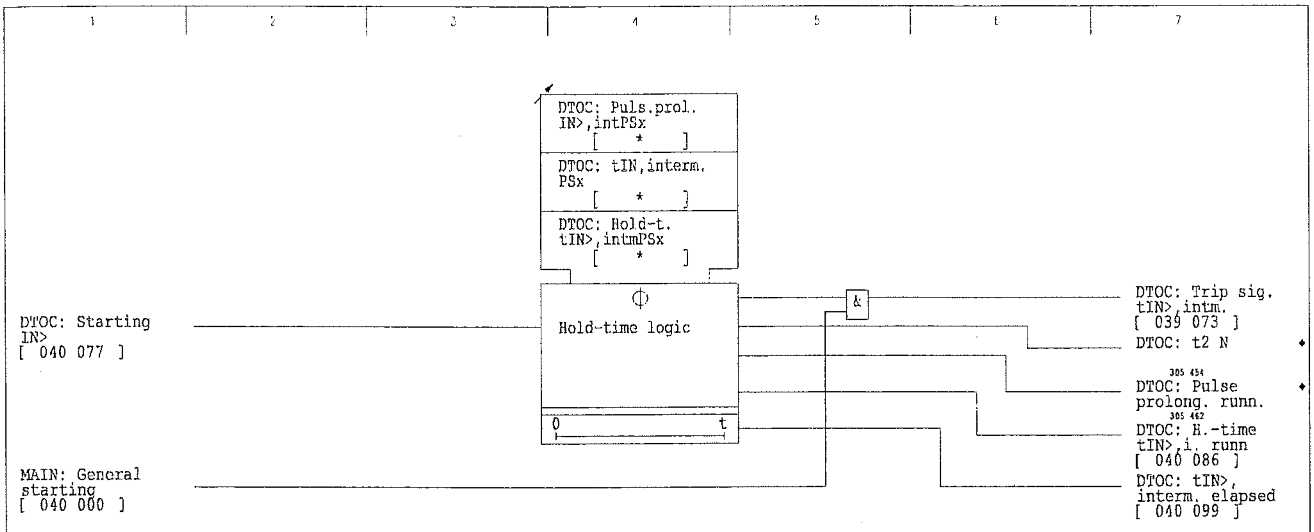


3-90 *Trip signals of the DTOC residual current stages* *logic for the of intermittent ults*

A hold-time logic for the treatment of intermittent ground faults is implemented in the P130C.

- As the I_N> starting in the residual current stage starts, the hold time is reset. At the same time, the starting time is accumulated at the onset of I_N> starting.
- As I_E> starting ends, the timer stage DTOC: Puls.prol.IN>,intPSx is started and the charging of the accumulation buffer is thereby prolonged by the set value of the timer stage.
- The accumulation result is compared with the settable limit value DTOC: tIN>, interm. PSx.
- If the limit value is reached and a general starting is present, then a trip results, provided that it is permitted by the relevant global settings.
  - MAIN: Block tim.st. IN,neg (address 017 015)
  - MAIN: Gen. starting mode (address 017 027)
  - MAIN: Fct.assig.trip cmd.1 (address 021 001)
  - MAIN: Fct.assig.trip cmd.2 (address 021 002)
- If the limit value is reached while the timer stage DTOC: Puls.prol.IN>,intPSx is running, then a trip will occur at the onset of the next general starting phase.
- With each release of the trigger stage I_N>, the set hold-time DTOC: Hold-t. tIN>,intmPSx is restarted. When the hold time elapses or after the hold-time logic has issued a trip (DTOC: Trip sig. tIE>,intm.), accumulation is stopped and the accumulation buffer is cleared.



* Parameter	DTOC: Puls.prol. IN>,intPSx	DTOC: tIN,interm. PSx	DTOC: Hold-t. tIN>,intmPSx
set 1	017 055	017 056	017 057
set 2	073 042	073 038	073 039
set 3	074 042	074 038	074 039
set 4	075 042	075 038	075 039

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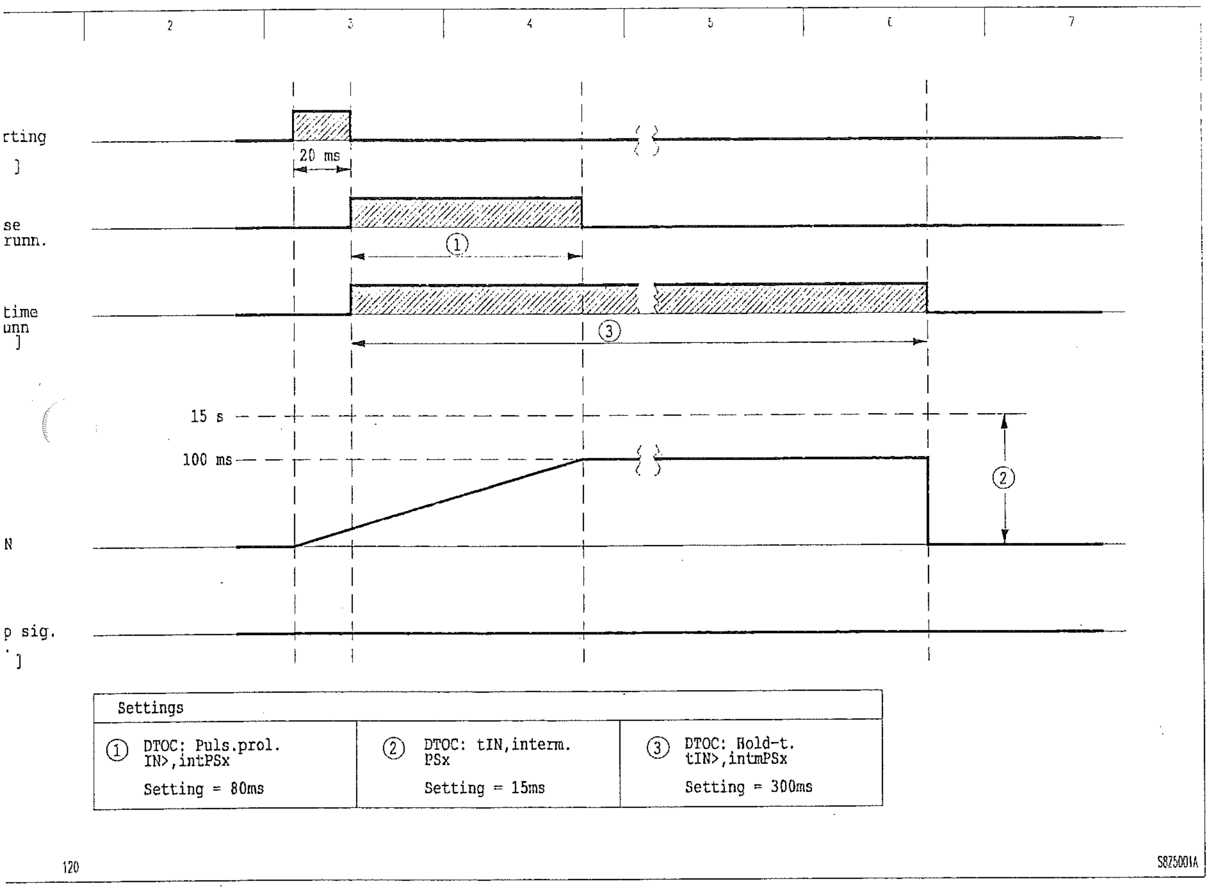
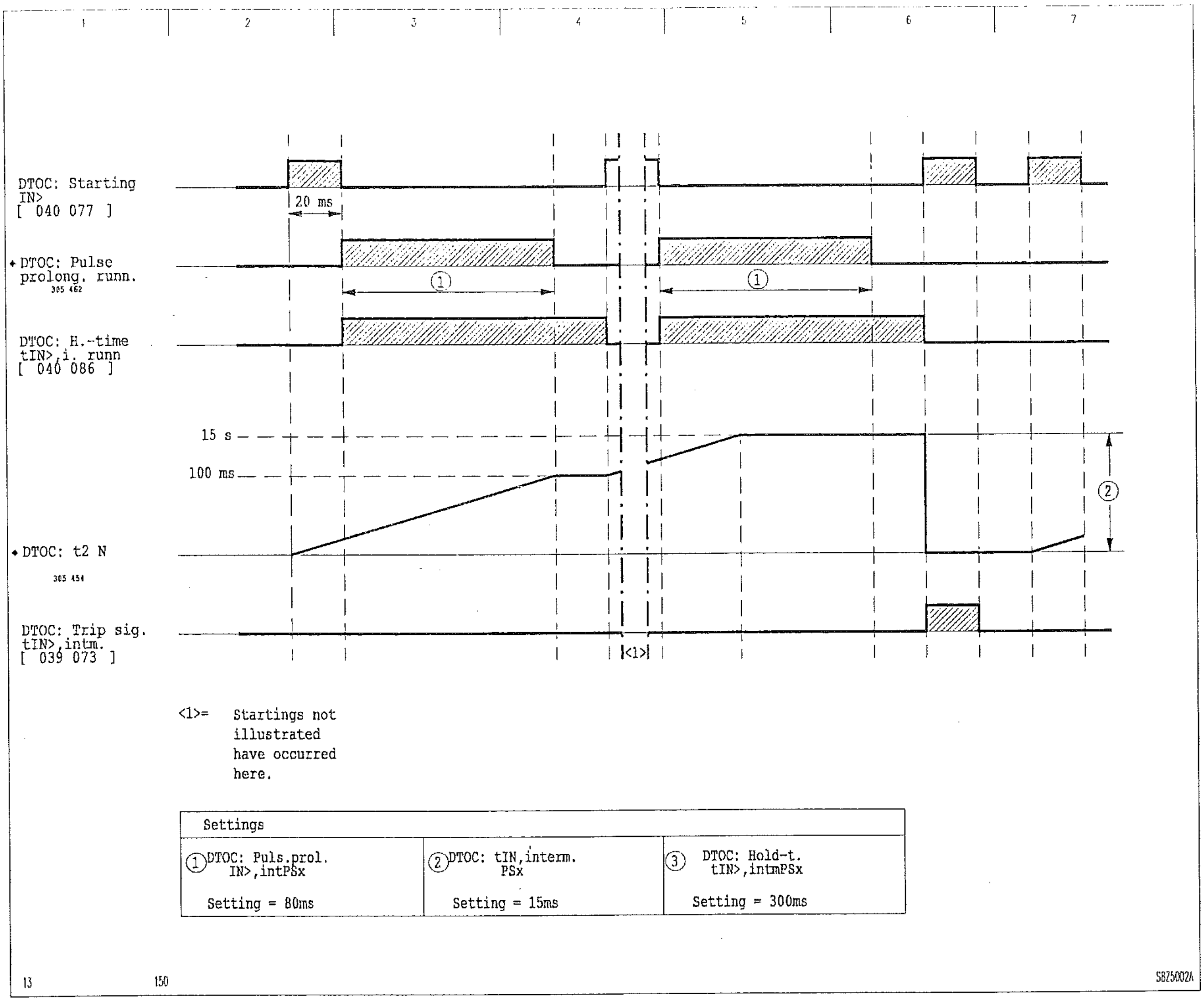
3-91 *Hold-time logic for definite-time characteristics*



Signal flow for values below the accumulation limit value



3-93 *Signal flow for values at the accumulation limit value*

3.22 Inverse-Time Overcurrent Protection (Function Group IDMT)

The inverse-time overcurrent protection (IDMT) function operates with three separate measuring systems:

- ☐ Phase currents
- ☐ Negative-sequence current
- ☐ Residual current

Either the short-circuit direction determination function or the auto-reclosing control may intervene in the functional sequence of the IDMT function.

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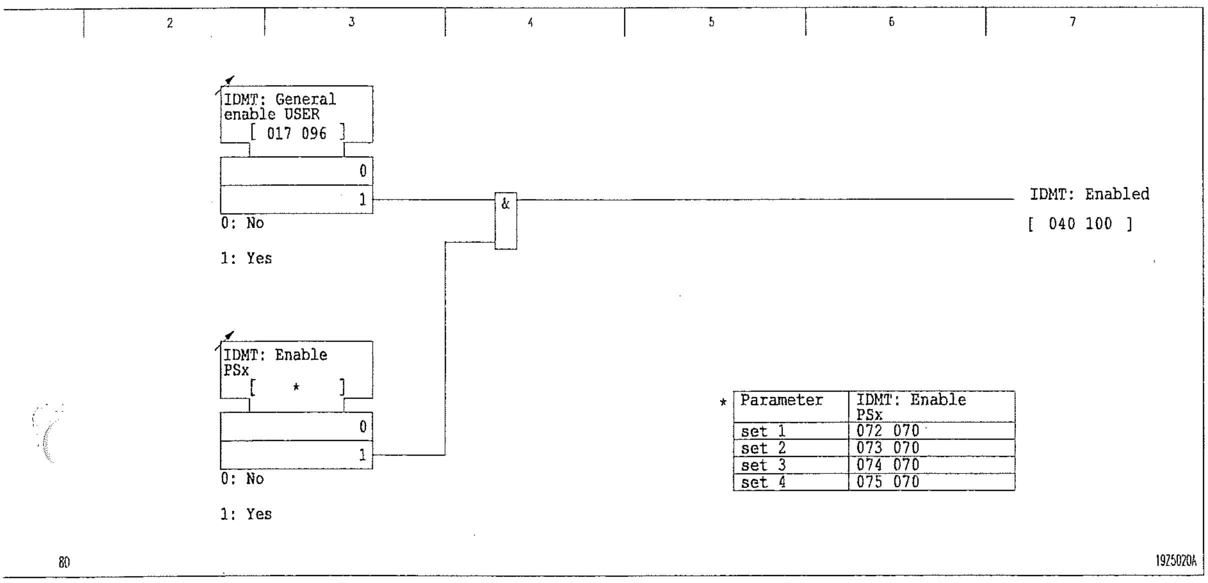
IDMT protection can be disabled or enabled from the integrated local control panel. Moreover, enabling can be carried out separately for each parameter set.



isabling or enabling IDMT protection

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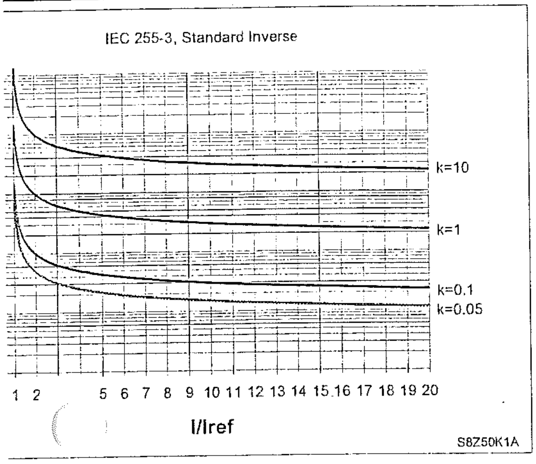
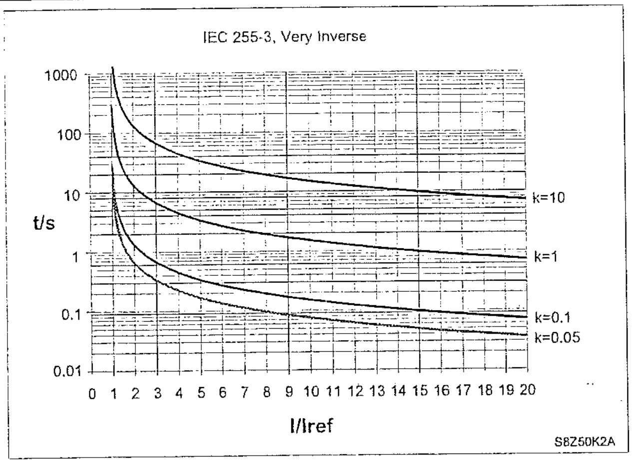
The measuring systems for the evaluation of the three phase currents, the negative-sequence current system and the residual current operate independently and can be set separately. The user can select from a large number of characteristics (see table below). The measured variable is the maximum phase current, the negative-sequence current, or the residual current, depending on the measuring system. The tripping characteristics available for selection are shown in Figures 3-95 to 3-98 .

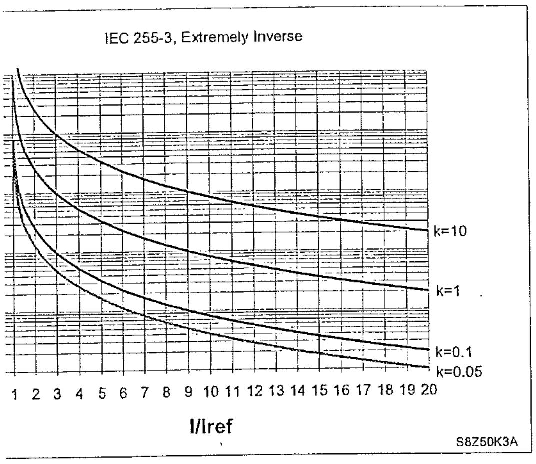
No.	Tripping Characteristic k = 0.01 to 10.00	Formula for the Tripping Characteristic	Constants a	b	c	Formula for the Release Characteristic	R
0	Definite Time	t = k					
	Per IEC 255-3	$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot \left(\frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1} + c\right)$				$t_r = k \cdot \frac{R}{\left(\frac{I}{I_{ref}}\right)^2 - 1}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4.85
6	Very Inverse		19.6100	2.0000	0.4910		21.60
7	Extremely Inverse		28.2000	2.0000	0.1217		29.10
	Per ANSI	$t = k \cdot \left(\frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1} + c\right)$				$t_r = k \cdot \frac{R}{\left(\frac{I}{I_{ref}}\right)^2 - 1}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9.00
9	Short Time Inverse		0.2663	1.2969	0.03393		0.50
10	Long Time Inverse		5.6143	1.0000	2.18592		15.75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$					
12	RXIDG-Type Inverse	$t = k \cdot \left(5.8 - 1.35 \cdot \ln \frac{I}{I_{ref}}\right)$					



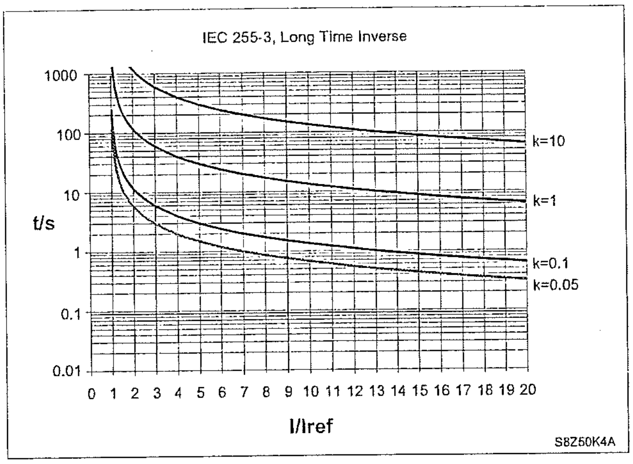
'ic No. 1



Characteristic No. 2

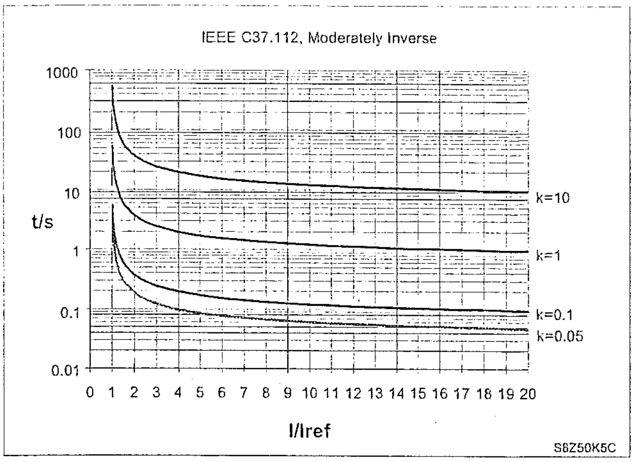


'ic N

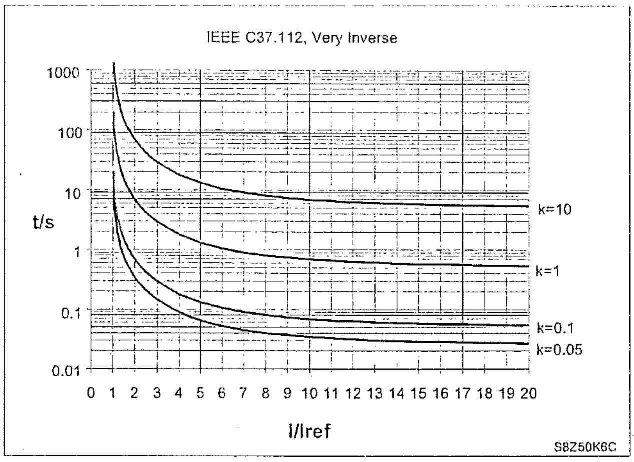


Characteristic No. 4

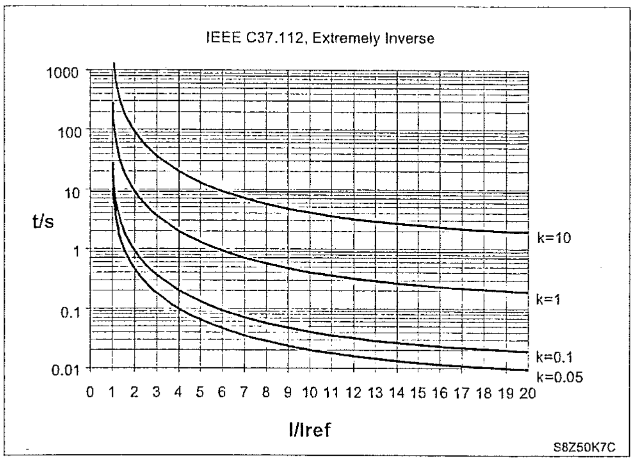
'ripping characteristics per IEC 255-3



Characteristic No. 5

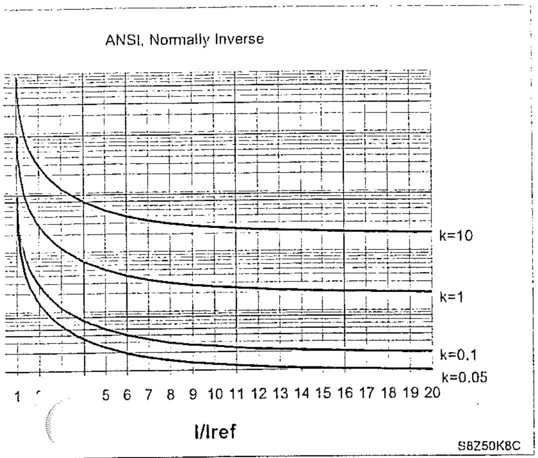


Characteristic No. 6

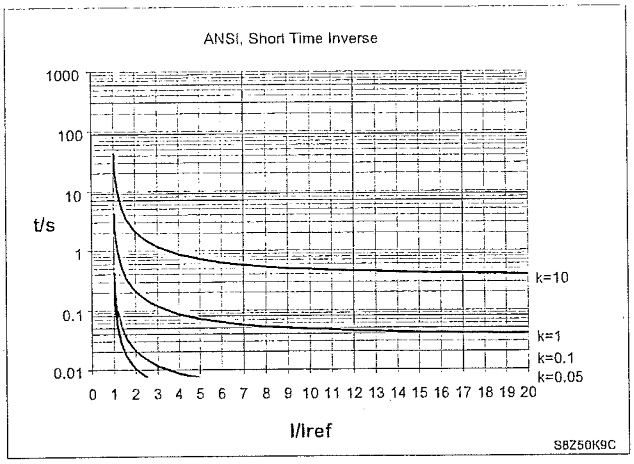


Characteristic No. 7

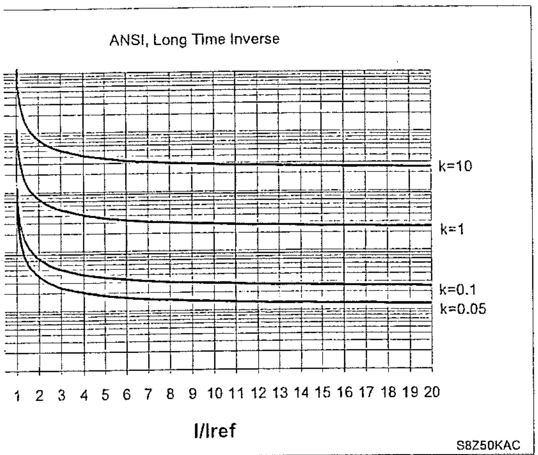
3-96 *Tripping characteristics per IEEE C37.112*



stic No. 8



Characteristic No. 9



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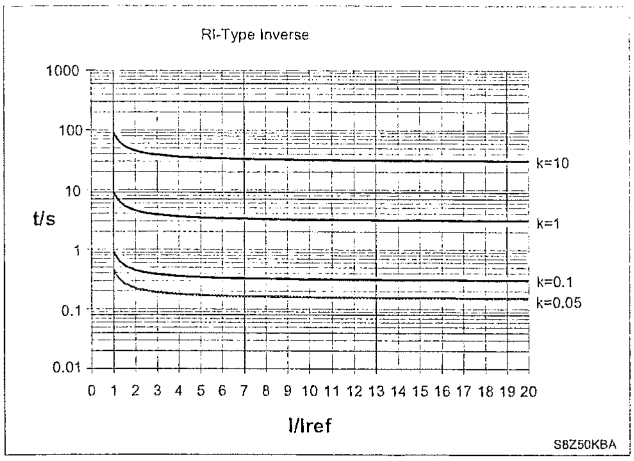
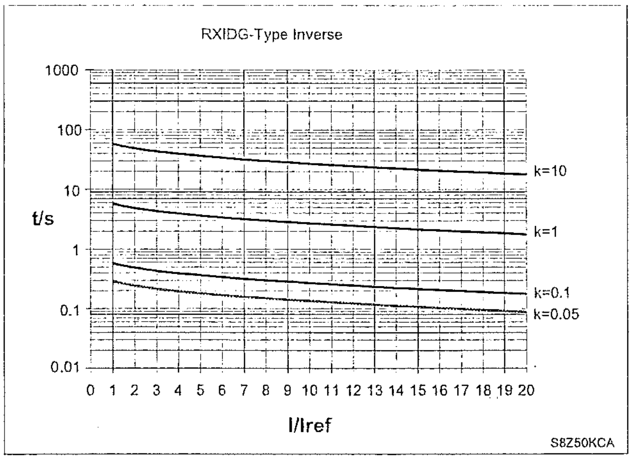
Tripping characteristics per ANSI





3-98 RI-type inverse and RXIDG-type inverse tripping characteristics *rent stage*

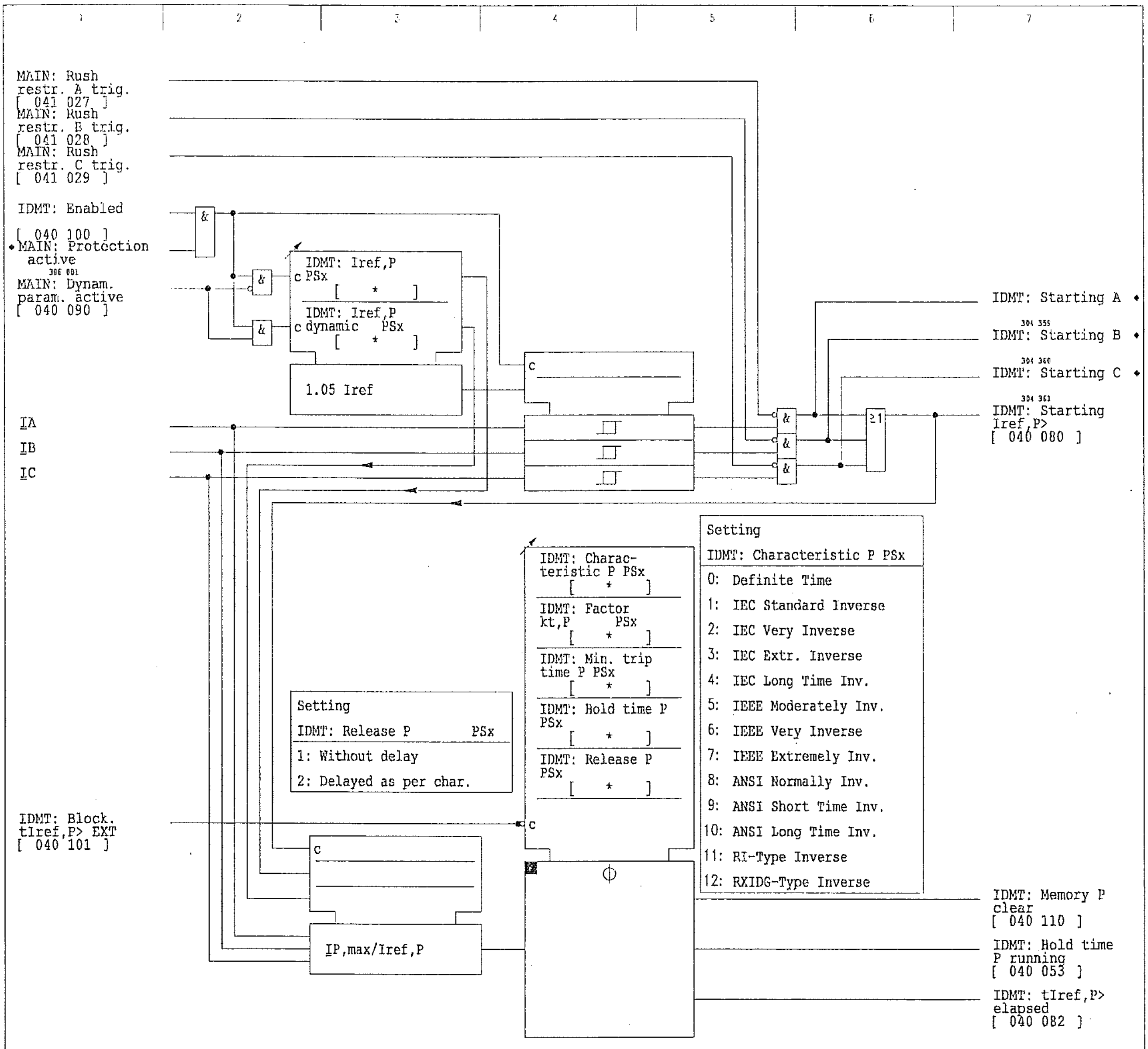
The three phase currents are monitored by the P130C to detect when they exceed the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" threshold is active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" threshold is active when no hold time is running. The IDMT protection function issues a starting signal if 1.05 times the set reference current is exceeded in one phase. The P130C determines the highest of the three phase currents for further processing. As a function of this current and of the set characteristic, the P130C will determine the tripping time. Furthermore, a minimum trip time can be set; the trip time will not fall below this minimum independent of the magnitude of the current.

When the inrush stabilization function (see: 'Main Functions of the P130C') is triggered, the phase current stage is blocked.

The inverse-time stage can be blocked by way of an appropriately configured binary signal input.

The trip signal of the IDMT protection function is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

The trip signal of the IDMT function can be blocked by the short-circuit direction determination function. Depending on the settings for the short-circuit direction determination function, the trip signal may be enabled.



*

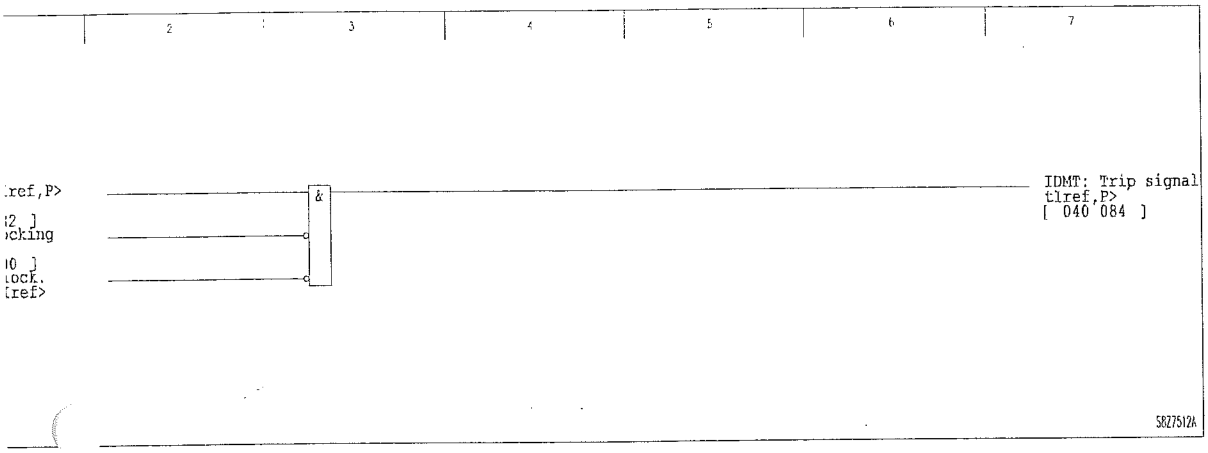
Parameter	IDMT: Iref,P PSx	IDMT: Iref,P dynamic PSx	IDMT: Charac- teristic P PSx	IDMT: Factor kt,P PSx
set 1	072 050	072 003	072 056	072 053
set 2	073 050	073 003	073 056	073 053
set 3	074 050	074 003	074 056	074 053
set 4	075 050	075 003	075 056	075 053

*

Parameter	IDMT: Min. trip time P PSx	IDMT: Hold time P PSx	IDMT: Release P PSx
set 1	072 077	072 071	072 059
set 2	073 077	073 071	073 059
set 3	074 077	074 071	074 059
set 4	075 077	075 071	075 059

2 220 10Z5008A

3-99 Phase current stage



Trip signal of the phase current stage

Negative-sequence current stage

The P130C determines the negative-sequence current – based on the set rotary field – according to the following formulas:

Clockwise rotating field:

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C \right) \right|$$

Anticlockwise rotating field:

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C \right) \right|$$

$$\underline{a} = e^{j120°}$$

$$\underline{a}^2 = e^{j240°}$$

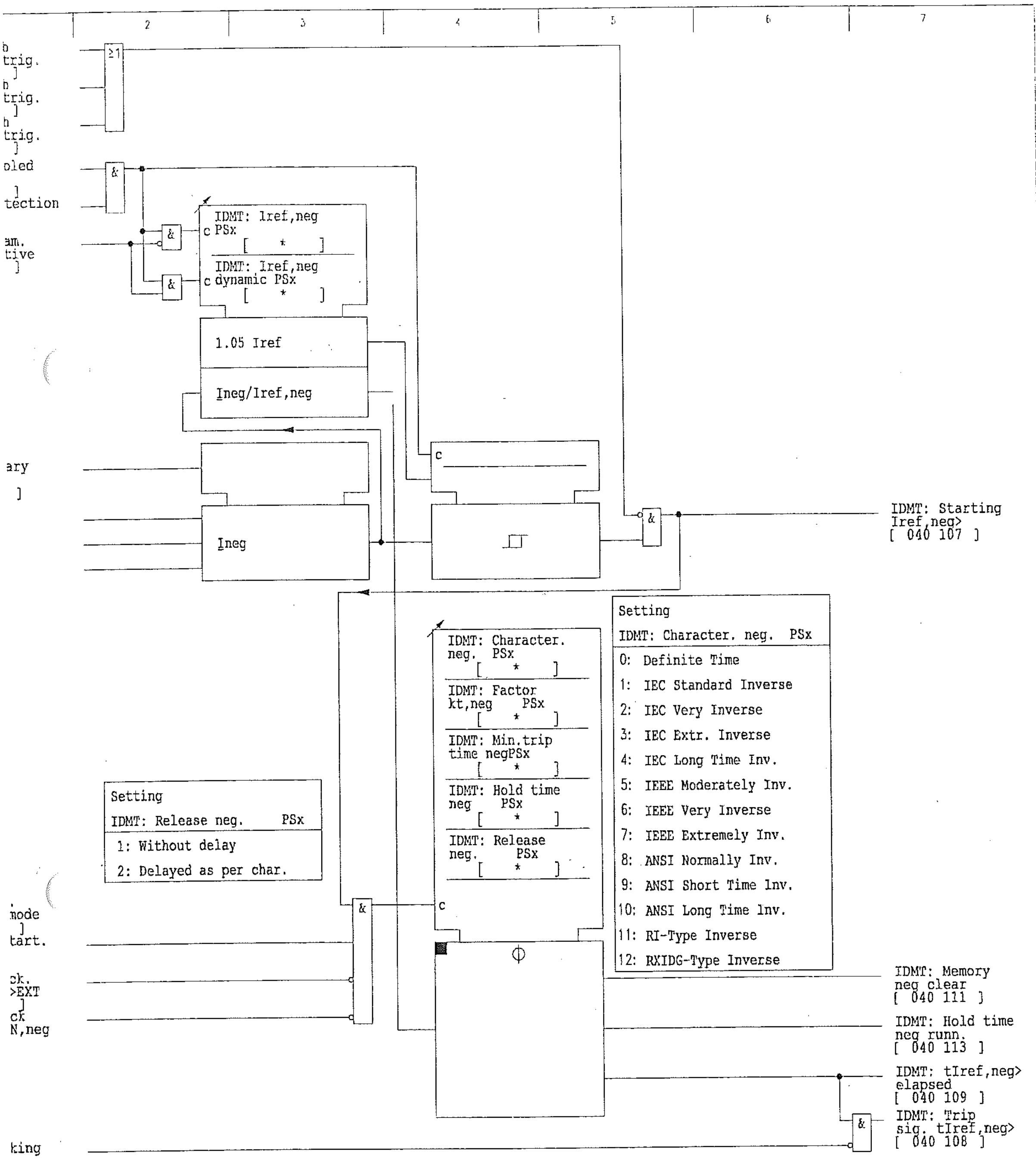
The negative-sequence current is monitored by the P130C to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" threshold is active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" threshold is active when no hold time is running. The IDMT protection function issues a starting signal if the negative-sequence current exceeds a value of 1.05 times the set reference current. As a function of the set characteristic and of the residual current, the P130C will determine the tripping time. Furthermore, a minimum trip time can be set; the trip time will not fall below this minimum independent of the magnitude of the negative-sequence current.

When the inrush stabilization function (see: 'Main Functions of the P130C') is triggered, the negative-sequence current stage is blocked.

The inverse-time stage can be blocked by way of an appropriately configured binary signal input. Furthermore, the inverse-time stage can – depending on the setting - be blocked automatically for single-pole or multi-pole startings.

If short-circuit direction determination is enabled, then the trip signal issued by the IDMT negative-sequence current stage is always non-directional.

The trip signals of the negative-sequence current stage are blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.



* Parameter	IDMT: Iref,neg PSx	IDMT: Iref,neg dynamic PSx	IDMT: Character. neg. PSx	IDMT: Factor kt,neg PSx
set 1	072 051	072 004	072 057	072 054
set 2	073 051	073 004	073 057	073 054
set 3	074 051	074 004	074 057	074 054
set 4	075 051	075 004	075 057	075 054

* Parameter	IDMT: Min.trip time negPSx	IDMT: Hold time neg PSx	IDMT: Release neg. PSx
set 1	072 078	072 072	072 060
set 2	073 078	073 072	073 060
set 3	074 078	074 072	074 060
set 4	075 078	075 072	075 060

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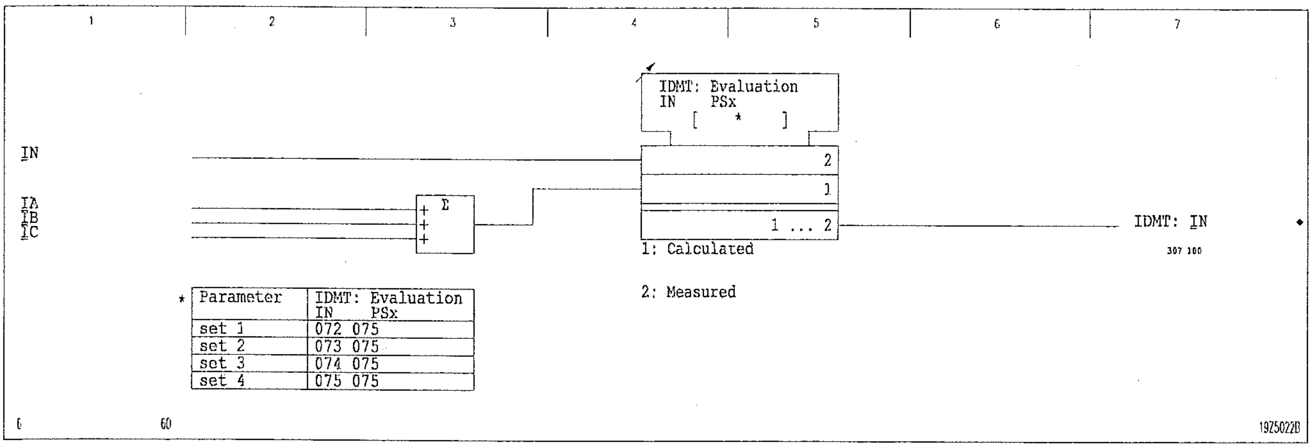
Negat... equence current stage

Selection of measured variables for the residual current stage

A setting specifies which current will be used by the P130C as the residual current: either the residual current calculated from the three phase currents or the residual current measured at the fourth transformer.



3-102 *Selecting the measured variable*

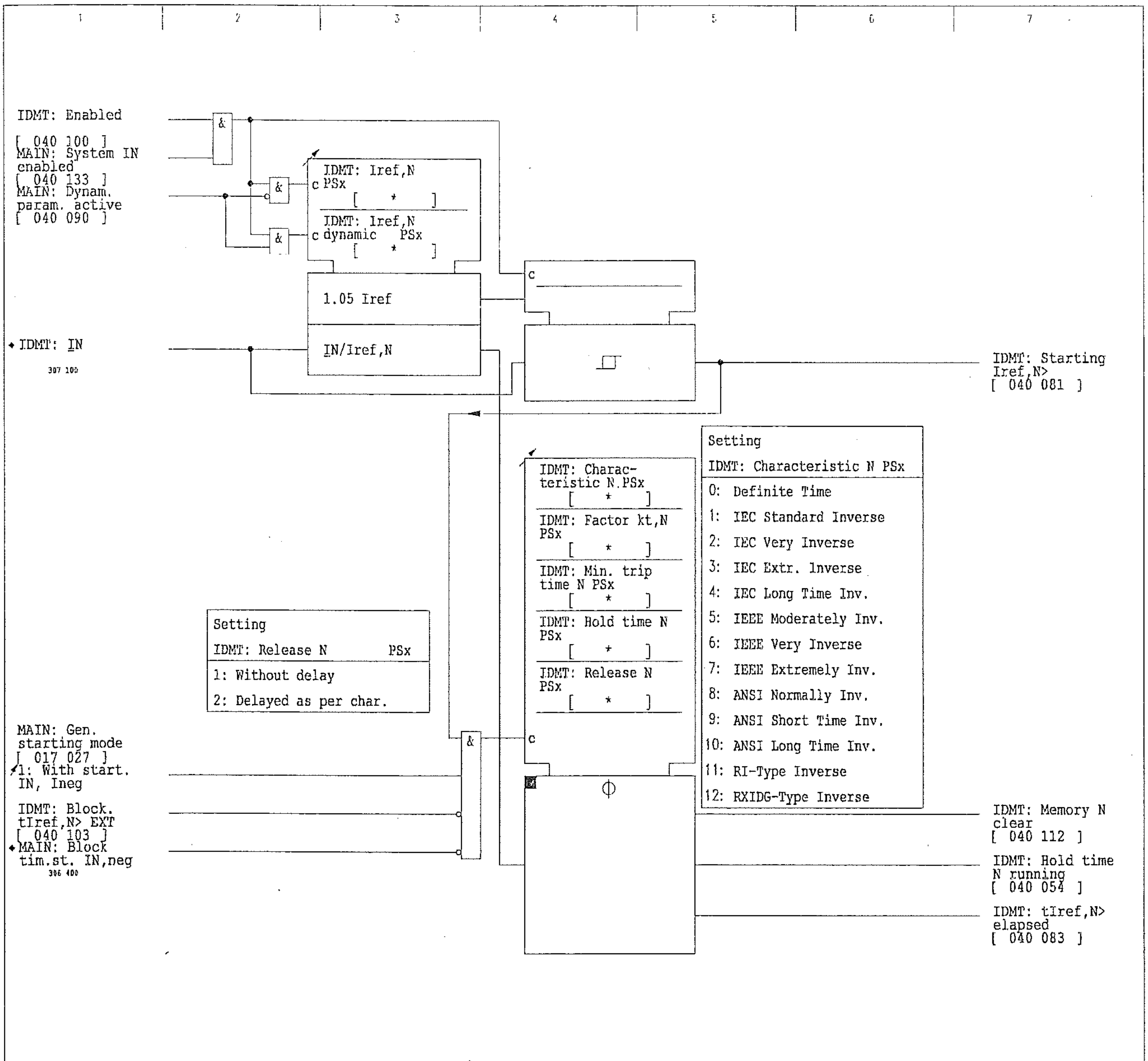
current stage

The residual current is monitored by the P130C to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" threshold is active for the set hold time of the "dynamic parameters" (see "Activation of Dynamic Parameters"); the "normal" threshold is active when no hold time is running. The IDMT protection function issues a starting signal if the residual current exceeds a value of 1.05 times the set reference current. As a function of the set characteristic and of the residual current, the P130C will determine the tripping time. Furthermore, a minimum trip time can be set; the trip time will not fall below this minimum independent of the magnitude of the residual current.

The inverse-time stage can be blocked by way of an appropriately configured binary signal input. Furthermore, the inverse-time stage can – depending on the setting - be blocked automatically for single-pole or multi-pole startings.

The trip signal of the IDMT protection function is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

The trip signal of the IDMT function can be blocked by the short-circuit direction determination function. Depending on the settings for the short-circuit direction determination function, the trip signal may be enabled.



Parameter	IDMT: Iref,N PSx	IDMT: Iref,N dynamic PSx	IDMT: Charac-teristic N PSx	IDMT: Factor kt,N PSx
set 1	072 052	072 005	072 058	072 055
set 2	073 052	073 005	073 058	073 055
set 3	074 052	074 005	074 058	074 055
set 4	075 052	075 005	075 058	075 055

Parameter	IDMT: Min. trip time N PSx	IDMT: Hold time N PSx	IDMT: Release N PSx
set 1	072 079	072 073	072 061
set 2	073 079	073 073	073 061
set 3	074 079	074 073	074 061
set 4	075 079	075 073	075 061

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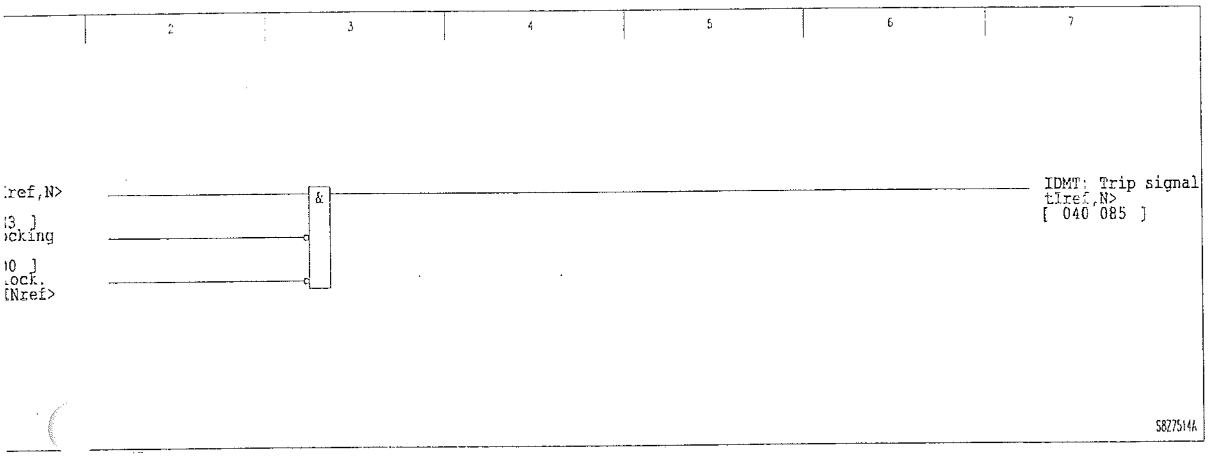
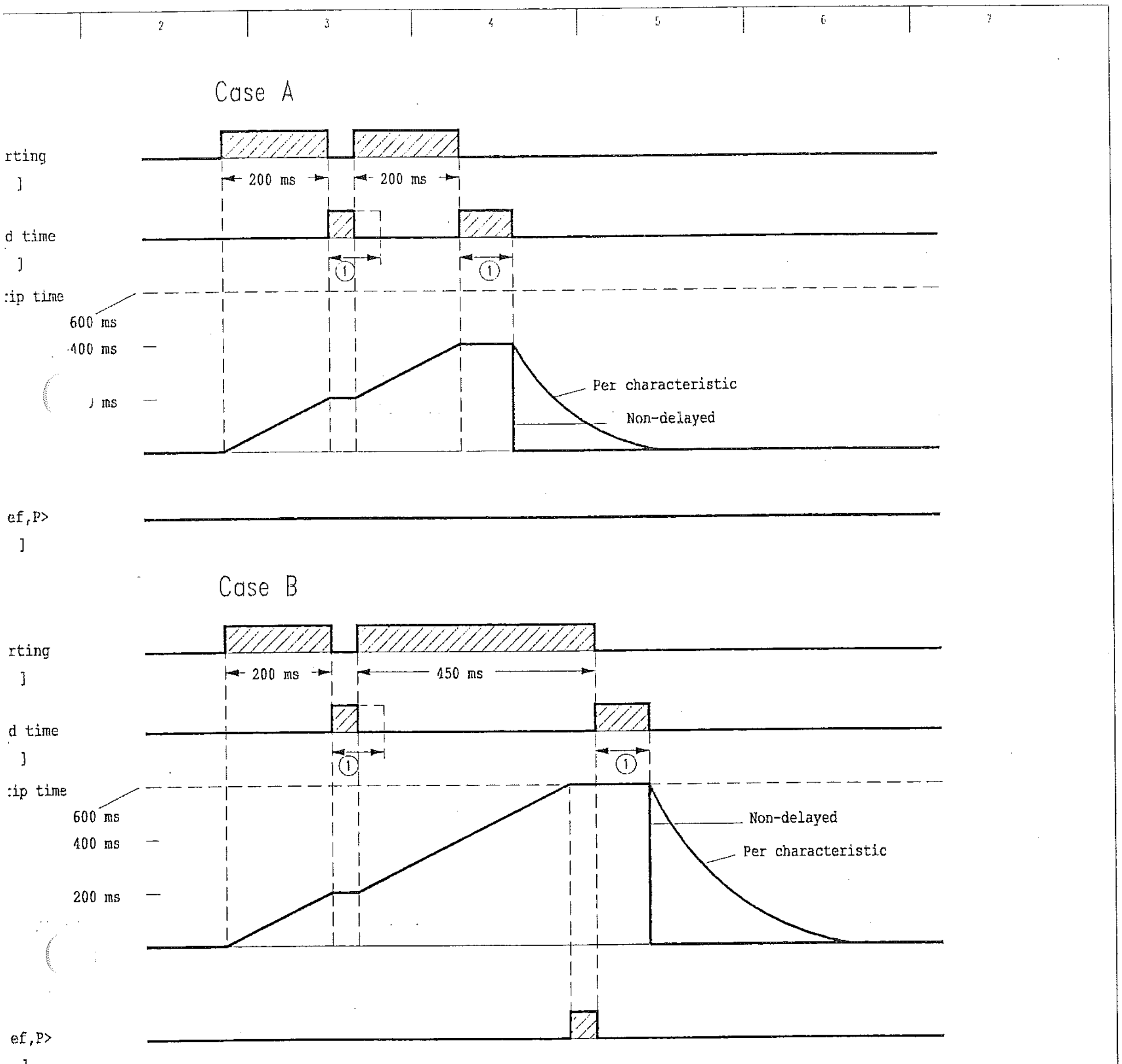
3-103 Residual current stage



Trip signal of the residual current stage

Holding time

As a function of the current, the P130C will determine the tripping time and start a timer stage. The setting for the holding time defines the period for the elapsed IDMT starting time to be stored after the starting has dropped out. If the starting time returns while the hold time elapses, the new starting time is added to the stored time. If the sum of the starting times reaches the tripping time determined by the P130C then the appropriate message is issued. If the starting time does not return while the hold time elapses then the memory storing the sum of the starting times will – in accordance with the setting - be cleared either without delay or according to the set characteristic. The phase current stage serves as an example to illustrate the effect of the holding time in Figure 3-105.



* Parameter	① IDMT: Hold time P PSx
set 1	072 071
set 2	073 071
set 3	074 071
set 4	075 071

'he effect of the holding time illustrated for the phase current stage as an example
;ase A: The determined tripping time is not reached.
;ase B: The determined tripping time is reached

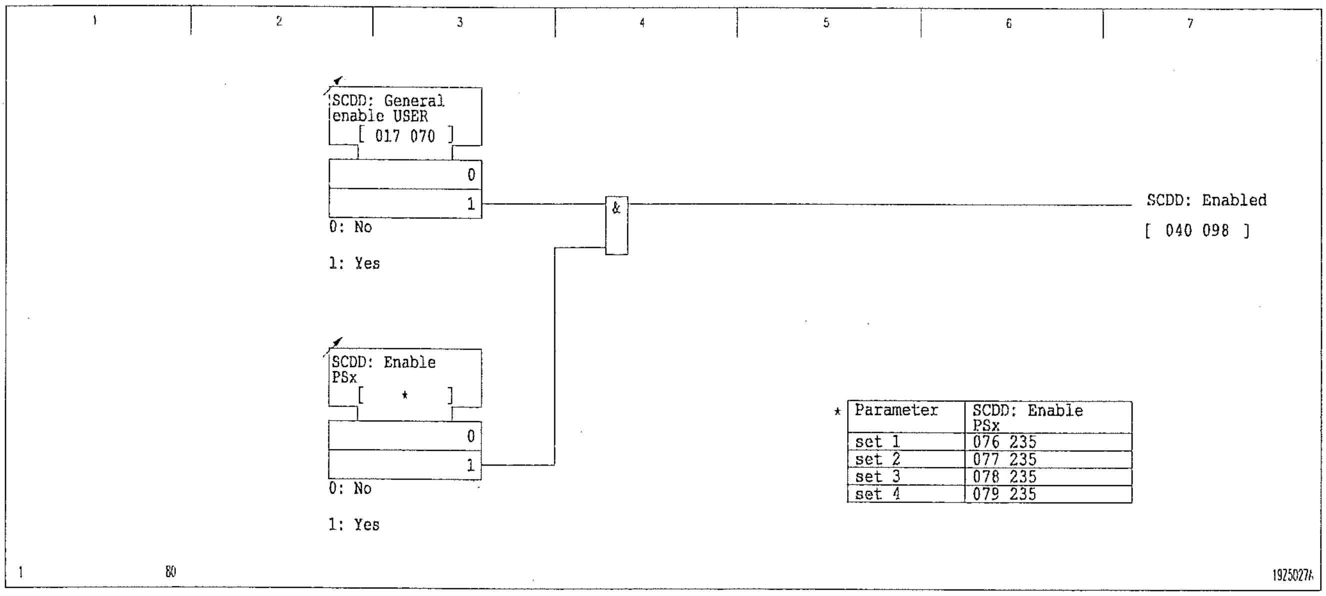
3.23 Short-Circuit Direction Determination (Function Group SCDD)

A short-circuit direction determination function (SCDD) has been implemented in the P130C. Thus the P130C can be used as a directional definite-time overcurrent protection device and also as a directional inverse-time overcurrent protection device. Two separate measuring systems are available for this purpose:

- Phase currents system
- Residual currents system

Disabling and enabling short-circuit direction determination

Short-circuit direction determination can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.



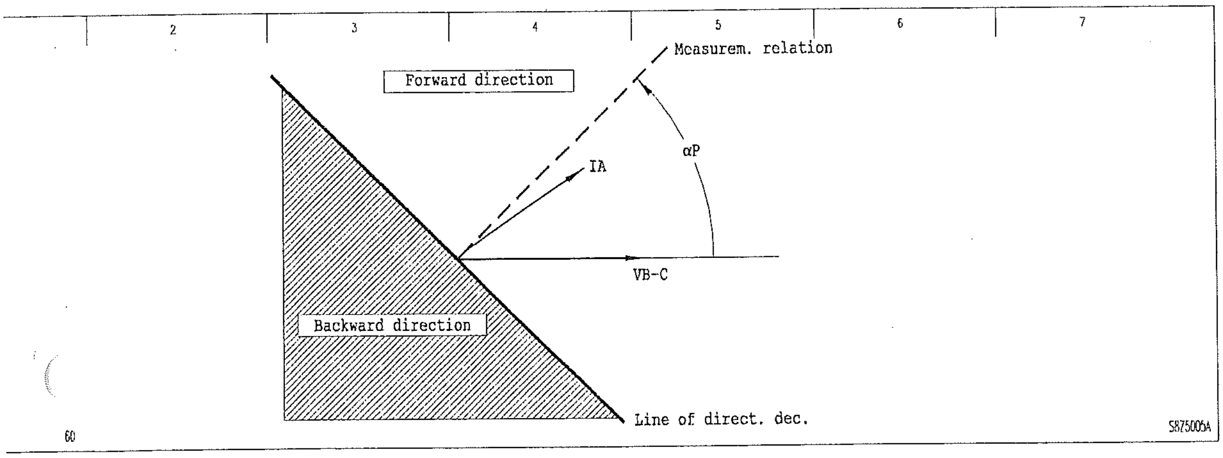
3-106 Disabling and enabling short-circuit direction determination *rent stages*

For direction determination of phase current stages, a phase current and the phase-to-phase voltage opposite this current are selected as a function of fault type, and an optimum characteristic angle is used.

For a single-pole fault in A-G, for example, the current A and the voltage $V_{B\text{-}C}$ are selected as measured variables, and a characteristic angle α_P of +45° is used (see Figure 3-107).

The reference quantity is the vector of the selected phase-to-phase voltage. The characteristic angle α_P specifies the measurement relation to the reference quantity. Different characteristic angles corresponding to fault type are specified by the P130C. The measuring position is defined as the bisector of the 'forward' direction zone. The forward direction applies if the vector of the selected phase current is in the range ≤ ± 90° of the measurement relation.

The backward direction applies if the vector of the selected phase current is in the range > ± 90° of the measurement relation.



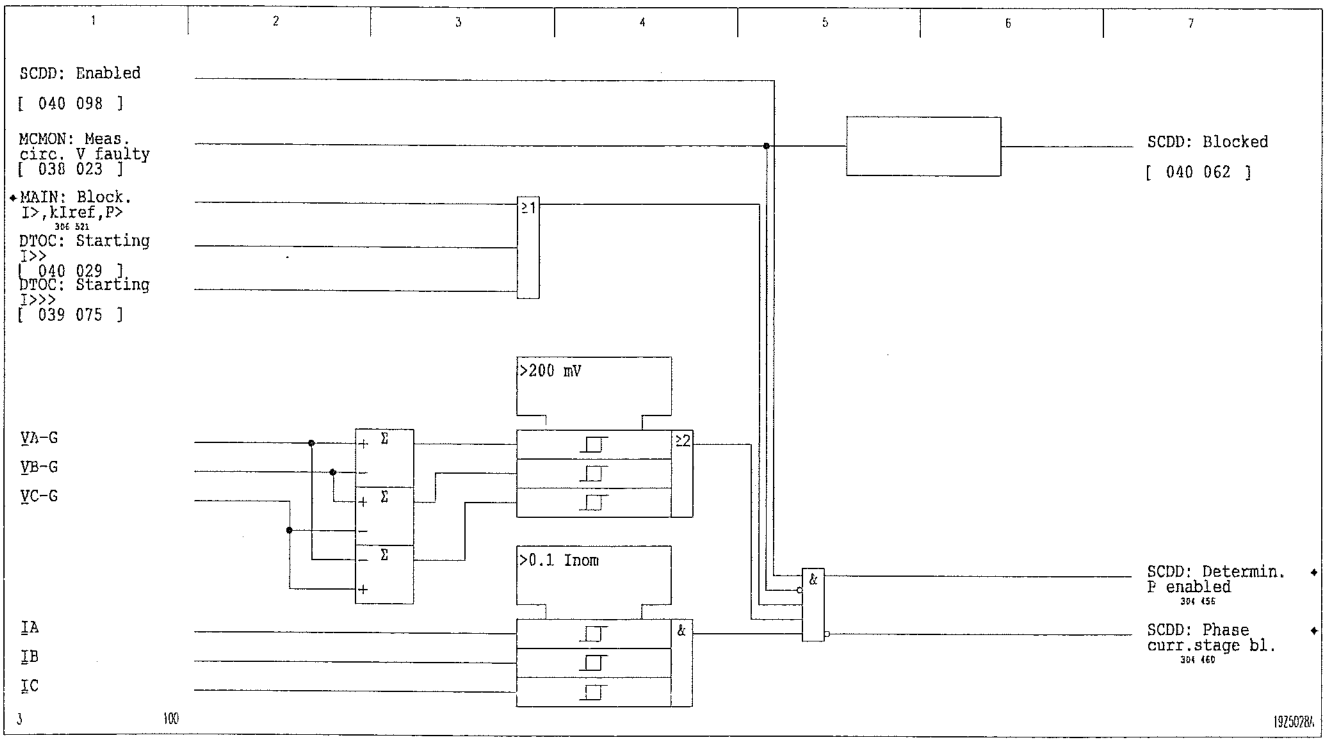
Example of formation of phase current stage direction decision with a single-pole fault in A-G, an inductive system, and a clockwise rotary field

Enabling the phase current stages

The direction determination function of the phase current stages is enabled if the following conditions are satisfied simultaneously:

- ☐ The short-circuit direction determination function is enabled.
- ☐ The measuring-circuit monitoring function has not identified any errors in the voltage measuring circuit (see Measuring-Circuit Monitoring).
- ☐ A phase starting signal is present.
- ☐ At least two phase-to-phase voltages are greater than 200 mV.
- ☐ All three phase currents are greater than 0.1 I_{nom}.
- ☐ There is no external signal MAIN: M.c.b. trip V EXT.

If there is no enable for direction determination, then the following internal signal is generated: SCDD: Phase curr. stage bl.

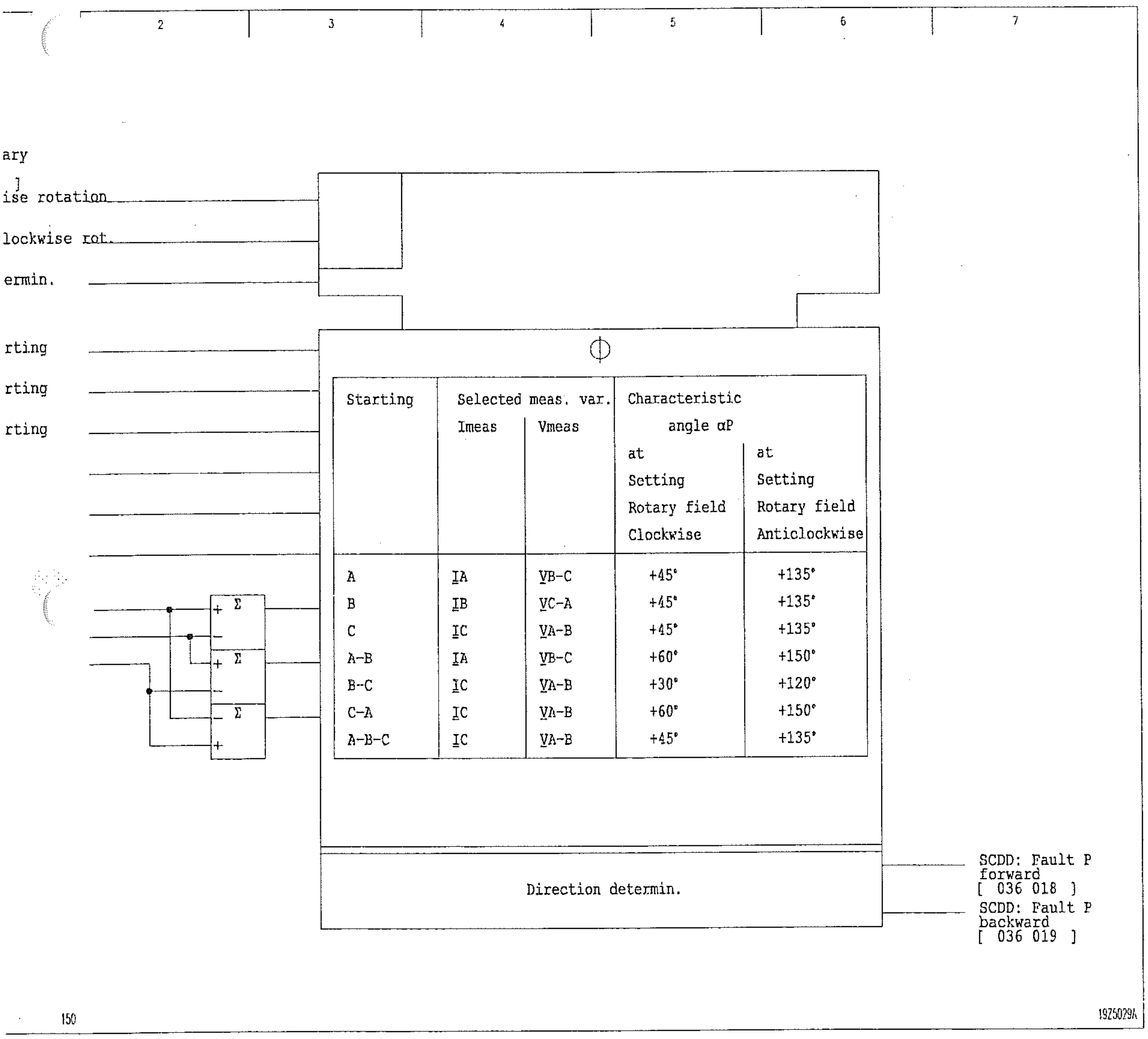


3-108 *Enable for the direction determination function of the phase current stages*

After direction determination is enabled, one of the following two signals is generated, depending on the measurement decision:

- ☐ In the case of a fault in the forward direction, SCDD: Fault P forward.
- ☐ In the case of a fault in the backward direction, SCDD: Fault P backward.

To control transient competition problems, the release of a direction decision in both directions is delayed by 30 ms.



Starting	Selected meas. var. Imeas	Vmeas	Characteristic angle αP at Setting Rotary field Clockwise	at Setting Rotary field Anticlockwise
A	IA	VB-C	+45°	+135°
B	IB	VC-A	+45°	+135°
C	IC	VA-B	+45°	+135°
A-B	IA	VB-C	+60°	+150°
B-C	IC	VA-B	+30°	+120°
C-A	IC	VA-B	+60°	+150°
A-B-C	IC	VA-B	+45°	+135°

Direction determination of the phase current stages

Formation of the blocking signal for the phase current stages

For the formation of the blocking signal for the two DTOC phase current stages and the single IDMT phase current stage, the fault direction for evaluating the measurement decision can be separately set, once the user has selected *forward*, *backward* or *non-directional*.

A blocking signal for the first DTOC phase current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{I>}$ is set on forward, and the short-circuit direction determination function identifies a fault in the backward direction.
- ☐ The direction for $t_{I>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

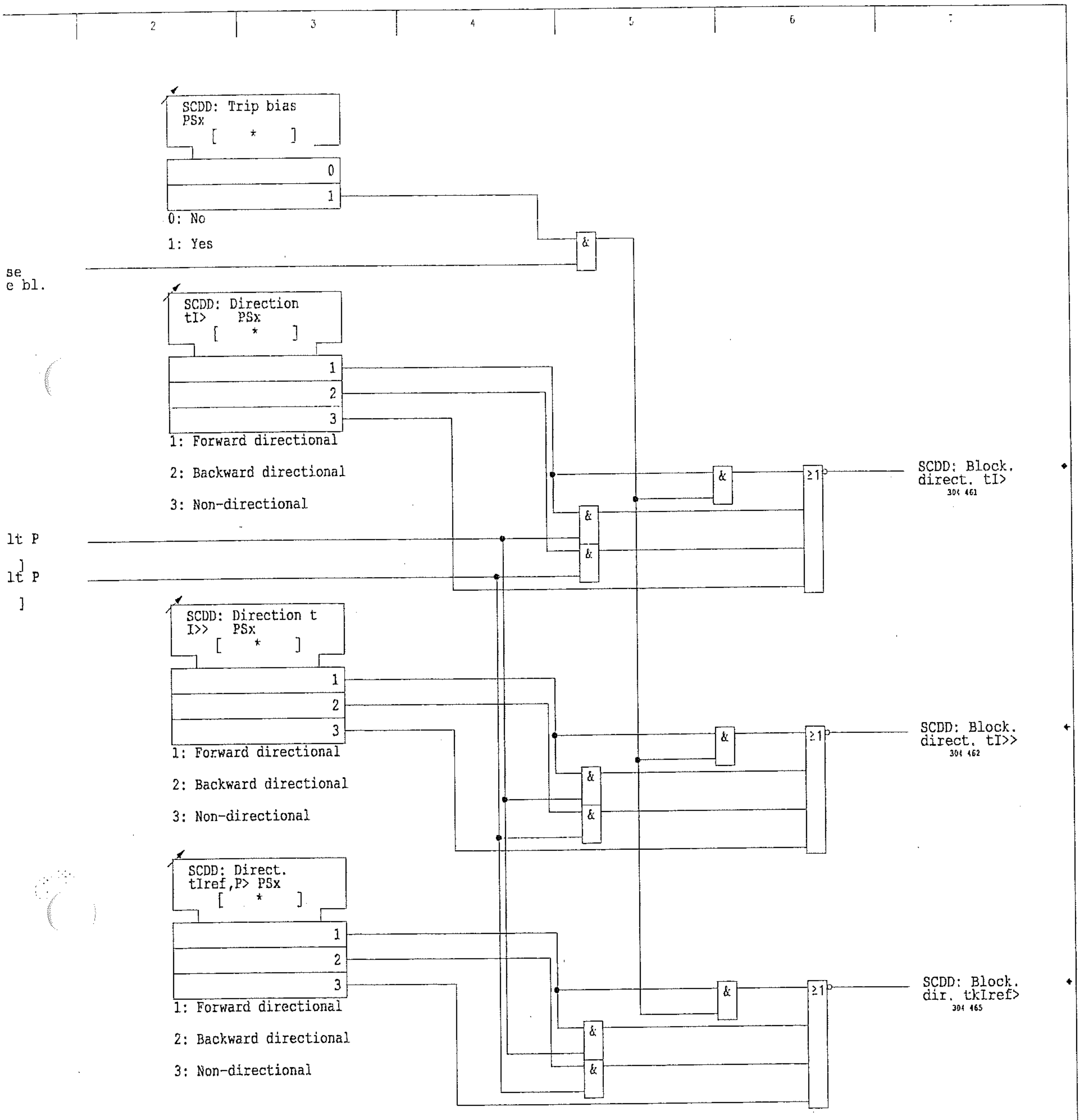
A blocking signal for the second DTOC phase current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{I>}$ is set on forward, and the short-circuit direction determination function identifies a fault in the backward direction.
- ☐ The direction for $t_{I>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

A blocking signal for the IDMT phase current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{Iref,P>}$ is set on forward, and the short-circuit direction determination function identifies a fault in the backward direction.
- ☐ The direction for $t_{Iref,P>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

If there is no enable for direction determination (in the case of m.c.b. trip, for example), the user may specify at `SCDD: Trip bias PSx` whether stages set to *forward* shall be operated with trip bias.



* Parameter	SCDD: Trip bias PSx	SCDD: Direction tI> PSx	SCDD: Direction t I>> PSx	SCDD: Direct. tIref,P> PSx
set 1	017 074	017 071	017 072	017 066
set 2	077 236	077 237	077 238	077 233
set 3	078 236	078 237	078 238	078 233
set 4	079 236	079 237	079 238	079 233

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ormation of the blocking signals for the phase current stage

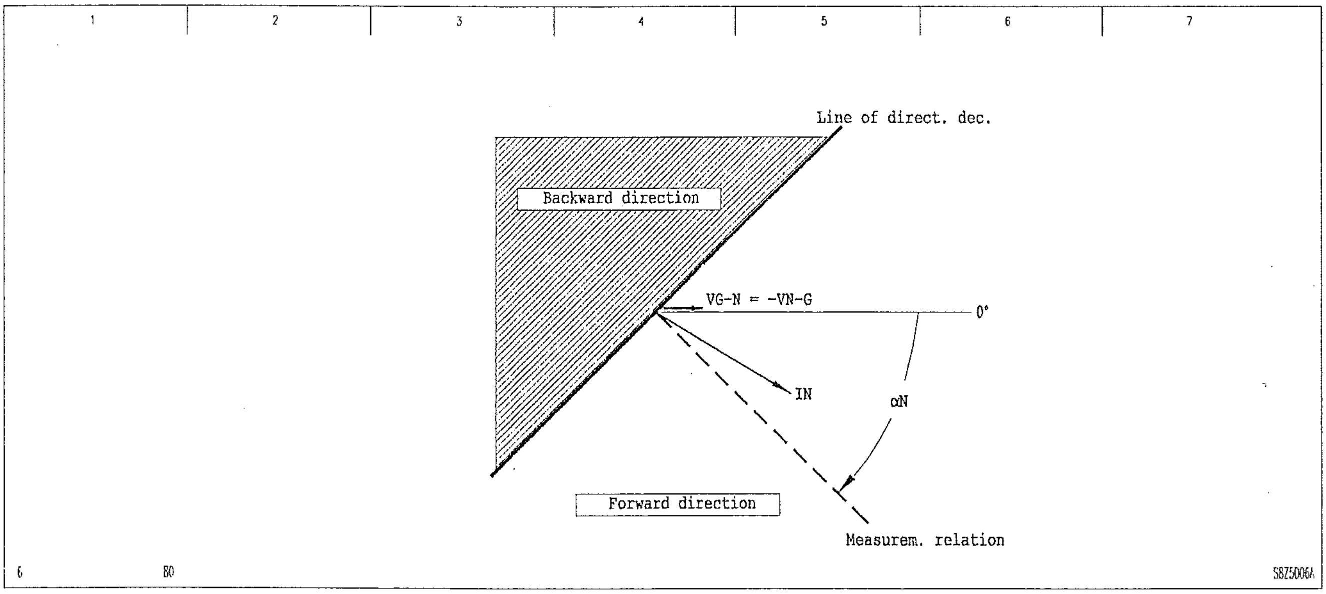
Residual current stages

The measured residual current $\underline{I}_N$ and the neutral displacement voltage $\underline{V}_{G\text{-}N} = -\underline{V}_{N\text{-}G}$ are used for the direction determination function of the residual current stages. The user must specify a favorable characteristic angle in accordance with the neutral-point treatment of the power system. The characteristic angle α_N can be set within the range of - 90° to + 90°.

The reference quantity is the vector of the neutral displacement voltage. The characteristic angle specifies the measuring position relative to the reference quantity. The measuring position is defined as the bisector of the 'forward' direction zone. The forward direction applies if the vector of the residual current is in the range of ≤ ± 90° of the measuring position.

The backward direction applies if the vector of the residual current is in the range > ± 90° of the measuring position.

In the following example the system neutral has been grounded with a relatively low resistance. When there is a single-pole fault in A-G and a fault in the forward direction, the residual current will then assume a position approximately like the one shown in Figure 3-111. With a set characteristic angle of α_N = - 45°, a direction decision in the forward direction is issued.

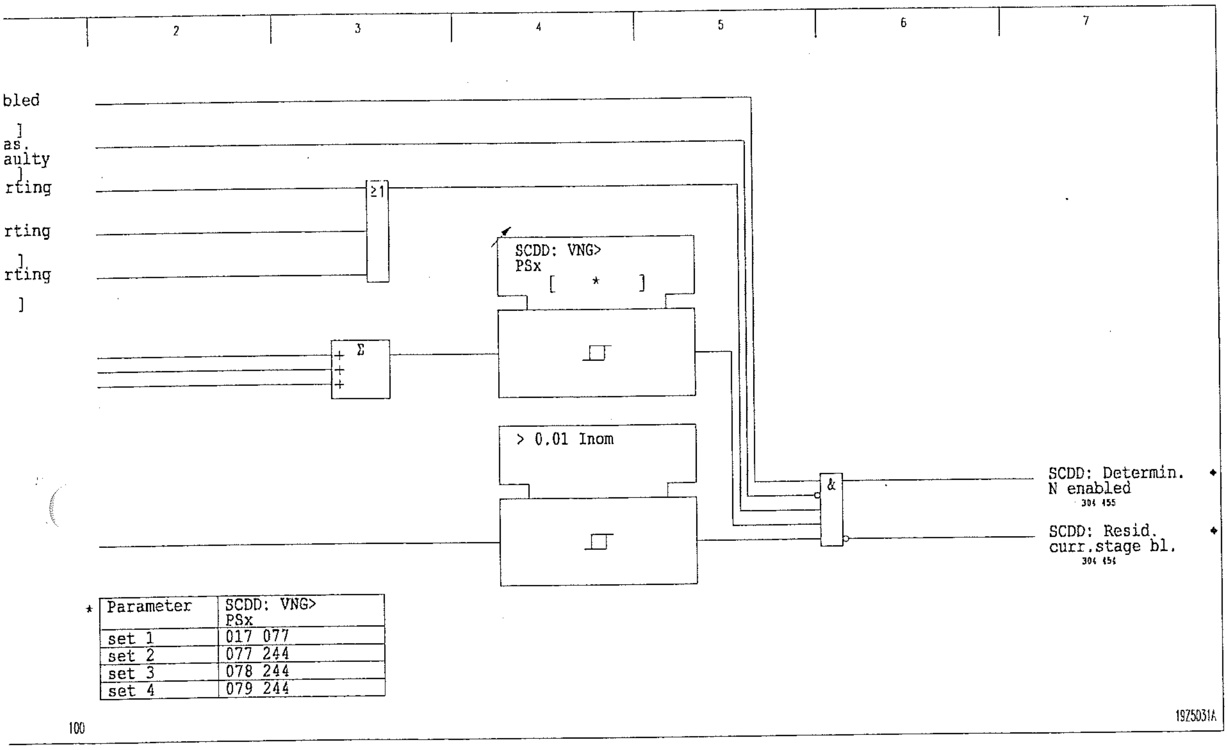


3-111 Example of direction decision formation for residual current stage

*the residual
ages*

The enable for the direction determination function of the residual current stages is issued if the following conditions are satisfied simultaneously:

- ☐ The short-circuit direction determination function is enabled.
- ☐ The short-circuit direction determination function is not blocked by measuring circuit monitoring (see 'Measuring Circuit Monitoring').
- ☐ A zero-sequence starting signal is present.
- ☐ The residual current is greater than $0.01 \cdot I_{nom}$.
- ☐ There is no external signal MAIN: M.c.b. trip V EXT.
- ☐ The neutral displacement voltage is greater than the set triggering value of the function SCDD: VNG>.



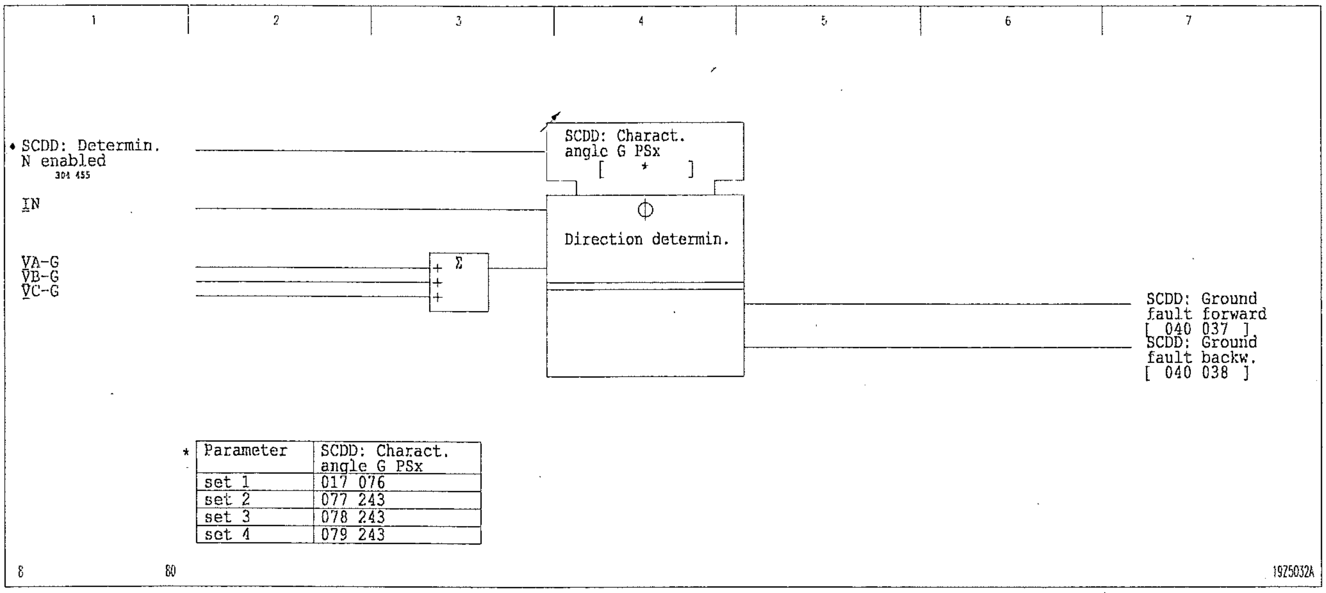
Parameter	SCDD: VNG> PSx
set 1	017 077
set 2	077 244
set 3	078 244
set 4	079 244

Enable for the direction determination function of the residual current stages

After direction determination is enabled, one of the following two signals is generated, depending on the measurement decision:

- ☐ If there is a fault in the forward direction, S C D D : G r o u n d f a u l t f o r w a r d .
- ☐ If there is a fault in the backward direction, S C D D : G r o u n d f a u l t b a c k w .

To control transient competition problems, the release of a direction decision in both directions is delayed by 30 ms.



3-113 Direction determination of the residual current stages *of the blocking the residual ages*

For the formation of the blocking signal for the two DTOC residual current stages and the IDMT residual current stage, the fault direction for evaluating the measurement decision can be separately set. once the user has selected *forward*, *backward* or *non-directional.*

A blocking signal for the first DTOC residual current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{IN>}$ is set on forward, and the short-circuit direction determination function identifies a fault in the backward direction.
- ☐ The direction for $t_{IN>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

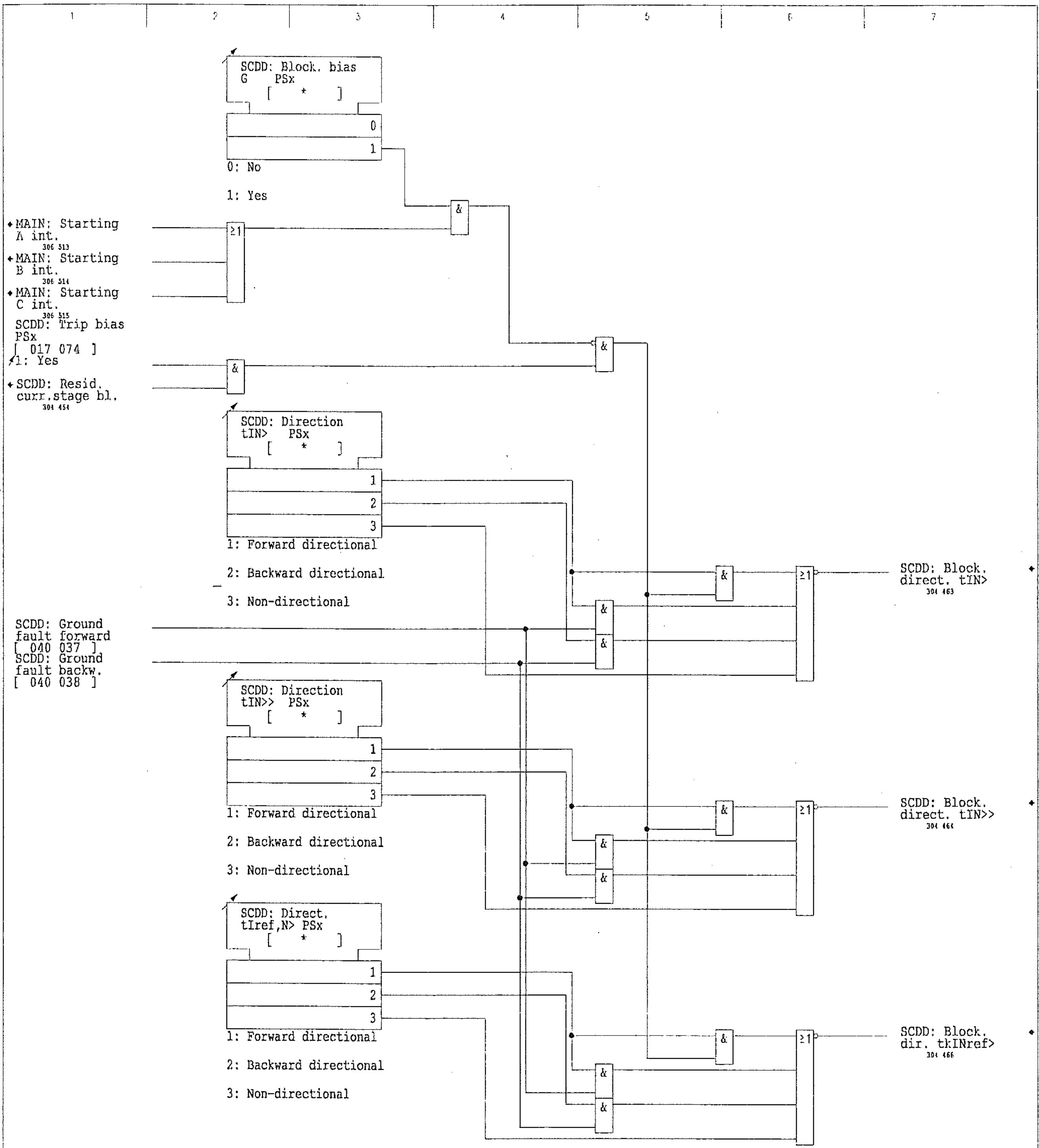
A blocking signal for the IDMT residual current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{IN>>}$ is set on forward, and the short-circuit direction determination function identifies a fault in the backward direction.
- ☐ The direction for $t_{IN>>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

A blocking signal for the IDMT residual current stage is formed if one of the following conditions is met:

- ☐ The direction for $t_{Iref,P>}$ is set on forward, and the short-circuit direction determination function detects a fault in the backward direction.
- ☐ The direction for $t_{Iref,N>}$ is set on backward, and the short-circuit direction determination function identifies a fault in the forward direction.

If there is no enable for direction determination (in the case of m.c.b. trip, for example), the user may specify at `SCDD: Trip bias PSx)` whether stages set to *forward* shall be operated with trip bias. In the event of phase current starting, the trip bias can be suppressed in the residual current stage by making the appropriate setting at `SCDD: Block. bias G PSx`.



* Parameter	SCDD: Block. bias G PSx	SCDD: Direction tIN> PSx	SCDD: Direction tIN>> PSx	SCDD: Direct. tIref,N> PSx
set 1	017 078	017 073	017 075	017 067
set 2	077 245	077 240	077 241	077 242
set 3	078 245	078 240	078 241	078 242
set 4	079 245	079 240	079 241	079 242

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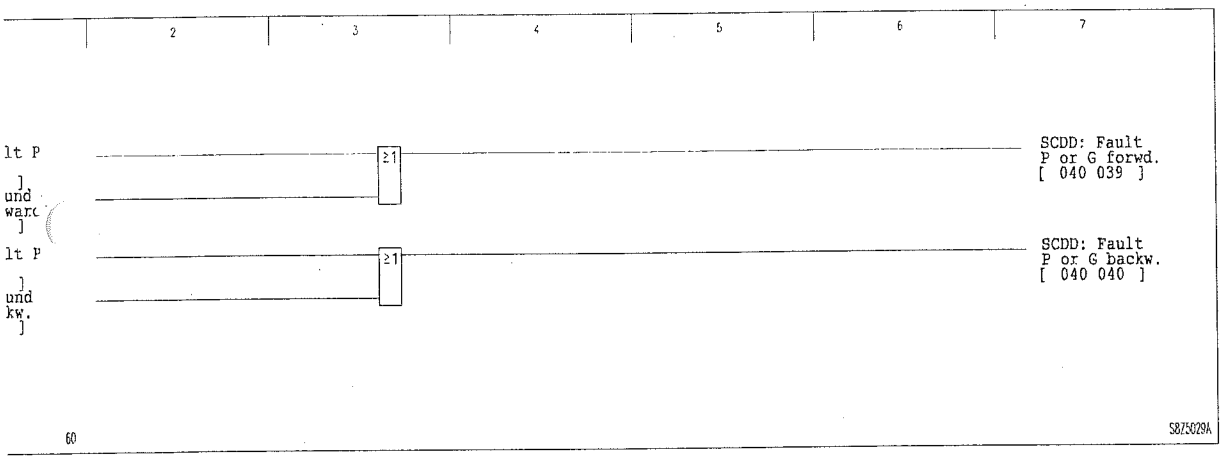
3-114 Formation of the blocking signals for the residual current stage *logic*

The signals for fault direction that are generated by the direction determination functions of the phase current and residual current stages are combined into one common function.



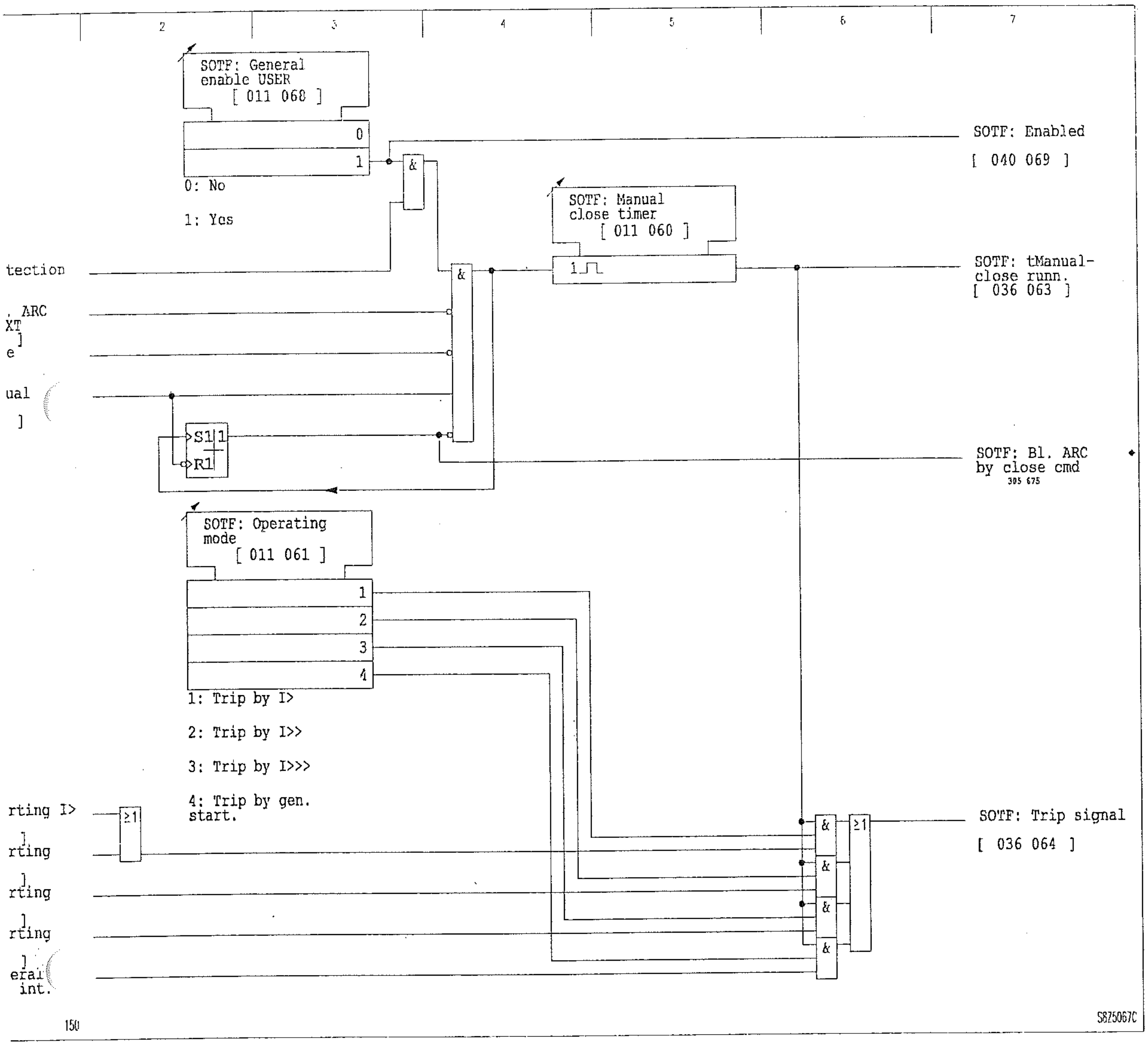
ault signals of phase current stage or residual current stages, forward or backward

3.24 Switch on to Fault Protection (Function Group SOTF)

When the circuit breaker is closed manually, it is possible to switch on to an existing fault. This is particularly critical since the time-overcurrent protection would not clear the fault until after the set operate delay had elapsed. In this situation, however, the fastest possible clearance is desired.

To ensure rapid clearing with manual closing, the manual close signal must be issued not only to the circuit breaker but also to the P130C at the same time. If there is no close request from the ARC and if no HSR cycle of an external auto-reclosure control is running, an adjustable timer stage is started with the manual close command. By setting a parameter, the user can choose which of the time-overcurrent protection starting decisions will generate a trip signal while the timer stage is elapsing:

An internal blocking signal is generated with the starting signal for the timer stage. This signal prevents the ARC from being activated when a manual close causes switching on to a fault.



Switch on to fault protection

3.25 Protective Signaling (Function Group PSIG)

Protective signaling

Protective signaling is used together with short-circuit direction determination in power systems with single-side infeed and a subsequent parallel line configuration (line section). Selective instantaneous clearing of the line section affected by the fault is initiated by this function, while the IDMT or DTOC tripping times are bypassed.

Disabling or enabling protective signaling

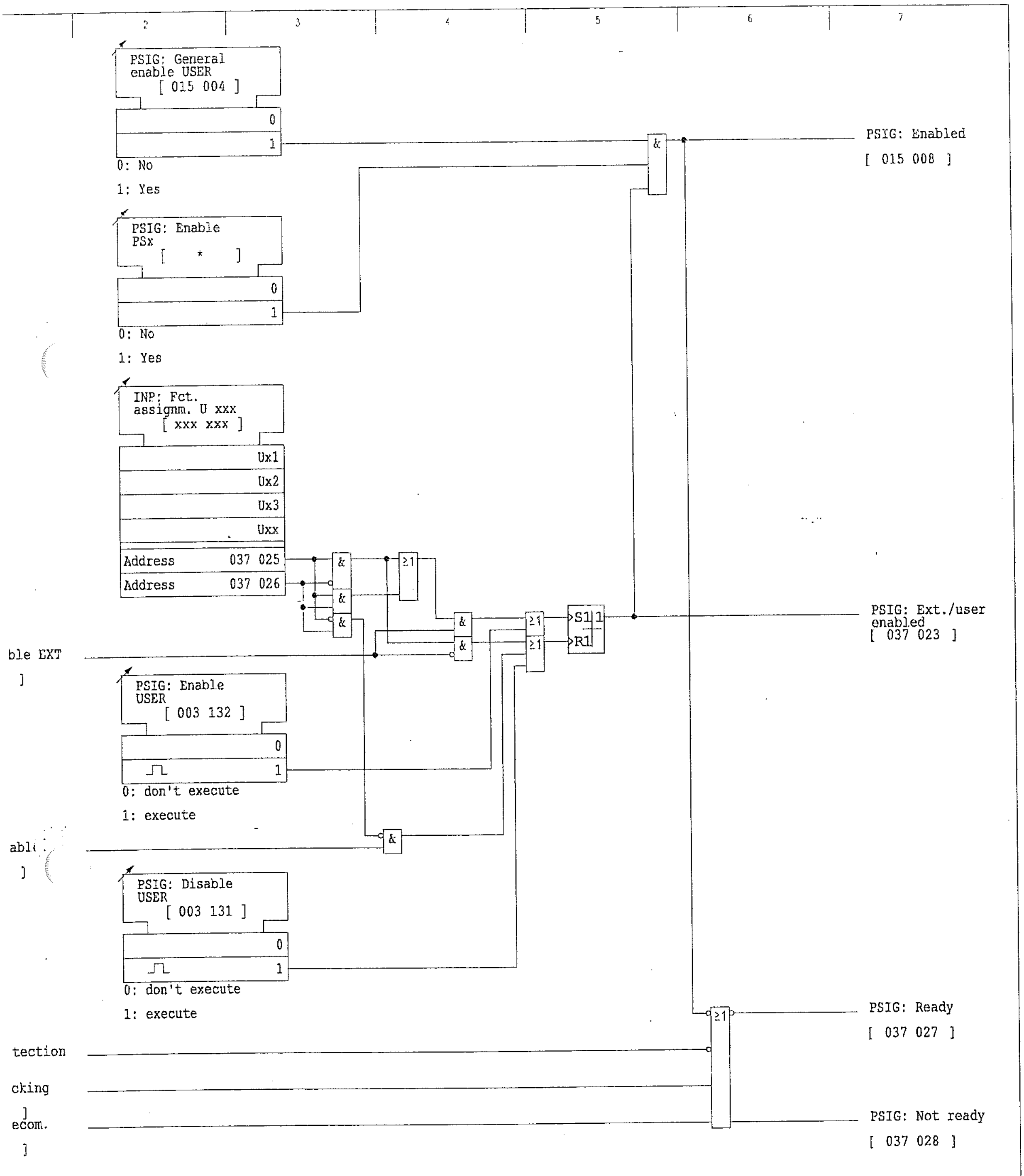
The function can be disabled or enabled from the integrated local control panel or through binary signal inputs.

Activation is enabled independent of parameter subset via PSIG: General enable USER. Activation is enabled for parameter subset PSx via PSIG: Enable PSx. Subsequently, protective signaling can be enabled via the local control panel or through appropriately configured binary signal inputs. Enabling from either the integrated local control panel or through binary signal inputs is equally effective. If only PSIG: Enable EXT is assigned to a binary signal input then protective signaling will be enabled by a positive edge of the input signal; it will be disabled by a negative edge. If only PSIG: Disable EXT is assigned to a binary signal input then a signal present at the input will have no effect.

Readiness of the protective signaling function

In order for protective signaling (PSIG) to function, the following requirements must be satisfied:

- It must be activated.
- There is no external block
- There is no transmission fault.



*

Parameter	PSIG: Enable PSx
set 1	015 014
set 2	015 015
set 3	015 016
set 4	015 017

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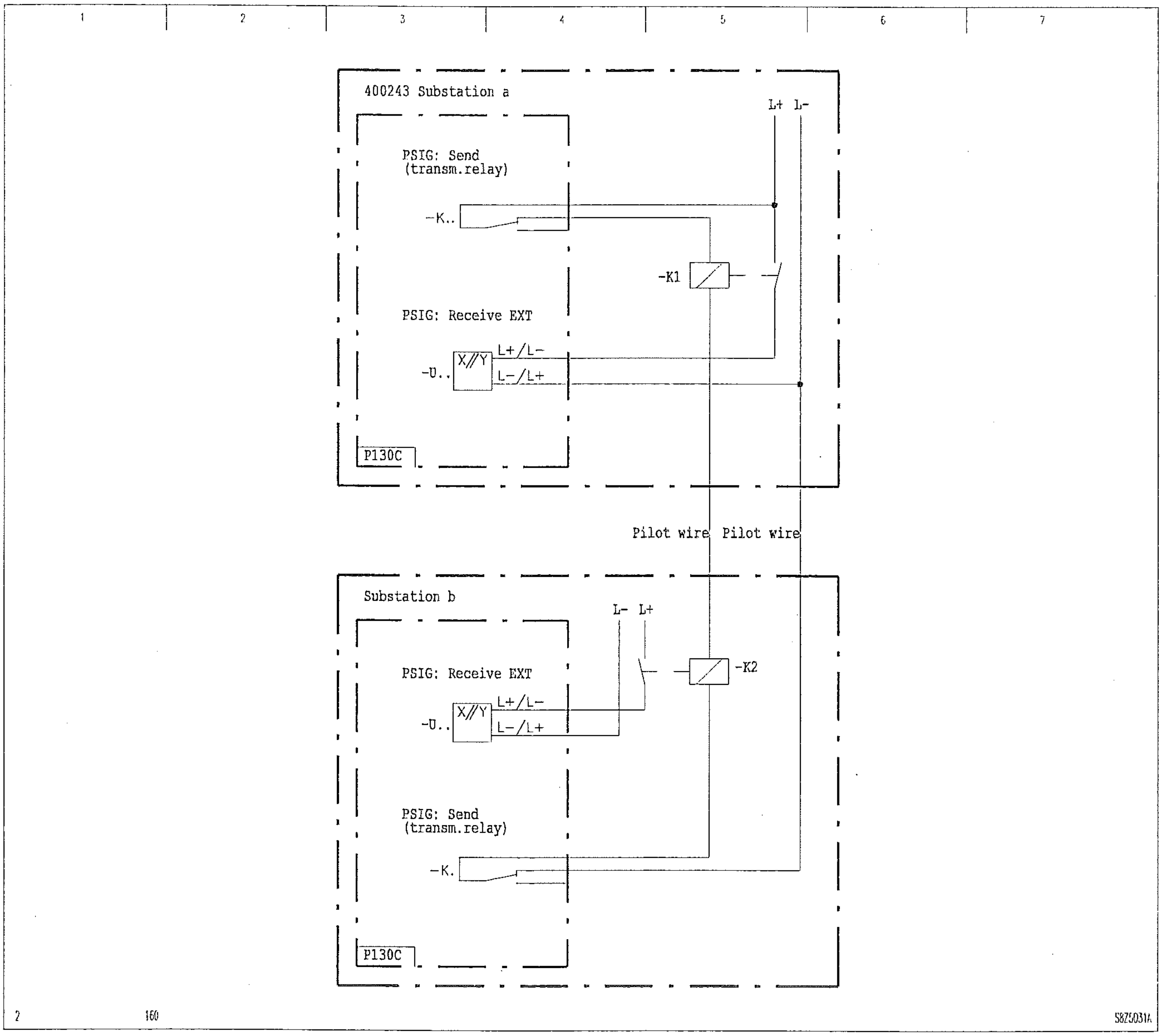
Prote signaling ready to operate

Forming the communication link

To form the communication link it is necessary to connect either the break contact or the make contact of the transmitting relay, depending on the transmitting relay mode selected ('*Transm. relay make contact*' or '*Transm. relay break contact*'), to the PSIG: Receive EXT input of the remote station by means of pilot wires (see 'Installation and Connection' and Figure 3-118). With both operating modes, a receive signal (DC loop closed) is present in both protection devices in the idle state.



3-118 Protective signaling using pilot wires, selected mode of operation: transmission relay break contact *of the protective function*

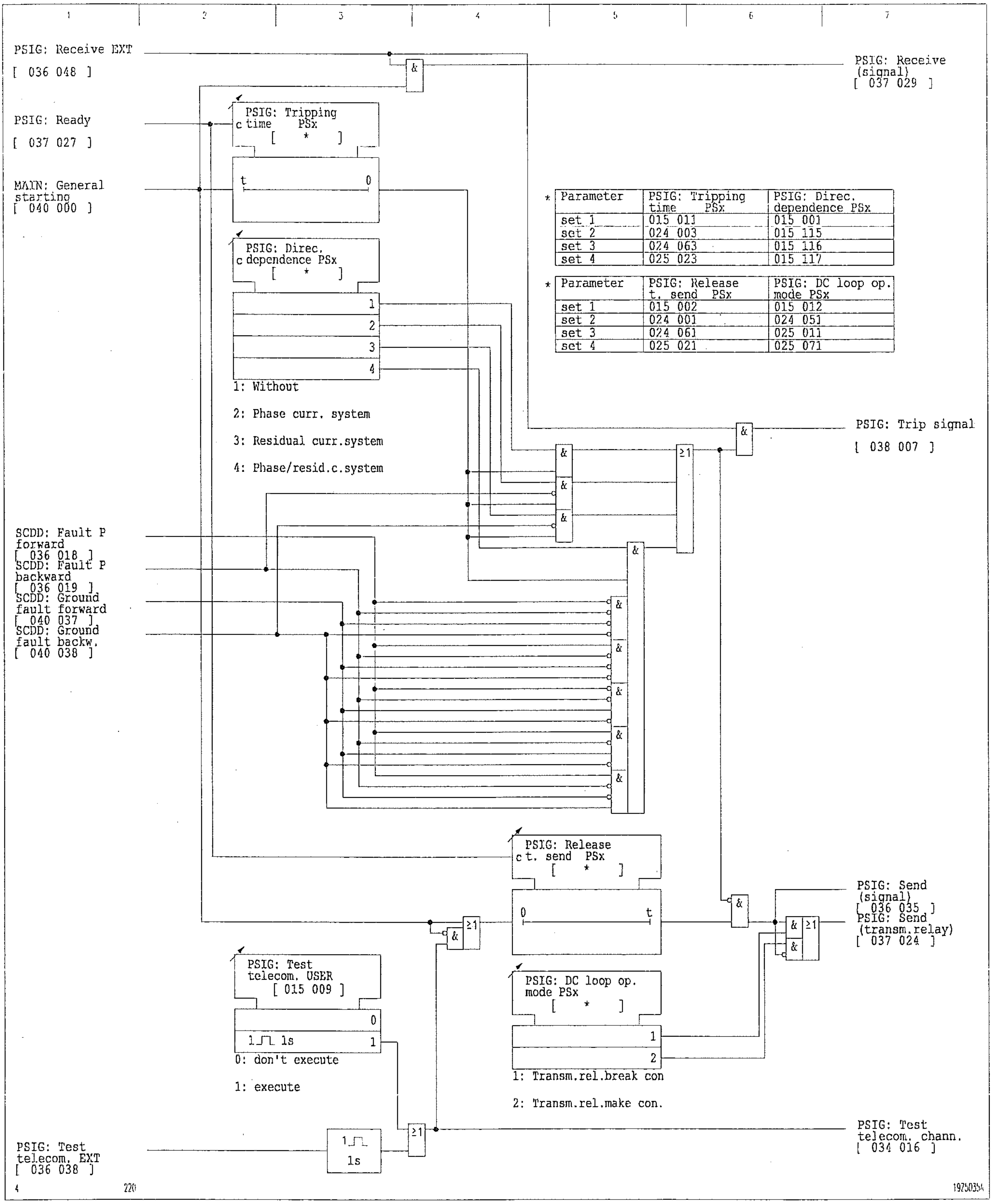
If a general starting condition begins, then the loop is opened without delay (transmitting). When a general starting signal is present and the set starting time has elapsed, loop reclosing takes place as follows in accordance with the mode selected at PSIG: Direct. depend. PSx and as a function of the direction decisions:

- ☐ Independently of any direction decision
- ☐ As a function of the condition that there not be any direction decision in the backward direction of the phase current stage
- ☐ As a function of the condition that there not be any direction decision in the backward direction of the residual current stage
- ☐ As a function of whether one of the following conditions in the table is satisfied (if one line of statements is true, then one condition is satisfied):

Fault Residual current stage Backwards	Fault Residual current stage Forwards	Fault Phase current stage Backwards	Fault Phase current stage Forwards
no	no	no	no
no	no	no	yes
no	yes	no	no
no	yes	no	yes
yes	no	no	yes

After the loop has reclosed and provided that both a general starting condition and a status signal through the PSIG: Receive EXT input of a closed loop are present, then the signal PSIG: Trip by PSIG is generated without delay. The loop recloses after dropout of the general starting condition and after a delay equal to the release time that can be set at PSIG: Release t. send. PSx.

If protective signaling is not ready, the DC loop will be open if *Transm. relay make contact* has been selected as operating mode for the transmitting relay or closed if *Transm. relay break contact* has been selected.



* Parameter	PSIG: Tripping time PSx	PSIG: Direc. dependence PSx
set 1	015 011	015 001
set 2	024 003	015 115
set 3	024 063	015 116
set 4	025 023	015 117

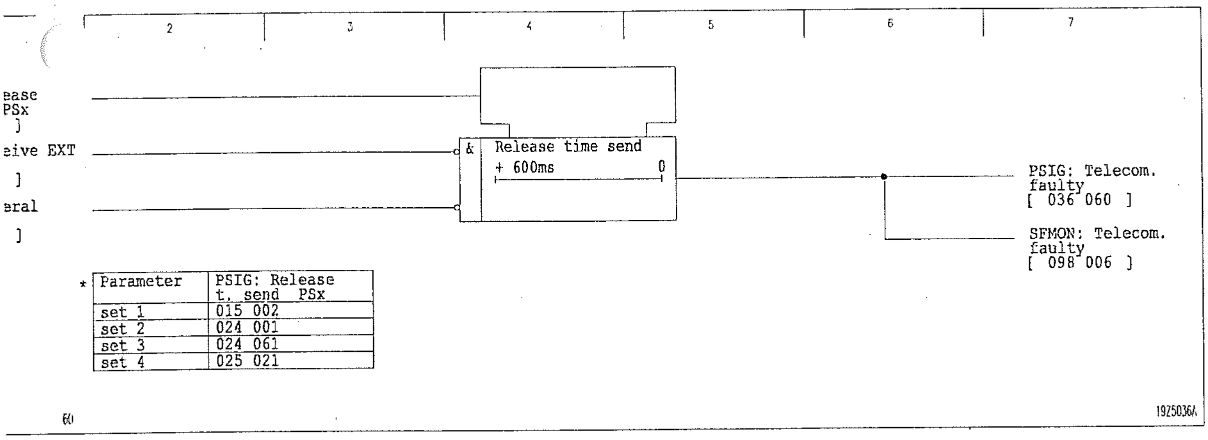
* Parameter	PSIG: Release t. send PSx	PSIG: DC loop op. mode PSx
set 1	015 002	015 012
set 2	024 001	024 051
set 3	024 061	025 011
set 4	025 021	025 071

3-119 Protective signaling logic

ɪ signaling
ɟ and loop check

The pilot wires are monitored for interruptions. If, in fault-free operation (i.e., in the absence of a general starting condition), no signal is received through the loop for a period longer than the set release time of the transmitting relay + 600 ms, then the signal PSIG: Telecom. faulty is issued (see Figure 3-120). A communication malfunction or failure leads to a protective signaling block.

To check the loop, the communications link can be opened from the local control panel by using the function PSIG: Test telecom. USER.

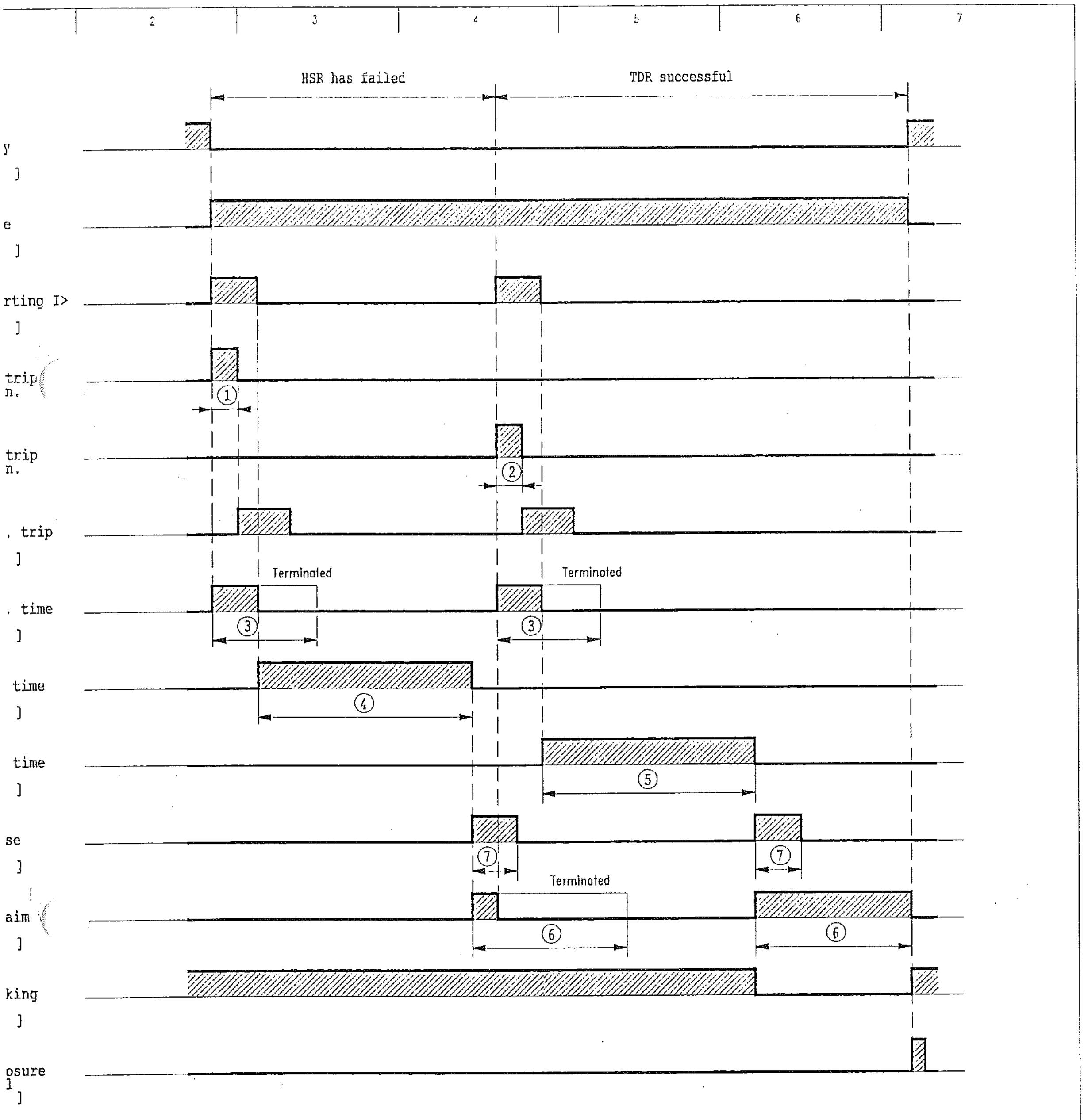


ɟaulty transmission channel of protective signaling

3.26 Auto-Reclosing Control (Function Group ARC)

Under certain conditions the automatic reclosing device (ARC) brings about clearing of a line section and, once the dead time has elapsed, automatic reclosing of the line section.

Figure 3-121 shows an example for the usual sequence of a failed high-speed reclosure followed by a subsequent successful time-delay reclosure.



	①	②	③	④	⑤	⑥
Parameter	ARC: HSR trip. time I> PSx	ARC: TDR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: Reclaim time PSx
set 1	015 072	015 073	015 066	015 056	015 057	015 054
set 2	024 040	024 041	024 035	024 030	024 031	024 028
set 3	025 000	025 001	024 095	024 090	024 091	024 088
set 4	025 060	025 061	025 055	025 050	025 051	025 048

⑦ MAIN: Close cmd.pulse time [015 067]
ARC: No. permit. TDR PSx Setting: 1

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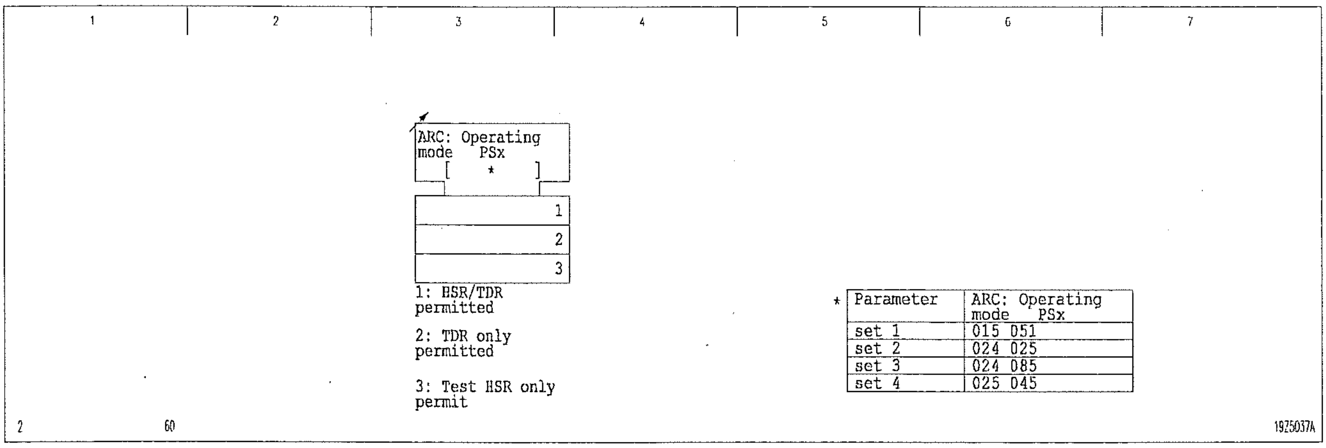
ample for an ARC sequence

ARC operating modes

The ARC, which is integrated into the P130C, offers the possibility of triggering starting times by way of different starting signals. Once the starting times have elapsed, a trip signal is generated. With the ARC function that is implemented in the P130C, multiple reclosings are possible. If the ARC operating mode has been set accordingly, multiple reclosures begin with a high-speed reclosure (HSR). If the fault is not cleared after reclosing by HSR, then another attempt can be made to clear the fault by means of a time-delay reclosure (TDR). Multiple reclosures using only TDRs are also possible if the ARC operating mode is set accordingly.

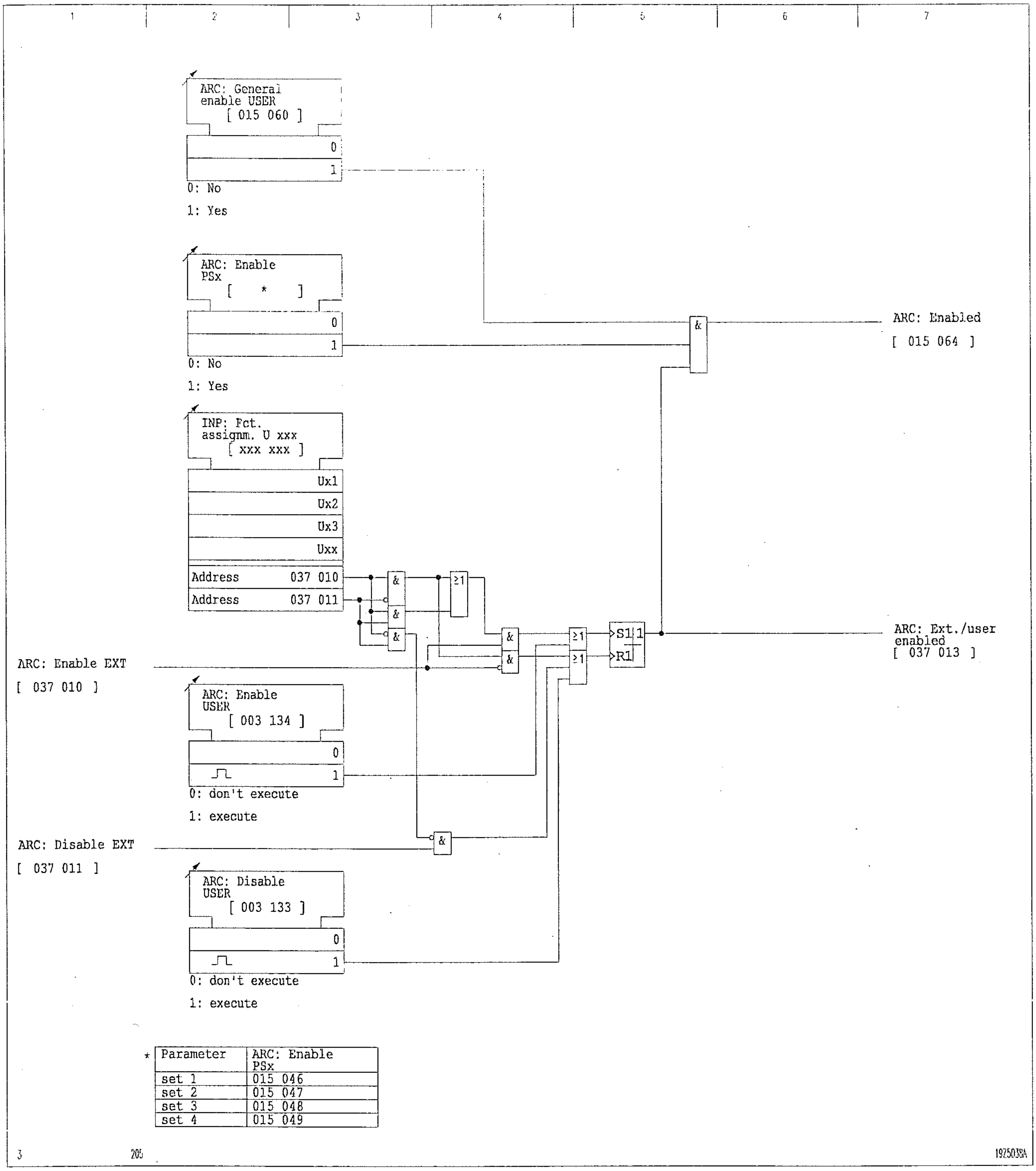


3-122 Setting the ARC operating mode

and enabling the
tion

The function can be disabled or enabled from the integrated local control panel or through binary signal inputs.

Activation is enabled independent of parameter subset via ARC: General enable USER. Activation is enabled for parameter subset PSx via ARC: Enable PSx. Subsequently, the ARC can be enabled via the local control panel or through appropriately configured binary signal inputs. Enabling from either the integrated local control panel or through binary signal inputs is equally effective. If only ARC: Enable EXT is assigned to a binary signal input then the ARC will be enabled by a positive edge of the input signal; it will be disabled by a negative edge. If only ARC: Disable EXT is assigned to a binary signal input then a signal present at the input will have no effect.



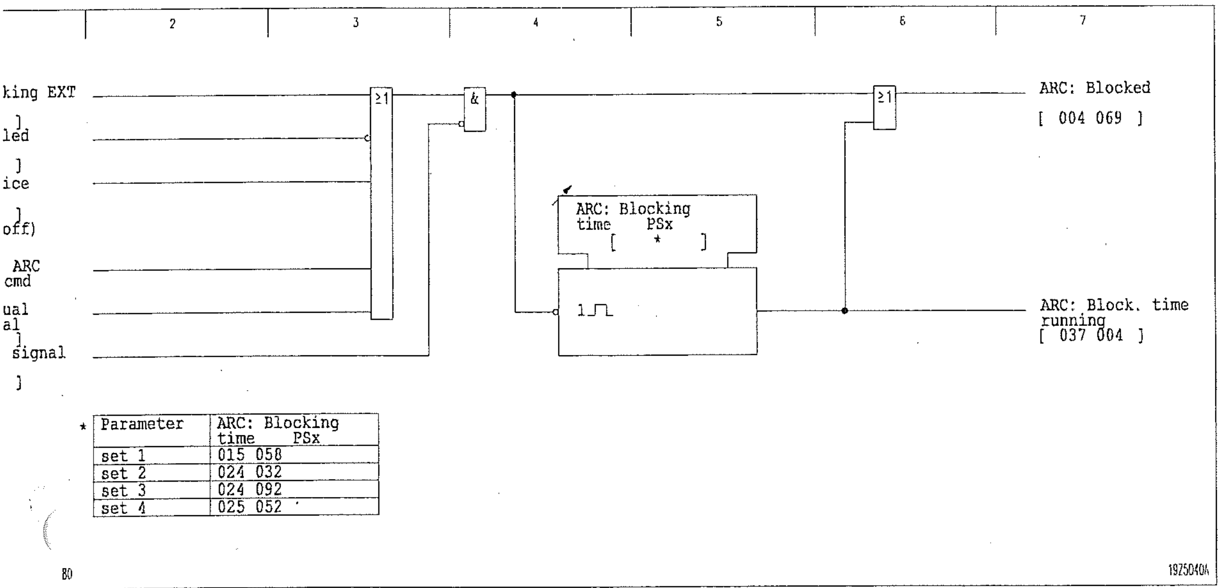
* Parameter	ARC: Enable PSx
set 1	015 046
set 2	015 047
set 3	015 048
set 4	015 049

3-123 *Enabling or disabling auto-reclosing control* *king*

Under certain conditions the ARC will be blocked and the signal ARC: Blocked will be generated, provided that one of the following conditions is met:

- A blocking signal is present through manual close.
- There is an external signal ARC: Blocking EXT.
- The ARC is not activated.
- Protection is disabled (off).
- A manual trip command is issued from the local control panel.

After all blocking conditions have dropped out, the blocking time is started. When the blocking time has elapsed, ARC blocking is canceled.



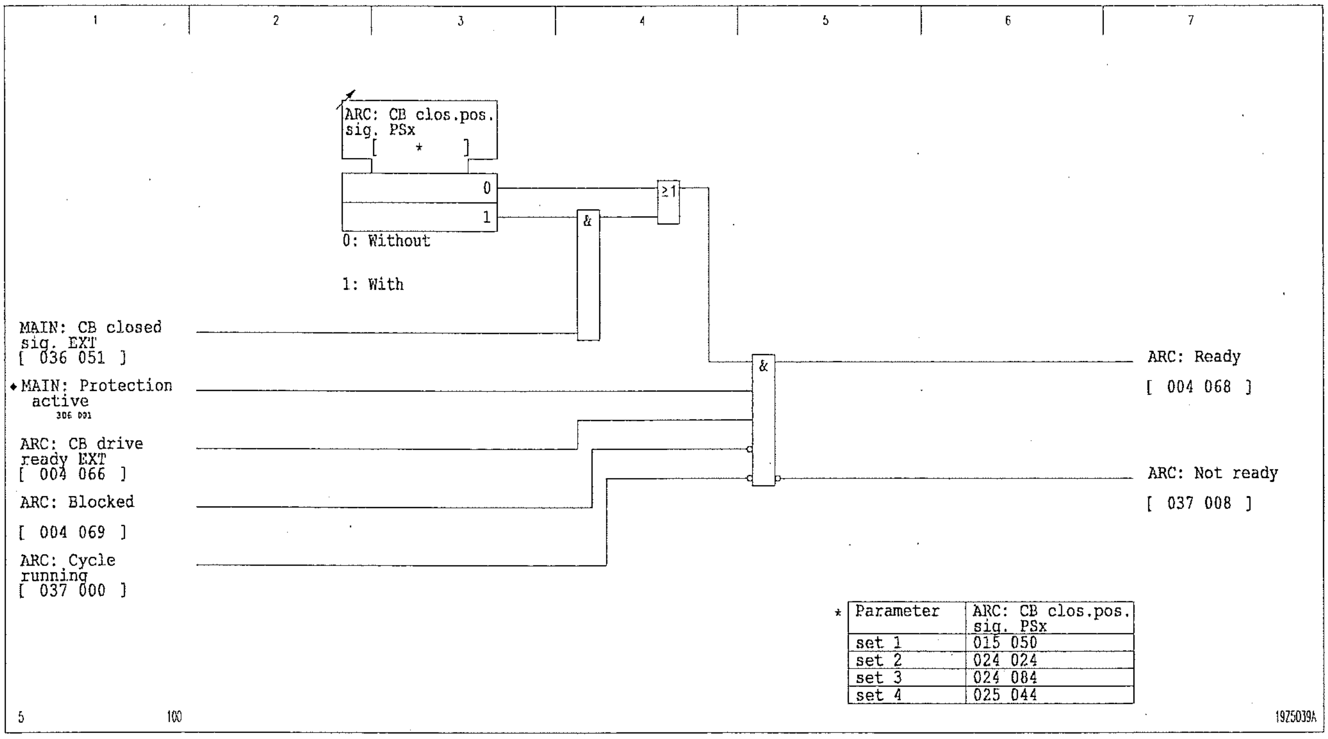
* Parameter	ARC: Blocking time PSx
set 1	015 058
set 2	024 032
set 3	024 092
set 4	025 052

\RC blocking

ARC ready to operate

An ARC cycle can only start if the ARC is ready. For this purpose the following conditions need to be met simultaneously:

- Protection is activated (on).
- The ARC is not blocked.
- The circuit breaker must be capable of opening and closing again (CB opening & closing mechanism ready).
- The circuit breaker must be in closed position (closed position scanning is optional).
- No ARC cycle is running.



3-125 *ARC ready to operate*

ʾimes

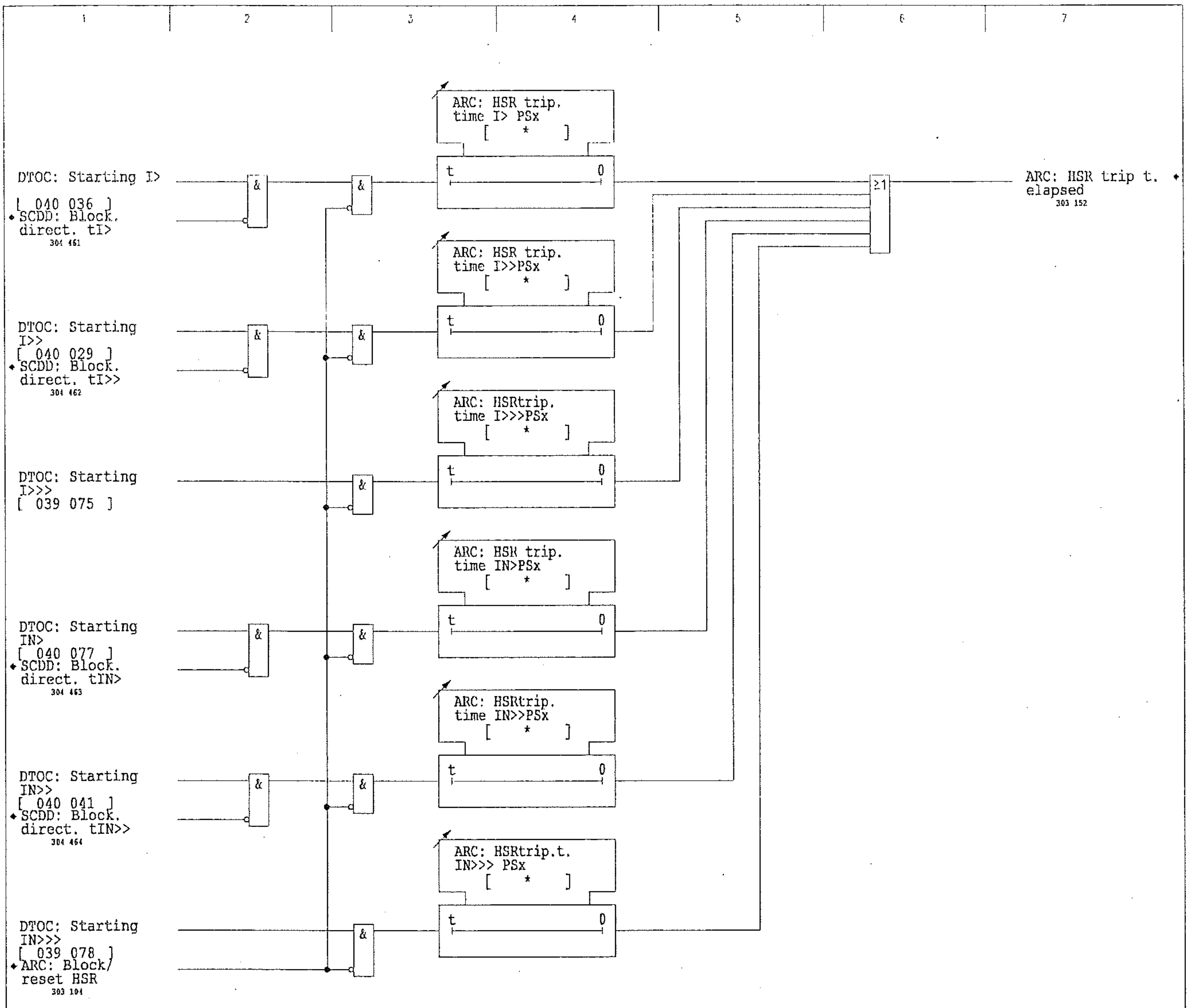
When protection functions operating with auto-reclosing control are started, the tripping times (HSR or TDR) are started together with the operative time. If the tripping time drops out within the active ARC cycle while the operative time is elapsing, a trip signal of defined duration is issued. The HSR or TDR trip time, having effected the trip signal, also determines the dead time (HSR or TDR). Once the dead time begins, all tripping times already triggered will be terminated as will the operative time.
The onset of the following startings or input signals trigger the tripping times provided that the starting conditions are met and the respective tripping times are not blocked. If short-circuit direction determination is enabled, then some of the starting signals are directional:

- General starting
- DTOC starting I> (directional)
- DTOC starting I>> (directional)
- DTOC starting I>>>
- DTOC starting I_N> (directional)
- DTOC starting I_N>> (directional)
- DTOC starting I_N>>>
- IDMT starting $I_{kIref,P}$> (directional)
- IDMT starting $I_{kIref,N}$> (directional)
- IDMT starting $I_{kIref,neg}$>
- Start by way of programmable logic
- Ground fault direction determination by steady-state values (GFDSS) has operated and detected one of the following faults:
  - GFDSS starting fault 'forward/LS'
  - GFDSS starting Y(N)>
  - GFDSS starting fault 'forward/LS' or GFDSS starting Y(N)>

If - in the operating mode *HSR/TDR permitted* - only one of the starting conditions listed above applies, then the first trip signal is always generated by the HSR trip timer stage, regardless of the duration of the HSR or TDR tripping time setting. HSR precedes TDR. If more than one starting is present then the trip signal will be issued after the HSR tripping time that has elapsed first. As an exception, a TDR will be triggered first after elapsing first, if the associated HSR tripping time is set to *Blocked*.

If the trip signal has been generated by a TDR tripping time stage, then no HSR will be initiated within the same ARC cycle.

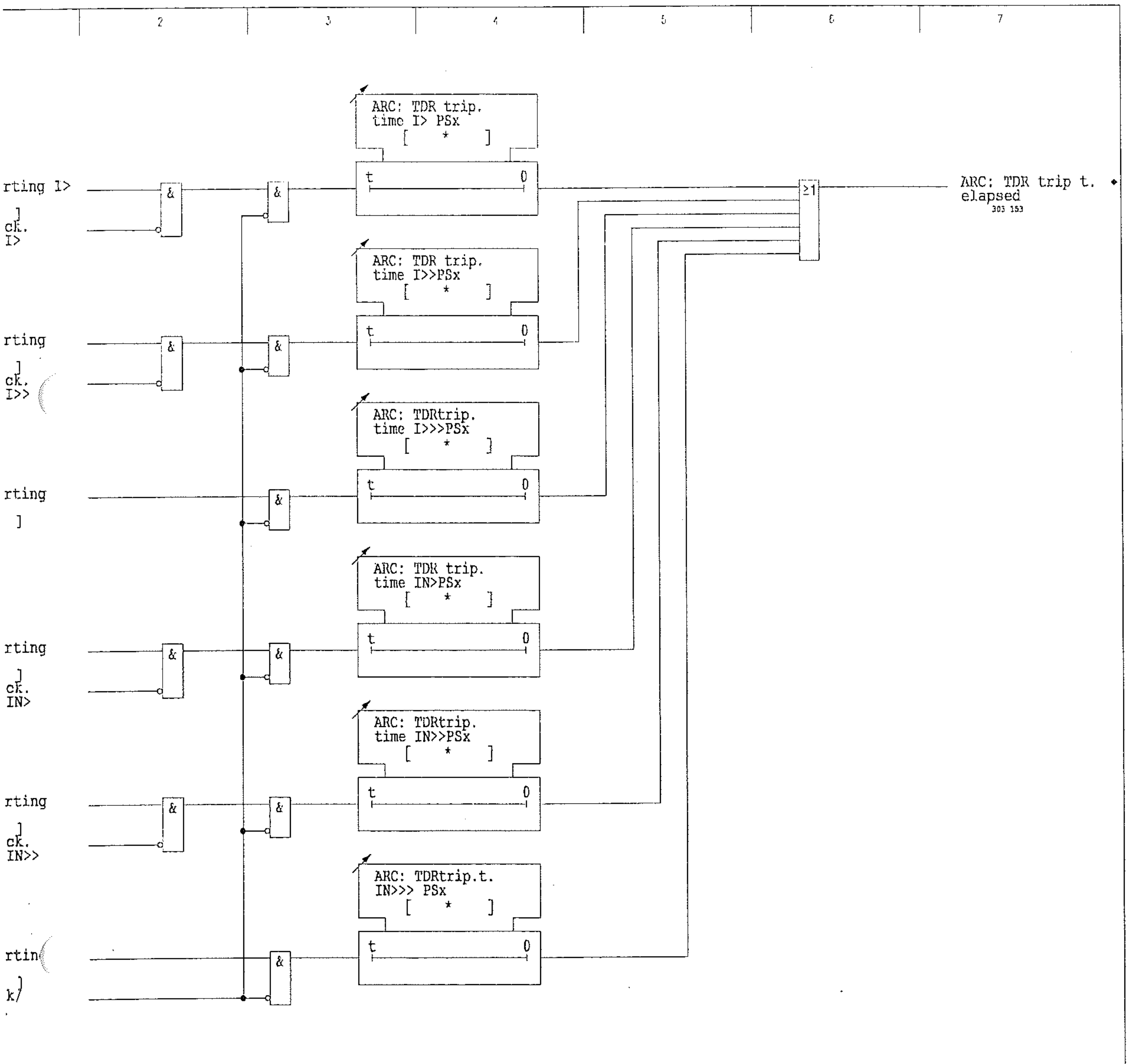
The ARC trip signal must be included in the 'm out of n' selection of the trip commands.



* Parameter	ARC: HSR trip. time I> PSx	ARC: HSR trip. time I>>PSx	ARC: HSRtrip. time I>>>PSx	ARC: HSR trip. time IN>PSx	ARC: HSRtrip. time IN>>PSx	ARC: HSRtrip.t. IN>>> PSx
set 1	015 072	015 074	014 096	015 076	015 031	014 098
set 2	024 040	024 101	024 102	024 103	024 104	024 105
set 3	025 000	024 151	024 152	024 153	024 154	024 155
set 4	025 060	025 101	025 102	025 103	025 104	025 105

7 180 S8275154

3-126 HSR tripping times of the definite-time overcurrent protection function



Parameter	ARC: TDR trip. time I> PSx	ARC: TDR trip. time I>>PSx	ARC: TDRtrip. time I>>>PSx	ARC: TDR trip. time IN>PSx	ARC: TDRtrip. time IN>>PSx	ARC: TDRtrip.t. IN>>> PSx
set 1	015 073	015 075	014 097	015 077	015 032	014 099
set 2	024 041	024 113	024 114	024 115	024 116	024 117
set 3	025 001	024 163	024 164	024 165	024 166	024 167
set 4	025 061	025 113	025 114	025 115	025 116	025 117

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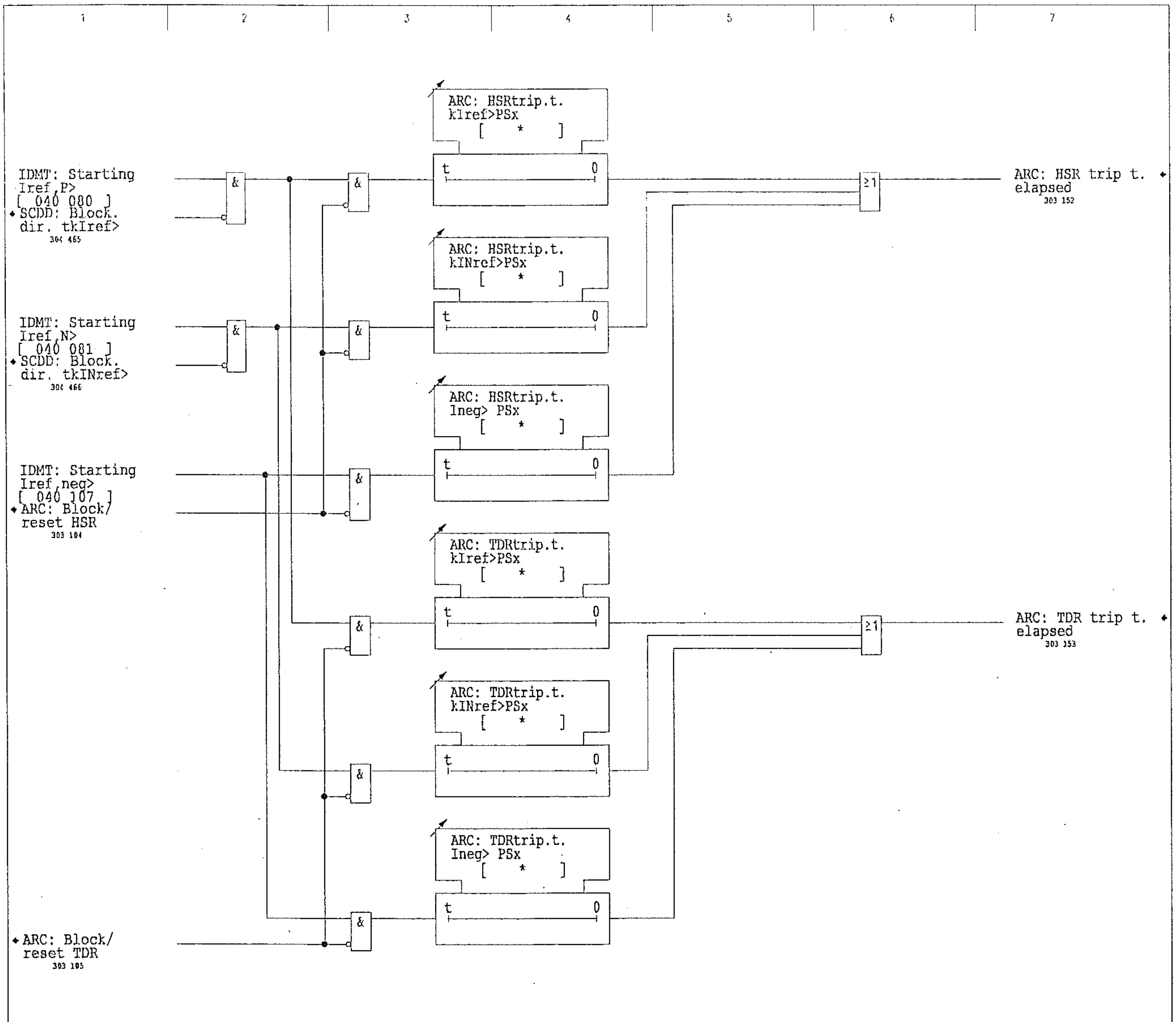
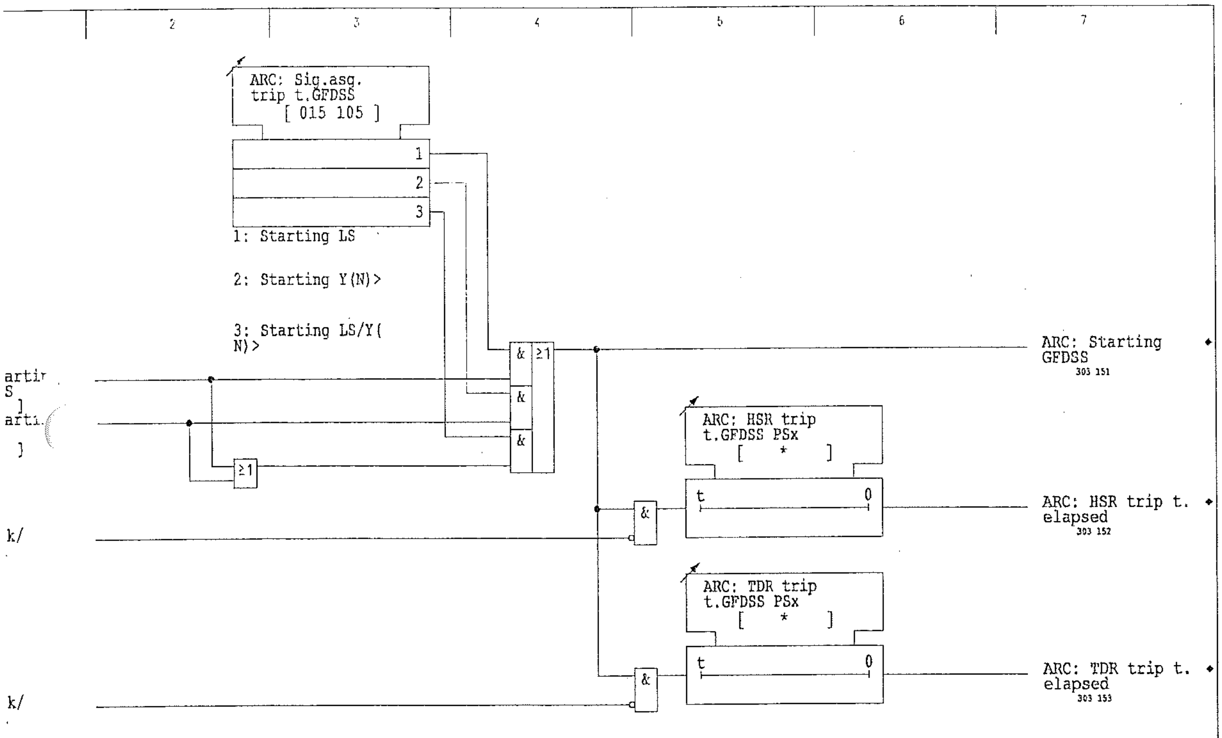
'DR tripping times of the definite-time overcurrent protection function



* Parameter	ARC: HSRtrip.t. kIref>PSx	ARC: HSRtrip.t. kINref>PSx	ARC: HSRtrip.t. Ineg> PSx	ARC: TDRtrip.t. kIref>PSx	ARC: TDRtrip.t. kINref>PSx	ARC: TDRtrip.t. Ineg> PSx
set 1	015 094	015 096	015 034	015 095	015 097	015 035
set 2	024 106	024 107	024 108	024 118	024 119	024 120
set 3	024 156	024 157	024 158	024 168	024 169	024 170
set 4	025 106	025 107	025 108	025 118	025 119	025 120

3-128 Tripping times of the inverse-time overcurrent protection function



* Parameter	ARC: HSR trip t.GFDSS PSx	ARC: TDR trip t.GFDSS PSx
set 1	015 078	015 079
set 2	024 109	024 121
set 3	024 159	024 171
set 4	025 109	025 121

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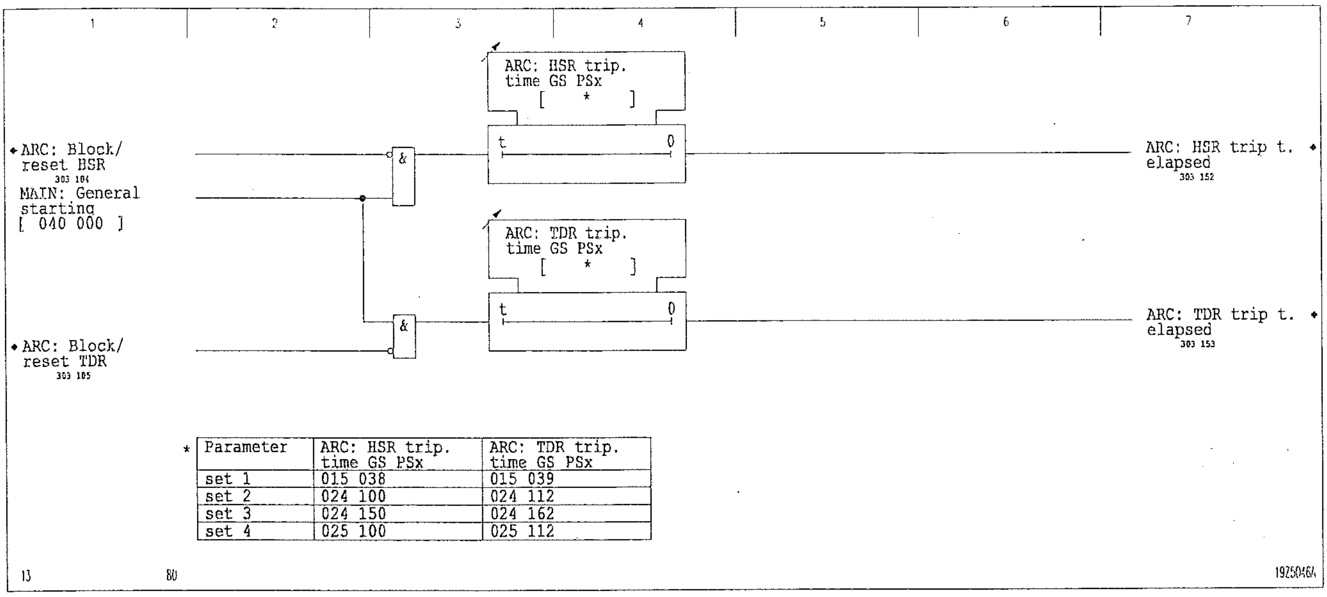
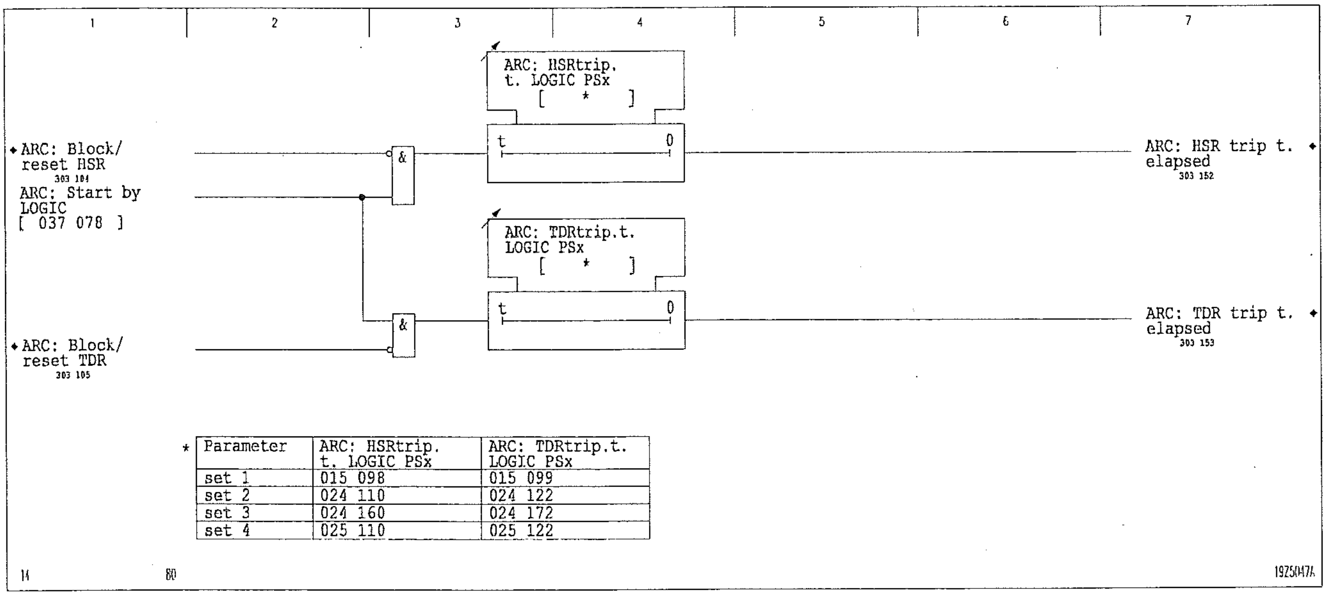
ripping times of the GFDSS function (ground fault direction determination using steady-state values)



* Parameter	ARC: HSR trip. time GS PSx	ARC: TDR trip. time GS PSx
set 1	015 038	015 039
set 2	024 100	024 112
set 3	024 150	024 162
set 4	025 100	025 112

3-130 Tripping times of general starting



* Parameter	ARC: HSRtrip. t. LOGIC PSx	ARC: TDRtrip.t. LOGIC PSx
set 1	015 098	015 099
set 2	024 110	024 122
set 3	024 160	024 172
set 4	025 110	025 122

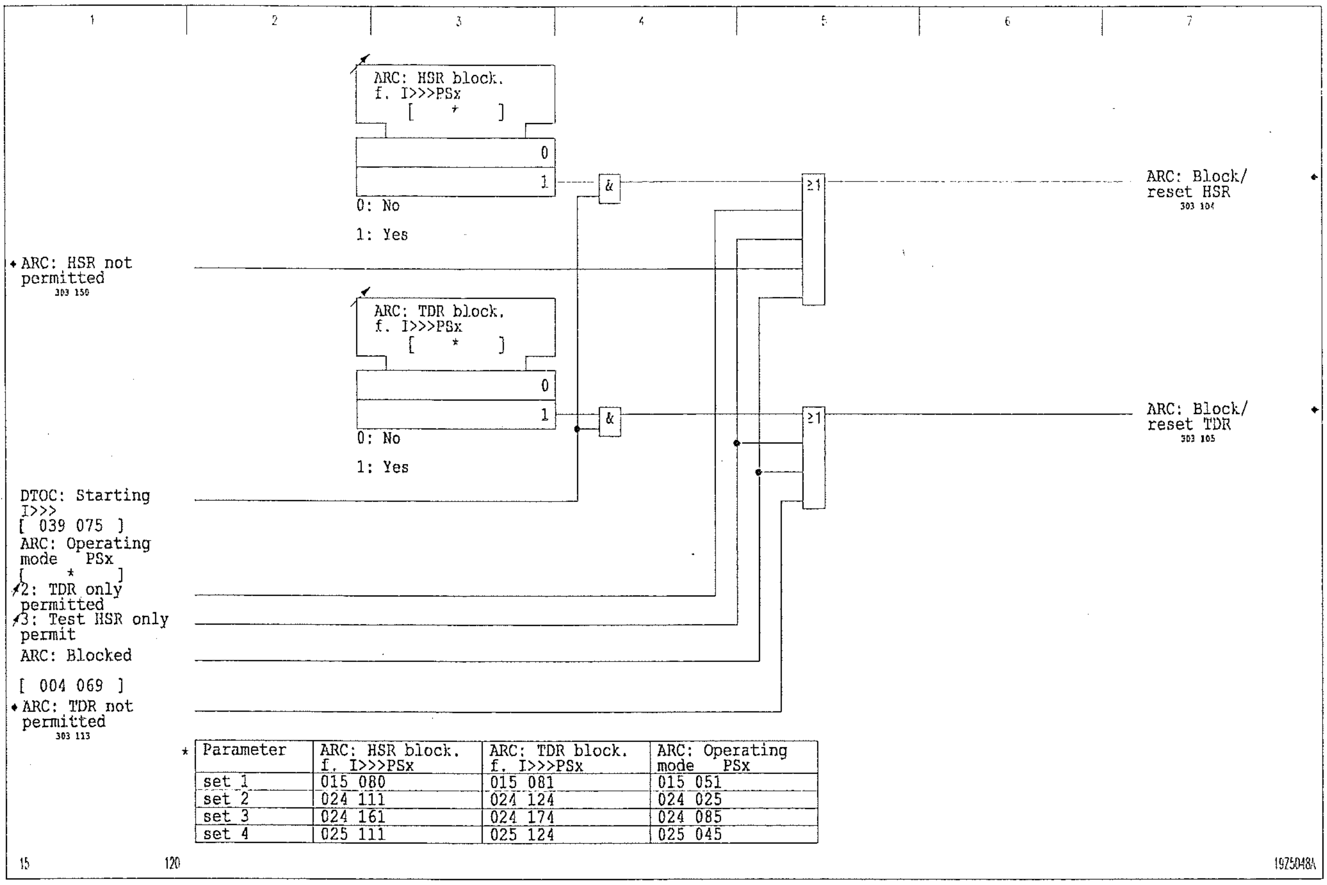
3-131 Tripping times via the LOGIC function *nd resetting the nes*

The HSR tripping time stages are blocked or reset either by the set value *Blocked* or by one of the following conditions:

- ARC: Operating mode PSx is set to *Test HSR only permitted.*
- I>>> starting is present and ARC: HSR blocking by I>>> PSx has been selected.
- ARC: Operating mode PSx is set to *TDR only permitted.*
- An HSR is not permitted because an HSR or TDR has already occurred within the current ARC cycle.
- The ARC is blocked..

The TDR tripping time stages are blocked or reset either by the set value *Blocked* or by one of the following conditions:

- ARC: Operating mode PSx is set to *Test HSR only permitted.*
- I>>> starting is present and ARC: TDR blocking by I>>> PSx has been selected.
- The ARC is blocked.
- The number of permitted TDRs has been reached and thus no further TDRs are permitted.



* Parameter	ARC: HSR block. f. I>>>PSx	ARC: TDR block. f. I>>>PSx	ARC: Operating mode PSx
set 1	015 080	015 081	015 051
set 2	024 111	024 124	024 025
set 3	024 161	024 174	024 085
set 4	025 111	025 124	025 045

3-132 Blocking and resetting the tripping time stages

ARC cycle

An ARC cycle begins, provided that the starting condition is satisfied, with the presence of a relevant starting option (DTOC/IDMT starting, starting via programmable logic, GFDSS, or start of a test HSR), as long as the signal ARC: Ready is present at this time. As the ARC cycle proceeds, the signal ARC: Ready is no longer taken into account.

An ARC cycle is running if the ARC is not blocked and one of the following conditions is met:

- The operative time is running.
- A dead time is running.
- The reclaim time is running.

he DTOC or
tection function,
S function, and
able logic

If the ARC is ready, it will block the trip signals of DTOC and IDMT as well as those of the GFDSS and the programmable logic via the signal `ARC: Blocking trip`. The ARC permits the generation of a trip command by the other protection functions if one of the following conditions is met:

- `ARC cycle running` is not applicable, and the ARC is not ready.
- The final reclaim time is running.
- Only an HSR test is permitted (*Test HSR only*).
- The ARC is blocked.
- The operative time is elapsing while the tripping time is running.
- A relevant starting type begins while a dead time is running.
- One or more startings do not trigger a tripping time stage because the relevant tripping time stages are disabled (t set to *Blocked*). If a tripping time stage is started in this condition by additional starting, as long as no definitive trip command has been issued, a trip command is again generated by the ARC.

Example of programmable logic in the ARC

This example (see Figure 3-133) illustrates the possible interconnection and the binary signal output for starting the tripping time stage via a logic input.

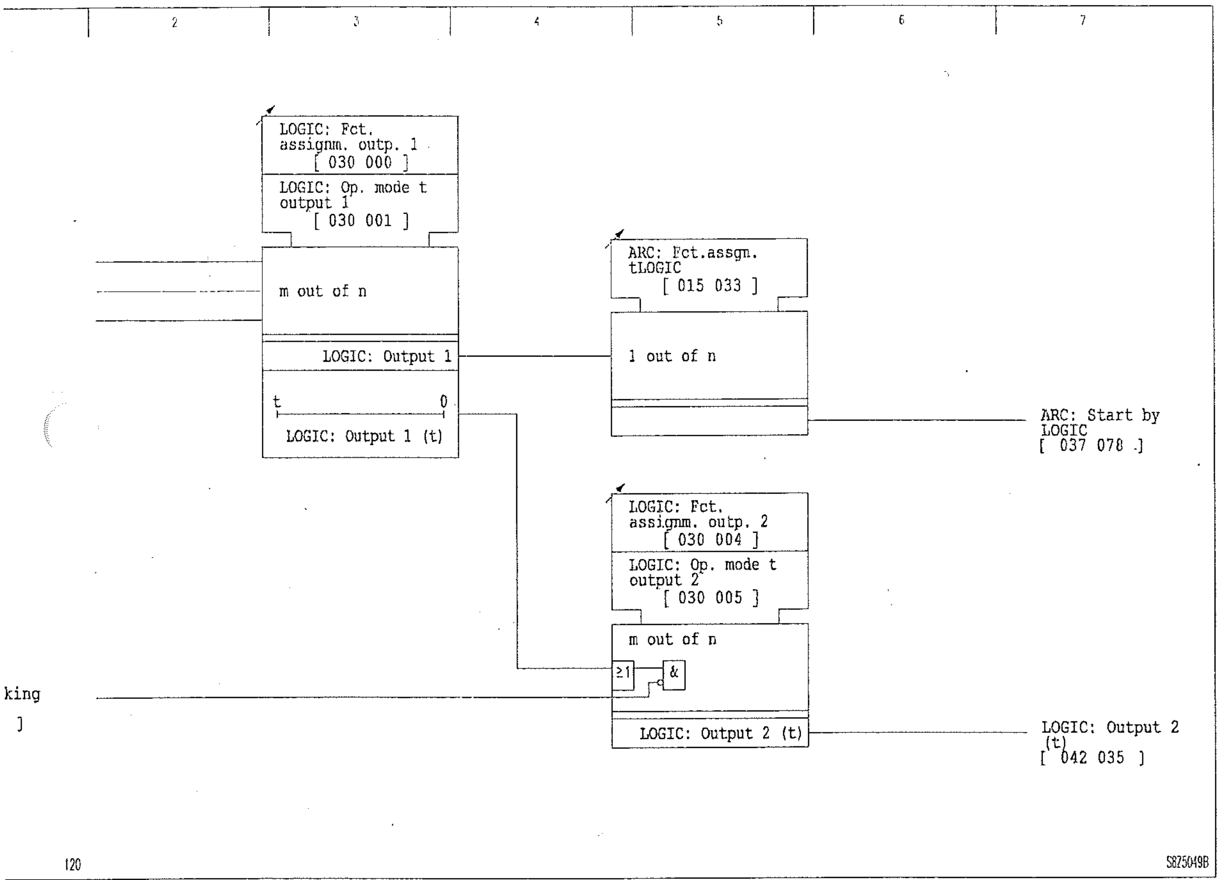
An input with serial operate delay and an AND element has been implemented by using the programmable logic function. At the second input of the AND element, the function ARC: Blocking trip has been connected in negation. The output of the AND element needs to be included in configuration of the 'm out of n' selection of the general trip command. The tripping time can be started by the output signal ARC: Start by logic.

For this example the following list parameters need to be set from the local control panel (see the section on 'Setting a List Parameter' in the chapter entitled 'Local Control').

	List Parameter	
LOGIC: Fct.assignm. output 1 (address 030 000)	OR	e.g. LOGIC: Input 4 EXT (address 034 003)
LOGIC: Fct.assignm. output 2	OR	LOGIC: Output 1 (t) (address 042 033)
	AND NOT	ARC: Blocking trip (address 042 000)

In general, any equation within the programmable logic function can be used to start the ARC tripping time.

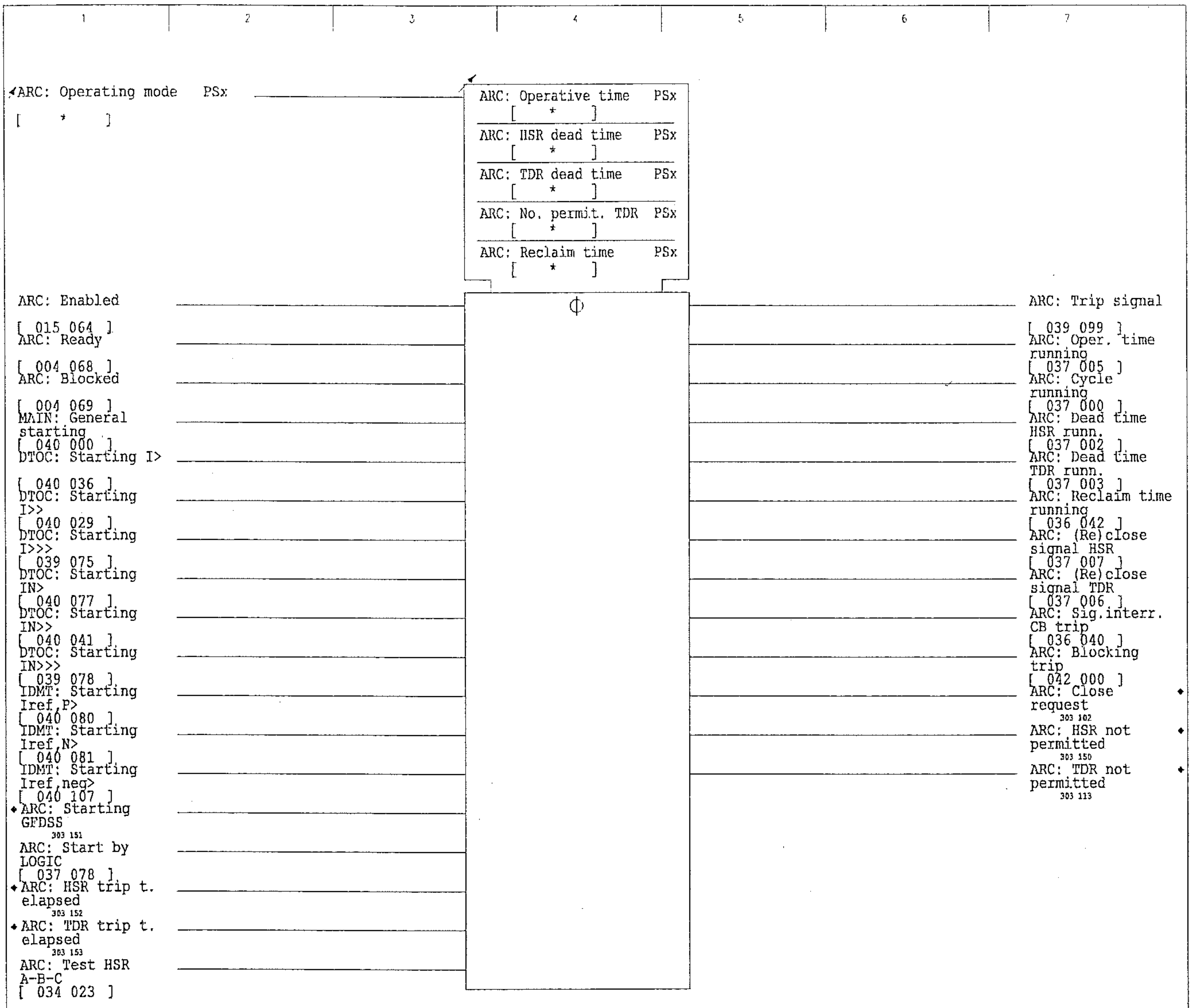
One of the options offered by the programmable logic is the triggering of the ARC by an external protection device.



ɩample of programmable logic in the ARC

ɔont unctions

The entire ARC sequence is monitored and controlled by a sequence control function.



* Parameter	ARC: Operating mode PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: No. permit. TDR PSx	ARC: Reclaim time PSx
set 1	015 051	015 066	015 056	015 057	015 068	015 054
set 2	024 025	024 035	024 030	024 031	024 037	024 028
set 3	024 085	024 095	024 090	024 091	024 097	024 088
set 4	025 045	025 055	025 050	025 051	025 057	025 048

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3-134 ARC sequence control

3.26.1 High-Speed Reclosure (HSR)

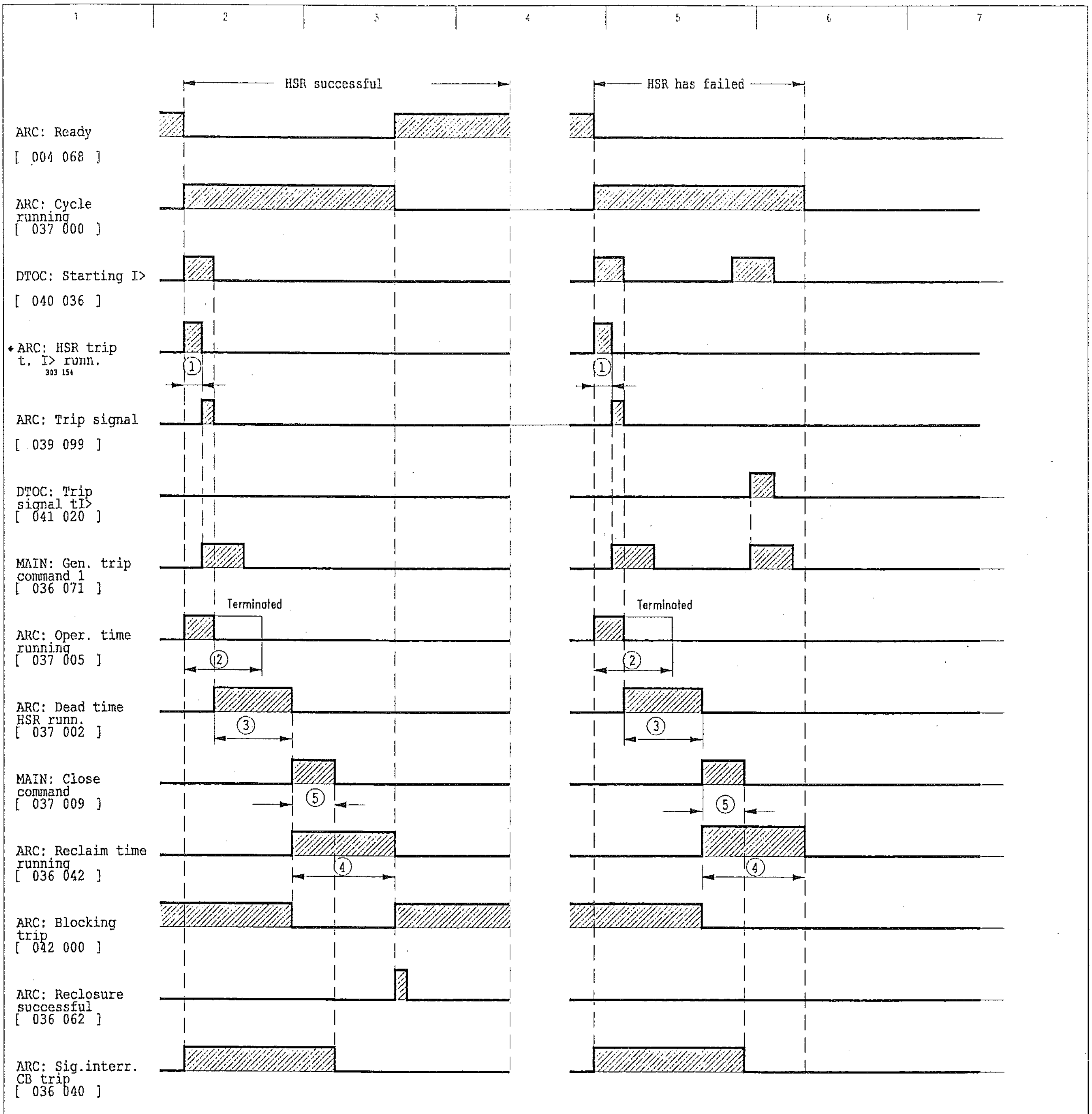
If the starting conditions are satisfied then any ARC-relevant protection startings will trigger an ARC cycle. The startings set off the associated tripping time stages and the operative time. If an HSR tripping time elapses during the operative time then the signal ARC: Trip signal is issued provided that the trip signal is configured accordingly. This signal can lead to a trip command if the function assignment for the trip commands is configured appropriately. As the starting drops out, the operative time is terminated and the HSR dead time begins. If there is no starting during the dead time, a reclosure command is issued once the dead time has elapsed. The reclaim time is started simultaneously. If there is no starting during the reclaim time, the signal ARC: Reclosure successful is issued and the ARC cycle is terminated once the reclaim time has elapsed.

If the HSR does not succeed and another starting occurs then a TDR is started if at least one TDR is permitted. If TDR after HSR is not permitted then the current reclaim time will be the last reclaim time of the ARC cycle. If the last reclaim time has elapsed and another starting occurs then the tripping time stages are no longer started. Instead the signal ARC: Blocking trip is set to a logic value of '0' and a trip by other protection functions is enabled. If a trip signal occurs during the last reclaim time then it will be regarded as a definitive trip. The ARC cycle is completed after the last reclaim time has elapsed.

When the signal ARC: Cycle running appears, the signal ARC: Sig.interr. CB trip (interruption breaker trip signal) is issued and is reset after the final HSR or TDR of the current ARC cycle once the close command pulse time has elapsed. When the signal ARC: Blocked appears during an ARC cycle, the signal is likewise immediately reset.

If the operative time elapses before the starting drops out, the last reclaim time will be started directly and the blocking of the protection trip signals is cancelled.

During the dead time, the P130C keeps checking whether any ARC-relevant startings occur. If this is the case, the last reclaim time is started and the blocking of the protection trip signals is cancelled.



* Parameter	① ARC: HSR trip. time I> PSx	② ARC: Operative time PSx	③ ARC: HSR dead time PSx	④ ARC: Reclaim time PSx
set 1	015 072	015 066	015 056	015 054
set 2	024 040	024 035	024 030	024 028
set 3	025 000	024 095	024 090	024 088
set 4	025 060	025 055	025 050	025 048

⑤ MAIN: Close cmd.pulse time

ARC: No. permit. TDR PSx Setting: 0

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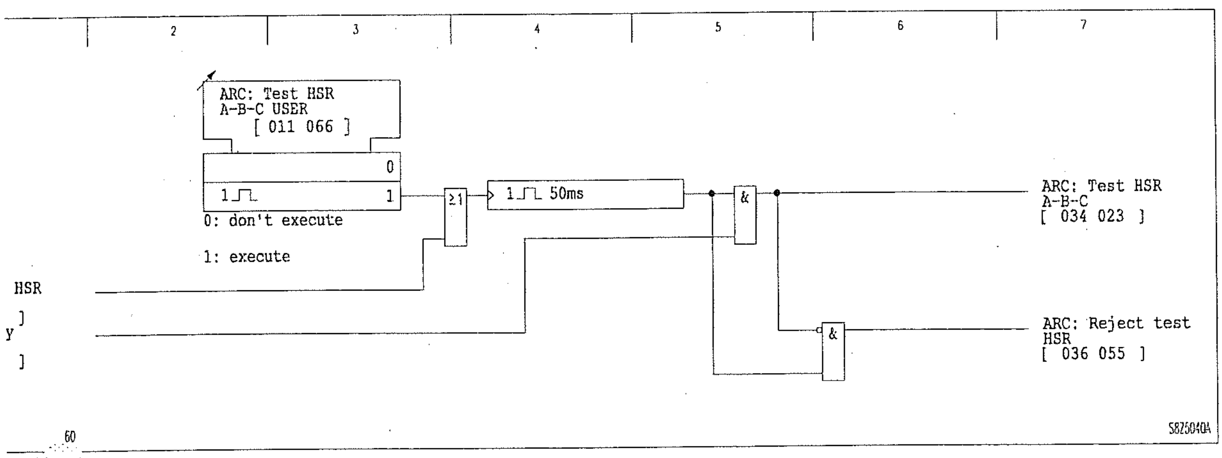
3-135 HSR signal sequence

A test HSR can only be triggered when the ARC is ready to operate and if the operating mode has been set to *Test HSR only permit*. In this operating mode, the blocking of the trip signals of the DTOC, IDMT and other protection functions is cancelled so that any system fault can be properly cleared.

Once a test HSR has been triggered, a trip signal of defined duration is issued. The subsequent sequence corresponds to a successful HSR (open and reclose command once the HSR dead time has elapsed). Once the close command pulse time has elapsed, further triggering during the reclaim time does not result in another HSR.

A test HSR can be triggered either from the local control panel or via a binary input and adds an increment to the ARC: Number HSR counter.

Each 'Test HSR' request that does not result in a test HSR generates the signal ARC: Reject test HSR.



'est

3.26.2 Time-Delay Reclosure (TDR)

Multiple reclosures using TDRs are possible if the operating mode is set accordingly. A TDR may occur after an HSR if reclosing has occurred as the result of the HSR. If the setting of the ARC operating mode allows only TDRs, then the TDR may occur immediately. In both cases, however, the setting for ARC: No. of permit. TDR PSx (Number of permitted TDRs) must not be equal to zero.

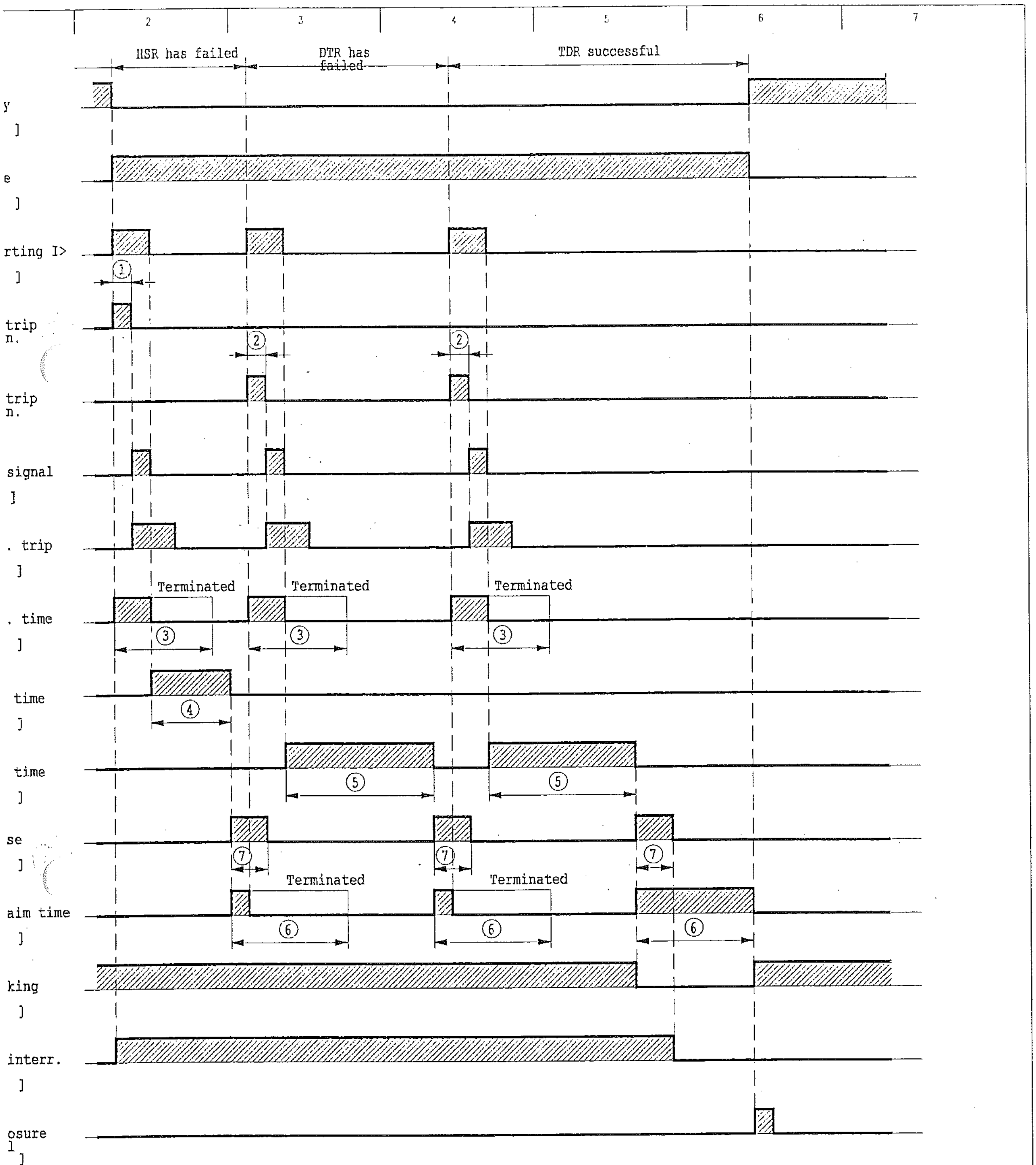
If the starting conditions are satisfied then any ARC-relevant protection startings will trigger the associated tripping times. The reclaim time is started simultaneously. If an TDR tripping time elapses during the operative time then the signal ARC: Trip signal is issued provided that the trip signal is configured accordingly. This signal can lead to a trip command if the function assignment for the trip commands is configured appropriately. As the starting drops out, the operative time is terminated and the TDR dead time begins. If there is no starting during the dead time, a reclosure command is issued once the dead time has elapsed. The reclaim time is started simultaneously. If no further TDR is permitted during the current ARC cycle then this will be the last reclaim time. If the last reclaim time has elapsed and another starting occurs then the tripping time stages are no longer started. Instead the signal ARC: Blocking trip is set to a logic value of '0' and a definitive trip by other protection functions is enabled. If a trip signal occurs during the last reclaim time then it will be regarded as a definitive trip. The ARC cycle is completed after the last reclaim time has elapsed. If there is no starting during the last reclaim time, the signal ARC: Reclosure successful will be issued.

If there is a new starting during the reclaim time and at least one TDR is still permitted then the reclaim time is terminated and another trip is issued once the tripping time has elapsed. Once the dead time has elapsed, a further reclosure command is issued.

When the signal ARC: Cycle running appears, the signal ARC: Sig.interr. CB trip (interruption breaker trip signal) is automatically issued. It is reset after the final HSR or TDR of the current ARC cycle once the close command pulse time has elapsed. When the signal ARC: Blocked appears during an ARC cycle, the signal is likewise immediately reset.

If the operative time elapses before the starting drops out, the last reclaim time will be started directly and the blocking of the protection trip signals is cancelled.

During the dead time, the P130C keeps checking whether any ARC-relevant startings occur. If this is the case, the last reclaim time is started and the blocking of the protection trip signals is cancelled.



Parameter	①	②	③	④	⑤	⑥
	ARC: HSR trip. time I> PSx	ARC: TDR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: Reclaim time PSx
set 1	015 072	015 073	015 066	015 056	015 057	015 054
set 2	024 040	024 041	024 035	024 030	024 031	024 028
set 3	025 000	025 001	024 095	024 090	024 091	024 088
set 4	025 060	025 061	025 055	025 050	025 051	025 048

⑦ MAIN: Close cmd.pulse time

ARC: No. permit. TDR PSx Setting: 2

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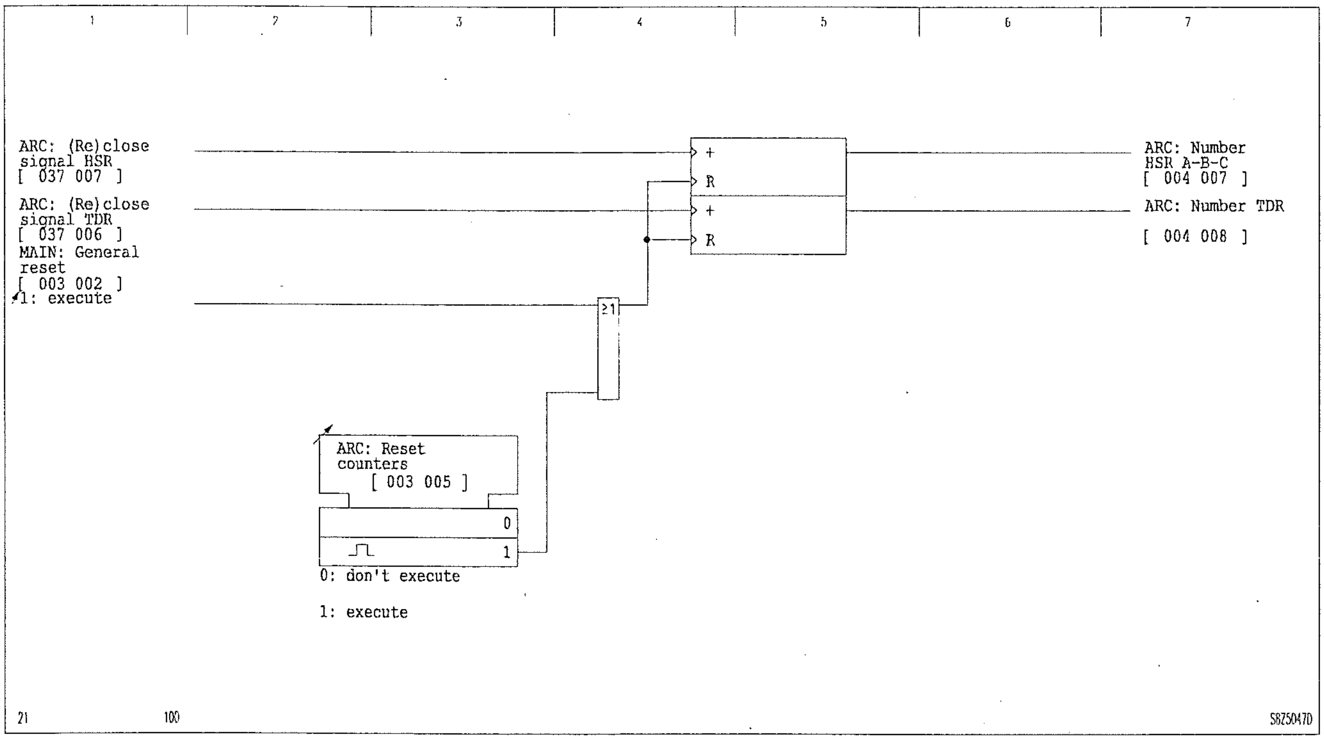
gnal ... ence of a failed HSR followed by a failed TDR and finally by a successful TDR

3.26.3 ARC Counters

The following events are counted:

- Number of high-speed reclosures (HSR) that have been carried out.
- Number of time-delay reclosures (TDR) that have been carried out.

The associated counters can be reset individually or as a group.



3-138 *ARC counters*

3.27 Ground Fault Direction Determination Using Steady-State Values (Function Group GFDSS)

Ground fault direction is determined by evaluating the neutral displacement voltage and the residual current using the steady-state power evaluation method or, alternatively, the admittance evaluation method. As an alternative, it is also possible to detect ground faults (without direction determination in this case) using a steady-state evaluation method based solely on current (steady-state current evaluation). In that case only the filtered residual current is used as the ground fault criterion.

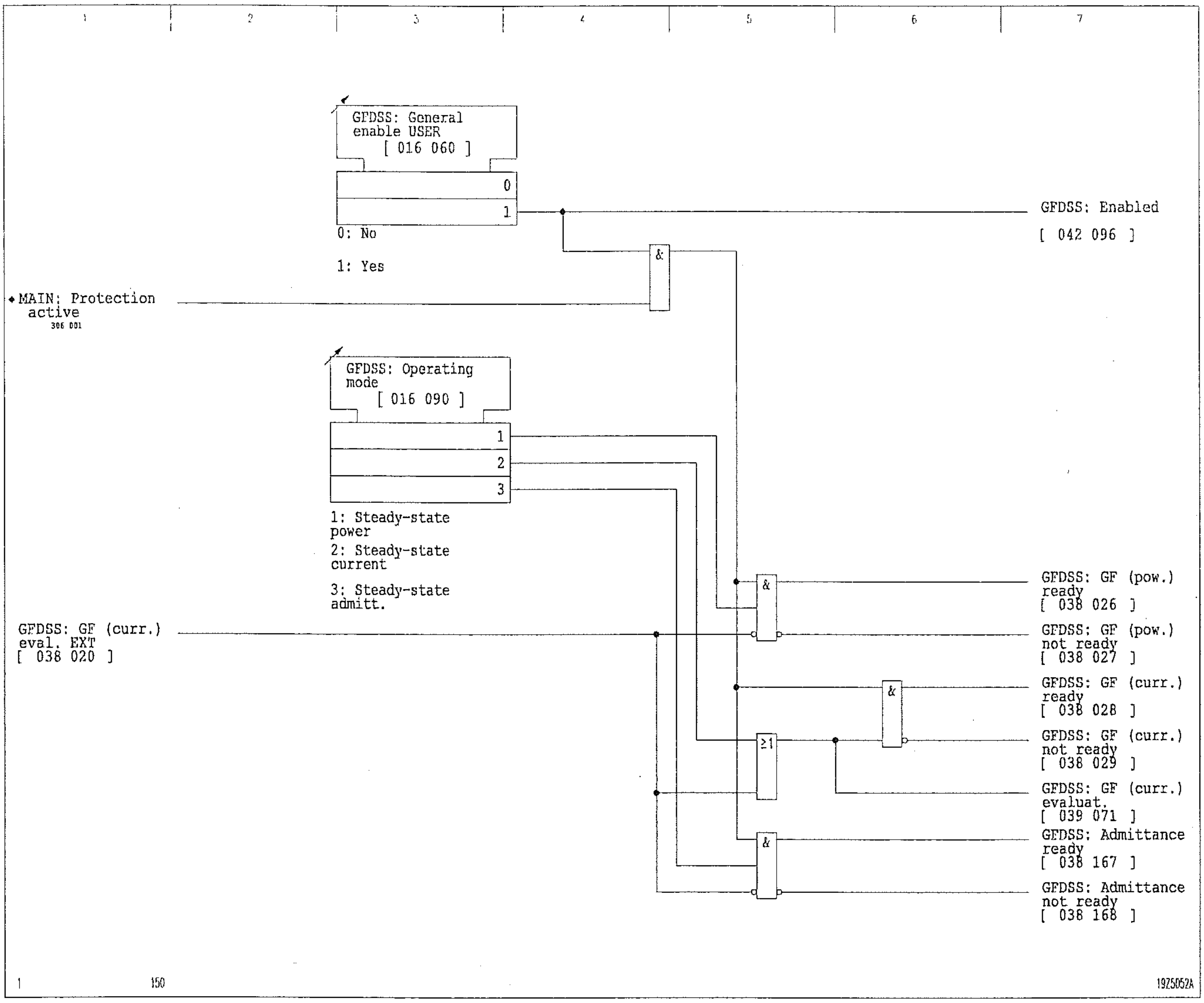
The functional sequence of ground fault direction determination can be influenced by the auto-reclosing control function.

an' abling ult ion ition using ate values

Ground fault direction determination using steady-state values (GFDSS) can be disabled or enabled from the local control panel. The user can switch to the current evaluation mode either from the local control panel or through an appropriately configured binary signal input.

s of ground fault ɟetermination ady-state values

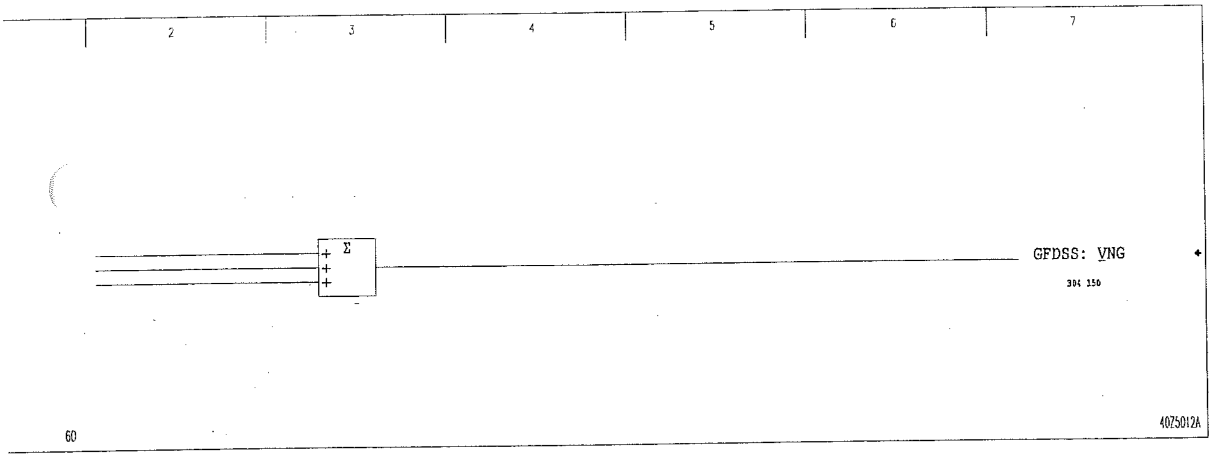
A readiness signal is issued for the selected evaluation mode if protection is active and if ground fault direction determination using steady-state values (GFDSS) is enabled.



3-139 *Enabling, disabling and readiness of ground fault direction determination using steady-state values (GFDSS)*

ing of the
l variables

The neutral displacement voltage calculated by the P130C from the three phase-to-ground voltages is used for steady-state power evaluation. The current transformer is designed specifically for this application so that it has a low phase-angle error.

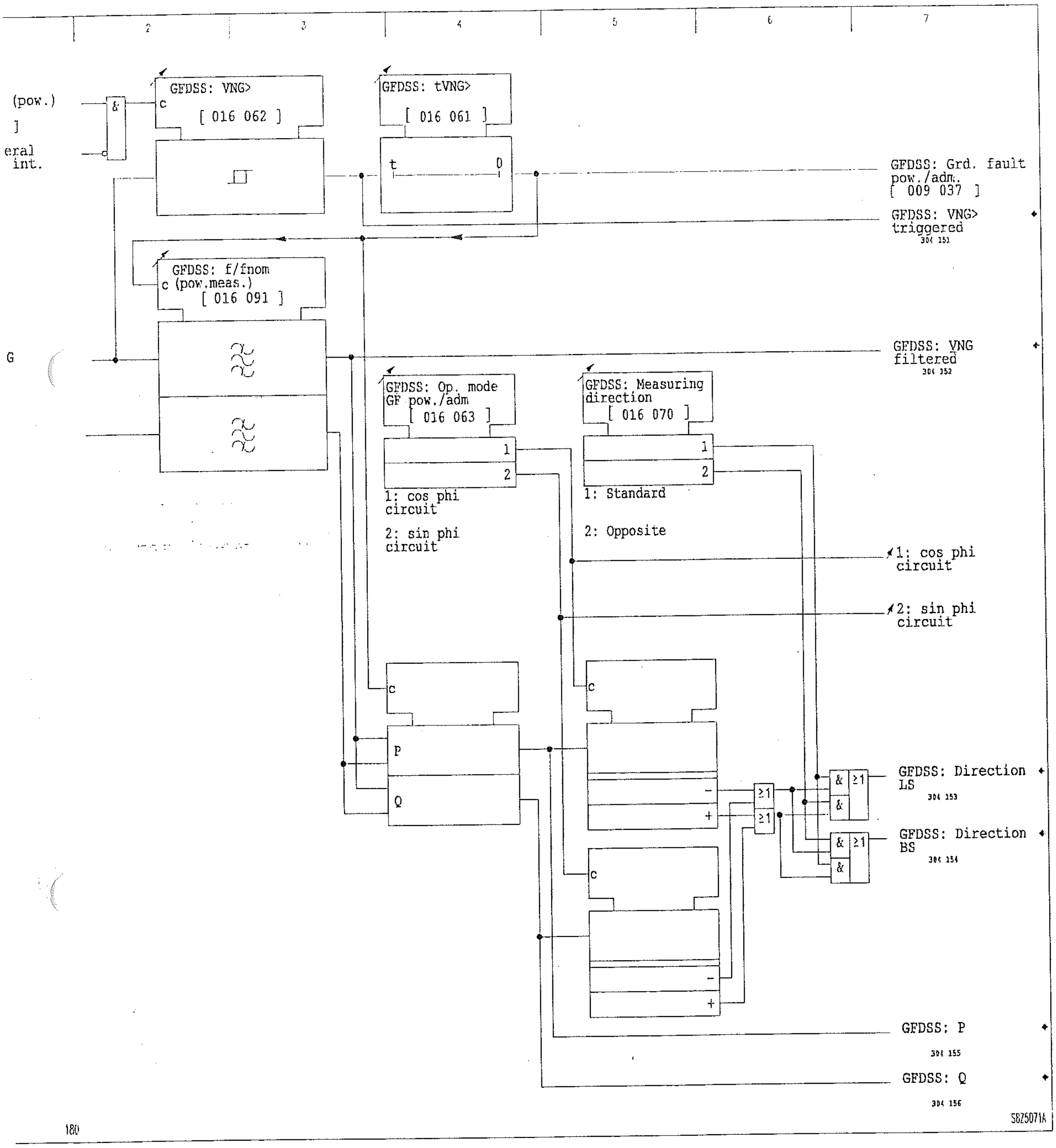


Conditioning of the measured voltage

3.27.1 Steady-State Power Evaluation

In order to detect the ground fault direction, ground fault direction determination by steady-state power evaluation requires the neutral-point displacement voltage and the residual current. The frequency given by the setting f/f_{nom} is filtered from these quantities using Fourier analysis. Three periods are used for analysis if the setting selected for the timer stage GFDSS: tVNG> is greater than or equal to 60 ms. This means that typical ripple control frequencies are suppressed in addition to all integer-frequency harmonics. If the timer stage has been set for values less than 60 ms, only one period is used for filtering purposes.

Measurement is enabled after timer stage tVNG> has elapsed; this stage is started by the trigger VNG>. The sign of either active power GFDSS: Oper. mode GF (pow.) *'cos phi circuit'* or reactive power GFDSS: Oper. mode GF (pow.) '*sin phi circuit*' is used for direction determination, depending on the operating mode selected – *cos phi circuit* or *sin phi circuit*. Connection of the measuring circuits is taken into account by the setting GFDSS: Measuring direction. With the standard connection, a decision for 'LS' is reached in the case of a ground fault on the line side and 'BS' in the case of a ground fault on the busbar side.

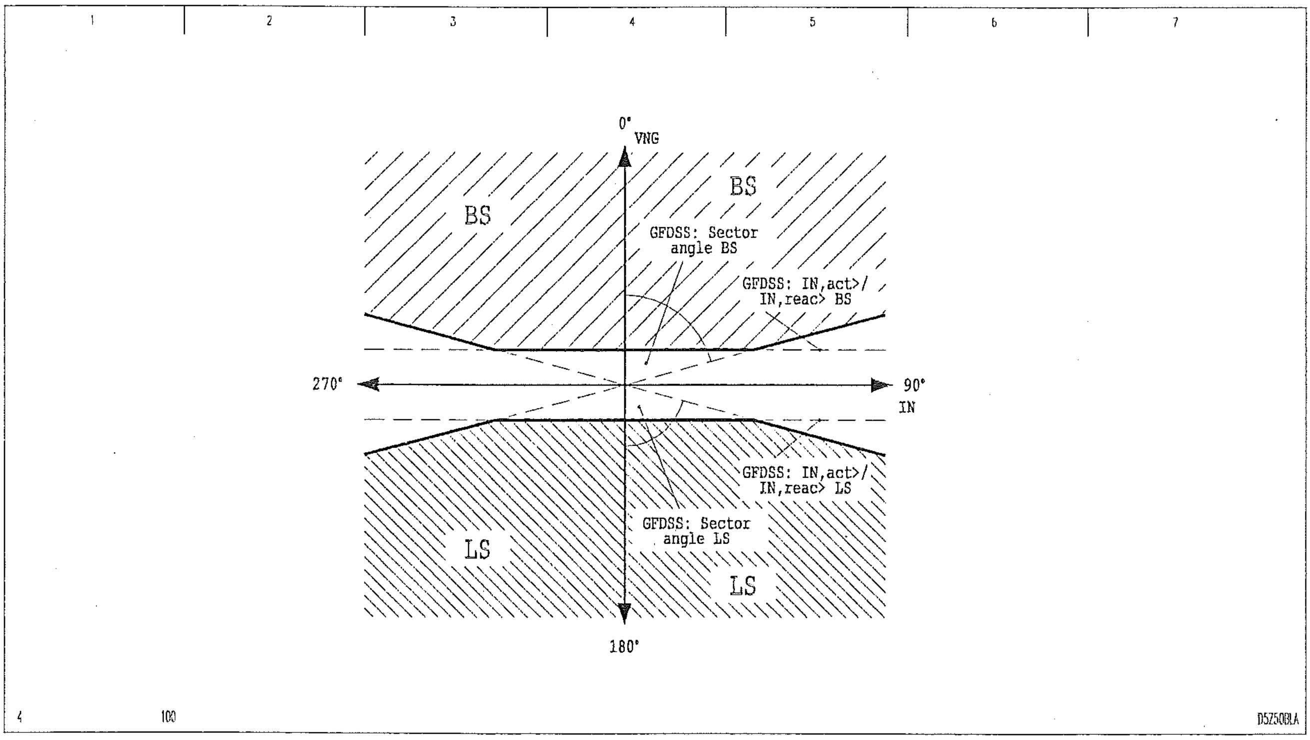


Direction determination in the power evaluation mode *cos φ circuit*

The direction decision is not enabled until the active component of the residual current exceeds the set value and the phase displacement between residual current and neutral displacement current is smaller than the set sector angle. The sector angle makes it possible to extend the "dead zone" to take into account the expected phase-angle errors of the measured variables. These settings make it possible to achieve the characteristic shown in Figure 3-142.

Output of the direction decisions is operate- and release-delayed.

The trip signal of the GFDSS function for the forward direction is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

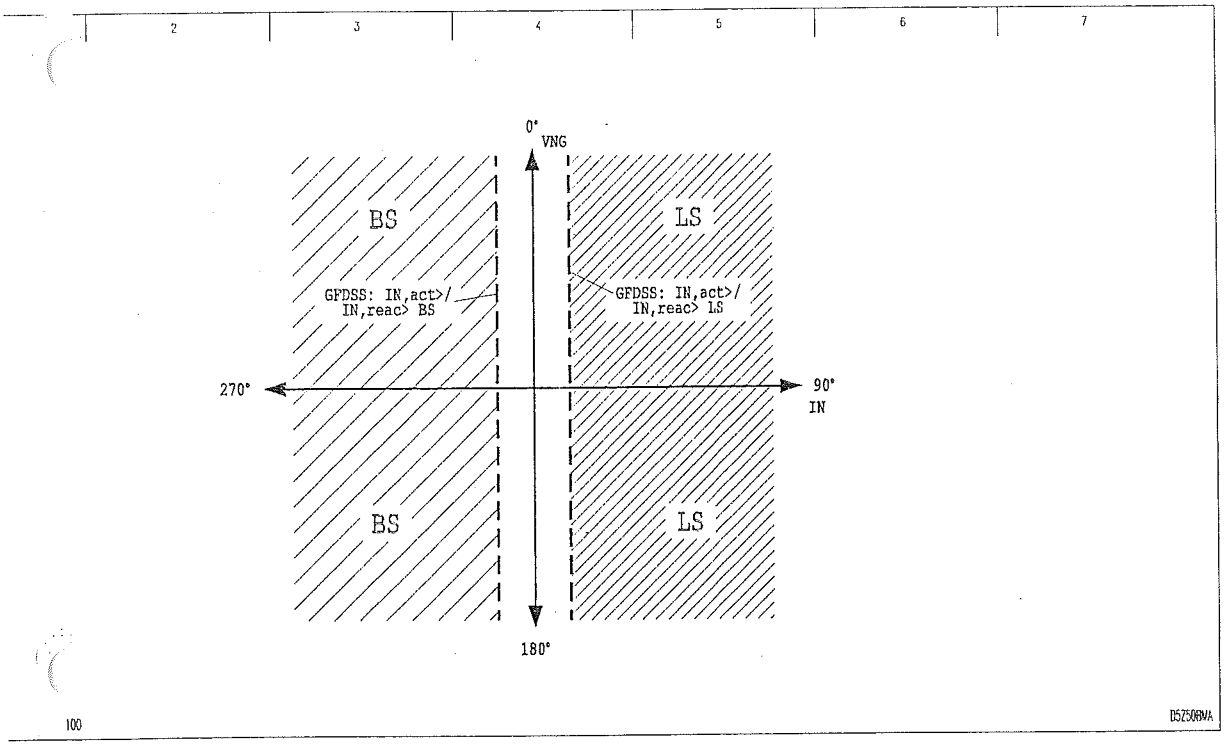


3-142 *Characteristic of ground fault direction determination by steady-state power evaluation, operating mode cos φ* it

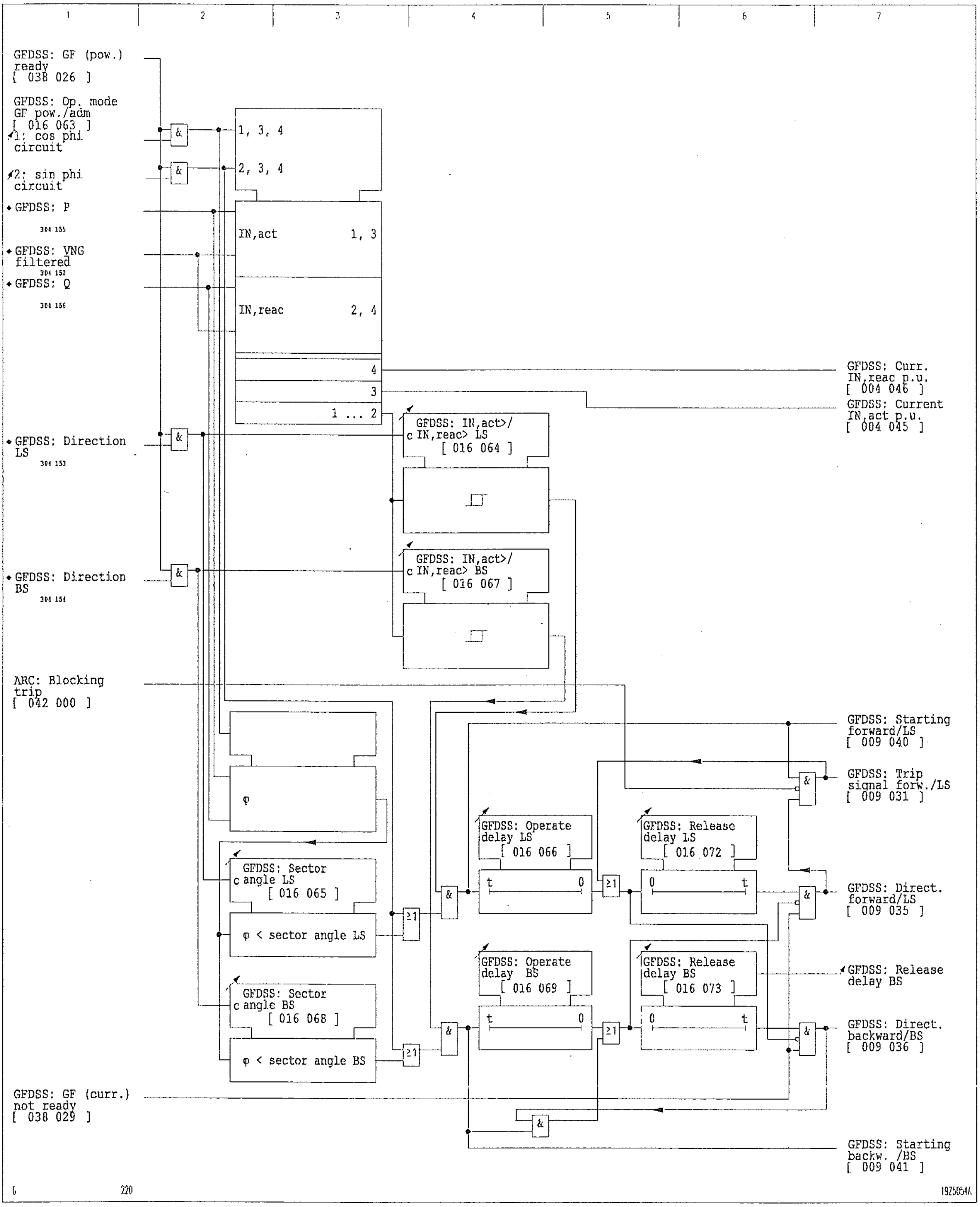
The direction decision is enabled if the reactive component of the residual current has exceeded the set threshold operate value. These settings make it possible to achieve the characteristic shown in Figure 3-143.

Output of the direction decisions is operate- and release-delayed.

The trip signal of the GFDSS function for the forward direction is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.



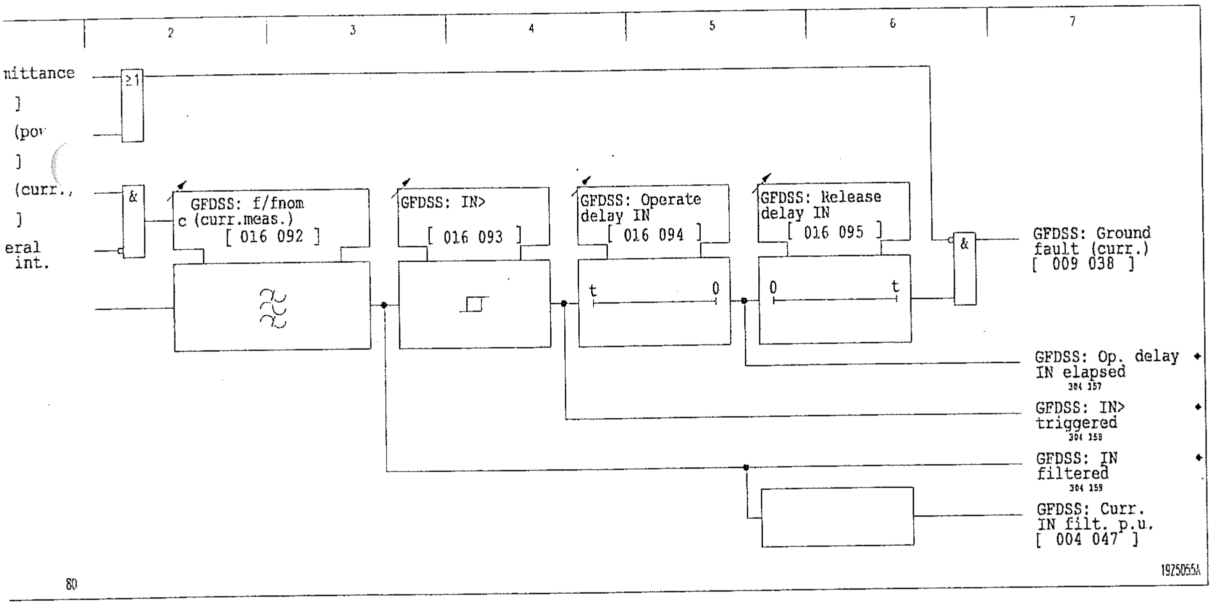
Characteristic of ground fault direction determination by steady-state power evaluation, operating mode sin φ



3-144 Output of direction decisions in the power evaluation mode

3.27.2 Steady-State Current Evaluation

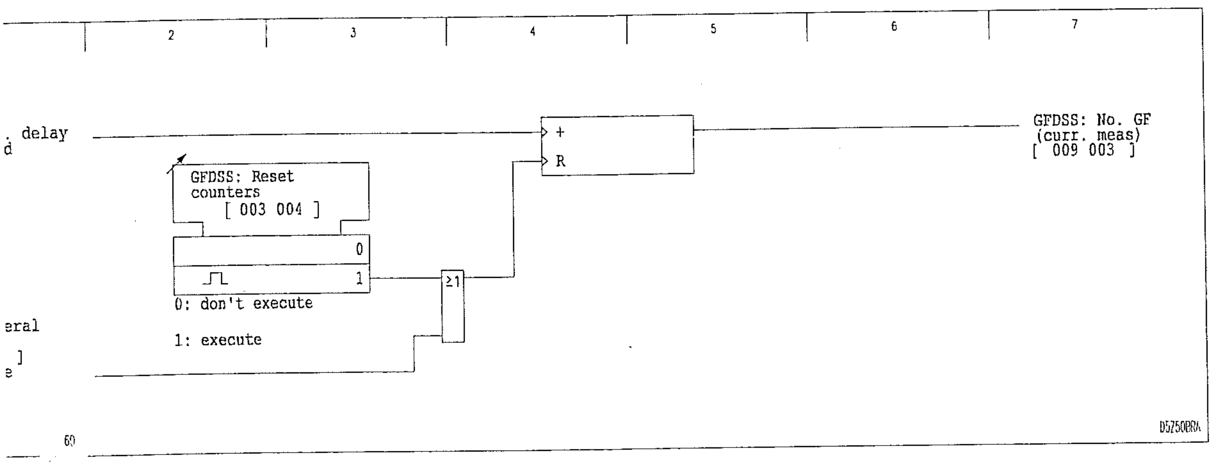
The frequency given by the setting f/f_{nom} is filtered from the residual current using Fourier analysis. Three periods are used for steady-state current evaluation. If the current exceeds the set threshold value, then a ground fault signal is issued after the set operate delay has elapsed.



:valuation of residual current

the ('nd faults

The number of ground faults is counted. The counter may be reset either individually or together with the other counters.

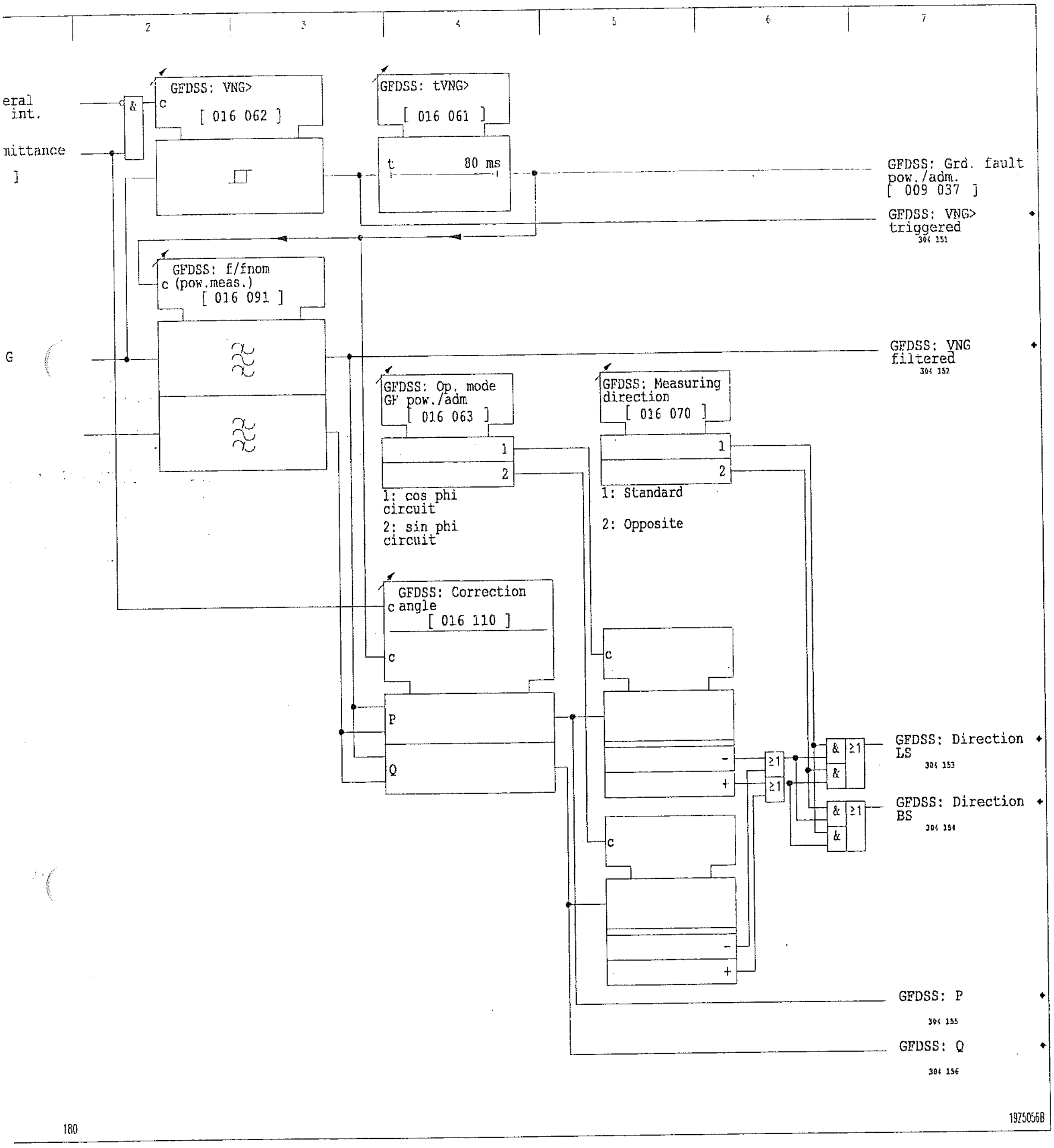


›untir... ..ie ground faults

3.27.3 Admittance Evaluation

In order to detect the ground fault direction, ground fault direction determination in the admittance evaluation mode requires the neutral-point displacement voltage and the residual current. The frequency given by the setting f/f_{nom} is filtered from these quantities using Fourier analysis.

Measurement is enabled after timer stage tVNG> has elapsed; this stage is started by the trigger VNG>. The sign of either active power GFDSS: Oper. mode GF (pow.) *'cos phi circuit'* or reactive power GFDSS: Oper. mode GF (pow.) *'sin phi circuit'* is used for direction determination, depending on the operating mode selected – *cos phi circuit* or *sin phi circuit*. Connection of the measuring circuits is taken into account by the setting GFDSS: Measuring direction. With the standard connection, a decision for 'LS' is reached in the case of a ground fault on the line side and 'BS' in the case of a ground fault on the busbar side. The setting GFDSS: Correction angle is provided to compensate for phase-angle errors of the system transformers.

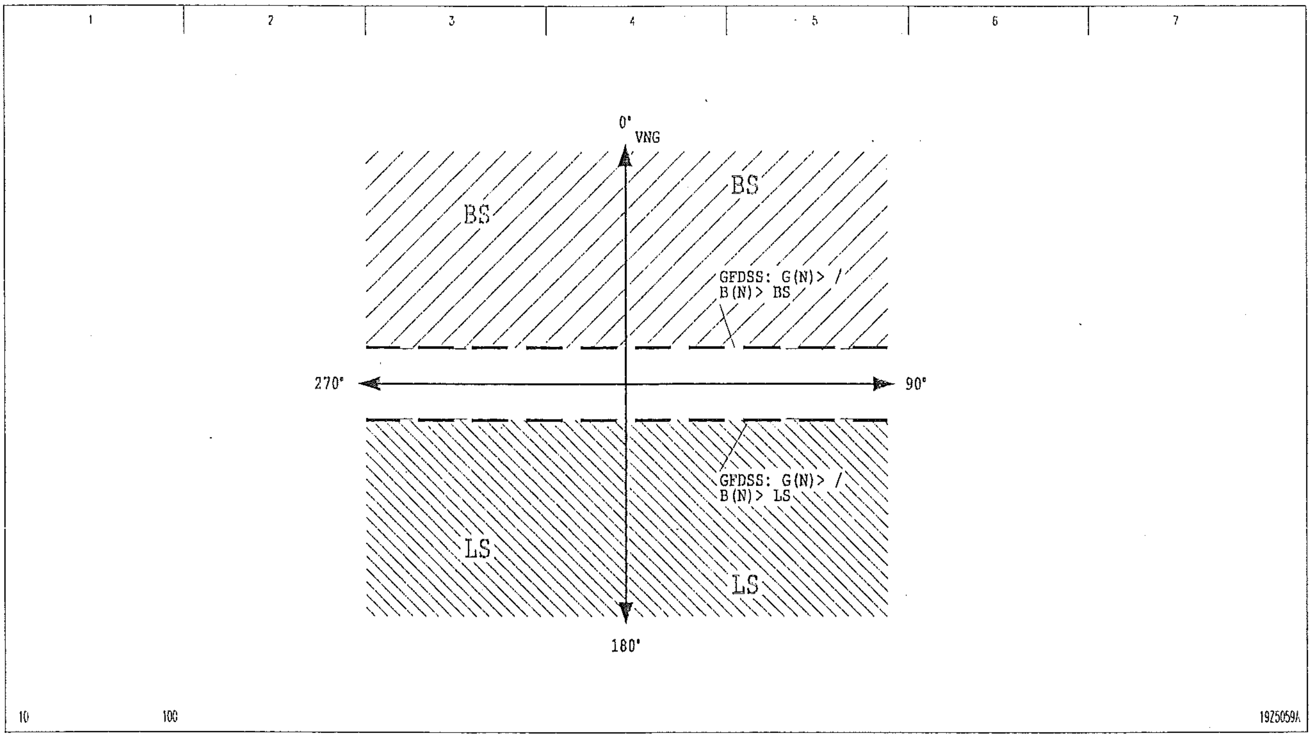


)irection determination in the admittance evaluation mode *cos φ circuit*

The direction decision is enabled if the conductance G(N) in the residual current loop has exceeded the set threshold operate value. This setting makes it possible to achieve the characteristic shown in Figure 3-148.

Output of the direction decisions is operate- and release-delayed.

The trip signal of the GFDSS function for the forward direction is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.

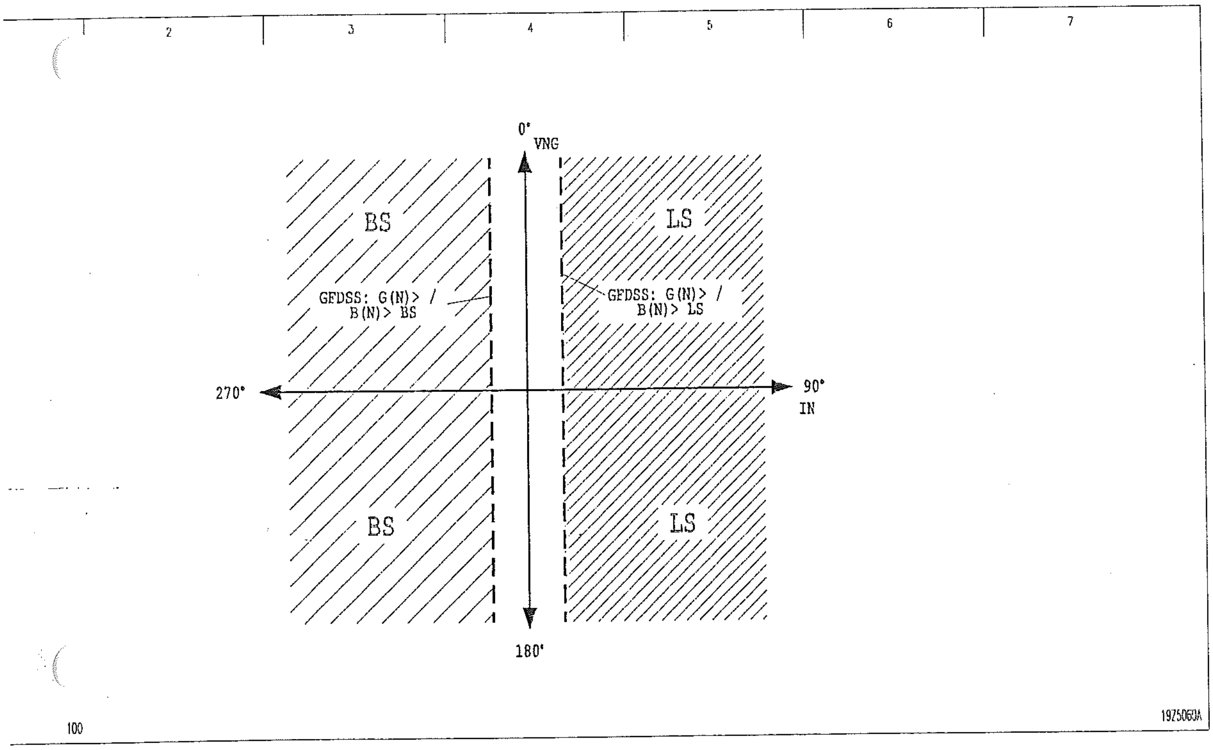


3-148 *Characteristic of ground fault direction determination by steady-state admittance evaluation, operating mode cos φ* it

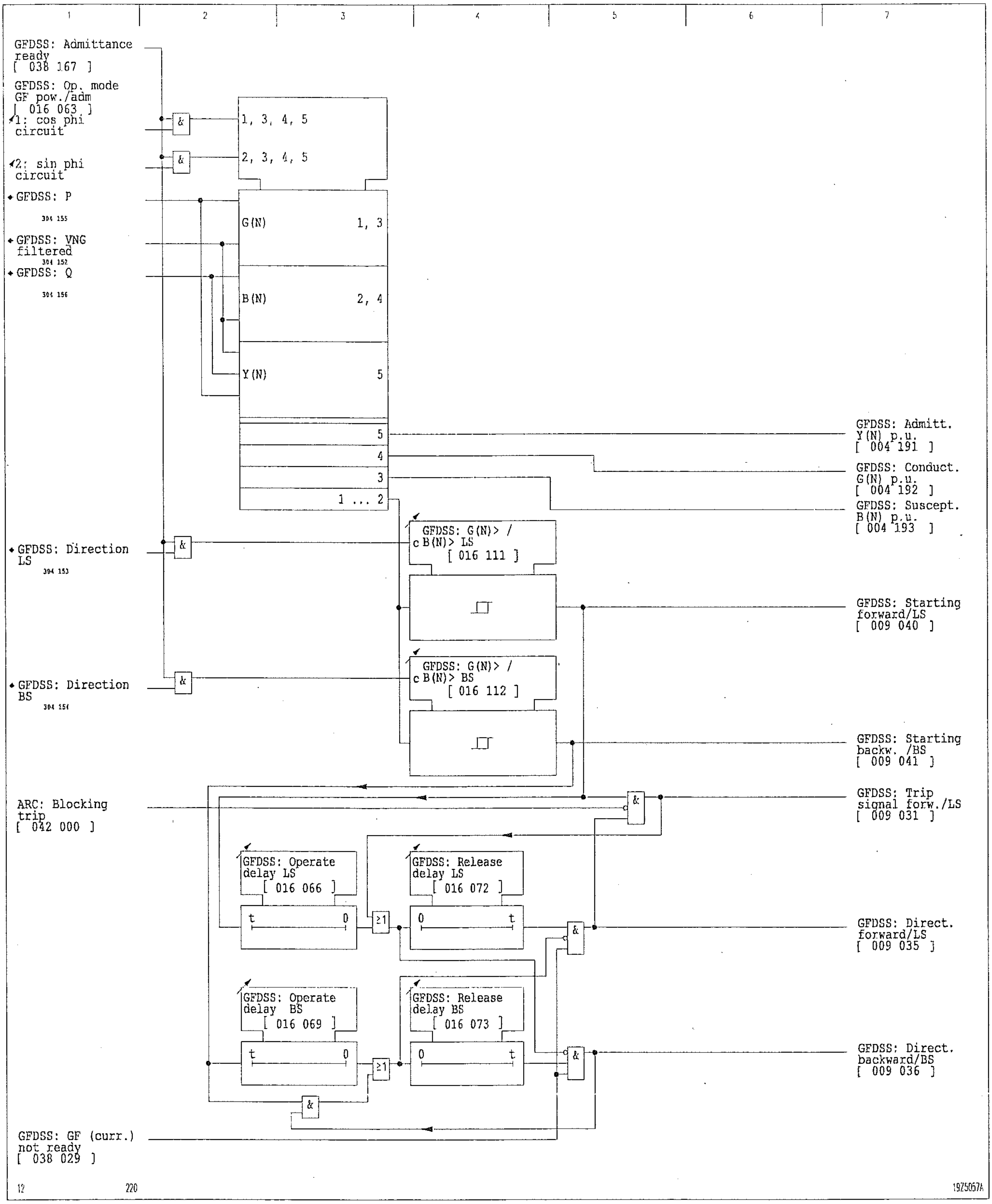
The direction decision is enabled if the susceptance B(N) in the residual current loop has exceeded the set threshold operate value. This setting makes it possible to achieve the characteristic shown in Figure 3-149.

Output of the direction decisions is operate- and release-delayed.

The trip signal of the GFDSS function for the forward direction is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.



Characteristic of ground fault direction determination by steady-state admittance evaluation, operating mode sin φ



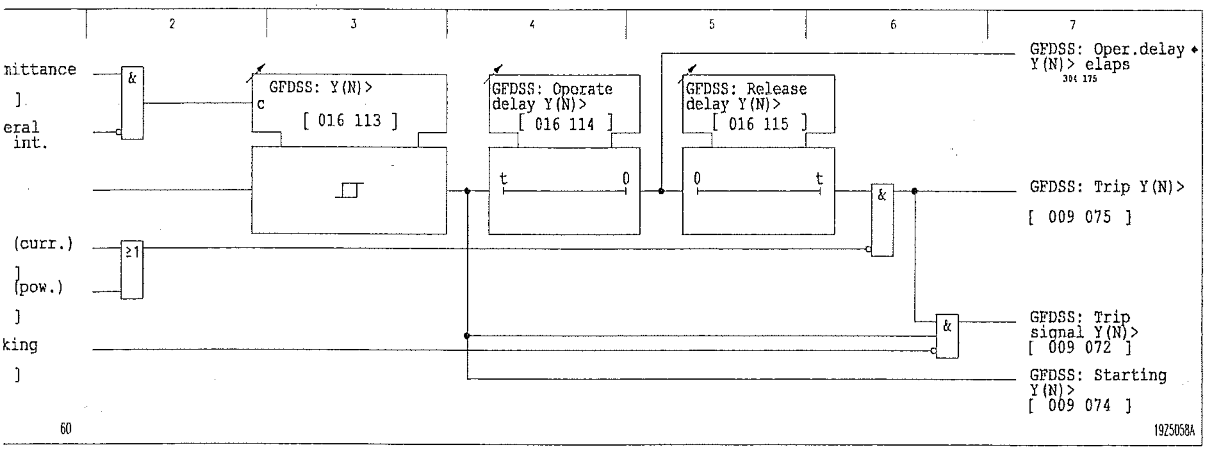
3-150 Output of the direction decisions in the admittance evaluation mode

*tional ground
rmination*

In the admittance evaluation mode, the non-directional ground fault determination function can serve as backup protection in case, for example, the active component G(E) is too small for directional determination.

The admittance in the residual current loop is used in the evaluation. If the current exceeds the set threshold value, then a ground fault signal is issued after the set operate delay has elapsed.

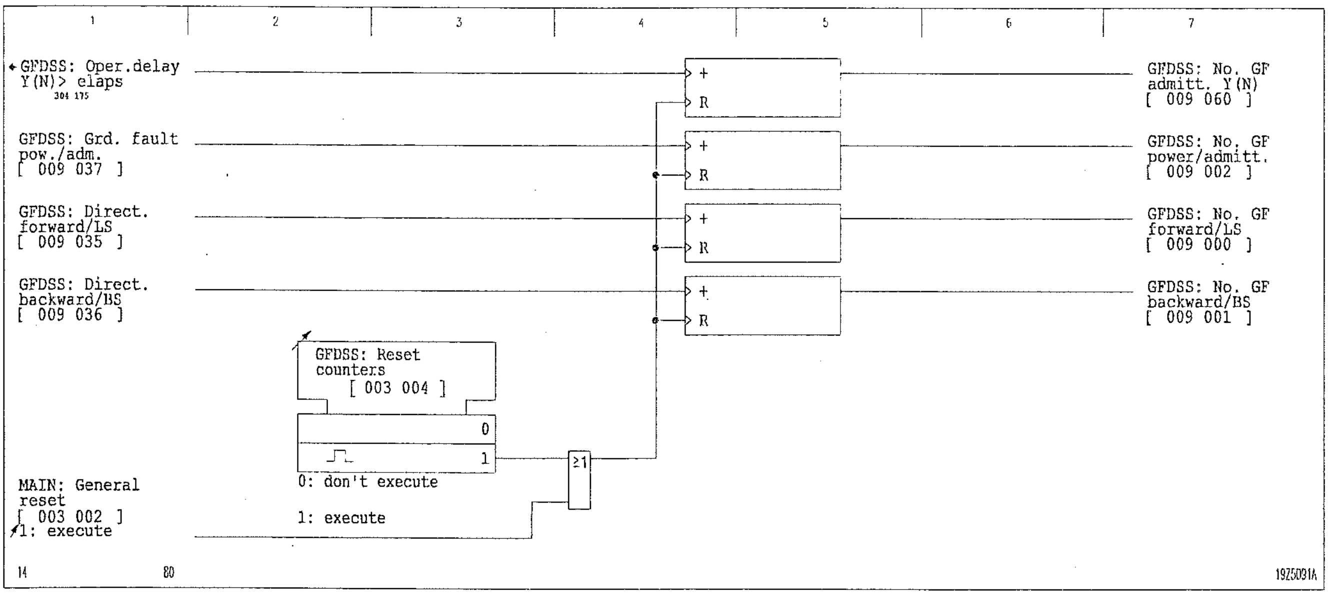
The trip signal of the non-directional ground fault determination is blocked by the auto-reclosing control function (ARC) if the ARC is able to form a trip command.



\dmittance evaluation

3.27.4 Counting the Ground Faults Detected by Steady-State Power and Admittance Evaluation

The number of ground faults and direction decisions is counted. The counters can be reset either individually or as a group.



3-152 *Counting the ground faults*

3.28 Motor Protection (Function Group MP)

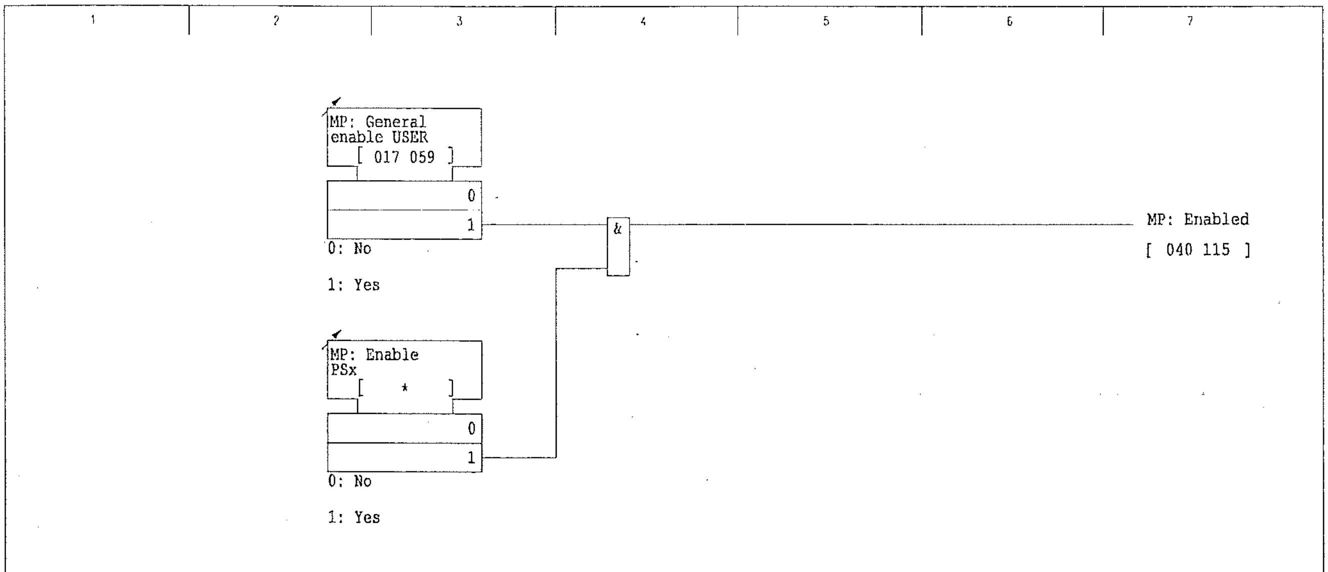
A motor protection function is implemented in the P130C. This motor protection function is designed especially for protection of directly switched, high-voltage asynchronous motors with thermally critical rotors. Optimized protection functions are available for this application:

- Overload protection with thermal replica of the motor (complete memory)
- Inclusion of heat dispersion processes in the rotor after several startups
- Separate cooling time constants for running and stopped machines
- Startup frequency monitoring for the number of startups, restart blocking
- Heavy starting logic
- Locked rotor protection
- Logic function for the operating mode with thermal overload protection (THERM)
- Special startup measured values for commissioning

The definite-time overcurrent protection stages and the unbalance protection function, which are necessary for comprehensive motor protection, are described in this chapter in the sections on DTOC protection and unbalance protection (I2>), respectively.

Enabling or disabling motor protection

Limit value monitoring can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.

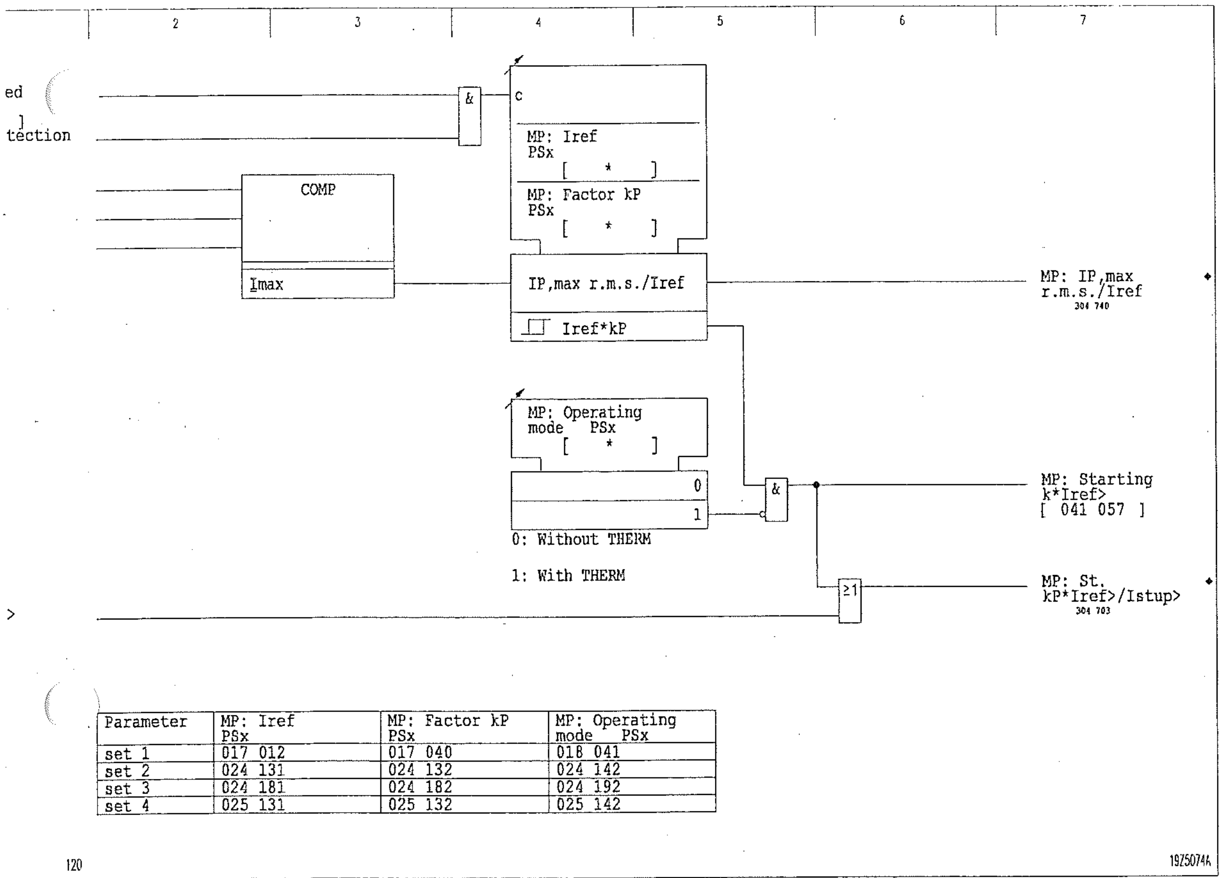


* Parameter	MP: Enable PSx
set 1	024 148
set 2	024 147
set 3	024 197
set 4	025 147

3-153 *Enabling or disabling motor protection* *onditions*

The overcurrent stage $I_{kIref,P}$> serves as the starting stage for the overload protection function. The maximum value of the three phase currents is evaluated. The reference quantity for operate value and tripping time is the set reference current $I_{ref,P}$. The current stage operates when $I_{kIref,P}$> is exceeded.

The output signal of the overcurrent stage $I_{kIref,P}$> is the starting signal.



Parameter	MP: Iref PSx	MP: Factor kP PSx	MP: Operating mode PSx
set 1	017 012	017 040	018 041
set 2	024 131	024 132	024 142
set 3	024 181	024 182	024 192
set 4	025 131	025 132	025 142

Starting conditions

3.28.1 Overload Protection

Recognition of operating state

In order to control the overload protection function, i.e., for optimized thermal tracking, the P130C is equipped with an operating state recognition function. The possible operating states of a directly switched asynchronous motor are detected by way of different trigger stages, as follows:

- ☐ Machine stopped:
  If the measured maximum r.m.s. phase current falls below the current threshold of 0.1 I_{ref}, the 'machine stopped' state is recognized. No-load currents of asynchronous motors will definitely be above the current threshold of 0.1 I_{ref}.
- ☐ Machine running:
  If the measured maximum r.m.s. phase current is above the current threshold of 0.1 I_{ref}, the 'machine running' state is recognized.
- ☐ Overload range:
  The overload range of a machine includes all those currents that exceed the maximum permissible continuous thermal current of the machine. If the measured maximum r.m.s. phase current exceeds the current threshold of $I_{kIref,P}>$, then an increment is added to the overload memory.
- ☐ Startup:
  The onset of startup in a directly switched asynchronous motor is detected when the measured maximum r.m.s. phase current exceeds the current threshold of MP: IStUp> PSx for a set minimum period $t_{IStUp>}$. The end of a startup process is detected when, after onset of startup has been identified, the measured maximum r.m.s. phase current falls below the current threshold of 0.6 $I_{StUp}>$.

Overload memory

The thermal overload protection function implemented in the P130C is designed especially for protection of motors with thermally critical rotors, a very common motor type. A special overload memory is included for this application. This memory contains a replica of the excess temperature of the protected object relative to the temperature of the coolant over a range of 0 to 100 %. The following memory loading values have a particular significance in conjunction with this model:

- ☐ 0 %:
  A value of 0 % represents the cold state of the protected object, i.e., after the protected object has cooled down to ambient temperature.
- ☐ 20 %:
  A value of 20 % represents the minimum load of the overload memory with the protected object at operating temperature or after initial startup. A running machine is always considered as being at operating temperature.
- ☐ 40 %:
  A value of 40 % temporarily represents the minimum load of the overload memory after two consecutive startups of the protected object.
- ☐ 60 %:
  A value of 60 % temporarily represents the minimum load of the overload memory after three consecutive startups of the protected object.

- 100 %:
  As soon as the overload memory reaches a value of 100 % (trip threshold), an overload protection trip is issued. The hysteresis for a defined release of the trip signal is 1 %.

The overload memory mapping process that results in a replica of the actual thermal conditions in the protected object includes the following operations:

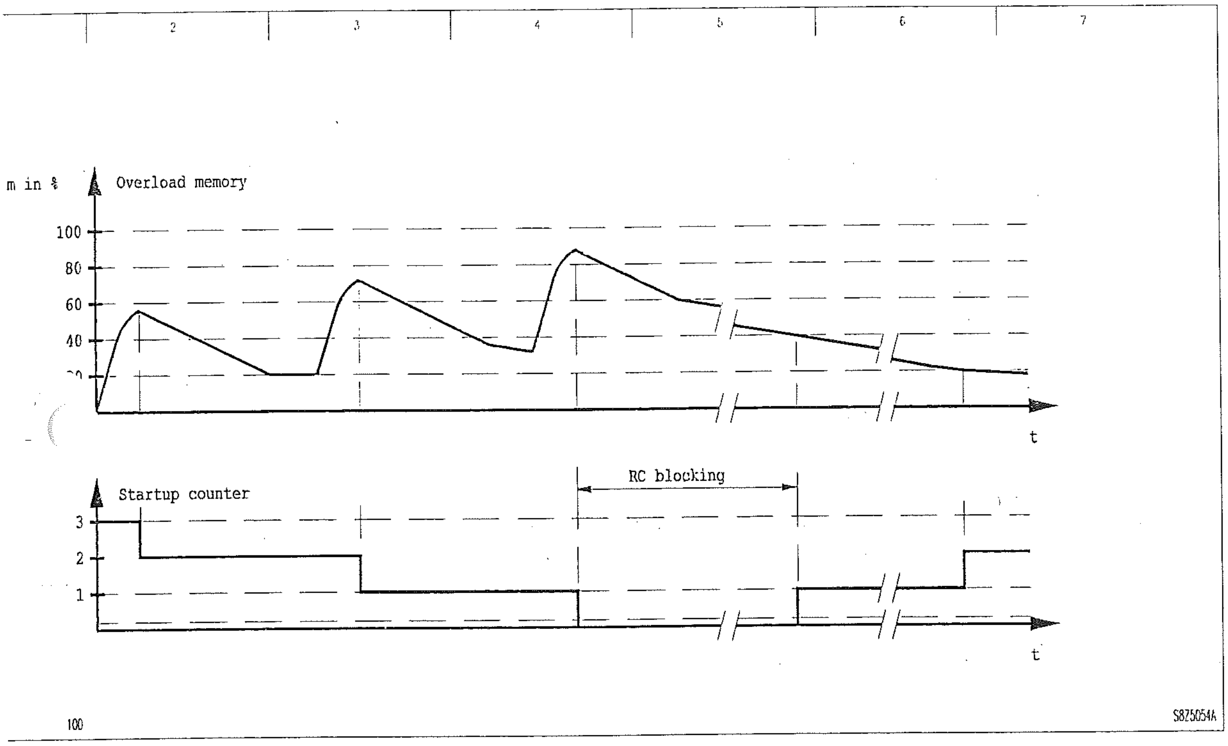
- Mapping of heating:
  The overload memory increases continuously by increments if the measured maximum r.m.s. phase current exceeds the current threshold of $I_{klref,P}>$ (overload range). The rate of this increase is a function of the magnitude of the maximum r.m.s. phase current and, to some extent, of the selected tripping characteristic MP: Character. type P PSx.
- Mapping of heat transfer:
  If a startup has been detected and the maximum r.m.s. phase current falls below the current threshold of $0.6 \cdot I_{StUp}>$, then a continuous pre-discharge of the overload memory will automatically occur, governed by the time constant MP: Tau after st.-up PSx of the overload memory. This time constant is used to map the heat transfer in the asynchronous motor from the copper of the rotor to the rotor core. This continuous pre-discharge is linear until the minimum load after startup (described above) is reached, which is a function of the count on the startup frequency counter. The rate of this pre-discharge is constant: 40 % discharge ($\tau_{after\ startup} = 20$) within a time period of 60 s, for example.
- Mapping of cooling:
  If the measured maximum r.m.s. phase current falls below the current threshold of $I_{klref,P}>$ and if the mapping of heat transfer, if applicable, has been completed, then cooling of the protected object is simulated by continuous overload memory discharge. If the machine is running, the discharge will be governed by the cooling time constant MP: Tau mach. running PSx and will continue until the minimum loading state of 20 % is reached. If the machine is stopped, discharge will be governed by the constant MP: Tau mach. stopped PSx and will continue until the minimum loading state of 0 % is reached. Discharge is an exponential function of time. The cooling time from an initial value m_0 to an interim value of m(t) can be determined as follows:

  - Machine running: $t = \tau_{machine.running} \cdot \ln \frac{m_0 - 0{,}2}{m(t) - 0{,}2}$
  - Machine stopped: $t = \tau_{machine.stopped} \cdot \ln \frac{m_0}{m(t)}$

Startup frequency monitoring

A startup counter in 'count down' circuit configuration is included in the P130C for startup frequency monitoring. Depending on the setting MP: Perm. No. st.-ups PSx, the permissible number of consecutive startups is either 'three from cold or two from warm' or 'two from cold or one from warm'. The counter reading at any given time indicates the number of consecutive startups that are still permitted. The startup counter is controlled as follows (see Figure 3-155):

- Decrementing the startup counter (number of startups still permitted):
  As the end of a startup is detected, the startup counter is decremented by '1'. If the counter reading reaches its minimum value of '0,' then the 'RC blocking' signal is formed and can - and indeed should - be configured to an output relay for the purpose of CB closure blocking.
- Incrementing the startup counter (number of startups still permitted)
  If the setting for the permissible number of consecutive startups is 'three from cold or two from warm' and the machine is running, then the startup counter is incremented by '1' if the overload memory charge drops below a threshold value of 40 % or 22 %, respectively, in conjunction with simulation of the cooling of the protected object. If the machine is stopped then the startup counter will be incremented by '1' if the overload memory charge drops below 40 %, 20 % or 2 %, respectively, as cooling of the protected object is simulated by the model.
  If the setting for the maximum permissible number of consecutive startups is 'two from cold or one from warm' and the machine is running, then the startup counter will be incremented by the value '1' if the overload memory charge drops below the threshold of 22 % as cooling of the protected object is simulated by the model. If the machine is stopped then the startup counter will be incremented by '1' if the overload memory charge drops below 20 % or 2 %, respectively, in conjunction with simulation of protected object cooling.
  The 'RC blocking' signal is withdrawn if the overload memory charge falls below the 40 % threshold (for three consecutive startups from cold or two from warm) or 22 % (for 'two from cold or one from warm').



verload memory and startup counter

rting logic

The heavy starting application involves a situation in which a machine's startup time tStUp exceeds its maximum possible blocking time t_E from operating temperature. For this application the P130C is equipped with a special logic function that can be activated by the following two settings:

- The permissible number of consecutive startups is limited to 'two from cold or one from warm' (MP: Perm. No. st.-ups PSx).
- For the permissible startup time t_{StUp} (MP: St.-up time tStUp PSx), a higher value is set than for the maximum permissible blocking time t_E from operating temperature (MP: Blocking time tE PSx). These two setting values are only relevant for this particular application; if both settings are identical, they have no effect on the protective function and the heavy starting logic is not active.

If this logic function has been activated, then the two timer stages t_E and t_{StUp} are started at the time when the onset of a startup is detected, corrected by the discrimination time $t_{IStUp>}$. Once the set time t_E has elapsed, the logic function checks to see whether the machine is actually running. The presence of an external signal – from an overspeed monitor, for example – serves as the criterion for a running machine.

If a running machine is detected once the set time t_E has elapsed, then the overload memory charge is automatically frozen and tracking is only restarted after the set startup time t_{StUp} has elapsed. If a locked rotor state is detected after the set time t_E has elapsed, the overload memory is automatically set to a value of 100 %, which leads to an immediate trip decision.

Tripping time characteristics

The P130C user can choose between the following two tripping time characteristics:

- ☐ Reciprocally squared $t = (1 - m_0) \cdot t_{6I_{ref}} \cdot \frac{36}{(I/I_{ref})^2}$

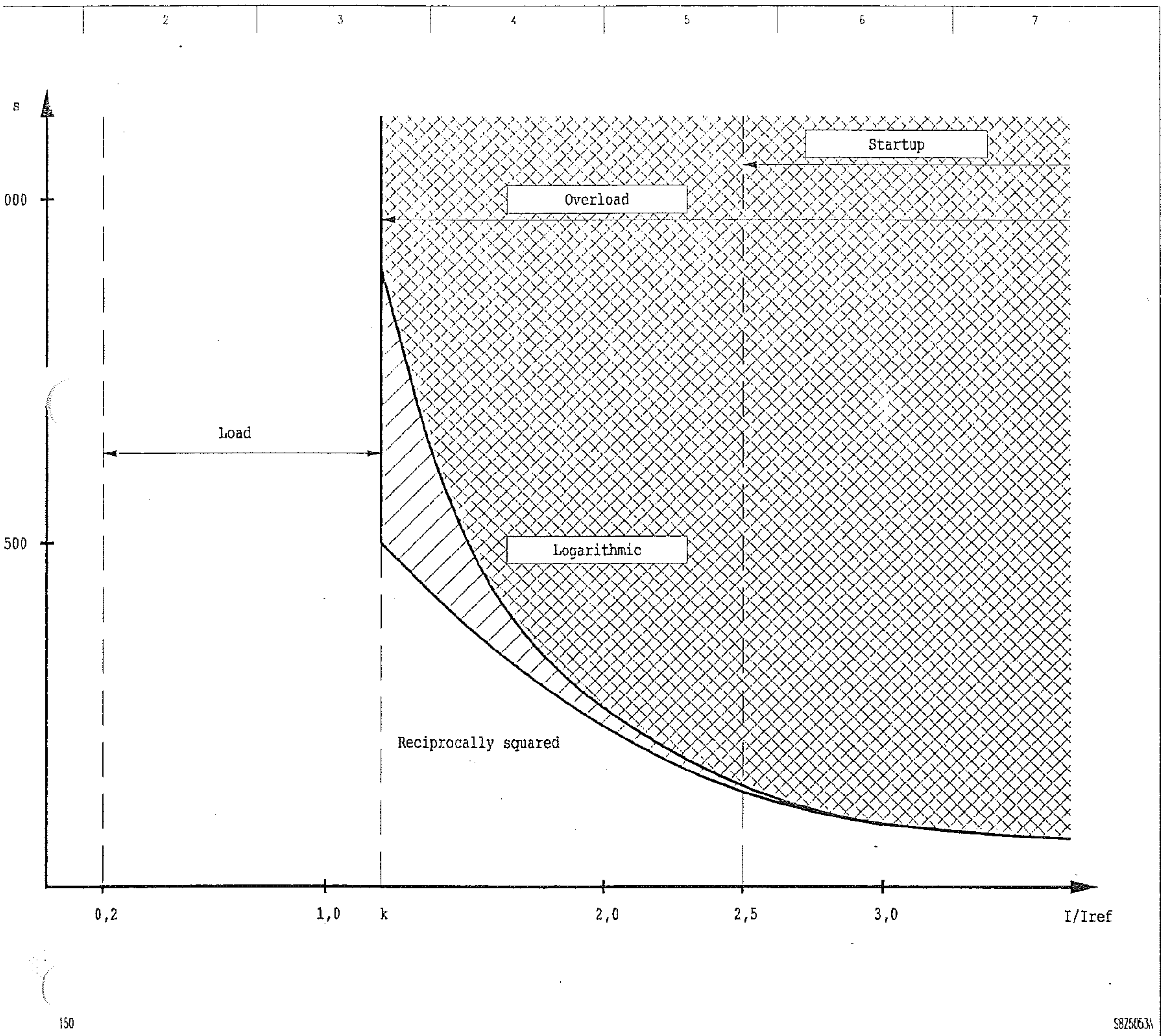
- ☐ Logarithmic: $t = (1 - m_0) \cdot t_{6I_{ref}} \cdot 36 \cdot \ln \frac{(I/I_{ref})^2}{(I/I_{ref})^2 - 1}$

where m_0 in each case signifies the pre-charging of the overload memory at time $t = 0$. With reference to the basic physical model (two-body model), the logarithmic characteristic in the overload range also takes into account heat transfer to the coolant, but this heat transfer becomes less significant as the overcurrent increases. At $I = 6 \cdot I_{ref}$, for example, the tripping time increase is only about 1.4 % and is thus below the specified accuracy of the protection device. In the low overcurrent range, selection of the logarithmic characteristic guarantees significantly higher tripping times than selection of the reciprocally squared characteristic (see Figure 3-156) since in the overload range the reciprocally squared characteristic always disregards heat transfer to the cooling medium. The possibility of choosing between two different tripping time characteristics takes into account the fact that the user or the application may require a more restrictive or less restrictive type of protection. For currents in excess of 10 I_{ref}, the tripping times are limited in the direction of lower values.

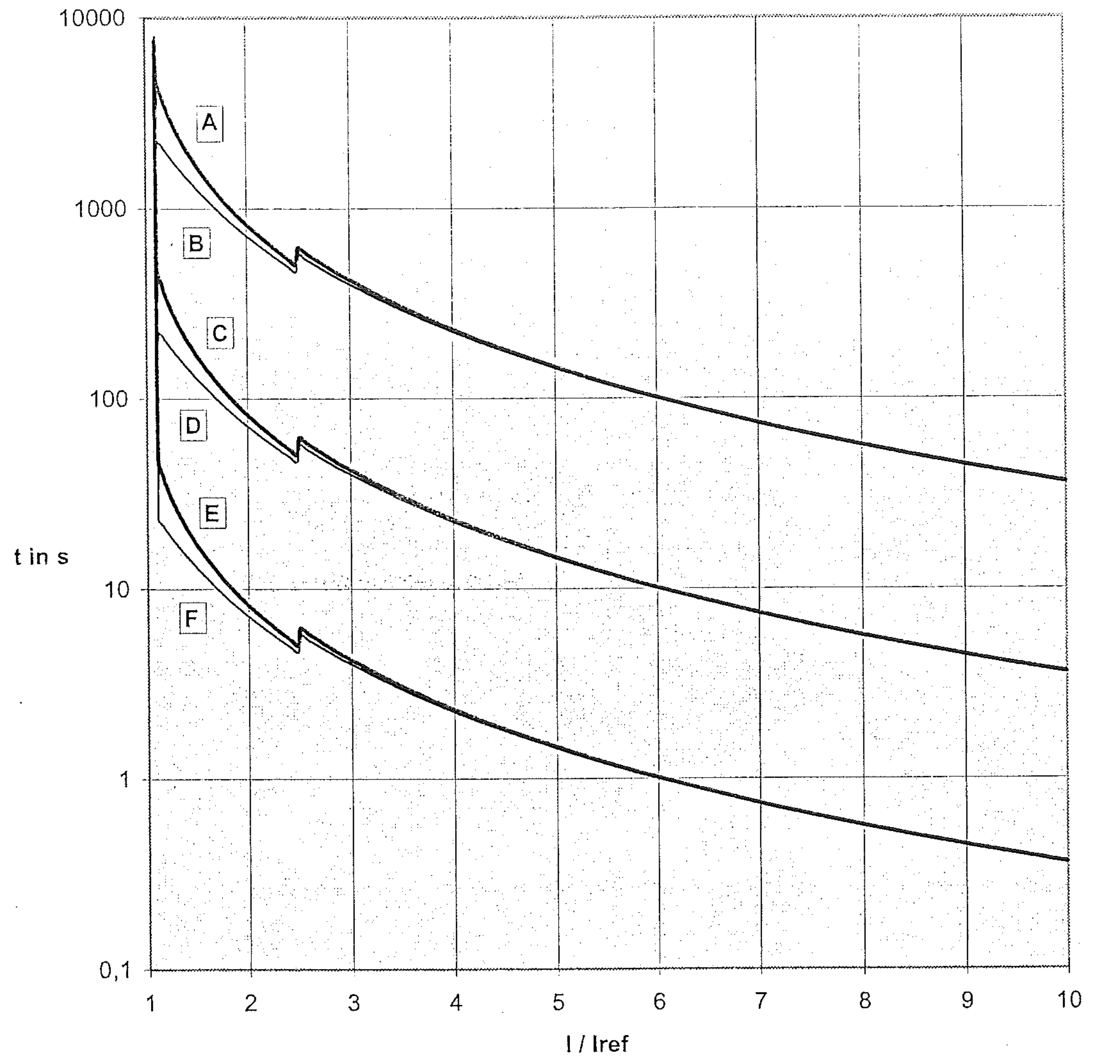
The equation for determining the setting value t_{6Iref} can be derived from the above equations for tripping time t. For this purpose the startup current $I_{startup}$ and the maximum permissible blocking time from cold $t_{block,cold}$ for the asynchronous motor must be known. Setting the overload protection function on the basis of the 'cold' tripping time where $m_0 = 0$ % ('cold curve') is permitted since the conditions for a machine at operating temperature are automatically taken into account. The conditional equations for the setting value t_{6Iref} are therefore the following:

- ☐ For the reciprocally squared characteristic we set: $t_{6I_B} = t_{block,cold} \cdot \frac{(I_{startup}/I_{ref})^2}{36}$

- ☐ For the logarithmic characteristic we set: $t_{6I_B} = t_{block,cold} \cdot \frac{1}{36 \cdot \ln \frac{(I_{startup}/I_{ref})^2}{(I_{startup}/I_{ref})^2 - 1}}$



Tripping time characteristics



A = logarithmic characteristic (at t6Iref=100s)

B = reciprocally squared characteristic (at t6Iref=100s)

C = logarithmic characteristic (at t6Iref=10s)

D = reciprocally squared characteristic (at t6Iref=10s)

E = logarithmic characteristic (at t6Iref=1s)

F = reciprocally squared characteristic (at t6Iref=1s)

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3-157 *Tripping characteristic of motor protection (at I/Iref ≤ 2.5 we have m=0.2, at I/Iref > 2.5 we have m=0)* *y conditions*

A number of plausibility conditions need to be observed in order to ensure that the protected object is given optimum protection and that unintended tripping is prevented.

- ☐ If the permissible number of consecutive startups is set for the sequence 'three from cold or two from warm' and if this set permissible number of consecutive startups is also intended to be used up during operation, then the heating during startup in the overload memory (OL_DA: Heat. dur. start-up) must not exceed 60 %. If the calculation is based on a constant startup current (OL_DA: Start-up current) over the entire startup period, then we obtain the plausibility condition $t_{startup} \leq 0.6 \cdot t_{block,cold}$. However, since the startup current decreases during the course of the startup time (OL_DA: Time taken f. startup), thereby causing rate of memory charging to decrease as well, one can therefore assume that there is a corresponding extra margin, for all practical purposes.
- ☐ The setting value for the overload protection function is determined on the basis of the stated maximum permissible blocking time from the cold state $t_{block,cold}$. However, when a machine at operating temperature is connected, a protective trip during the t_E period must be guaranteed. Therefore, it is always necessary to check the plausibility condition $t_{block,cold} \leq 1.25 \cdot t_E$ and make sure the condition is met.

on or plausibility he thermal

Under the following conditions, the P130C will not be able to track the thermal replica of the protected object, and re-initialization of the thermal replica will be triggered :

- ☐ The power supply has been interrupted.
- ☐ Protection has been disabled.
- ☐ Motor protection has been disabled.

If the above conditions no longer apply, a plausibility check of the thermal replica is automatically performed prior to cyclic processing.

- ☐ Operation condition 'machine running' but not 'starting up':
  A cyclic plausibility check of the thermal replica is carried out such that if the overload memory's charge is below 20 % it is increased to the minimum value of 20 % (≡ machine at operating temperature).
- ☐ Operation condition 'machine starting up':
  Once the end of a startup is detected and the startup counter is decremented as a result, the charging state of the overload memory is increased, if appropriate, to the associated minimum value.

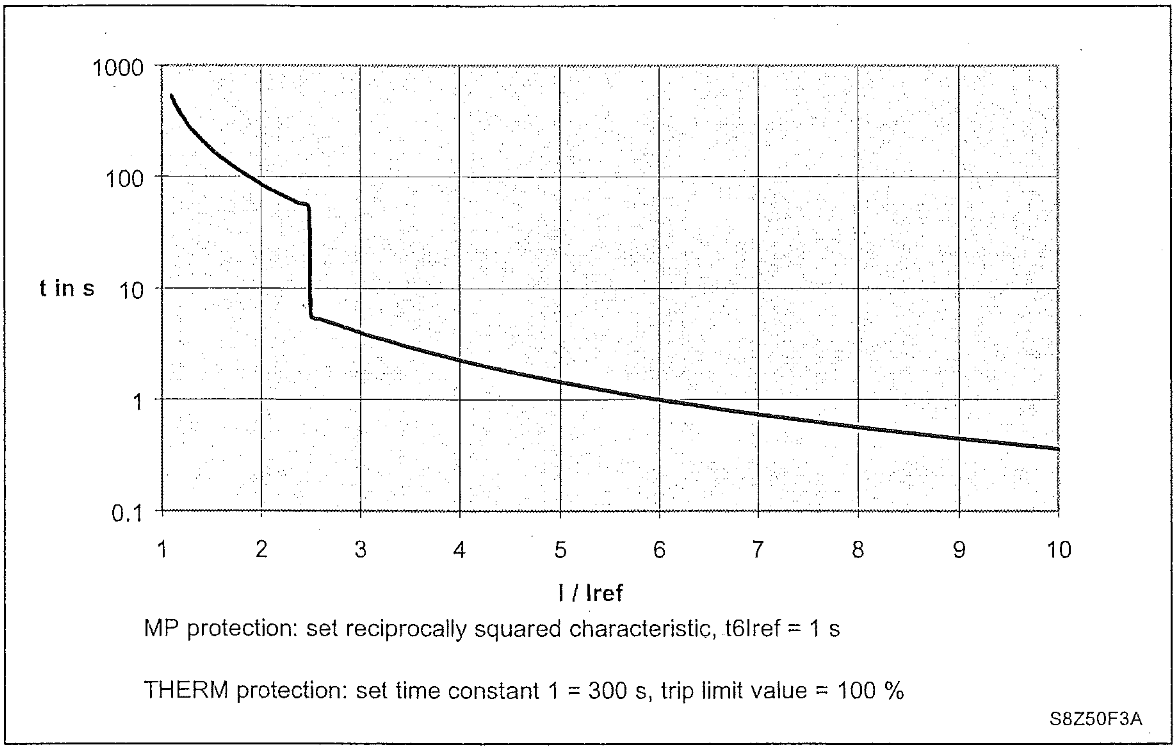
For each of the above procedures involving initialization or a plausibility check of the thermal replica, the charging stage of the overload memory is always coupled to the reading of the counter for 'number of startups still permitted' (MP: St-ups still permitt.) Therefore, if the overload memory is set automatically, the counter reading is also changed to a plausible value as a function of the protection setting.

3.28.2 Special Overload Protection Cases

Logic function for the operating mode with thermal overload protection (THERM)

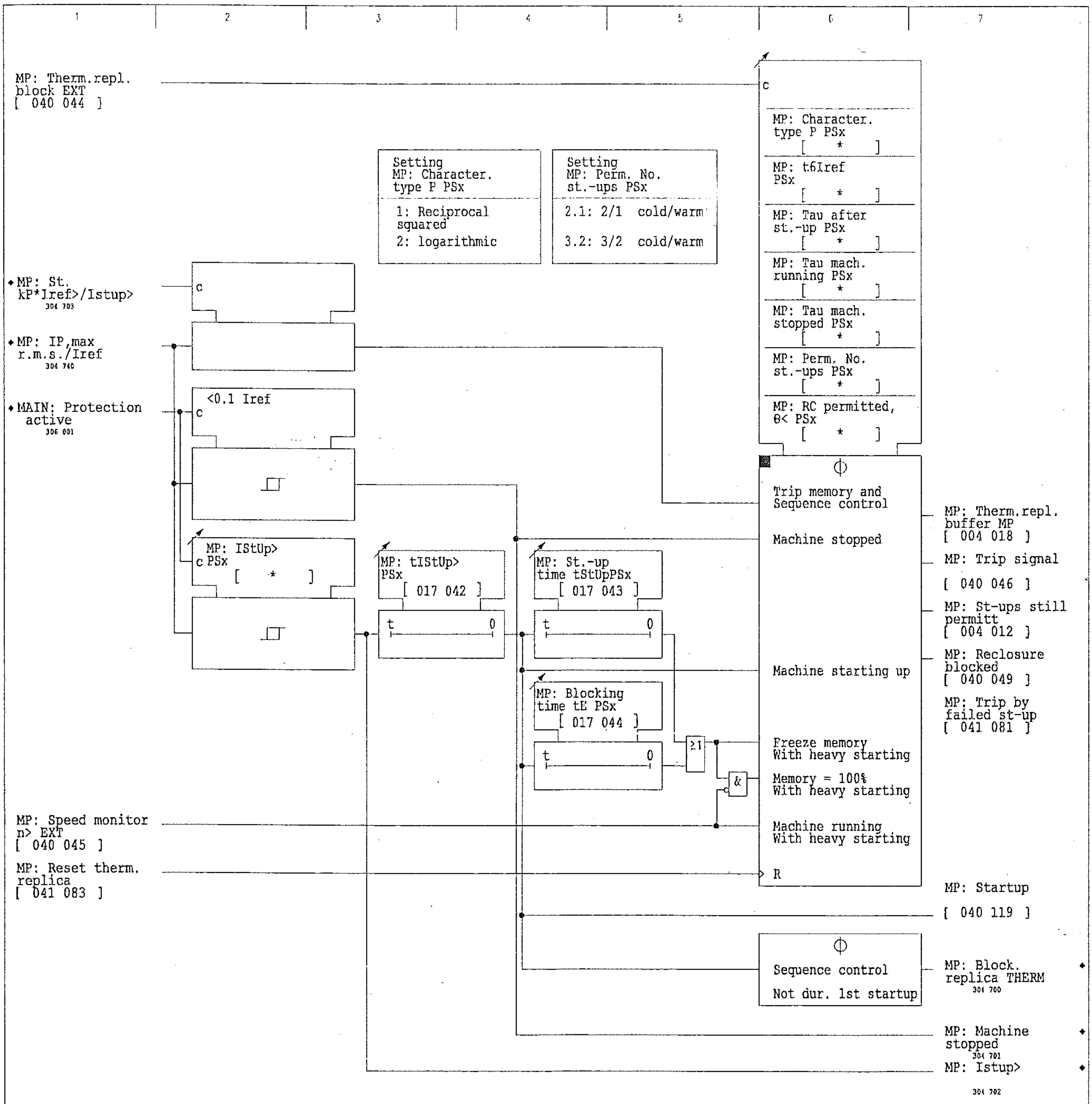
For particular applications, the machine may be operated in the overload range for a longer period of time. In such cases the motor protection function (MP) is too restrictive. For these applications the MP and THERM protection functions are combined. The MP protection function then serves as rotor protection and the THERM protection function as stator protection.

If MP: Operating mode PSx is set to *With THERM*, the overload memory will be incremented when the maximum r.m.s. phase current is above the set current threshold current threshold MP: I_{StUp}> PSx. If this threshold is not exceeded, the memory contents after a startup will initially be decremented until the mapping of the heat transfer from the copper of the rotor to the rotor core is complete. Thereafter, the overload memory will maintain a constant load and the thermal model of the thermal overload protection function (THERM) will become active. With the onset of another startup of the asynchronous motor (not the first startup), the thermal model of the THERM protection function will be temporarily blocked during the startup time.



3-158 Tripping characteristic of motor protection with operating mode 'With THERM' ('cold' characteristic) *f threshold for permitted"*

Depending on the particular application, it is possible to change the overload memory threshold value assumed for general use, when simulating protected object cooling, to either 40 % (with 'three startups from cold or two from warm') or 22 % (with 'two startups from cold or one from warm'). This set threshold value M P: RC permitted, Θ< PSx can differ from these average values so as to be more or less restrictive.



* Parameter	MP: Character. type P PSx	MP: t6Iref PSx	MP: Tau after st.-up PSx	MP: Tau mach. running PSx	MP: Tau mach. stopped PSx	MP: Perm. No. st.-ups PSx
set 1	017 029	017 041	018 042	017 088	017 089	017 047
set 2	024 135	024 136	024 137	024 138	024 139	024 140
set 3	024 185	025 186	024 187	024 188	024 189	024 190
set 4	025 135	025 136	025 137	025 138	025 139	025 140

* Parameter	MP: RC permitted, θ< PSx	MP: IStUp> PSx	MP: tIStUp> PSx	MP: St.-up time tStUpPSx	MP: Blocking time tE PSx
set 1	018 043	017 053	017 042	017 043	017 044
set 2	024 141	024 133	024 134	024 143	024 144
set 3	024 191	024 183	024 184	024 193	024 194
set 4	025 141	025 133	025 134	025 143	025 144

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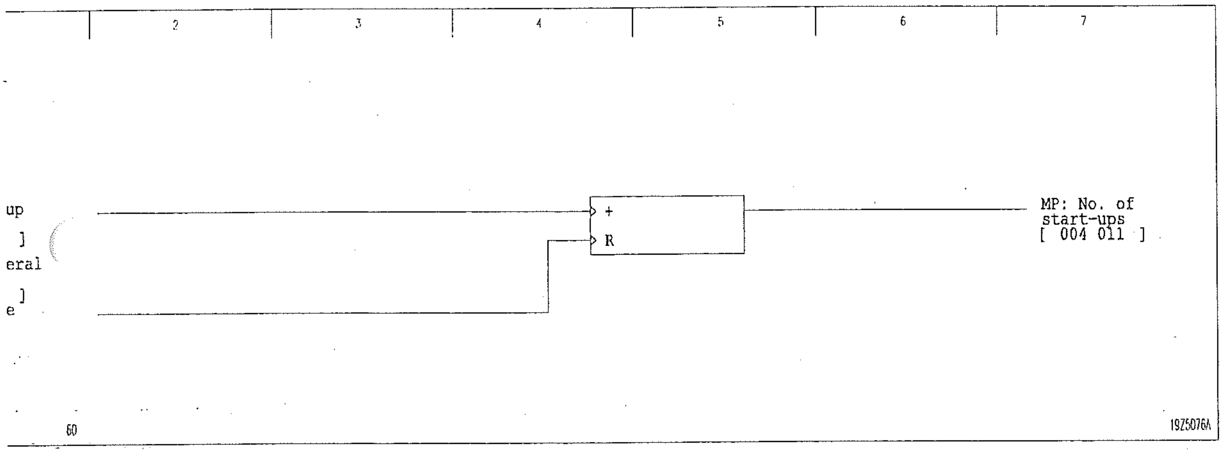
3-159 *Overload protection in motor protection* *ounter*

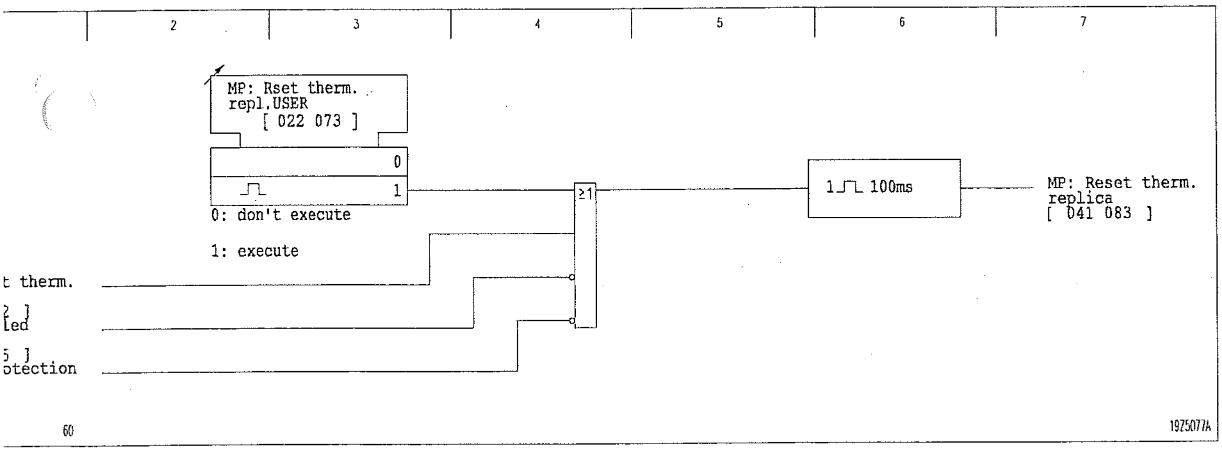
The motor startups are counted. The counter can be reset either individually or with others as a group.



Startup counter

he thermal

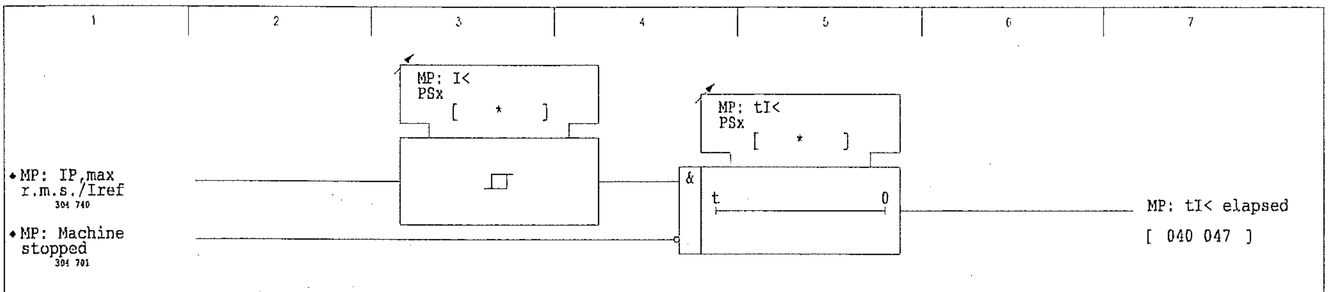
The thermal replica of motor heating can be reset at the local control panel or via a binary signal input that is configured accordingly.



Reset of the thermal replica

3.28.3 Low Load Protection

The low load protection function makes it possible to monitor the load torque of a motor drive for a minimum level. If the operating state recognition function detects a running machine and the maximum r.m.s. phase current falls below the set operate value for a set time, then an appropriate signal is generated. The signal needs to be configured to a separate output relay, since it cannot be linked directly to either the general starting signal or the trip command.



Parameter	MP: I< PSx	MP: tI< PSx
set 1	017 048	017 050
set 2	024 145	024 146
set 3	024 195	024 196
set 4	025 145	025 146

3-162 Overload protection in motor protection

3.28.4 Protection of Increased-Safety Machines

Motors that are operated in areas subject to explosion hazards must not reach a temperature in the case of overload or blocking that would be critical for the existing air-gas mixture.

The P130C is suitable for this type of application, which requires increased-safety protection (Type "e"), but the device must be installed outside the hazardous area.

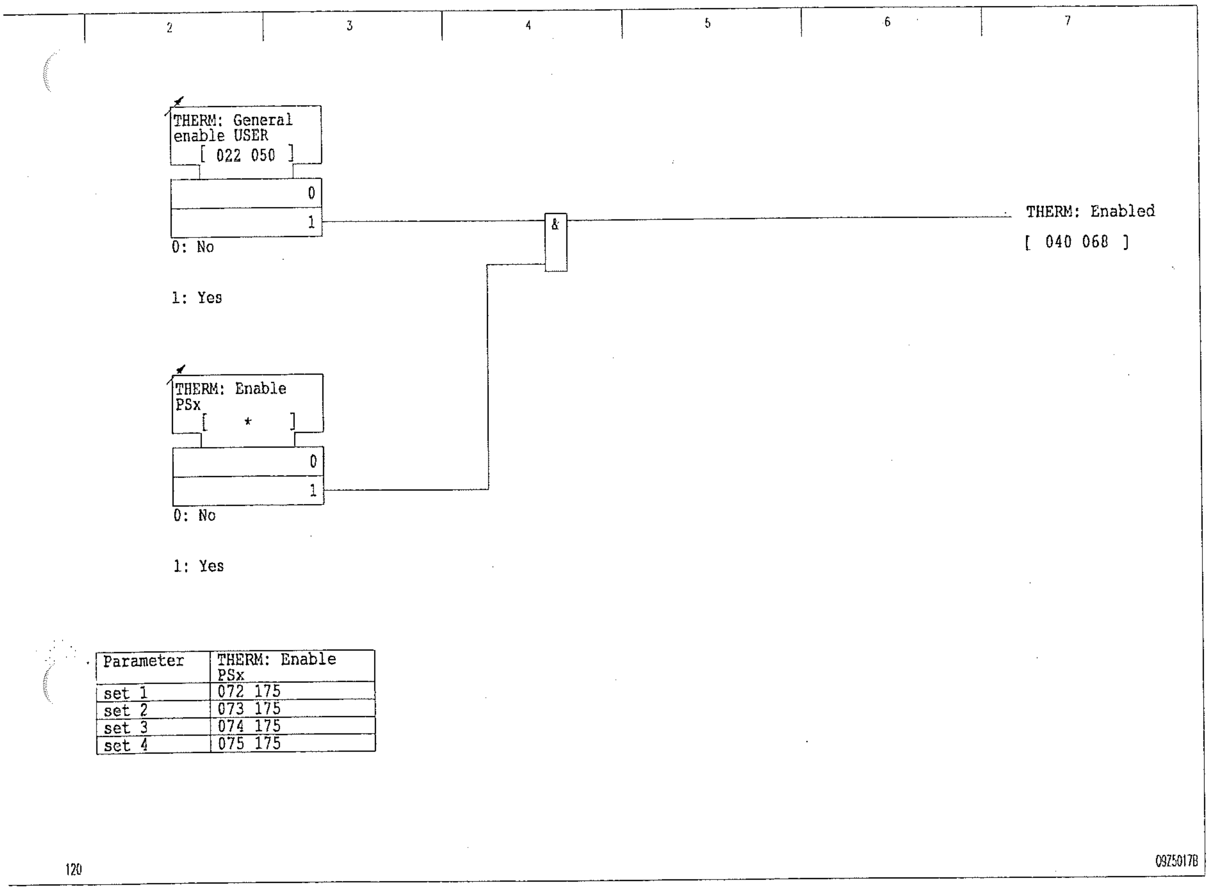
Please follow the setting instructions in Section 7.2: Protection of Increased-Safety Machines.

3.29 Thermal Overload Protection (Function Group THERM)

Using this function, thermal overload protection can be realized. The thermal overload protection function can be operated together with the motor protection function.

or enabling verload protection

Thermal overload protection can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.



Parameter	THERM: Enable PSx
set 1	072 175
set 2	073 175
set 3	074 175
set 4	075 175

)isabling or enabling thermal overload protection

Tripping characteristics

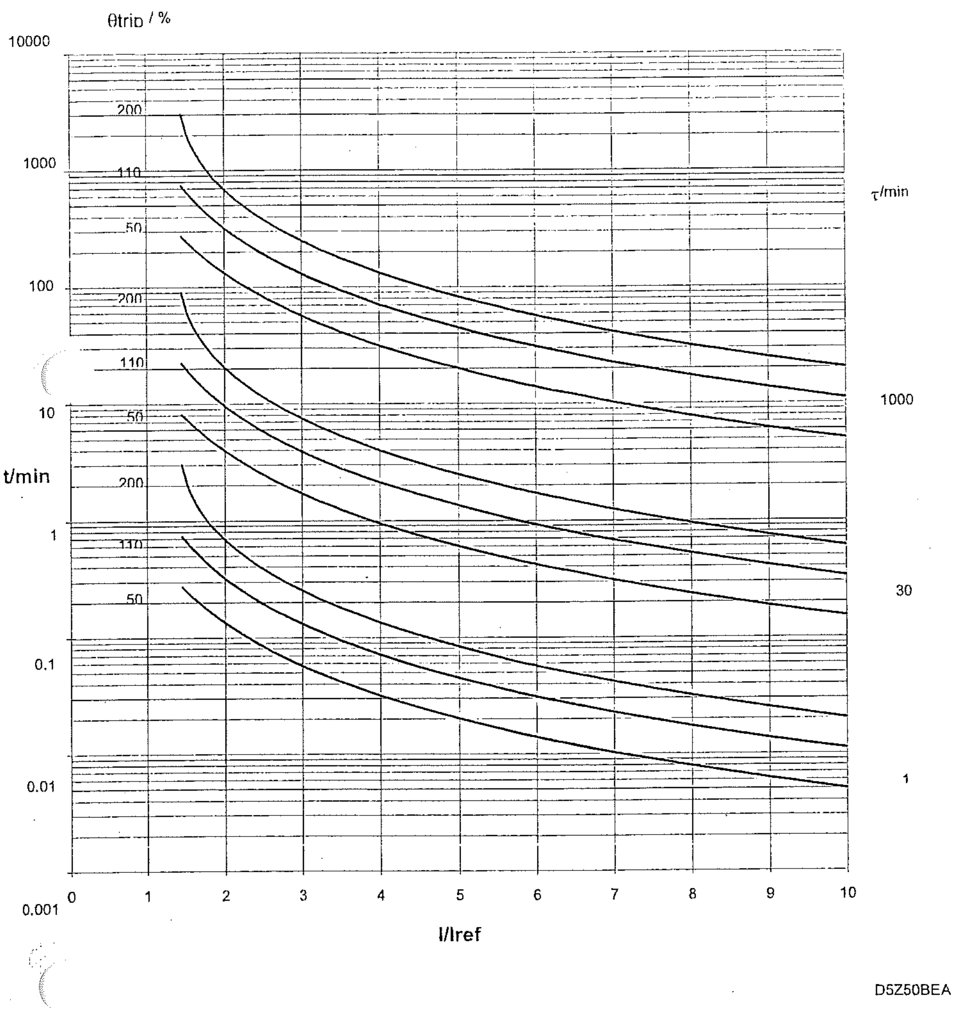
The maximum r.m.s. phase current is used to track a first-order thermal replica as specified in IEC 255-8. The following parameters will govern the tripping time:

- The set thermal time constant (τ) of the protected object THERM: Tim.const.1,>Ibl PSx.
- The set tripping level THERM: Rel. O/T trip PSx
- The accumulated thermal load Θ_P.
- The updated measured coolant temperature Θ_c for the protected object
- The maximum permissible coolant temperature $\Theta_{c,max}$ set at THERM: Max. cool. temp. PSx
- The maximum permissible object temperature Θ_{max}

$$t = \tau \cdot \ln \frac{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_P}{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_{trip} \cdot \left(1 - \frac{\Theta_c - \Theta_{c,max}}{\Theta_{max} - \Theta_{c,max}}\right)}$$

Figure 3-164 shows the tripping characteristics for Θ_P = 0 % and with a measured coolant temperature Θ_c identical to the maximum permissible coolant temperature.

The setting for the operating mode selects an 'absolute' or 'relative' replica. If the setting is for *Absolute replica*, the P130C will operate with a fixed trip threshold Θ_{trip} of 100 %.



Tripping characteristic of thermal overload protection (for Θ_P = 0 % and with a measured coolant temperature Θ_c identical to the maximum permissible coolant temperature)

Coolant temperature

The P130C is not fitted with an analog I/O module Y. As a result, coolant temperature acquisition for the protected object is not possible. Instead, the setting THERM: Default CTA PSx is used in the calculation of the tripping time.

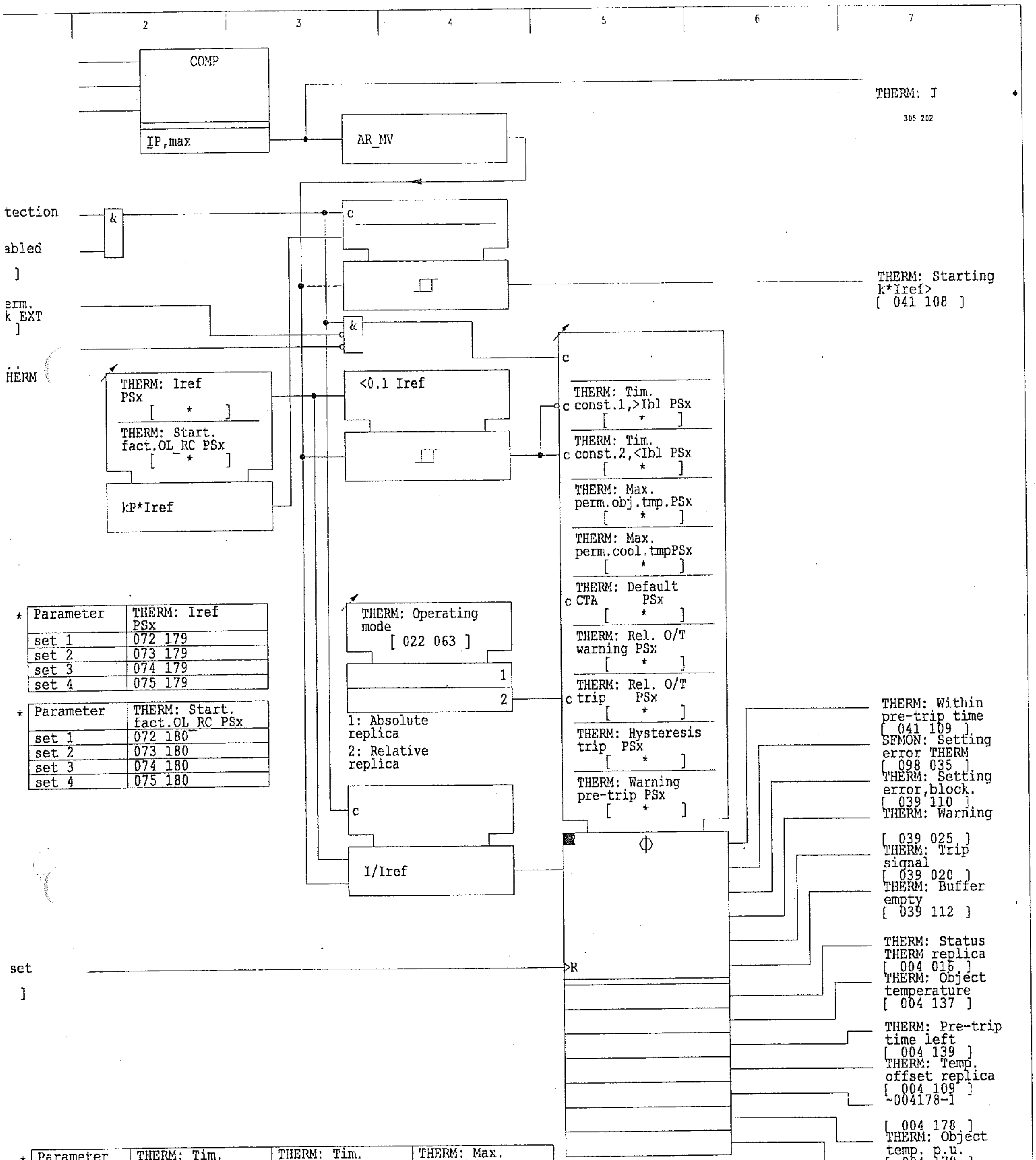
Warning

A warning signal can be set in accordance with the set operate value (THERM: Rel. O/T warning PSx). Moreover, a pre-trip time limit can be set. When the time left until tripping will occur falls below this pre-trip limit, a warning will be issued.

If the current falls below the default threshold of 0.1 I_{ref}, the buffer is discharged with the set time constant THERM: Tim.const.2,<Ibl PSx). The thermal replica may be reset either from the local control panel or via an appropriately configured binary signal input. Resetting is possible even when thermal overload protection is disabled. Thermal overload protection can be blocked via an appropriately configured binary signal input.

Operation together with the motor protection function

If the thermal overload protection function is being operated together with the motor protection function and if another startup of an asynchronous motor occurs (other than the first startup), then the thermal overload protection function will be temporarily blocked during the startup time.
If the motor protection function (MP) and the thermal overload protection function (THERM) are being used simultaneously, then MP protection will act on THERM protection rather than the other way around.



Parameter	THERM: Iref PSx
set 1	072 179
set 2	073 179
set 3	074 179
set 4	075 179

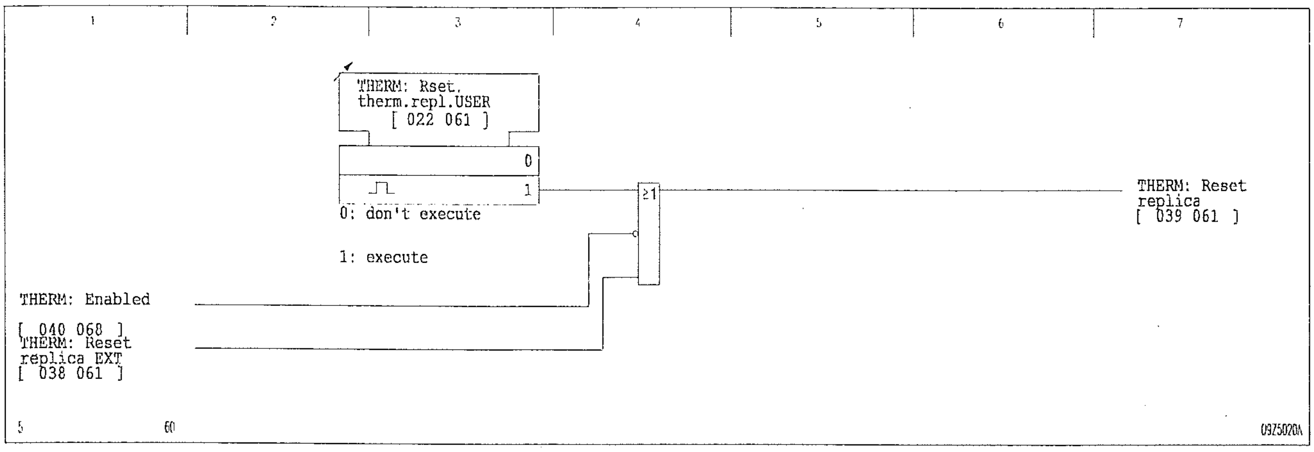
Parameter	THERM: Start. fact.OL_RC PSx
set 1	072 180
set 2	073 180
set 3	074 180
set 4	075 180

Parameter	THERM: Tim. const.1,>Ibl PSx	THERM: Tim. const.2,<Ibl PSx	THERM: Max. perm.obj.tmp.PSx
set 1	072 187	072 188	072 182
set 2	073 187	073 188	073 182
set 3	074 187	074 188	074 182
set 4	075 187	075 188	075 182

Parameter	THERM: Max. perm.cool.tmpPSx	THERM: Default CTA PSx	THERM: Rel. O/T warning PSx	THERM: Rel. O/T trip PSx	THERM: Hysteresis trip PSx	THERM: Warning pre-trip PSx
set 1	072 185	072 186	072 184	072 181	072 183	072 191
set 2	073 185	073 186	073 184	073 181	073 183	073 191
set 3	074 185	074 186	074 184	074 181	074 183	074 191
set 4	075 185	075 186	075 184	075 181	075 183	075 191

220 S6Z7510A

The... erload protection



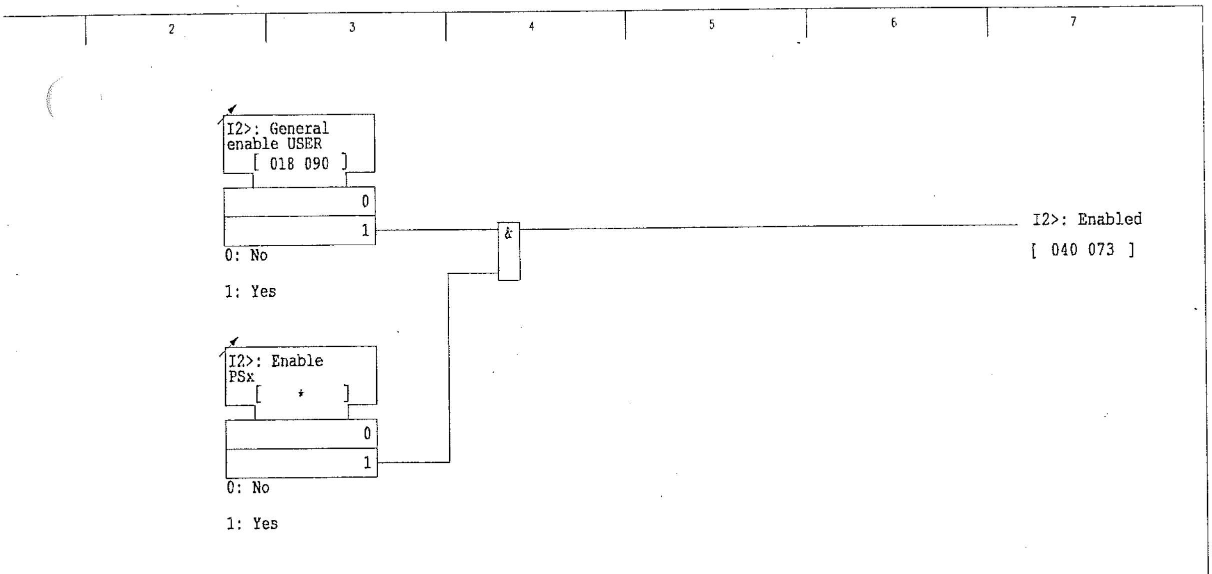
3-166 Reset of the thermal replica

3.30 Unbalance Protection (Function Group I2>)

A two-stage unbalance protection function (I2>) is implemented in the P130C.

ɔr disabling ɘ protection

Unbalance protection can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.



* Parameter	I2>: Enable PSx
set 1	018 220
set 2	018 221
set 3	018 222
set 4	018 223

ɛnabling or disabling unbalance protection

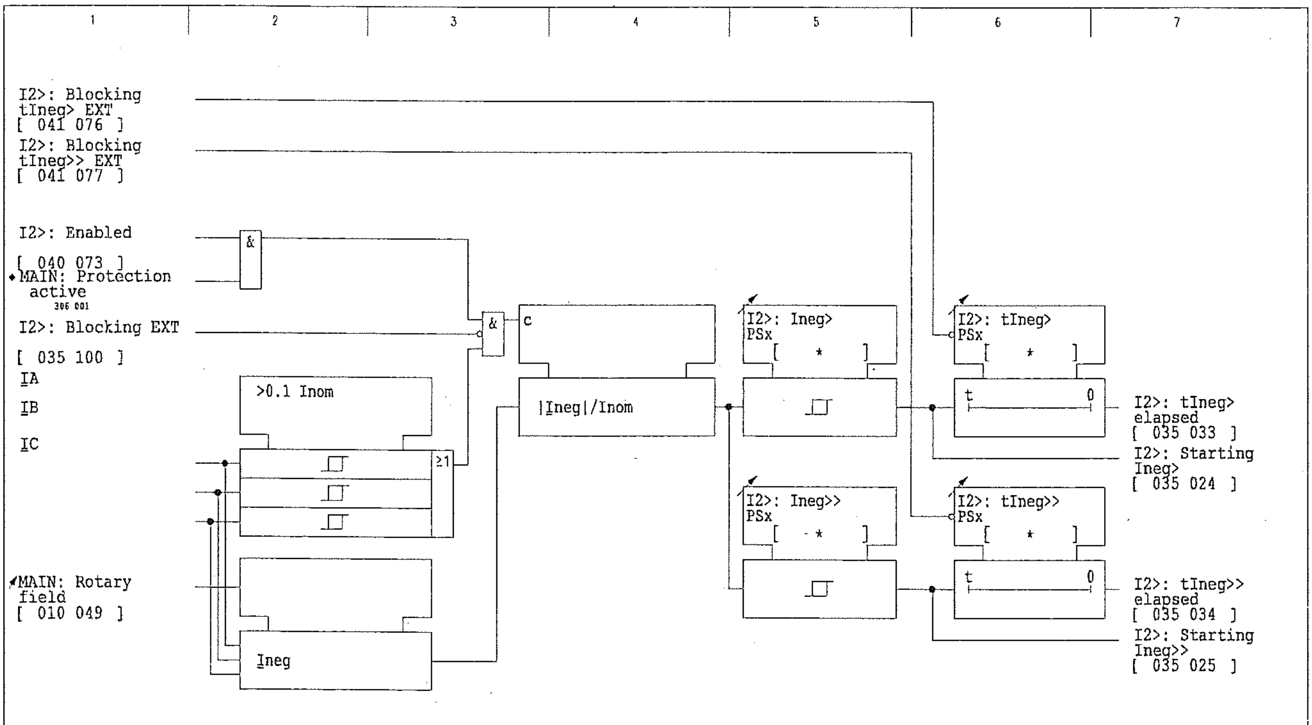
Operation

The presence or absence of unbalance is assessed on the basis of the negative-sequence system current. The negative-sequence current is monitored to determine whether it exceeds the set thresholds. After the set operate delay periods have elapsed, a signal is issued. The following stages are available for the negative-sequence current:

- Unbalance stage I_{neg}> with time delay t_{Ineg}>.
- Unbalance stage I_{neg}>> with time delay t_{Ineg}>>.

The elapsing of all operate delays may be blocked via appropriately configured binary signal inputs.

The unbalance protection signals can be configured to separate output relays. These signals cannot be linked to the general starting signal but can be configured to the trip command.



* Parameter	I2>: Ineg> PSx	I2>: tIneg> PSx	I2>: Ineg>> PSx	I2>: tIneg>> PSx
set 1	018 091	018 093	018 092	018 094
set 2	018 224	018 230	018 227	018 233
set 3	018 225	018 231	018 228	018 234
set 4	018 226	018 232	018 229	018 235

2 120 19Z5083A

3-168 *Unbalance protection*

3.31 Time-Voltage Protection (Function Group V<>)

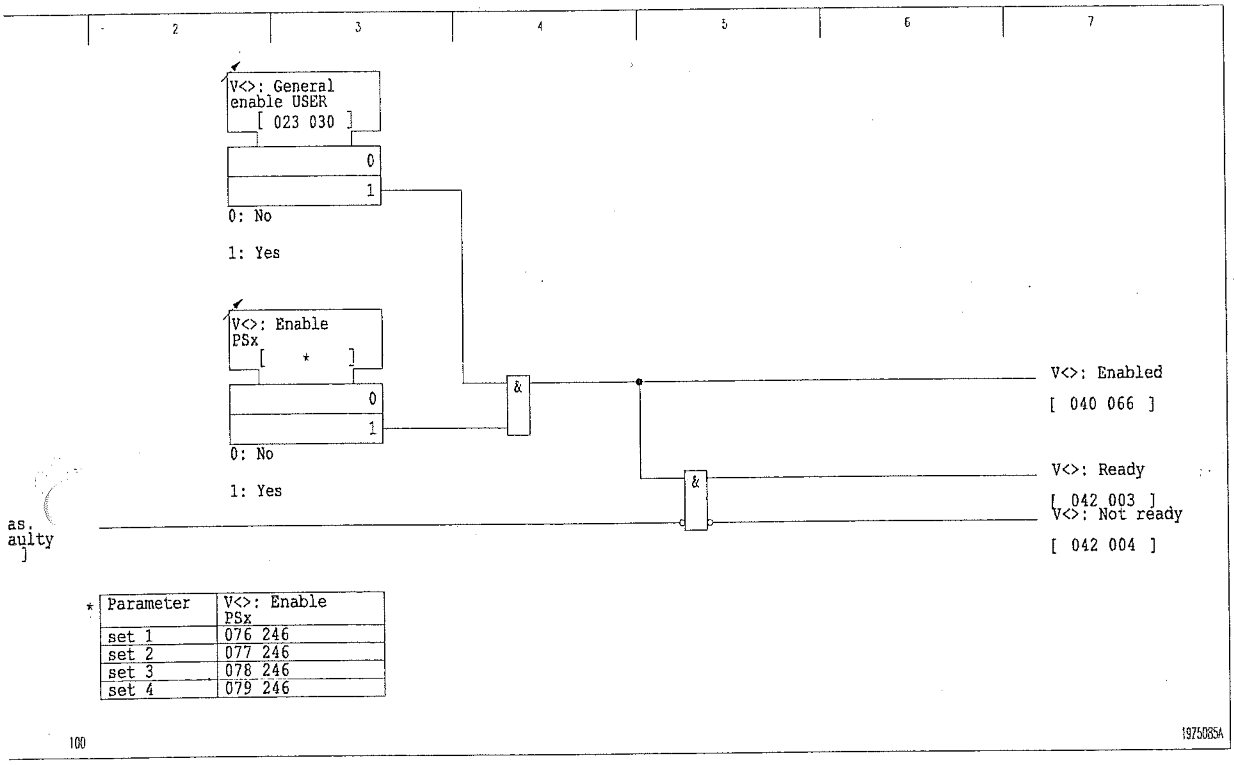
The time-voltage protection function evaluates the fundamental wave of the phase voltages and of the neutral displacement voltage as well as the positive-sequence voltage and negative-sequence voltage obtained from the fundamental waves of the three phase-to-ground voltages.

or enabling ·ction

V<> protection can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.

·ction readiness

V<> protection is ready if it is enabled and no fault has been detected in the voltage-measuring circuit by measuring-circuit monitoring.

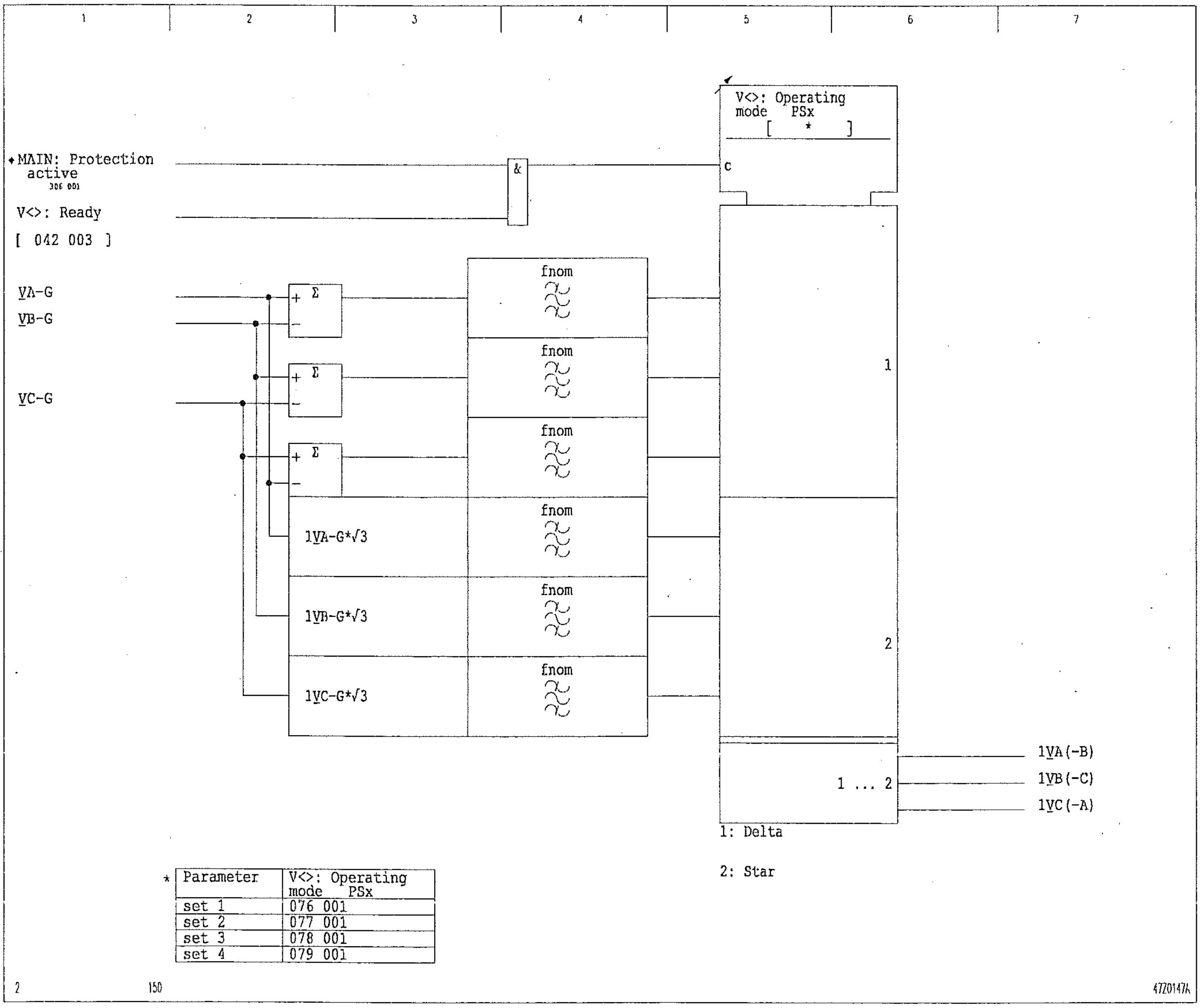


)isabling, enabling, and readiness of V<> protection

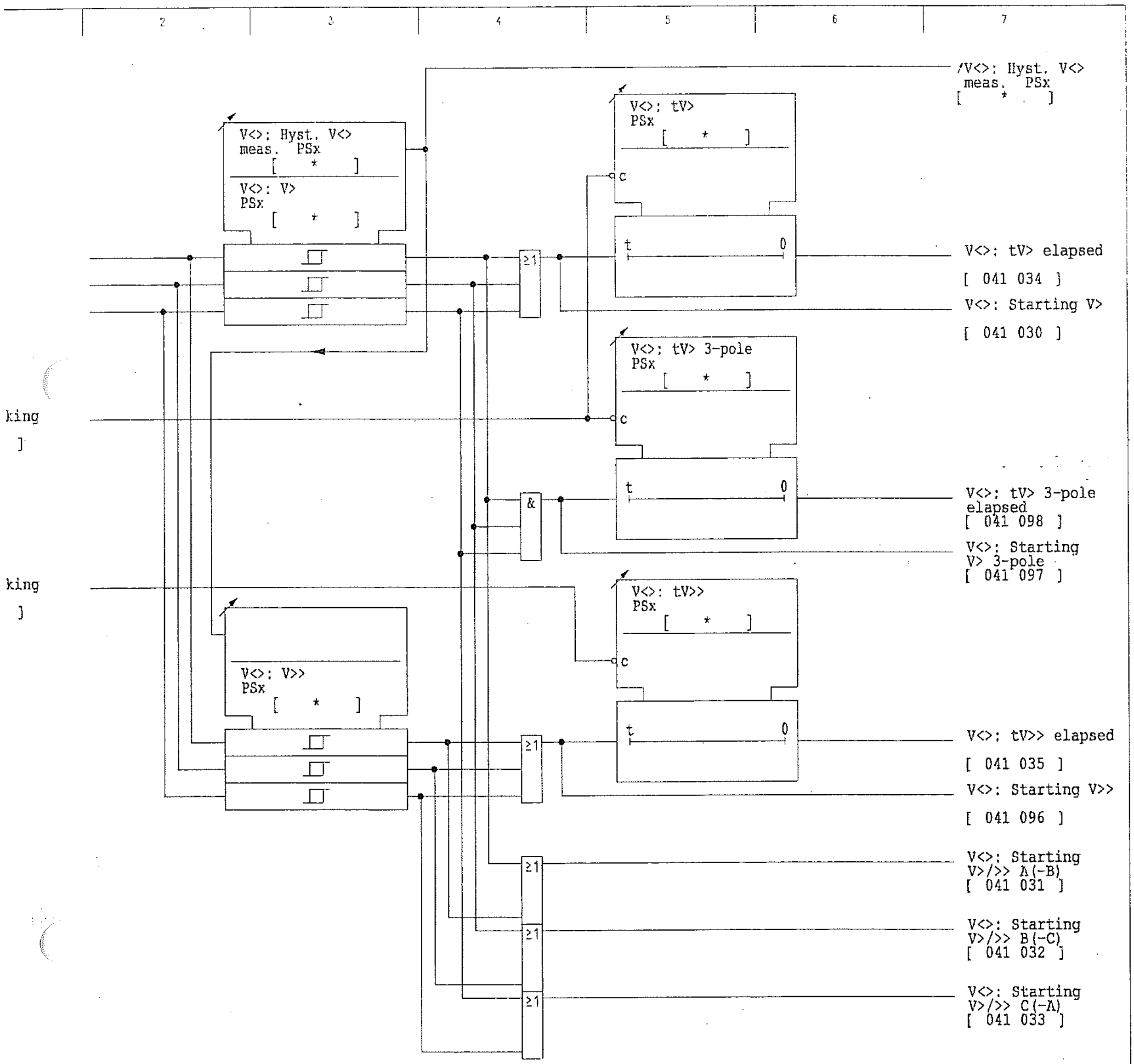
Monitoring the phase voltages

The P130C checks the voltages to determine whether they exceed or fall below set thresholds. Depending on the set operating mode of V<> protection, either the phase-to-ground voltages ('star' operating mode) or the phase-to-phase voltages ('delta' operating mode) are monitored. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

If the decisions of undervoltage monitoring are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and thus it would not be possible to reclose the circuit breaker.



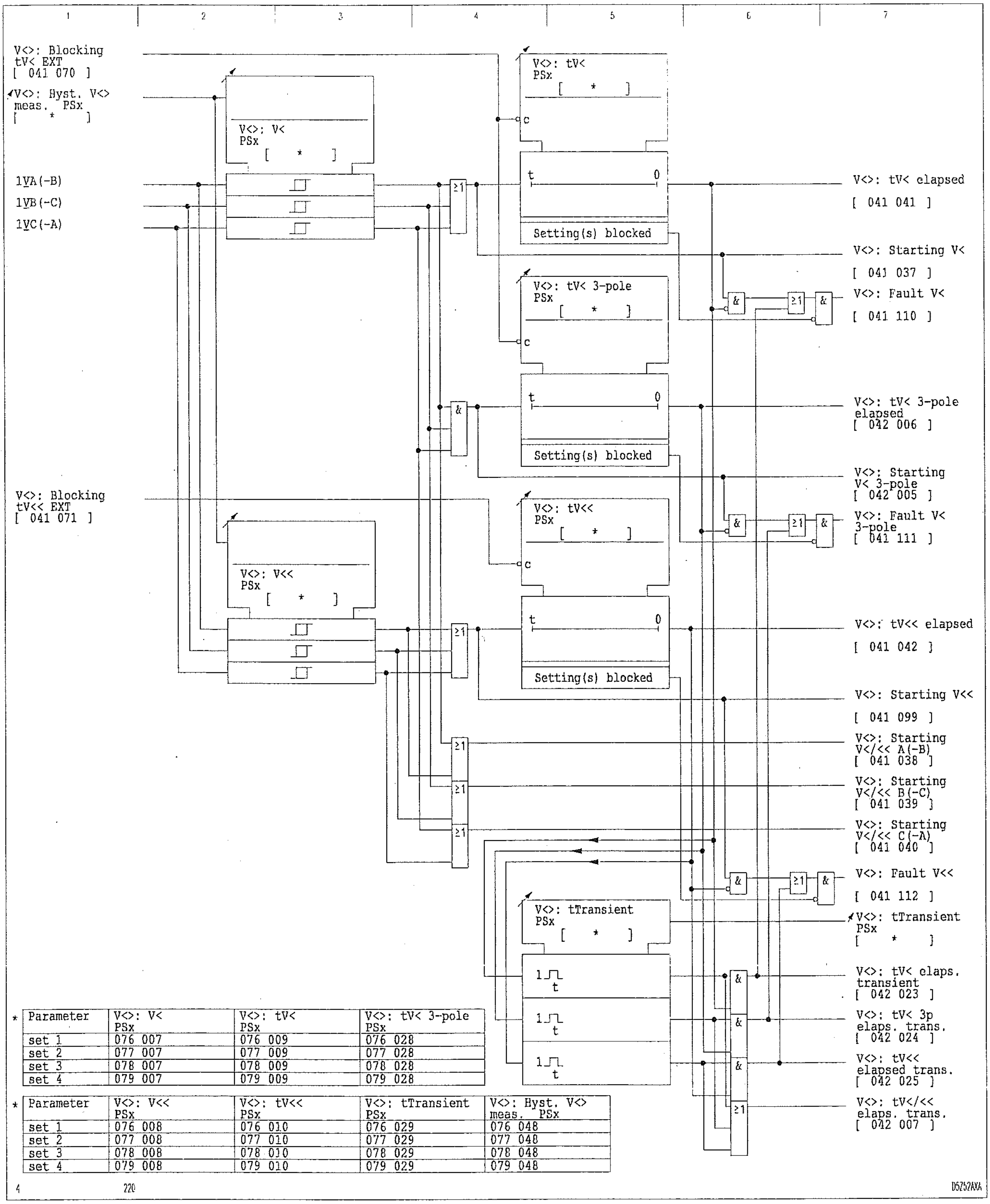
3-170 *Selection of measured variables*



* Parameter	V<>: V> PSx	V<>: tV> PSx	V<>: tV> 3-pole PSx	V<>: V>> PSx	V<>: tV>> PSx	V<>: Hyst. V<> meas. PSx
set 1	076 003	076 005	076 027	076 004	076 006	076 048
set 2	077 003	077 005	077 027	077 004	077 006	077 048
set 3	078 003	078 005	078 027	078 004	078 006	078 048
set 4	079 003	079 005	079 027	079 004	079 006	079 048

180 D5Z52AWA

Overvoltage monitoring



* Parameter	V<>: V< PSx	V<>: tV< PSx	V<>: tV< 3-pole PSx
set 1	076 007	076 009	076 028
set 2	077 007	077 009	077 028
set 3	078 007	078 009	078 028
set 4	079 007	079 009	079 028

* Parameter	V<>: V<< PSx	V<>: tV<< PSx	V<>: tTransient PSx	V<>: Hyst. V<> meas. PSx
set 1	076 008	076 010	076 029	076 048
set 2	077 008	077 010	077 029	077 048
set 3	078 008	078 010	078 029	078 048
set 4	079 008	079 010	079 029	079 048

3-172 *Undervoltage monitoring*

g the positive- and negative- voltages

The P130C determines the positive-sequence and negative-sequence voltages from the fundamental components of the phase-to-ground voltages according to the formulas given below, based on the MAIN: Rotary field setting.

Clockwise rotary field:

Positive-sequence voltage: $$\underline{V}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a} \cdot \underline{V}_{B-G} + \underline{a}^2 \cdot \underline{V}_{C-G} \right) \right|$$

Negative-sequence voltage: $$\underline{V}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a}^2 \cdot \underline{V}_{B-G} + \underline{a} \cdot \underline{V}_{C-G} \right) \right|$$

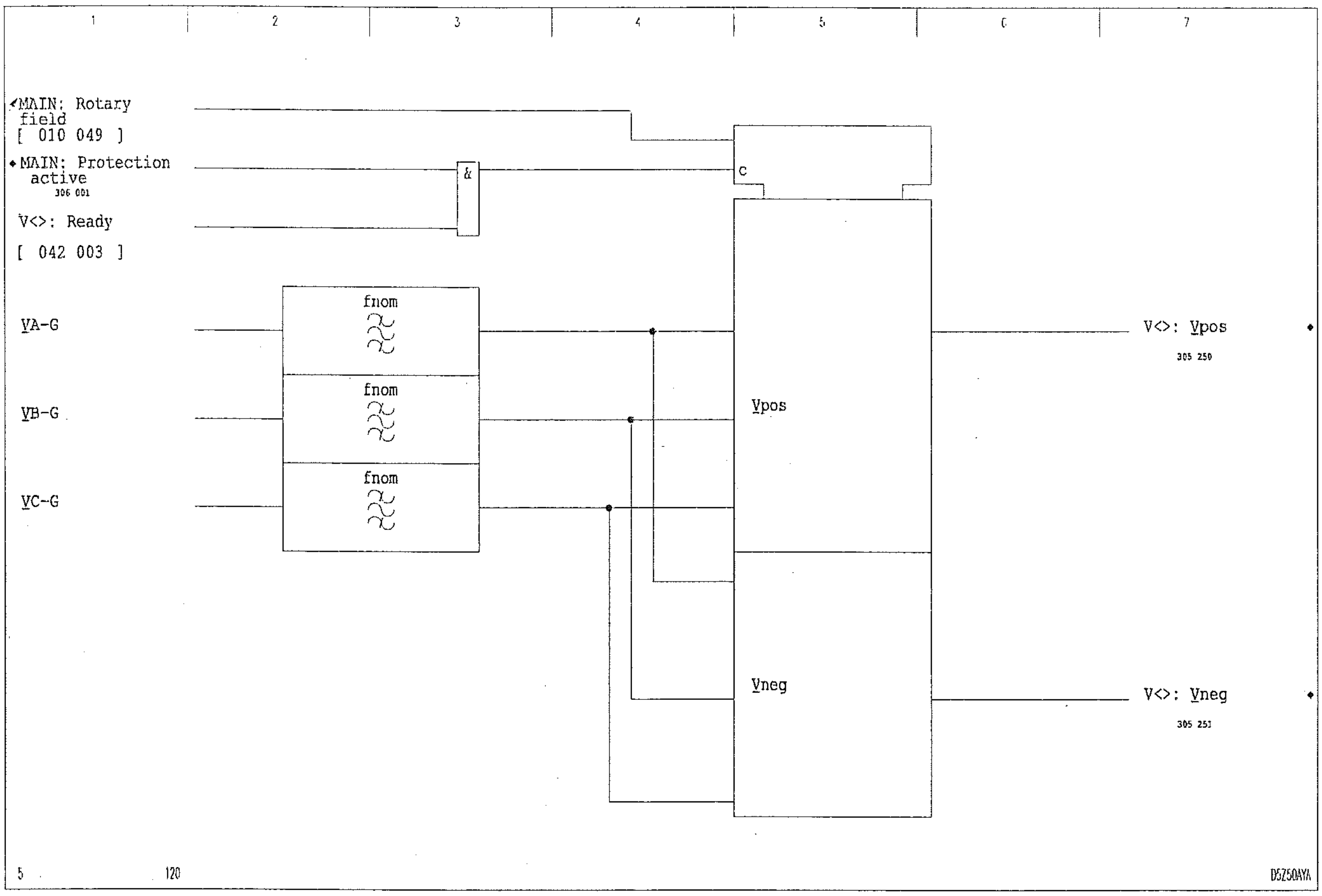
Anti-clockwise rotary field:

Positive-sequence voltage: $$\underline{V}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a}^2 \cdot \underline{V}_{B-G} + \underline{a} \cdot \underline{V}_{C-G} \right) \right|$$

Negative-sequence voltage: $$\underline{V}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a} \cdot \underline{V}_{B-G} + \underline{a}^2 \cdot \underline{V}_{C-G} \right) \right|$$

$\underline{a} = e^{j120°}$

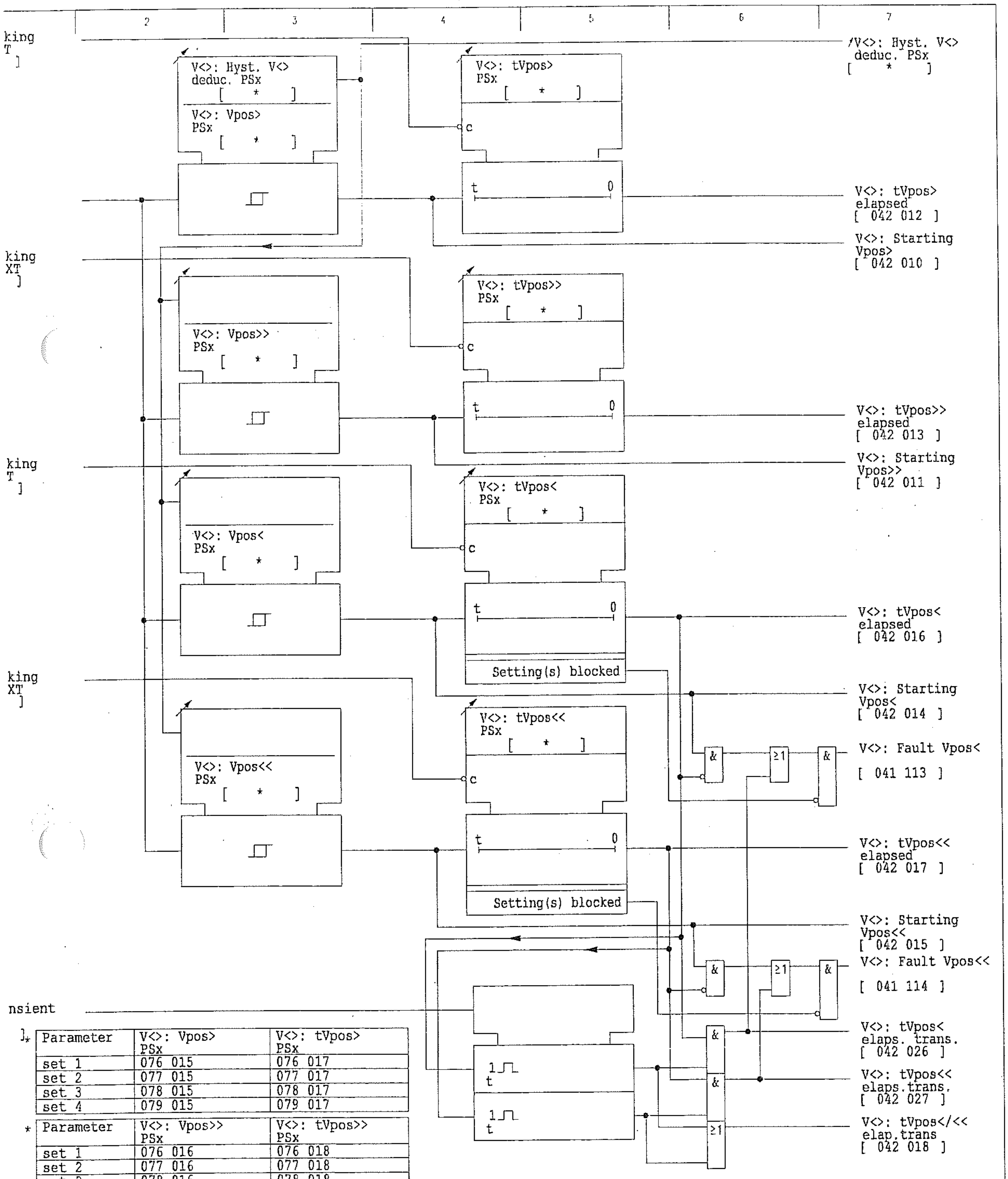
$\underline{a}^2 = e^{j240°}$



3-173 Determining positive-sequence and negative-sequence voltages

The positive-sequence voltage is monitored to determine whether it exceeds or falls below set thresholds, and the negative-sequence voltage is monitored to determine whether it exceeds set thresholds. If the voltage exceeds or falls below the set thresholds, then a signal is issued once the set operate delays have elapsed. The timer stages may be blocked via appropriately configured binary signal inputs.

If the decisions of undervoltage monitoring are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and thus it would not be possible to reclose the circuit breaker.



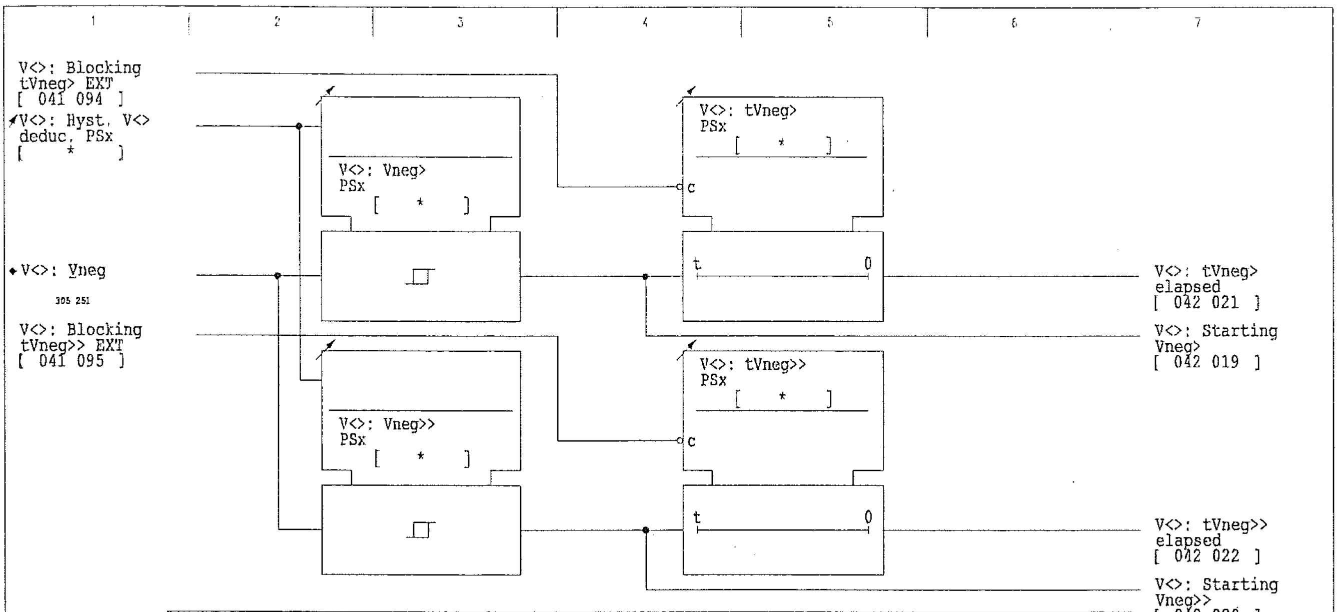
], Parameter	V<>: Vpos> PSx	V<>: tVpos> PSx
set 1	076 015	076 017
set 2	077 015	077 017
set 3	078 015	078 017
set 4	079 015	079 017

* Parameter	V<>: Vpos>> PSx	V<>: tVpos>> PSx
set 1	076 016	076 018
set 2	077 016	077 018
set 3	078 016	078 018
set 4	079 016	079 018

* Parameter	V<>: Vpos< PSx	V<>: tVpos< PSx	V<>: Vpos<< PSx	V<>: tVpos<< PSx	V<>: tTransient PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 019	076 021	076 020	076 022	076 029	076 049
set 2	077 019	077 021	077 020	077 022	077 029	077 049
set 3	078 019	078 021	078 020	078 022	078 029	078 049
set 4	079 019	079 021	079 020	079 022	079 029	079 049

?20

Monit... g the positive-sequence voltage

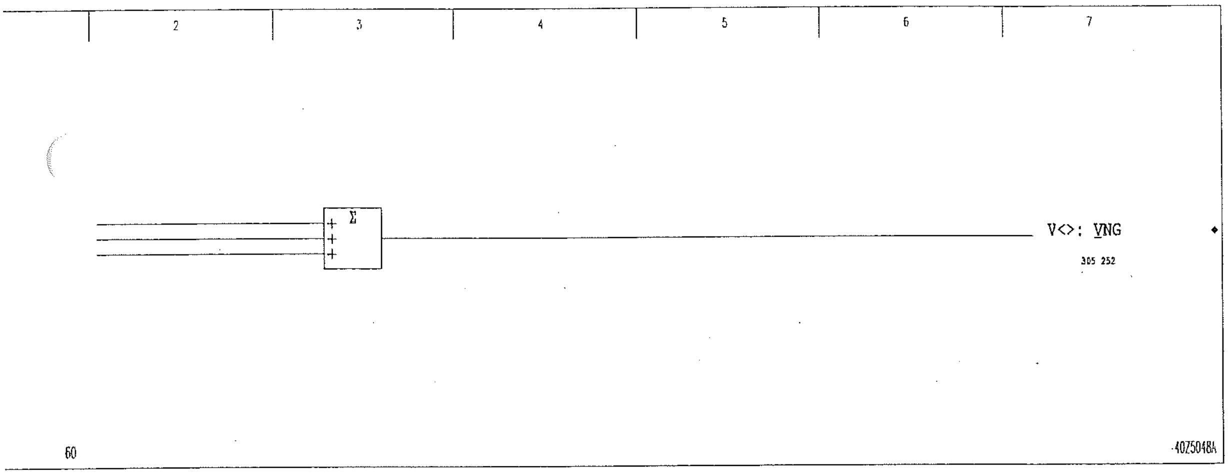


* Parameter	V<>: Vneg> PSx	V<>: tVneg> PSx	V<>: Vneg>> PSx	V<>: tVneg>> PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 023	076 025	076 024	076 026	076 049
set 2	077 023	077 025	077 024	077 026	077 049
set 3	078 023	078 025	078 024	078 026	078 049
set 4	079 023	079 025	079 024	079 026	079 049

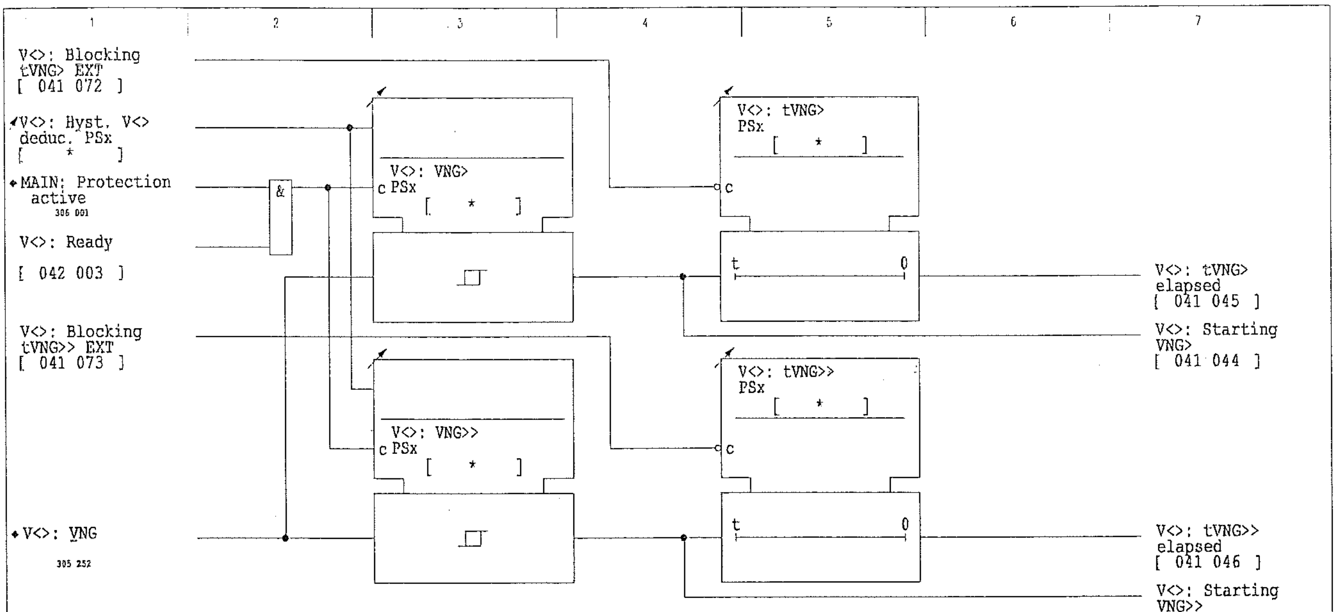
3-175 *Monitoring the negative-sequence voltage*

ɟ the neutral-
ıent voltage

The V<> function monitors either the neutral-displacement voltage calculated by the P130C from the three phase-to-ground voltages. The neutral displacement voltage is monitored to determine whether it exceeds set thresholds. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.



Conditioning the measured variable



* Parameter	V<>: VNG> PSx	V<>: tVNG> PSx	V<>: VNG>> PSx	V<>: tVNG>> PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 011	076 013	076 012	076 014	076 049
set 2	077 011	077 013	077 012	077 014	077 049
set 3	078 011	078 013	078 012	078 014	078 049
set 4	079 011	079 013	079 012	079 014	079 049

9 100 D5Z52BCA

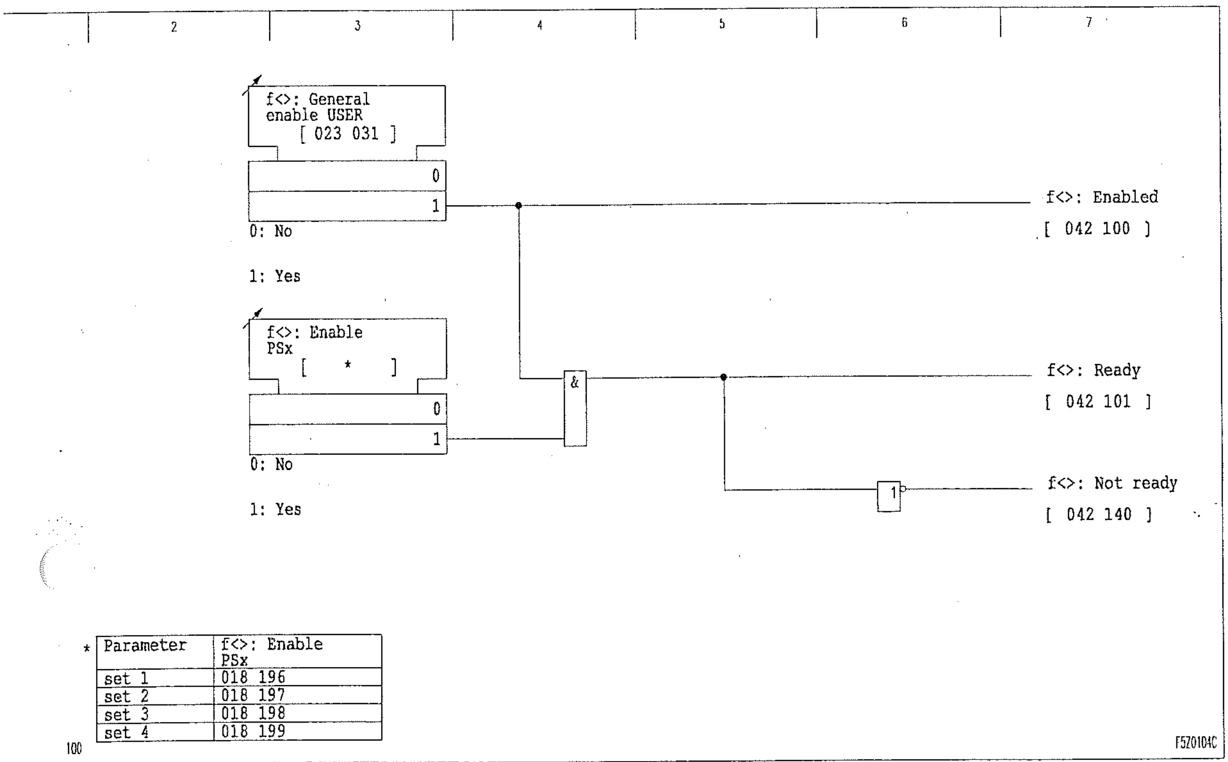
3-177 *Monitoring the neutral-displacement voltage*

3.32 Over-/Underfrequency Protection (Function Group f<>)

The P130C monitors the selected voltage to determine whether it exceeds or falls below set frequencies. The frequency is determined from the difference in time between the zero crossings of the voltage (voltage zeroes). The over-/underfrequency protection function has four stages. The operation of over-/underfrequency protection will be explained below using the first stage as an example.

or enabling
erfrequency

Over-/underfrequency protection can be disabled or enabled from the local control panel. Moreover, enabling can be done separately for each parameter subset.

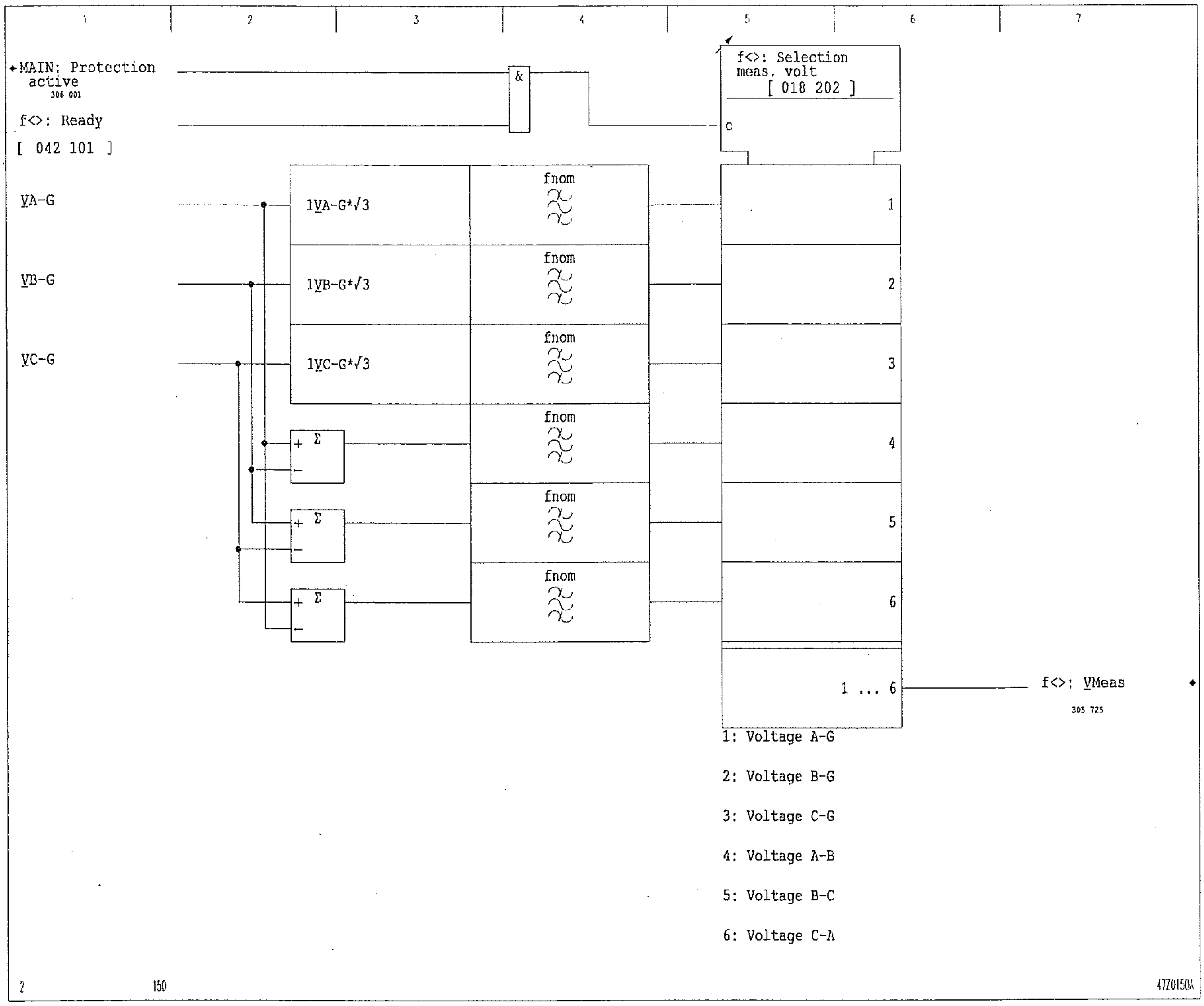


* Parameter	f<>: Enable PSx
set 1	018 196
set 2	018 197
set 3	018 198
set 4	018 199

Disabling, enabling, and readiness of f<> protection

Selecting the measuring voltage

By selecting a measuring voltage setting, the user defines the voltage that is used by the over-/underfrequency protection function for measurement purposes. This can be either a phase-to-ground voltage or a phase-to-phase voltage.

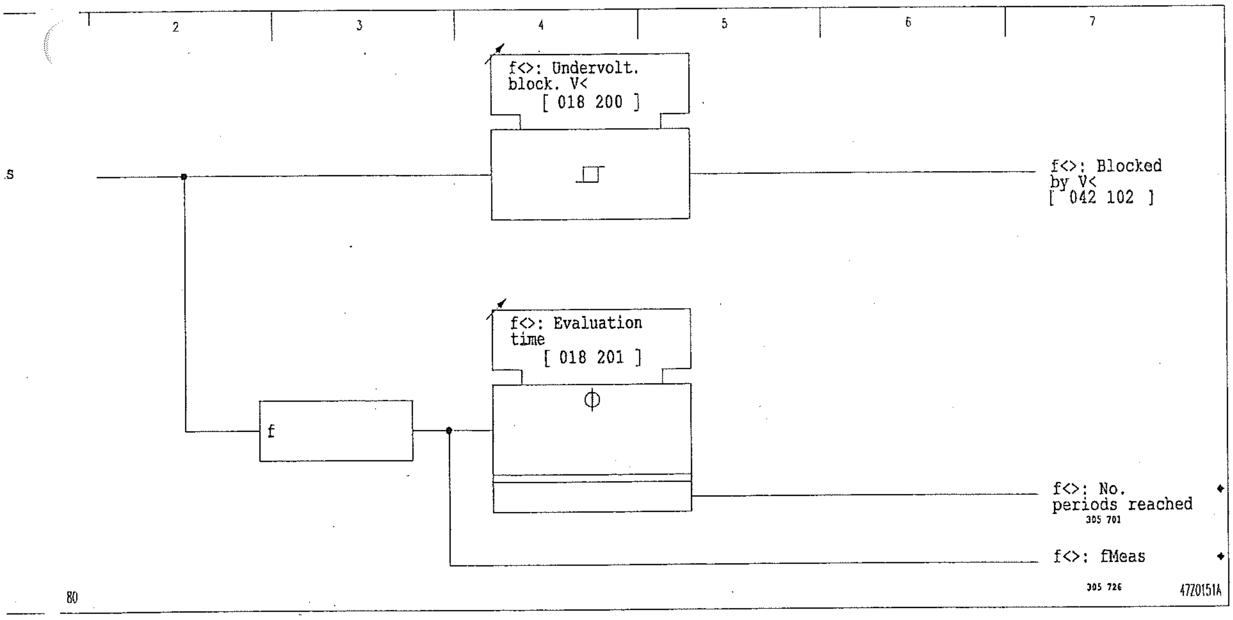


3-179 *Selecting the measuring voltage*

age blocking and
n time

Over-/underfrequency protection requires a measuring voltage of sufficient magnitude. Over-/underfrequency protection will be blocked instantaneously if the measuring voltage falls below the set threshold of the undervoltage stage.

In order to avoid frequency stage starting caused by brief frequency fluctuations or interference, the evaluation time can be set by the user. The operate conditions must be satisfied for at least the duration of the set evaluation time in order for a signal to be issued.



Inde ge blocking and evaluation time setting

Operating modes of over-/ underfrequency protection

For each stage of the over-/underfrequency protection function, the user can choose between the following operating modes:

- Frequency monitoring
- Frequency monitoring combined with differential frequency gradient monitoring (df/dt)
- Frequency monitoring combined with mean frequency gradient monitoring ($\Delta f/\Delta t$)

Frequency monitoring

Depending on the setting, the P130C monitors the frequency to determine whether it exceeds or falls below set thresholds. If an operate threshold in excess of the set nominal frequency is set, the P130C checks to determine whether the frequency exceeds the operate threshold. If an operate threshold below the set nominal frequency is set, the P130C checks to determine whether the frequency falls below the operate threshold. If it exceeds or falls below the set threshold, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

Frequency monitoring combined with differential frequency gradient monitoring (df/dt)

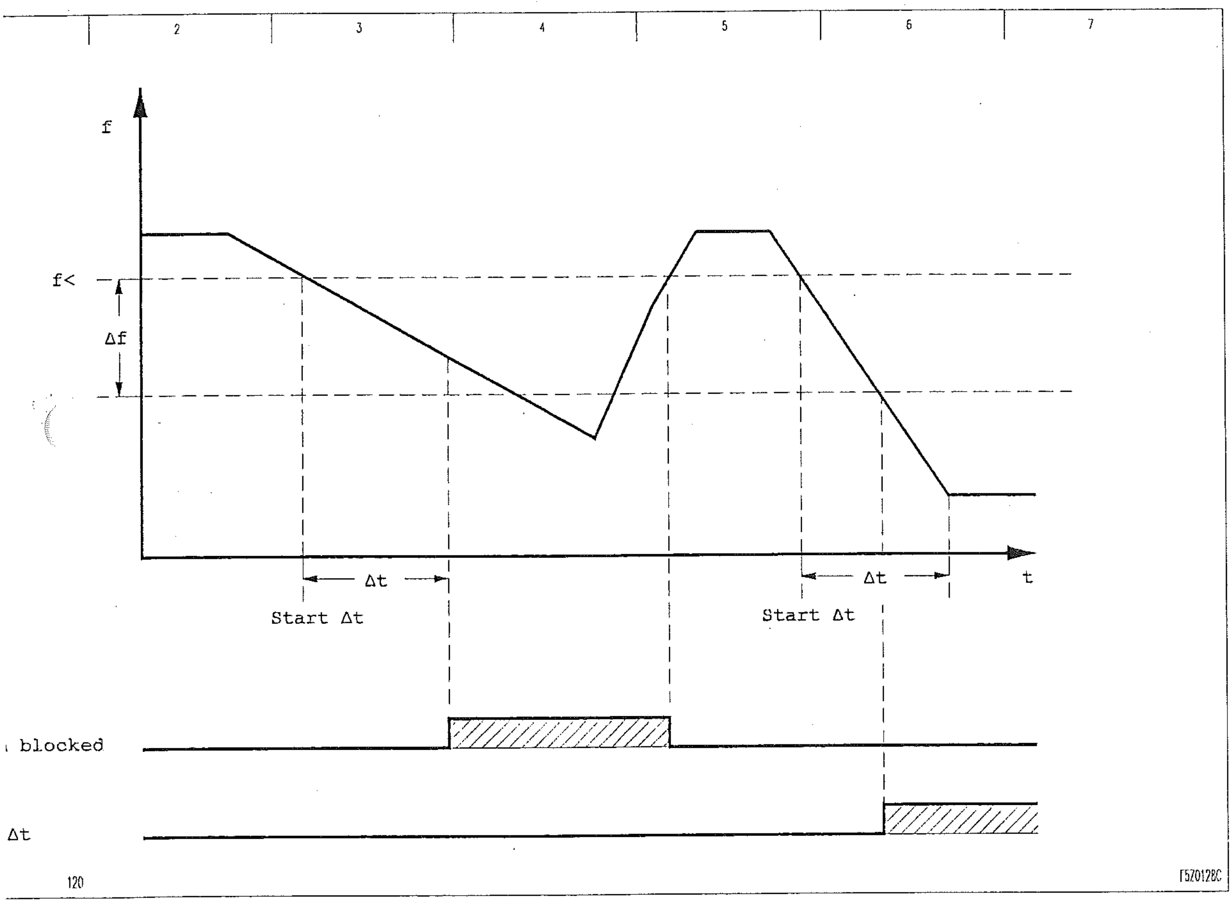
In this operating mode of the over-/ underfrequency protection function, the frequency is also checked to determine whether the set frequency gradient is reached (in addition to being monitored for exceeding or falling below the set threshold). Monitoring for overfrequency is combined with monitoring for a frequency increase; monitoring for underfrequency is combined with monitoring for a frequency decrease. If both operate conditions are satisfied, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

y monitoring
' with mean
' gradient
ȝ (Δf/Δt)

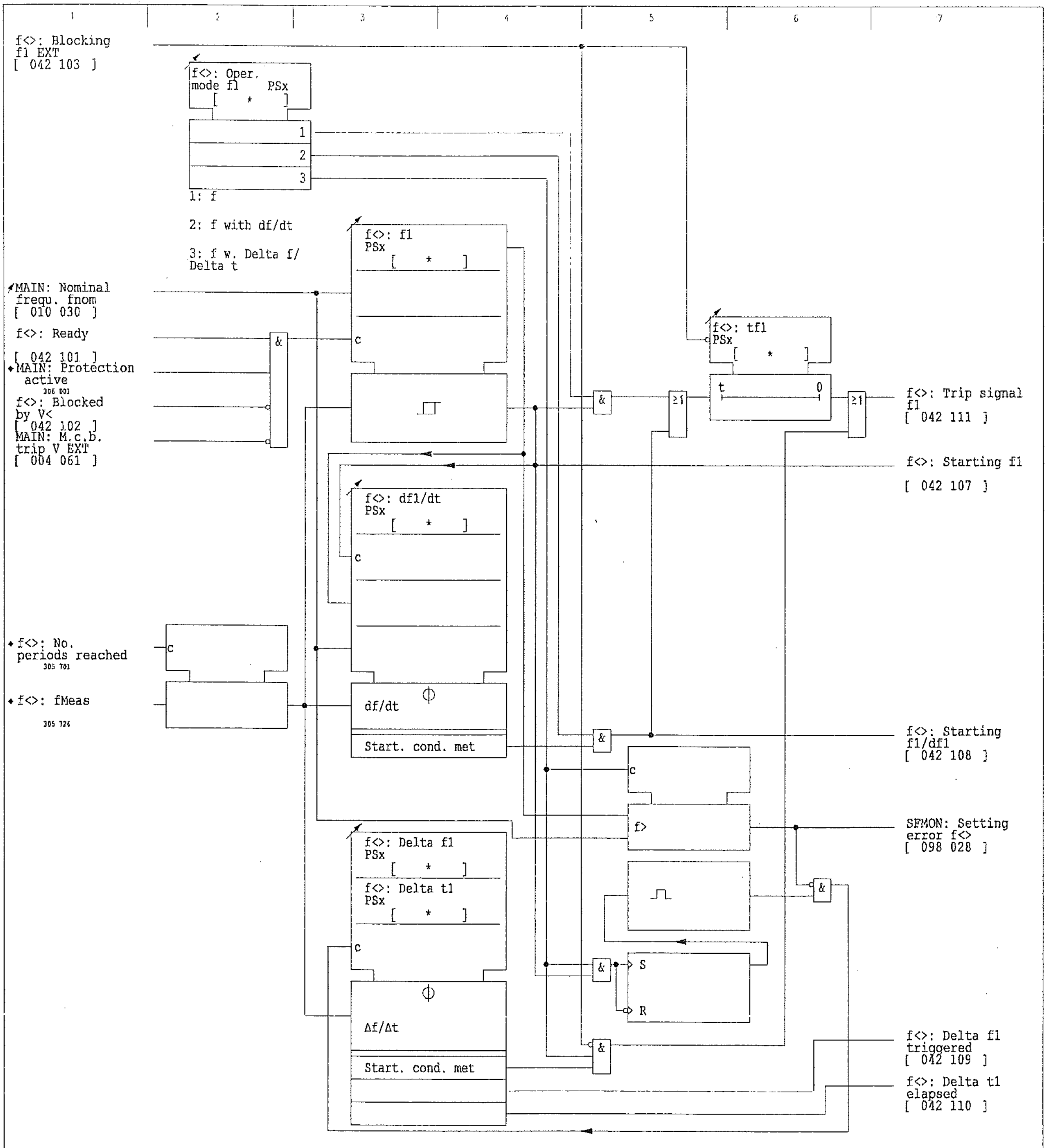
The frequency gradient can differ for system disturbances in individual substations and may vary over time due to power swings. Therefore it makes sense to take the mean value of the frequency gradient into account for load-shedding systems.

In this operating mode of over-/underfrequency protection, frequency monitoring must be set for 'underfrequency monitoring'.

Monitoring the mean value of the frequency gradient is started with the starting of frequency monitoring. If the frequency decreases by the set value Δf within the set time Δt, then the Δt/Δf monitoring function operates instantaneously and generates a trip signal. If a frequency change does not lead to an operate decision of the monitoring function, then the Δt/Δf monitoring function will be blocked until the underfrequency monitoring function drops out. The trip signal can be blocked by way of an appropriately configured binary signal input.



›peration of frequency monitoring combined with Δf/Δt monitoring



* Parameter	f<>: Oper. mode f1 PSx	f<>: f1 PSx	f<>: df1/dt PSx	f<>: Delta f1 PSx	f<>: Delta t1 PSx	f<>: tf1 PSx
set 1	018 120	018 100	018 108	018 112	018 116	018 104
set 2	018 121	018 101	018 109	018 113	018 117	018 105
set 3	018 122	018 102	018 110	018 114	018 118	018 106
set 4	018 123	018 103	018 111	018 115	018 119	018 107

4 220 47Z0152A

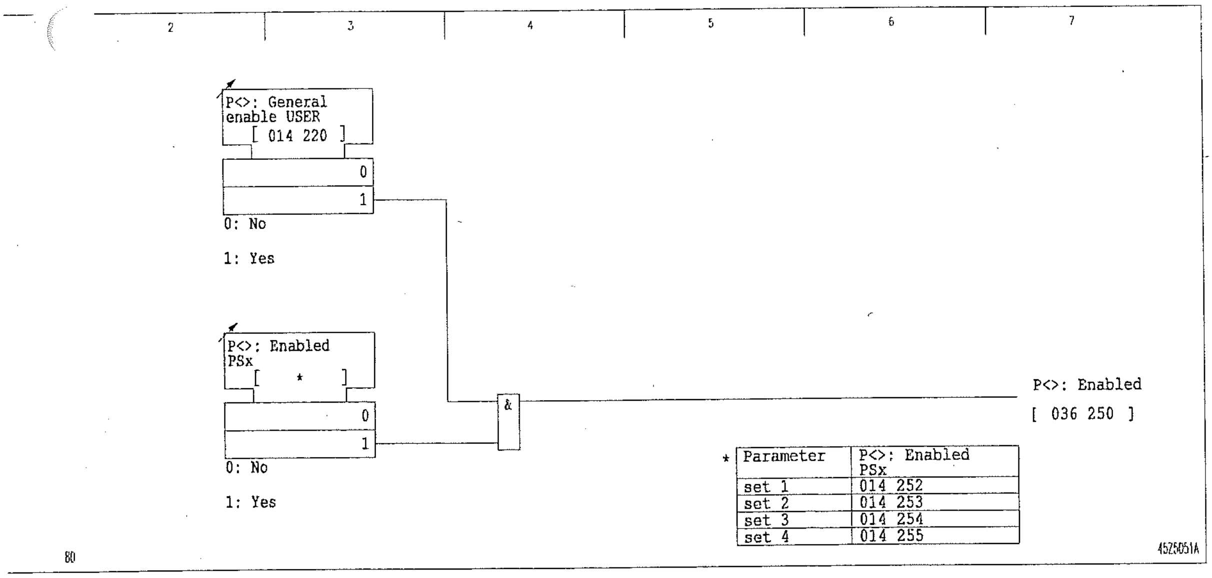
3-182 *First stage of the over-/ underfrequency protection function*

3.33 Power Directional Protection (Function Group P<>)

The power directional protection function determines the active and reactive power from the fundamental waves of current and voltage. The sign of the active or the reactive power, respectively, is evaluated for direction determination.

or enabling ·ction

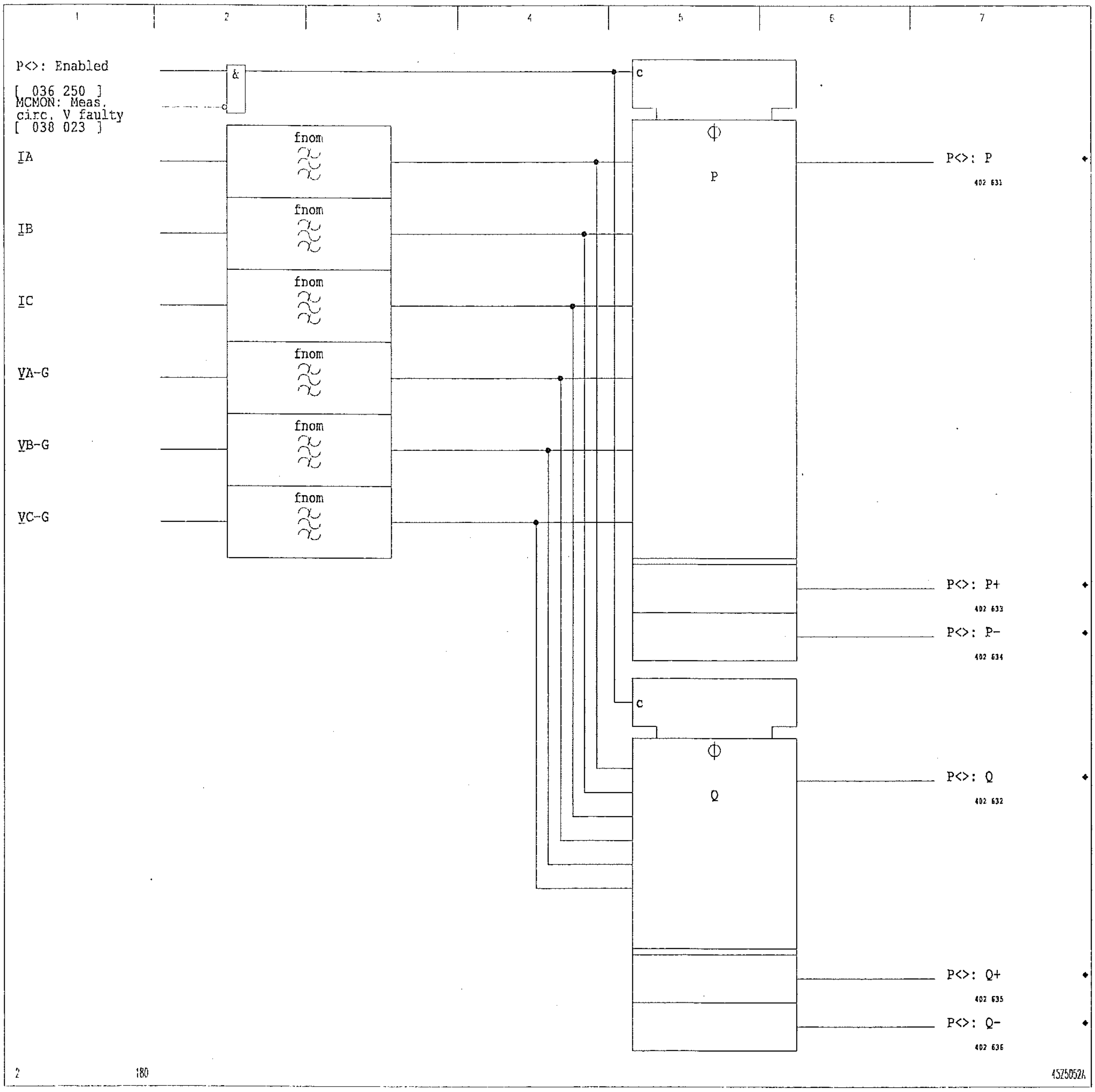
The power directional protection function can be disabled or enabled from the local control panel. Moreover, enabling can be carried out separately for each parameter set.



ɛnal ... ɔr disabling power directional protection

termination

The P130C determines the active and reactive power from the fundamental waves of the three phase currents and the phase-to-ground voltages. If the measuring-circuit monitoring function detects malfunctioning in the voltage measuring circuit, power determination will be blocked.

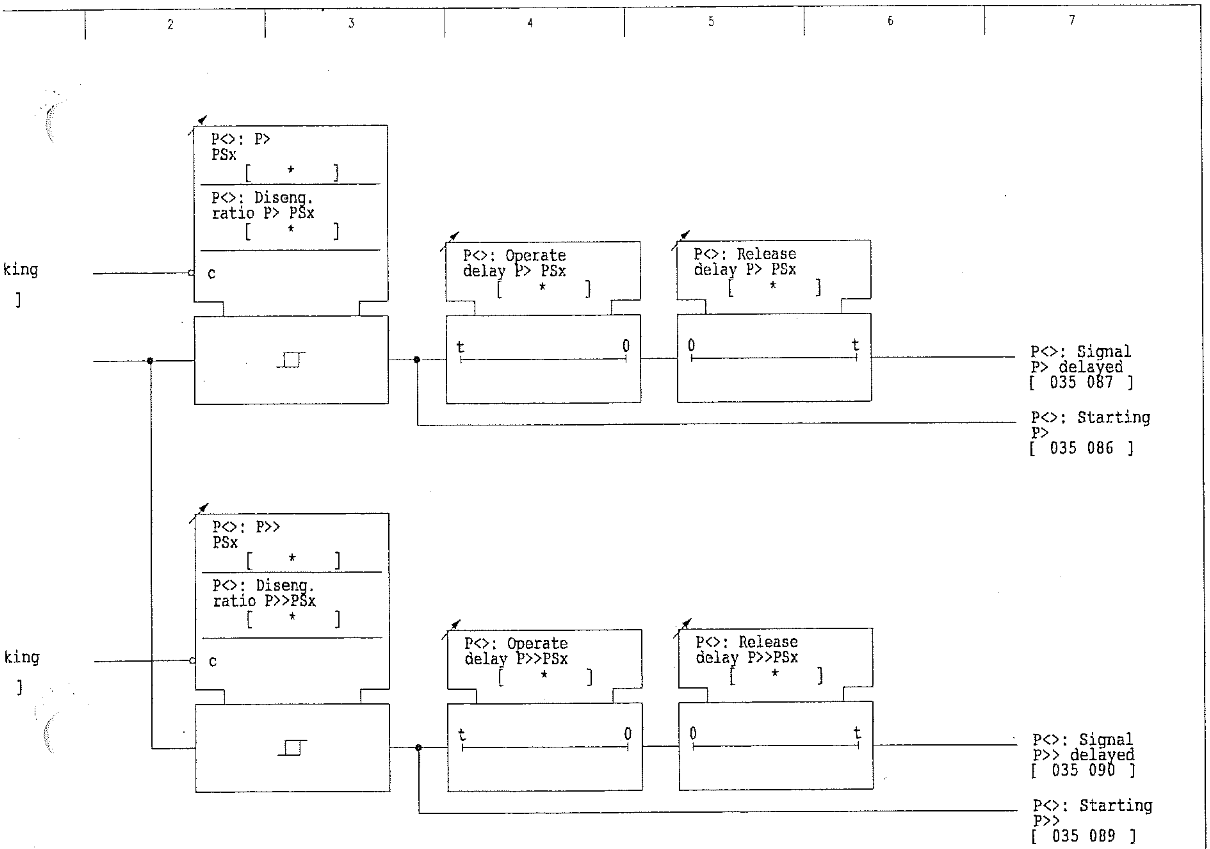


3-184 Power determination

ver monitoring

The P130C monitors the active power with two-stage functions to detect when it exceeds the set thresholds. The disengaging ratio of the threshold stages can be set.

When the active power exceeds the set thresholds, a starting results. The starting signal is followed by the set operate and release delays.



* Parameter	P<>: P> PSx	P<>: Diseng. ratio P> PSx	P<>: Operate delay P> PSx	P<>: Release delay P> PSx
set 1	017 120	017 124	017 128	017 132
set 2	017 200	017 125	017 129	017 133
set 3	017 201	017 126	017 130	017 134
set 4	017 202	017 127	017 131	017 135

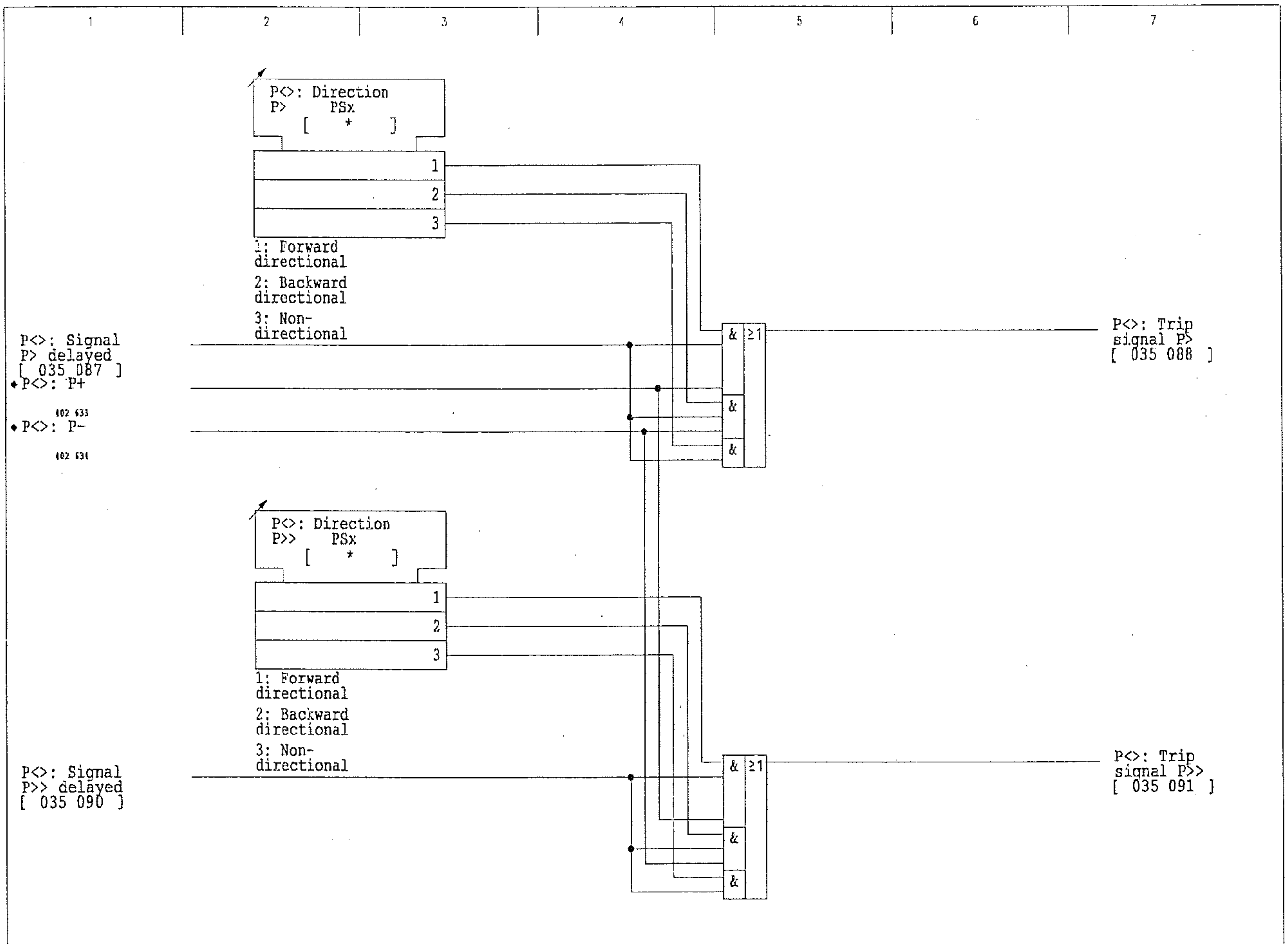
* Parameter	P<>: P>> PSx	P<>: Diseng. ratio P>>PSx	P<>: Operate delay P>>PSx	P<>: Release delay P>>PSx
set 1	017 140	017 144	017 148	017 152
set 2	017 141	017 145	017 149	017 153
set 3	017 142	017 146	017 150	017 154
set 4	017 143	017 147	017 151	017 155

150 19Z50ARA

ctive power monitoring

Active power direction

The P130C determines the sign of the active power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.

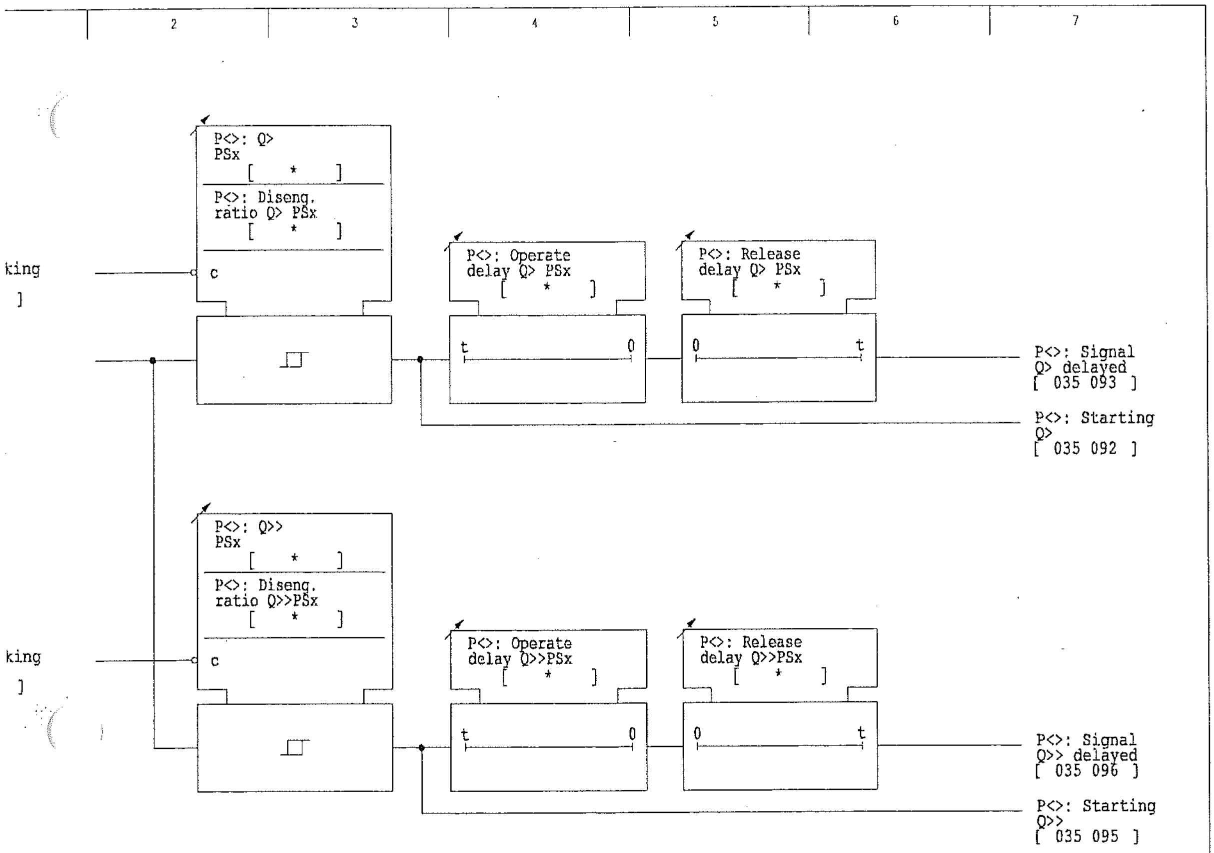


* Parameter	P<>: Direction P> PSx	P<>: Direction P>> PSx
set 1	017 136	017 156
set 2	017 137	017 157
set 3	017 138	017 158
set 4	017 139	017 159

3-186 *The direction-dependent trip signal of the active power protection function* *power monitoring*

The P130C monitors the reactive power with two-stage functions to detect when it exceeds the set thresholds. The disengaging ratio of the threshold stages can be set.

When the reactive power exceeds the set thresholds, a starting results. The starting signal is followed by the set operate and release delays.



* Parameter	P<>: Q> PSx	P<>: Diseng. ratio Q> PSx	P<>: Operate delay Q> PSx	P<>: Release delay Q> PSx
set 1	017 160	017 164	017 168	017 172
set 2	017 161	017 165	017 169	017 173
set 3	017 162	017 166	017 170	017 174
set 4	017 163	017 167	017 171	017 175

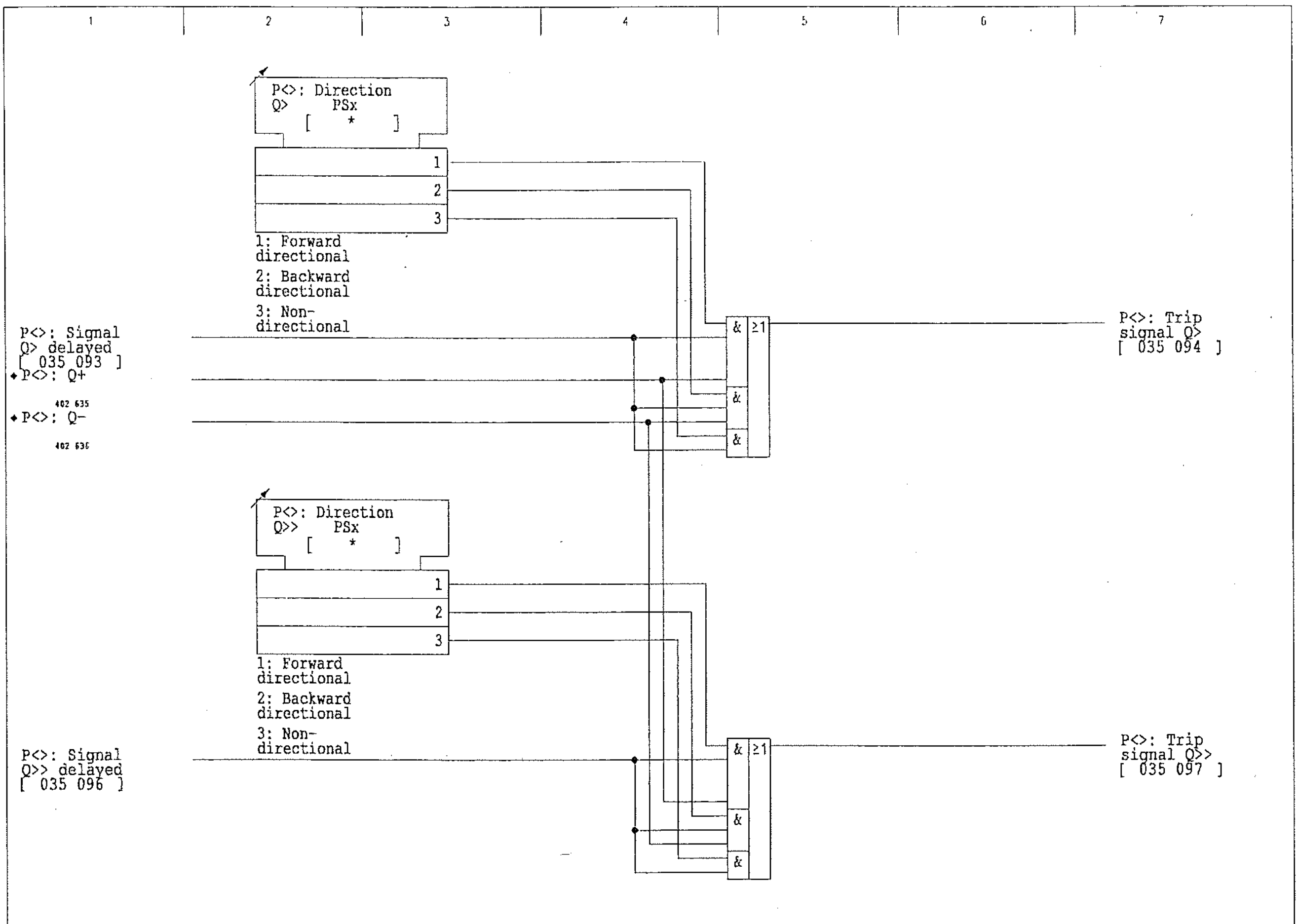
* Parameter	P<>: Q>> PSx	P<>: Diseng. ratio Q>>PSx	P<>: Operate delay Q>>PSx	P<>: Release delay Q>>PSx
set 1	017 180	017 184	017 188	017 192
set 2	017 181	017 185	017 189	017 193
set 3	017 182	017 186	017 190	017 194
set 4	017 183	017 187	017 191	017 195

150 19Z50ASA

Reactive power monitoring

Reactive power direction

The P130C determines the sign of the reactive power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.



* Parameter	P<>: Direction Q> PSx	P<>: Direction Q>> PSx
set 1	017 176	017 196
set 2	017 177	017 197
set 3	017 178	017 198
set 4	017 179	017 199

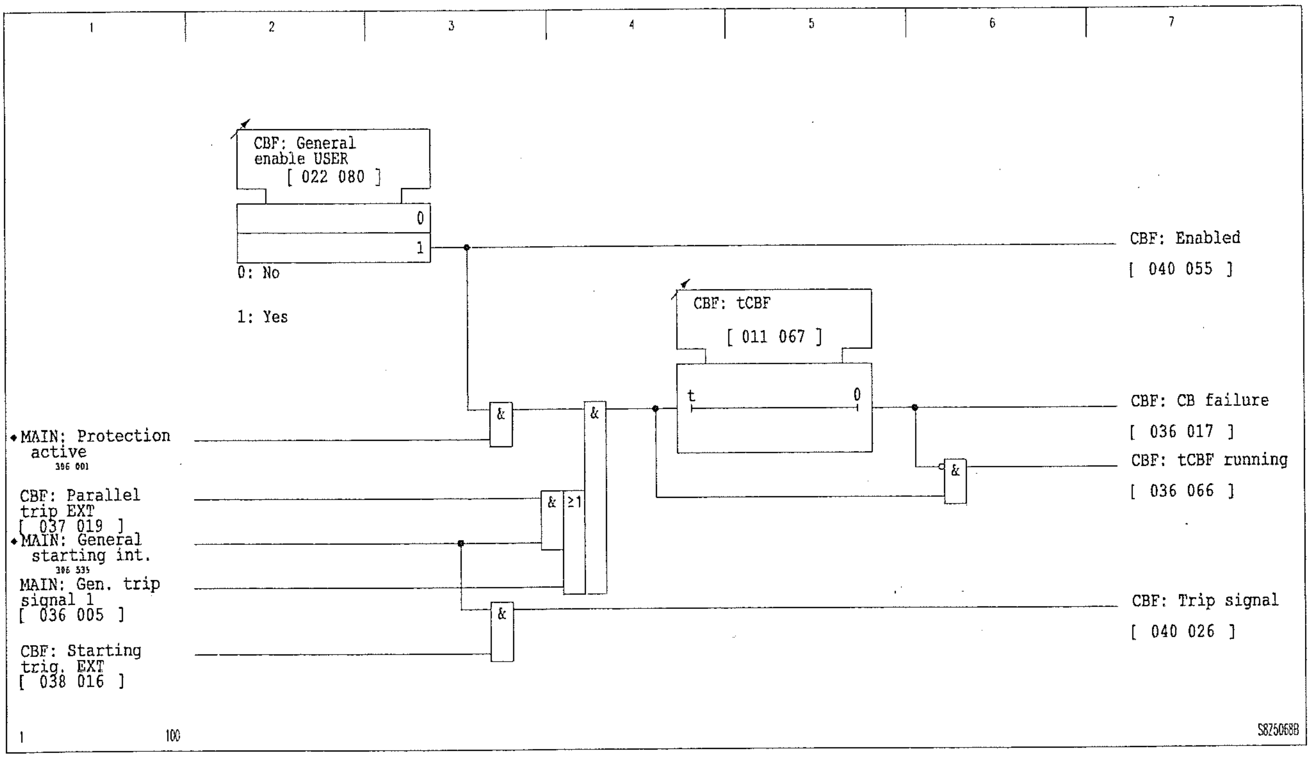
6 150 45Z5056A

3-188 *The direction-dependent trip signal of the reactive power protection function*

3.34 Circuit Breaker Failure Protection (Function Group CBF)

An adjustable timer stage for monitoring circuit breaker action is started with the general trip signal 1. This timer stage is also triggered if, in the presence of a general starting signal, a trip decision from an external protection device is acquired through a signal input. The general trip signal 2 of the P130C is not used to trigger circuit breaker failure protection. If the fault still persists when the timer stage elapses, the 'CB failure' signal is issued.

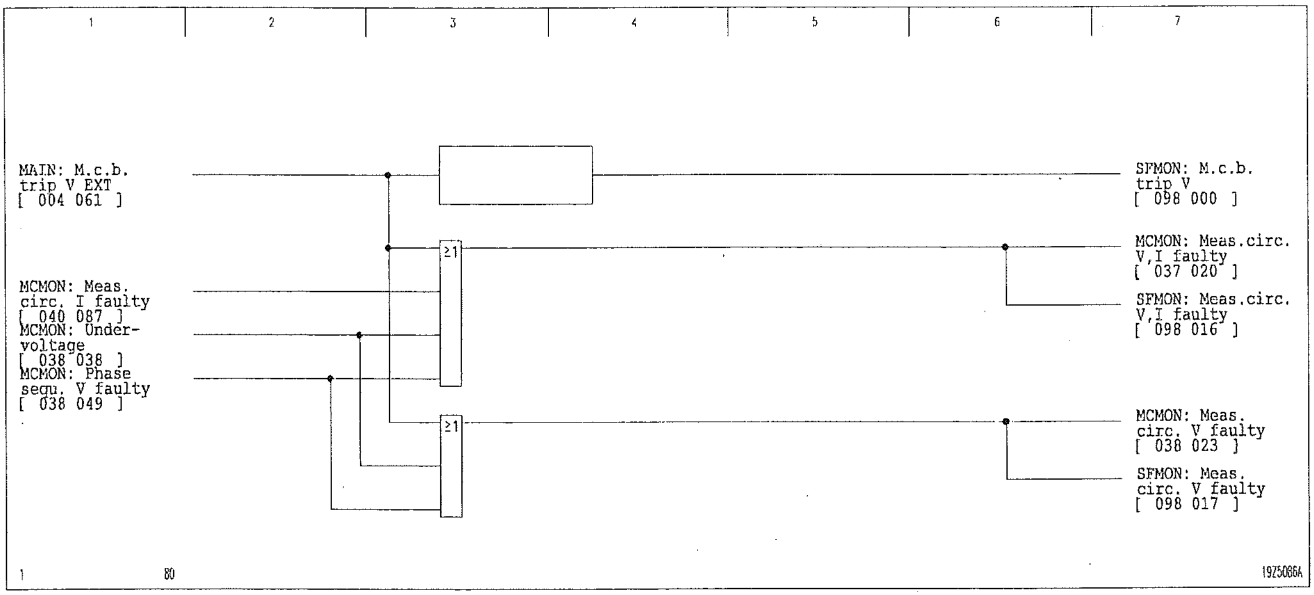
The input of a 'trip on starting' signal via an appropriately configured binary signal input generates an undelayed trip signal, provided a general starting signal is present.



3-189 *Circuit breaker failure protection*

3.35 Measuring Circuit Monitoring (Function Group MCMON)

The P130C monitors the phase currents and voltages for balance during healthy system operation. If either unbalance or the lack of measuring voltage is detected, action is taken to prevent the unit from malfunctioning.



3-190 Monitoring signals

Measuring-circuit monitoring can be deactivated by the appropriate setting. In the event of a fault, measuring-circuit monitoring is blocked.

onitoring

Current monitoring is only enabled if the following conditions are met simultaneously:

- ☐ Measuring-circuit monitoring is enabled.
- ☐ The difference between the maximum and the minimum phase current exceeds $0.05 \cdot I_{nom}$.
- ☐ A general starting signal is absent.

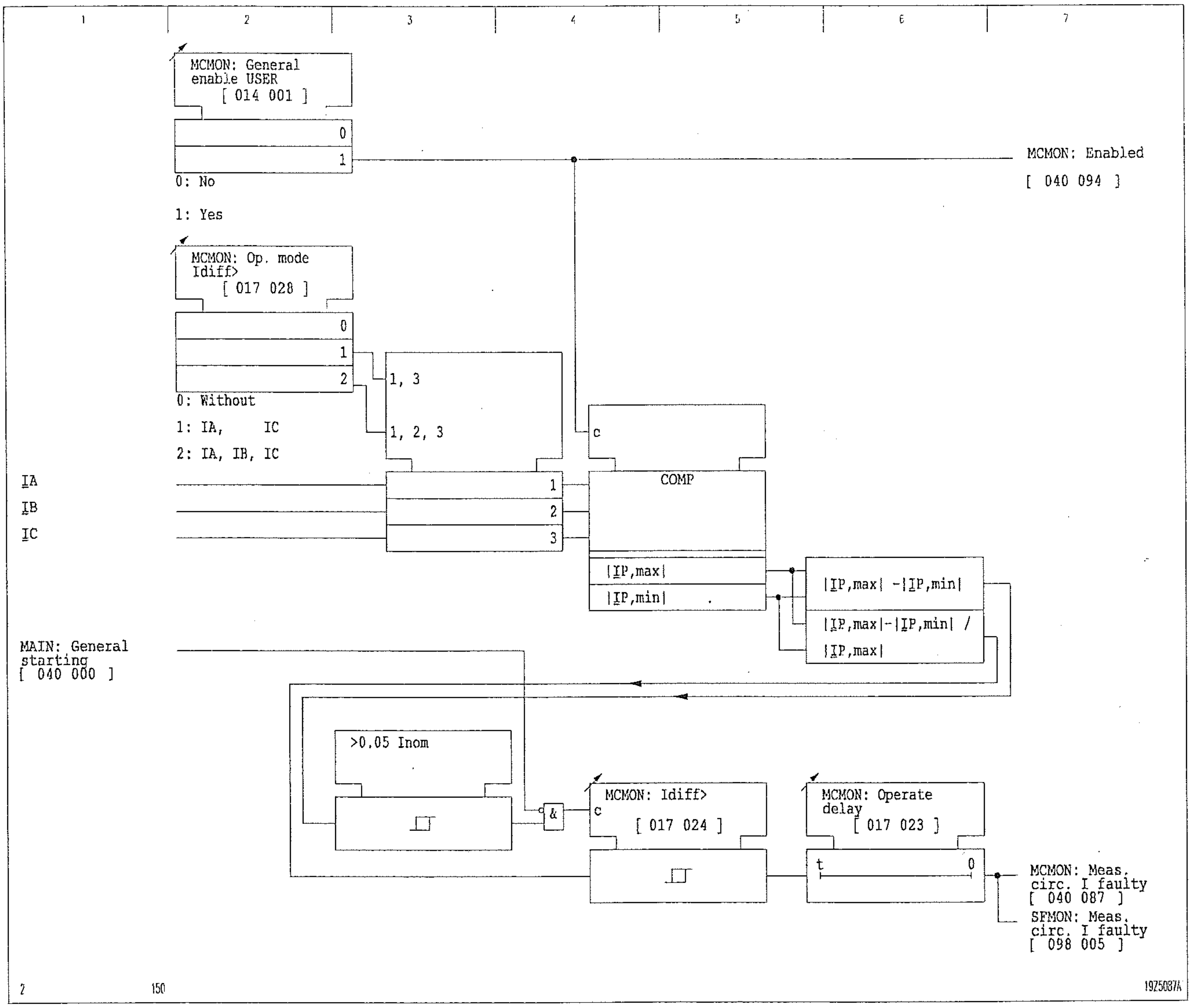
Current monitoring is based on checking the difference in the phase current magnitudes under the following operate condition:

$$\frac{I_{P,max} - I_{P,min}}{I_{P,max}} \geq I_{diff} >$$

where $I_{P,max}$ is the highest of the three phase currents and $I_{P,min}$ is the lowest; $I_{diff}>$ is the set operate value MCMON: Idiff>.

In order to suppress short-term transient processes, the measuring stage $I_{diff}>$ is followed by a set operate-delayed timer stage MCMON: Operate delay.

If connection is to two current transformers only (in resonant-grounded systems, for example) evaluation of current I_A can be disabled by an appropriate selection for the operating mode.



3-191 Monitoring the current-measuring circuits *onitoring*

Voltage monitoring is only enabled if the following conditions are met simultaneously:

- ☐ Measuring circuit monitoring is enabled.
- ☐ A general starting signal is absent.

In addition to these conditions, either a minimum current having the default threshold setting of $I > 0.05 \cdot I_{nom}$ or the closed position of the circuit breaker can be used as enabling criteria. If at least one of the phase-to-phase voltages falls below the set trigger value MCMON: Vmin< for the period of the operate-delayed timer stage MCMON: Operate delay, then the MCMON: Undervoltage signal is generated.

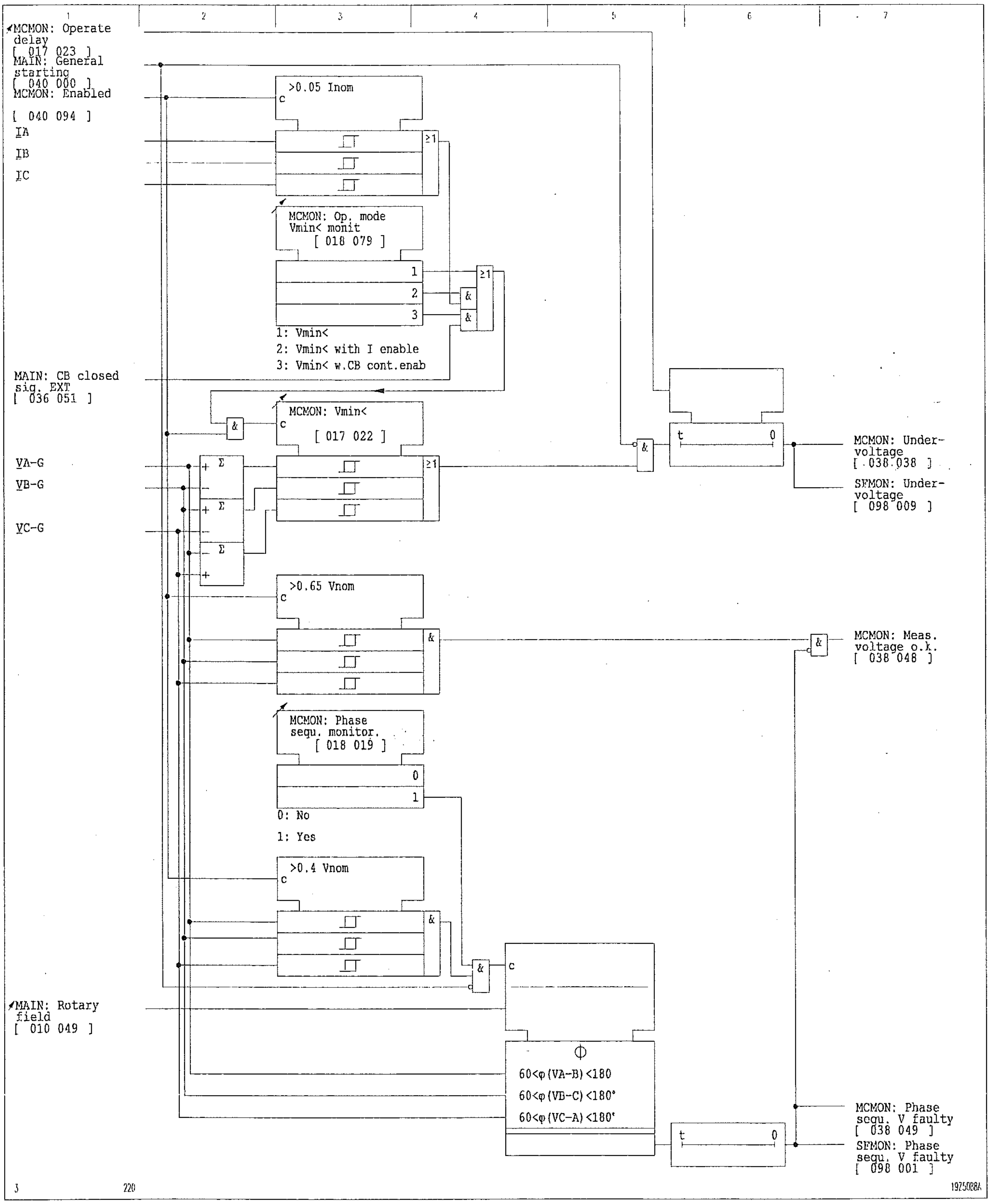
The signal MCMON: Meas. voltage o.k. is generated if all three phase-to-phase voltages exceed the fixed threshold of 0.65 V_{nom} and there is no incorrect phase sequence.

quence
g

Phase-sequence monitoring is enabled if the following conditions are met simultaneously:

- ☐ Measuring circuit monitoring is enabled.
- ☐ Phase-sequence monitoring is activated.
- ☐ All three phase-to-ground voltages exceed $0.4 \cdot V_{nom}$.
- ☐ A general starting signal is absent.

In order to suppress short-term transient processes, the phase-sequence monitoring trigger is followed by a set operate delay of 1 s. Once the operate delay has elapsed, the signal MCMON: Phase sequence faulty is generated.



3-192 *Monitoring the voltage-measuring circuits*

3.36 Limit Value Monitoring (Function Group LIMIT)

*or enabling limit
nitoring*

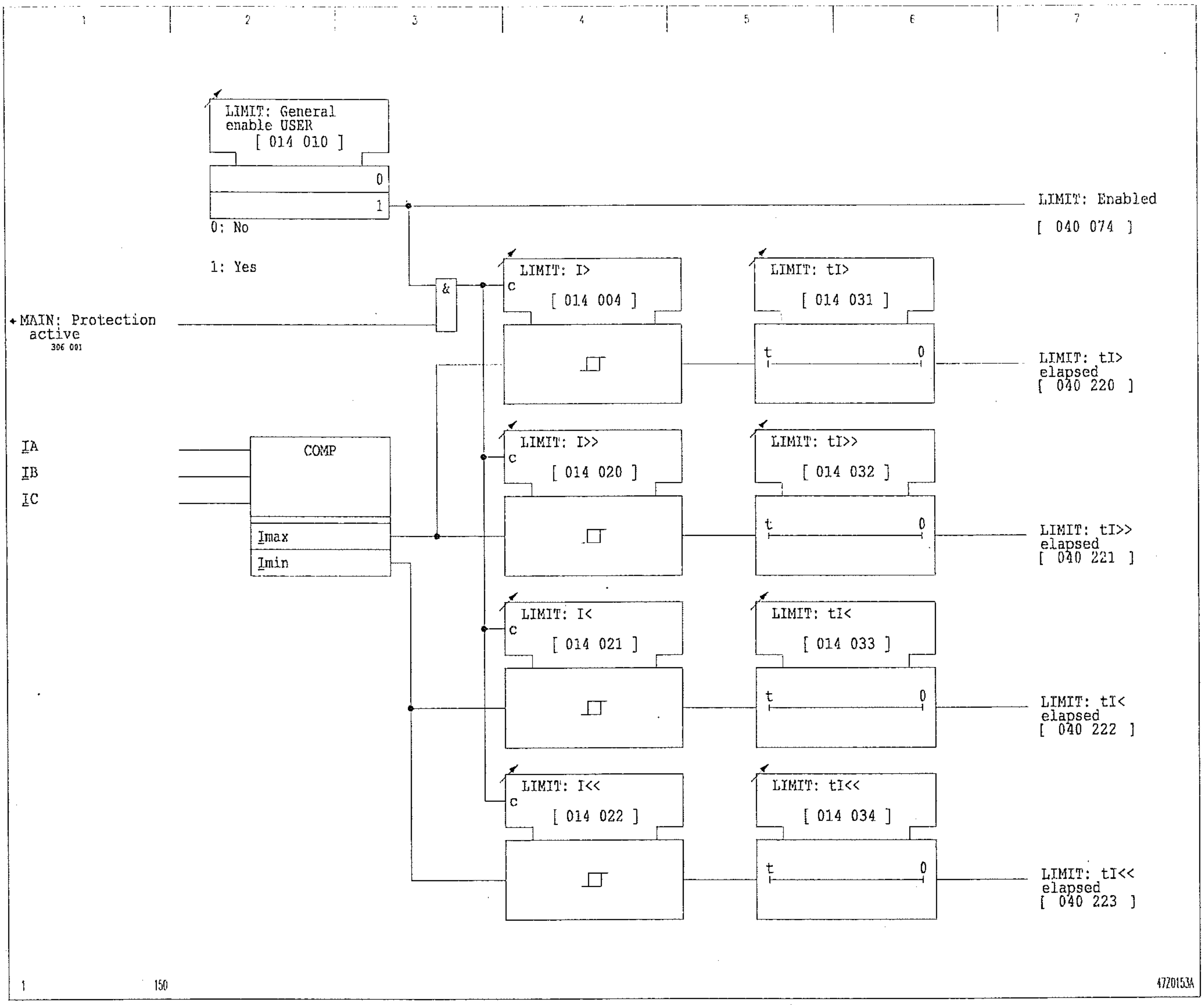
Limit value monitoring can be disabled or enabled from the integrated local control panel.

*g phase currents
e voltages*

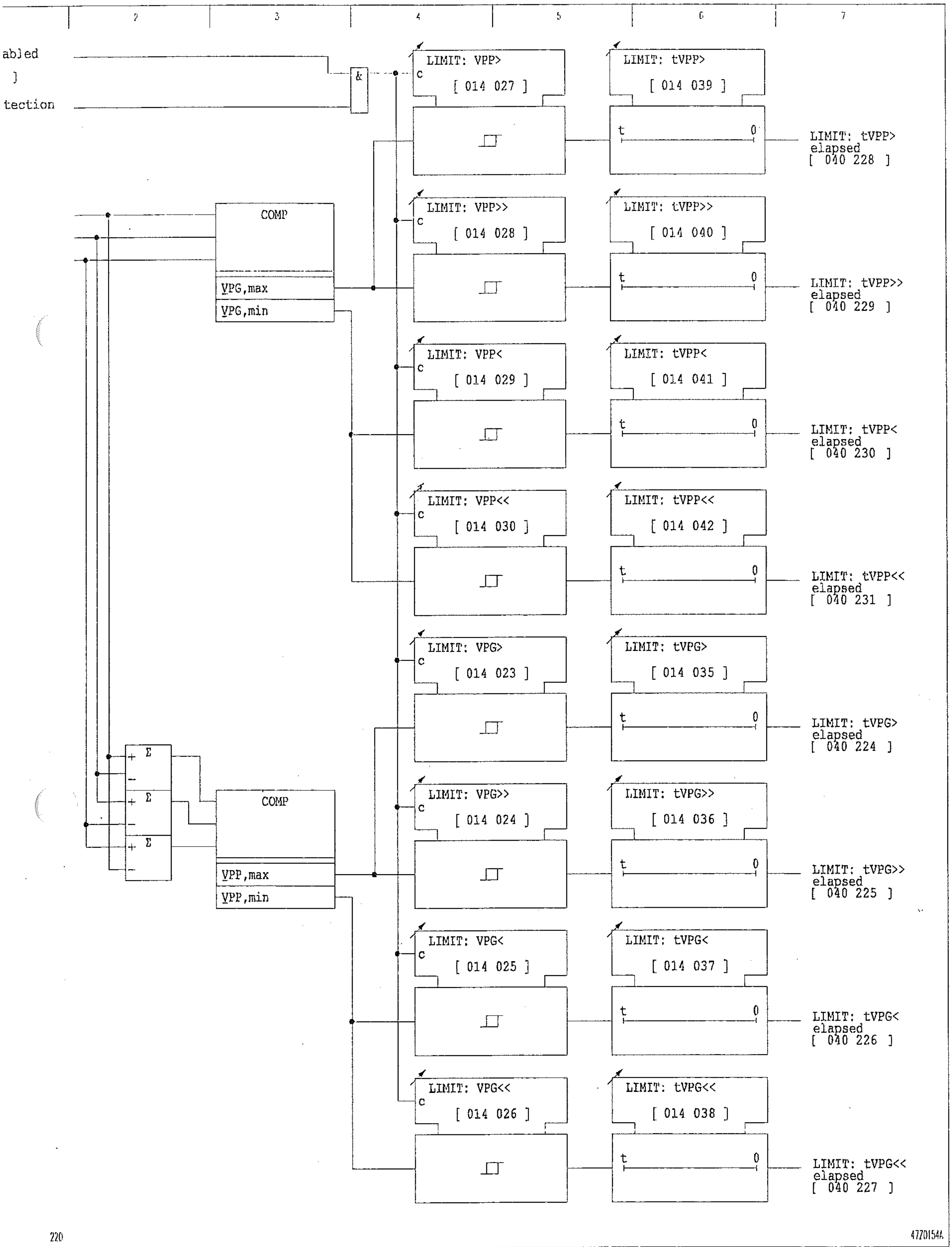
The P130C offers the possibility of monitoring the following measured values to determine if they exceed a set upper limit value or fall below a set lower limit value:

- Maximum phase current
- Minimum phase current
- Maximum phase-to-phase voltage
- Minimum phase-to-phase voltage
- Maximum phase-to-ground voltage
- Minimum phase-to-ground voltage

If one of the measured values exceeds or falls below one of the set upper or lower limit values, respectively, then a signal is issued once a set time period has elapsed.



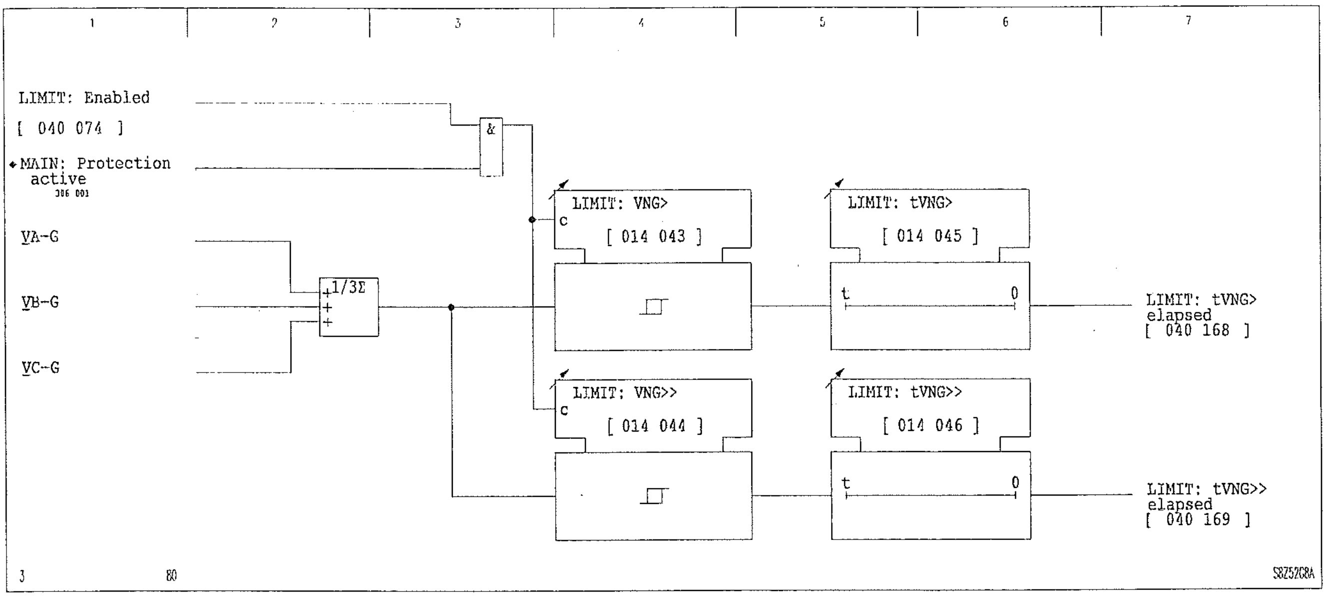
3-193 Limit value monitoring of minimum and maximum phase current



.imit monitoring of maximum and minimum phase-to-phase voltage and maximum and minimum phase-to-ground voltage

Monitoring the neutral-displacement voltage

The neutral-displacement voltage calculated from the three phase-to-ground voltages is monitored by two stages to determine whether it exceeds set thresholds. If the thresholds are exceeded, a signal is issued after the set timer stage has elapsed.



3-195 *Monitoring the neutral-displacement voltage*

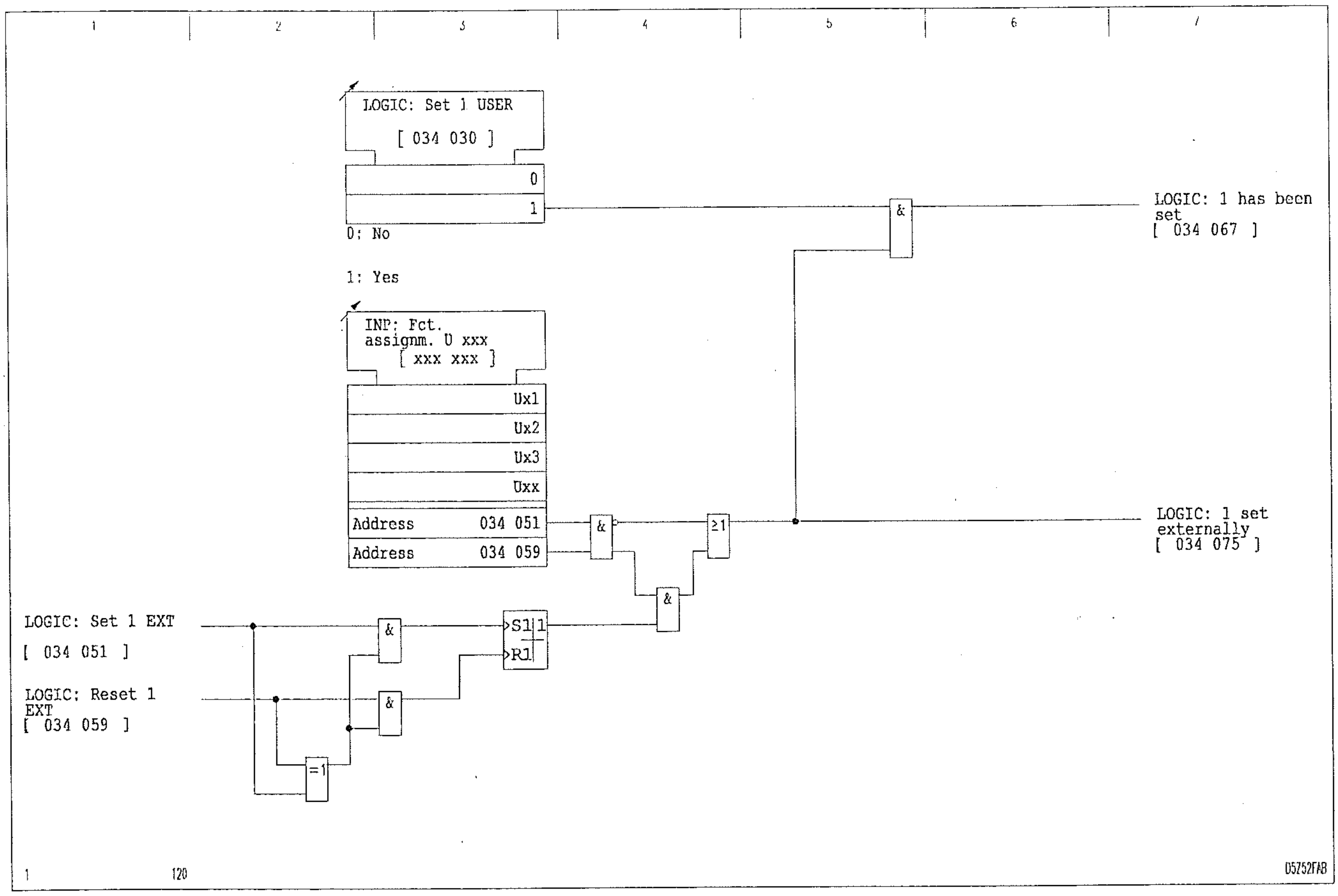
3.37 Programmable Logic (Function Group LOGIC)

Programmable (or user-configurable) logic enables the user to link binary signals within a framework of Boolean equations.

Binary signals in the P130C can be linked by logical 'OR' or 'AND' operations with the option of additional NOT operations by setting LOGIC: Fct. assignm. outp. n, where n = 1 to 32. The Boolean equations need to be defined without the use of brackets. The following rule applies to the operators: 'NOT' before 'AND' before 'OR'.

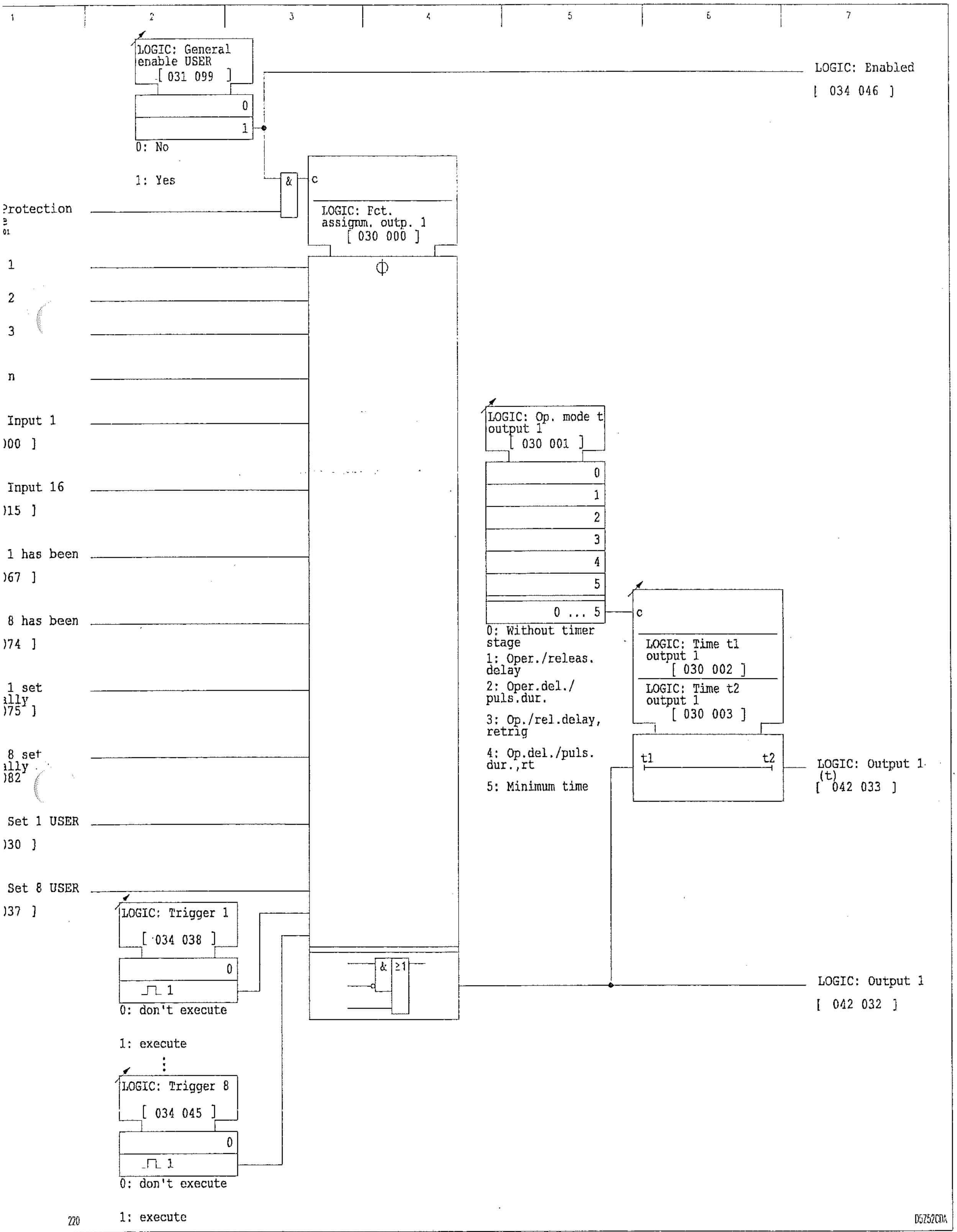
A maximum of 32 elements can be processed in one Boolean equation. In addition to the signals generated by the P130C, initial conditions for governing the equations can be set from the local control panel, through binary signal inputs, or through the serial interfaces.

Logical operations can be controlled through the binary signal inputs in different ways. The binary input signals LOGIC: Input n EXT (n = 1 to 16) have an updating function, whereas the input signals LOGIC: Set n EXT (n = 1 to 8) are stored. The logic can only be controlled from the binary signal inputs that are configured for LOGIC: Set n EXT if the corresponding reset input (LOGIC: Reset n EXT) has also been configured for a binary signal input. If only one or neither of the two functions is configured, then this is interpreted as 'Logic externally set'. If the input signals of the two binary signal inputs are implausible (such as when they both have a logic value of '1'), then the last plausible state remains stored in memory.



3-196 Control of logic operations via setting parameters or stored input signals

The LOGIC: Trigger n signal is a 'triggering function' that causes a 100 ms pulse to be issued.

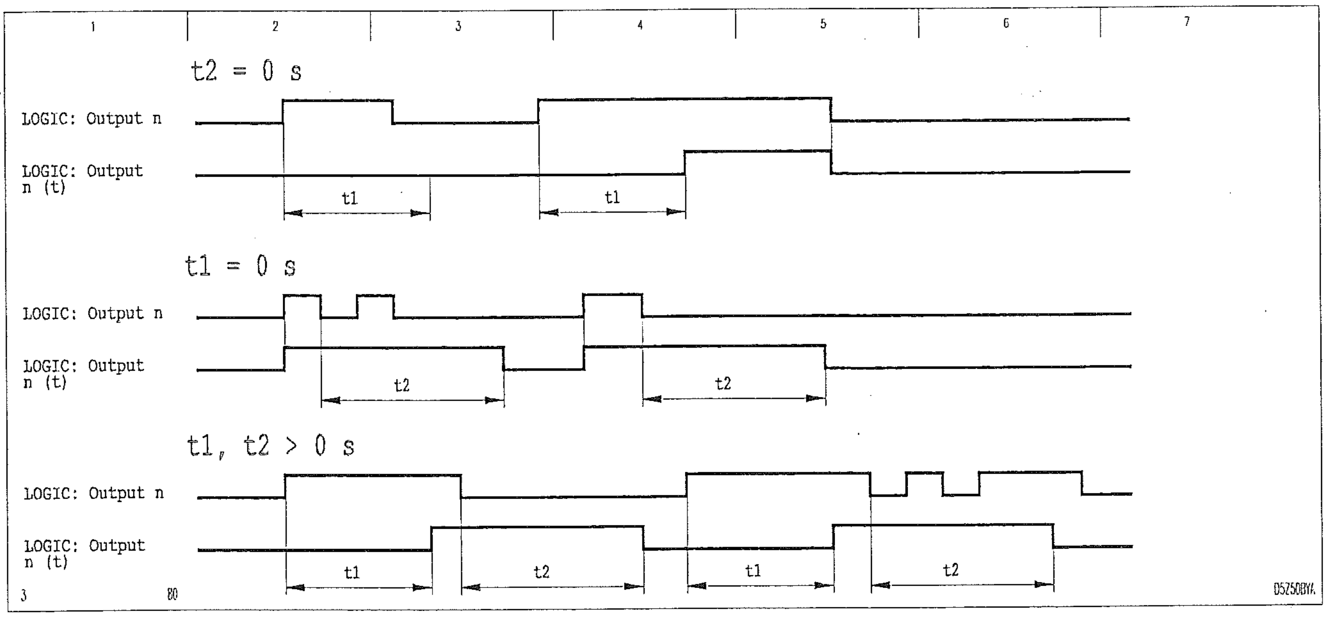


Setti... ɔtions for programmable logic (shown here for output 1)

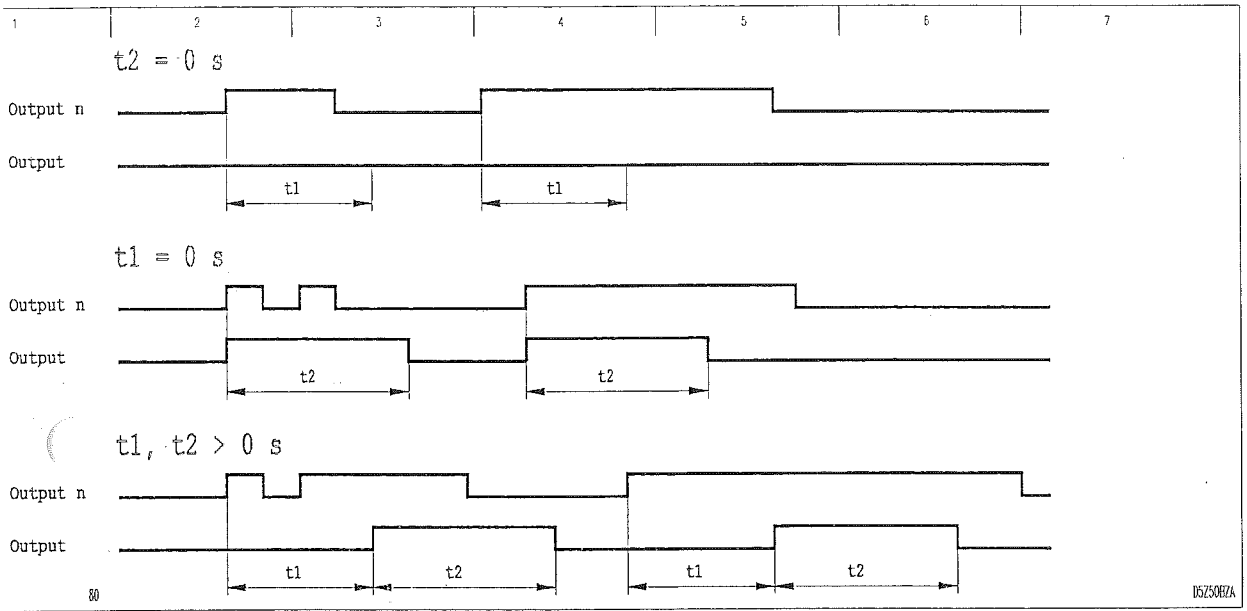
The output signal of one equation can be processed as the input signal for another, higher-order, equation and this makes it possible to have a sequence of interlinked Boolean equations. The equations are processed in the sequence defined by the order of each equation so that the end result of a sequence of interlinked Boolean equations is given by the highest-order equation.

The output signal of each equation is fed to a separate timer stage with two timer elements and a choice of operating modes. This offers the possibility of assigning a freely configurable time characteristic to the output signal of each Boolean equation. In the *Minimum time* operating mode, the setting of timer stage t2 has no effect. Figures 3-198 to 3-202 show the time characteristics for the various timer stage operating modes.

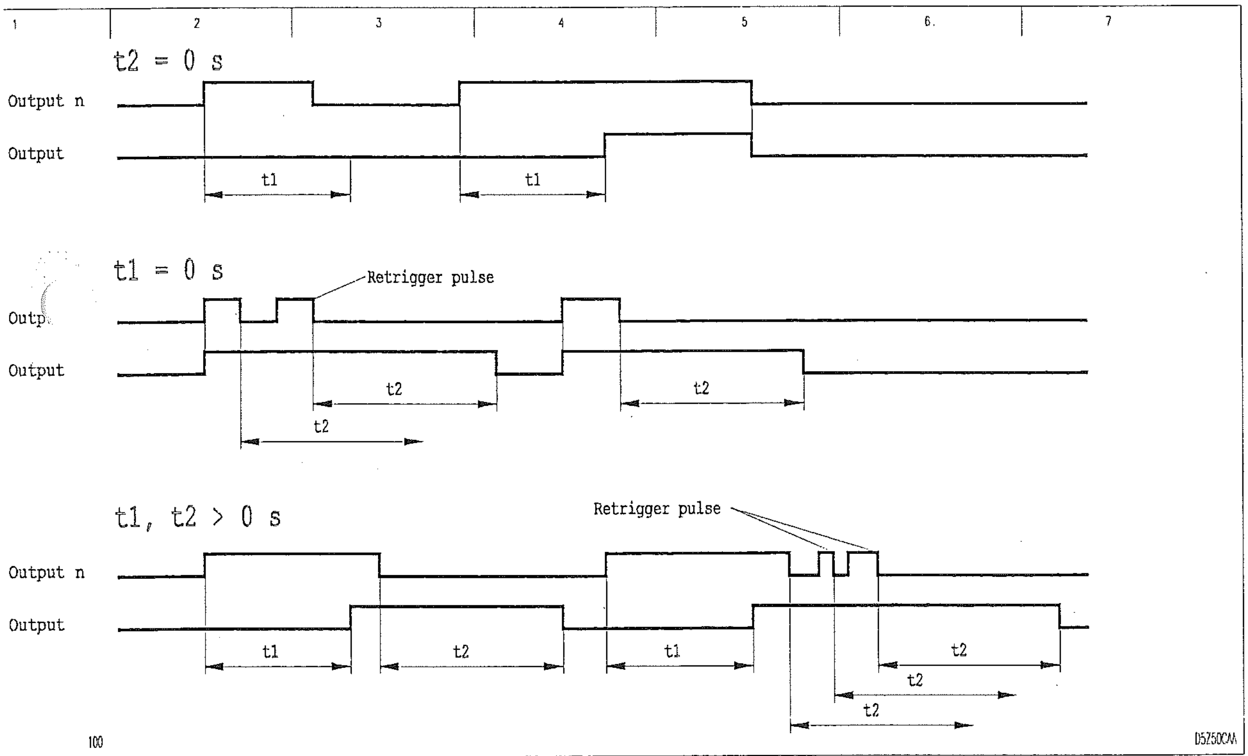
Note: If the unit is set to "off-line", the equations are not processed and all outputs are set to a logic value of '0'.



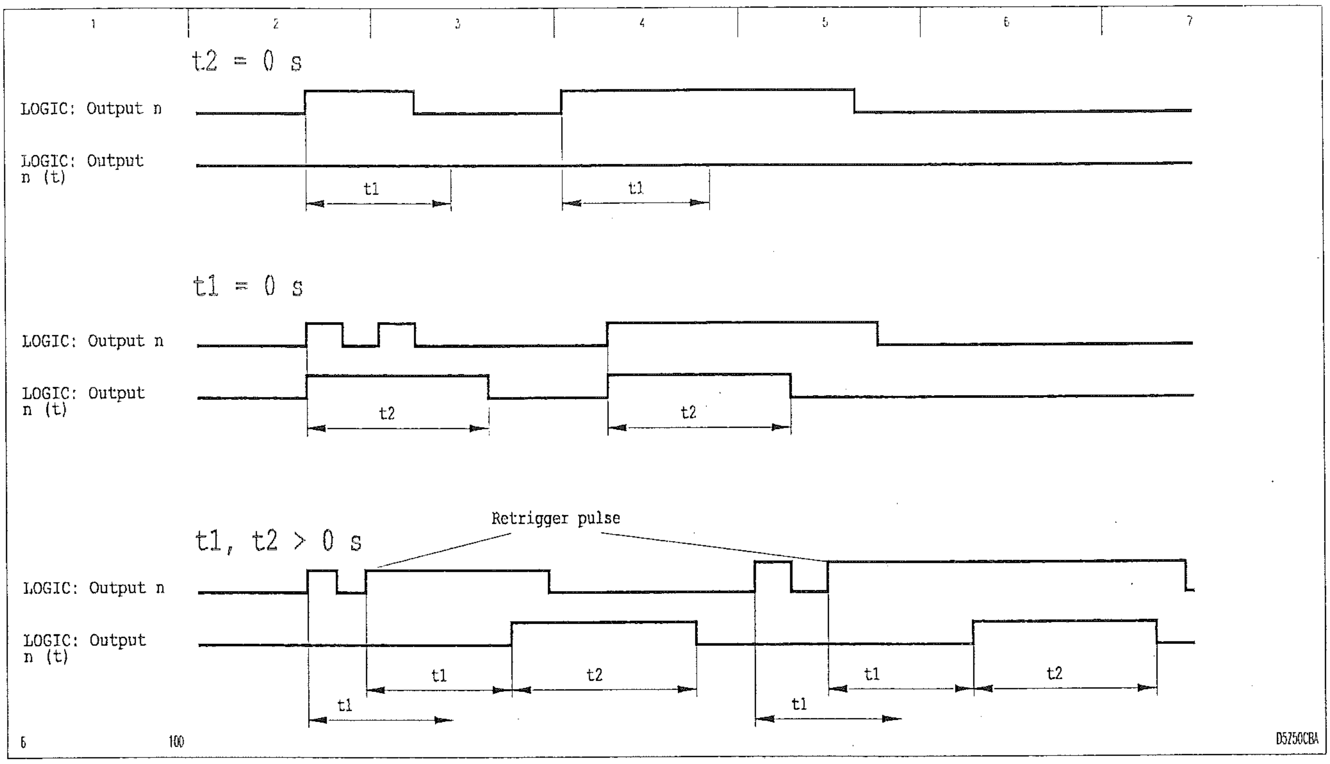
3-198 *Operating mode 1: Operate/release delay*



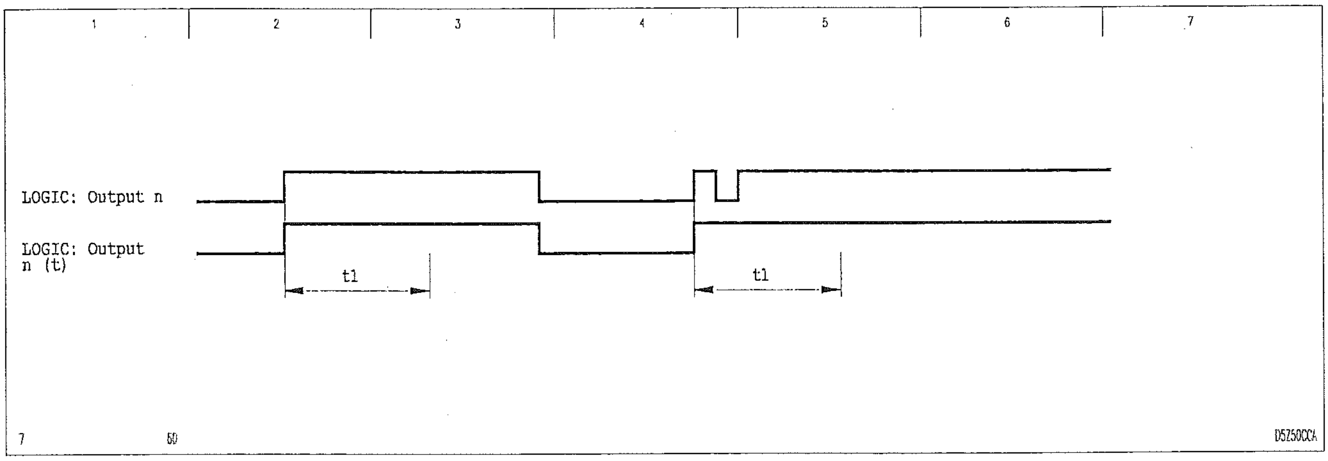
Operating mode 2: Operate-delay/pulse duration



Operating mode 3: Operate/release delay, retriggerable

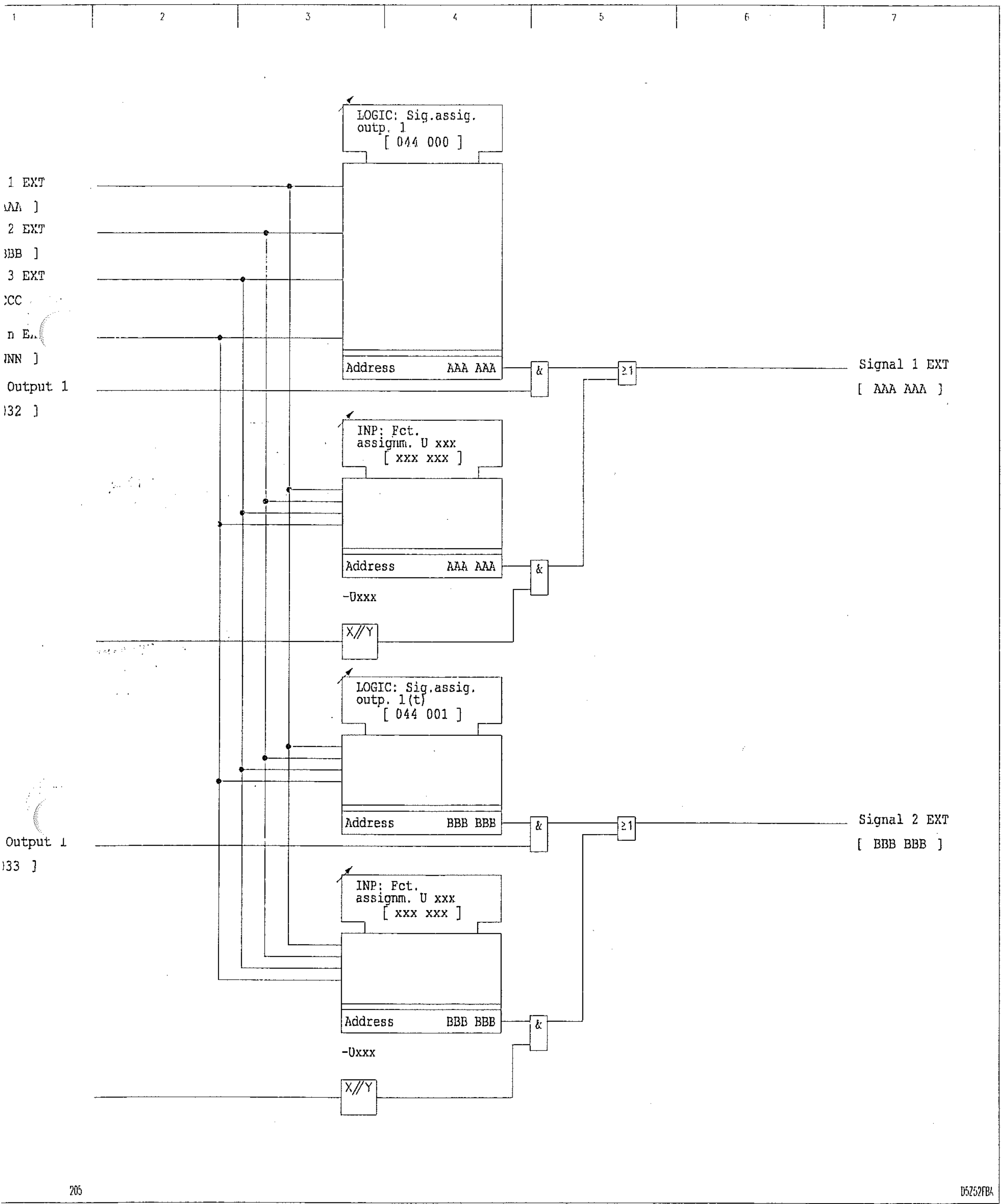


3-201 *Operating mode 4: Operate-delay/pulse duration, retriggerable*



3-202 *Operating mode 5: Minimum time*

Through appropriate configuration, it is possible to assign the function of a binary input signal to each output of a logic operation. The output of the logic operation then has the same effect as if the binary signal input to which this function has been assigned were triggered.



Signal assignment to outputs of Boolean equations

4 Design

The P130C is mounted in an aluminum case. Connection is via threaded terminal ends. The case is suitable for either wall-surface mounting or flush panel-mounting. The mounting brackets adjust for flush mounting.

Figures 4-1 and 4-2 show the case dimensions and mounting dimensions. A cover frame is supplied for flush mounting (see Installation and Connection).

Regardless of model, the P130C - like all other device types in the MiCom Px30 system - is equipped with the standard local control panel. The local control panel is covered with a tough film so that the specified degree of protection will be maintained. In addition to the essential control and display elements, a parallel display consisting of a total of 17 LED indicators is also incorporated into the local control panel. The meaning of the various LED indications is shown in plain text on a label strip.

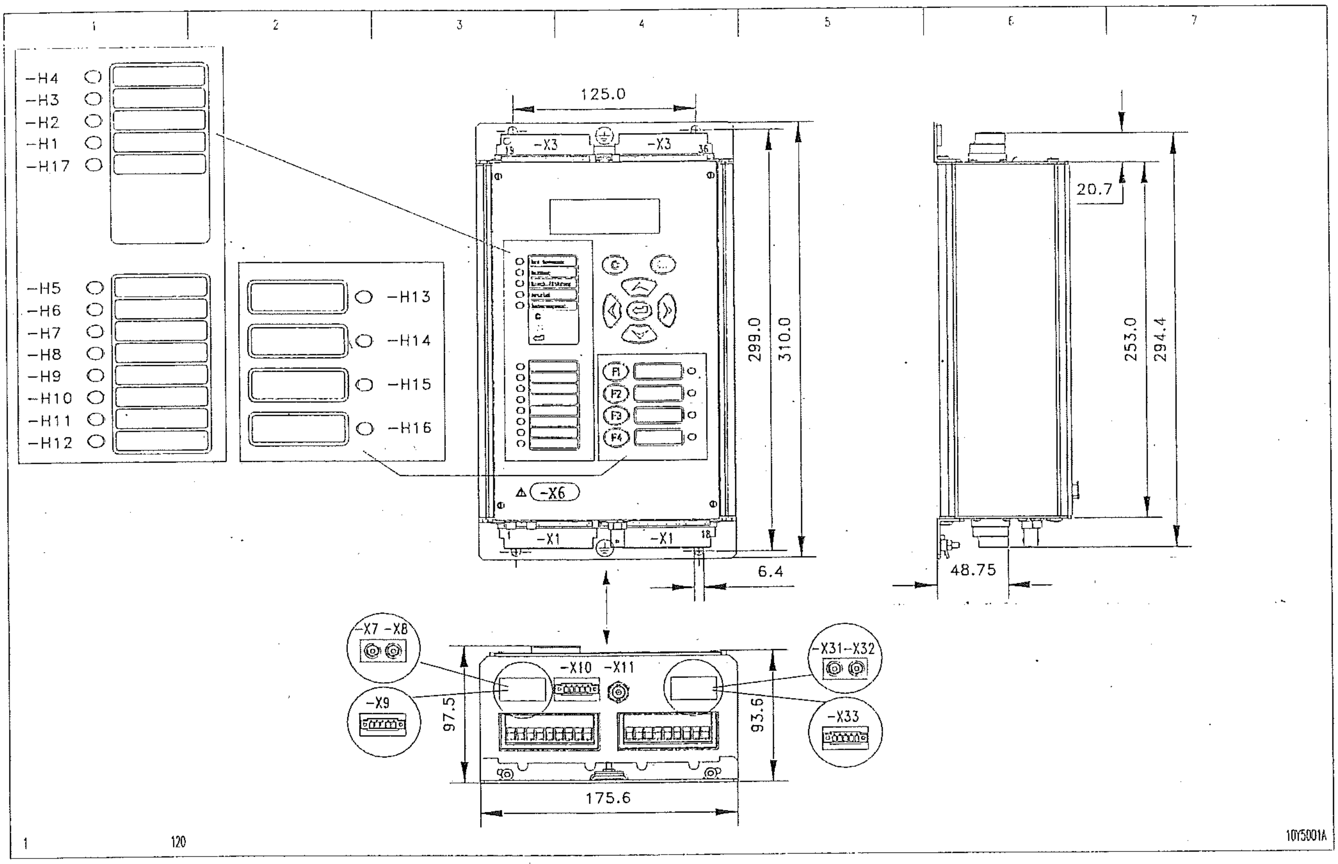
The components located behind the front panel are energized. Therefore always turn off the supply voltage before opening the device.

The processor module with the local control module is attached to the reverse side of the removable front plate and connected to the combined I/O module via a ribbon cable. The I/O module incorporates the power supply, the optional input transformers, the output relays and optical couplers for binary input signals.

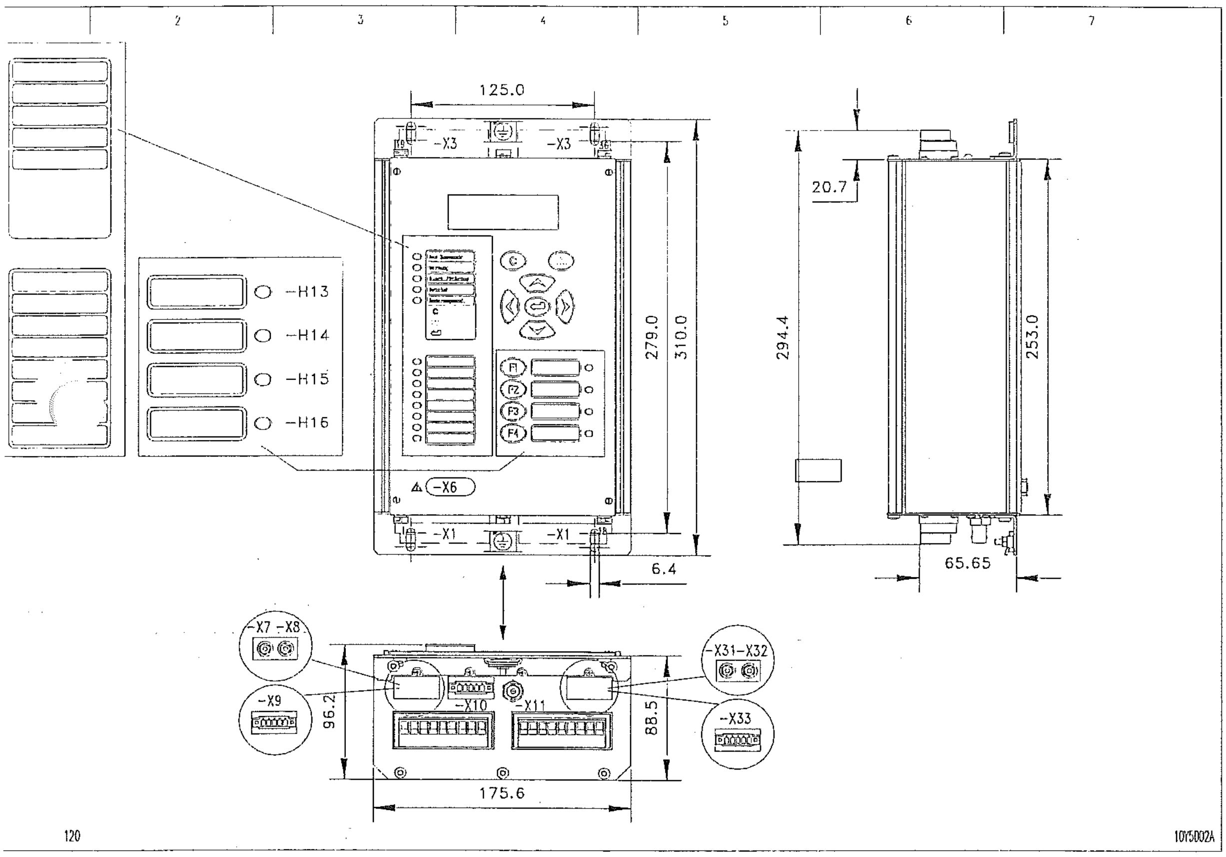
The secondary circuit of operating current transformers must not be opened. If the secondary circuit of an operating current transformer is opened, there is the danger that resulting voltages may injure personnel or damage the insulation.

The threaded terminal block for current transformer connection is not a shorting block. Therefore always short-circuit the current transformer before loosening the threaded terminals.

The front panel houses the -X6 serial interface for parameter setting by way of a PC. The optional communication interfaces (-X7 and -X8 or -X9 and -X10) and the optional IRIG-B input (-X11) are located on the underside of the case.



4-1 Dimensional drawing of the wall-mounting case (-X7 and -X8 or -X9 and -X10: optional communication interfaces; -X11: optional IRIG input; -X31 and -X32: optional InterMiCOM interface for connection to optical fiber, X33: optional InterMiCOM interface for connection to wire)



ısional drawing of the flush-mounting case (-X7 and -X8 or -X9 and -X10: optional communication interfaces; -X11: optional IRIG input; and -X32: optional InterMiCOM interface for connection to optical fiber, X33: optional InterMiCOM interface for connection to wire)

5 Installation and Connection

5.1 Unpacking and Packing

All P130C units are packaged separately in their own cartons and shipped inside outer packaging. Use special care when opening cartons and unpacking units, and do not use force. In addition, make sure to remove the supporting documents supplied with each individual unit from the inside carton.

After unpacking each unit, inspect it visually to make sure it is in proper mechanical condition.

If the P130C needs to be shipped, both inner and outer packaging must be used. If the original packaging is no longer available, make sure that packaging conforms to DIN ISO 2248 specifications for a drop height ≤ 0.8 m.

5.2 Checking the Nominal Data and the Design Version

The nominal data and design version of the P130C can be determined by consulting the type identification label (see Figure 5-1). One type identification label is located next to the upper terminal blocks. Another copy of the type identification label is affixed to the outside of the P130C packaging.

P130C	P130C-XXXXXXX-301-401-601			Diagram P130C.401		xx.yy
$U_{nom\,/\,NE,nom}$ = 50 ... 130 V	I_{nom} = 1 / 5 A	$I_{E,nom}$ = 1 / 5 A	$I_{EP,nom}$ = A		f_{nom} = 50/60 Hz	
$U_{H,nom}$ =		$U_{E,nom}$ = 24 ... 250 V DC				CE
AREVA	Specification EN 60255-6 / IEC 255-6		F 6.xxxxxx.y			

130C type identification label

The data shown on the type identification label include the nominal auxiliary voltage $V_{A,nom}$ ('$U_{H,nom}$') and the nominal input voltage $V_{in,nom}$ ('$U_{E,nom}$').

The P130C design version can be determined from the order number. A breakdown of the order number is given in Chapter 14 of this manual and in the supporting documents supplied with the unit.

5.3 Location Requirements

The P130C has been designed to conform to EN 69255-6. Therefore it is important when choosing the installation location to make sure that it provides the conditions specified in the chapter entitled 'Technical Data'. Several important conditions are listed below.

Climatic conditions

Ambient temperature: -5 °C to +55 °C [+23 °F to +131 °F]

Air pressure: 800 to 1100 hPa

Relative humidity: The relative humidity must not result in the formation of either condensed water or ice in the P130C.

Ambient air: The ambient air must not be significantly polluted by dust, smoke, gases or vapors, or salt.

Mechanical conditions

Vibration stress: 10 to 60 Hz, 0.035 mm and 60 to 150 Hz, 0.5 g

Earthquake resistance: 5 to 8 Hz, 3.5 mm / 1.5 mm, 8 to 35 Hz, 5 m/s^2, 3 x 1 cycle

Electrical conditions for auxiliary voltage for the power supply

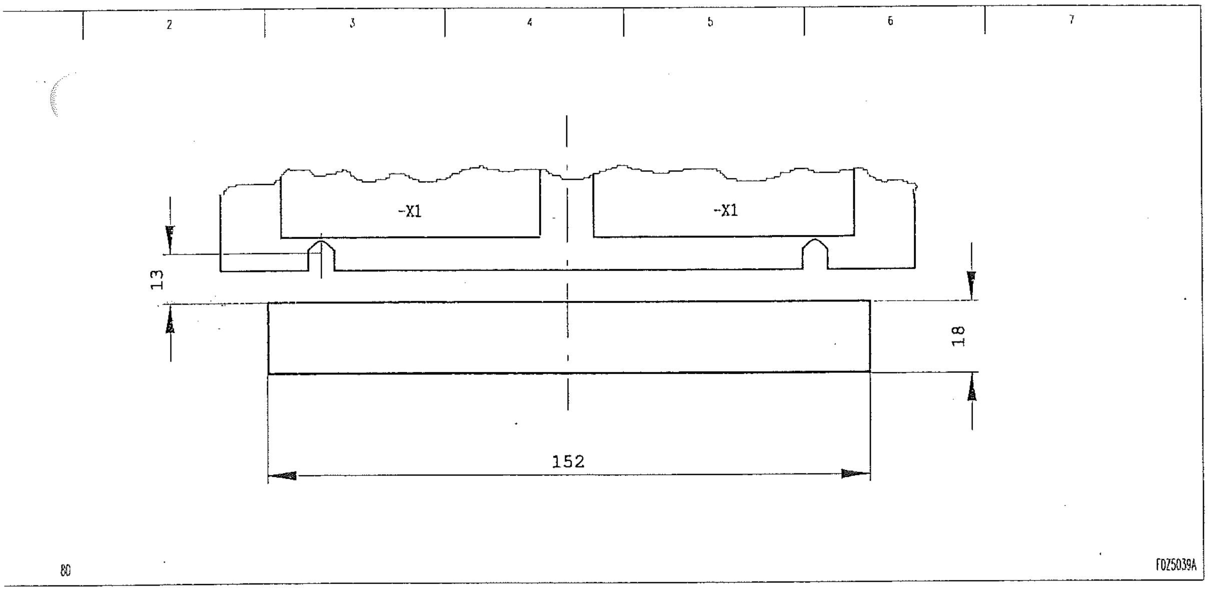
Operating range: 0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 12 % $V_{A,nom}$

Electromagnetic conditions

Appropriate measures taken in substations must correspond to the state of the art (see, for example, the VDEW ring binder entitled "Schutztechnik" [Protective Systems], Section 8, June 1992 edition, which includes recommended measures for reducing transient overvoltage in secondary lines in high voltage substations).

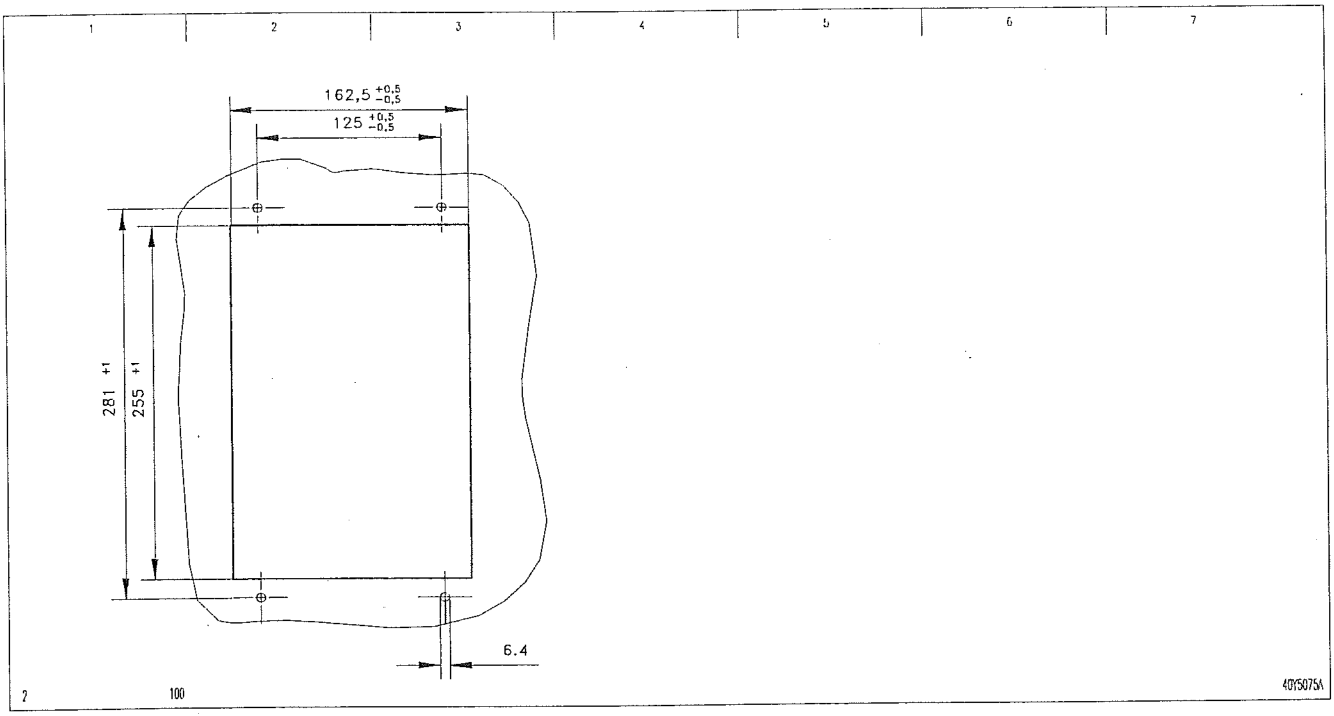
5.4 Installation

The dimensions and mounting dimensions for surface-mounted cases are given in Chapter 4. When the P130C is surface-mounted on a panel, the leads to the P130C are normally run along the front side of the mounting plane. If the wiring is to be in back, an opening can be provided above and below the surface-mounted case, as shown in Figure 5-2 for the lower opening. The same applies analogously to the upper opening.

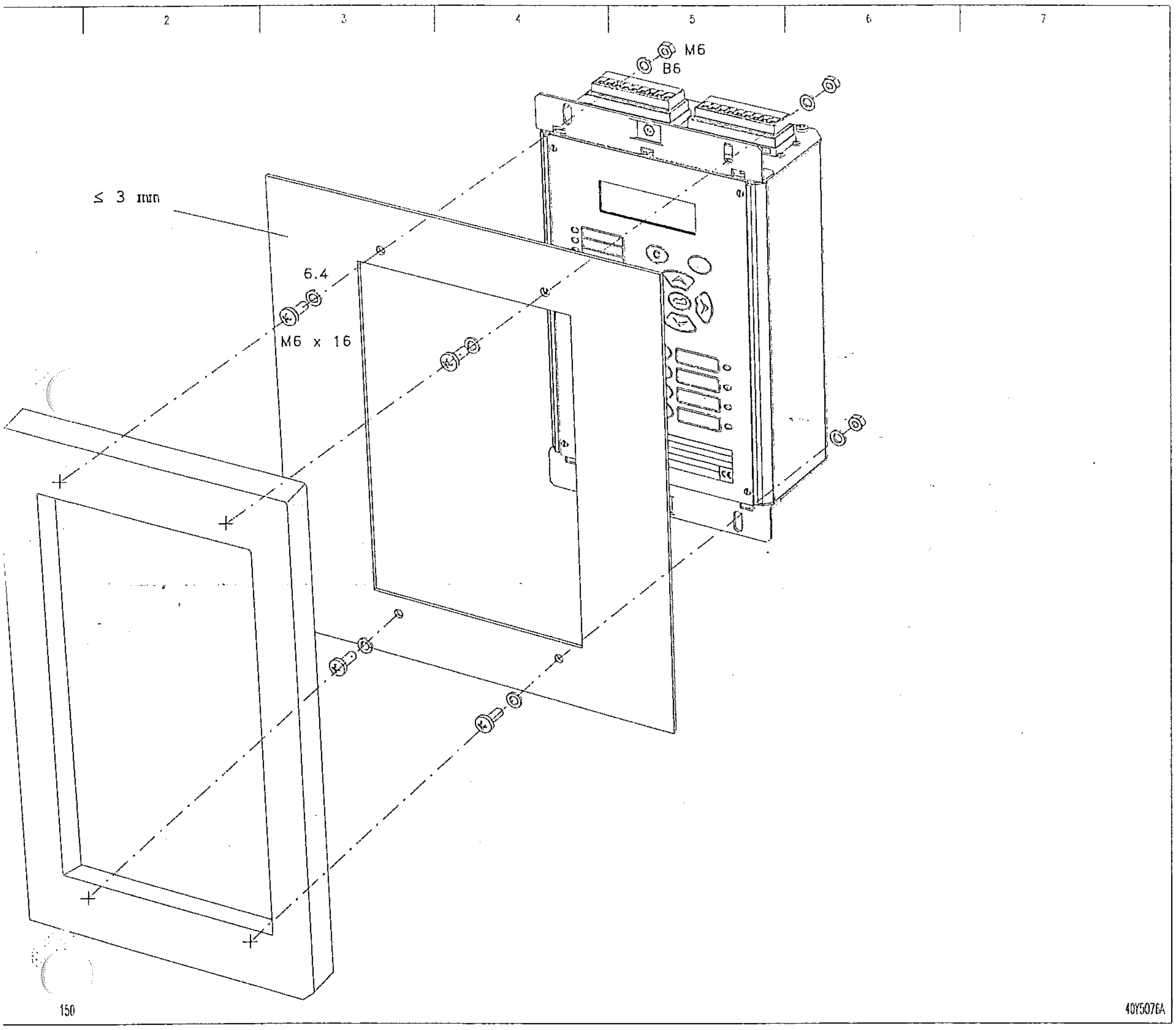


)pening for running the connecting leads to the surface-mounted case (dimensions in mm)

Flush-mounted cases are designed to be flush-mounted in control panels. The dimensions and mounting dimensions are given in Chapter 4. When the P130C is mounted in a cabinet door, special sealing measures are necessary to provide the degree of protection required for the cabinet (IP 51). Figure 5-3 shows the required panel cutout for the flush-mounted case. After the case has been mounted, the cover frame must be snapped onto the mounting bolts of the flush-mounted case (see Figure 5-4) in order to maintain the required degree of protection.



5-3 *Panel cutout for the flush-mounted case (dimensions in mm)*



ıstallation of the flush-mounted case

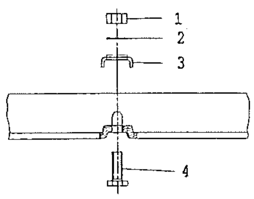
5.5 Protective Grounding

The unit must be reliably grounded to meet protective equipment grounding requirements. The case is grounded using the appropriate bolt and nut as the ground connection. The cross-sectional area of this ground conductor must also conform to applicable national standards. A minimum conductor cross section of 2.5 mm^2 is required.

In addition, a protective ground connection at the terminal contact on the power supply module (identified by the letters "PE" on the terminal connection diagram) is also required for proper operation of the unit. The cross-sectional area of this ground conductor must also conform to applicable national standards. A minimum cross section of 1.5 mm^2 is required.

The grounding connection at both locations must be low-inductance, i.e., as short as possible.

1 2 3 4 5 6 7



PE terminal	
Pos.	Description
1	Nut M4
2	Tooth lock wash.A4.3
3	Clamp bracket
4	Bolt M4

4 100 40Y5079A

5-5 *Mounting the PE terminal*

5.6 Connection

The P130C must be connected in accordance with the terminal connection diagram indicated on the type identification label. The terminal connection diagram is included in the Supporting Documents supplied with the unit. The terminal connection diagrams that apply to the P130C are also found in the appendix to this manual.

Copper leads having a 2.5-mm^2 cross-section are generally suitable as the connecting leads between the current transformers and the P130C. Under certain conditions the connecting leads between the main current transformers and the P130C must be short and have a larger cross-section in order to handle the allowable burden on the main current transformers. Copper leads having a 1.5 mm^2 cross section are adequate for connecting the binary signal inputs, the signaling and triggering circuits, and the power supply input.

All connections run into the system must always have a defined potential. Connections that are pre-wired but not used should preferably be grounded when binary inputs and output relays are isolated. When binary inputs and output relays are connected to common potential, the pre-wired but unused connections should be connected to the common potential of the grouped connections.

5.6.1 Connecting the Measuring and Auxiliary Circuits

pply

Before connecting the auxiliary voltage V_A for the P130C power supply, make sure that the nominal value of the auxiliary device voltage agrees with the nominal value of the auxiliary system voltage.

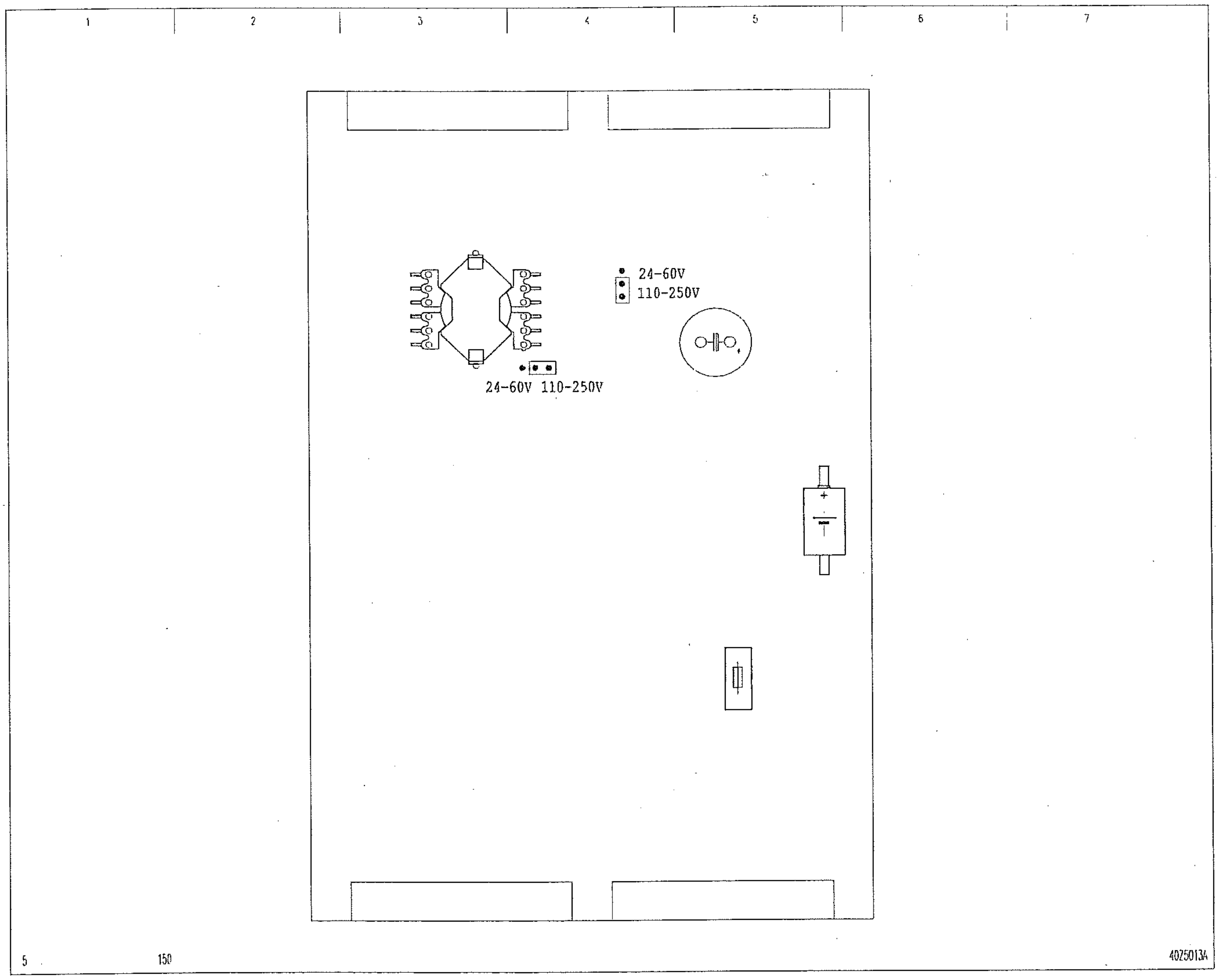
The P130C has an auxiliary voltage supply that can be switched between ranges and is factory-set for the voltage range of $V_{A,nom}$ = 110 to 250 V DC or 100 to 230 V AC.

Before changing the auxiliary voltage range, turn off any connected auxiliary voltage. The components located behind the front panel are energized!

The voltage range is switched by repositioning plug-in jumpers on the I / O (input-output) module. After loosening four bolts on the front side of the front panel the local control module (front panel and processor module), can be removed once the following connectors have been unplugged:

- The ribbon cable plug connecting the local control module to the I / O module
- The ribbon cable plug connecting the local control module to the optional serial communication interfaces (to optical fibers or to wires)

In the upper portion of the I / O module, between output relay and current input transformers, are plug-in jumpers, which are plugged in a position depending on the desired auxiliary voltage range.



5-6 *Switching the auxiliary voltage supply. The factory-set jumper position is shown.*

easuring inputs

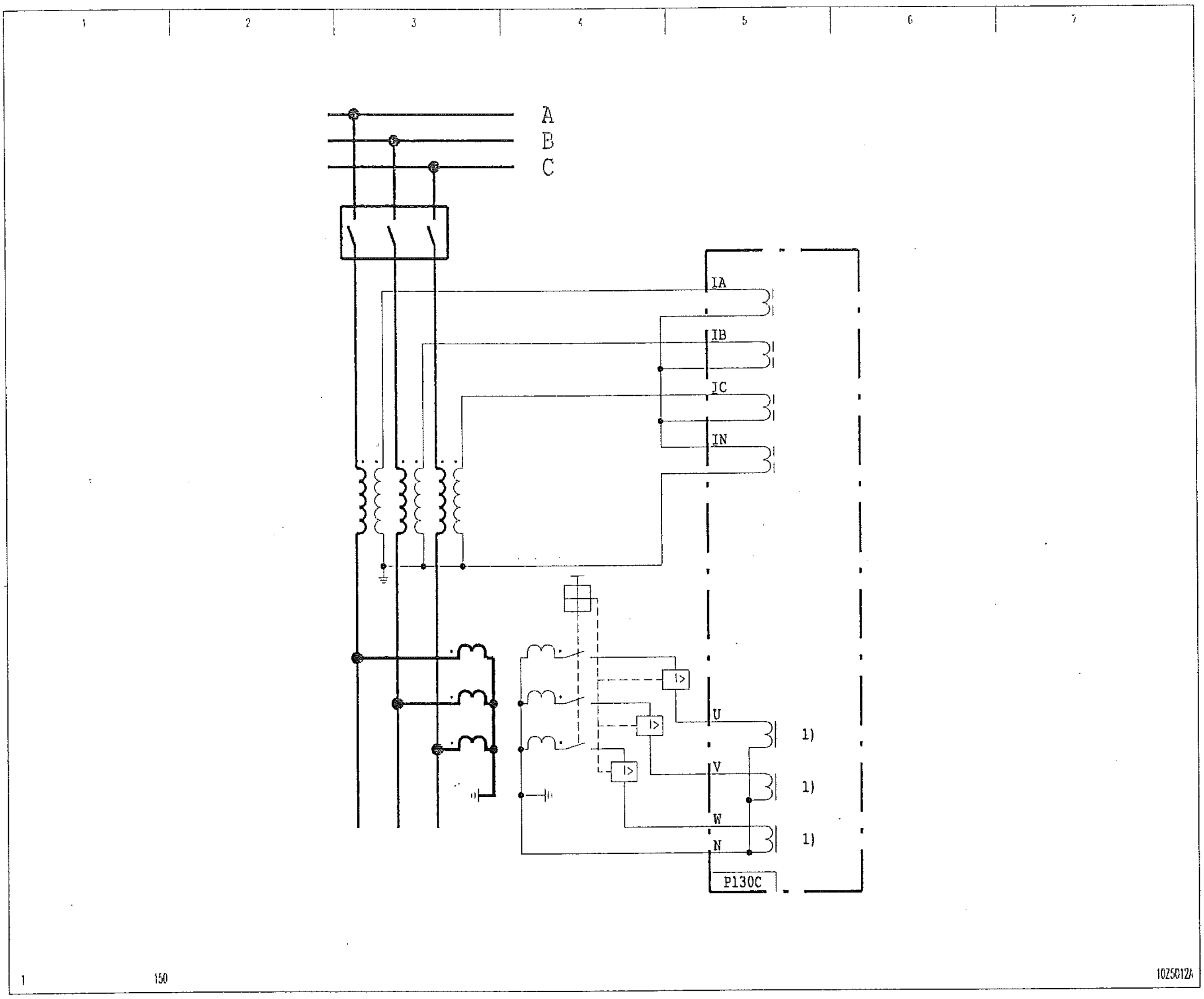
When connecting the system transformers, check to make sure that the secondary nominal currents of the system and the unit agree.

The secondary circuit of operating current transformers must not be opened. If the secondary circuit of an operating current transformer is opened, there is the danger that the resulting voltages may injure personnel or damage the insulation.

The threaded terminal block for current transformer connection is not a shorting block. Therefore always short-circuit current transformers before loosening the threaded terminals.

g the measuring

The system current transformers must be connected in accordance with the standard schematic diagram shown in Figure 5-7. It is essential that the grounding configuration shown in the diagram be followed. If a connection is in opposition, this can be taken into account when making settings (see Chapter 7).



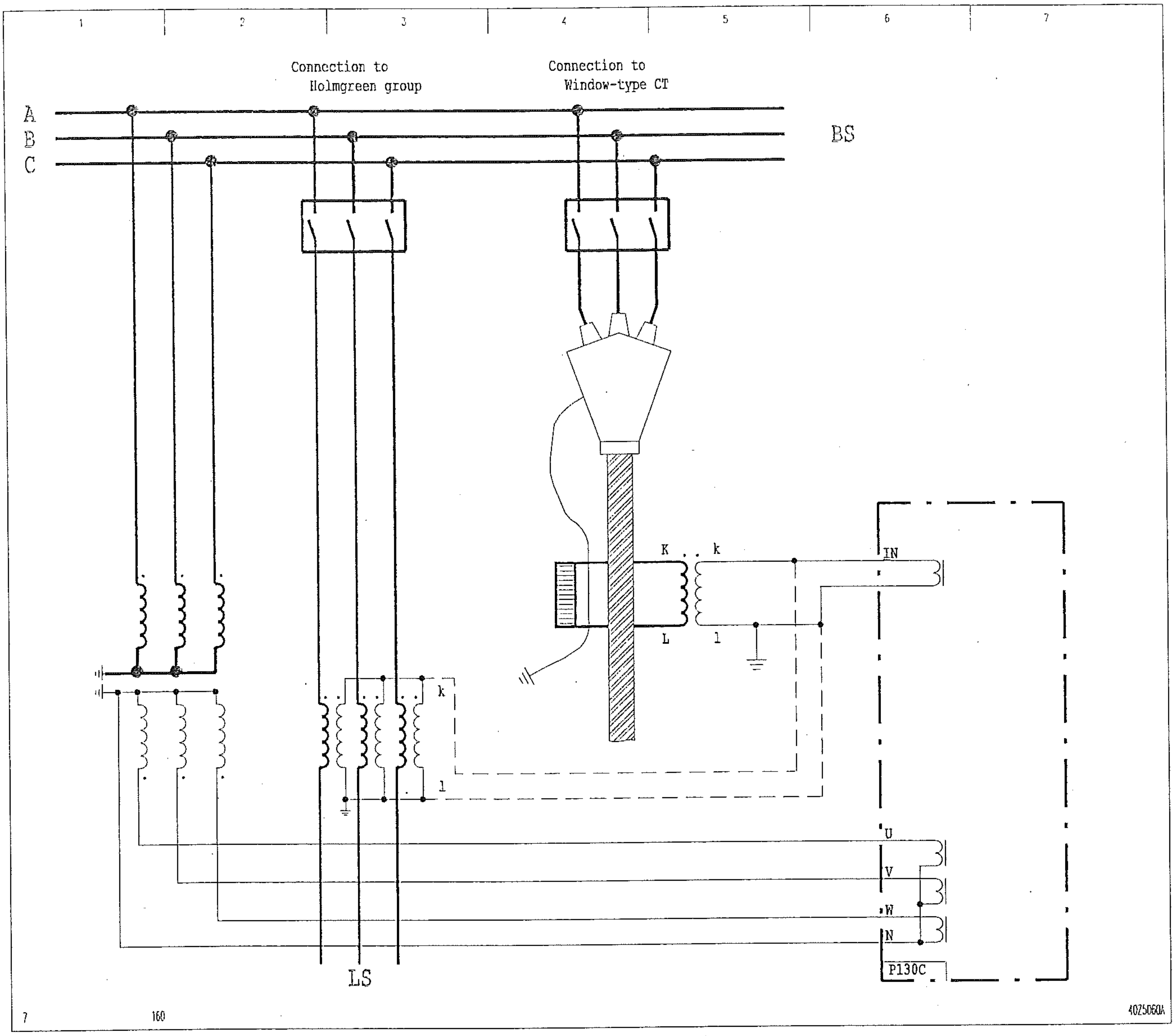
5-7 *Standard schematic diagram for the P130C.*
1) The current transformers are not fitted in the frequency protection model.

ıg the measuring
ᐟ ground fault
ɟetermination
ıdy-state values

If P130C operation is to include the GFDSS function (ground fault direction determination using steady-state values), then the T 4 current transformer must be connected to a window-type current transformer or a current transformer in Holmgreen configuration. If the metal sheath of the cable is led through the window-type transformer, then the overhead ground wire must be led through the core again before it is connected to ground. The cable sealing end must be attached so that it is insulated from ground. This ensures that any currents flowing through the sheath will not affect measurement.

Ground fault direction determination using steady-state values (GFDSS) requires the three phase-to-ground voltages as the measuring voltage. From these, the P130C calculates the the neutral-displacement voltage. The phase voltages are taken from the same transformers as the measured variables for distance protection.

Figure 5-8 shows the standard connection for the GFDSS function. With this connection configuration, 'forward/LS' is displayed if a ground fault occurs on the line side. A different connection direction for the current or voltage transformer is possible if the appropriate setting is made (see Chapter 7).

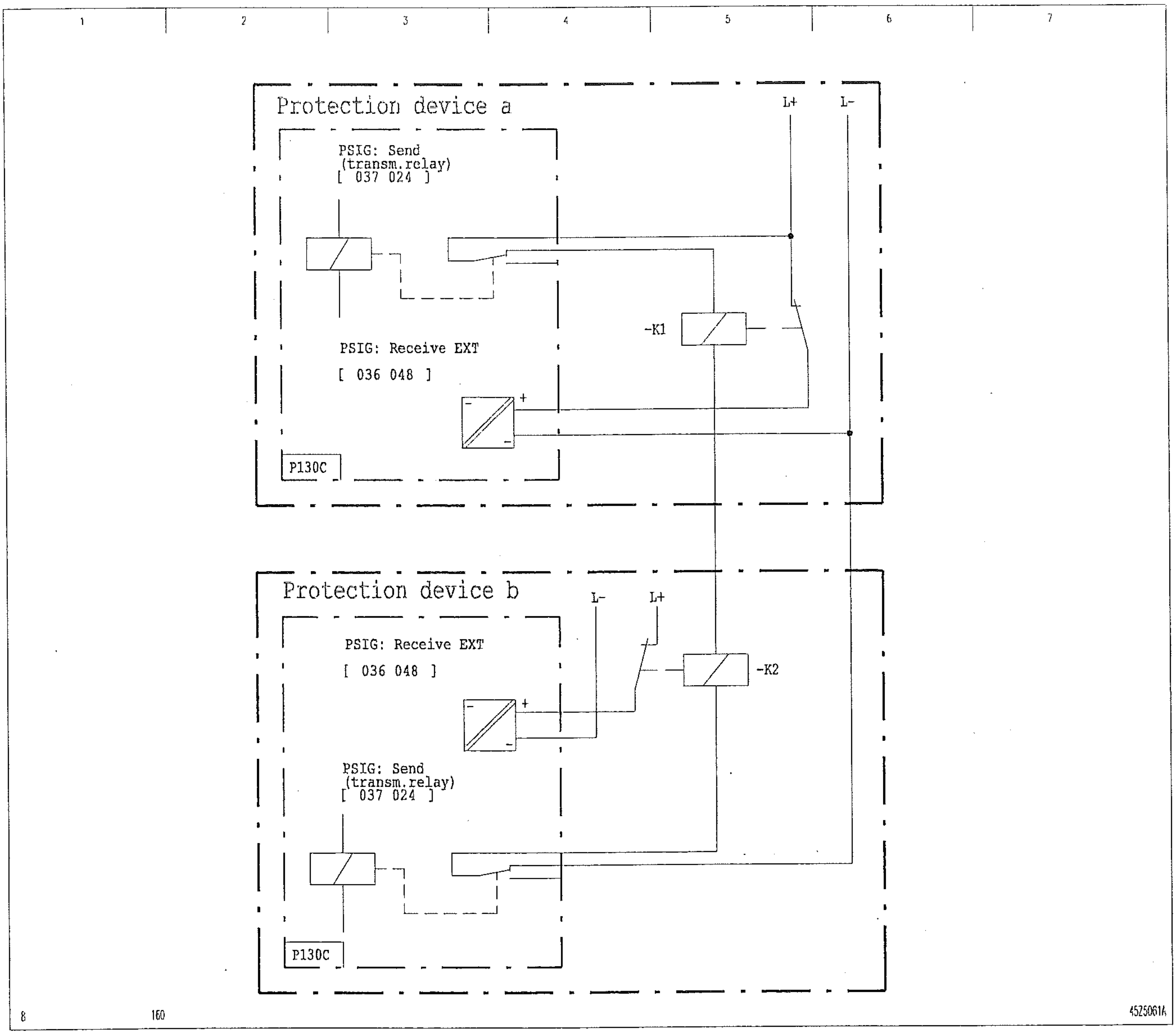


5-8 *Connecting the GFDSS function to Holmgreen-configuration transformers and window-type transformers*

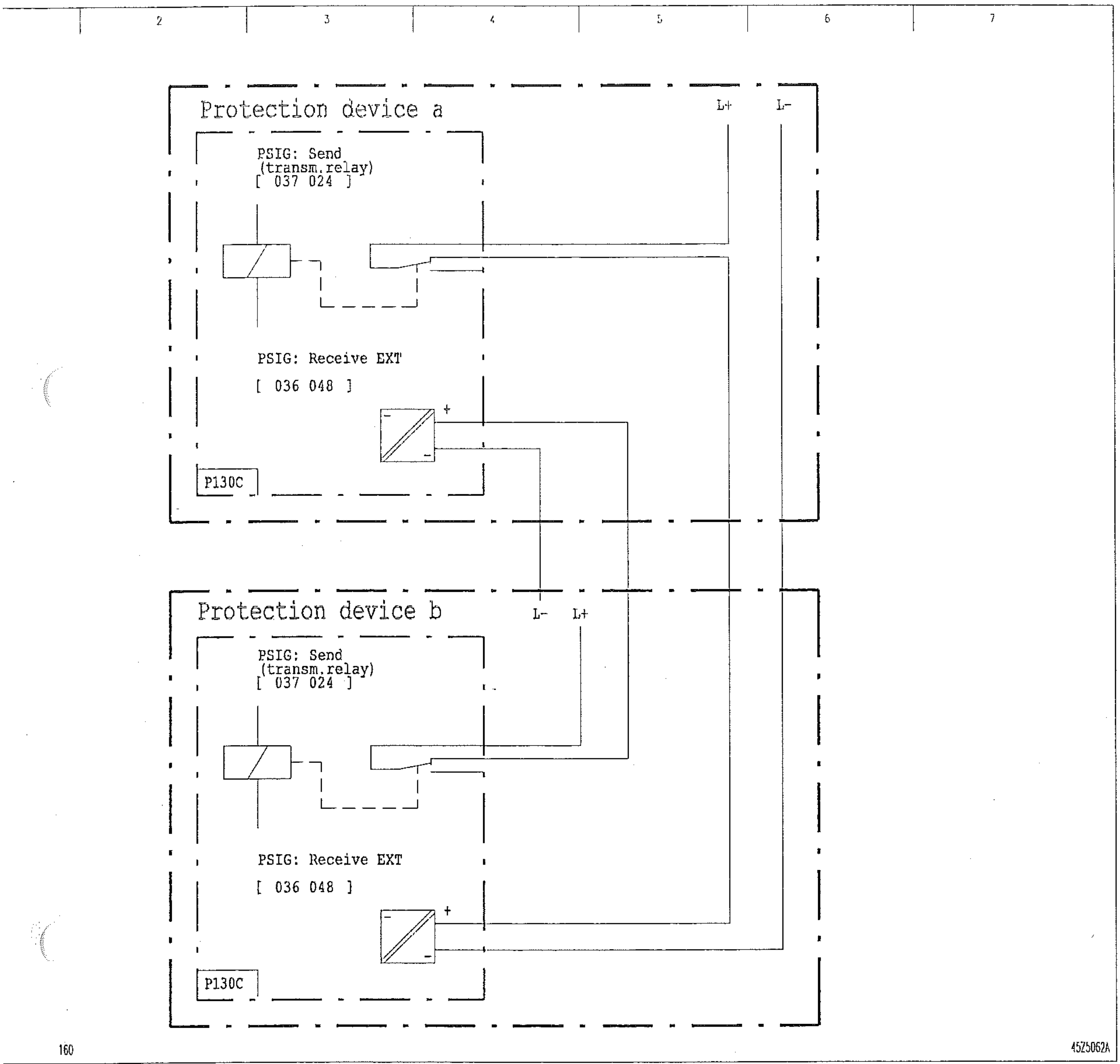
*ng the signal
protective*

Either a transmission device or pilot wires are required for signal transmission, depending on the operating mode selected. Transposed or twisted lines should be used for the pilot wires. Two or four lines are required. If only two lines are available, there must be an all-or-nothing relay in each station for coupling received and transmitted signals. The coils of the all-or-nothing relays must be designed for half the loop voltage. Figure 5-9 shows connection with two lines and Figure 5-10 connection with four lines.

The protective signaling transmitting relay can be set to either *Transm. relay break contact* or *Transm. relay make contact*. In the first case the break contact of the transmitting relay must be wired, and in the second case the make contact must be wired. The figures show the connection for the setting *Transm. relay break contact*.



5-9 Connection of the protective signaling function with two lines



:onnection of the protective signaling function with four lines

Connecting the binary inputs and output relays

The binary inputs and output relays are freely configurable.

The terminal connection diagrams give a polarity for connection of the binary signal inputs. However, this is only a recommendation. Connection can be as desired.

5.6.2 Connecting the IRIG-B Interface

An IRIG-B-interface for time synchronization may be installed as an optional feature. It is connected by means of a BNC connector. Coaxial cable having a characteristic impedance of 50 Ω must be used as the connecting cable.

5.6.3 Connecting the Serial Interfaces

ıce

The PC interface is provided in order to operate the unit from a personal computer (PC).

The PC interface is not designed for permanent connection. Consequently, the female connector does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101.

cation interfaces

Communication interfaces are provided for permanent connection of the unit to a control system for substations or to a central substation unit. The unit is connected to communication channel 1 either by a special connector with optical fibers or an RS 485 interface with twisted copper wires, depending on the type of communication interface. Connection to channel 2 is always by way of an RS 485 interface.

The selection and assembly of a properly cut fiber-optic connecting cable requires special knowledge and expertise and is therefore not covered in this operating manual.

The fiber-optic interface may only be connected or disconnected when the supply voltage for the unit is shut off.

A communication link consisting of a communication master and several slaves can be established via the RS 485 interface. The communication master can be a control station, for example. The devices connected to the communication master, such as the P130C, are the communication slaves.

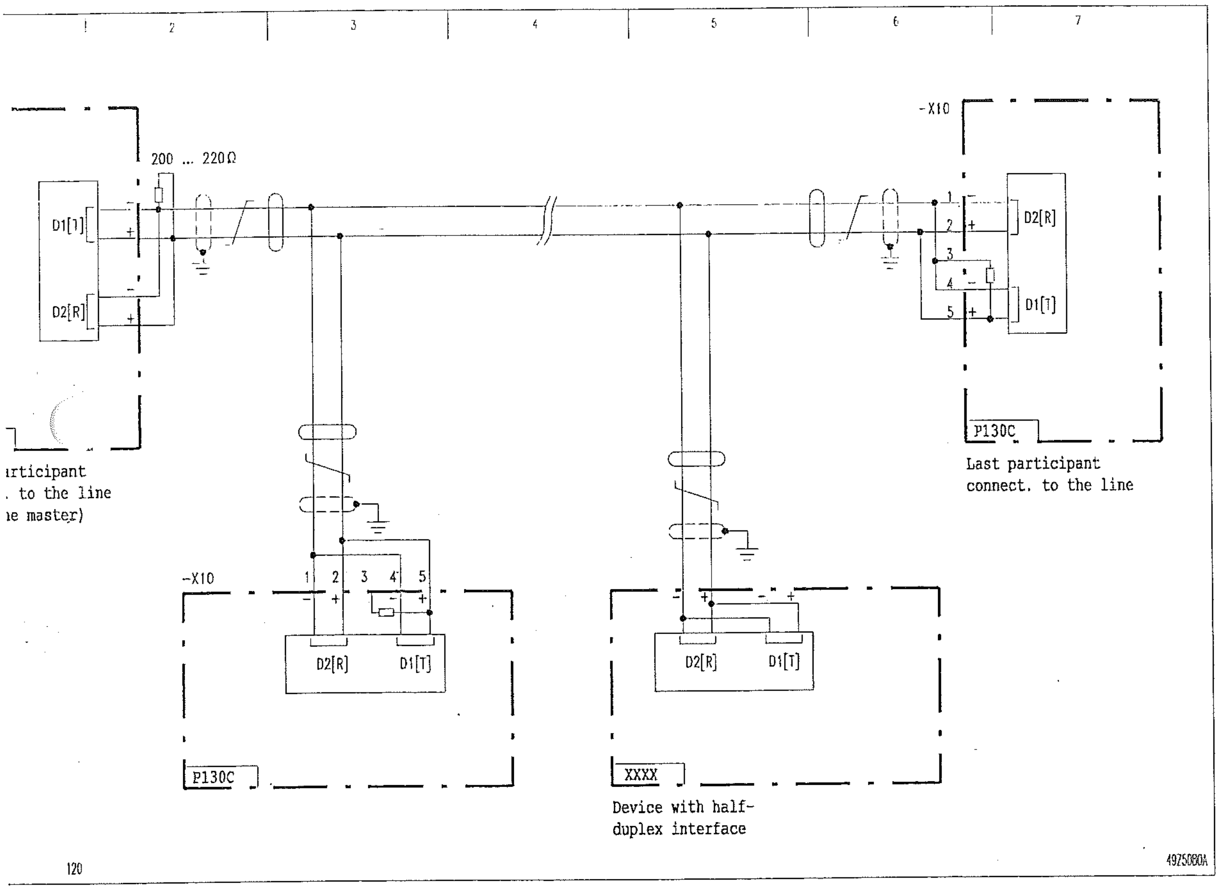
The RS 485 interface of the P130C is designed electrically to permit full-duplex operation through a 4-wire connection. However, communication through the RS 485 interface is always in the half-duplex mode of operation. The following connection instructions must always be followed:

- Always use twisted-pair shielded cables only, the kind used for telecommunications systems.
- At least one symmetrically twisted core pair will be required.
- Strip cable cores and cable shield right at the connection point and connect properly in accordance with specifications.
- Ground all shields at both ends (large-area grounding).
- Ground free (unshielded) cores at one end only.

As another option, a 2-wire or 4-wire connection is also possible. For the 4-wire connection, a cable with two symmetrically twisted core pairs is required. Figure 5-11 shows the 2-wire connection and Figure 5-12 the 4-wire connection, as illustrated for channel 2 of the communication module. If channel 1 of the communication module is designed as an RS 485 interface, then the same arrangement would apply.

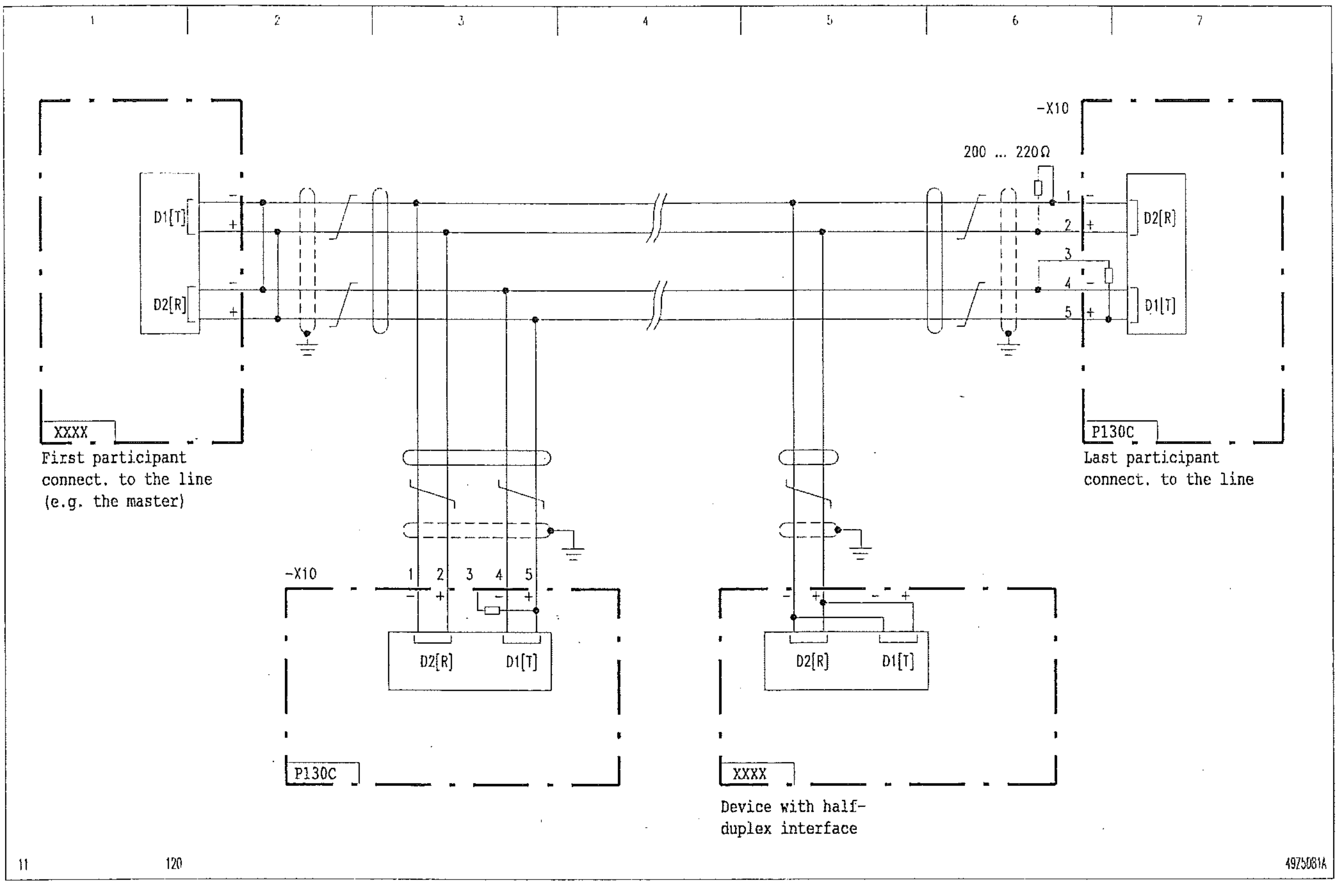
2-wire connection:
Transmitter and receiver must be bridged in all devices that have a full-duplex interface as part of their electrical system – like the P130C, for example. In the two devices that form the physical ends of the line, the pair of leads must be terminated by a 200-to-220-Ω resistor. In most AREVA devices, and also in the P130C, a 220-Ω resistor is integrated into the RS 485 interface and can be connected by means of a wire jumper. An external resistor is therefore not necessary.

4-wire connection:
Transmitter and receiver must be bridged in the device that forms one physical end of the line. The receivers of the slaves that have a full-duplex interface as part of their electrial system (like the P130C, for example) are connected to the transmitter of the communication master, and the transmitters of the slaves are connected to the receiver of the master. Devices that only have a half-duplex interface are connected to the transmitter of the communication master. In the last physical participant (master or slave) of the communication link, the transmitter and receiver must each be terminated by a 200-to-220-Ω resistor. In most AREVA devices, and also in the P130C, a 220-Ω resistor is integrated into the RS 485 interface and can be connected by means of a wire jumper. An external resistor is therefore not necessary. The second resistor must be connected to the device externally (see Chapter 13 for the resistor Order No.).



ırticipant
. to the line
ıe master)

:-wire connection



5-12 *4-wire connection^*

6 Local Control Panel

6 Local Control Panel

Local control panel

All data required for operation of the protection device are entered from the local control panel, and the data important for system management are read out there as well. The following tasks can be handled from the local control panel:

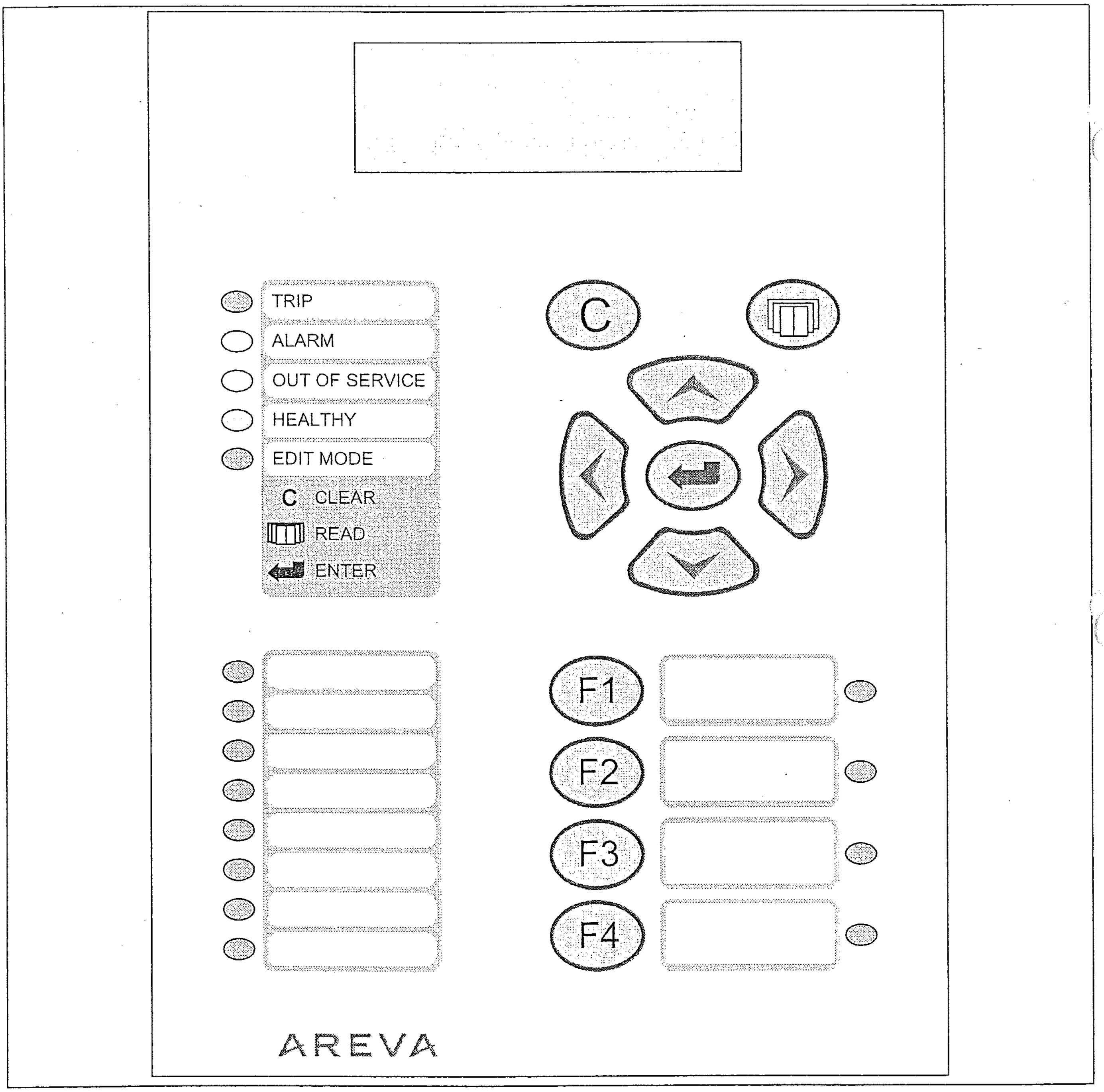
- □ Readout and modification of settings
- □ Readout of cyclically updated measured operating data and logic state signals
- □ Readout of operating data logs and of monitoring signal logs
- □ Readout of event logs after overload situations, ground faults, or short circuits in the power system
- □ Device resetting and triggering of additional control functions used in testing and commissioning

Control through the PC interface is also possible. This requires a suitable PC and operating program (S&R-103).

6.1 Display and Keypad

Control and display elements

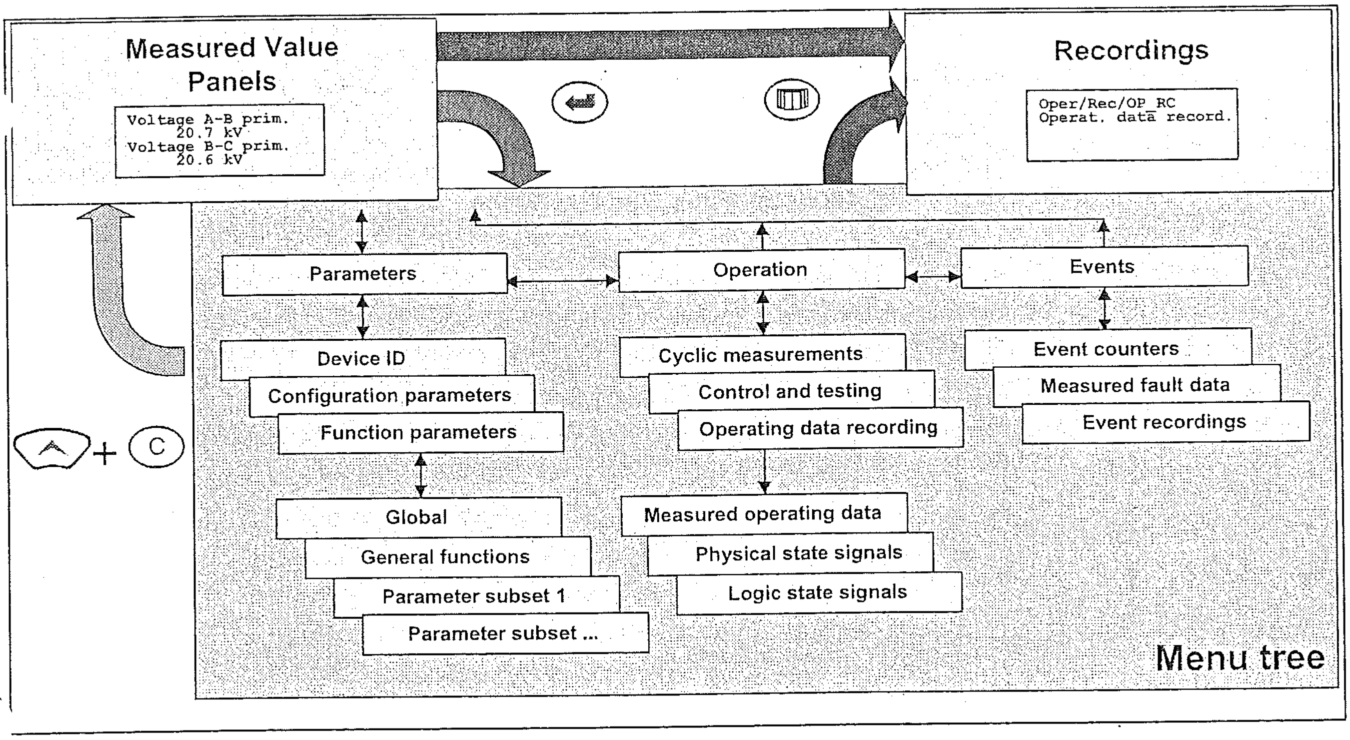
The local control panel consists of an LCD display containing 4 x 20 alphanumeric characters, eleven function keys positioned below the display, and 17 LED indicators.



6-1 View of the local control panel

Display levels

All data relevant for operation and all device settings are displayed on two levels. At the Panel level, data such as measured operating data are displayed in Panels that provide a quick overview of the current state of the bay. The menu tree level below the Panel level allows the user to select all *data points* (settings, signals, measured variables, etc.) and to change them, if appropriate. The user can access a selected event recording (event log) from either the Panel level or from any other point in the menu tree, by pressing the READ key.



6-2 *Display Panels and menu tree*

Display Panels

The P430 can display 'Measured Value Panels' which are called up by the device according to system conditions.

Selected measured values are displayed on the Measured Value Panels. The system condition determines which Panel is called up (examples are the Operation Panel and the Fault Panel). Only the Measured Value Panels relevant for the design version of the given unit and its associated range of functions are actually available. The Operation Panel is always available.

Menu tree and data points

All data points (setting values, signals, measured values, etc.) are selected using a *menu tree*. As the user navigates through the menu tree, the first two lines of the LCD display always show the branch of the menu tree that is active, as selected by the user. The data points are accessed at the lowest level of a menu tree branch. They are displayed either with their plain text description or in numerically coded form, as selected by the user. The value associated with the selected data point, its meaning, and its unit of measurement are displayed in the line below.

List data points

List data points are a special category. In contrast to other data points, list data points generally have more than one value element associated with them. This category includes tripping matrices, programmable logic functions, and event logs. When a list data point is selected, the symbol '↓' is displayed in the bottom line of the LCD display, indicating that there is another level below the displayed level. The individual value elements of a list data point are found at the lower level. In the case of a list *parameter*, the individual value elements are linked by operators such as 'OR'.

Keys

- **'Up' and 'Down' Keys** ▲ / ▼
  Panel Level:
  Press the 'Up' and 'Down' keys to switch between the pages of the Measured Value Panel.
  Menu Tree Level:
  Press the 'Up' and 'Down' keys to navigate up and down through the menu tree in a vertical direction. If the unit is in input mode, the 'Up' and 'Down' keys have a different function.
  <u>Input mode</u>:
  Parameter values can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. Press the 'Up' and 'Down' keys in this mode to change the parameter value.
  ('Up' key: the next higher value is selected.
  'Down' key: the next lower value is selected.)
  With list parameters, press the 'Up' and 'Down' key to change the logic operator of the value element.

- **'Left' and 'Right' Keys** ◄ / ►
  Menu Tree Level:
  Press the 'Left' and 'Right' keys to navigate through the menu tree in a horizontal direction. If the unit is in input mode, the 'Left' and 'Right' keys have a different function.
  <u>Input mode</u>:
  Parameter values can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. When the 'Left' and 'Right' keys are pressed, the cursor positioned below one of the digits in the change-enabled value moves one digit to the right or left.
  ('Left' key: the cursor moves to the next digit on the left.
  'Right' key: the cursor moves to the next digit on the right.)
  In the case of a list parameter, press the 'Left' and 'Right' keys to navigate through the list of items available for selection.

- **ENTER Key**
  Panel Level:
  Press the ENTER key at the Panel level to go to the menu tree.
  Menu Tree Level:
  Press the ENTER key to enter the input mode. Press the ENTER key a second time to accept the changes as entered and exit the input mode. The LED indicator labeled EDIT MODE signals that the input mode is active.

- **CLEAR Key** (C)
  Press the CLEAR key to reset the LED indicators and clear all measured event data. The records in the recording memories are not affected by this action.
  <u>Input mode</u>:
  Press the CLEAR key to reject the changes entered and exit the input mode.

- **READ Key**
  Press the READ key to access the set of user-selected functions (see "Configurable Function Keys" in Chapter 3) from either the Panel level or from any other point in the menu tree. Repeated pressing of the READ key will then sequentially trigger the selected functions (such as event recordings or setting parameters) if several functions have been selected.

- **Function Keys** (F1) to (Fx)
  A single function or a menu jump list can be assigned to each function key (see "Configurable Function Keys" in Chapter 3). Once a menu jump list has been assigned to a function key, then repeated pressing of the function key will sequentially trigger the selected functions.

The following tables, which show the individual control steps, specify the displays that can be changed by pressing specific keys. A small black square to the right of the ENTER key indicates that the LED indicator labeled EDIT MODE is on. The examples shown here do not necessarily apply to the device type described in this manual; they merely serve to illustrate the control principles involved.

6.2 Illumination of the Display

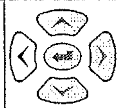
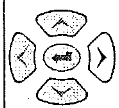
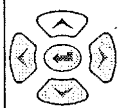
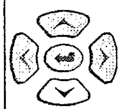
If none of the control keys is pressed, the display illumination will switch off once the set return time has elapsed ('return time illumination' setting in the menu tree at 'Par/Conf/LOC'). The display illumination is turned on again by pressing one of the control keys. In this case, the control action that is normally triggered by the key will not be executed. This response is also exhibited by the function keys. Reactivation of display illumination is also possible by way of a binary input.

If continuous illumination is desired, the user can set the 'return time illumination' function to *'blocked'*.

6.3 Configurable Function Keys F1 to Fx

Function key F1 is not enabled unless the associated password F_KEY: Password funct. key1 has been entered first. Once the password has been entered, the function key remains active for no longer than the set time F_KEY: Return time fct.keys. Thereafter, the function key is disabled until the password is entered again. The same rules apply to function keys F2 to Fx.

In the following example, the password for the function keys is the factory-set password. If the password has been changed by the user (see the section entitled 'Changing the Password'), the following description will apply analogously.

Control Step / Description	Control Action	Display
0 Display example.		Voltage C-A prim. 20.8 kV Current A prim. 415 A
1 Press function key F1. Eight asterisks (*) appear in the fourth line as a prompt for entering the password.	F1	********
2a Press the following keys in sequence: 'Left'		*
'Right'		*
'Up'		*
'Down' The display will change as shown in the column on the right.		*
Now press the ENTER key. If the correct password has been entered, the the previous display will re-appear. Function keys F1 to Fx are enabled for the set return time. If an invalid password has been entered, the display shown in Step 1 appears.		Voltage C-A prim. 20.8 kV Current A prim. 415 A
2b Until the enter key is pressed, the control action can be aborted at any time by pressing the CLEAR key.	C	Voltage C-A prim. 20.8 kV Current A prim. 415 A
3 Press F1 again. The function assigned to this function key will now be executed.	F1	Voltage C-A prim. 20.8 kV Current A prim. 415 A
4 If you press any further function keys while the return time is running, the assigned functions will be executed without a further password prompt.	Fx	Voltage C-A prim. 20.8 kV Current A prim. 415 A

6.4 Changing Between Display Levels

After start-up of the device, the menu tree level is displayed.

Going from the menu tree level to the Panel level

Control Step / Description	Control Action	Display

0 From the menu tree level, the user can go to the Panel level from any position within the menu tree.		`Par/Func/Glob/MAIN`
		`Device on-line`
		`No (=off)`

1 First press the 'Up' key and hold it down while pressing the CLEAR key.
 	
Note:
It is important to press the 'Up' key first and release it last to avoid unintentional resetting of stored data.
	▲ + C	`Voltage C-A prim.`
		`20.8 kV`
		`Current A prim.`
		`415 A`

Going from the Panel level to the menu tree level

0 Example of a Measured Value Panel.		`Voltage C-A prim.`
		`20.8 kV`
		`Current A prim.`
		`415 A`

1 Press the ENTER key to go from the Panel level to the menu tree level.	↵	`XX YYY`

After the set return time has elapsed (setting in menu tree: 'Par/Conf/LOC'), the display will automatically switch to the Panel level if a Measured Value Panel has been configured.

6.5 Control at the Panel Level

The measured values to be displayed on the Measured Value Panels can first be selected at 'Par/Conf/LOC' in the menu tree. The user can select different sets of measured values for the Operation Panel, the Overload Panel, the Ground Fault Panel, and the Fault Panel. Only the Measured Value Panels relevant for the design version of the given unit and its associated range of functions are actually available. The selected set of values for the Operation Panel is always available. Please see the section entitled 'Setting a List Parameter' for instructions regarding selection. If the user has selected `MAIN: Without function` for a Panel, then that Panel will be inactive.

The Measured Value Panels are called up in accordance with system conditions. If, for example, the unit detects an overload or a ground fault, then the corresponding Measured Value Panel will be displayed as long as the overload or ground fault situation exists. If the unit detects a fault, then the Fault Panel is displayed and remains active until the measured fault values are reset – by pressing the CLEAR key Ⓒ, for example.

Control Step / Description	Control Action	Display

0 Up to six selected measured values can be displayed simultaneously on the Panel.		`Voltage A-B prim.`
		`20.7 kV`
		`Voltage B-C prim.`
		`20.6 kV`

1 If more than two measured values have been selected, they can be viewed one page at a time by pressing the 'Up'/'Down' keys. The next page of the Measured Value Panel will also be displayed after the set Panel hold time has elapsed (setting in menu tree at 'Par/Conf/LOC').	or	`Voltage C-A prim.`
		`20.8 kV`
		`Current A prim.`
		`415 A`

6.6 Control at the Menu Tree Level

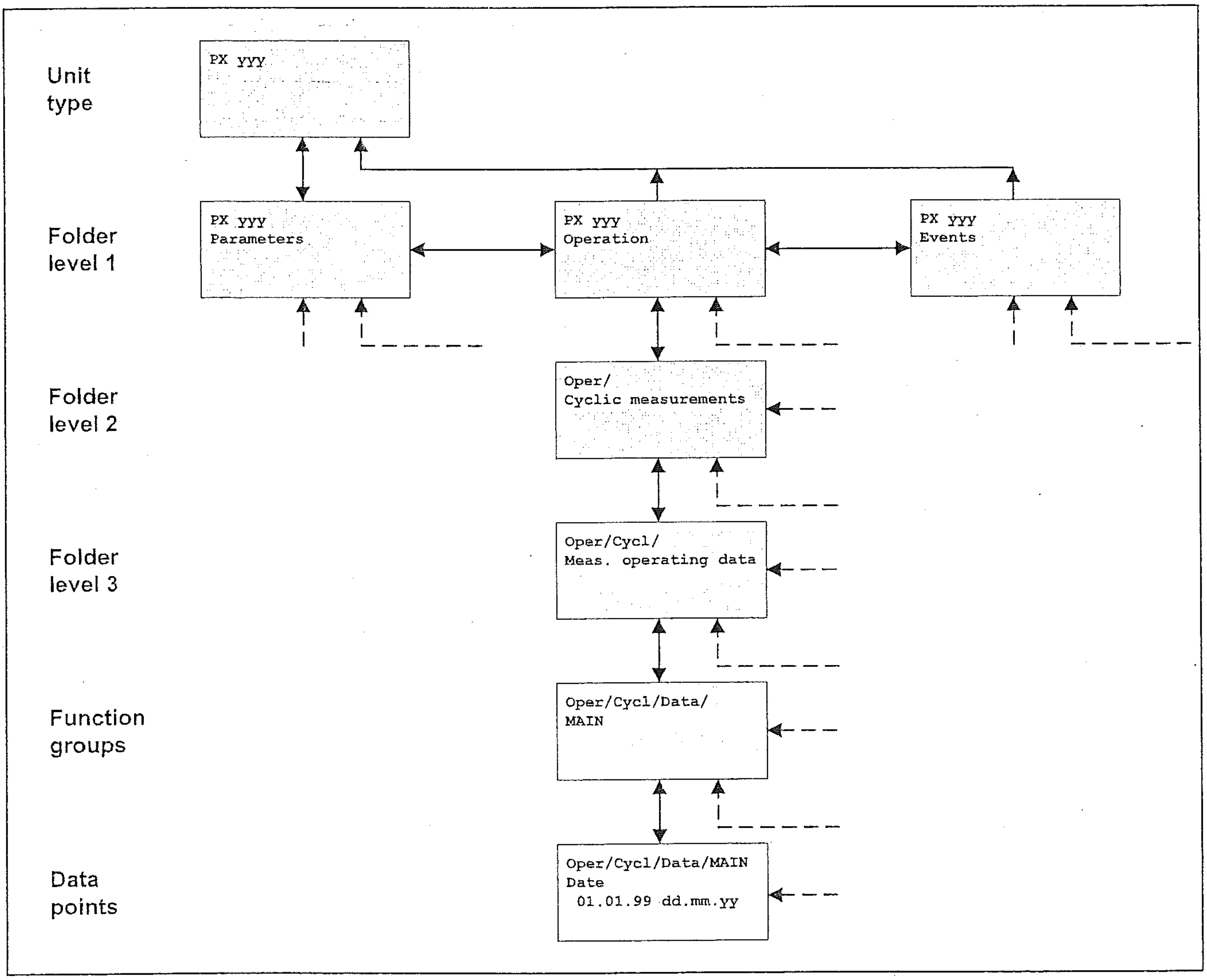
6.6.1 Navigation in the Menu Tree

Folders and function groups

All data points are grouped according to their function group association and are also organized in different folders based on practical control requirements.

At the root of the menu tree is the unit type; the tree branches into the three main folders 'Parameters', 'Operation' and 'Events', which form the first folder level. Up to two further folder levels follow so that the entire folder structure consists of three main branches and a maximum of three folder levels.

At the end of each branch of folders are the various function groups in which the individual data points are combined.



6-3 *Basic menu tree structure*

6.6.2 Switching Between Address Mode and Plain Text Mode

The display on the local control panel can be switched between address mode and plain text mode. In the address mode the display shows setting parameters, signals, and measured values in numerically coded form, that is, as addresses. In plain text mode the setting parameters, signals, and measured values are displayed in the form of plain text descriptions. In either case, control is guided by the menu tree. The active branch of the menu tree is displayed in plain text in both modes. In the following examples, the display is shown in plain text mode only.

Control Step / Description	Control Action	Display
0 In this example, the user switches from plain text mode to address mode.		Par/Func/Glob/MAIN Device on-line No (=off)
1 To switch from address mode to plain text mode or vice versa, press the CLEAR key (C) and either the 'Left' key or the 'Right' key simultaneously. This can be done at any point in the menu tree.	(C) + (<) or (C) + (>)	Par/Func/Glob/MAIN 003.030 0

6.6.3 Change-Enabling Function

Although it is possible to select any data point in the menu tree and read the associated value by pressing the keys, it is not possible to switch directly to the input mode. This safeguard prevents unintended changes in the settings.

There are two ways to enter the input mode.

Global change-enabling function

- To activate the global change-enabling function, set the 'Param. change enabl.' parameter to 'Yes' (menu tree: 'Oper/CtrlTest/LOC').
  The change can only be made after the password has been entered. Thereafter, all further changes – with the exception of specially protected control actions (see the section entitled 'Password-Protected Control Actions') – are enabled without entering the password.

Selective change-enabling function

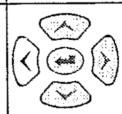
- Password input prior to any parameter change.

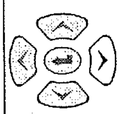
The password consists of a pre-defined sequential key combination entered within a specific time interval. The following example is based on the factory-set password. If the password has been changed by the user (see the section entitled 'Changing the Password'), the following description will apply analogously.

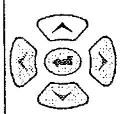
Control Step / Description	Control Action	Display

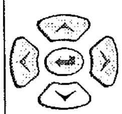
0 In the menu tree 'Oper/CtrlTest/LOC', select the 'Param. change enabl.' parameter.		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`

1 Press the ENTER key. Eight asterisks (*) appear in the fourth line of the display.		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`********`

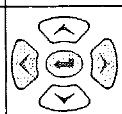
2 Press the following keys in sequence:
'Left'
		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`*`

'Right'		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`*`

'Up'		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`*`

'Down'
The display will change as shown in the column on the right.
		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`*`

Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the 'Up' or 'Down' keys.
 	
If an invalid password has been entered, the display shown in Step 1 appears.
		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`

3 Change the setting to '*Yes*'.		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`Yes`

4 Press the ENTER key again. The LED indicator will go out. The unit is enabled for further parameter changes.		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`Yes`

The same procedure applies to any parameter change unless the global change-enabling function has been activated. This method is recommended for a single parameter change only. If several settings are to be changed, then the global change-enabling function is preferable. In the following examples, the global change-enabling function has been activated.

Automatic return

The automatic return function prevents the change-enabling function from remaining activated after a change of settings has been completed. Once the set return time (menu tree 'Par/Conf/LOC') has elapsed, the change-enabling function is automatically deactivated, and the display switches to a Measured Value Panel corresponding to the current system condition. The return time is restarted when any of the control keys is pressed.

Forced return

The return described above can be forced from the local control panel by first pressing the 'Up' key and then holding it down while pressing the CLEAR key.

Note: It is important to press the 'Up' key first and release it last in order to avoid unintentional deletion of stored data.

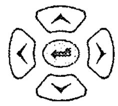
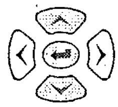
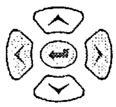
Even when the change-enabling function is activated, not all parameters can be changed. For some settings it is also necessary to disable the protective function (menu tree: Par/Func/Glob/MAIN, 'Protection enabled'). Such settings include the configuration parameters, by means of which the device interfaces can be adapted to the system. The following entries in the "Change" column of the address list (see appendix) indicate whether values can be changed or not:

- **"on"**: The value can be changed even when the protective function is enabled.
- **"off"**: The value can only be changed when the protective function is disabled.
- **"-"**: The value can be read out but cannot be changed.

The device is factory-set so that the protective function is disabled.

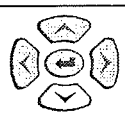
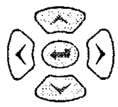
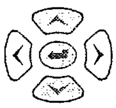
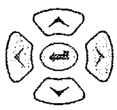
6.6.4 Changing Parameters

If all the conditions for a value change are satisfied (see above), the desired setting can be entered.

Control Step / Description	Control Action	Display
0 Example of a display. In this example, the change-enabling function is activated and the protective function is disabled, if necessary.		Oper/CtrlTest/LOC Param. change enabl. Yes
1 Select the desired parameter by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s
2 Press the ENTER key. The LED indicator labeled EDIT MODE will light up. The last digit of the value is highlighted by a cursor (underlined).		Par/Conf/LOC Autom. return time 50000 s
3 Press the 'Left' or 'Right' keys to move the cursor to the left or right.		Par/Conf/LOC Autom. return time 50000 s
4 Change the value highlighted by the cursor by pressing the 'Up' and 'Down' keys. In the meantime the device will continue to operate with the old value.		Par/Conf/LOC Autom. return time 50010 s
5 Press the ENTER key. The LED indicator labeled EDIT MODE will go out and the device will now operate with the new value. Press the keys to select another setting parameter for a value change.		Par/Conf/LOC Autom. return time 50010 s
6 If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will go out and the device will continue to operate with the old value. A further parameter can be selected for a value change by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s

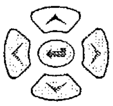
6.6.5 Setting a List Parameter

Using list parameters, the user is able to select several elements from a list in order to perform tasks such as defining a trip command or defining the measured values that will be displayed on Measured Value Panels. The maximum possible number 'm' that can be selected out of the total number 'n' of the set is given in the address list in the 'Remarks' column. As a rule, the selected elements are linked by an 'OR' operator. Other operators (NOT, OR, AND, NOT OR and NOT AND) are available in the LOGIC function group for linking the selected list items. In this way binary signals and binary input signals can be processed in a Boolean equation tailored to meet user requirements. For the DNP 3.0 communication protocol, the user defines the class of a parameter instead of assigning operators. The definition of a trip command shall be used here as an example to illustrate the setting of a list parameter.

Control Step / Description	Control Action	Display
0 Select a list parameter (in this example, the parameter 'Fct.assign.trip cmd.' at 'Par/Func/Glob/ MAIN' in the menu tree). The down arrow (↓) indicates that a list parameter has been selected.		Par/Func/Glob/MAIN Fct.assign.trip cmd. ↓
1 Press the 'Down' key. The first function and the first selected signal will appear in the third and fourth lines, respectively. The symbol '#01' in the display indicates the first item of the selection. If 'MAIN: Without function' appears for the first item, then this means that no function assignment has been made yet.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #01 DIST Trip zone 1
2 Scroll through the list of assigned functions by pressing the 'Right' and 'Left' keys.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 2
Once the end of the list is reached, the display shown on the right will appear.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #05 MAIN ?????
3 Press the ENTER key at any position in the list. The LED indicator labeled EDIT MODE will light up.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 2
4 Scroll through the assignable functions by pressing the 'Right' and 'Left' keys in the input mode.		Par/Func/Glob/MAIN Fct.assign.trip cmd. #02 DIST Trip zone 4
5 Select the operator or the class using the 'Up' and 'Down' keys. In this particular case, only the 'OR' operator can be selected. There is no limitation on the selection of classes.		Par/Func/Glob/MAIN Fct.assign.trip cmd. OR #02 DIST Trip zone 4

Control Step / Description	Control Action	Display

6 Press the ENTER key. The LED indicator will go out. The assignment has been made. The unit will now operate with the new settings.
 	
If no operator has been selected, the 'OR' operator is always assigned automatically when the ENTER key is pressed. There is no automatic assignment of classes.
	Ⓒ	`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR           #02 DIST`
		`Trip zone 4`

7 Press the 'Up' key to exit the list at any point in the list.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		
		↓

8 If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will go out.	Ⓒ	`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR           #02 DIST`
		`Trip zone 2`

Deleting a list parameter

If 'MAIN: Without function' is assigned to a given item, then all the following items are deleted. If this occurs for item #01, everything is deleted.

6.6.6 Memory Readout

After a memory is entered, the memory can be read out at the entry point. It is not necessary to activate the change-enabling function or even to disable the protective functions. Inadvertent clearing of a memory at the entry point is not possible.

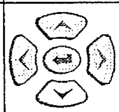
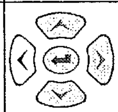
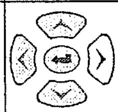
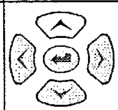
The following memories are available:

- In the menu tree 'Oper/Rec/OP_RC': Operating data memory
- In the menu tree 'Oper/Rec/MT_RC': Monitoring signal memory
- Event memories
  - In the menu tree 'Events/Rec/FT_RC': Fault memories 1 to 8
  - In the menu tree 'Events/Rec/OL_RC': Overload memories 1 to 8
  - In the menu tree 'Events/Rec/GF_RC': Ground fault memories 1 to 8

Not all of these event memories are present in each unit. A given unit may contain only some of them or even none at all, depending on the device type.

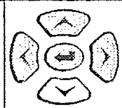
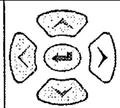
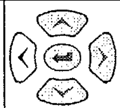
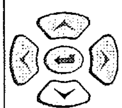
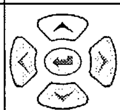
Readout of the operating data memory

The operating data memory contains stored signals of actions that occur during operation, such as the enabling or disabling of a device function. A maximum of 100 entries is possible, after which the oldest entry is overwritten.

Control Step / Description	Control Action	Display
0 Select the entry point for the operating data memory.		Oper/Rec/OP_RC Operat. data record. ↓
1 Press the 'Down' key to enter the operating data memory. The latest entry is displayed.		Oper/Rec/OP_RC 01.01.97 11:33 ARC Enabled USER No
2 Press the 'Left' key repeatedly to display the entries one after the other in chronological order. Once the end of the operating data memory has been reached, pressing the 'Left' key again will have no effect.		Oper/Rec/OP_RC 01.01.97 10:01 PSIG Enabled USER Yes
3 Press the 'Right' key to display the previous entry.		Oper/Rec/OP_RC 01.01.97 11:33 ARC Enabled USER No
4 Press the 'Up' key at any point within the operating data memory to return to the entry point.		Oper/Rec/OP_RC Operat. data record. ↓

Readout of the monitoring signal memory

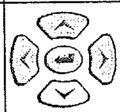
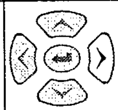
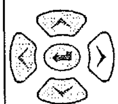
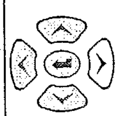
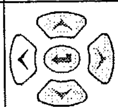
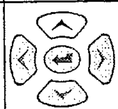
If the unit detects an internal fault in the course of internal self-monitoring routines or if it detects power system conditions that prevent flawless functioning of the unit, then an entry is made in the monitoring signal memory. A maximum of 30 entries is possible. After that an 'overflow' signal is issued.

Control Step / Description	Control Action	Display
0 Select the entry point for the monitoring signal memory.		Oper/Rec/MT_RC Mon. signal record. ↓
1 Press the 'Down' key to enter the monitoring signal memory. The oldest entry is displayed.		Mon. signal record. 01.01.97 13:33 SFMON Checksum error param
2 Press the 'Right' key repeatedly to display the entries one after the other in chronological order. If more than 30 monitoring signals have been entered since the last reset, the 'overflow' signal is displayed as the last entry.		Mon. signal record. 01.01.97 10:01 SFMON Exception oper. syst.
3 Press the 'Left' key to display the previous entry.		Mon. signal record. 01.01.97 13:33 SFMON Checksum error param
4 If the 'Down' key is held down while a monitoring signal is being displayed, the following additional information will be displayed: First: Time when the signal first occurred Active: The fault is still being detected (Yes) or is no longer detected (No) by the self-monitoring function. Reset: The fault was no longer detected by the self-monitoring function and has been reset (Yes). Number: The signal occurred x times.		Mon. signal record. 01.01.97 13:33 SFMON Checksum error param First: 13:33:59.744 Active: Yes Reset: No Number: 5
5 Press the 'Up' key at any point within the monitoring signal memory to return to the entry point.		Oper/Rec/MT_RC Mon. signal record. ↓

Readout of the event memories

There are eight event memories for each type of event. The latest event is stored in event memory 1, the previous one in event memory 2, and so forth.

Readout of event memories is illustrated using the fault memory as an example.

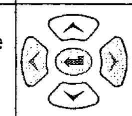
Control Step / Description	Control Action	Display
0 Select the entry point for the first fault memory, for example. If the memory contains entries, the third line of the display will show the date and time the fault began. If the third line is blank, then there are no entries in the fault memory.		Events/Rec/FT_RC Fault recording 1 01.01.99 10:00:33 ↓
1 Press the 'Down' key to enter the fault memory. First, the fault number is shown. In this example it is the 22nd fault since the last reset.		Fault recording 1 FT_RC Event 22
2 Press the 'Right' key repeatedly to see first the measured fault data and then the binary signals in chronological order. The time shown in the second line is the time, measured from the onset of the fault, at which the value was measured or the binary signal started or ended. Once the end of the fault has been reached (after the 'Right' key has been pressed repeatedly), pressing the 'Right' key again will have no effect.	  	Fault recording 1 200 ms FT_DA Running time 0.17 s Fault recording 1 0 ms FT_RC Record. in progress Start Fault recording 1 241 ms FT_RC Record. in progress End
3 Press the 'Left' key to see the previous measured value or the previous signal.		Fault recording 1 0 ms FT_RC Record. in progress Start
4 Press the 'Up' key at any point within the fault memory to return to the entry point.		Events/Rec/FT_RC Fault recording 1 01.01.99 10:00:33 ↓

6.6.7 Resetting

All information memories – including the event memories and the monitoring signal memory – as well as the LED indicators can be reset manually. In addition, the LED indicators are automatically cleared and initialized at the onset of a new fault – provided that the appropriate operating mode has been selected – so that they always indicate the latest fault.

The LED indicators can also be reset manually by pressing the CLEAR key, which is always possible in the standard control mode. This action also triggers an LED indicator test and an LCD display test. The event memories are not affected by this action, so that inadvertent deletion of the records associated with the reset signal pattern is reliably prevented.

Because of the ring structure of the event memories, the data for eight consecutive events are updated automatically so that manual resetting should not be necessary, in principle. If the event memories need to be cleared completely, however, as would be the case after functional testing, this can be done after selecting the appropriate parameter. The resetting procedure will now be illustrated using the fault memory as an example. In this example the global change-enabling function has already been activated.

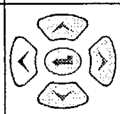
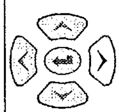
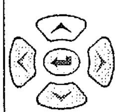
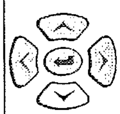
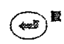
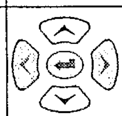
Control Step / Description	Control Action	Display
0 Select the reset parameter. Line 3 of the display shows the number of faults since the last reset, 10 in this example.		Oper/CtrlTest/FT_RC Reset recording 10
1 Press the ENTER key. The LED indicator labeled EDIT MODE will light up.		Oper/CtrlTest/FT_RC Reset recording 10 Don't execute
2 Press the 'Up' or 'Down' keys to change the setting to *'Execute'*.		Oper/CtrlTest/FT_RC Reset recording 10 Execute
3 Press the ENTER key. The LED indicator labeled EDIT MODE will go out. The value in line 3 is reset to '0'.		Oper/CtrlTest/FT_RC Reset recording 0

Control Step / Description	Control Action	Display
4 To cancel the intended clearing of the fault recordings after leaving the standard control mode (the LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will go out, and the fault recordings remain stored in the device unchanged. Any parameter can be selected again for a value change by pressing the keys.	(C)	Oper/CtrlTest/FT_RC Reset recording 10

6.6.8 Password-Protected Control Actions

Certain actions from the local control panel (such as a manual trip command for testing purposes) can only be carried out by entering a password. This setup is designed to prevent accidental output and applies even when the global change-enabling function has been activated. (See also Chapter 6.3 "Configurable Function Keys F1 to Fx.)

The password consists of a pre-defined sequential key combination entered within a specific time interval. The following example illustrates the password-protected output of a manual trip command using the factory-set password. If the password has been changed by the user (see the section entitled 'Changing the Password'), the following description will apply analogously.

Control Step / Description	Control Action	Display
0 In the menu tree 'Oper/CtrlTest/MAIN', select the parameter 'Man. trip cmd. USER'.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute
1 Press the ENTER key. Eight asterisks (*) appear in the fourth line of the display.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute ********
2 Press the following keys in sequence: 'Left'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Right'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Up'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Down' The display will change as shown in the column on the right.		Oper/CtrlTest/MAIN Man. trip cmd USER Don't execute *
Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the 'Up' or 'Down' keys.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute
3 Change the setting to *'Execute'*.		Oper/CtrlTest/MAIN Man. trip cmd. USER Execute

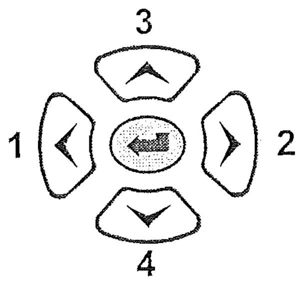
Control Step / Description	Control Action	Display

4 Press the ENTER key again. The LED indicator labeled EDIT MODE will go out. The unit will execute the command.		`Oper/CtrlTest/MAIN`
		`Man. trip cmd. USER`
		`Don't execute`

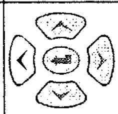
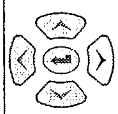
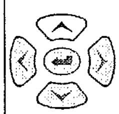
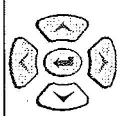
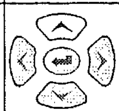
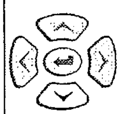
5 As long as the LED indicator labeled EDIT MODE is on, the control action can be terminated by pressing the CLEAR key. The LED indicator labeled EDIT MODE will go out.	C	`Oper/CtrlTest/MAIN`
		`Man. trip cmd. USER`
		`Don't execute`

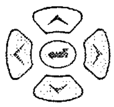
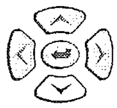
6.6.9 Changing the Password

The password consists of a combination of keys that must be entered sequentially within a specific time interval. The 'Left', 'Right', 'Up' and 'Down' keys may be used to define the password and represent the numbers 1, 2, 3 and 4, respectively:



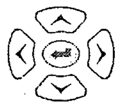
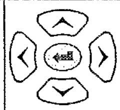
The password can be changed by the user at any time. The procedure for this change is described below. The starting point is the factory-set password.

Control Step / Description	Control Action	Display
0 In the menu tree 'Par/Conf/LOC', select the 'Password' parameter.		Par/Conf/LOC Password ********
1 Press the ENTER key. Eight asterisks appear in the fourth line of the display.		Par/Conf/LOC Password ******** ********
2 Press the 'Left', 'Right', 'Up' and 'Down' keys to enter the valid password. The display will change as shown in the column on the right.		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
3 Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. The third line shows an underscore character (_) as the prompt for entering a new password.		Par/Conf/LOC Password _
4 Enter the new password, which in this example is done by pressing the 'Up' key followed by the 'Down' key.		Par/Conf/LOC Password *
		Par/Conf/LOC Password **
5 Press the ENTER key again. Asterisks appear in the third line, and a cursor (underscore) in the fourth line prompts the user to enter the new password again.		Par/Conf/LOC Password ** _

Control Step / Description	Control Action	Display
6 Re-enter the password.	 	Par/Conf/LOC Password ** * Par/Conf/LOC Password ** **
7a Press the ENTER key again. If the password has been re-entered correctly, the LED indicator labeled EDIT MODE goes out and the display appears as shown on the right. The new password is now valid. **7b** If the password has been re-entered incorrectly, the LED indicator labeled EDIT MODE remains on and the display shown on the right appears. The password needs to be re-entered. It is also possible to cancel the change in password by pressing the CLEAR key (see Step 8).	 	Par/Conf/LOC Password ******** Par/Conf/LOC Password ** _
8 The change in password can be canceled at any time before Step 7 by pressing the CLEAR key. If this is done, the original password continues to be valid.		Par/Conf/LOC Password ********

Operation from the local control panel without password protection is also possible. To select this option, immediately press the ENTER key a second time in steps 4 and 6 without entering anything else. This will configure the local control panel without password protection, and no control actions involving changes will be possible until the global change-enabling function has been activated (see the section entitled 'Change-Enabling Function').

If the configured password has been forgotten, it can be called up on the LCD display as described below. The procedure involves turning the device off and then on again.

Control Step / Description	Control Action	Display
0 Turn off the device.		
1 Turn the device on again. At the very beginning of device startup, press the four directional keys ('Left', 'Right', 'Up' and 'Down') at the same time and hold them down.		TEST □□□□□□□□
2 When this condition is detected during startup, the password is displayed.		Password 1234 □□□□□□□□□□□□□□□□
3 After the four keys are released, startup will continue.		TEST □□□□□□□□□□□□□□□□□□□□

7 Settings

7.1 Parameter

The P130C must be adjusted to the system and to the protected equipment by means of appropriate settings. This section gives instructions for determining the settings, which are located in the folder entitled 'Parameters' in the menu tree. The sequence in which the settings are listed and described in this chapter corresponds to their sequence in the menu tree. The 'Address List' in the Appendix lists all parameters, along with setting ranges and incrementation or selection tables.

The units are supplied with a factory-set configuration of settings that in most cases correspond to the default settings given in the Address List. If the factory settings differ from the default settings, then this is indicated below at the appropriate points.

The default settings given in the Address List are activated after a cold restart. The P130C is blocked in that case. All settings must be re-entered after a cold restart.

7.1.1 Device Identification

The device identification settings are used to record the ordering information and the design version of the P130C. They have no effect on the device functions. These settings should only be changed if the design version of the P130C is modified.

Device

DVICE: Device type	000 000
The device type is displayed. This display cannot be altered.	
DVICE: Software version	002 120
Software version for the device. This display cannot be altered.	
DVICE: SW date	002 122
Date the software was created. This display cannot be altered.	
DVICE: SW version communic.	002 103
Software version for the device's communication software. This display cannot be altered.	
DVICE: Language version	002 123
Identification of the change level of the texts of the data model. This display cannot be altered.	
DVICE: Text vers.data model	002 121
Using the 'text replacement tool' provided by the operating program, the user can change the parameter descriptors (plain text designations) and load them into the device. These customized data models contain an identifier defined by the user while preparing the data model. This identifier is displayed at this point in the menu tree. Standard data models have the identifier '0' (factory-set default).	
DVICE: F number	002 124
The F number is the serial number of the device. This display cannot be altered.	
DVICE: Order No.	000 001
Order number of the device. This number cannot be altered by the user.	

DVICE: Order ext. No. 1	000 003
DVICE: Order ext. No. 2	000 004
DVICE: Order ext. No. 3	000 005
DVICE: Order ext. No. 4	000 006
DVICE: Order ext. No. 5	000 007
DVICE: Order ext. No. 6	000 008
DVICE: Order ext. No. 7	000 009
DVICE: Order ext. No. 8	000 010
DVICE: Order ext. No. 9	000 011
DVICE: Order ext. No. 10	000 012
DVICE: Order ext. No. 11	000 013
DVICE: Order ext. No. 12	000 014
DVICE: Order ext. No. 13	000 015
DVICE: Order ext. No. 14	000 016
DVICE: Order ext. No. 15	000 017
DVICE: Order ext. No. 16	000 018
DVICE: Order ext. No. 17	000 019
DVICE: Order ext. No. 18	000 020
DVICE: Order ext. No. 19	000 021
DVICE: Order ext. No. 20	000 022
DVICE: Order ext. No. 21	000 023
DVICE: Order ext. No. 22	000 024
DVICE: Order ext. No. 23	000 025
DVICE: Order ext. No. 24	000 026
DVICE: Order ext. No. 25	000 027
DVICE: Order ext. No. 26	000 028
DVICE: Order ext. No. 27	000 029

Order extension numbers for the device.

DVICE: Module var. slot 1	086 050
DVICE: Module var. slot 2	086 051

Item number of the module inserted in the respective slot. The display always shows the actual component configuration at any given time.

DVICE: Module vers. slot 1	086 193
DVICE: Module vers. slot 2	086 194

Index letter specifying the version of the module inserted in the respective slot.

DVICE: Variant of module A	086 047

Item number of module A in this design version.

DVICE: Version of module A	086 190

Index letter specifying the version of module A.

DVICE: Customer ID data 1	000 040
DVICE: Customer ID data 2	000 041
DVICE: Customer ID data 3	000 042
DVICE: Customer ID data 4	000 043
DVICE: Customer ID data 5	000 044
DVICE: Customer ID data 6	000 045
DVICE: Customer ID data 7	000 046
DVICE: Customer ID data 8	000 047
Set your numerically coded user data here for your records.	
DVICE: Device ID	000 035
ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.	
DVICE: Substation ID	000 036
ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.	
DVICE: Feeder ID	000 037
ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.	
DVICE: Device password 1	000 048
DVICE: Device password 2	000 049
ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.	

7.1.2 Configuration Parameters

Local control panel

LOC: Language	003 020	
Language in which texts will be displayed on the local control panel.		
LOC: Decimal delimiter	003 021	
Character to be used as decimal delimiter on the local control panel.		
LOC: Password	003 035	
The password to be used for changing settings from the local control panel can be defined here. Further information on changing the password is given in Chapter 6.		
LOC: Fct. read key	080 110	
Selection of up to 16 functions to be triggered when pressing the read key. Event counters and event recordings are offered for selection. If several functions have been selected then they will be sequentially triggered by repeated pressing of the read key.		
LOC: Fct. menu jmp list 1 LOC: Fct. menu jmp list 2	030 238 030 239	
Compilation of functions for the two menu jump lists. One of these menu jump lists can be assigned to a function key by selecting the entry LOC: Trig. menu jmp x EXT (x: 1 or 2) at F_KEY: Fct. assignm. Fx (Fx: F1, F2, F3 or F4). Up to 16 functions can be selected as described for LOC: Fct. read key. Repeated pressing (in this case of the assigned function key rather than the read key) will then sequentially trigger the selected functions.		
LOC: Fct. Operation Panel	053 007	Fig. 3-2
Definition of the values to be displayed on the Measured Value Panel referred to as the Operation Panel.		
LOC: Fct. Overload Panel	053 005	Fig. 3-5
Definition of the values to be displayed on the Overload Panel.		
LOC: Fct. Grd.Fault Panel	053 004	Fig. 3-4
Definition of the values to be displayed on the Ground Fault Panel.		
LOC: Fct. Fault Panel	053 003	Fig. 3-3
Definition of the values to be displayed on the Fault Panel.		
LOC: Hold-time for Panels	031 075	Fig. 3-2
Setting for the time period for which a panel is displayed before the unit switches to the next panel. This setting is only relevant if more values are selected for display than can be shown on the LCD display.		
LOC: Autom. return time	003 014	Fig. 3-2
If the user does not press a key on the local control panel during this set time period, the change-enabling function is deactivated.		
LOC: Return time illumin.	003 023	
If the user does not press a key on the local control panel during this set time period, then the backlighting of the LCD display is switched off.		

PC link

PC: Name of manufacturer	003 183 Fig. 3-6
Setting for the name of the manufacturer. **Note:** This setting can be changed to ensure compatibility.	
PC: Bay address	003 068 Fig. 3-6
PC: Device address	003 069 Fig. 3-6
Bay and device addresses are used to address the device in communication via the PC interface. An identical setting must be selected for both addresses.	
PC: Baud rate	003 081 Fig. 3-6
Baud rate of the PC interface.	
PC: Parity bit	003 181 Fig. 3-6
Set the same parity that is set at the interface of the PC connected to the P130C.	
PC: Spontan. sig. enable	003 187 Fig. 3-6
Enable for the transmission of spontaneous signals via the PC interface.	
PC: Select. spontan.sig.	003 189 Fig. 3-6
Selection of spontaneous signals for transmission via the PC interface.	
PC: Transm.enab.cycl.dat	003 084 Fig. 3-6
Enable for the cyclic transmission of measured values via the PC interface.	
PC: Cycl. data ILS tel.	003 185 Fig. 3-6
Selection of the measured values that are transmitted in a user-defined telegram via the PC interface.	
PC: Delta V	003 055 Fig. 3-6
A measured voltage value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.	
PC: Delta I	003 056 Fig. 3-6
A measured current value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.	
PC: Delta P	003 059 Fig. 3-6
The active power value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.	
PC: Delta f	003 057 Fig. 3-6
The measured frequency value is transmitted via the PC interface if it differs by the set delta from the last measured value transmitted.	
PC: Delta meas.v.ILS tel	003 155 Fig. 3-6
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.	
PC: Delta t	003 058 Fig. 3-6
All measured data are transmitted again through the PC interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.	

PC: Time-out	003 188 Fig. 3-6
Setting for the time to elapse after the last telegram exchange via the PC interface before activating the second communication channel of communication module A.	

"Logical" communication interface 1

COMM1: Function group COMM1	056 026
Canceling function group COMM1 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	
COMM1: General enable USER	003 170 Fig. 3-7
Disabling or enabling "logical" communication interface 1.	
COMM1: Basic IEC870-5enable	003 215 Fig. 3-7
Common settings for enabling all protocols based on IEC 870-5-xxx.	
COMM1: Addit. -101 enable	003 216 Fig. 3-7
Enabling additional settings that are relevant for the protocol based on IEC 870-5-101.	
COMM1: Addit. ILS enable	003 217 Fig. 3-7
Enabling additional settings that are relevant for the ILS protocol.	
COMM1: MODBUS enable	003 220 Fig. 3-7
Enabling settings relevant for the MODBUS protocol.	
COMM1: DNP3 enable	003 231 Fig. 3-7
Enabling settings relevant for the DNP 3.0 protocol.	
COMM1: COURIER enable	103 040
Enabling settings relevant for the COURIER protocol.	
COMM1: Communicat. protocol	003 167 Fig. 3-7
Select the communication protocol that shall be used for the communication interface.	
COMM1: MODBUS prot. variant	003 214 Fig. 3-11
The user may select either the AREVA D or the AREVA variant of the MODBUS protocol. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Line idle state	003 165 Fig. 3-8, 3-9, 3-10,3-11, 3-12
Setting for the line idle state indication.	
COMM1: Baud rate	003 071 Fig. 3-8,3-9,3-10,3-11,3-12
Baud rate of the communication interface.	
COMM1: Parity bit	003 171 Fig. 3-8,3-9,3-10,3-11,3-12
Set the same parity that is set at the interface of the control system connected to the P130C.	

COMM1: Dead time monitoring	003 176	Fig. 3-8,3-9,3-10,3-11,3-12
The P130C monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required. **Note:** This setting is only necessary for modem transmission.		
COMM1: Mon. time polling	003 202	Fig. 3-8,3-9,3-10,3-11,3-12
The time between two polling calls from the communication master must be less than the time set here.		
COMM1: Octet comm. address	003 072	Fig. 3-8,3-9,3-10,3-11,3-12
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. **Note:** The former designation for 'COMM1: Octet comm. address' was ILSA: Bay address "ASDU": Application Service Data Unit		
COMM1: Oct.2 comm.addr.DNP3	003 240	Fig. 3-12
In the DNP 3.0 protocol, a 16 bit address is used to identify devices. The address that can be set here is the higher-order octet, whereas the address set at COMM1: Octet comm. address is the lower-order octet of the DNP address. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.		
COMM1: Test monitor on	003 166	Fig. 3-8,3-9,3-10,3-11,3-12
Setting specifying whether data shall be recorded for service activities.		
COMM1: Name of manufacturer	003 161	Fig. 3-8,3-9,3-10
Setting for the name of the manufacturer (to ensure compatibility). **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Octet address ASDU	003 073	Fig. 3-8,3-9,3-10
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled. The former designation for 'COMM1: Octet address ASDU' was 'ILSA: Device address'. "ASDU": Application Service Data Unit		

COMM1: Spontan. sig. enable	003 177	Fig. 3-8,3-9,3-10
Enable for the transmission of spontaneous signals via the communication interface. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Select. spontan.sig.	003 179	Fig. 3-8,3-9,3-10,3-15
Selection of spontaneous signals for transmission via "logical" communication interface 1.		
COMM1: Transm.enab.cycl.dat	003 074	Fig. 3-8,3-9,3-10
Enabling of cyclic transmission of measured values via the communication interface. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Cycl. data ILS tel.	003 175	Fig. 3-8,3-9,3-10
Selection of the measured values transmitted in a user-defined telegram via the communication interface. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta V	003 050	Fig. 3-8,3-9,3-10
A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta I	003 051	Fig. 3-8,3-9,3-10
A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta P	003 054	Fig. 3-8,3-9,3-10
The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta f	003 052	Fig. 3-8,3-9,3-10
The measured frequency is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta meas.v.ILS tel	003 150	Fig. 3-8,3-9,3-10
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		

COMM1: Delta t	003 053	Fig. 3-8,3-9,3-10
All measured data are transmitted again through the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Delta t (energy)	003 151	Fig. 3-8,3-9,3-10
The measured data for active energy and reactive energy are transmitted through the communication interface after this time has elapsed. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Contin. general scan	003 077	Fig. 3-8,3-9,3-10
A continuous or background general scan means that the P130C transmits all settings, signals, and monitoring signals through the communication interface during slow periods when there is not much activity. This ensures that there will be data consistency with a connected control system. The time to be set defines the minimum time difference between two telegrams. **Note:** This setting is hidden unless an IEC 870-5 protocol is enabled.		
COMM1: Comm. address length	003 201	Fig. 3-9
Setting for the communication address length. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set.		
COMM1: Octet 2 comm. addr.	003 200	Fig. 3-9
Setting for the length of the higher-order communication address. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set.		
COMM1: Cause transm. length	003 192	Fig. 3-9
Setting for the length of the cause of transmission. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set.		
COMM1: Address length ASDU	003 193	Fig. 3-9
Setting for the length of the common address for identification of telegram structures. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set. "ASDU": Application Service Data Unit		
COMM1: Octet 2 addr. ASDU	003 194	Fig. 3-9
Setting for the length of the common higher-order address for identification of telegram structures. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set. "ASDU": Application Service Data Unit		
COMM1: Addr.length inf.obj.	003 196	Fig. 3-9
Setting for the length of the address for information objects. **Note:** This setting is hidden unless the IEC 870-5-101 protocol is set.		

COMM1: Oct.3 addr. inf.obj. 003 197 Fig. 3-9

Setting for the length of the higher-order address for information objects.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Inf.No.<->funct.type 003 195 Fig. 3-9

Setting specifying whether information numbers and function type shall be reversed in the object address.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Time tag length 003 198 Fig. 3-9

Setting for the time tag length.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: ASDU1 / ASDU20 conv. 003 190 Fig. 3-9

Setting specifying whether telegram structure 1 or 20 shall be converted as a single signal or double signal.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is set.

"ASDU": Application Service Data Unit

COMM1: ASDU2 conversion 003 191 Fig. 3-9

Setting specifying whether telegram structure 2 shall be converted as a single signal or double signal.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is set.

"ASDU": Application Service Data Unit

COMM1: Initializ. signal 003 199 Fig. 3-9

Setting specifying whether an initialization signal shall be issued.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Balanced operation 003 226 Fig. 3-9

Setting that determines whether communication takes place on a balanced basis (full duplex operation).

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Direction bit 003 227 Fig. 3-9

Setting for the transmission direction. Normally this value will be set at '1' at the control center and at '0' at the substation.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Time-out interval 003 228 Fig. 3-9

Setting for the maximum time that will elapse until the status signal for the acknowledgment command is issued.

Note: This setting is hidden unless the IEC 870-5-101 protocol is set.

COMM1: Reg.asg. selec. cmds	003 210 Fig. 3-11
MODBUS registers in the range 00301 to 00400 are assigned to the selected commands. Assignment is made in the order of selection. This means that the first command is given the register no. 00301, the second the register no. 00302, etc. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Reg.asg. selec. sig.	003 211 Fig. 3-11
MODBUS registers in the range 10301 to 10400 are assigned to the selected signals. Assignment is made in the order of selection. This means that the first signal is given the register no. 10301, the second the register no. 10302, etc. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Reg.asg. sel. m.val.	003 212 Fig. 3-11
MODBUS registers in the range 30301 to 30400 are assigned to the selected measured values. Assignment is made in the order of selection. This means that the first measured value is given the register no. 30301, the second the register no. 30302, etc. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Reg.asg. sel. param.	003 213 Fig. 3-11
MODBUS registers in the range 40301 to 40400 are assigned to the selected parameters. Assignment is made in the order of selection. This means that the first parameter is given the register no. 40301, the second the register no. 40302, etc. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Delta t (MODBUS)	003 152 Fig. 3-11
All MODBUS registers are transmitted again through the communication interface after this time has elapsed. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Autom.event confirm.	003 249 Fig. 3-11
Setting specifying whether an event must be confirmed by the master in order for an event to be deleted from the 'event queue'. **Note:** This setting is hidden unless the MODBUS protocol is enabled.	
COMM1: Phys. Charact. Delay	003 241 Fig. 3-12
Number of bits that must pass between the receipt of the 'request' and the start of sending the 'response'. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Phys. Char. Timeout	003 242 Fig. 3-12
Number of bits that may be missing from the telegram before receipt is terminated. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Link Confirm. Mode	003 243 Fig. 3-12
Setting for the acknowledgment mode of the link layer. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	

COMM1: Link Confirm.Timeout	003 244 Fig. 3-12
Setting for the time period within which the master must acknowledge at the link layer. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Link Max. Retries	003 245 Fig. 3-12
Number of repetitions that are carried out on the link layer if errors have occurred during transmission (such as failure to acknowledge). **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Appl.Confirm.Timeout	003 246 Fig. 3-12
Setting for the time period within which the master must acknowledge at the application layer. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Appl. Need Time Del.	003 247 Fig. 3-12
Time interval within which the slave requests time synchronization cyclically from the master. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Ind./cl. bin. inputs	003 232 Fig. 3-12
Selection of data points and data classes for object 1 – binary inputs. Assignment of indices is made in the order of selection, beginning with 0. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Ind./cl. bin.outputs	003 233 Fig. 3-12
Selection of data points and data classes for object 10 – binary outputs. Assignment of indices is made in the order of selection, beginning with 0. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Ind./cl. analog inp.	003 235 Fig. 3-12
Selection of data points and data classes for object 30 – analog inputs. Assignment of indices is made in the order of selection, beginning with 0. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Ind./cl. analog outp	003 236 Fig. 3-12
Selection of data points and data classes for object 40 – analog outputs. Assignment of indices is made in the order of selection, beginning with 0. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Delta meas.v. (DNP3)	003 250 Fig. 3-12
Initialization value of threshold values for transmission of measured values in object 30. The threshold values can be changed separately by the master for each measured value by writing to object 34, 'analog input reporting deadband'. **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	
COMM1: Delta t (DNP3)	003 248 Fig. 3-12
Cycle time for updating DNP object 30 (analog inputs). **Note:** This setting is hidden unless the DNP 3.0 protocol is enabled.	

COMM1: Command selection	103 042
Selection of commands to be issued via the COURIER protocol.	
Note: This setting is hidden unless the COURIER protocol is enabled.	
COMM1: Signal selection	103 043
Selection of signals to be transmitted via the COURIER protocol.	
Note: This setting is hidden unless the COURIER protocol is enabled.	
COMM1: Meas. val. selection	103 044
Selection of measured values to be transmitted via the COURIER protocol.	
Note: This setting is hidden unless the COURIER protocol is enabled.	
COMM1: Parameter selection	103 045
Selection of settings to be altered via the COURIER protocol.	
Note: This setting is hidden unless the COURIER protocol is enabled.	
COMM1: Delta t (COURIER)	103 046
Cycle for re-transmission of the selected measured values.	
Note: This setting is hidden unless the COURIER protocol is enabled.	

"Logical" communication interface 2

COMM2: Function group COMM2	056 057
Canceling function group COMM2 or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	
COMM2: General enable USER	103 170 Fig. 3-15
Disabling or enabling "logical" communication interface 2.	
COMM2: Line idle state	103 165 Fig. 3-15
Setting for the line idle state indication.	
COMM2: Baud rate	103 071 Fig. 3-15
Baud rate of the communication interface.	
COMM2: Parity bit	103 171 Fig. 3-15
Set the same parity that is set at the interface of the control system connected to the P130C.	
COMM2: Dead time monitoring	103 176 Fig. 3-15
The P130C monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required. **Note:** This setting is only necessary for modem transmission.	
COMM2: Mon. time polling	103 202 Fig. 3-15
The time between two polling calls from the communication master must be less than the time set here.	
COMM2: Octet comm. address	103 072 Fig. 3-15
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. "ASDU": Application Service Data Unit	
COMM2: Name of manufacturer	103 161 Fig. 3-15
Setting for the name of the manufacturer. **Note:** This setting can be changed to ensure compatibility.	
COMM2: Octet address ASDU	103 073 Fig. 3-15
The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses. "ASDU": Application Service Data Unit	
COMM2: Spontan. sig. enable	103 177 Fig. 3-15
Enable for the transmission of spontaneous signals via the communication interface.	
COMM2: Select. spontan.sig.	103 179
Selection of the spontaneous signals for transmission via logical communication interface 2.	
COMM2: Transm.enab.cycl.dat	103 074 Fig. 3-15
Enabling of cyclic transmission of measured values via the communication interface.	

COMM2: Cycl. data ILS tel.	103 175 Fig. 3-15
Selection of the measured values transmitted in a user-defined telegram via the communication interface.	
COMM2: Delta V	103 050 Fig. 3-15
A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.	
COMM2: Delta I	103 051 Fig. 3-15
A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.	
COMM2: Delta P	103 054 Fig. 3-15
The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.	
COMM2: Delta f	103 052 Fig. 3-15
The measured frequency is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.	
COMM2: Delta meas.v.ILS tel	103 150 Fig. 3-15
The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.	
COMM2: Delta t	103 053 Fig. 3-15
All measured data are transmitted again through the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.	

"Logical" communication interface 3

COMM3: Function group COMM3	056 058
Canceling function group COMM3 or including it in the configuration. This setting parameter is only visible if the relevant optional communication module is fitted. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	
COMM3: General enable USER	120 030
Disabling or enabling "logical" communication interface 3.	
COMM3: Baud rate	120 038
Adjustment of the baud rate for telegram transmission via the guidance interface (InterMiCOM interface) so as to meet the requirements of the transmission carrier.	
COMM3: Source address	120 031
Address for send signals.	
COMM3: Receiving address	120 032
Address for receive signals.	
COMM3: Fct. assignm. send 1	121 001
COMM3: Fct. assignm. send 2	121 003
COMM3: Fct. assignm. send 3	121 005
COMM3: Fct. assignm. send 4	121 007
COMM3: Fct. assignm. send 5	121 009
COMM3: Fct. assignm. send 6	121 011
COMM3: Fct. assignm. send 7	121 013
COMM3: Fct. assignm. send 8	121 015
Assignment of functions for the 8 send signals.	
COMM3: Fct. assignm. rec. 1	120 001
COMM3: Fct. assignm. rec. 2	120 004
COMM3: Fct. assignm. rec. 3	120 007
COMM3: Fct. assignm. rec. 4	120 010
COMM3: Fct. assignm. rec. 5	120 013
COMM3: Fct. assignm. rec. 6	120 016
COMM3: Fct. assignm. rec. 7	120 019
COMM3: Fct. assignm. rec. 8	120 022
Configuration (assignment of functions) for the 8 receive signals	
COMM3: Oper. mode receive 1	120 002
COMM3: Oper. mode receive 2	120 005
COMM3: Oper. mode receive 3	120 008
COMM3: Oper. mode receive 4	120 011
Selection of *Blocking* or *Direct intertrip* for the operating mode of receive signals 1 to 4 (single-pole transmission).	
COMM3: Oper. mode receive 5	120 014
COMM3: Oper. mode receive 6	120 017
COMM3: Oper. mode receive 7	120 020
COMM3: Oper. mode receive 8	120 023
Selection of *Permissive or Direct intertrip* for the operating mode of receive signals 5 to 8 (two-pole transmission).	

COMM3: Default value rec. 1	120 060	
COMM3: Default value rec. 2	120 061	
COMM3: Default value rec. 3	120 062	
COMM3: Default value rec. 4	120 063	
COMM3: Default value rec. 5	120 064	
COMM3: Default value rec. 6	120 065	
COMM3: Default value rec. 7	120 066	
COMM3: Default value rec. 8	120 067	
Definition of the default value for the 8 receive signals.		
COMM3: Time-out comm.fault	120 033	Fig. 3-18
This timer triggers the alarm signals COMM3: Communications fault and SFMON: Communic.fault COMM3 and sets the received signals to their user-defined default values. Time-out occurs when the set time has elapsed since the most recent 100% valid telegram was received.		
COMM3: Sig.asg. comm.fault	120 034	
Using this setting, the alarm signal can be configured (assigned) to the corresponding PSIG input signal.		
COMM3: Time-out link fail.	120 035	Fig. 3-18
Time indicating a persistent failure of the transmission channel. After this timer stage has elapsed, alarm signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are raised. These can be mapped to give the operator a warning LED or contact to indicate that maintenance attention is required.		
COMM3: Limit telegr. errors	120 036	
Percentage of corrupted messages compared to total messages transmitted before an alarm is raised (COMM3: Lim.exceed.,tel.err. and SFMON: Lim.exceed.,tel.err.). When this threshold is exceeded, the receive signals are set to their user-defined default values.		

IRIG-B interface

IRIGB: Function group IRIGB	056 072	
Canceling function group IRIGB or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.		
IRIGB: General enable USER	023 200	Fig. 3-19
Disabling or enabling the IRIG-B interface.		

Function keys

F_KEY: Password funct. key1	003 036	
F_KEY: Password funct. key2	030 242	
F_KEY: Password funct. key3	030 243	
F_KEY: Password funct. key4	030 244	
These passwords enable the corresponding function keys. Further information on changing the passwords is given in Chapter 6.		
F_KEY: Fct. assignm. F1	080 112	Fig. 3-20
F_KEY: Fct. assignm. F2	080 113	
F_KEY: Fct. assignm. F3	080 114	
F_KEY: Fct. assignm. F4	080 115	
Assignment of functions to the function keys. Either a single function or a menu jump list may be selected. The two menu jump lists are composed via LOC: Fct. menu jmp list x (x: 1 or 2).		
F_KEY: Operating mode F1	080 132	Fig. 3-20
F_KEY: Operating mode F2	080 133	
F_KEY: Operating mode F3	080 134	
F_KEY: Operating mode F4	080 135	
Choice between operation of the function key as a key or switch.		
F_KEY: Return time fct.keys	003 037	
Once the password has been entered, the function keys remain active for no longer than this time. Thereafter, the function keys are disabled until the password is entered again.		

Binary inputs

The P130C has optical coupler inputs for processing binary signals from the substation. The number and connection schemes for the available binary inputs are shown in the terminal connection diagrams. The Address List in the Appendix gives information about the configuration options for all binary inputs.

When configuring binary inputs, one should keep in mind that the same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

In order to ensure that the device will recognize the input signals, the triggering signals must persist for at least 30 ms.

The operating mode for each binary signal input can be defined. The user can specify whether the presence (*active 'high'* mode) or absence (*active 'low'* mode) of a voltage shall be interpreted as the logic '1' signal.

INP: Fct. assignm. U 1	178 002
INP: Fct. assignm. U 2	178 006
Assignment of functions to binary signal inputs.	
INP: Oper. mode U 1	178 003
INP: Oper. mode U 2	178 007
Selection of operating mode for binary signal inputs.	

Binary outputs

The P130C has output relays for the output of binary signals. The number and connection schemes for the available output relays are shown in the terminal connection diagrams. The Address List in the Appendix gives information about the configuration options for all binary outputs.

The contact data for the all-or-nothing relays permits them to be used either as command relays or as signal relays. One signal can also be assigned to several output relays simultaneously for the purpose of contact multiplication.

An operating mode can be defined for each output relay. Depending on the selected operating mode, the output relay will operate in either an energize-on-signal (ES) mode or a normally-energized (NE) mode and in either a latching or non-latching mode. For output relays operating in latching mode, the operating mode setting also determines when latching will be canceled.

Note: For relays with make contacts, the energize-on-signal (ES) mode corresponds to normally-open operation. The normally-energized (NE) mode means that the polarity of the driving signal is inverted, such that a logic "0" maintains the relay normally-closed. For relays with changeover contacts, these more common descriptions are not applicable.

OUTP: Fct. assignm. K 1	157 002
OUTP: Fct. assignm. K 2	157 006
OUTP: Fct. assignm. K 3	157 010
OUTP: Fct. assignm. K 4	157 014
OUTP: Fct. assignm. K 5	157 018
OUTP: Fct. assignm. K 6	157 022
OUTP: Fct. assignm. K 7	157 026
OUTP: Fct. assignm. K 8	157 030
Assignment of functions to output relays.	
OUTP: Oper. mode K 1	157 003
OUTP: Oper. mode K 2	157 007
OUTP: Oper. mode K 3	157 011
OUTP: Oper. mode K 4	157 015
OUTP: Oper. mode K 5	157 019
OUTP: Oper. mode K 6	157 023
OUTP: Oper. mode K 7	157 027
OUTP: Oper. mode K 8	157 031
Selection of operating mode for output relays.	

LED indicators

The P130C has a total of 17 LED indicators for parallel display of binary signals. The Address List in the Appendix gives information about the configuration options for all LED indicators. The following table provides an overview.

LED indicator	Description on the label strip as supplied	Configuration
H 1	'HEALTHY'	Not configurable. H 1 signals the operational readiness of the device (supply voltage present).
H 17	'EDIT MODE'	Not configurable. H 17 signals the fact that the user is in the 'EDIT MODE'. In this mode, parameter values can be changed. (See the section entitled 'Display and Keypad' in Chapter 6.)
H 2	'OUT OF SERVICE'	Permanently assigned to the function MAIN: Blocked/faulty.
H 3	'ALARM'	Permanently assigned to the function SFMON: Warning (LED).
H 4	'TRIP'	The factory-set configuration is shown in the Terminal Connection Diagrams. These diagrams are found in the appendix to this manual or in the Supporting Documents shipped with the device.
H 5 to H 16	----	The user has the option of assigning functions to these LED indicators.

The arrangement of the LED indicators on the local control panel is illustrated in the dimensional drawings of Chapter 4.

An operating mode can be defined for each LED indicator. Depending on the selected operating mode, the output relay will operate in either energize-on-signal (ES) mode or normally-energized (NE) mode and in either latching or non-latching mode. For LED indicators operating in latching mode, the operating mode setting also determines when latching will be canceled.

Note: For relays with make contacts, the energize-on-signal (ES) mode corresponds to normally-open operation. The normally-energized (NE) mode means that the polarity of the driving signal is inverted, such that a logic "0" maintains the relay normally-closed. For relays with changeover contacts, these more common descriptions are not applicable.

LED: Fct. assignm. H 2	085 001
Display of the function assigned to LED indicator H 2 ('OUT OF SERVICE'). The MAIN: Blocked/faulty function is permanently assigned to this LED.	
LED: Fct. assignm. H 3	085 004
Display of the function assigned to LED indicator H 3 ('ALARM'). The SFMON: Warning (LED) function is permanently assigned to this LED.	
LED: Fct. assignm. H 4	085 007
LED: Fct. assignm. H 5	085 010
LED: Fct. assignm. H 6	085 013
LED: Fct. assignm. H 7	085 016
LED: Fct. assignm. H 8	085 019
LED: Fct. assignm. H 9	085 022
LED: Fct. assignm. H 10	085 025
LED: Fct. assignm. H 11	085 028
LED: Fct. assignm. H 12	085 031
LED: Fct. assignm. H 13	085 034
LED: Fct. assignm. H 14	085 037
LED: Fct. assignm. H 15	085 040
LED: Fct. assignm. H 16	085 043
Assignment of functions to LED indicators.	
LED: Operating mode H 2	085 002
LED: Operating mode H 3	085 005
LED: Operating mode H 4	085 008
LED: Operating mode H 5	085 011
LED: Operating mode H 6	085 014
LED: Operating mode H 7	085 017
LED: Operating mode H 8	085 020
LED: Operating mode H 9	085 023
LED: Operating mode H 10	085 026
LED: Operating mode H 11	085 029
LED: Operating mode H 12	085 032
LED: Operating mode H 13	085 035
LED: Operating mode H 14	085 038
LED: Operating mode H 15	085 041
LED: Operating mode H 16	085 044
Selection of operating mode for LED indicators.	

Main function

MAIN: Chann.assign.COMM1/2 003 169
Assignment of "logical" communication interfaces to physical communication channels.

Fault recording

FT_RC: Rec. analog chann. 1 035 160
FT_RC: Rec. analog chann. 2 035 161
FT_RC: Rec. analog chann. 3 035 162
FT_RC: Rec. analog chann. 4 035 163
FT_RC: Rec. analog chann. 5 035 164
FT_RC: Rec. analog chann. 6 035 165
FT_RC: Rec. analog chann. 7 035 166
The user specifies the channel on which each physical variable is recorded.

Canceling protection functions

By means of a configuration procedure, the user can adapt the device functions flexibly to the scope of protection functions required in each particular h.v. system.

The following conditions must be met before a protection function can be canceled:

- The protection function in question must be disabled.
- None of the functions of the protection function being canceled may be assigned to a binary input.
- None of the signals of the protection function may be assigned to a binary output or to an LED indicator.
- None of the signals of the protection function may be linked to other signals by way of an 'm out of n' parameter.

The protection function to which a parameter, a signal, or a measured value belongs is defined by the function group designation (example: 'LIMIT').

Definite-time overcurrent protection

DTOC: Function group DTOC	056 008
Canceling function group DTOC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Inverse-time overcurrent protection

IDMT: Function group IDMT	056 009
Canceling function group IDMT or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Short-circuit direction determination

SCDD: Function group SCDD	056 021
Canceling function group SCDD or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Switch on to fault protection

SOTF: Function group SOTF	056 003
Canceling function group SOTF or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Protective signaling

PSIG: Function group PSIG	056 004
Canceling function group PSIG or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Auto-reclosing control

ARC: Function group ARC	056 005
Canceling function group ARC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Ground fault direction determination using steady-state values

GFDSS: Function group GFDSS	056 012
Canceling function group GFDSS or including it in the configuration. . If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Motor protection

MP: Function group MP	056 022
Canceling function group MP or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Thermal overload protection

THERM: Function group THERM	056 023
Canceling function group THERM or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Unbalance protection

I2>: Function group I2>	056 024
Canceling function group I2> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Time-voltage protection

V<>: Function group V<>	056 010
Canceling function group V<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Over-/underfrequency protection

f<>: Function group f<>	056 033
Canceling function group f<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Power directional protection

P<>: Function group P<>	056 045
Canceling function group P<> or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Circuit breaker failure protection

CBF: Function group CBF	056 007
Canceling function group CBF or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.	

Measuring-circuit monitoring

MCMON: Function group MCMON 056 015
Canceling function group MCMON or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

Limit value monitoring

LIMIT: Function group LIMIT 056 025
Canceling function group LIMIT or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

Logic

LOGIC: Function group LOGIC 056 017
Canceling function group LOGIC or including it in the configuration. If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

7.1.3 Function Parameters

7.1.3.1 Global

PC link

PC: Command blocking	003 182	Fig. 3-6
When command blocking is activated, commands are rejected at the PC interface.		
PC: Sig./meas.val.block.	003 086	Fig. 3-6
When signal and measured value blocking is activated, no signals or measured data are transmitted through the PC interface.		

"Logical" communication interface 1

COMM1: Command block. USER	003 172	Fig. 3-7
When command blocking is activated, commands are rejected at communication interface 1.		
COMM1: Sig./meas.block.USER	003 076	Fig. 3-8,3-9,3-10
When signal and measured value blocking is activated, no signals or measured data are transmitted through communication interface 1.		

"Logical" communication interface 2

COMM2: Command block. USER	103 172	Fig. 3-15
When command blocking is activated, commands are rejected at communication interface 2.		
COMM2: Sig./meas.block.USER	103 076	Fig. 3-15
When signal and measured value blocking is activated, no signals or measured data are transmitted through communication interface 2.		

Binary outputs

OUTP: Outp.rel.block USER	021 014	Fig. 3-22
When this blocking is activated, all output relays are blocked.		

Main function

MAIN: Device on-line	003 030	Fig. 3-36
Disabling or enabling protection. Parameters marked *'No (=off)'* in the Address List can only be changed when protection is disabled.		
MAIN: Test mode USER	003 012	Fig. 3-54
When the test mode is activated, signals or measured data for PC and communication interfaces are labeled 'test mode'.		
MAIN: Nominal frequ. fnom	010 030	Fig. 3-182
Setting for the nominal frequency of the protected system.		
MAIN: Rotary field	010 049	Fig. 3-109, 3-168, 3-173, 3-192
Setting for the rotary field direction, either clockwise or anticlockwise.		
MAIN: Inom C.T. prim.	010 001	Fig. 3-26, 3-77
Setting for the primary nominal current of the main current transformers for measurement of phase currents.		

MAIN: IN,nom C.T. prim.	010 018 Fig. 3-27
Setting for the primary nominal current of the main current transformer for measurement of residual current.	
MAIN: Vnom V.T. prim.	010 002 Fig. 3-30,3-77
Setting for the primary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.	
MAIN: Inom device	010 003 Fig. 3-25
Setting for the secondary nominal current of the system transformer for measurement of phase currents. This also corresponds to the nominal device current.	
MAIN: IN,nom device	010 026 Fig. 3-25
Setting for the secondary nominal current of the system transformer for measurement of residual current. This also corresponds to the nominal device current.	
MAIN: Vnom V.T. sec.	010 009 Fig. 3-25
Setting for the secondary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.	
MAIN: Conn. meas. circ. IP	010 004 Fig. 3-25
Direction determination is governed by the connection of the measuring circuits. If the connection is as shown in Chapter 5, then the setting must be '*Standard*' if the P130C's 'Forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter 5 – if the 'forward' decision is to be in the busbar direction, then the setting must be *'Opposite'.*	
MAIN: Conn. meas. circ. IN	010 019 Fig. 3-25
The direction determination function of the ground fault measuring systems is governed by the connection of the measuring circuits. If the connection is as shown in Chapter 5, then the setting must be '*Standard'* if the P130C's 'Forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter 5 – if the 'forward' decision is to be in the busbar direction, then the setting must be *'Opposite'.*	
MAIN: Meas. value rel. IP	011 030 Fig. 3-26
Setting for the minimum current that must be exceeded in order for the measured operating values of the phase currents – and the currents derived from them – to be displayed.	
MAIN: Meas. value rel. IN	011 031 Fig. 3-27
Setting for the minimum current that must be exceeded in order for the measured operating value of the residual current to be displayed.	
MAIN: Meas. value rel. V	011 032 Fig. 3-30
Setting for the minimum voltage that must be exceeded in order for the measured operating values of the phase-to-ground voltages, phase-to-phase voltages, and the voltages derived from them to be displayed.	
MAIN: Op. mode energy cnt.	010 138 Fig. 3-34
Selection of the procedure for the determination of the active and reactive energy output. Procedure 1: Acquisition every second (approximately) Procedure 2: Acquisition every 100 ms (approximately)	

MAIN: Settl. t. IP,max,del	010 113 Fig. 3-26
Setting for the time after which the delayed maximum current display shall reach 95% of the maximum current $I_{P,max}$.	
MAIN: Fct.assign. block. 1	021 021 Fig. 3-40
Assignment of functions that will be blocked together when blocking input 1 (MAIN: Blocking 1 EXT) is activated.	
MAIN: Fct.assign. block. 2	021 022 Fig. 3-40
Assignment of functions that will be blocked together when blocking input 2 (MAIN: Blocking 2 EXT) is activated.	
MAIN: Trip cmd.block. USER	021 012 Fig. 3-48
Blocking of the trip commands from the local control panel.	
MAIN: Fct.assig.trip cmd.1	021 001 Fig. 3-48
Assignment of the signals that trigger trip command 1.	
MAIN: Fct.assig.trip cmd.2	021 002 Fig. 3-48
Assignment of the signals that trigger trip command 2.	
MAIN: Min.dur. trip cmd. 1	021 003 Fig. 3-48
Setting for the minimum duration of trip command 1.	
MAIN: Min.dur. trip cmd. 2	021 004 Fig. 3-48
Setting for the minimum duration of trip command 2.	
MAIN: Latching trip cmd. 1	021 023 Fig. 3-48
Specification as to whether trip command 1 should latch.	
MAIN: Latching trip cmd. 2	021 024 Fig. 3-48
Specification as to whether trip command 2 should latch.	
MAIN: Close cmd.pulse time	015 067 Fig. 3-42
Setting for the duration of the close command.	
MAIN: Fct. assign. fault	021 031 Fig. 3-41
Selection of the signals whose appearance shall result in a 'Blocked/faulty' signal and in the activation of the LED indicator labeled 'OUT OF SERVICE' – in addition to the signals that always result in the above signal and indication. In both cases, the device is blocked.	

Parameter subset selection

PSS: Control via USER	003 100 Fig. 3-55
If parameter subset selection is to be handled from the integrated local control panel rather than via the binary signal inputs, choose the '*Yes*' setting.	
PSS: Param.subs.sel. USER	003 060 Fig. 3-55
Selection of the parameter subset from the local control panel.	
PSS: Keep time	003 063 Fig. 3-55
The setting of this timer stage is relevant only if parameter subset selection is carried out via the binary signal inputs. Any voltage-free pause that may occur during selection is bridged. If, after this time period has elapsed, no binary signal input has yet been set, then the parameter subset selected from the local control panel shall apply.	

Self-monitoring

SFMON: Fct. assign. warning	021 030 Fig. 3-56
Selection of the signals whose appearance shall result in the signals 'Warning (LED)' and 'Warning (relay) and in the activation of the LED indicator labeled 'ALARM'. Signals caused by faulty hardware and leading to blocking of the device are not configurable. They always result in the above signals and indication.	

Fault data acquisition

FT_DA: Line length 010 005 Fig. 3-78

This setting defines the distance in km that the fault locator interprets as 100 % when calculating the fault distance.

FT_DA: Line reactance 010 012 Fig. 3-78

This setting defines the reactance X that the fault locator interprets as 100 % when calculating the fault distance.

FT_DA: Angle kG 012 036 Fig. 3-75

Angle setting for the complex ground factor $\underline{k}_G$.

$$\underline{k}_G = \frac{\underline{Z}_0 - \underline{Z}_{pos}}{3 \cdot \underline{Z}_{pos}}$$

$\underline{Z}_0$: zero-sequence impedance

$\underline{Z}_{pos}$: positive-sequence impedance

$$k_G \text{ angle} = \arctan\frac{X_0 - X_{pos}}{R_0 - R_{pos}} - \arctan\frac{X_{pos}}{R_{pos}}$$

R_0: resistance component of zero-sequence impedance

R_{pos}: resistance component of positive-sequence impedance

X_0: reactance component of zero-sequence impedance

X_{pos}: reactance component of positive-sequence impedance

If the calculated value cannot be set exactly, then next smaller value should be set.

FT_DA: Abs. value kG 012 037 Fig. 3-75

Setting for the absolute value of the complex ground factor $\underline{k}_G$.

$$\underline{k}_G = \frac{\underline{Z}_0 - \underline{Z}_{pos}}{3 \cdot \underline{Z}_{pos}}$$

$\underline{Z}_0$: zero-sequence impedance

$\underline{Z}_{pos}$: positive-sequence impedance

$$\left|\underline{k}_G\right| = \frac{\sqrt{\left(X_0 - X_{pos}\right)^2 + \left(R_0 - R_{pos}\right)^2}}{3 \cdot \sqrt{R_{pos}^2 + X_{pos}^2}}$$

R_0: resistance component of zero-sequence impedance

R_{pos}: resistance component of positive-sequence impedance

X_0: reactance component of zero-sequence impedance

X_{pos}: reactance component of positive-sequence impedance

If the calculated value cannot be set exactly, then the next smaller value should be set.

FT_DA: Start data acquisit. 010 011 Fig. 3-74	
This setting determines at what point during a fault the acquisition of fault data should take place.	
FT_DA: Output fault locat. 010 032 Fig. 3-74	
Setting for the conditions under which fault location output occurs.	

Fault recording

FT_RC: Fct. assig. trigger 003 085 Fig. 3-80	
This setting defines the signals that will trigger fault recording.	
FT_RC: I> 017 065 Fig. 3-80	
This setting defines the threshold value of the phase currents that will trigger fault recording and fault data acquisition.	
FT_RC: Pre-fault time 003 078 Fig. 3-82	
Setting for the time during which data will be recorded before the onset of a fault (pre-fault recording time).	
FT_RC: Post-fault time 003 079 Fig. 3-82	
Setting for the time during which data will be recorded after the end of a fault (post-fault recording time).	
FT_RC: Max. recording time 003 075 Fig. 3-82	
Setting for the maximum recording time per fault. This includes pre-fault and post-fault recording times.	

7.1.3.2 General Functions

Main function

MAIN: Hold time dyn.param.	018 009 Fig. 3-38
Setting for the hold time of the "dynamic parameters". After switching to the "dynamic" thresholds, the latter will remain active in place of the "normal" thresholds during this period.	
MAIN: Syst.IN enabled USER	018 008 Fig. 3-37
Enable/disable the DTOC or IDMT residual current stages.	
MAIN: Block tim.st. IN,neg	017 015 Fig. 3-45
This setting defines whether a blocking of the residual current stages should take place for single-pole or multi-pole phase current startings.	
MAIN: Gen. starting mode	017 027 Fig. 3-46
This setting defines whether the triggering of the residual current stages $I_N>$, $I_{ref,N}>$, $I_N>>$ or $I_{ref}>>>$ as well as the negative-sequence current stage $I_{ref,neg}>$ should result in the formation of the general starting signal. If the setting is *W/o start. IN, Ineg* then the associated time delays $t_{IN>}$, $t_{Iref,N>}$, $t_{IN>>}$, $t_{IN>>>}$, $t_{Iref,neg>}$ are automatically excluded from the formation of the trip command.	
MAIN: Op. mode rush restr.	017 097
Setting the operating mode of the inrush stabilization function.	
MAIN: Rush I(2*fn)/I(fn)	017 098
Setting for the operate value of inrush stabilization.	
MAIN: I> lift rush restr.	017 095
Setting the current threshold for inactivation of inrush stabilization.	
MAIN: Suppress start. sig.	017 054 Fig. 3-45
Setting of the timer stage for the suppression of the phase-selective startings and of the residual and negative-sequence system starting.	
MAIN: tGS	017 005 Fig. 3-46
Setting for the time delay of the general starting signal.	

Definite-time overcurrent protection

DTOC: General enable USER	022 075 Fig. 3-83
Disabling or enabling the definite-time overcurrent protection function.	

Inverse-time overcurrent protection

IDMT: General enable USER	017 096 Fig. 3-94
Disabling or enabling the inverse-time overcurrent protection function.	

Short-circuit direction determination

SCDD: General enable USER	017 070 Fig. 3-106
Disabling and enabling short-circuit direction determination.	

Switch on to fault protection

SOTF: General enable USER	011 068	Fig. 3-116
Disabling or enabling switch on to fault protection.		
SOTF: Operating mode	011 061	Fig. 3-116
The operating mode setting determines whether during elapsing of the timer stage a general starting state will lead to a trip (*Trip with starting*) or whether the measuring range of impedance zone 1 will be extended by the DIST: kze HSR zone extension factor (*Trip with overreach).*		
SOTF: Manual close timer	011 060	Fig. 3-116
Setting for the timer stage that will be started by a manual close.		

Protective signaling

PSIG: General enable USER	015 004	Fig. 3-117
Disabling or enabling protective signaling.		

Auto-reclosing control

ARC: General enable USER	015 060	Fig. 3-123
Disabling or enabling auto-reclosing control.		
ARC: Sig.asg.trip t.GFDSS	015 105	Fig. 3-129
Selection of the GFDSS starting to trigger the auto-reclosing control function.		
ARC: Fct.assgn. tLOGIC	015 033	Fig. 3-133
Function assignment to tLOGIC.		

Ground fault direction determination using steady-state values

GFDSS: General enable USER	016 060	Fig. 3-139
Disabling or enabling ground fault direction determination by steady-state values.		
GFDSS: Operating mode	016 090	Fig. 3-139
This setting specifies whether steady-state power evaluation or steady-state current evaluation will be performed.		
GFDSS: Op. mode GF pow./adm	016 063	Fig. 3-141, 3-147
Setting for the operating mode of ground fault direction determination by steady-state power evaluation. The following settings are possible: □ *Cos φ circuit* for resonant-grounded systems □ *Sin φ circuit* for isolated-neutral systems.		
GFDSS: Measuring direction	016 070	Fig. 3-141,3-147
This setting defines the measuring direction for the 'forward' or 'backward' decision.		
GFDSS: VNG>	016 052	Fig. 3-141,3-147
Setting for the operate value of the neutral-displacement voltage.		
GFDSS: tVNG>	016 061	Fig. 3-141,3-147
Setting for the operate delay of the VNG> trigger.		
GFDSS: f/fnom (pow.meas.)	016 091	Fig. 3-141,3-147
Setting for the frequency of the measured variables evaluated in steady-state power evaluation.		

GFDSS: f/fnom (curr.meas.)	016 092	Fig. 3-145
Setting for the frequency of the measured variables evaluated in steady-state current evaluation.		
GFDSS: IN,act>/IN,reac> LS	016 064	Fig. 3-144
Setting for the threshold of the active or reactive power component of residual current that must be exceeded in order for the 'LS' (line side) direction decision to be enabled.		
GFDSS: Sector angle LS	016 065	Fig. 3-144
Setting of the sector angle for measurement in the line side direction. **Note:** This setting is only effective in the *cos φ circuit* operating mode.		
GFDSS: Operate delay LS	016 066	Fig. 3-144, 3-150
Setting for the operate delay of the direction decision in the forward direction.		
GFDSS: Release delay LS	016 072	Fig. 3-144,3-150
Setting for the release delay of the direction decision in the forward direction.		
GFDSS: IN,act>/IN,reac> BS	016 067	Fig. 3-144
Setting for the threshold of the active or reactive power component of residual current that must be exceeded in order for the 'BS' (busbar side) direction decision to be enabled.		
GFDSS: Sector angle BS	016 068	Fig. 3-144
Setting for the sector angle for measurement in the direction of the busbar side. **Note:** This setting is only effective in the *cos φ circuit* operating mode.		
GFDSS: Operate delay BS	016 069	Fig. 3-144,3-150
Setting for the operate delay of the direction decision in the backward direction.		
GFDSS: Release delay BS	016 073	Fig. 3-144,3-150
Setting for the release delay of the direction decision in the backward direction.		
GFDSS: IN>	016 093	Fig. 3-145
Setting for the operate value of the steady-state current evaluation.		
GFDSS: Operate delay IN	016 094	Fig. 3-145
Setting for the operate delay of steady-state current evaluation.		
GFDSS: Release delay IN	016 095	Fig. 3-145
Setting for the release delay of steady-state current evaluation.		

GFDSS: G(N)> / B(N)> LS — 016 111 — Fig. 3-150

Setting for the threshold of the conductance or susceptance component of the residual current loop that must be exceeded in order for the 'LS' (line side) direction decision to be enabled.

GFDSS: G(N)> / B(N)> BS — 016 112 — Fig. 3-150

Setting for the threshold of conductance or susceptance component of the residual current loop that must be exceeded in order for the 'BS' (busbar side) direction decision to be enabled.

GFDSS: Y(N)> — 016 113 — Fig. 3-151

Setting for the operate value of the admittance for the non-directional ground fault determination in the admittance evaluation mode.

GFDSS: Correction angle — 016 110 — Fig. 3-147

This setting is provided to compensate for phase-angle errors of the system transformers (in the admittance evaluation mode).

GFDSS: Operate delay Y(N)> — 016 114 — Fig. 3-151

Setting for the operate delay of the admittance for the non-directional ground fault determination in the admittance evaluation mode.

GFDSS: Release delay Y(N)> — 016 115 — Fig. 3-151

Setting for the release delay of the admittance for the non-directional ground fault determination in the admittance evaluation mode.

Motor protection

MP: General enable USER — 017 059 — Fig. 3-153

Enabling or disabling motor protection

Thermal overload protection

THERM: General enable USER — 022 050 — Fig. 3-163

Disabling or enabling thermal overload protection.

THERM: Operating mode — 022 063 — Fig. 3-165

Setting the operating mode of thermal overload protection.

Unbalance protection

I2>: General enable USER — 018 090 — Fig. 3-167

Enabling or disabling unbalance protection.

Time-voltage protection

V<>: General enable USER — 023 030 — Fig. 3-169

Disabling or enabling time-voltage protection.

Over-/ underfrequency protection

f<>: General enable USER — 023 031 — Fig. 3-178

Disabling or enabling over-/underfrequency protection.

f<>: Selection meas. volt — 018 202 — Fig. 3-179

Setting for the voltage that shall be used for frequency measurement.

f<>: Evaluation time — 018 201 — Fig. 3-180

Setting for the evaluation time. The operate conditions must be met for the duration of the set evaluation time in order for a signal to be issued.

f<>: Undervolt. block. V< — 018 200 — Fig. 3-180

Setting for the threshold of undervoltage blocking. If the voltage falls below this threshold, the over-/underfrequency protection function will be blocked.

Power directional protection

Parameter	Address	Fig.
P<>: General enable USER	014 220	Fig. 3-183
Disabling or enabling the power directional protection function.		

Circuit breaker failure protection

Parameter	Address	Fig.
CBF: General enable USER	022 080	Fig. 3-189
Disabling or enabling circuit breaker failure protection.		
CBF: tCBF	011 057	Fig. 3-189
Setting for the operate delay at the conclusion of which the 'Circuit breaker failure' signal is issued.		

Measuring-circuit monitoring

Parameter	Address	Fig.
MCMON: General enable USER	014 001	Fig. 3-191
Disabling or enabling measuring-circuit monitoring.		
MCMON: Op. mode Idiff>	017 026	Fig. 3-191
Adaptation of measuring-circuit monitoring to the system current transformers.		
MCMON: Idiff>	017 024	Fig. 3-191
Setting for the operate value of measuring-circuit monitoring.		
MCMON: Op. mode Vmin< monit	018 079	Fig. 3-192
Selection of the monitoring mode in the voltage-measuring circuit.		
MCMON: Vmin<	017 022	Fig. 3-192
Operate value setting for the voltage trigger Vmin< of measuring circuit monitoring.		
MCMON: Operate delay	017 023	Fig. 3-191
Setting of the time delay for current and voltage monitoring.		
MCMON: Phase sequ. monitor.	018 019	Fig. 3-192
Enabling or disabling phase sequence monitoring.		

Limit value monitoring

Parameter	Address	Fig.
LIMIT: General enable USER	014 010	Fig. 3-193
Disabling or enabling limit value monitoring.		
LIMIT: I>	014 004	Fig. 3-193
Setting for the operate value of the first overcurrent stage of limit value monitoring.		
LIMIT: I>>	014 020	Fig. 3-193
Setting for the operate value of the second overcurrent stage of limit value monitoring.		
LIMIT: tI>	014 031	Fig. 3-193
Setting for the operate delay of the first overcurrent stage of limit value monitoring.		
LIMIT: tI>>	014 032	Fig. 3-193
Setting for the operate delay of the second overcurrent stage of limit value monitoring.		

LIMIT: I< 014 021 Fig. 3-193

Setting for the operate value of the first undercurrent stage of limit value monitoring.

LIMIT: I<< 014 022 Fig. 3-193

Setting for the operate value of the second undercurrent stage of limit value monitoring.

LIMIT: tI< 014 033 Fig. 3-193

Setting for the operate delay of the first undercurrent stage of limit value monitoring.

LIMIT: tI<< 014 034 Fig. 3-193

Setting for the operate delay of the second undercurrent stage of limit value monitoring.

LIMIT: VPG> 014 023

Setting for the operate value of overvoltage stage VPG> of limit value monitoring.

LIMIT: VPG>> 014 024

Setting for the operate value of overvoltage stage VPG>> of limit value monitoring.

LIMIT: tVPG> 014 035

Setting for the operate delay of overvoltage stage VPG> of limit value monitoring.

LIMIT: tVPG>> 014 036

Setting for the operate delay of overvoltage stage VPG>> of limit value monitoring.

LIMIT: VPG< 014 025

Setting for the operate value of undervoltage stage VPG< of limit value monitoring.

LIMIT: VPG<< 014 026

Setting for the operate value of undervoltage stage VPG<< of limit value monitoring.

LIMIT: tVPG< 014 037

Setting for the operate delay of undervoltage stage VPG< of limit value monitoring.

LIMIT: tVPG<< 014 038

Setting for the operate delay of undervoltage stage VPG<< of limit value monitoring.

LIMIT: VPP> 014 027

Setting for the operate value of overvoltage stage VPP> of limit value monitoring.

LIMIT: VPP>> 014 028

Setting for the operate value of overvoltage stage VPP>> of limit value monitoring.

Parameter	Address	Reference
LIMIT: tVPP>	014 039	
Setting for the operate delay of overvoltage stage VPP> of limit value monitoring.		
LIMIT: tVPP>>	014 040	
Setting for the operate delay of overvoltage stage VPP>> of limit value monitoring.		
LIMIT: VPP<	014 029	
Setting for the operate value of undervoltage stage VPP< of limit value monitoring.		
LIMIT: VPP<<	014 030	
Setting for the operate value of undervoltage stage VPP<< of limit value monitoring.		
LIMIT: tVPP<	014 041	
Setting for the operate delay of undervoltage stage VPP< of limit value monitoring.		
LIMIT: tVPP<<	014 042	
Setting for the operate delay of undervoltage stage VPP<< of limit value monitoring.		
LIMIT: VNG>	014 043	Fig. 3-195
Setting for the operate value of overvoltage stage VNG> of limit value monitoring.		
LIMIT: VNG>>	014 044	Fig. 3-195
Setting for the operate value of overvoltage stage VNG>> of limit value monitoring.		
LIMIT: tVNG>	014 045	Fig. 3-195
Setting for the operate delay of overvoltage stage VNG> of limit value monitoring.		
LIMIT: tVNG>>	014 046	Fig. 3-195
Setting for the operate delay of overvoltage stage VNG>> of limit value monitoring.		

Logic

Parameter	Address	Reference
LOGIC: General enable USER	031 099	Fig. 3-197
Disabling or enabling the logic function.		
LOGIC: Set 1 USER	034 030	Fig. 3-196, 3-203
LOGIC: Set 2 USER	034 031	
LOGIC: Set 3 USER	034 032	
LOGIC: Set 4 USER	034 033	
LOGIC: Set 5 USER	034 034	
LOGIC: Set 6 USER	034 035	
LOGIC: Set 7 USER	034 036	
LOGIC: Set 8 USER	034 037	Fig. 3-203
These settings define the static input conditions for the logic function.		

LOGIC: Fct.assignm. outp. 1	030 000	Fig. 3-133,3-197
LOGIC: Fct.assignm. outp. 2	030 004	Fig. 3-133
LOGIC: Fct.assignm. outp. 3	030 008	
LOGIC: Fct.assignm. outp. 4	030 012	
LOGIC: Fct.assignm. outp. 5	030 016	
LOGIC: Fct.assignm. outp. 6	030 020	
LOGIC: Fct.assignm. outp. 7	030 024	
LOGIC: Fct.assignm. outp. 8	030 028	
LOGIC: Fct.assignm. outp. 9	030 032	
LOGIC: Fct.assignm. outp.10	030 036	
LOGIC: Fct.assignm. outp.11	030 040	
LOGIC: Fct.assignm. outp.12	030 044	
LOGIC: Fct.assignm. outp.13	030 048	
LOGIC: Fct.assignm. outp.14	030 052	
LOGIC: Fct.assignm. outp.15	030 056	
LOGIC: Fct.assignm. outp.16	030 060	
LOGIC: Fct.assignm. outp.17	030 064	
LOGIC: Fct.assignm. outp.18	030 068	
LOGIC: Fct.assignm. outp.19	030 072	
LOGIC: Fct.assignm. outp.20	030 076	
LOGIC: Fct.assignm. outp.21	030 080	
LOGIC: Fct.assignm. outp.22	030 084	
LOGIC: Fct.assignm. outp.23	030 088	
LOGIC: Fct.assignm. outp.24	030 092	
LOGIC: Fct.assignm. outp.25	030 096	
LOGIC: Fct.assignm. outp.26	031 000	
LOGIC: Fct.assignm. outp.27	031 004	
LOGIC: Fct.assignm. outp.28	031 008	
LOGIC: Fct.assignm. outp.29	031 012	
LOGIC: Fct.assignm. outp.30	031 016	
LOGIC: Fct.assignm. outp.31	031 020	
LOGIC: Fct.assignm. outp.32	031 024	

These settings assign functions to the outputs.

LOGIC: Op. mode t output 1	030 001	Fig. 3-133,3-197
LOGIC: Op. mode t output 2	030 005	Fig. 3-133
LOGIC: Op. mode t output 3	030 009	
LOGIC: Op. mode t output 4	030 013	
LOGIC: Op. mode t output 5	030 017	
LOGIC: Op. mode t output 6	030 021	
LOGIC: Op. mode t output 7	030 025	
LOGIC: Op. mode t output 8	030 029	
LOGIC: Op. mode t output 9	030 033	
LOGIC: Op. mode t output 10	030 037	
LOGIC: Op. mode t output 11	030 041	
LOGIC: Op. mode t output 12	030 045	
LOGIC: Op. mode t output 13	030 049	
LOGIC: Op. mode t output 14	030 053	
LOGIC: Op. mode t output 15	030 057	
LOGIC: Op. mode t output 16	030 061	
LOGIC: Op. mode t output 17	030 065	
LOGIC: Op. mode t output 18	030 069	
LOGIC: Op. mode t output 19	030 073	
LOGIC: Op. mode t output 20	030 077	
LOGIC: Op. mode t output 21	030 081	
LOGIC: Op. mode t output 22	030 085	
LOGIC: Op. mode t output 23	030 089	
LOGIC: Op. mode t output 24	030 093	
LOGIC: Op. mode t output 25	030 097	
LOGIC: Op. mode t output 26	031 001	
LOGIC: Op. mode t output 27	031 005	
LOGIC: Op. mode t output 28	031 009	
LOGIC: Op. mode t output 29	031 013	
LOGIC: Op. mode t output 30	031 017	
LOGIC: Op. mode t output 31	031 021	
LOGIC: Op. mode t output 32	031 025	

These settings define the operating modes for the output timer stages.

LOGIC: Time t1 output 1	030 002	Fig. 3-197
LOGIC: Time t1 output 2	030 006	
LOGIC: Time t1 output 3	030 010	
LOGIC: Time t1 output 4	030 014	
LOGIC: Time t1 output 5	030 018	
LOGIC: Time t1 output 6	030 022	
LOGIC: Time t1 output 7	030 026	
LOGIC: Time t1 output 8	030 030	
LOGIC: Time t1 output 9	030 034	
LOGIC: Time t1 output 10	030 038	
LOGIC: Time t1 output 11	030 042	
LOGIC: Time t1 output 12	030 046	
LOGIC: Time t1 output 13	030 050	
LOGIC: Time t1 output 14	030 054	
LOGIC: Time t1 output 15	030 058	
LOGIC: Time t1 output 16	030 062	
LOGIC: Time t1 output 17	030 066	
LOGIC: Time t1 output 18	030 070	
LOGIC: Time t1 output 19	030 074	
LOGIC: Time t1 output 20	030 078	
LOGIC: Time t1 output 21	030 082	
LOGIC: Time t1 output 22	030 086	
LOGIC: Time t1 output 23	030 090	
LOGIC: Time t1 output 24	030 094	
LOGIC: Time t1 output 25	030 098	
LOGIC: Time t1 output 26	031 002	
LOGIC: Time t1 output 27	031 006	
LOGIC: Time t1 output 28	031 010	
LOGIC: Time t1 output 29	031 014	
LOGIC: Time t1 output 30	031 018	
LOGIC: Time t1 output 31	031 022	
LOGIC: Time t1 output 32	031 026	

Settings for timer stage t1 of the respective outputs.

LOGIC: Time t2 output 1	030 003	Fig. 3-197
LOGIC: Time t2 output 2	030 007	
LOGIC: Time t2 output 3	030 011	
LOGIC: Time t2 output 4	030 015	
LOGIC: Time t2 output 5	030 019	
LOGIC: Time t2 output 6	030 023	
LOGIC: Time t2 output 7	030 027	
LOGIC: Time t2 output 8	030 031	
LOGIC: Time t2 output 9	030 035	
LOGIC: Time t2 output 10	030 039	
LOGIC: Time t2 output 11	030 043	
LOGIC: Time t2 output 12	030 047	
LOGIC: Time t2 output 13	030 051	
LOGIC: Time t2 output 14	030 055	
LOGIC: Time t2 output 15	030 059	
LOGIC: Time t2 output 16	030 063	
LOGIC: Time t2 output 17	030 067	
LOGIC: Time t2 output 18	030 071	
LOGIC: Time t2 output 19	030 075	
LOGIC: Time t2 output 20	030 079	
LOGIC: Time t2 output 21	030 083	
LOGIC: Time t2 output 22	030 087	
LOGIC: Time t2 output 23	030 091	
LOGIC: Time t2 output 24	030 095	
LOGIC: Time t2 output 25	030 099	
LOGIC: Time t2 output 26	031 003	
LOGIC: Time t2 output 27	031 007	
LOGIC: Time t2 output 28	031 011	
LOGIC: Time t2 output 29	031 015	
LOGIC: Time t2 output 30	031 019	
LOGIC: Time t2 output 31	031 023	
LOGIC: Time t2 output 32	031 027	

Settings for timer stage t2 of the respective outputs.

Note: This setting has no effect in the 'minimum time' operating mode.

LOGIC: Sig.assig. outp. 1	044 000	Fig. 3-203
LOGIC: Sig.assig. outp. 2	044 002	
LOGIC: Sig.assig. outp. 3	044 004	
LOGIC: Sig.assig. outp. 4	044 006	
LOGIC: Sig.assig. outp. 5	044 008	
LOGIC: Sig.assig. outp. 6	044 010	
LOGIC: Sig.assig. outp. 7	044 012	
LOGIC: Sig.assig. outp. 8	044 014	
LOGIC: Sig.assig. outp. 9	044 016	
LOGIC: Sig.assig. outp. 10	044 018	
LOGIC: Sig.assig. outp. 11	044 020	
LOGIC: Sig.assig. outp. 12	044 022	
LOGIC: Sig.assig. outp. 13	044 024	
LOGIC: Sig.assig. outp. 14	044 026	
LOGIC: Sig.assig. outp. 15	044 028	
LOGIC: Sig.assig. outp. 16	044 030	
LOGIC: Sig.assig. outp. 17	044 032	
LOGIC: Sig.assig. outp. 18	044 034	
LOGIC: Sig.assig. outp. 19	044 036	
LOGIC: Sig.assig. outp. 20	044 038	
LOGIC: Sig.assig. outp. 21	044 040	
LOGIC: Sig.assig. outp. 22	044 042	
LOGIC: Sig.assig. outp. 23	044 044	
LOGIC: Sig.assig. outp. 24	044 046	
LOGIC: Sig.assig. outp. 25	044 048	
LOGIC: Sig.assig. outp. 26	044 050	
LOGIC: Sig.assig. outp. 27	044 052	
LOGIC: Sig.assig. outp. 28	044 054	
LOGIC: Sig.assig. outp. 29	044 056	
LOGIC: Sig.assig. outp. 30	044 058	
LOGIC: Sig.assig. outp. 31	044 060	
LOGIC: Sig.assig. outp. 32	044 062	

These settings assign the function of a binary input signal to the output of the logic equation.

LOGIC: Sig.assig.outp. 1(t)	044 001	Fig. 3-203
LOGIC: Sig.assig.outp. 2(t)	044 003	
LOGIC: Sig.assig.outp. 3(t)	044 005	
LOGIC: Sig.assig.outp. 4(t)	044 007	
LOGIC: Sig.assig.outp. 5(t)	044 009	
LOGIC: Sig.assig.outp. 6(t)	044 011	
LOGIC: Sig.assig.outp. 7(t)	044 013	
LOGIC: Sig.assig.outp. 8(t)	044 015	
LOGIC: Sig.assig.outp. 9(t)	044 017	
LOGIC: Sig.assig.outp.10(t)	044 019	
LOGIC: Sig.assig.outp.11(t)	044 021	
LOGIC: Sig.assig.outp.12(t)	044 023	
LOGIC: Sig.assig.outp.13(t)	044 025	
LOGIC: Sig.assig.outp.14(t)	044 027	
LOGIC: Sig.assig.outp.15(t)	044 029	
LOGIC: Sig.assig.outp.16(t)	044 031	
LOGIC: Sig.assig.outp.17(t)	044 033	
LOGIC: Sig.assig.outp.18(t)	044 035	
LOGIC: Sig.assig.outp.19(t)	044 037	
LOGIC: Sig.assig.outp.20(t)	044 039	
LOGIC: Sig.assig.outp.21(t)	044 041	
LOGIC: Sig.assig.outp.22(t)	044 043	
LOGIC: Sig.assig.outp.23(t)	044 045	
LOGIC: Sig.assig.outp.24(t)	044 047	
LOGIC: Sig.assig.outp.25(t)	044 049	
LOGIC: Sig.assig.outp.26(t)	044 051	
LOGIC: Sig.assig.outp.27(t)	044 053	
LOGIC: Sig.assig.outp.28(t)	044 055	
LOGIC: Sig.assig.outp.29(t)	044 057	
LOGIC: Sig.assig.outp.30(t)	044 059	
LOGIC: Sig.assig.outp.31(t)	044 061	
LOGIC: Sig.assig.outp.32(t)	044 063	

These settings assign the function of a binary input signal to the output of the logic equation.

7.1.3.3 Parameter Subsets

Definite-time overcurrent protection

DTOC: Enable PSx — 072 098 073 098 074 098 075 098 — Fig. 3-83

This setting defines the parameter subset in which definite-time overcurrent protection is enabled.

DTOC: I> PSx — 017 000 073 007 074 007 075 007 — Fig. 3-84

Setting for the operate value of the first overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: I> dynamic PSx — 017 080 073 032 074 032 075 032 — Fig. 3-84

Setting for the operate value of the first overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: I>> PSx — 017 001 073 008 074 008 075 008 — Fig. 3-84

Setting for the operate value of the second overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: I>> dynamic PSx — 017 084 073 033 074 033 075 033 — Fig. 3-84

Setting for the operate value of the second overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: I>>> PSx — 017 002 073 009 074 009 075 009 — Fig. 3-84

Setting for the operate value of the third overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: I>>> dynamic PSx — 017 085 073 034 074 034 075 034 — Fig. 3-84

Setting for the operate value of the third overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: tI> PSx — 017 004 073 019 074 019 075 019 — Fig. 3-84

Setting for the operate delay of the first overcurrent stage.

DTOC: tI>> PSx — 017 006 073 020 074 020 075 020 — Fig. 3-84

Setting for the operate delay of the second overcurrent stage.

DTOC: tI>>> PSx 017 007 073 021 074 021 075 021 Fig. 3-84

Setting for the operate delay of the third overcurrent stage.

DTOC: Ineg> PSx 072 011 073 011 074 011 075 011

Setting for operate value Ineg> (Ineg = negative-sequence current).

DTOC: Ineg> dynamic PSx 076 200 077 200 078 200 079 200

Setting for operate value Ineg> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: Ineg>> PSx 072 012 073 012 074 012 075 012

Setting for operate value Ineg>> (Ineg = negative-sequence current).

DTOC: Ineg>> dynamic PSx 076 201 077 201 078 201 079 201

Setting for operate value Ineg>> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: Ineg>>> PSx 072 013 073 013 074 013 075 013

Setting for operate value Ineg>>> (Ineg = negative-sequence current).

DTOC: Ineg>>> dynamic PSx 076 202 077 202 078 202 079 202

Setting for operate value Ineg>>> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: tIneg> PSx 072 023 073 023 074 023 075 023

Setting for the operate delay of overcurrent stage Ineg> (Ineg = negative-sequence current).

DTOC: tIneg>> PSx 072 024 073 024 074 024 075 024

Setting for the operate delay of overcurrent stage Ineg>>
(Ineg = negative-sequence current).

DTOC: tIneg>>> PSx 072 025 073 025 074 025 075 025

Setting for the operate delay of overcurrent stage Ineg>>>
(Ineg = negative-sequence current).

DTOC: Evaluation IN PSx 072 128 073 128 074 128 075 128 Fig. 3-88

This setting determines which current will be monitored: the current calculated by the P130C P130CP130Cor the residual current measured at the T 4 current transformer.

DTOC: IN> PSx 017 003 073 015 074 015 075 015 Fig. 3-89

Setting for the operate value of the first overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: IN> dynamic PSx 017 081 073 035 074 035 075 035 Fig. 3-89

Setting for the operate value of the dynamic first overcurrent stage (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: IN>> PSx 017 009 073 016 074 016 075 016 Fig. 3-89

Setting for the operate value of the second overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: IN>> dynamic PSx 017 086 073 036 074 036 075 036 Fig. 3-89

Setting for the operate value of the second overcurrent stage in dynamic mode (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: IN>>> PSx 017 018 073 017 074 017 075 017 Fig. 3-89

Setting for the operate value of the third overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: IN>>> dynamic PSx 017 087 073 037 074 037 075 037 Fig. 3-89

Setting for the operate value of the dynamic third overcurrent stage (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see 'Technical Data').

DTOC: tIN> PSx 017 008 073 027 074 027 075 027 Fig. 3-89

Setting for the operate delay of the first overcurrent stage (residual current stage).

DTOC: tIN>> PSx 017 010 073 028 074 028 075 028 Fig. 3-89

Setting for the operate delay of the second overcurrent stage (residual current stage).

DTOC: tIN>>> PSx 017 019 073 029 074 029 075 029 Fig. 3-89

Setting for the operate delay of the third overcurrent stage (residual current stage).

DTOC: Puls.prol.IN>,intPSx 017 055 073 042 074 042 075 042 Fig. 3-89

Setting for the pulse prolongation time of the hold-time logic for intermittent ground faults.

DTOC: tIN,interm. PSx 017 056 073 038 074 038 075 038 Fig. 3-89

Setting for the tripping time of the hold-time logic for intermittent ground faults.

DTOC: Hold-t. tIN>,intmPSx 017 057 073 039 074 039 075 039 Fig. 3-89

Setting for the hold-time for intermittent ground faults.

Inverse-time overcurrent protection

IDMT: Enable PSx	072 070 073 070 074 070 075 070	Fig. 3-94
This setting defines the parameter subset in which IDMT protection is enabled.		
IDMT: Iref,P PSx	072 050 073 050 074 050 075 050	Fig. 3-99
Setting for the reference current (phase current system).		
IDMT: Iref,P dynamic PSx	072 003 073 003 074 003 075 003	Fig. 3-99
Setting for the reference current in dynamic mode (phase current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.		
IDMT: Characteristic P PSx	072 056 073 056 074 056 075 056	Fig. 3-99
Setting for the tripping characteristic (phase current system).		
IDMT: Factor kt,P PSx	072 053 073 053 074 053 075 053	Fig. 3-99
Setting for factor kt,P of the starting characteristic (phase current system).		
IDMT: Min. trip time P PSx	072 077 073 077 074 077 075 077	Fig. 3-99
Setting for the minimum trip time (phase current system). As a rule, this value should be set as for the first DTOC stage (I>).		
IDMT: Hold time P PSx	072 071 073 071 074 071 075 071	Fig. 3-99
Setting for the holding time for intermittent short circuits (phase current system).		
IDMT: Release P PSx	072 059 073 059 074 059 075 059	Fig. 3-99
Setting for the release or reset characteristic (phase current system).		
IDMT: Iref,neg PSx	072 051 073 051 074 051 075 051	Fig. 3-99
Setting for the reference current (negative-sequence current system).		
IDMT: Iref,neg dynamic PSx	072 004 073 004 074 004 075 004	
Setting for the reference current in dynamic mode (negative-sequence current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.		
IDMT: Character. neg. PSx	072 057 073 057 074 057 075 057	
Setting for the tripping characteristic (negative-sequence current system).		
IDMT: Factor kt,neg PSx	072 054 073 054 074 054 075 054	
Setting for factor kt,neg of the starting characteristic (negative-sequence current system).		
IDMT: Min.trip time negPSx	072 078 073 078 074 078 075 078	
Setting for the minimum trip time (negative-sequence current system). As a rule, this value should be set as for the first DTOC stage (I>).		
IDMT: Hold time neg PSx	072 072 073 072 074 072 075 072	
Setting for the holding time for intermittent short circuits (negative-sequence current system).		
IDMT: Release neg. PSx	072 060 073 060 074 060 075 060	
Setting for the release or reset characteristic (negative-sequence current system).		
IDMT: Evaluation IN PSx	072 075 073 075 074 075 075 075	Fig. 3-102
This setting determines which current will be monitored: the current calculated by the P130C P130CP130Cor the residual current measured at the T 4 current transformer.		

IDMT: Iref,N PSx 072 052 073 052 074 052 075 052 — Fig. 3-103

Setting for the reference current (residual current system).

IDMT: Iref,N dynamic PSx 072 005 073 005 074 005 075 005 — Fig. 3-103

Setting for the reference current in dynamic mode (residual current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

IDMT: Characteristic N PSx 072 058 073 058 074 058 075 058 — Fig. 3-103

Setting for the tripping characteristic (residual current system).

IDMT: Factor kt,N PSx 072 055 073 055 074 055 075 055 — Fig. 3-103

Setting for factor kt,N of the starting characteristic (residual current system).

IDMT: Min. trip time N PSx 072 079 073 079 074 079 075 079 — Fig. 3-103

Setting for the minimum trip time (residual current system). As a rule, this value should be set as for the first DTOC stage (IN>).

IDMT: Hold time N PSx 072 073 073 073 074 073 075 073 — Fig. 3-103

Setting for the holding time for intermittent short circuits (residual current system).

IDMT: Release N PSx 072 061 073 061 074 061 075 061 — Fig. 3-103

Setting for the release characteristic (residual current system).

Short-circuit direction determination

SCDD: Enable PSx 076 235 077 235 078 235 079 235 — Fig. 3-106

This setting defines the parameter subset in which the short-circuit direction determination function is enabled.

SCDD: Trip bias PSx 017 074 077 236 078 236 079 236 — Fig. 3-110

This setting determines whether an overcurrent direction determination in forward direction shall be formed when the direction determination of the phase current and residual current stage is blocked.

SCDD: Direction tI> PSx 017 071 077 237 078 237 079 237 — Fig. 3-110

This setting for the measuring direction determines whether a tI> trip signal in the DTOC phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direction tI>> PSx 017 072 077 238 078 238 079 238 — Fig. 3-110

This setting for the measuring direction determines whether a tI>> trip signal in the DTOC phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direct. tIref,P> PSx 017 066 077 239 078 239 079 239 — Fig. 3-110

This setting for the measuring direction determines whether a tIref,P> trip signal in the IDMT phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direction tIN> PSx	017 073 077 240 078 240 079 240	Fig. 3-114
This setting for the measuring direction determines whether a tIN> trip signal in the DTOC residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.		
SCDD: Direction tIN>> PSx	017 075 077 241 078 241 079 241	Fig. 3-114
This setting for the measuring direction determines whether a tIN>> trip signal in the DTOC residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.		
SCDD: Direct. tIref,N> PSx	017 067 077 242 078 242 079 242	Fig. 3-114
This setting for the measuring direction determines whether a tIref,N> trip signal in the IDMT residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.		
SCDD: Charact. angle G PSx	017 076 077 243 078 243 079 243	Fig. 3-113
Setting for the characteristic angle for the residual current stage in correspondence to the measuring relation. Using this setting, a wide range of conditions in dependence of the system neutral grounding impedance can be accommodated, including the following: ☐ System neutral with relatively high resistance $\alpha_G = 0°$ ☐ System neutral with relatively low resistance α_G - 45° ☐ System neutral effectively grounded α_G= - 75° ☐ System neutral reactance-grounded α_G= - 90° ☐ System with isolated neutral α_G= + 90°		
SCDD: VNG> PSx	017 077 077 244 078 244 079 244	Fig. 3-112
Setting for operate value VNG>. This setting value is an enabling criterion of the base point release of short-circuit direction determination. In choosing this setting, the set nominal voltage MAIN: VNG,nom V.T. sec. should be taken into account.		
SCDD: Block. bias G PSx	017 078 077 245 078 245 079 245	Fig. 3-114
This setting defines whether the trip bias of the residual current stage should be blocked in the event of a phase current starting.		

Protective signaling

PSIG: Enable PSx 015 014 015 015 015 016 015 017 Fig. 3-117

This setting defines the parameter subset in which protective signaling is enabled.

PSIG: Tripping time PSx 015 011 024 003 024 063 025 023 Fig. 3-119

The tripping time replaces timer stage t1,ze of distance protection when protective signaling is ready.

PSIG: Release t. send PSx 015 002 024 001 024 061 025 021 Fig. 3-119

This setting determines the duration of the send signal.

PSIG: DC loop op. mode PSx 015 012 024 051 025 011 025 071 Fig. 3-119

This setting defines whether the transmitting relay will be operated in energize-on-signal mode ('open-circuit principle') or normally-energized mode ('closed-circuit principle'), i.e., *Transm. relay make contact* or *Transm. relay break contact*, respectively.

PSIG: Direc.dependence PSx 015 001 015 115 015 116 015 117 Fig. 3-119

This setting governs the evaluation for the directional dependence of protective signaling. The following settings are possible:

Without
Phase curr. system
Residual curr. system
Phase/resid.c.system

Auto-reclosing control

Parameter	Addresses	Figure	Description
ARC: Enable PSx	015 046 015 047 015 048 015 049	Fig. 3-123	This setting defines the parameter subset in which ARC is enabled.
ARC: CB clos.pos.sig. PSx	015 050 024 024 024 084 025 044	Fig. 3-125	This setting defines whether the CB closed position will be scanned or not. If the setting is *With*, a binary signal input must be configured accordingly.
ARC: Operating mode PSx	015 051 024 025 024 085 025 045	Fig. 3-122	The operating mode setting defines which of the following reclosure types is permitted. ☐ TDR only ☐ HSR or TDR ☐ Test HSR only
ARC: Operative time PSx	015 066 024 035 024 095 025 055	Fig. 3-134	Setting for operative time 1.
ARC: HSR trip.time GS PSx	015 038 024 100 024 150 025 100	Fig. 3-130	Setting for the HSR tripping time and start via a general starting condition.
ARC: HSR trip.time I> PSx	015 072 024 040 025 000 025 060	Fig. 3-126	The HSR tripping time replaces timer stage t1,ze of distance protection or the operate delay of backup overcurrent-time protection – provided that the BUOC operating mode is set accordingly – if a HSR is permitted and protective signaling is not ready.
ARC: HSR trip.time I>>PSx	015 074 024 101 024 151 025 101	Fig. 3-126	Setting for the HSR tripping time and start via a phase current starting in the second DTOC overcurrent stage.
ARC: HSRtrip.time I>>>PSx	014 096 024 102 024 152 025 102	Fig. 3-126	Setting for the HSR tripping time and start via a phase current starting in the third DTOC overcurrent stage.
ARC: HSR trip.time IN>PSx	015 076 024 103 024 153 025 103	Fig. 3-126	Setting for the HSR tripping time and start via a residual current starting in the first DTOC overcurrent stage.
ARC: HSRtrip.time IN>>PSx	015 031 024 104 024 154 025 104	Fig. 3-126	Setting for the HSR tripping time and start via a residual current starting in the second DTOC overcurrent stage.
ARC: HSRtrip.t. IN>>> PSx	014 098 024 105 024 155 025 105	Fig. 3-126	Setting for the HSR tripping time and start via a residual current starting in the third DTOC overcurrent stage.
ARC: HSRtrip.t. kIref>PSx	015 094 024 106 024 156 025 106	Fig. 3-128	Setting for the HSR tripping time and start via a starting in the IDMT phase current system.
ARC: HSRtrip.t.kINref>PSx	015 096 024 107 024 157 025 107	Fig. 3-128	Setting for the HSR tripping time and start via a starting in the IDMT residual current system.
ARC: HSRtrip.t. Ineg> PSx	015 034 024 108 024 158 025 108	Fig. 3-128	Setting for the HSR tripping time and start via a starting in the IDMT negative-sequence current system.

ARC: HSR trip t.GFDSS PSx	015 078 024 109 024 159 025 109	Fig. 3-129
Setting for the HSR tripping time and start via 'ground fault direction determination using steady-state values'.		
ARC: HSRtrip.t. LOGIC PSx	015 098 024 110 024 160 025 110	Fig. 3-131
Setting for the HSR tripping time and start via programmable logic.		
ARC: HSR block.f. I>>>PSx	015 080 024 111 024 161 025 111	Fig. 3-132
The selection of the HSR blocking by I>>> defines whether an HSR is blocked during an I>>> starting.		
ARC: HSR dead time PSx	015 056 024 030 024 090 025 050	Fig. 3-134
Dead time setting for a three-pole HSR.		
ARC: No. permit. TDR PSx	015 068 024 037 024 097 025 057	Fig. 3-134
Setting for the number of time-delay reclosures permitted. With the '*0*' setting, only one HSR is carried out.		
ARC: TDR trip.time GS PSx	015 039 024 112 024 162 025 112	Fig. 3-130
Setting for the TDR tripping time and start via a general starting condition.		
ARC: TDR trip.time I> PSx	015 073 024 041 025 001 025 061	Fig. 3-127
The TDR tripping time replaces timer stage t1,ze of distance protection or the operate delay of backup overcurrent-time protection – provided that the BUOC operating mode is set accordingly – if a TDR is permitted and protective signaling is not ready.		
ARC: TDR trip.time I>>PSx	015 075 024 113 024 163 025 113	Fig. 3-127
Setting for the TDR tripping time and start via a phase current starting in the second DTOC overcurrent stage.		
ARC: TDRtrip.time I>>>PSx	014 097 024 114 024 164 025 114	Fig. 3-127
Setting for the TDR tripping time and start via a phase current starting in the third DTOC overcurrent stage.		
ARC: TDR trip.time IN>PSx	015 077 024 115 024 165 025 115	Fig. 3-127
Setting for the TDR tripping time and start via a residual current starting in the first DTOC overcurrent stage.		
ARC: TDRtrip.time IN>>PSx	015 032 024 116 024 166 025 116	Fig. 3-127
Setting for the TDR tripping time and start via a residual current starting in the second DTOC overcurrent stage.		
ARC: TDRtrip.t. IN>>> PSx	014 099 024 117 024 167 025 117	Fig. 3-127
Setting for the TDR tripping time and start via a residual current starting in the third DTOC overcurrent stage.		
ARC: TDRtrip.t. kIref>PSx	015 095 024 118 024 168 025 118	Fig. 3-128
Setting for the TDR tripping time and start via a starting in the IDMT phase current system.		
ARC: TDRtrip.t.kINref>PSx	015 097 024 119 024 169 025 119	Fig. 3-128
Setting for the TDR tripping time and start via a starting in the IDMT residual current system.		
ARC: TDRtrip.t. Ineg> PSx	015 035 024 120 024 170 025 120	Fig. 3-128
Setting for the TDR tripping time and start via a starting in the IDMT negative-sequence current system.		

ARC: TDR trip t.GFDSS PSx 015 079 024 121 024 171 025 121 Fig. 3-129

Setting for the TDR tripping time and start via 'ground fault direction determination using steady-state values'.

ARC: TDRtrip.t. LOGIC PSx 015 099 024 122 024 172 025 122 Fig. 3-131

Setting for the TDR tripping time and start via programmable logic.

ARC: TDR dead time PSx 015 057 024 031 024 091 025 051 Fig. 3-134

Setting for the TDR dead time.

ARC: TDR block.f. I>>>PSx 015 081 024 124 024 174 025 124 Fig. 3-132

The selection of the TDR blocking by I>>> defines whether an TDR is blocked during an I>>> starting.

ARC: Reclaim time PSx 015 054 024 028 024 088 025 048 Fig. 3-134

Setting for the reclaim time.

ARC: Blocking time PSx 015 058 024 032 024 092 025 052 Fig. 3-124

Setting for the time that will elapse before the ARC will be ready again after blocking by a binary signal input.

Motor protection

MP: Enable PSx 024 148 024 147 024 197 025 147 Fig. 3-153

This setting defines the parameter subset in which motor protection is enabled.

MP: Iref PSx 017 012 024 131 024 181 025 131 Fig. 3-154

For the determination of the reference current, the nominal motor current needs to be calculated first from the motor data.

$$I_{nom,motor} = \frac{P_{nom}}{\sqrt{3} \cdot V_{nom} \cdot \eta \cdot \cos\varphi}$$

The reference current is the nominal motor current as projected onto the transformer secondary side and is thus calculated as follows:

$$\frac{I_{ref}}{I_{nom,(relay)}} = \frac{I_{nom,motor} / T_{nom}}{I_{nom,(relay)}}$$

Example:

Motor and System Data

Nominal motor voltage V_{nom}:	10 kV
Nominal motor power P_{nom}:	1500 kW
Efficiency η:	96.6 %
Active power factor $\cos\varphi$:	0.86
Nominal transformation ratio T_{nom} of the main current transformer:	1 A

Determination of the Nominal Motor Current

$$I_{nom,motor} = \frac{1500\ \text{kW}}{\sqrt{3} \cdot 10\ \text{kV} \cdot 0.966 \cdot 0.86} = 104\ \text{A}$$

Determination of the reference current

$$\frac{I_{ref}}{I_{nom,(relay)}} = \frac{104\ \text{A}/100}{1\ \text{A}} = 1.04$$

MP: Factor kP PSx	017 040 024 132 024 182 025 132	Fig. 3-154

The starting factor k should be set according to the maximum permissible thermal continuous current:

$$k = \frac{I_{therm,motor}}{I_{nom,motor}}$$

Example:

Motor Data:

Maximum permissible continuous thermal motor current

$I_{therm,motor}$:   1.1 $I_{nom,motor}$

Determination of the Starting Factor

$$k = \frac{1.1\ I_{nom,motor}}{I_{nom,motor}} = 1.1$$

MP: IStUp> PSx	017 053 024 133 024 183 025 133	Fig. 3-159

Setting for the current threshold for the operational status determination 'machine starting up'.

MP: tIStUp> PSx	017 042 024 134 024 184 025 134	Fig. 3-159

Setting for the operate delay for the operational status determination 'machine starting up'. Usually, the default setting can be retained.

MP: Character.type P PSx	017 029 024 135 024 185 025 135	Fig. 3-159

The selection of the tripping characteristic defines the restrictiveness of the motor protection function. For low overcurrents, the logarithmic characteristic provides significantly higher tripping times than the reciprocally squared characteristic since the latter neglects any heat transfer to the cooling medium in the overload range.

MP: t6Iref PSx 017 041 024 136 024 186 025 136 Fig. 3-159

This setting for the overload tripping time t_{6Iref} is determined from the cold machine data, using $I_{ref} = I_{nom,motor}$.

For the reciprocally squared characteristic we set:

$$t_{6Iref} = t_{block,cold} \cdot \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{36}$$

For the logarithmic characteristic we set:

$$t_{6I_{ref}} = t_{block,cold} \cdot \frac{1}{36 \cdot \ln \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2 - 1}}$$

Based on the setting value thus determined, the tripping time for a warm machine is now defined as follows.

For the reciprocally squared characteristic we have:

$$t = (1 - 0.2) \cdot t_{6I_{ref}} \cdot \frac{36}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}$$

For the logarithmic characteristic we have:

$$t = (1 - 0.) \cdot t_{6I_{ref}} \cdot 36 \cdot \ln \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2 - 1}$$

Example:

Motor Data

Motor startup current $I_{startup}$: 5.7 $I_{nom,motor}$

Max. permissible locked-rotor time with cold machine $t_{block,cold}$: 18 s

Max. permissible locked-rotor time with warm machine $t_{block,warm}$: 16 s

Determination of the Setting Value for the Reciprocally Squared Characteristic

$$t_{6I_{ref}} = 18\ s \cdot \frac{5.7^2}{36} = 16.2\ s$$

Control of Tripping Time with Warm Machine

$$t = 0.8 \cdot 16.2\ s \cdot \frac{36}{5.7^2}$$
$$= 14.4\ s \le 16\ s \quad \text{(o.k.)}$$

MP: Tau after st.-up PSx — 018 042 024 137 024 187 025 137 — Fig. 3-159

Setting for the heat dispersion time constant after startup. Usually, the default setting can be retained.

MP: Tau mach.running PSx — 017 088 024 138 024 188 025 138 — Fig. 3-159
MP: Tau mach.stopped PSx — 017 089 024 139 024 189 025 139 — Fig. 3-159

Setting for the cooling time constant with a running or stopped machine, respectively.

If the thermal time constants of the motor are unknown, the cooling time constant with machine running is best set to the highest setting value and the cooling time with machine stopped to the five-fold value of that with machine running.

MP: Perm. No.st.-ups PSx — 017 047 024 140 024 190 025 140 — Fig. 3-159

Setting for the startup sequence of the motor as permitted by thermal considerations.

Note:
The heavy starting logic (addresses 017 043 and 017 044) can only be activated if the permissible startup sequence is set to two startups from cold and one startup from warm.

MP: RC permitted, Θ< PSx — 018 043 024 141 024 191 025 141 — Fig. 3-159

Setting for the threshold value of the overload memory for reclosure permission. Usually, the default setting can be retained.

MP: Operating mode PSx — 018 041 024 142 024 192 025 142 — Fig. 3-154

This setting defines whether motor protection will be operated together with thermal overload protection (THERM).

MP: St.-up time tStUpPSx	017 043 024 143 024 193 025 143	Fig. 3-159
MP: Blocking time tE PSx	017 044 024 144 024 194 025 144	Fig. 3-159

Using an overspeed monitor, the heavy starting logic can be activated if necessary. For this purpose, the load-torque-dependent operational startup time needs to be set for tStUp and the maximum permissible locked-rotor time (the 'tE time') with a machine at operating temperature needs to be set for tE.

If the heavy starting logic is not used then the set startup time tStUp and the tE-time should be set to the same value; the default values can be retained.

Note:
The heavy starting logic (address 017 047) can only be activated if the permissible startup sequence is set to two startups from cold and one startup from warm.

MP: I< PSx	017 048 024 145 024 195 025 145	Fig. 3-162

Setting for the operate value of the minimum current stage of the underload protection function of motor protection.

MP: tI< PSx	017 050 024 146 024 196 025 146	Fig. 3-162

Setting for the operate delay of the minimum current stage of the underload protection function of motor protection.

Thermal overload protection

Parameter	Addresses	Figure
THERM: Enable PSx	072 175 073 175 074 175 075 175	Fig. 3-163
This setting defines the parameter subset in which thermal overload protection is enabled.		
THERM: Iref PSx	072 179 073 179 074 179 075 179	Fig. 3-165
Setting for the reference current.		
THERM: Start.fact.OL_RC PSx	072 180 073 180 074 180 075 180	Fig. 3-165
Setting for the starting characteristic factor kP.		
THERM: Tim.const.1,>Ibl PSx	072 187 073 187 074 187 075 187	Fig. 3-165
Setting for the thermal time constants of the protected object with current flow (Ibl: base line current).		
THERM: Tim.const.2,<Ibl PSx	072 188 073 188 074 188 075 188	Fig. 3-165
Setting for the thermal time constants of the protected object without current flow (Ibl: base line current). **Note:** This setting option is only relevant when machines are running. In all other cases, time constant 2 must be set equal to time constant 1.		
THERM: Max.perm.obj.tmp.PSx	072 182 073 182 074 182 075 182	Fig. 3-165
Setting for the maximum permissible temperature of the protected object.		
THERM: Max.perm.cool.tmpPSx	072 185 073 185 074 185 075 185	Fig. 3-165
Setting for the maximum permissible coolant temperature.		
THERM: Default CTA PSx	072 186 073 186 074 186 075 186	Fig. 3-165
Setting for the coolant temperature to be used for calculation of the trip time if coolant temperature is not measured.		
THERM: Rel. O/T warning PSx	072 184 073 184 074 184 075 184	Fig. 3-165
Setting for the operate value of the warning stage.		
THERM: Rel. O/T trip PSx	072 181 073 181 074 181 075 181	Fig. 3-165
Setting for the operate value of the trip stage. **Note:** If the operating mode has been set to *Absolute replica*, the setting here will be automatically set to 100% and this parameter will be hidden as far as the local control panel is concerned.		
THERM: Hysteresis trip PSx	072 183 073 183 074 183 075 183	Fig. 3-165
Setting for the hysteresis of the trip stage.		
THERM: Warning pre-trip PSx	072 191 073 191 074 191 075 191	Fig. 3-165
A warning will be given in advance of the trip. The time difference between the warning time and the trip time is set here.		

Unbalance protection

I2>: Enable	PSx	018 220 018 221 018 222 018 223	Fig. 3-167
This setting defines the parameter subset in which unbalance protection is enabled.			
I2>: Ineg>	PSx	018 091 018 224 018 225 018 226	Fig. 3-168
Setting for the operate value of the first overcurrent stage.			
I2>: Ineg>>	PSx	018 092 018 227 018 228 018 229	Fig. 3-168
Setting for the operate value of the second overcurrent stage.			
I2>: tIneg>	PSx	018 093 018 230 018 231 018 232	Fig. 3-168
Setting for the operate delay of the first overcurrent stage.			
I2>: tIneg>>	PSx	018 094 018 233 018 234 018 235	Fig. 3-168
Setting for the operate delay of the second overcurrent stage.			

Time-Voltage Protection

V<>: Enable PSx 076 246 077 246 078 246 079 246 — Fig. 3-169

This setting defines the parameter subset in which time-voltage protection is enabled.

V<>: Operating mode PSx 076 001 077 001 078 001 079 001 — Fig. 3-170

This setting specifies whether the phase-to-ground voltages (*Star* operating mode) or the phase-to-phase voltages (*Delta* operating mode) will be monitored.

Note:
In the settings for the operate values of the time-voltage protection function, the reference quantity is V_{nom} in the *Star* operating mode but $V_{nom}/\sqrt{3}$ in the *Delta* operating mode.

To work out the settings for the over/undervoltage stages, consider the following example for V_{nom} = 100 V:

Setting in the *Delta* operating mode for an operate value of 80 V (phase-to-phase):

$$\text{Setting} = \frac{\text{OperateValue}}{V_{nom}} = \frac{80\text{V}}{100\text{V}} = 0.80$$

Setting in the *Star* operating mode for an operate value of 46.2 V (phase-to-ground):

$$\text{Setting} = \frac{\text{OperateValue}}{V_{nom}/\sqrt{3}} = \frac{46.2\text{V}}{100\text{V}/\sqrt{3}} = \frac{46.2\text{V}\cdot\sqrt{3}}{100\text{V}} = 0.80$$

V<>: V> PSx 076 003 077 003 078 003 079 003 — Fig. 3-171

Setting for operate value V>.

V<>: V>> PSx 076 004 077 004 078 004 079 004 — Fig. 3-171

Setting for operate value V>>.

V<>: tV> PSx 076 005 077 005 078 005 079 005 — Fig. 3-171

Setting for the operate delay of overvoltage stage V>.

V<>: tV> 3-pole PSx 076 027 077 027 078 027 079 027 — Fig. 3-171

Setting for the operate delay of overvoltage stage V> when all three trigger stages are activated.

V<>: tV>> PSx 076 006 077 006 078 006 079 006 — Fig. 3-171

Setting for the operate delay of overvoltage stage V>>.

V<>: V< PSx 076 007 077 007 078 007 079 007 — Fig. 3-172

Setting for operate value V<.

V<>: V<< PSx 076 008 077 008 078 008 079 008 — Fig. 3-172

Setting for operate value V<<.

V<>: tV< PSx 076 009 077 009 078 009 079 009 — Fig. 3-172

Setting for the operate delay of undervoltage stage V<.

V<>: tV< 3-pole PSx 076 028 077 028 078 028 079 028 — Fig. 3-172

Setting for the operate delay of undervoltage stage V< when all three trigger stages are activated.

V<>: tV<< PSx 076 010 077 010 078 010 079 010 — Fig. 3-172

Setting for the operate delay of undervoltage stage V<<.

V<>: Vpos> PSx	076 015 077 015 078 015 079 015	Fig. 3-174
Setting for operate value Vpos>.		
V<>: Vpos>> PSx	076 016 077 016 078 016 079 016	Fig. 3-174
Setting for operate value Vpos>>.		
V<>: tVpos> PSx	076 017 077 017 078 017 079 017	Fig. 3-174
Setting for the operate delay of overvoltage stage Vpos>.		
V<>: tVpos>> PSx	076 018 077 018 078 018 079 018	Fig. 3-174
Setting for the operate delay of overvoltage stage Vpos>>.		
V<>: Vpos< PSx	076 019 077 019 078 019 079 019	Fig. 3-174
Setting for operate value Vpos<.		
V<>: Vpos<< PSx	076 020 077 020 078 020 079 020	Fig. 3-174
Setting for operate value Vpos<<.		
V<>: tVpos< PSx	076 021 077 021 078 021 079 021	Fig. 3-174
Setting for the operate delay of undervoltage stage Vpos<.		
V<>: tVpos<< PSx	076 022 077 022 078 022 079 022	Fig. 3-174
Setting for the operate delay of undervoltage stage Vpos<<.		
V<>: Vneg> PSx	076 023 077 023 078 023 079 023	Fig. 3-175
Setting for operate value Vneg>.		
V<>: Vneg>> PSx	076 024 077 024 078 024 079 024	Fig. 3-175
Setting for operate value Vneg>>.		
V<>: tVneg> PSx	076 025 077 025 078 025 079 025	Fig. 3-175
Setting for the operate delay of overvoltage stage Vneg>.		
V<>: tVneg>> PSx	076 026 077 026 078 026 079 026	Fig. 3-175
Setting for the operate delay of overvoltage stage Vneg>>.		
V<>: VNG> PSx	076 011 077 011 078 011 079 011	Fig. 3-177
Setting for operate value VNG>.		
V<>: VNG>> PSx	076 012 077 012 078 012 079 012	Fig. 3-177
Setting for operate value VNG>>.		
V<>: tVNG> PSx	076 013 077 013 078 013 079 013	Fig. 3-177
Setting for the operate delay of overvoltage stage VNG>.		
V<>: tVNG>> PSx	076 014 077 014 078 014 079 014	Fig. 3-177
Setting for the operate delay of overvoltage stage VNG>>.		
V<>: tTransient PSx	076 029 077 029 078 029 079 029	Fig. 3-172
Setting for the time limit of the signals generated by the undervoltage stages.		
V<>: Hyst. V<> meas. PSx	076 048 077 048 078 048 079 048	Fig. 3-171
Setting for the hysteresis of the trigger stages for monitoring measured voltages.		
V<>: Hyst. V<> deduc. PSx	076 049 077 049 078 049 079 049	Fig. 3-174
Setting for the hysteresis of the trigger stages for monitoring deduced voltages such as Vneg and VNG.		

Over-/ underfrequency protection

Parameter	Subset	Addresses	Figure
f<>: Enable	PSx	018 196 018 197 018 198 018 199	Fig. 3-178

This setting defines the parameter subset in which over-/underfrequency protection is enabled.

Parameter	Subset	Addresses	Figure
f<>: Oper. mode f1	PSx	018 120 018 121 018 122 018 123	Fig. 3-182
f<>: Oper. mode f2	PSx	018 144 018 145 018 146 018 147	
f<>: Oper. mode f3	PSx	018 168 018 169 018 170 018 171	
f<>: Oper. mode f4	PSx	018 192 018 193 018 194 018 195	

Setting the operating mode of the timer stages of over-/underfrequency protection.

Parameter	Subset	Addresses	Figure
f<>: f1	PSx	018 100 018 101 018 102 018 103	Fig. 3-182
f<>: f2	PSx	018 124 018 125 018 126 018 127	
f<>: f3	PSx	018 148 018 149 018 150 018 151	
f<>: f4	PSx	018 172 018 173 018 174 018 175	

Setting for the frequency threshold. The over-/underfrequency protection function will operate if one of the following two conditions applies: The threshold is higher than the set nominal frequency and the frequency exceeds this threshold. The threshold is lower than the set nominal frequency and the frequency falls below this threshold. Depending on the selected operating mode, a signal will be issued without further monitoring or, alternatively, further monitoring mechanisms will be triggered.

Parameter	Subset	Addresses	Figure
f<>: tf1	PSx	018 104 018 105 018 106 018 107	Fig. 3-182
f<>: tf2	PSx	018 128 018 129 018 130 018 131	
f<>: tf3	PSx	018 152 018 153 018 154 018 155	
f<>: tf4	PSx	018 176 018 177 018 178 018 179	

Setting for the operate delay of over-/underfrequency protection.

Parameter	Subset	Addresses	Figure
f<>: df1/dt	PSx	018 108 018 109 018 110 018 111	Fig. 3-182
f<>: df2/dt	PSx	018 132 018 133 018 134 018 135	
f<>: df3/dt	PSx	018 156 018 157 018 158 018 159	
f<>: df4/dt	PSx	018 180 018 181 018 182 018 183	

Setting for the frequency gradient to be monitored

Note: This setting is ineffective unless operating mode "*f with df/dt*" has been selected.

Parameter	Subset	Addresses	Figure
f<>: Delta f1	PSx	018 112 018 113 018 114 018 115	Fig. 3-182
f<>: Delta f2	PSx	018 136 018 137 018 138 018 139	
f<>: Delta f3	PSx	018 160 018 161 018 162 018 163	
f<>: Delta f4	PSx	018 184 018 185 018 186 018 187	

Setting for delta f.

Note: This setting is ineffective unless operating mode "*f w. Delta f/Delta t*" has been selected.

Parameter	Subset	Addresses	Figure
f<>: Delta t1	PSx	018 116 018 117 018 118 018 119	Fig. 3-182
f<>: Delta t2	PSx	018 140 018 141 018 142 018 143	
f<>: Delta t3	PSx	018 164 018 165 018 166 018 167	
f<>: Delta t4	PSx	018 188 018 189 018 190 018 191	

Setting for delta f.

Note: This setting is ineffective unless operating mode "*f w. Delta f/Delta t*" has been selected.

Power Directional Protection

Parameter	Addresses	Figure	Description
P<>: Enabled PSx	014 252 014 253 014 254 014 255	Fig. 3-183	This setting defines the parameter subset in which power directional protection is enabled.
P<>: P> PSx	017 120 017 200 017 201 017 202	Fig. 3-185	Setting for the operate value P> for the active power.
P<>: Operate delay P> PSx	017 128 017 129 017 130 017 131	Fig. 3-185	Setting for the operate delay of stage P>.
P<>: Release delay P> PSx	017 132 017 133 017 134 017 135	Fig. 3-185	Setting for the operate delay of stage P>.
P<>: Direction P> PSx	017 136 017 137 017 138 017 139	Fig. 3-186	This setting for the measuring direction determines whether a P> trip signal will be issued for forward, backward or non-directional fault decisions.
P<>: Diseng. ratio P> PSx	017 124 017 125 017 126 017 127	Fig. 3-185	Setting for the disengaging ratio of the operate value P> for the active power.
P<>: P>> PSx	017 140 017 141 017 142 017 143	Fig. 3-185	Setting for the operate value P>> for the active power.
P<>: Operate delay P>>PSx	017 148 017 149 017 150 017 151	Fig. 3-185	Setting for the operate delay of stage P>>.
P<>: Release delay P>>PSx	017 152 017 153 017 154 017 155	Fig. 3-185	Setting for the operate delay of stage P>>.
P<>: Direction P>> PSx	017 156 017 157 017 158 017 159	Fig. 3-186	This setting for the measuring direction determines whether a P>> trip signal will be issued for forward, backward or non-directional fault decisions.
P<>: Diseng. ratio P>>PSx	017 144 017 145 017 146 017 147	Fig. 3-185	Setting for the disengaging ratio of the operate value P>> for the active power.
P<>: Q> PSx	017 160 017 161 017 162 017 163	Fig. 3-187	Setting for the operate value Q> of the reactive power.
P<>: Operate delay Q> PSx	017 168 017 169 017 170 017 171	Fig. 3-187	Setting for the operate delay of stage Q>.
P<>: Release delay Q> PSx	017 172 017 173 017 174 017 175	Fig. 3-187	Setting for the release delay of stage Q>.
P<>: Direction Q> PSx	017 176 017 177 017 178 017 179	Fig. 3-188	This setting for the measuring direction determines whether a Q> trip signal will be issued for forward, backward or non-directional fault decisions.
P<>: Diseng. ratio Q> PSx	017 164 017 165 017 166 017 167	Fig. 3-187	Setting for the disengaging ratio of the operate value Q> of the reactive power.

P<>: Q>> PSx		017 180 017 181 017 182 017 183	Fig. 3-187
Setting for the operate value Q>> of the reactive power.			
P<>: Operate delay Q>>PSx		017 188 017 189 017 190 017 191	Fig. 3-187
Setting for the operate delay of stage Q>>.			
P<>: Release delay Q>>PSx		017 192 017 193 017 194 017 195	Fig. 3-187
Setting for the release delay of stage Q>>.			
P<>: Direction Q>> PSx		017 196 017 197 017 198 017 199	Fig. 3-188
This setting for the measuring direction determines whether a Q>> trip signal will be issued for forward, backward or non-directional fault decisions.			
P<>: Diseng. ratio Q>>PSx		017 184 017 185 017 186 017 187	Fig. 3-187
Setting for the disengaging ratio of the operate value Q>> of the reactive power.			

7.2 Protection of Increased-Safety Machines

7.2.1 General

The P130C was subjected to risk analysis based on the DIN V 19 250 standard of May 1994 (on basic safety considerations for measuring and protection relays) as well as DIN V 19 251 of February 1995 (on measuring and protection relays, specifications and measures for their fail-safe functioning) and owing to a lack of more specific standards also based on DIN V VDE 0801 (on computers in safety systems).
Based on this risk analysis involving the examination of extensive measures for prevention and management of malfunction, the P130C has been classified in specifications class 3. According to NAMUR NE 31 (NAMUR: German committee on standards for measuring and control engineering), specifications class 3 corresponds to risk area 1.For this risk area, a protection device of single-channel design with alarm signal and/or normally-energized arrangement ('closed-circuit principle') will normally suffice. In special cases, a requirement for a higher specifications class can be met by a customized '1 out of 2' or '2 out of 3' circuit.

By connection and configuration of the output relay MAIN: Blocked/faulty , the increased-safety machine can be switched off immediately or, alternatively, an alarm signal can be given for delayed switch-off based on an assessment of the operational conditions by trained staff.

7.2.2 Restrictive Safety-Oriented Configuration

For the P130C to operate in a restrictive safety-oriented mode under all operational conditions, the output relays must be operated in a normally-energized arrangement ('closed-circuit principle'). In this arrangement, the relevant output relay is energized during normal operation and drops out in the event of an activation of the associated function or in the event of a malfunction.

On the configuration of functions, please see the Chapter on 'Local Control'.

Essential General Configuration

Function	Address	Folder [1]	Setting
MAIN: Device on-line	003 030	Par/Func/Glob/'	Yes = on (1)
MAIN: Trip cmd.block. USER	021 012	Par/Func/Glob/	No (0)
OUTP: Outp.rel.block USER	021 014	Par/Func/Glob/	No (0)
DTOC: Function group DTOC	056 008	Par/Conf/	With (1)
MP: Function group MP	056 022	Par/Conf/	With (1)
I2>: Function group I2>	056 024	Par/Conf/	With (1)
DTOC: General enable USER	022 075	Par/Func/Gen/	Yes (1)
MP: General enable USER	017 059	Par/Func/Gen/	Yes (1)
I2>: General enable USER	018 090	Par/Func/Gen/	Yes (1)

[1] See the Chapter on 'Local Control' for notes on the folders.

In order to implement a restrictive safety-oriented configuration for the protection of electrical increased-safety machines, the configuration should be equivalent to the example shown in the table below.

Relay	Function	Address	Folder	Associated function
K 2	OUTP: Fct. assignm. K 2	150 196	Par/Conf/	MAIN: Gen. trip command 1
	OUTP: Operation mode K 2	150 197	Par/Conf/	NE updating
	MAIN: Gen. trip command 1	021 001	Par/Func/Glob/	MP: Trip signal
				DTOC: Trip signal
				I2>: tIneg> elapsed

During device startup and during P130C operation, cyclic self-monitoring tests are run. In the event of a positive test result, a specified monitoring signal will be issued and stored in a non-volatile memory – the monitoring signal memory (see Chapter 'Troubleshooting'). A listing of all possible entries in this monitoring signal memory is given in the address list (see Appendix). Monitoring signals prompted by a serious hardware or software fault in the unit are always entered in the monitoring signal memory. The entry of monitoring signals of lesser significance into the monitoring signal memory is optional. The user can select this option by setting an 'm out of n' parameter.

The blocking of the protection device is governed by similar principles, that is, signals prompted by a serious hardware or software fault in the unit always lead to a blocking of the unit. The assignment of signals of lesser significance to the signal MAIN: Blocked/faulty by an 'm out of n' parameter (MAIN: Fct. assignm. fault) is optional.

K 8	OUTP: Fct. assignm. K 8	150 214	Par/Conf/	MAIN: Fct. assign. fault
	OUTP: Operation mode K 8	150 215	Par/Conf/	NE updating
	MAIN: Fct. assign. fault	021 031	Par/Func/Glob/	SFMON: Error K 902
				SFMON: Defect. module slot 1
				SFMON: Defect. module slot 4
				SFMON: Defect. module slot 9

For safety-oriented operation, the 'Warning' can be configured onto an output relay as in the following example.

Relay	Function	Address	Folder	Associated function
E.g. K 1	OUTP: Fct. assignm. K 1	150 193	Par/Conf/	SFMON: Warning (relay)
	SFMON: Fct. assign. warning	021 030	Par/Func/Glob/	SFMON: Phase sequ. V faulty
				SFMON: Undervoltage

8 Information and Control Functions

8 Information and Control Functions

The P130C generates a large number of signals, processes binary input signals, and acquires measured data during fault-free operation of the protected object as well as fault-related data. A number of counters are maintained for statistical purposes. This information can be read out from the integrated local control panel. All this information can be found in the 'Operation' and 'Events' folders in the menu tree.

8.1 Operation

8.1.1 Cyclic Values

8.1.1.1 Measured Operating Data

"Logical" communication interface 3

COMM3: No. tel. errors p.u.	120 040
Display of the updated measured operating value for the proportion of corrupted messages within the last 1000 received messages.	
COMM3: No.t.err.,max,stored	120 041
Display of the updated measured operating value for the proportion of corrupted messages within the last 1000 received messages.	
COMM3: Loop back result	120 057
COMM3: Loop back receive	120 056
While the hold time is running, the loop back test results can be checked by reading out these values.	

Main function

MAIN: Date 003 090 Fig. 3-51

Date display.

Note: The date can also be set here.

MAIN: Time of day 003 091 Fig. 3-51

Display of the time of day.

Note: The time can also be set here.

MAIN: Time switching 003 095 Fig. 3-51

Setting for standard time or daylight saving time.

This setting is necessary in order to avoid misinterpretation of the times assigned to signals and event data that can be read out through the PC or communication interfaces.

Note:
The time can be set here for standard time or daylight saving time.

In the case of clock synchronization via the clock synchronization telegram from a central control system or a central device, this setting will be overwritten each time a new clock synchronization telegram is received. With a free-running clock or synchronization by minute pulse through a binary input, the time of day setting and the time switching setting in the device must be plausible. The two settings do not have a mutual effect on one another.

MAIN: Frequency f 004 040 Fig. 3-33

Display of system frequency.

MAIN: Curr. IP,max prim. 005 050 Fig. 3-26

Display of the maximum phase current as a primary quantity.

MAIN: IP,max prim.,delay 005 036 Fig. 3-26

Display of the delayed maximum phase current as a primary quantity.

MAIN: IP,max prim.,stored 005 034 Fig. 3-26

Display of the delayed stored maximum phase current as a primary quantity.

MAIN: Curr. IP,min prim. 005 055 Fig. 3-26

Display of the minimum phase current as a primary quantity.

MAIN: Current A prim. 005 040 Fig. 3-26

Display of phase current A as a primary quantity.

MAIN: Current B prim. 006 040 Fig. 3-26

Display of phase current B as a primary quantity.

MAIN: Current C prim. 007 040 Fig. 3-26

Display of phase current C as a primary quantity.

MAIN: Current Σ(IP) prim. 005 010 Fig. 3-26

Display of the calculated resultant current as a primary quantity.

MAIN: Current IN prim. 004 043 Fig. 3-27

Display of the updated value for the residual current as a primary quantity.

MAIN: Volt. VPG,max prim. 008 042 Fig. 3-30

Display of the maximum phase-to-ground voltage as a primary quantity.

MAIN: Volt. VPG,min prim. 009 042 Fig. 3-30

Display of the minimum phase-to-ground voltage as a primary quantity.

MAIN: Voltage A-G prim. 005 042 Fig. 3-30

Display of the updated value for phase-to-ground voltage A-G as a primary quantity.

MAIN: Voltage B-G prim. 006 042 Fig. 3-30

Display of the updated value for phase-to-ground voltage B-G as a primary quantity.

MAIN: Voltage C-G prim. 007 042 Fig. 3-30

Display of the updated value for phase-to-ground voltage C-G as a primary quantity.

MAIN: Volt. Σ(VPG)/3 prim. 005 012 Fig. 3-30

Display of the calculated neutral-displacement voltage as a primary quantity.

MAIN: Volt. VPP,max prim. 008 044 Fig. 3-30

Display of the maximum phase-to-phase voltage as a primary quantity.

MAIN: Voltage VPP,min prim 009 044 Fig. 3-30

Display of the minimum phase-to-phase voltage as a primary quantity.

MAIN: Voltage A-B prim. 005 044 Fig. 3-30

Display of the updated value for phase-to-phase voltage A-B as a primary quantity.

MAIN: Voltage B-C prim. 006 044 Fig. 3-30

Display of the updated value for the phase-to-phase voltage B-C as a primary quantity.

MAIN: Voltage C-A prim. 007 044 Fig. 3-30

Display of the updated value for phase-to-phase voltage C-A as a primary quantity.

MAIN: Active power P prim. 004 050 Fig. 3-31

Display of the updated active power value as a primary quantity.

MAIN: Reac. power Q prim. 004 052 Fig. 3-31

Display of the updated reactive power value as a primary quantity.

MAIN: Act.energy outp.prim 005 061 Fig. 3-34

Display of the updated active energy output as a primary quantity.

MAIN: Act.energy inp. prim 005 062 Fig. 3-34

Display of the updated active energy input as a primary quantity.

MAIN: React.en. outp. prim 005 063 Fig. 3-34

Display of the updated reactive energy output as a primary quantity.

MAIN: React. en. inp. prim 005 064 Fig. 3-34

Display of the updated reactive energy input as a primary quantity.

MAIN: Current IP,max p.u. 005 051 Fig. 3-26

Display of the maximum phase current referred to I_{nom}.

MAIN: IP,max p.u.,delay 005 037 Fig. 3-26

Display of the delayed maximum phase current referred to I_{nom}.

MAIN: IP,max p.u.,stored 005 035 Fig. 3-26

Display of the delayed stored maximum phase current referred to I_{nom}.

MAIN: Current IP,min p.u. 005 056 Fig. 3-26

Display of the minimum phase current referred to I_{nom}.

MAIN: Current A p.u. 005 041 Fig. 3-26

Display of phase current A referred to I_{nom}.

MAIN: Current B p.u. 006 041 Fig. 3-26

Display of phase current B referred to I_{nom}.

MAIN: Current C p.u. 007 041 Fig. 3-26

Display of phase current C referred to I_{nom}.

MAIN: Current Σ(IP) p.u. 005 011 Fig. 3-26

Display of the calculated resultant current referred to I_{nom}.

MAIN: Current ΣI unfilt. 004 074

Display of calculated unfiltered resultant current.

MAIN: Current IN p.u. 004 044 Fig. 3-27

Display of the updated residual current value referred to I_{nom}.

MAIN: Voltage VPG,max p.u. 008 043 Fig. 3-30

Display of the maximum phase-to-ground voltage referred to V_{nom}.

MAIN: Voltage VPG,min p.u. 009 043 Fig. 3-30

Display of the minimum phase-to-ground voltage referred to V_{nom}.

MAIN: Voltage A-G p.u. 005 043 Fig. 3-30

Display of the updated value for phase-to-ground voltage A-G referred to V_{nom}.

MAIN: Voltage B-G p.u. 006 043 Fig. 3-30

Display of the updated value for phase-to-ground voltage B-G referred to V_{nom}.

MAIN: Voltage C-G p.u. 007 043 Fig. 3-30

Display of the updated value for phase-to-ground voltage C-G referred to V_{nom}.

MAIN: Volt. Σ(VPG)/√3 p.u. 005 013 Fig. 3-30

Display of the calculated neutral-displacement voltage referred to V_{nom}.

MAIN: Voltage VPP,max p.u. 008 045 Fig. 3-30

Display of the maximum phase-to-phase voltage referred to V_{nom}.

MAIN: Voltage VPP,min p.u. 009 045 Fig. 3-30

Display of the minimum phase-to-phase voltage referred to V_{nom}.

MAIN: Voltage A-B p.u. 005 045 Fig. 3-30

Display of the updated value for phase-to-phase voltage A-B referred to V_{nom}.

MAIN: Voltage B-C p.u. 006 045 Fig. 3-30

Display of the updated value for phase-to-phase voltage B-C referred to V_{nom}.

MAIN: Voltage C-A p.u. 007 045 Fig. 3-30

Display of the updated value for phase-to-phase voltage C-A referred to V_{nom}.

MAIN: Active power P p.u. 004 051	Fig. 3-31
Display of the updated value for active power referred to nominal apparent power S_{nom}.	
MAIN: Reac. power Q p.u. 004 053	Fig. 3-31
Display of the updated value for reactive power referred to nominal apparent power S_{nom}.	
MAIN: Active power factor 004 054	Fig. 3-31
Display of the updated active power factor.	
MAIN: Load angle phi A 004 055	Fig. 3-31
Display of the updated load angle value in phase A.	
MAIN: Load angle phi B 004 056	Fig. 3-31
Display of the updated load angle value in phase B.	
MAIN: Load angle phi C 004 057	Fig. 3-31
Display of the updated load angle value in phase C.	
MAIN: Phase rel.,IN vs ΣIP 004 073	Fig. 3-32
The phase relations of measured and calculated residual current are compared.	

ault direction ation using ate values

GFDSS: Current IN,act p.u. 004 045	Fig. 3-144
Display of the updated value for the active component of residual current referred to $I_{N,nom}$.	
GFDSS: Curr. IN,reac p.u. 004 046	Fig. 3-144
Display of the updated value for the reactive component of residual current referred to $I_{N,nom}$.	
GFDSS: Curr. IN filt. p.u. 004 047	Fig. 3-145
Display of the updated value for the harmonic content of residual current referred to $I_{N,nom}$. This display is only active when the steady-state current evaluation mode of the ground fault direction determination function (GFDSS) is enabled.	
GFDSS: Admitt. Y(N) p.u. 004 191	Fig. 3-150
Display of the updated admittance value referred to $Y_{N,nom}$. If GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated*: $Y_{N,nom} = I_{N,nom} / V_{nom}$	
GFDSS: Conduct. G(N) p.u. 004 192	Fig. 3-150
Display of the updated conductance value referred to $Y_{N,nom}$. If GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated*: $Y_{N,nom} = I_{N,nom} / V_{nom}$	
GFDSS: Suscept. B(N) p.u. 004 193	Fig. 3-150
Display of the updated susceptance value referred to $Y_{N,nom}$. GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated*: $Y_{N,nom} = I_{N,nom} / V_{nom}$	

Motor protection

MP: Therm.repl.buffer MP	004 018	Fig. 3-159
Display of the buffer content of the motor protection function.		
MP: St-ups still permitt	004 012	Fig. 3-159
Display of the current number of motor startups still permitted before RC blocking.		

Thermal overload protection

THERM: Status THERM replica	004 016	Fig. 3-165
Display of the buffer content of the thermal overload protection function.		
THERM: Object temperature	004 137	Fig. 3-165
Display of the temperature of the protected object.		
THERM: Pre-trip time left	004 139	Fig. 3-165
Display of the time remaining before the thermal overload protection function will reach the tripping threshold.		
THERM: Therm. replica p.u.	004 017	
Display of the buffer content of the thermal overload protection function referred to a buffer content of 100 %.		
THERM: Object temp. p.u.	004 179	
Display of the temperature of the protected object referred to 100 °C.		
THERM: Temp. offset replica	004 109	Fig. 3-165
Display of the additional reserve if the coolant temperature is taken into account. This display is relevant if the coolant temperature has been set to a value below the maximum permissible coolant temperature or, in other words, if the thermal model has been shifted downwards. If, on the other hand, the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to zero in this case.		

8.1.1.2 Physical State Signals

communication 3

COMM3: State receive 1	120 000
COMM3: State receive 2	120 003
COMM3: State receive 3	120 006
COMM3: State receive 4	120 009
COMM3: State receive 5	120 012
COMM3: State receive 6	120 015
COMM3: State receive 7	120 018
COMM3: State receive 8	120 021

Display of the relevant receive signal.

COMM3: State send 1	121 000
COMM3: State send 2	121 002
COMM3: State send 3	121 004
COMM3: State send 4	121 006
COMM3: State send 5	121 008
COMM3: State send 6	121 010
COMM3: State send 7	121 012
COMM3: State send 8	121 014

Display of the updated value for the relevant send signal.

keys

F_KEY: State F1	080 122 Fig. 3-20
F_KEY: State F2	080 123
F_KEY: State F3	080 124
F_KEY: State F4	080 125

The state of the function keys is displayed as follows:

- *Without function* No functions are assigned to the function key.
- *"Off"*: The function key is in the "Off" position.
- *"On"*: The function key is in the "On" position.

ɔuts

INP: State U 1	178 001
INP: State U 2	178 005

The state of the binary signal inputs is displayed as follows:

- *Without function*: No functions are assigned to the binary signal input.
- *Low:* Not energized.
- *High:* Energized.

This display appears regardless of the setting for the binary signal input mode.

Binary and analog outputs

OUTP: State K 1	157 001
OUTP: State K 2	157 005
OUTP: State K 3	157 009
OUTP: State K 4	157 013
OUTP: State K 5	157 017
OUTP: State K 6	157 021
OUTP: State K 7	157 025
OUTP: State K 8	157 029

The state of the output relays is displayed as follows:

- *Without function*: No functions are assigned to the output relay.
- *Low:* The output relay is not energized.
- *High*: The output relay is energized.

This display appears regardless of the operating mode set for the output relay.

LED: State H 2	085 000
LED: State H 3	085 003
LED: State H 4	085 006
LED: State H 5	085 009
LED: State H 6	085 012
LED: State H 7	085 015
LED: State H 8	085 018
LED: State H 9	085 021
LED: State H 10	085 024
LED: State H 11	085 027
LED: State H 12	085 030
LED: State H 13	085 033
LED: State H 14	085 036
LED: State H 15	085 039
LED: State H 16	085 042

The state of the LED indicators is displayed as follows:

- Inactive: The LED indicator is not energized.
- Active: The LED indicator is energized.

8.1.1.3 Logic state signals

ıtrol panel

LOC: Trig. menu jmp 1 EXT	030 230	
LOC: Trig. menu jmp 2 EXT	030 231	
LOC: Illumination on EXT	037 101	

communication 1

COMM1: Command block. EXT	003 173	Fig. 3-7
COMM1: Sig./meas. block EXT	037 074	Fig. 3-8, 3-9,3-10
COMM1: Command blocking	003 174	Fig. 3-7
COMM1: Sig./meas.val.block.	037 075	Fig. 3-8, 3-9,3-10
COMM1: IEC 870-5-103	003 219	Fig. 3-8
COMM1: IEC 870-5-101	003 218	Fig. 3-9
COMM1: IEC 870-5,ILS	003 221	Fig. 3-10
COMM1: MODBUS	003 223	Fig. 3-11
COMM1: DNP3	003 230	Fig. 3-12
COMM1: COURIER	103 041	

communication 3

COMM3: Communications fault	120 043	Fig. 3-18
COMM3: Comm. link failure	120 044	Fig. 3-18
COMM3: Lim.exceed.,tel.err.	120 045	

terface

IRIGB: Enabled	023 201	Fig. 3-19
IRIGB: Synchron. ready	023 202	Fig. 3-19

ıd analog outputs

OUTP: Block outp.rel. EXT	040 014	Fig. 3-22
OUTP: Reset latch. EXT	040 015	Fig. 3-22
OUTP: Outp. relays blocked	021 015	Fig. 3-22
OUTP: Latching reset	040 088	Fig. 3-22

ːtic

MAIN: Enable protect. EXT	003 027	Fig. 3-36
MAIN: Disable protect. EXT	003 026	Fig. 3-36
MAIN: System IN enable EXT	040 130	Fig. 3-37
MAIN: Syst. IN disable EXT	040 131	Fig. 3-37
MAIN: Test mode EXT	037 070	Fig. 3-54
MAIN: Blocking 1 EXT	040 060	Fig. 3-40
MAIN: Blocking 2 EXT	040 061	Fig. 3-40
MAIN: Reset latch.trip EXT	040 138	Fig. 3-48
MAIN: Trip cmd. block. EXT	036 045	Fig. 3-48
MAIN: M.c.b. trip V EXT	004 061	Fig. 3-77, 3-190
MAIN: Switch dyn.param.EXT	036 033	Fig. 3-38
MAIN: CB closed sig. EXT	036 051	Fig. 3-42, 3-125,3-192
MAIN: Man.cl.cmd.enabl.EXT	041 023	Fig. 3-42
MAIN: Manual close EXT	036 047	Fig. 3-116
MAIN: Man. close cmd. EXT	041 022	Fig. 3-42
MAIN: Man. trip cmd. EXT	037 018	Fig. 3-49
MAIN: Reset indicat. EXT	065 001	Fig. 3-52
MAIN: Min-pulse clock EXT	060 060	Fig. 3-51
MAIN: Prot. ext. enabled	003 028	Fig. 3-36
MAIN: Prot. ext. disabled	038 046	Fig. 3-36

MAIN: Gen. trip signal	036 251	Fig. 3-48
MAIN: Syst.IN ext/user en.	040 132	Fig. 3-37
MAIN: System IN enabled	040 133	Fig. 3-37
MAIN: System IN disabled	040 134	Fig. 3-37
MAIN: Device not ready	004 060	Fig. 3-41
MAIN: Test mode	037 071	Fig. 3-54
MAIN: Blocked/faulty	004 065	Fig. 3-41
MAIN: Trip cmd. blocked	021 013	Fig. 3-48
MAIN: Latch. trip c. reset	040 139	Fig. 3-48
MAIN: Manual trip signal	034 017	Fig. 3-49
MAIN: Man. close command	037 068	Fig. 3-42
MAIN: Gen. trip command	035 071	Fig. 3-48
MAIN: Gen. trip signal 1	036 005	Fig. 3-48
MAIN: Gen. trip signal 2	036 023	Fig. 3-48
MAIN: Gen. trip command 1	036 071	Fig. 3-48
MAIN: Gen. trip command 2	036 022	Fig. 3-48
MAIN: Close command	037 009	Fig. 3-42
MAIN: Dynam. param. active	040 090	Fig. 3-38
MAIN: General starting	040 000	Fig. 3-46
MAIN: tGS elapsed	040 009	Fig. 3-46
MAIN: Starting A	040 005	Fig. 3-45
MAIN: Starting B	040 006	Fig. 3-45
MAIN: Starting C	040 007	Fig. 3-45
MAIN: Starting GF	040 008	Fig. 3-45
MAIN: Starting Ineg	040 105	Fig. 3-45
MAIN: Rush restr. A trig.	041 027	
MAIN: Rush restr. B trig.	041 028	
MAIN: Rush restr. C trig.	041 029	
MAIN: Timer stage P elaps.	040 031	Fig. 3-47
MAIN: Timer st. Ineg elaps	040 050	
MAIN: Timer stage N elaps.	040 032	Fig. 3-47
MAIN: TripSig. tI>/tIrefP>	040 042	Fig. 3-47
MAIN: Tr.sig.tIneg>/Ir,neg	040 051	
MAIN: TripSig tIN>/tIrefN>	040 043	Fig. 3-47
MAIN: Ground fault	041 087	Fig. 3-44
MAIN: Ground fault A	041 054	Fig. 3-43
MAIN: Ground fault B	041 055	Fig. 3-43
MAIN: Ground fault C	041 056	Fig. 3-43
MAIN: Gnd. fault forw./LS	041 088	Fig. 3-44
MAIN: Gnd. fault backw./BS	041 089	Fig. 3-44

Parameter subset selection

PSS: Control via user EXT	036 101	Fig. 3-55
PSS: Activate PS 1 EXT	065 002	Fig. 3-55
PSS: Activate PS 2 EXT	065 003	Fig. 3-55
PSS: Activate PS 3 EXT	065 004	Fig. 3-55
PSS: Activate PS 4 EXT	065 005	Fig. 3-55
PSS: Control via user	036 102	Fig. 3-55
PSS: Ext.sel.param.subset	003 061	Fig. 3-55

PSS: PS 1 activated ext.	036 094	Fig. 3-55
PSS: PS 2 activated ext.	036 095	Fig. 3-55
PSS: PS 3 activated ext.	036 096	Fig. 3-55
PSS: PS 4 activated ext.	036 097	Fig. 3-55
PSS: Actual param. subset	003 062	Fig. 3-55
PSS: PS 1 active	036 090	Fig. 3-55
PSS: PS 2 active	036 091	Fig. 3-55
PSS: PS 3 active	036 092	Fig. 3-55
PSS: PS 4 active	036 093	Fig. 3-55

itoring

SFMON: Warning (LED)	036 070	Fig. 3-56
SFMON: Warning (relay)	036 100	Fig. 3-56
SFMON: Warm restart exec.	041 202	
SFMON: Cold restart exec.	041 201	
SFMON: Cold restart	093 024	
SFMON: Cold rest./SW update	093 025	
SFMON: Blocking/ HW failure	090 019	
SFMON: Relay Kxx faulty	041 200	
SFMON: Hardware clock fail.	093 040	
SFMON: Battery failure	090 010	
SFMON: Invalid SW d.loaded	096 121	
SFMON: +15V supply faulty	093 081	
SFMON: +24V supply faulty	093 082	
SFMON: -15V supply faulty	093 080	
SFMON: Power supply faulty	093 083	
SFMON: Wrong module slot 1	096 100	
SFMON: Wrong module slot 2	096 101	
SFMON: Defect.module slot 1	097 000	
SFMON: Defect.module slot 2	097 001	
SFMON: Module A DPR faulty	093 070	
SFMON: Module A RAM faulty	093 071	
SFMON: Error K 1	097 038	
SFMON: Error K 2	097 039	
SFMON: Error K 3	097 040	
SFMON: Error K 4	097 041	
SFMON: Error K 5	097 042	
SFMON: Error K 6	097 043	
SFMON: Error K 7	097 044	
SFMON: Error K 8	097 045	
SFMON: Undef. operat. code	093 010	
SFMON: Invalid arithm. op.	093 011	
SFMON: Undefined interrupt	093 012	
SFMON: Exception oper.syst.	093 013	
SFMON: Data acquis. failure	090 021	
SFMON: Checksum error param	090 003	
SFMON: Clock sync. error	093 041	
SFMON: Interm.volt.fail.RAM	093 026	
SFMON: Overflow MT_RC	090 012	Fig. 3-58
SFMON: Semaph. MT_RC block.	093 015	
SFMON: Inval. SW vers.COMM1	093 075	
SFMON: IRIGB faulty	093 117	
SFMON: Time-out module L	093 130	
SFMON: Inom not adjustable	093 118	

SFMON: M.c.b. trip V	098 000	Fig. 3-190
SFMON: Phase sequ. V faulty	098 001	Fig. 3-192
SFMON: Undervoltage	098 009	Fig. 3-192
SFMON: Meas. circ. V faulty	098 017	Fig. 3-190
SFMON: Meas. circ. I faulty	098 005	Fig. 3-191
SFMON: Meas.circ.V,I faulty	098 016	Fig. 3-190
SFMON: Communic.fault COMM3	093 140	
SFMON: Comm.link fail.COMM3	093 142	
SFMON: Lim.exceed.,tel.err.	093 141	
SFMON: Telecom. faulty	098 006	Fig. 3-120
SFMON: Setting error THERM	098 035	Fig. 3-165
SFMON: Setting error f<>	098 028	Fig. 3-182
SFMON: Output 30	098 053	
SFMON: Output 30 (t)	098 054	
SFMON: Output 31	098 055	
SFMON: Output 31 (t)	098 056	
SFMON: Output 32	098 057	
SFMON: Output 32 (t)	098 058	

Overload recording

OL_RC: Record. in progress	035 003	Fig. 3-62
OL_RC: Overl. mem. overflow	035 007	Fig. 3-63

Ground fault recording

GF_RC: Record. in progress	035 005	Fig. 3-71
GF_RC: GF memory overflow	035 006	Fig. 3-72

Fault data acquisition

FT_DA: Trigger EXT	036 088	Fig. 3-74

Fault recording

FT_RC: Trigger EXT	036 089	Fig. 3-80
FT_RC: Trigger	037 076	Fig. 3-80
FT_RC: I> triggered	040 063	Fig. 3-80
FT_RC: Record. in progress	035 000	Fig. 3-80
FT_RC: System disturb. runn	035 004	Fig. 3-80
FT_RC: Fault mem. overflow	035 001	Fig. 3-81
FT_RC: Faulty time tag	035 002	

Definite-time overcurrent protection

DTOC: Blocking tI> EXT	041 060	Fig. 3-84
DTOC: Blocking tI>> EXT	041 061	Fig. 3-84
DTOC: Blocking tI>>> EXT	041 062	Fig. 3-84
DTOC: Block. tIneg> EXT	036 141	
DTOC: Block. tIneg>> EXT	036 142	
DTOC: Block. tIneg>>> EXT	036 143	
DTOC: Blocking tIN> EXT	041 063	Fig. 3-89
DTOC: Blocking tIN>> EXT	041 064	Fig. 3-89
DTOC: Blocking tIN>>> EXT	041 065	Fig. 3-89
DTOC: Enabled	040 120	Fig. 3-83
DTOC: Starting I>	040 036	Fig. 3-84
DTOC: Starting I>>	040 029	Fig. 3-84
DTOC: Starting I>>>	039 075	Fig. 3-84
DTOC: Starting Ineg>	036 145	Fig. 3-86, 3-45,3-46
DTOC: Starting Ineg>>	036 146	Fig. 3-86, 3-45,3-46

DTOC: Starting Ineg>>>	036 147	Fig. 3-86, 3-45,3-46
DTOC: Starting IN>	040 077	Fig. 3-89
DTOC: Starting IN>>	040 041	Fig. 3-89
DTOC: Starting IN>>>	039 078	Fig. 3-89
DTOC: tI> elapsed	040 010	Fig. 3-84
DTOC: tI>> elapsed	040 033	Fig. 3-84
DTOC: tI>>> elapsed	040 012	Fig. 3-84
DTOC: Trip signal tI>	041 020	Fig. 3-85
DTOC: Trip signal tI>>	040 011	Fig. 3-85
DTOC: Trip signal tI>>>	040 076	Fig. 3-85
DTOC: tIneg> elapsed	036 148	Fig. 3-86, 3-47
DTOC: tIneg>> elapsed	036 149	Fig. 3-86, 3-47
DTOC: tIneg>>> elapsed	036 150	Fig. 3-86, 3-47
DTOC: Trip signal tIneg>	036 151	Fig. 3-86, 3-87
DTOC: Trip signal tIneg>>	036 152	Fig. 3-86, 3-87
DTOC: Trip signal tIneg>>>	036 153	Fig. 3-86, 3-87
DTOC: tIN> elapsed	040 013	Fig. 3-89
DTOC: tIN>> elapsed	040 121	Fig. 3-89
DTOC: tIN>>> elapsed	039 079	Fig. 3-89
DTOC: Trip signal tIN>	041 021	Fig. 3-90
DTOC: Trip signal tIN>>	040 028	Fig. 3-90
DTOC: Trip signal tIN>>>	040 079	Fig. 3-90
DTOC: H.-time tIN>,i. runn	040 086	Fig. 3-91
DTOC: tIN>,interm. elapsed	040 099	Fig. 3-91
DTOC: Trip sig. tIN>,intm.	039 073	Fig. 3-91

'me overcurrent
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IDMT: Block. tIref,P> EXT	040 101	Fig. 3-99
IDMT: Block. tIref,neg>EXT	040 102	
IDMT: Block. tIref,N> EXT	040 103	Fig. 3-103
IDMT: Enabled	040 100	Fig. 3-94
IDMT: Starting Iref,P>	040 080	Fig. 3-99
IDMT: tIref,P> elapsed	040 082	Fig. 3-99
IDMT: Trip signal tIref,P>	040 084	Fig. 3-100
IDMT: Hold time P running	040 053	Fig. 3-99
IDMT: Memory P clear	040 110	Fig. 3-99
IDMT: Starting Iref,neg>	040 107	
IDMT: tIref,neg> elapsed	040 109	
IDMT: Trip sig. tIref,neg>	040 108	
IDMT: Hold time neg runn.	040 113	
IDMT: Memory neg clear	040 111	
IDMT: Starting Iref,N>	040 081	Fig. 3-103
IDMT: tIref,N> elapsed	040 083	Fig. 3-103
IDMT: Trip signal tIref,N>	040 085	Fig. 3-104
IDMT: Hold time N running	040 054	Fig. 3-103
IDMT: Memory N clear	040 112	Fig. 3-103

Short-circuit direction determination	SCDD: Enabled	040 098	Fig. 3-106
	SCDD: Blocked	040 062	Fig. 3-108
	SCDD: Fault P forward	036 018	Fig. 3-109
	SCDD: Fault P backward	036 019	Fig. 3-109
	SCDD: Ground fault forward	040 037	Fig. 3-113
	SCDD: Ground fault backw.	040 038	Fig. 3-113
	SCDD: Fault P or G forwd.	040 039	Fig. 3-115
	SCDD: Fault P or G backw.	040 040	Fig. 3-115
Switch on to fault protection	SOTF: Par. ARC running EXT	039 063	Fig. 3-116
	SOTF: Enabled	040 069	Fig. 3-116
	SOTF: tManual-close runn.	036 063	Fig. 3-116
	SOTF: Trip signal	036 064	Fig. 3-116
Protective signaling	PSIG: Enable EXT	037 025	Fig. 3-117
	PSIG: Disable EXT	037 026	Fig. 3-117
	PSIG: Test telecom. EXT	036 038	Fig. 3-119
	PSIG: Blocking EXT	036 049	Fig. 3-117
	PSIG: Receive EXT	036 048	Fig. 3-119, 3-120
	PSIG: Ext./user enabled	037 023	Fig. 3-117
	PSIG: Enabled	015 008	Fig. 3-117
	PSIG: Ready	037 027	Fig. 3-117
	PSIG: Not ready	037 028	Fig. 3-117
	PSIG: Test telecom. chann.	034 016	Fig. 3-119
	PSIG: Telecom. faulty	036 060	Fig. 3-120
	PSIG: Send (signal)	036 035	Fig. 3-119
	PSIG: Send (transm.relay)	037 024	Fig. 3-119
	PSIG: Receive (signal)	037 029	Fig. 3-119
	PSIG: Trip signal	038 007	Fig. 3-119
Auto-reclosing control	ARC: Enable EXT	037 010	Fig. 3-123
	ARC: Disable EXT	037 011	Fig. 3-123
	ARC: Test HSR A-B-C EXT	037 017	Fig. 3-136
	ARC: Blocking EXT	036 050	Fig. 3-124
	ARC: CB drive ready EXT	004 066	Fig. 3-125
	ARC: Ext./user enabled	037 013	Fig. 3-123
	ARC: Enabled	015 064	Fig. 3-123
	ARC: Test HSR A-B-C	034 023	Fig. 3-136
	ARC: Blocked	004 069	Fig. 3-124
	ARC: Blocking trip	042 000	Fig. 3-134
	ARC: Ready	004 068	Fig. 3-125
	ARC: Not ready	037 008	Fig. 3-125
	ARC: Reject test HSR	036 055	Fig. 3-136
	ARC: Block. time running	037 004	Fig. 3-124
	ARC: Cycle running	037 000	Fig. 3-134
	ARC: Oper. time running	037 005	Fig. 3-134
	ARC: Start by LOGIC	037 078	Fig. 3-133
	ARC: Dead time HSR runn.	037 002	Fig. 3-134
	ARC: Dead time TDR runn.	037 003	Fig. 3-134
	ARC: Reclaim time running	036 042	Fig. 3-134
	ARC: Trip signal	039 099	Fig. 3-134

ARC: (Re)close signal HSR		037 007	Fig. 3-134
ARC: (Re)close signal TDR		037 006	Fig. 3-134
ARC: Reclosure successful		036 062	Fig. 3-134
ARC: Sig.interr. CB trip		036 040	Fig. 3-134

ɜult direction
ɜtion using
ate values

GFDSS: GF (curr.) eval. EXT	038 020	Fig. 3-139
GFDSS: Enabled	042 096	Fig. 3-139
GFDSS: GF (pow.) ready	038 026	Fig. 3-139
GFDSS: GF (pow.) not ready	038 027	Fig. 3-139
GFDSS: GF (curr.) evaluat.	039 071	Fig. 3-139
GFDSS: GF (curr.) ready	038 028	Fig. 3-139
GFDSS: GF (curr.) not ready	038 029	Fig. 3-139
GFDSS: Admittance ready	038 167	Fig. 3-139
GFDSS: Admittance not ready	038 168	Fig. 3-139
GFDSS: Grd. fault pow./adm.	009 037	Fig. 3-141, 3-147
GFDSS: Direct. forward/LS	009 035	Fig. 3-144, 3-150
GFDSS: Direct. backward/BS	009 036	Fig. 3-144, 3-150
GFDSS: Starting forward/LS	009 040	Fig. 3-144, 3-150
GFDSS: Starting backw. /BS	009 041	Fig. 3-144, 3-150
GFDSS: Trip signal forw./LS	009 031	Fig. 3-144, 3-150
GFDSS: Ground fault (curr.)	009 038	Fig. 3-145
GFDSS: Starting Y(N)>	009 074	Fig. 3-151
GFDSS: Trip Y(N)>	009 075	Fig. 3-151
GFDSS: Trip signal Y(N)>	009 072	Fig. 3-151

ɔtection

MP: Therm.repl.block EXT	040 044	Fig. 3-159
MP: Reset therm.repl.EXT	041 082	Fig. 3-161
MP: Speed monitor n> EXT	040 045	Fig. 3-159
MP: Enabled	040 115	Fig. 3-153
MP: Reset therm. replica	041 083	Fig. 3-161
MP: Reclosure blocked	040 049	Fig. 3-159
MP: Starting k*Iref>	041 057	Fig. 3-154
MP: Startup	040 119	Fig. 3-159
MP: Trip by failed st-up	041 081	Fig. 3-159
MP: Trip signal	040 046	Fig. 3-159
MP: tI< elapsed	040 047	Fig. 3-162

Thermal overload protection

THERM: Therm.repl.block EXT	041 074	Fig. 3-165
THERM: Reset replica EXT	038 061	Fig. 3-166
THERM: Enabled	040 068	Fig. 3-163
THERM: Reset replica	039 061	Fig. 3-166
THERM: Starting k*Iref>	041 108	Fig. 3-165
THERM: Warning	039 025	Fig. 3-165
THERM: Trip signal	039 020	Fig. 3-165
THERM: Buffer empty	039 112	Fig. 3-165
THERM: Within pre-trip time	041 109	Fig. 3-165
THERM: Setting error,block.	039 110	Fig. 3-165

Unbalance protection

I2>: Blocking EXT	035 100	Fig. 3-168
I2>: Blocking tIneg> EXT	041 076	Fig. 3-168
I2>: Blocking tIneg>> EXT	041 077	Fig. 3-168
I2>: Enabled	040 073	Fig. 3-167
I2>: Starting Ineg>	035 024	Fig. 3-168
I2>: Starting Ineg>>	035 025	Fig. 3-168
I2>: tIneg> elapsed	035 033	Fig. 3-168
I2>: tIneg>> elapsed	035 034	Fig. 3-168

Time-voltage protection

V<>: Blocking tV> EXT	041 068	Fig. 3-171
V<>: Blocking tV>> EXT	041 069	Fig. 3-171
V<>: Blocking tV< EXT	041 070	Fig. 3-172
V<>: Blocking tV<< EXT	041 071	Fig. 3-172
V<>: Blocking tVpos> EXT	041 090	Fig. 3-174
V<>: Blocking tVpos>> EXT	041 091	Fig. 3-174
V<>: Blocking tVpos< EXT	041 092	Fig. 3-174
V<>: Blocking tVpos<< EXT	041 093	Fig. 3-174
V<>: Blocking tVneg> EXT	041 094	Fig. 3-175
V<>: Blocking tVneg>> EXT	041 095	Fig. 3-175
V<>: Blocking tVNG> EXT	041 072	Fig. 3-177
V<>: Blocking tVNG>> EXT	041 073	Fig. 3-177
V<>: Enabled	040 066	Fig. 3-169
V<>: Ready	042 003	Fig. 3-169
V<>: Not ready	042 004	Fig. 3-169
V<>: Starting V>/>> A(-B)	041 031	Fig. 3-171
V<>: Starting V>/>> B(-C)	041 032	Fig. 3-171
V<>: Starting V>/>> C(-A)	041 033	Fig. 3-171
V<>: Starting V>	041 030	Fig. 3-171
V<>: Starting V> 3-pole	041 097	Fig. 3-171
V<>: Starting V>>	041 096	Fig. 3-171
V<>: tV> elapsed	041 034	Fig. 3-171
V<>: tV> 3-pole elapsed	041 098	Fig. 3-171
V<>: tV>> elapsed	041 035	Fig. 3-171
V<>: Starting V</<< A(-B)	041 038	Fig. 3-172
V<>: Starting V</<< B(-C)	041 039	Fig. 3-172
V<>: Starting V</<< C(-A)	041 040	Fig. 3-172
V<>: Starting V<	041 037	Fig. 3-172
V<>: Starting V< 3-pole	042 005	Fig. 3-172
V<>: Starting V<<	041 099	Fig. 3-172
V<>: tV< elapsed	041 041	Fig. 3-172
V<>: tV< elaps. transient	042 023	Fig. 3-172
V<>: Fault V<	041 110	Fig. 3-172

V<>: tV< 3-pole elapsed	042 006	Fig. 3-172
V<>: tV< 3p elaps. trans.	042 024	Fig. 3-172
V<>: Fault V< 3-pole	041 111	Fig. 3-172
V<>: tV<< elapsed	041 042	Fig. 3-172
V<>: tV<< elapsed trans.	042 025	Fig. 3-172
V<>: tV</<< elaps. trans.	042 007	Fig. 3-172
V<>: Fault V<<	041 112	Fig. 3-172
V<>: Starting Vpos>	042 010	Fig. 3-174
V<>: Starting Vpos>>	042 011	Fig. 3-174
V<>: tVpos> elapsed	042 012	Fig. 3-174
V<>: tVpos>> elapsed	042 013	Fig. 3-174
V<>: Starting Vpos<	042 014	Fig. 3-174
V<>: Starting Vpos<<	042 015	Fig. 3-174
V<>: tVpos< elapsed	042 016	Fig. 3-174
V<>: tVpos< elaps. trans.	042 026	Fig. 3-174
V<>: Fault Vpos<	041 113	Fig. 3-174
V<>: tVpos<< elapsed	042 017	Fig. 3-174
V<>: tVpos<< elaps.trans.	042 027	Fig. 3-174
V<>: Fault Vpos<<	041 114	Fig. 3-174
V<>: tVpos</<< elap.trans	042 018	Fig. 3-174
V<>: Starting Vneg>	042 019	Fig. 3-175
V<>: Starting Vneg>>	042 020	Fig. 3-175
V<>: tVneg> elapsed	042 021	Fig. 3-175
V<>: tVneg>> elapsed	042 022	Fig. 3-175
V<>: Starting VNG>	041 044	Fig. 3-177
V<>: Starting VNG>>	042 008	Fig. 3-177
V<>: tVNG> elapsed	041 045	Fig. 3-177
V<>: tVNG>> elapsed	041 046	Fig. 3-177

ıderfrequency
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f<>: Blocking f1 EXT	042 103	Fig. 3-182
f<>: Blocking f2 EXT	042 104	
f<>: Blocking f3 EXT	042 105	
f<>: Blocking f4 EXT	042 106	
f<>: Enabled	042 100	Fig. 3-178
f<>: Ready	042 101	Fig. 3-178
f<>: Not ready	042 140	Fig. 3-178
f<>: Blocked by V<	042 102	Fig. 3-180
f<>: Starting f1	042 107	Fig. 3-182
f<>: Starting f1/df1	042 108	Fig. 3-182
f<>: Delta f1 triggered	042 109	Fig. 3-182
f<>: Delta t1 elapsed	042 110	Fig. 3-182
f<>: Trip signal f1	042 111	Fig. 3-182
f<>: Starting f2	042 115	
f<>: Starting f2/df2	042 116	
f<>: Delta f2 triggered	042 117	
f<>: Delta t2 elapsed	042 118	
f<>: Trip signal f2	042 119	
f<>: Starting f3	042 123	
f<>: Starting f3/df3	042 124	
f<>: Delta f3 triggered	042 125	
f<>: Delta t3 elapsed	042 126	
f<>: Trip signal f3	042 127	

	f<>: Starting f4	042 131	
	f<>: Starting f4/df4	042 132	
	f<>: Delta f4 triggered	042 133	
	f<>: Delta t4 elapsed	042 134	
	f<>: Trip signal f4	042 135	
Power directional protection	P<>: Blocking P> EXT	035 082	Fig. 3-185
	P<>: Blocking P>> EXT	035 083	Fig. 3-185
	P<>: Blocking Q> EXT	035 084	Fig. 3-187
	P<>: Blocking Q>> EXT	035 085	Fig. 3-187
	P<>: Enabled	036 250	Fig. 3-183
	P<>: Starting P>	035 086	Fig. 3-185
	P<>: Starting P>>	035 089	Fig. 3-185
	P<>: Signal P> delayed	035 087	Fig. 3-185
	P<>: Signal P>> delayed	035 090	Fig. 3-185
	P<>: Trip signal P>	035 088	Fig. 3-186
	P<>: Trip signal P>>	035 091	Fig. 3-186
	P<>: Starting Q>	035 092	Fig. 3-187
	P<>: Starting Q>>	035 095	Fig. 3-187
	P<>: Signal Q> delayed	035 093	Fig. 3-187
	P<>: Signal Q>> delayed	035 096	Fig. 3-187
	P<>: Trip signal Q>	035 094	Fig. 3-188
	P<>: Trip signal Q>>	035 097	Fig. 3-188
Circuit breaker failure protection	CBF: Starting trig. EXT	038 016	Fig. 3-189
	CBF: Parallel trip EXT	037 019	Fig. 3-42, 3-189
	CBF: Enabled	040 055	Fig. 3-189
	CBF: Trip signal	040 026	Fig. 3-189
	CBF: tCBF running	036 066	Fig. 3-189
	CBF: CB failure	036 017	Fig. 3-189
Measuring-circuit monitoring	MCMON: Enabled	040 094	Fig. 3-191
	MCMON: Meas. circ. I faulty	040 087	Fig. 3-191
	MCMON: Undervoltage	038 038	Fig. 3-192
	MCMON: Phase sequ. V faulty	038 049	Fig. 3-192
	MCMON: Meas. circ. V faulty	038 023	Fig. 3-190
	MCMON: Meas.circ.V,I faulty	037 020	Fig. 3-190
	MCMON: Meas. voltage o.k.	038 048	Fig. 3-192

ıe monitoring

LIMIT: Enabled	040 074	Fig. 3-193
LIMIT: tI> elapsed	040 220	Fig. 3-193
LIMIT: tI>> elapsed	040 221	Fig. 3-193
LIMIT: tI< elapsed	040 222	Fig. 3-193
LIMIT: tI<< elapsed	040 223	Fig. 3-193
LIMIT: tVPG> elapsed	040 224	
LIMIT: tVPG>> elapsed	040 225	
LIMIT: tVPG< elapsed	040 226	
LIMIT: tVPG<< elapsed	040 227	
LIMIT: tVPP> elapsed	040 228	
LIMIT: tVPP>> elapsed	040 229	
LIMIT: tVPP< elapsed	040 230	
LIMIT: tVPP<< elapsed	040 231	
LIMIT: tVNG> elapsed	040 168	Fig. 3-195
LIMIT: tVNG>> elapsed	040 169	Fig. 3-195

Logic

LOGIC: Input 1 EXT	034 000	Fig. 3-197
LOGIC: Input 2 EXT	034 001	
LOGIC: Input 3 EXT	034 002	
LOGIC: Input 4 EXT	034 003	
LOGIC: Input 5 EXT	034 004	
LOGIC: Input 6 EXT	034 005	
LOGIC: Input 7 EXT	034 006	
LOGIC: Input 8 EXT	034 007	
LOGIC: Input 9 EXT	034 008	
LOGIC: Input 10 EXT	034 009	
LOGIC: Input 11 EXT	034 010	
LOGIC: Input 12 EXT	034 011	
LOGIC: Input 13 EXT	034 012	
LOGIC: Input 14 EXT	034 013	
LOGIC: Input 15 EXT	034 014	
LOGIC: Input 16 EXT	034 015	Fig. 3-197
LOGIC: Set 1 EXT	034 051	Fig. 3-196
LOGIC: Set 2 EXT	034 052	
LOGIC: Set 3 EXT	034 053	
LOGIC: Set 4 EXT	034 054	
LOGIC: Set 5 EXT	034 055	
LOGIC: Set 6 EXT	034 056	
LOGIC: Set 7 EXT	034 057	
LOGIC: Set 8 EXT	034 058	
LOGIC: Reset 1 EXT	034 059	Fig. 3-196
LOGIC: Reset 2 EXT	034 060	
LOGIC: Reset 3 EXT	034 061	
LOGIC: Reset 4 EXT	034 062	
LOGIC: Reset 5 EXT	034 063	
LOGIC: Reset 6 EXT	034 064	
LOGIC: Reset 7 EXT	034 065	
LOGIC: Reset 8 EXT	034 066	
LOGIC: 1 has been set	034 067	Fig. 3-196
LOGIC: 2 has been set	034 068	
LOGIC: 3 has been set	034 069	
LOGIC: 4 has been set	034 070	
LOGIC: 5 has been set	034 071	
LOGIC: 6 has been set	034 072	
LOGIC: 7 has been set	034 073	
LOGIC: 8 has been set	034 074	
LOGIC: 1 set externally	034 075	Fig. 3-196
LOGIC: 2 set externally	034 076	
LOGIC: 3 set externally	034 077	
LOGIC: 4 set externally	034 078	
LOGIC: 5 set externally	034 079	
LOGIC: 6 set externally	034 080	
LOGIC: 7 set externally	034 081	
LOGIC: 8 set externally	034 082	
LOGIC: Enabled	034 046	Fig. 3-197
LOGIC: Output 1	042 032	Fig. 3-197
LOGIC: Output 1 (t)	042 033	Fig. 3-197
LOGIC: Output 2	042 034	
LOGIC: Output 2 (t)	042 035	Fig. 3-133

LOGIC: Output 3	042 036
LOGIC: Output 3 (t)	042 037
LOGIC: Output 4	042 038
LOGIC: Output 4 (t)	042 039
LOGIC: Output 5	042 040
LOGIC: Output 5 (t)	042 041
LOGIC: Output 6	042 042
LOGIC: Output 6 (t)	042 043
LOGIC: Output 7	042 044
LOGIC: Output 7 (t)	042 045
LOGIC: Output 8	042 046
LOGIC: Output 8 (t)	042 047
LOGIC: Output 9	042 048
LOGIC: Output 9 (t)	042 049
LOGIC: Output 10	042 050
LOGIC: Output 10 (t)	042 051
LOGIC: Output 11	042 052
LOGIC: Output 11 (t)	042 053
LOGIC: Output 12	042 054
LOGIC: Output 12 (t)	042 055
LOGIC: Output 13	042 056
LOGIC: Output 13 (t)	042 057
LOGIC: Output 14	042 058
LOGIC: Output 14 (t)	042 059
LOGIC: Output 15	042 060
LOGIC: Output 15 (t)	042 061
LOGIC: Output 16	042 062
LOGIC: Output 16 (t)	042 063
LOGIC: Output 17	042 064
LOGIC: Output 17 (t)	042 065
LOGIC: Output 18	042 066
LOGIC: Output 18 (t)	042 067
LOGIC: Output 19	042 068
LOGIC: Output 19 (t)	042 069
LOGIC: Output 20	042 070
LOGIC: Output 20 (t)	042 071
LOGIC: Output 21	042 072
LOGIC: Output 21 (t)	042 073
LOGIC: Output 22	042 074
LOGIC: Output 22 (t)	042 075
LOGIC: Output 23	042 076
LOGIC: Output 23 (t)	042 077
LOGIC: Output 24	042 078
LOGIC: Output 24 (t)	042 079
LOGIC: Output 25	042 080
LOGIC: Output 25 (t)	042 081
LOGIC: Output 26	042 082
LOGIC: Output 26 (t)	042 083
LOGIC: Output 27	042 084
LOGIC: Output 27 (t)	042 085
LOGIC: Output 28	042 086
LOGIC: Output 28 (t)	042 087
LOGIC: Output 29	042 088

LOGIC: Output 29 (t)	042 089
LOGIC: Output 30	042 090
LOGIC: Output 30 (t)	042 091
LOGIC: Output 31	042 092
LOGIC: Output 31 (t)	042 093
LOGIC: Output 32	042 094
LOGIC: Output 32 (t)	042 095

8.1.2 Control and Testing

DVICE: Service info 031 080	031 080	

ɪtrol panel

LOC: Param. change enabl.	003 010	
Setting the enable for changing values from the local control panel.		

communication 1

COMM1: Sel.spontan.sig.test	003 180	
Signal selection for testing purposes.		
COMM1: Test spont.sig.start	003 184	
Trigger for the transmission of the selected signal (as signal 'start').		
COMM1: Test spont.sig. end	003 186	
Trigger for the transmission of the selected signal (as signal 'end').		

communication 2

COMM2: Sel.spontan.sig.test	103 180	
Signal selection for testing purposes.		
COMM2: Test spont.sig.start	103 184	
Trigger for the transmission of the selected signal (as signal 'start').		
COMM2: Test spont.sig. end	103 186	
Trigger for the transmission of the selected signal (as signal 'end').		

communication 3

COMM3: Reset No. tel.errors	120 037	
COMM3: Send signal for test	120 050	
COMM3: Log. state for test	120 051	
COMM3: Send signal, test	120 053	
COMM3: Loop back send	120 055	
COMM3: Loop back test	120 054	
COMM3: Hold time for test	120 052	

ɪd analog outputs

OUTP: Reset latch. USER	021 009	Fig. 3-22
Reset of latched output relays from the local control panel.		
OUTP: Relay assign. f.test	003 042	Fig. 3-23
Selection of the relay to be tested.		
OUTP: Relay test	003 043	Fig. 3-23
The relay selected for testing is triggered for the set time (OUTP: Hold-time for test). This control action is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).		
OUTP: Hold-time for test	003 044	Fig. 3-23
Setting for the time period for which the selected output relay is triggered for functional testing.		

Main function

MAIN: Enable syst. IN USER — 003 142 Fig. 3-37

Enabling the residual current stages of the DTOC/IDMT protection.

MAIN: Disable syst.IN USER — 003 141 Fig. 3-37

Disabling the residual current stages of the DTOC/IDMT protection.

MAIN: General reset — 003 002 Fig. 3-52

Reset of the following memories:

- All counters
- LED indicators
- Operating data memory
- All event memories
- Event counters
- Fault data
- Measured overload data
- Recorded fault values

This control action is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

MAIN: Reset indicat. USER — 021 010 Fig. 3-52

Reset of the following displays:

- LED indicators
- Fault data

MAIN: Rset.latch.trip USER — 021 005 Fig. 3-48

Reset of latched trip commands from the local control panel.

MAIN: Reset c. cl./trip c. — 003 007 Fig. 3-50

The counters for counting the close and trip commands are reset.

MAIN: Reset IP,max,stored — 003 033 Fig. 3-26

The display for the stored maximum phase current is reset.

MAIN: Reset meas.v. energy — 003 032 Fig. 3-34

The display for active and reactive energy output and input is reset.

MAIN: Man. trip cmd. USER — 003 040 Fig. 3-49

A trip command is issued from the local control panel for 100 ms. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

Note:
The command is only executed if the manual trip command has been configured as trip command 1 or 2.

MAIN: Man. close cmd. USER — 018 033 Fig. 3-42

A close command is issued from the local control panel for the set reclose command time. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

	MAIN: Warm restart 003 039 A warm restart is carried out. The device functions as it does when the power supply is turned on.	
	MAIN: Cold restart 000 085 A cold restart is executed. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6). A cold restart means that all settings and recordings are cleared. The values with which the device operates after a cold restart are the underlined default settings given in the 'Range of Values' column in the Address List. They are selected so as to block the device after a cold restart.	
g data recording	OP_RC: Reset recording 100 001 The operating data memory and the counter for operation signals are reset.	Fig. 3-57
g signal recording	MT_RC: Reset recording 003 008 Reset of the monitoring signal memory.	Fig. 3-58
recording	OL_RC: Reset recording 100 003 Reset of the overload memory.	Fig. 3-63
ault recording	GF_RC: Reset recording 100 000 Reset of the ground fault memory.	Fig. 3-72
ording	FT_RC: Trigger USER 003 041 Fault recording is enabled from the local control panel for 500 ms.	Fig. 3-80
	FT_RC: Reset recording 003 006 Reset of the following memories: □ LED indicators □ Fault memory □ Fault counter □ Fault data □ Recorded fault values	Fig. 3-81
e signaling	PSIG: Enable USER 003 132 Protective signaling is enabled from the local control panel.	Fig. 3-117
	PSIG: Disable USER 003 131 Protective signaling is disabled from the local control panel.	Fig. 3-117
	PSIG: Test telecom. USER 015 009 A send signal is issued for 500 ms.	Fig. 3-119

Auto-reclosing control

ARC: Enable USER	003 134	Fig. 3-123
The auto-reclosing control function is enabled from the local control panel.		
ARC: Disable USER	003 133	Fig. 3-123
The auto-reclosing control function is disabled from the local control panel.		
ARC: Test HSR A-B-C USER	011 066	Fig. 3-136
A three-pole test HSR is triggered.		
ARC: Reset counters	003 005	Fig. 3-138
The ARC counters are reset.		

Ground fault direction determination using steady-state values

GFDSS: Reset counters	003 004	Fig. 3-146, 3-152
The counters for the ground fault direction determination function using steady-state values are reset.		

Motor protection

MP: Rset therm.repl.USER	022 073	Fig. 3-161
Resetting the thermal replica of the motor protection function.		

Thermal overload protection

THERM: Rset.therm.repl.USER	022 061	Fig. 3-166
Resetting the thermal replica of the thermal overload protection function.		

Logic

LOGIC: Trigger 1	034 038	Fig. 3-197
LOGIC: Trigger 2	034 039	
LOGIC: Trigger 3	034 040	
LOGIC: Trigger 4	034 041	
LOGIC: Trigger 5	034 042	
LOGIC: Trigger 6	034 043	
LOGIC: Trigger 7	034 044	
LOGIC: Trigger 8	034 045	Fig. 3-197
Intervention in the logic at the appropriate point by a 100 ms pulse.		

8.1.3 Operating Data Recording

ɟ data recording

OP_RC: Operat. data record. 003 024	Fig. 3-57
Point of entry into the operating data log.	

'g signal recording

MT_RC: Mon. Signal record. 003 001	Fig. 3-58
Point of entry into the monitoring signal log.	

8.2 Events

8.2.1 Event counters

"Logical" communication interface 3	COMM3: No. telegram errors	120 042
Main function	MAIN: No. general start. Number of general starting signals.	004 000 Fig. 3-46
	MAIN: No. gen.trip cmds. 1 Number of general trip commands 1.	004 006 Fig. 3-50
	MAIN: No. gen.trip cmds. 2 Number of general trip commands 2.	009 050 Fig. 3-50
	MAIN: No. close commands Number of close commands.	009 055 Fig. 3-42
	MAIN: No.overfl.act.en.out	009 090 Fig. 3-34
	MAIN: No.overfl.act.en.inp	009 091 Fig. 3-34
	MAIN: No.ov/fl.reac.en.out	009 092 Fig. 3-34
	MAIN: No.ov/fl.reac.en.inp	009 093 Fig. 3-34
Operating data recording	OP_RC: No. oper. data sig. Number of signals stored in the operating data memory.	100 002 Fig. 3-57
Monitoring signal recording	MT_RC: No. monit. signals Number of signals stored in the monitoring signal memory.	004 019 Fig. 3-58
Overload recording	OL_RC: No. overload Number of overload events.	004 101 Fig. 3-62
Ground fault recording	GF_RC: No. ground faults Number of ground faults.	004 100 Fig. 3-71
Fault recording	FT_RC: No. of faults Number of faults.	004 020 Fig. 3-80
	FT_RC: No. system disturb. Number of system disturbances.	004 010 Fig. 3-80
Auto-reclosing control	ARC: Number HSR A-B-C Number of high-speed reclosures.	004 007 Fig. 3-138
	ARC: Number TDR Number of time-delay reclosures.	004 008 Fig. 3-138

ault direction
ation using
ate values

GFDSS: No. GF power/admitt.	009 002 Fig. 3-152
Number of ground faults detected by steady-state power evaluation.	
GFDSS: No. GF (curr. meas)	009 003 Fig. 3-146
Number of ground faults detected by steady-state current evaluation.	
GFDSS: No. GF admitt. Y(N)	009 060 Fig. 3-152
Number of ground faults (non-directional) detected by the admittance evaluation method.	
GFDSS: No. GF forward/LS	009 000 Fig. 3-152
Number of ground faults in the forward direction.	
GFDSS: No. GF backward/BS	009 001 Fig. 3-152
Number of ground faults in the backward direction.	
MP: No. of start-ups	004 011 Fig. 3-160
Number of motor startups since the last reset.	

8.2.2 Measured event data

Overload data acquisition

OL_DA: Overload duration	004 102 Fig. 3-59
Duration of the overload event.	
OL_DA: T.taken f.startup,MP	005 096 Fig. 3-60
Display of the motor startup time.	
OL_DA: Start-up current, MP	005 098 Fig. 3-60
Display of the motor startup current.	
OL_DA: Heat.dur.start-up,MP	005 097 Fig. 3-60
Display of startup heating in motor protection.	
OL_DA: Status THERM replica	004 147 Fig. 3-61
Display of the buffer content of the thermal overload protection function.	
OL_DA: Load current THERM	004 058 Fig. 3-61
Display of the load current used by the thermal overload protection function to calculate the tripping time.	
OL_DA: Object temp. THERM	004 035 Fig. 3-61
Anzeige der Temperatur des Schuztobjektes.	
OL_DA: Pre-trip t.leftTHERM	004 148 Fig. 3-61
Display of the time remaining before the thermal overload protection function will reach the tripping threshold.	
OL_DA: Offset THERM replica	004 154 Fig. 3-61
Display of the additional reserve if the coolant temperature is taken into account. This display is relevant if the coolant temperature has been set to a value below the maximum permissible coolant temperature or, in other words, if the thermal model has been shifted downwards. If, on the other hand, the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to zero in this case.	

ault data acquisition

GF_DA: Ground flt. duration 009 100 Fig. 3-64

Display of the ground fault duration of the most recent ground fault.

GF_DA: GF duration pow.meas 009 024 Fig. 3-65

Display of the ground fault duration of the most recent ground fault as determined by the steady-state power evaluation feature of the ground fault direction determination function.

GF_DA: Voltage VNG p.u. 009 020 Fig. 3-66, 3-70

Display of the neutral-displacement voltage of the most recent ground fault referred to V_{nom}.

Note:
This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.

GF_DA: Current IN p.u. 009 021 Fig. 3-66, 3-68,3-70

Display of the residual current of the most recent ground fault referred to I_{nom}.

Note:
This display is only active when the ground fault direction determination function using steady state values (GFDSS) is enabled.

GF_DA: Curr. IN,act p.u. 009 022 Fig. 3-66

Display of the active component of the residual current of the most recent ground fault referred to I_{nom}.

Note:

This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.

GF_DA: Curr.IN,reac p.u. 009 023 Fig. 3-66

Display of the reactive component of the residual current of the most recent ground fault referred to I_{nom}.

Note:
This display is only active if the steady-state power evaluation mode of the ground fault direction determination function is enabled.

GF_DA: GF durat. curr.meas. 009 026 Fig. 3-67

Display of the ground fault duration of the most recent ground fault as determined by the steady-state current evaluation feature of the ground fault direction determination function.

GF_DA: Curr. IN filt. p.u. 009 025 Fig. 3-68

Display of the residual current component having the set filter frequency for the most recent ground fault (referred to I_{nom}).

GF_DA: GF duration admitt. 009 068 Fig. 3-69

Display of the ground fault duration of the most recent ground fault as determined by the admittance evaluation mode of the ground fault direction determination function.

GF_DA: Admittance Y(N) p.u.	009 065 Fig. 3-70
Display of the admittance value referred to $Y_{N,nom}$. If GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated*: $Y_{N,nom} = I_{N,nom} / V_{nom}$	
GF_DA: Conduct. G(N) p.u.	009 066 Fig. 3-70
Display of the conductance value referred to $Y_{N,nom}$. If GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated:* $Y_{N,nom} = I_{N,nom} / V_{nom}$	
GF_DA: Suscept. B(N) p.u.	009 067 Fig. 3-70
Display of the susceptance value referred to $Y_{N,nom}$. If GFDSS: Evaluation VNG is set to *Measured*: $Y_{N,nom} = I_{N,nom} / V_{NG,nom}$ If GFDSS: Evaluation VNG is set to *Calculated:* $Y_{N,nom} = I_{N,nom} / V_{nom}$	

ə acquisition

FT_DA: Fault duration	003 010 Fig. 3-73
Display of the fault duration.	
FT_DA: Running time	004 021 Fig. 3-73
Display of the running time.	
FT_DA: Fault current P p.u.	004 025 Fig. 3-77
Display of the fault current referred to I_{nom}.	
FT_DA: Flt.volt. PG/PP p.u.	004 026 Fig. 3-77
Display of the fault voltage referred to V_{nom}.	
FT_DA: Fault loop angle P	004 024 Fig. 3-77
Display of the fault angle.	
FT_DA: Fault curr. N p.u.	004 049 Fig. 3-77
Display of the ground fault current referred to $I_{N,nom}$.	
FT_DA: Fault loop angle N	004 048 Fig. 3-77
Display of the ground fault angle.	
FT_DA: Meas. loop selected	004 079 Fig. 3-77
Display of the measuring loop selected for determination of fault data.	
FT_DA: Fault react., prim.	004 029 Fig. 3-77
Display of the fault reactance as a primary quantity.	
FT_DA: Fault reactance,sec.	004 028 Fig. 3-77
Display of the fault reactance as a secondary quantity.	
FT_DA: Fault impedance, sec	004 023 Fig. 3-77
Display of the fault impedance as a secondary quantity.	
FT_DA: Fault locat. percent	004 027 Fig. 3-78
Display of the fault location of the last fault (in %) referred to the setting FT_DA: Line reactance PSx.	
FT_DA: Fault location	004 022 Fig. 3-78
Display of the fault location of the last fault in km.	
FT_DA: Load imped.post-flt.	004 037 Fig. 3-79
Display of the load impedance (in Ω) after the general starting condition of distance protection has ended. The display only appears if the fault has been detected by the fault data acquisition function of the P130C.	
FT_DA: Load angle post-flt.	004 038 Fig. 3-79
Display of the load angle (in degrees) after the general starting condition of time-overcurrent protection has ended. The display only appears if the fault has been detected by the fault data acquisition function of the P130C.	
FT_DA: Resid.curr. post-flt	004 039 Fig. 3-79
Display of the residual current of the last fault referred to I_{nom}. The display only appears if the fault has been detected by the fault data acquisition function of the P130C.	

8.2.3 Event recording

Overload recording

OL_RC: Overload recording 1	033 020	Fig. 3-63
OL_RC: Overload recording 2	033 021	Fig. 3-63
OL_RC: Overload recording 3	033 022	Fig. 3-63
OL_RC: Overload recording 4	033 023	Fig. 3-63
OL_RC: Overload recording 5	033 024	Fig. 3-63
OL_RC: Overload recording 6	033 025	Fig. 3-63
OL_RC: Overload recording 7	033 026	Fig. 3-63
OL_RC: Overload recording 8	033 027	Fig. 3-63
Point of entry into the overload log.		

Ground fault recording

GF_RC: Ground flt.record. 1	033 010	Fig. 3-72
GF_RC: Ground flt.record. 2	033 011	Fig. 3-72
GF_RC: Ground flt.record. 3	033 012	Fig. 3-72
GF_RC: Ground flt.record. 4	033 013	Fig. 3-72
GF_RC: Ground flt.record. 5	033 014	Fig. 3-72
GF_RC: Ground flt.record. 6	033 015	Fig. 3-72
GF_RC: Ground flt.record. 7	033 016	Fig. 3-72
GF_RC: Ground flt.record. 8	033 017	Fig. 3-72
Point of entry into the ground fault log.		

Fault recording

FT_RC: Fault recording 1	003 000	Fig. 3-81
FT_RC: Fault recording 2	033 001	Fig. 3-81
FT_RC: Fault recording 3	033 002	Fig. 3-81
FT_RC: Fault recording 4	033 003	Fig. 3-81
FT_RC: Fault recording 5	033 004	Fig. 3-81
FT_RC: Fault recording 6	033 005	Fig. 3-81
FT_RC: Fault recording 7	033 006	Fig. 3-81
FT_RC: Fault recording 8	033 007	Fig. 3-81
Point of entry into the fault log.		

9 Commissioning

9 Commissioning

9.1 Safety Instructions

The device must be reliably grounded before auxiliary voltage is turned on.

The case is grounded using the appropriate bolt and nut as the ground connection. The cross-sectional area of this ground conductor must also conform to applicable national standards. A minimum conductor cross section of 2.5 mm^2 is required.

Before working on the device itself or in the space where the device is connected, always disconnect the device from the supply.

The secondary circuit of operating current transformers must not be opened. If the secondary circuit of an operating current transformer is opened, there is the danger that the resulting voltages will endanger people and damage the insulation.

The threaded terminal block for current transformer connection is not a shorting block. Therefore always short-circuit the current transformers before loosening the threaded terminals.

The fiber-optic interface may only be connected or disconnected when the supply voltage for the unit is shut off.

The PC interface is not designed for permanent connection. Consequently the socket does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter entitled 'Technical Data').

9.2 Commissioning Tests

After the P130C has been installed and connected as described in Chapter 5, the commissioning procedure can begin.

Before turning on the power supply voltage, the following items must be checked again:

- □ Is the device connected to the protective ground at the specified location?
- □ Does the nominal voltage of the battery agree with the nominal auxiliary voltage of the device?
- □ Are the current and voltage transformer connections, grounding, and phase sequences correct?

After the wiring work is completed, check the system to make sure it is properly isolated. The conditions given in VDE 0100 must be satisfied.

Once all checks have been made, the power supply voltage may be turned on. After voltage has been applied, the device starts up. During startup, various startup tests are carried out (see section entitled 'Self-Monitoring' in Chapter 3). The LED indicator labeled 'HEALTHY' (H1) and the LED indicator labeled 'OUT OF SERVICE' (H2) will light up. (The LED indicator H2 is coupled to the signal MAIN: Blocked/faulty.) After approximately 15 s, the P130C is ready for operation. This is indicated by the display 'P130C' in the first line of the LCD.

Once the change-enabling command has been issued (see the Section Change-Enabling Function in Chapter 6), all settings can be entered. The procedure for entering settings from the integrated local control panel is described in Chapter 6.

If either the PC interface or the communication interface will be used for setting the P130C and reading out event records, then the following settings must first be made from the integrated local control panel.

- 'Par/DvID/' folder:
  - DVICE: Device password 1
  - DVICE: Device password 2
- 'Par/Conf/' folder:
  - PC: Name of manufacturer
  - PC: Bay address
  - PC: Device address
  - PC: Baud rate
  - PC: Parity bit
  - COMM1: Function group COMM1
  - COMM1: General enable USER
  - COMM1: Name of manufacturer
  - COMM1: Line idle state
  - COMM1: Baud rate
  - COMM1: Parity bit
  - COMM1: Communicat. protocol
  - COMM1: Octet comm. address
  - COMM1: Octet address ASDU
  - COMM2: Function group COMM2
  - COMM2: General enable USER
  - COMM2: Name of manufacturer
  - COMM2: Line idle state
  - COMM2: Baud rate
  - COMM2: Parity bit
  - COMM2: Octet comm. address
  - COMM2: Octet comm. ASDU
  - COMM3: Function group COMM3
  - COMM3: General enable USER
  - COMM3: Baud rate

□ 'Par/Func/Glob/' folder:

- PC: Command blocking
- PC: Sig./meas.val.block
- COMM1: Command block. USER
- COMM1: Sig./meas.block.USER
- COMM2: Command block. USER
- COMM2: Sig./meas.block.USER

Instructions on these settings are given in Chapters 7 and 8.

Note: The settings given above apply to the IEC 60870-5-103 communication protocol. If another protocol is being used for the communication interface, additional settings may be necessary. See Chapter 7 for further details.

After the settings have been made, the following checks should be carried out again before blocking is canceled:

□ Does the function assignment of the binary signal inputs agree with the terminal connection diagram?

□ Has the correct operating mode been selected for the binary signal inputs?

□ Does the function assignment of the output relays agree with the terminal connection diagram?

□ Has the correct operating mode been selected for the output relays?

□ Have all settings been made correctly?

Now the block can be cleared as follows ('Par/Func/Glob/' folder):

□ MAIN: Device on-line *"Yes (on)"*

Tests

By using the signals and displays generated by the P130C, it is possible to determine whether the P130C is correctly set and properly interconnected with the station. Signals are signaled by output relays and LED indicators and entered into the event memory. In addition, the signals can be checked by selecting the appropriate signal in the menu tree.

If the user does not wish to operate the circuit breaker during the protection functions test, the trip commands can be blocked through MAIN: Trip cmd. block. USER ('Par/Func/Glob/' folder) or an appropriately configured binary signal input. If circuit breaker testing is desired, it is possible to issue a trip command for 100 ms through MAIN: Man. trip cmd. USER ('Oper/CtrlTest' folder) or an appropriately configured binary signal input. Selection of the trip command from the integrated local control panel is password-protected (see Section Password-Protected Control Actions in Chapter 6).

Note: The manual trip command is only executed if it has been configured for trip command 1 or 2.

If the P130C is connected to substation control level, it is advisable to activate the test mode via MAIN: Test mode USER ('Par/Func/Glob/' folder) or an appropriately configured binary signal input. The telegrams are then identified accordingly (cause of transmission: test mode).

the binary signal

By selecting the corresponding state signal ('Oper/Cycl/Phys' folder), it is possible to determine whether the input signal that is present is recognized correctly by the P130C. The values displayed have the following meanings:

- *Low*: Not energized.
- *High*: Energized.
- *Without function*: No functions are assigned to the binary signal input.

This display appears regardless of the binary signal input mode selected.

the ... tput relays

It is possible to trigger the output relays for a settable time period for test purposes (time setting at OUTP: Hold-time for test in 'Oper/CtrlTest/' folder). First select the output relay to be tested (OUTP: Relay assign. f.test, 'Oper/CtrlTest/' folder). Test triggering then occurs via OUTP: Relay test (Oper/CtrlTest/' folder). It is password-protected (see the section entitled 'Password-Protected Control Operations' in Chapter 6).

⚠

Before starting the test, open any triggering circuits for external devices so that no inadvertent switching operations will take place.

the current-
g inputs

By applying appropriate analog signals as 'measuring variables' to the measuring inputs, the user can check via the operating data displays (see Chapter 'Information and Control Functions') whether the protection and control unit detects the analog signals with the specified accuracy (folder 'Oper/Cycl/Data/').

- MAIN: Current A p.u.: Display of the updated phase current A referred to the nominal device current I_{nom}
- MAIN: Current B p.u.: Display of the updated phase current B referred to the nominal device current I_{nom}
- MAIN: Current C p.u.: Display of the updated phase current C referred to the nominal device current I_{nom}
- MAIN: Current IN p.u.: Display of the updated phase current IN referred to the nominal device current I_{nom}

⚠

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

Checking the protection function

Four parameter subsets are stored in the P130C, one of which is activated. Before checking the protective function, the user should determine which parameter subset is activated. The activated parameter subset is displayed at PSS: Actual param. subset ('Oper/Cycl/Log/" folder).

When testing the time-overcurrent protection with a testing device, the measuring-circuit monitoring function should be deactivated (MCMON: General enable USER, folder 'Par/Func/Gen/') since it would otherwise always operate and thus, depending on the setting, issue fault signals.

Checking the connection of the phase current and voltage transformers with load current for correct phase

The user can check to make sure connection to the system's current and voltage transformers involves the correct phase by consulting the operating data displays for load angle (MAIN: Load angle phi A, MAIN: Load angle phi B, MAIN: Load angle phi C in the 'Oper/Cycl/Meas/' folder). To this end, it is necessary for the connection to be *standard* in accordance with the standard schematic diagram shown in Chapter 'Installation and Connection' and for the setting of MAIN: Conn. meas. circ. IP to be *'standard'*. In the case of a purely resistive load, the load angles of all three phases must be 0° in line direction. The load angles are only determined if at least 5% of the nominal device current is flowing.

the connection of
'al current
er with load
r correct phase

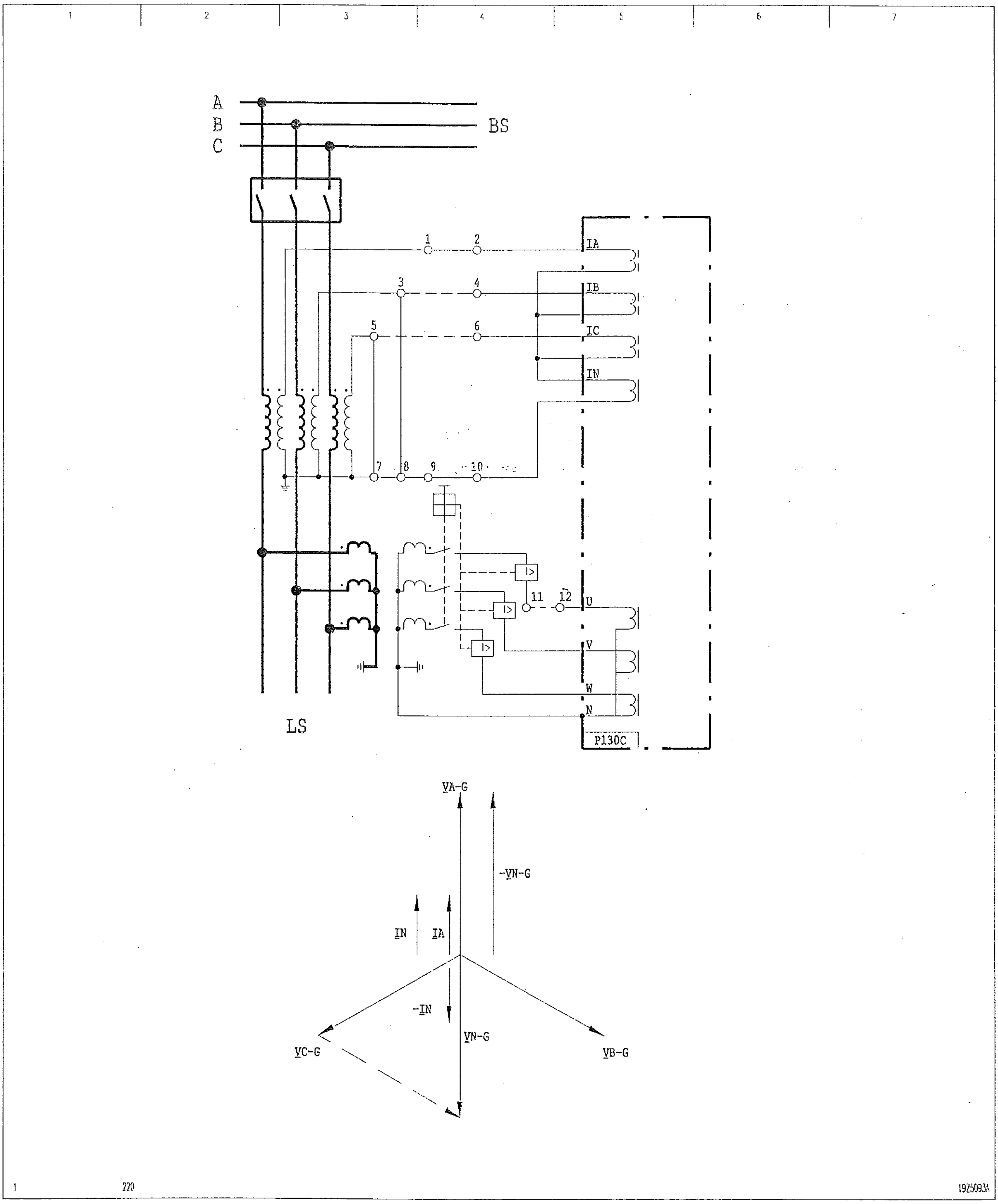
Whether connection of the P130C's residual current transformer involves the correct phase can be checked using the operating data displays (MAIN: Angle phiN, folder 'Oper/Cycl/Data/'). The required measuring variables V_{NG} and I_N must be generated. If the connection is standard in accordance with the standard schematic diagram shown in Chapter 'Installation and Connection' and the setting of MAIN: Conn. meas. circ. IN (folder 'Par/Func/Glob/') is 'standard' then a phase-to-ground voltage needs to be disconnected and the phase currents of the other two phases need to be shorted at the same time (see Figure 9-1).

The set rotary field needs to match the actual rotary field. In the case of a purely resistive load, the angle φ_N must have the following values (depending on the direction of energy flow in either line or busbar direction):

Display	Energy in line direction	Energy in busbar direction
MAIN: Angle phiN (folder 'Oper/Cycl/Data/')	Approx. 0°	Approx. 180°

testing of the
n of the residual
ansformer with
nt for correct

If the residual current does not originate from a dedicated main current transformer such as a window-type transformer, a simplified test can be carried out. In this procedure, after a positive test as to whether connection of the phase current and voltage transformers involves the correct phase and after shorting any one of the phase currents, the phase of the measured residual current is compared to the phase of the sum of phase currents. In the case of a phase match (or a positive direction check), the measured operating value MAIN: Phase rel.,IN vs ΣIP (folder 'Oper/Cycl/Data/') is displayed as '1'. The phase relation check is carried out only if the calculated residual current is in excess of $0.1 \cdot I_{nom}$.



9-1 *Connection example - generation of measuring variables*

the definite-time
nt protection

Testing of the definite-time overcurrent protection function can only be carried out if the following conditions are met:

- ☐ DTOC protection is enabled. This may be interrogated at the logic state signal DTOC: Enabled ('Oper/Cycl/Log/' folder).
- ☐ The function MAIN: Block tim.st. IN,neg is set to *No* (folder Par/Func/Gen).
- ☐ The function MAIN: Gen. starting mode is set to '*Starting IN, Ineg*' (folder Par/Func/Gen).
- ☐ The short-circuit direction determination function is disabled. SCDD: General enable USER (folder 'Par/Func/Gen') is set to *'No'*.

By applying appropriate measuring variables, the overcurrent stages and the associated timer stages can be tested.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

the inverse-time
nt protection

Testing of the inverse-time overcurrent protection function can only be carried out if the following conditions are met:

- ☐ IDMT protection is enabled. This may be interrogated at the logic state signal IDMT: Enabled (folder 'Oper/Cycl/Log/').
- ☐ The function MAIN: Block tim.st. IN,neg is set to *No* (folder Par/Func/Gen).
- ☐ The function MAIN: Gen. starting mode is set to '*Starting IN, Ineg*' (folder Par/Func/Gen).
- ☐ The short-circuit direction determination function is disabled. SCDD: General enable USER (folder 'Par/Func/Gen') is set to *'No'*.

By applying appropriate measuring variables, the overcurrent stages and the associated time delays can be tested.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

The trip times for the inverse-time overcurrent protection function as a function of the set tripping characteristics are shown in the following table:

No.	Tripping Characteristic	Formula for the Tripping Characteristic	Constants a	Constants b	Constants c	Formula for the Release Characteristic	R
	k = 0.01 to 10.00		a	b	c		R
0	Definite Time	t = k					
	Per IEC 255-3	$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot \left(\frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1} + c\right)$				$t_r = k \cdot \frac{R}{\left(\frac{I}{I_{ref}}\right)^2 - 1}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4.85
6	Very Inverse		19.6100	2.0000	0.4910		21.60
7	Extremely Inverse		28.2000	2.0000	0.1217		29.10
	Per ANSI	$t = k \cdot \left(\frac{a}{\left(\frac{I}{I_{ref}}\right)^b - 1} + c\right)$				$t_r = k \cdot \frac{R}{\left(\frac{I}{I_{ref}}\right)^2 - 1}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9.00
9	Short Time Inverse		0.2663	1.2969	0.03393		0.50
10	Long Time Inverse		5.6143	1.0000	2.18592		15.75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$					
12	RXIDG-Type Inverse	$t = k \cdot \left(5.8 - 1.35 \cdot \ln\frac{I}{I_{ref}}\right)$					

l testing of the rent stages of the uit direction ation function

The current and voltage transformers of the system need to be simulated with a suitable testing device. In order to check the phase current stages of the short-circuit direction determination function, the following conditions must be met:

- □ The short-circuit direction determination function is enabled (see Chapter 3).
- □ All three phase currents are greater than 0.1 I_{nom}.
- □ At least two phase-to-phase voltages are greater than 200 mV.
- □ The directions of the short-circuit direction determination function are set to *forward.*

If the connection is standard in accordance with the standard schematic diagram shown in Chapter 'Installation and Connection' and the setting of MAIN: Conn. meas. circ. IP is *Standard* then the measurement of the short-circuit direction determination function will be in line direction. The set rotary field needs to match the actual rotary field. It is now possible to simulate the various fault types with the appropriate starting via the DTOC or IDMT protection function by applying various shorting jumpers (such as A-G). The trip signals of the phase current stages are now directional. The trip signals of the phase current stages are now directional.

testing of the urrent stages of circuit direction ation function

In order to check the residual current stages of the short-circuit direction determination function, the following conditions must be met:

- □ The short-circuit direction determination function is enabled (see Chapter 3).
- □ The residual current is in excess of $0.01 \cdot I_{nom}$.
- □ The neutral displacement voltage is greater than the set triggering value of the function SCDD: VNG>.

If the connection is standard in accordance with the standard schematic diagram shown in Chapter 'Installation and Connection' and the setting of MAIN: Conn. meas. circ. IN is '*standard*' then the measurement of the short-circuit direction determination function will be in line direction. The set rotary field needs to match the actual rotary field. It is now possible to simulate the various fault types as described under 'Direction testing of the phase current stages'. The trip signals of the residual current stages are now directional.

Checking protective signaling

The protective signaling function can only be checked if protective signaling is ready. This can be determined via the logic state signal PSIG: Ready ('Oper/Cycl/Log/' folder).

If protective signaling is not ready, this may be due to the following reasons:

- Protective signaling is not enabled.
  PSIG: General enable USER is set to *'No'*
- Protective signaling is being blocked by the triggering of a correspondingly configured binary signal input (PSIG: Blocking EXT).
- A fault was detected in the telecommunications channel (PSIG: Telecom. faulty).

If the conditions for testing are satisfied, it is possible to generate a send signal for test purposes from the integrated local control panel (PSIG: Test telecom. USER). This pulse will be present for 1 ms and is extended for the set reset time. This pulse will be present for 1 s and will be extended for the set reset time. The generated signal can be checked via the logic state signal PSIG: Send (transm. relay).

the auto-
control

The auto-reclosing function (ARC) can only be checked if it is ready. This can be determined via the logic state signal ARC: Ready ('Oper/Cycl/Log/' folder).

If the ARC function is not ready, this may be due to the following reasons:

- The ARC function is not enabled
  (this can be determined by checking the logic state signal ARC: Enabled ('Oper/Cycl/Log/' folder). This can be due to the following reasons:
  - ARC: General enable USER ('Par/Func/Gen' folder) is set to *'No'*.
  - The ARC has been disabled through an appropriately configured binary signal input ARC: Disable EXT. (This can be determined by checking the logic state signal ARC: Ext. enabled in the 'Oper/Cycl/Log/' folder.)
- The ARC is being blocked. (This can be checked at the logic state signal ARC: Blocked in folder 'Oper/Cycl/Log/'.)
- There is no signal with a logic value of "1" at the binary signal input configured for ARC: CB drive ready EXT.
- There is no signal with a logic value of '1' at the binary signal input configured for MAIN: CB closed sig. EXT. The circuit breaker position signal is only necessary if *'With'* has been set at ARC: CB clos. pos. sig. (folder 'Par/Func/Gen/').
- An ARC cycle is currently running. (This can be checked at logic state signal ARC: Cycle running in the 'Oper/Cycl/Log/' folder.)

A test HSR for checking can be executed from the integrated local control panel or by triggering a binary signal input. The test HSR function first issues a trip command and then issues a reclose command after the set dead time has elapsed.

Checking the motor protection function

By applying appropriate measuring variables, the overcurrent stages and the associated time delays can be tested.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

In order to test the motor protection function, first clear the thermal replica. Clearing the thermal replica is achieved by briefly disabling the protection function (MAIN: Device on-line set to *No,* folder 'Par/Func/Glob/'). The updated status of the thermal replica can be interrogated via the operating data display MP: Therm. repl. buffer MS (folder 'Oper/Cycl/Data/'). The trip times depend on the set tripping characteristic:

With cleared thermal replica, the test current is changed abruptly from 0 (≡ machine stopped) to a value ≥ setting value MP: IStUp> PSx, folder 'Par/Func/Gen/' (≡ machine running).

- ☐ Reciprocally squared characteristic $t = t_{6I_{ref}} \cdot \frac{36}{(I/I_{ref})^2}$
- ☐ Logarithmic characteristic: $t = t_{6I_{ref}} \cdot 36 \cdot \ln \frac{(I/I_{ref})^2}{(I/I_{ref})^2 - 1}$

the thermal
protection

By applying appropriate measuring variables, the reference current and the associated time delay can be tested.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

In order to test the thermal overload protection function, first clear the thermal replica. Clearing the thermal replica is achieved by briefly disabling the protection function (`MAIN: Device on-line` set to *No,* folder 'Par/Func/Glob/'). The updated status of the thermal replica can be interrogated via the operating data display `THERM: Therm. replica vers.` (folder 'Oper/Cycl/Data/') The trip time can be checked:
With cleared thermal replica, the test current is changed abruptly from 0 to a value of $\geq 0.1\ I_{ref}$

$$t = \tau \cdot \ln \frac{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_P}{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_{trip} \cdot \left(1 - \frac{\Theta_c - \Theta_{c,max}}{\Theta_{max} - \Theta_{c,max}}\right)}$$

Checking the voltage-time protection function

By applying appropriate analog signals as 'measuring variables' to the measuring inputs, the user can check via the operating data displays (see Chapter 'Information and Control Functions') whether the unit detects the analog signals with the specified accuracy (folder 'Oper/Cycl/Data/').

- ☐ MAIN: Voltage A-G p.u.: Display of the updated phase-to-ground voltage A-G referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage B-G p.u.: Display of the updated phase-to-ground voltage B-G referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage C-G p.u.: Display of the updated phase-to-ground voltage C-G referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage PG,max p.u.: Display of the updated maximum phase-to-ground voltage referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage PG,min p.u.: Display of the updated minimum phase-to-ground voltage referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage A-B p.u.: Display of the updated phase-to-ground voltage A-B referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage B-C p.u.: Display of the updated phase-to-ground voltage B-C referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage C-A p.u.: Display of the updated phase-to-ground voltage C-A referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage PP,max p.u.: Display of the updated maximum phase-to-phase voltage referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage PP,min p.u.: Display of the updated minimum phase-to-phase voltage referred to the nominal voltage V_{nom}.
- ☐ MAIN: Voltage VNG p.u.: Display of the neutral-point displacement voltage as measured at transformer T 90, referred to V_{nom}.
- ☐ MAIN: Voltage Σ(VPG)/$\sqrt{3}$ p.u.: Display of the calculated neutral-point displacement voltage referred to V_{nom}.

⚠

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

By applying appropriate measuring variables, the overvoltage stages and the undervoltage stages as well as the associated timer stages can be tested.

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see the Chapter on Technical Data).

The P130C calculates the neutral-point displacement voltage from the input-side measured variables as follows:

$$|\underline{V}_{N-G}| = \frac{1}{3} \cdot |\underline{V}_{A-G} + \underline{V}_{B-G} + \underline{V}_{C-G}|$$

For a single-phase test where $|\underline{V}_{B-G}| = |\underline{V}_{C-G}| = 0$, the result of the calculation formula for $\underline{V}_{N-G}$ just cited is that the V_{N-G}> and V_{N-G}>> triggers operate if the test voltage exceeds the following value:

$$|\underline{V}_{test}| = 3 \cdot V_{NG} \cdot \frac{V_{nom}}{\sqrt{3}}$$

V_{NG}: Setting V<>: V_{NG}> or V<>: V_{NG}>>

Checking the 'ground fault direction determination by steady-state values' (GFDSS) function

If both residual current and neutral displacement voltage are available as measured variables, then the P130C determines the ground fault direction by steady-state power evaluation of the measured variables if the operating mode is set to *Steady-state power* or *Steady-state admittance.* Depending on the setting, either the neutral-point displacement voltage calculated by the P130C or that measured at transformer T 90 is evaluated. If only the current can be measured, the P130C reaches a 'ground fault' decision on the basis of the level of the residual current (steady-state current evaluation). Switching to steady-state current evaluation is done from the integrated local control panel or by triggering an appropriately configured binary signal input.

If allowed by system operation, a ground fault can be closed on the busbar side (BS) or the line side (LS). The P130C must then transmit the corresponding signals. However, a requirement for ground fault recognition in the steady-state power evaluation mode is that the set thresholds for residual current (GFDSS: IN,act> / IN,reac> BS or LS) and for neutral displacement voltage (GFDSS: VNG>) be exceeded. For steady-state current evaluation, the requirement is that the residual current threshold GFDSS: IN> be exceeded. In the admittance evaluation mode, the requirement is that the set thresholds for conductance / susceptance (GFDSS: G(N)> / B(N) LS or BS) and the neutral displacement voltage (GFDSS: VNG>) be exceeded or that the admittance (GFDSS: Y(N)>) be exceeded.

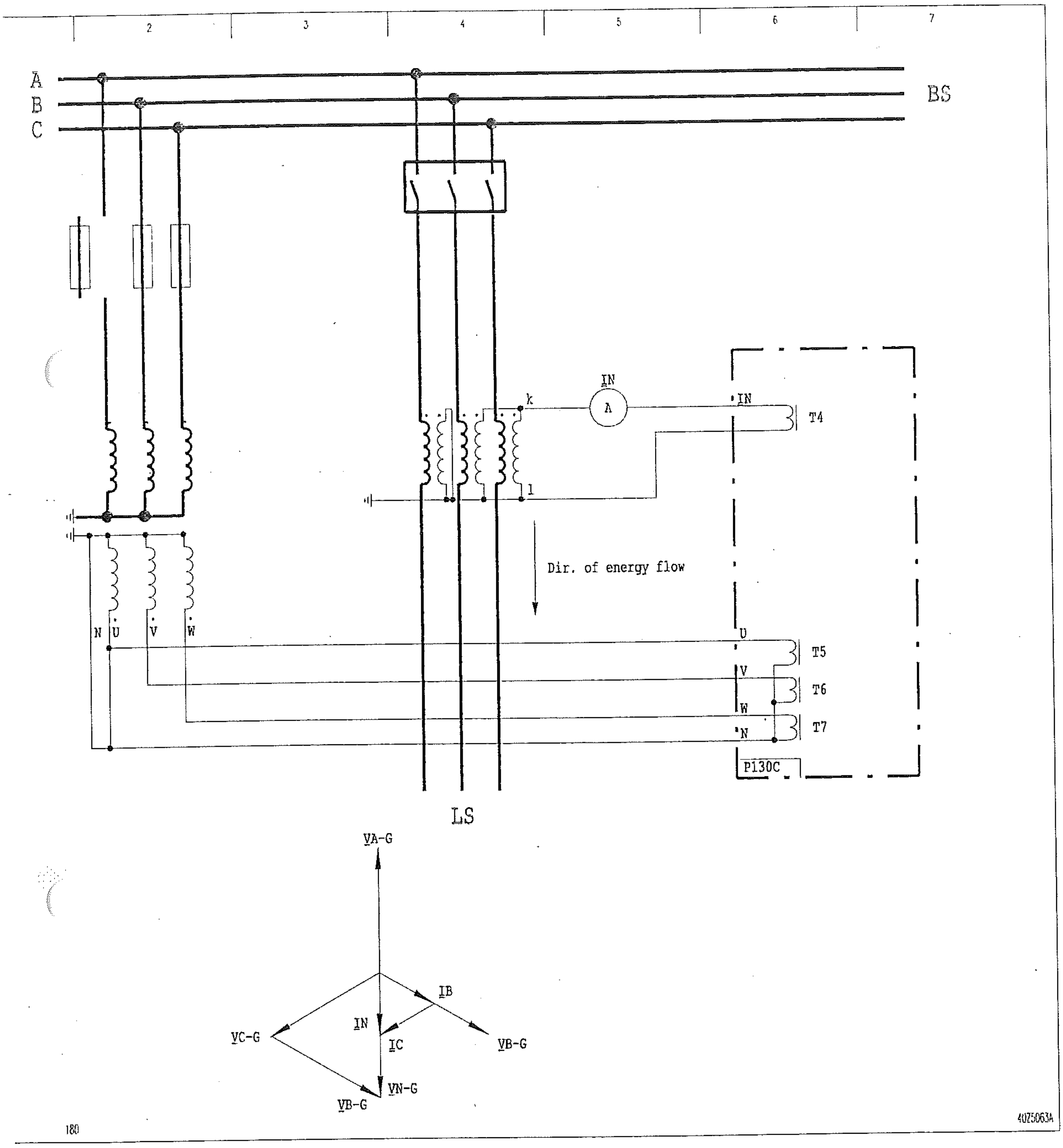
Because of the danger of a double ground fault, a function test involving the closing of a ground fault will not be possible in most cases. In these cases the current and voltage transformers in the system can be connected so that a function test is possible without a ground fault.

The residual current measured by the P130C and the neutral displacement voltage are displayed as measured operating data both in primary quantities and referred to the nominal quantities of the P130CP130C (see the section entitled 'Measured Operating Data' in the Address List).

Auxiliary circuit in resonant-grounded systems

First the fuse in phase A of the voltage transformer is removed and the associated secondary side is short-circuited (see Figures 9-2 and 9-3). The result is a displacement voltage $\underline{V}_{N-G}$ with a magnitude smaller by a factor of $\sqrt{3}$ than that of the displacement voltage in the case of a dead fault to ground.

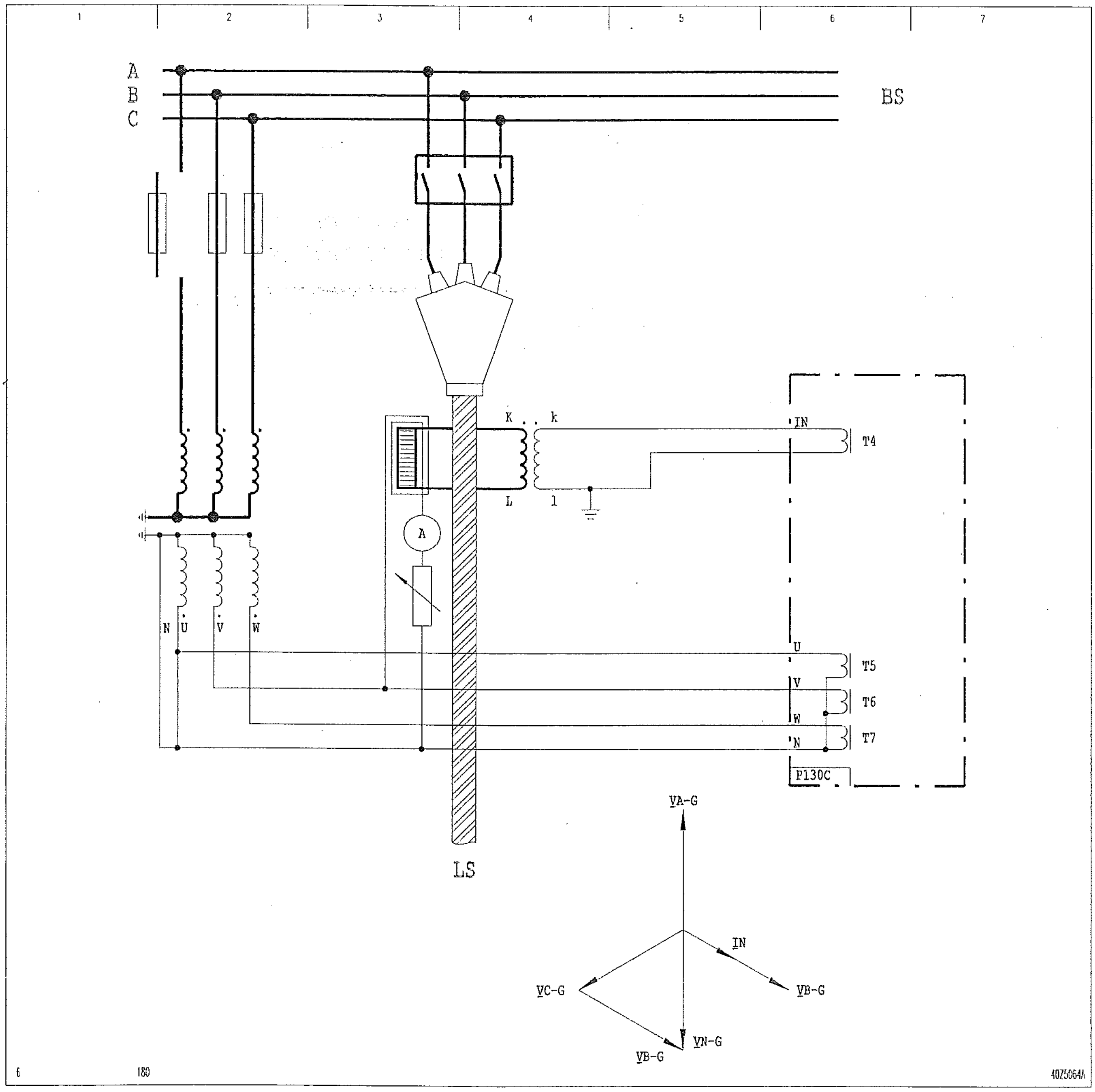
If the current is measured in a Holmgreen group, then the current transformer in A on the secondary side must be disconnected and short-circuited (see Figure 9-2).



\uxiliary circuit in resonant-grounded systems with Holmgreen group, ground fault in BS direction

A pilot wire is threaded into window-type current transformers, and a current is drawn from phase B through the wire (see Figure 9-3). The vectorial assignment of currents and voltages is shown in the phasor diagrams included with the terminal connection diagrams.

In the example shown below, a ground fault is simulated on the busbar side. To check a ground fault on the line side, the current or voltage connections must be switched.

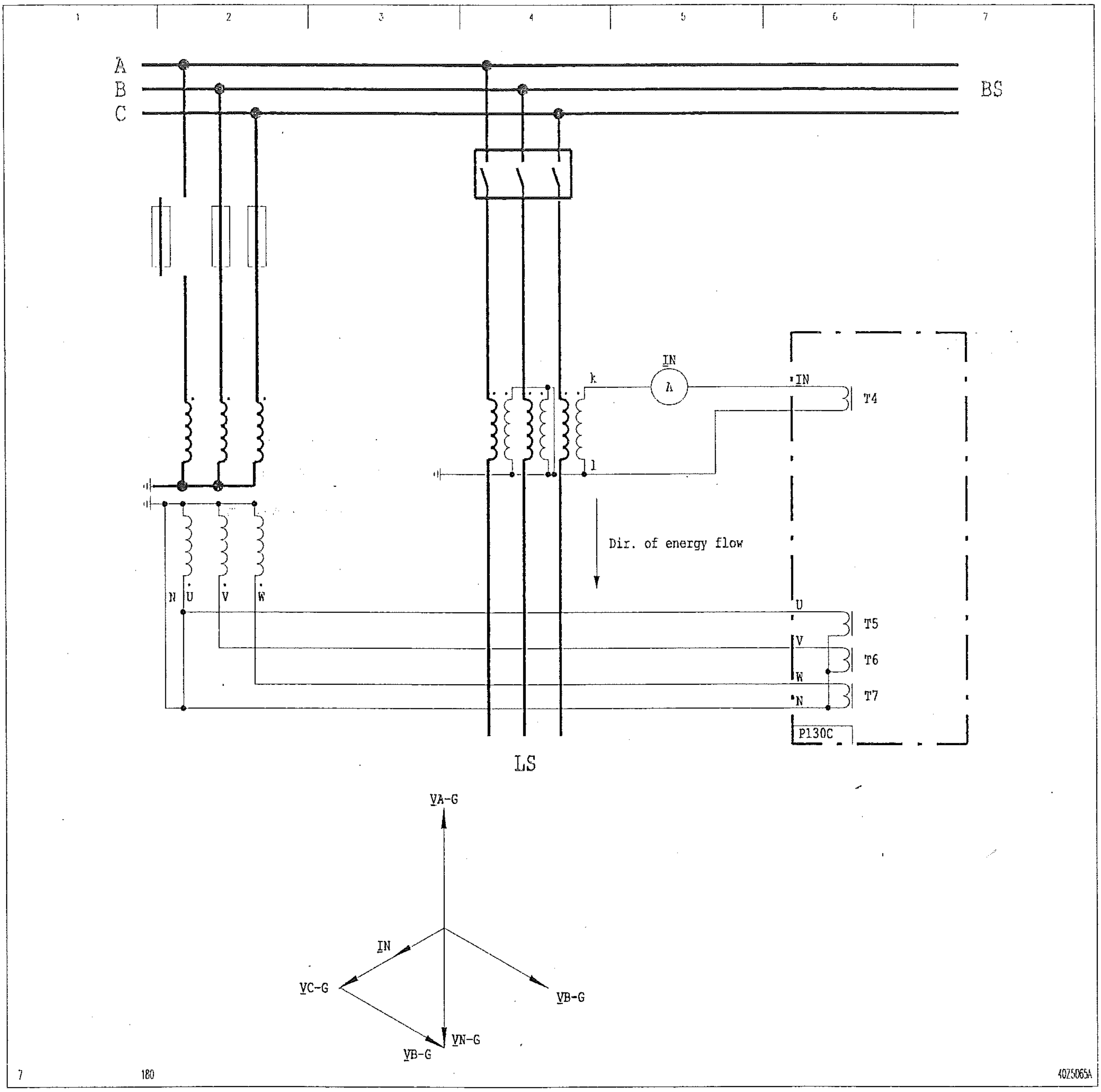


9-3 *Auxiliary circuit in resonant-grounded systems with window-type current transformer, ground fault in BS direction*

ircuit in systems
ed neutral

First the fuse in phase A on the primary side of the voltage transformer is removed and the corresponding secondary side is short-circuited (see Figures 9-4 and 9-5). The result is a displacement voltage $\underline{V}_{N\text{-}G}$ with a magnitude smaller by a factor of $\sqrt{3}$ than that of the displacement voltage in the case of a dead fault to ground.

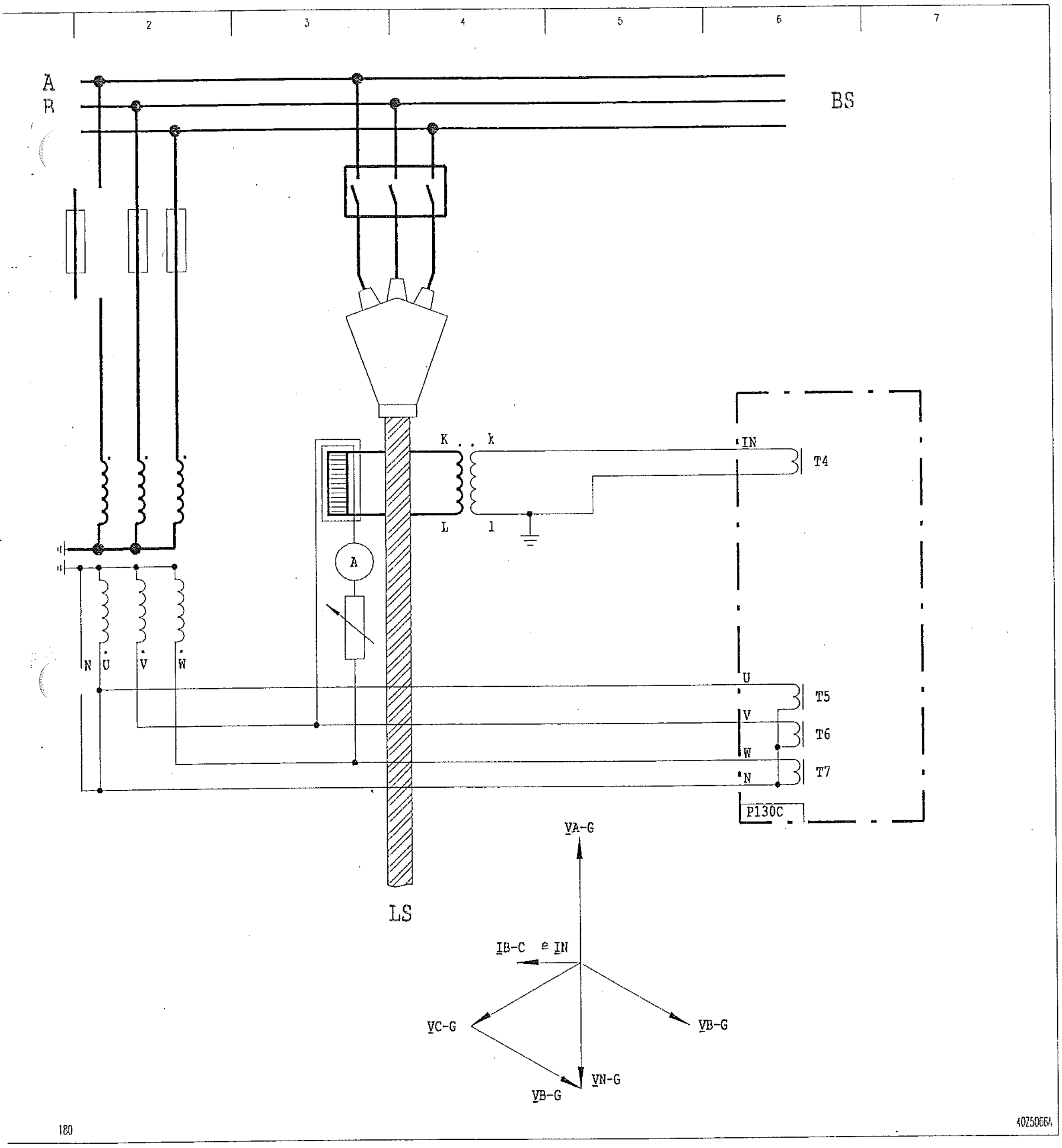
If the current is measured in a Holmgreen group, then the current transformers in A and B on the secondary side must be disconnected and short-circuited (see Figure 9-4).



. 9-4 *Auxiliary circuit in systems with isolated neutral and Holmgreen group, ground fault in BS direction*

A pilot wire is threaded into window-type current transformers, and a current is drawn from phases B and C through this wire (see Figure 9-5). The vectorial assignment of currents and voltages is shown in the phasor diagrams included with the terminal connection diagrams.

In the example shown below, a ground fault is simulated on the busbar side. To check a ground fault on the line side, the current or voltage connections must be switched.



\uxi' circuit in systems with isolated neutral and window-type current transformer, ground fault in BS direction

Completion of commissioning

Before the P130C is released for operation, the user should make sure that the following steps have been taken:

- All memories have been reset.
  (Reset at MAIN: General reset (password-protected) and MT_RC: Reset recording, both in 'Oper/CtrlTest/ folder.)
- Blocking of output relays has been canceled.
  (OUTP: Outp.rel.block USER in 'Par/Func/Glob/' folder, setting *'No'*)
- Blocking of the trip command has been canceled.
  (MAIN: Trip cmd.block.USER, 'Par/Func/Glob/' folder, setting *'No'*)
- The device is on-line
  (MAIN: Device on-line, 'Par/Func/Glob/' folder, setting *'Yes' (on).*)
- The residual current stages of the protection functions are enabled (on).
  (MAIN: Syst.IN enabled USER ,'Par/Func/Gen/' folder, setting *'Yes (on)'*)
- The measuring-circuit monitoring function is enabled – if it was disabled for testing purposes.
  (MCMON: General enable USER, 'Par/Func/Gen/' folder, setting *'Yes'*)

After completion of commissioning, only the green LED indicator labeled 'HEALTHY' (H1)

10 Troubleshooting

This chapter describes problems that might be encountered, their causes, and possible methods for eliminating them. It is intended as a general orientation only, and in cases of doubt it is better to return the P130C to the manufacturer. Please follow the packaging instructions in the section entitled 'Unpacking and Packing' in Chapter 5 when returning equipment to the manufacturer.

Problem:

- Lines of text are not displayed on the local control panel.
  - Check to see whether there is supply voltage at the device connection points.

Before checking further, disconnect the P130C from the power supply.

The local control panel is connected to the I/O module by a plug-in connecting cable. Make sure the connector position is correct. Do not bend the connecting cable.

  - Check to see whether the magnitude of the auxiliary voltage is correct. The P130C has an auxiliary voltage supply that can be switched between ranges and is factory-set for the voltage range of $V_{A,nom}$ = 110 to 250 V DC or 100 to 230 V AC. See Chapter 5 for information on switching to the voltage range of $V_{A,nom}$ = 24 to 60 V DC . The P130C is protected against damage from polarity reversal.

- The P130C issues a 'Warning' signal on LED H3. (H3 is labeled 'ALARM', it is coupled to the signal SFMON: Warning (LED).)

  Identify the specific problem by reading out the monitoring signal memory (see the section entitled 'Monitoring Signal Memory Readout' in Chapter 6). The table below lists possible monitoring or warning indications (provided that a configuration setting has been entered at SFMON: Fct. assign. warning), the faulty area, the P130C response, and the mode of the output relay configured for 'Warning' and 'Blocked/faulty'.

SFMON: Warning (LED)	036 070
Warning configured for LED H3.	
SFMON: Warning (relay)	036 100
Warning configured for an output relay.	

Key

- :	No reaction and/or no output relay triggered.
Yes:	The corresponding output relay is triggered.
Updating:	The output relay configured for 'Warning' starts only if the monitoring signal is still present.
1) :	The 'Blocked/faulty' output relay only operates if the signal has been configured at MAIN: Fct. assignm. fault.
2) :	The 'Warning' output relay only operates if the signal has been configured at SFMON: Fct. assignm. warning.

SFMON: Cold restart		093 024
A cold restart has been carried out on account of a checksum error in the memory (NOVRAM).		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: Cold rest./SW update		093 025
A cold restart has been carried out following a software update.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: Blocking HW failure		090 019
Supplementary warning that this device is blocked.		
'Warning' output relay:	Updating / Updating	

SFMON: Relay Kxx faulty		041 200
Multiple signal: output relay defective.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Updating / Updating	
'Blocked/faulty' output relay:	Yes / Yes [1)]	
SFMON: Hardware clock fail.		093 040
The hardware clock has failed.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	– / –	
SFMON: Battery failure		090 010
Battery voltage too low. Replace battery.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Updating / Updating	
'Blocked/faulty' output relay:	– / –	
SFMON: Invalid SW d.loaded		096 121
Wrong or invalid software has been downloaded.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: +15V supply faulty		093 081
The +15 V internal supply voltage has dropped below a minimum value.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: +24V supply faulty		093 082
The +24 V internal supply voltage has dropped below a minimum value.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: -15V supply faulty		093 080
The -15 V internal supply voltage has dropped below a minimum value.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: Power supply faulty		093 083
The +24 V or +15 V or -15 V internal supply voltage has dropped below a minimum value.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	

SFMON: Wrong module slot 1		096 100
SFMON: Wrong module slot 2		096 101
Module in wrong slot.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	
SFMON: Defect.module slot 1		097 000
SFMON: Defect.module slot 2		097 001
Defective module in slot x.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Updating / Updating	
'Blocked/faulty' output relay:	Yes / Yes [1)]	
SFMON: Module A DPR faulty		093 070
Dual-Port-RAM fault on communication module A. This fault is only detected during device startup.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	– / –	
SFMON: Module A RAM faulty		093 071
RAM fault on communication module A.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	– / –	
SFMON: Error K 1		097 038
SFMON: Error K 2		097 039
SFMON: Error K 3		097 040
SFMON: Error K 4		097 041
SFMON: Error K 5		097 042
SFMON: Error K 6		097 043
SFMON: Error K 7		097 044
SFMON: Error K 8		097 045
Output relay K xxx defective.		
1st device reaction / 2nd device reaction:	– / –	
'Warning' output relay:	Updating / Updating	
'Blocked/faulty' output relay:	Yes / Yes [1)]	
SFMON: Undef. operat. code		093 010
Undefined operation code, i.e. software error.		
1st device reaction / 2nd device reaction:	Warm restart / Device blocking	
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	

SFMON: Invalid arithm. op. 093 011

Invalid arithmetic operation, i.e. software error.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Undefined interrupt 093 012

Undefined interrupt, i.e. software error.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Exception oper.syst. 093 013

Interrupt of the operating system.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Data acquis. failure 090 021

Watchdog is monitoring the periodic start of protection routines. It has detected an error.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Checksum error param 090 003

A checksum error involving the parameters in the memory (NOVRAM) has been detected.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Clock sync. error 093 041

In 10 consecutive clock synchronization telegrams, the difference between the time of day given in the telegram and that of the hardware clock is greater than 10 ms.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: Interm.volt.fail.RAM 093 026

Faulty test pattern in the RAM. This can occur, for example, if the processor module or the power supply module is removed from the bus module (digital). This fault is only detected during device startup. After the fault is detected, the software initializes the RAM. This means that all records are deleted.

1st device reaction / 2nd device reaction:	Warm restart / Device blocking
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	Yes / Yes

SFMON: Overflow MT_RC 090 012

Last entry in the monitoring signal memory in the event of overflow.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: Semaph. MT_RC block. 093 015

Software overloaded.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: Inval. SW vers.COMM1 093 075

Incorrect or invalid communication software has been downloaded.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: IRIGB faulty 093 117

Although the IRIG-B interface is enabled, no plausible input signal is received.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: Time-out module L 093 130

Watchdog is monitoring the periodic status signal of the local control component. It has detected an error.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: M.c.b. trip V 098 000

The voltage transformer m.c.b. has tripped.

1st device reaction / 2nd device reaction:	Blocking of distance protection, directional measurement of inverse-time overcurrent protection and time-voltage protection, and switching to backup overcurrent-time protection, if applicable
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Phase sequ. V faulty 098 001

Measuring-circuit monitoring has detected a fault in the phase sequence of the phase-to-ground voltages.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Undervoltage 098 009

The measuring-circuit monitoring function has detected an undervoltage.

1st device reaction / 2nd device reaction: – / –
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Meas. circ. V faulty 098 017

Multiple signaling: voltage-measuring circuits faulty.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Meas. circ. I faulty 098 005

The measuring-circuit monitoring function has detected a fault in the current-measuring circuits.

1st device reaction / 2nd device reaction: – / –
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Meas.circ.V,I faulty 098 016

Multiple signaling: current- or voltage-measuring circuits faulty.

1st device reaction / 2nd device reaction: Depends on type of fault.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Communic.fault COMM3 093 140

The set time `COMM3: Time-out comm.fault` has elapsed since the most recent 100% valid telegram was received. The receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction: – / –
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Hardware error COMM3 093 143

The device has detected a hardware fault in the InterMiCOM interface ("Logical" Communication Interface 3).

1st device reaction / 2nd device reaction: – / –
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: – / –

SFMON: Comm.link fail.COMM3 093 142

Timer stage `COMM3: Time-out link fail.` has elapsed indicating a persistent failure of the transmission channel. The receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction: – / –
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: – / –

SFMON: Lim.exceed.,tel.err. 093 141

The operate threshold COMM3: Limit telegr. errors has been exceeded. The receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Telecom. faulty 093 006

The transmission channel of protective signaling is faulty.

1st device reaction / 2nd device reaction:	Blocking of protective signaling
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Setting error THERM 098 035

Invalid parameters in the setting for the thermal replica.

1st device reaction / 2nd device reaction:	Blocking of the thermal overload protection function
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

SFMON: Peripheral fault 098 018

Multiple signaling

1st device reaction / 2nd device reaction:	Depends on type of fault.
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Setting error f<> 098 028

The over-/underfrequency protection function has been set for 'overfrequency' monitoring (based on the settings for operate value and nominal frequency). This setting is not valid in the *f w. Delta f / Delta t* operating mode.

1st device reaction / 2nd device reaction:	Blocking of over-/under-frequency protection
'Warning' output relay:	Yes / Yes 2)
'Blocked/faulty' output relay:	– / –

SFMON: Output 30 098 053
SFMON: Output 30 (t) 098 054
SFMON: Output 31 098 055
SFMON: Output 31 (t) 098 056
SFMON: Output 32 098 057
SFMON: Output 32 (t) 098 058

These LOGIC outputs can be included in the list of warning signals by selection at SFMON: Fct. assign. warning. These warning signals are also recorded in the monitoring signal memory.

1st device reaction / 2nd device reaction:	– / –
'Warning' output relay:	Yes / Yes
'Blocked/faulty' output relay:	– / –

11 Maintenance

The P130C is a low-maintenance device. The components used in the units are selected to meet exacting requirements. Recalibration is not necessary.

nce procedures in supply area

Electrolytic capacitors are installed in the power supply area because of dimensioning requirements. The useful life of these capacitors is significant from a maintenance standpoint. When the equipment is operated continuously at the upper limit of the recommended temperature range (+55°C or 131°F), the useful life of these components is 80,000 hours, or more than 9 years. Under these conditions, replacement of the electrolytic capacitors is recommended after a period of 8 to 10 years. Component drift follows the '10-degree rule'. This means that the useful life is doubled for each 10 K reduction in temperature. When the operating temperatures inside the devices are lower, the required maintenance intervals are increased accordingly.

The P130C is equipped with a lithium battery for non-volatile storage of fault data and for keeping the internal clock running in the event of failure of the auxiliary power supply. Loss of capacity due to module-internal self-discharging amounts to less than 1% per year over a period of availability of 10 years. Since the terminal voltage remains virtually constant until capacity is exhausted, usefulness is maintained until a very low residual capacity is reached. With a nominal capacity of 850 mAh and discharge currents of only a few µA during device storage or in the range of the self-discharge current during device operation, the result is a correspondingly long service life. It is therefore recommended that the lithium battery only be replaced after the maintenance interval cited above.

Replacement of the maintenance-related components named above is not possible without soldering and must be carried out by AREVA Service personnel.

Routine functional testing

The P130C is used as a safety device and must therefore be routinely checked for proper operation. The first functional tests should be carried out approximately 6 to 12 months after commissioning. Additional functional tests should be performed at intervals of 2 to 3 years – 4 years at the maximum.

The P130C incorporates in its system a very extensive self-monitoring function for hardware and software. The internal structure guarantees, for example, that communication within the processor system will be checked on a continuing basis.

Nonetheless, there are a number of subfunctions that cannot be checked by the self-monitoring feature without running a test from the device terminals. The respective device-specific properties and setting parameters must be observed in such cases.

In particular, none of the control and signaling circuits that are run to the device from the outside are checked by the self-monitoring function.

Analog input circuits

The analog measured variables are fed through an analog preprocessing feature (anti-aliasing filtering) to a common analog-to-digital converter. In conjunction with the self-monitoring function, the measuring-circuit monitoring function that is available for the device's general functions can detect deviations in many cases, depending on the parameter settings for sensitivity. However, it is still necessary to test from the device terminals in order to make sure that the analog measuring circuits are functioning correctly.

The best way to carry out a static test of the analog input circuits is to check the primary measured operating data using the operating data measurement function or to use a suitable testing instrument. A "small" measured value (such as the nominal current in the current path) and a "large" measured value (such as the nominal voltage in the voltage path) should be used to check the measuring range of the A/D converter. This makes it possible to check the entire control range.

The accuracy of operating data measurement is <1 %. An important factor in evaluating device performance is long-term performance based on comparison with previous measurements.

In addition, a dynamic test can be used to check transmission performance and the phase relation of the current transformers and the anti-aliasing filter. This can best be done by measuring the trigger point of the first zone when there is a two-phase ungrounded fault. For this test, the short-circuit current should be dimensioned so that a loop voltage of approximately 2 V is obtained at the device terminals with the set impedance. Furthermore, a suitable testing instrument that correctly replicates the two-phase ungrounded fault should be used for this purpose.

This dynamic test is not absolutely necessary, since it only checks the stability of a few less passive components. Based on reliability analysis, the statistical expectation is that only <u>one</u> component in 10 years in 1000 devices will be outside the tolerance range.

Additional analog testing of such factors as the impedance characteristic or the starting characteristic is not necessary, in our opinion, since information processing is completely digital and is based on the measured analog current and voltage values. Proper operation was checked in conjunction with type testing.

uts

The binary inputs are not checked by the self-monitoring function. However, a testing function is integrated into the software so that the trigger state of each input can be read out ('Oper/Cycl/Phys' folder). This check should be performed for each input being used and can be done, if necessary, without disconnecting any device wiring.

tputs

With respect to binary outputs, the integrated self-monitoring function includes even two-phase triggering of the relay coils of <u>all</u> the all-or-nothing relays. There is no monitoring function for the external contact circuit. In this case, the all-or-nothing relays must be triggered by way of device functions or integrated test functions. For these testing purposes, triggering of the output circuits is integrated into the software through a special control function ('Oper/CtrlTest/' folder).

Before starting testing, open any triggering circuits for external devices so that no inadvertent switching operations will take place.

rfaces

The integrated self-monitoring function for the PC or communication interface also includes the communication module. The complete communication system, including connecting link and fiber-optic module (if applicable), is always totally monitored as long as a link is established through the control program or the communication protocol.

12 Storage

Devices must be stored in a dry and clean environment. A temperature range of -25°C to +70°C (-13°F to +158°F) must be maintained during storage (see chapter entitled 'Technical Data'). The relative humidity must be controlled so that neither condensation nor ice formation will result.

If the units are stored without being connected to auxiliary voltage, then the electrolytic capacitors in the power supply area need to be reformed every 4 years. Reform the capacitors by connecting auxiliary voltage to the P130C for approximately 10 minutes.

13 Accessories and Spare Parts

The P130C is supplied with standard labeling for the LED indicators. LED indicators that are not already configured and labeled can be labeled using the label strips supplied with the P130C. Affix the label strips to the front of the unit at the appropriate location.

The label strips can be filled in using a Stabilo brand pen containing water-resistant ink (Type OH Pen 196 PS).

Description	Order No.
Operating program for Windows	On request

ıformation

tion

Order No.																		
former)	P 1 3 0 -	9	8	0	0	3	0	2	0	-301	-401	-6xx	-7xx	-46x	-9	x	-9	x	-8xx
t Protection	P 1 3 0 -	9	8	9	0	3	0	2	0	-301	-401	-6xx	-7xx	-46x	-9	x	-9	x	-8xx

d 8 output relays	9
display:	
ıted, local control panel with text display	8
	0
˙4) 2)	9
-pole)	3
itional outputs:	
; or 110 to 250 VDC / 100 to 230 VAC 1)	2
ı binary inputs:	
	Without order extension no.
n = 125 to 150 V) 8)	-461
ım = 220 to 250 V) 8)	-462
information interface:	
ck synchronization	-90 0
)3 only	-91
ȷ between:	-92
}, Modbus, DNP3, Courier	
lock synchronization	
ı85, IEC 60870-5-103)	
⌐S485, isolated	1
: fiber, FSMA connector	2
fiber ... connector	4
tion ... ace:	-95
⌐S485, isolated	1
: fiber, FSMA connector	2
fiber, ST connector	4
	Without order extension No. -800
	Not available yet -801
	Not available yet -802
	Not available yet -803
	Not available yet -804
	Not available yet -805

ımper, default setting underlined
ter, default setting inderlined
uage in brackets
ports Cyrillic letters instead of special West European characters
mm ... ed unless there is a special requirement for higher thresholds

14 Order Information
(continued)

Notes on the Ordering Options

Language Versions

For a display of the Russian data model (menu texts), order extension No. -805 must be specified with the order. The device will then be fitted with the hardware supporting Cyrillic characters. The English reference texts are fully supported by this hardware option but additional characters in other West European languages are not. The Russian / English language version is therefore not suited to a subsequent loading of West European data models.

Operate Value of the Binary Inputs
The standard variant of the binary inputs (optical couplers) operates for all input voltages of 18 V and above and is therefore recommended for most applications. The special variants with higher operate / release values (see "Technical Data") are designed for applications with a special requirement for operate values of 60 to 70 % V_{nom}.

A Glossary

B List of Signals

C Terminal Connection Diagrams

D Address Lists
(Available as a PDF file. Not included in the printed manual.)

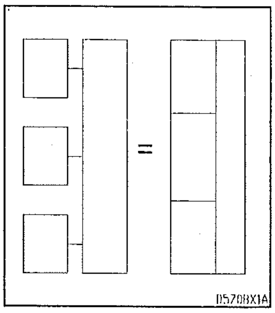
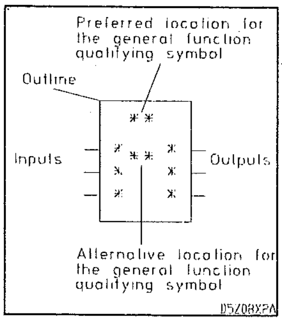
A 1 Function Groups

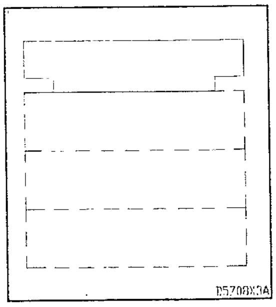
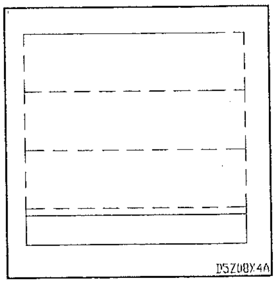
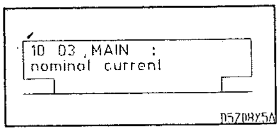
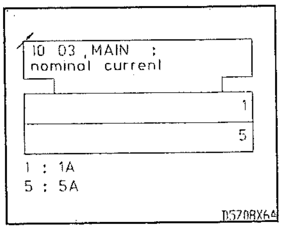
	Current Transformers	CT fitted	CT not fitted
ARC:	Auto-reclosing control	X	
CBF:	Circuit breaker failure protection	X	
COMM1:	"Logical" communication interface 1	X	X
COMM2:	"Logical" communication interface 2	X	X
COMM3:	"Logical" communication interface 3	X	X
DTOC:	Definite-time overcurrent protection	X	
DVICE:	Device	X	X
FT_DA:	Fault data acquisition	X	X
FT_RC:	Fault recording	X	X
f<>:	Frequency protection	X	X
F_KEY	Function Keys	X	X
GF_DA:	Ground fault data acquisition	X	
GF_RC:	Ground fault recording	X	
GFDSS:	Ground fault direction determination using steady-state values	X	
I2>:	Unbalance protection	X	
IDMT:	Inverse-time overcurrent protection	X	
INP:	Binary input	X	X
LED:	LED indicators	X	X
LIMIT:	Limit monitoring	X	
LOC:	Local control panel	X	X
LOGIC:	Logic	X	X
MAIN:	Main function	X	X
MCMON:	Measuring-circuit monitoring	X	X
MP:	Motor protection	X	
MT_RC:	Monitoring signal recording	X	X
OL_DA:	Overload data acquisition	X	
OL_RC:	Overload recording	X	
OP_RC:	Operating data recording	X	X
OUTP:	Binary and analog output	X	X
P<>:	Power directional protection	X	
PC:	PC link	X	X
PSIG:	Protective signaling	X	
PSS:	Parameter subset selection	X	X
SCDD:	Short-circuit direction determination	X	
SFMON:	Self-monitoring	X	X
SOTF:	Switch on to fault protection	X	
THERM:	Thermal overload protection	X	
V<>:	Time-voltage protection	X	X

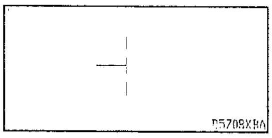
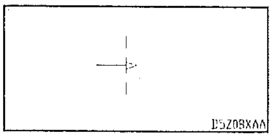
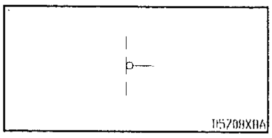
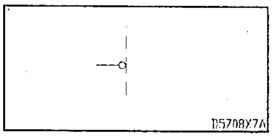
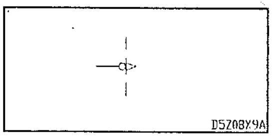
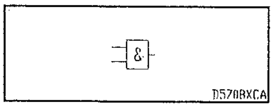
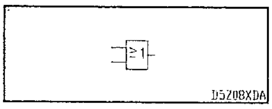
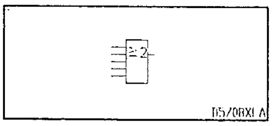
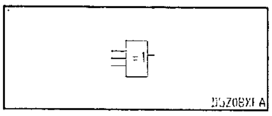
A 2 Symbols

Graphic symbols for block diagrams
Binary elements according to DIN 40900 Part 12, September 1992,
IEC 617-12: amended 1991
Analog information processing according to DIN 40900 Part 13, January 1981

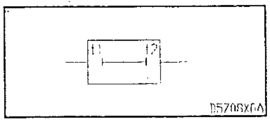
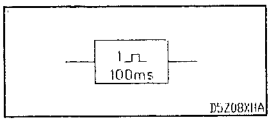
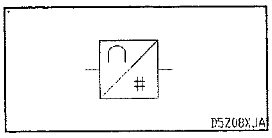
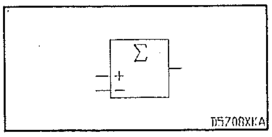
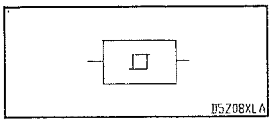
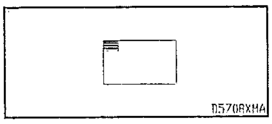
To document the linking of analog and binary signals, additional symbols have been used, taken from several DIN documents.
As a rule, direction of the signal flow is from left to right and from top to bottom. Other flow directions are marked by an arrow. Input signals are listed on the left side of the signal flow, output signals on the right side.

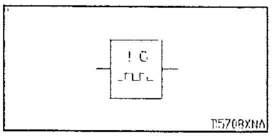
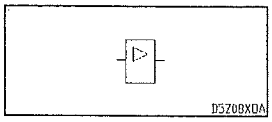
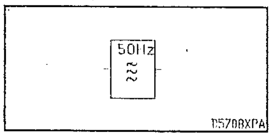
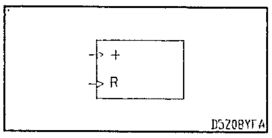
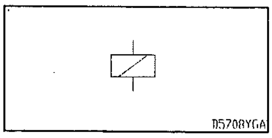
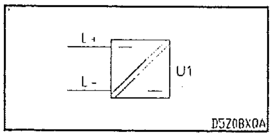
Symbol	Description
	To obtain more space for representing a group of related elements, contours of the elements may be joined or cascaded if the following rules are met: There is no functional linkage between elements whose common contour line is oriented in the signal flow direction. Note: This rule does not necessarily apply to configurations with two or more signal flow directions, such as for symbols with a control block and an output block. There exists at least one logical link between elements whose common contour line runs perpendicularly to the signal flow direction.
	<u>Components of a symbol</u> A symbol consists of a contour or contour combination and one or more qualifiers.

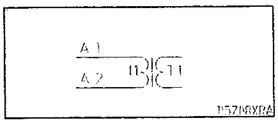
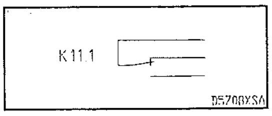
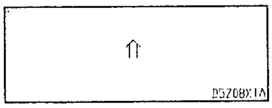
Symbol	Description
	<u>Control block</u> A control block contains an input function common to several symbols. It is used for the collective setting of several trigger elements, for example.
	<u>Output block</u> An output block contains an output function common to several symbols.
	<u>Settable control block</u> The four digits represent the address under which the function shown in the text after the colon may be set via the local control panel.
	<u>Settable control block with function blocks</u> The digits in the function block show the settings that are possible at this address. The text below the symbol shows the setting and the corresponding unit or meaning.

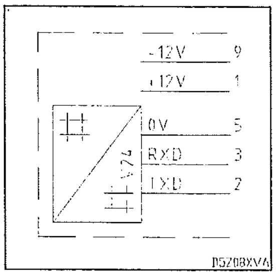
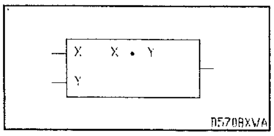
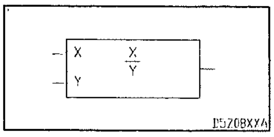
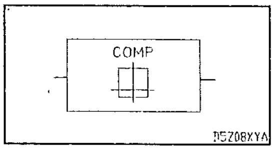
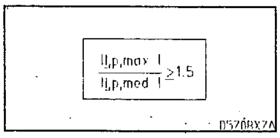
Symbol	Description
	<u>Static input</u> Only the state of the binary input variable is effective.
	<u>Dynamic input</u> Only the transition from value 0 to value 1 is effective.
	<u>Negation of an output</u> The value up to the border line is negated at the output.
	<u>Negation of an input</u> The input value is negated before the border line.
	<u>Dynamic input with negation</u> Only the transition from value 1 to value 0 is effective.
	<u>AND element</u> The output variable will be 1 only if all input variables are 1.
	<u>OR element</u> The output variable will be 1 only if at least one input variable is 1.
	<u>Threshold element</u> The output variable will be 1 only if at least two input variables are 1. The number in the symbol may be replaced by any other number.
	<u>(m out of n) element</u> The output variable will be 1 only if just one input variable is 1. The number in the symbol may be replaced by any other number if the number of inputs is increased or decreased accordingly.

Appendix A - Glossary
(continued)

Symbol	Description
	<u>Delay element</u> The transition from value 0 to 1 at the output occurs after a time delay of t1 relative to the corresponding transition at the input. The transition from value 1 to 0 at the output occurs after a time delay of t2 relative to the corresponding transition at the input. t1 and t2 may be replaced by the actual delay values (in seconds or strobe ticks).
	<u>Monostable flip-flop</u> The output variable will be 1 only if the input variable changes to 1. The output variable will remain 1 for 100 ms, independent of the duration of the input value 1 (non-retriggerable). Without a 1 in the function block the monostable flip-flop is retriggerable. The time is 100 ms in this example, but it may be changed to any other duration.
	<u>Analog-digital converter</u> An analog input signal is converted to a binary signal.
	<u>Subtractor</u> The output variable is the difference between the two input variables. A *summing element* is obtained by changing the minus sign to a plus sign at the symbol input.
	<u>Schmitt Trigger with binary output signal</u> The binary output variable will be 1 if the input signal exceeds a specific threshold. The output variable remains 1 until the input signal drops below the threshold again.
	<u>Memory, general</u> Storage of a binary or analog signal.

Symbol	Description
	Non-stable flip-flop When the input variable changes to 1, a pulse sequence is generated at the output. The ! to the left of the G indicates that the pulse sequence starts with the input variable transition (synchronized start). If there is a ! to the right of the G, the pulse sequence ends with the ending of the 1 signal at the input (synchronized stop).
	Amplifier The output variable is 1 only if the input variable is also 1.
	Band pass filter The output only transmits the 50 Hz component of the input signals. All other frequencies (above and below 50 Hz) are attenuated.
	Counter At the + input the input variable transitions from 0 to 1 are counted and stored in the function block. At the R(eset) input a transition of the input variable from 0 to 1 resets the counter to 0.
	Electromechanical drive in general, here a relay, for example.
	Signal level converter with electrical isolation between input and output. L+ = pos. voltage input L- = neg. voltage input U1 = device identifier

Symbol	Description
	<u>Input transformer</u> <u>with phase and item identifiers</u> (according to DIN EN 60445) Phase identifiers for current inputs: for A: A1 and A2 for B: B1 and B2 for C: C1 and C2 for N: N1 and N2 Phase identifiers for voltage inputs via transformer 1: for A: 1U for B: 1V for C: 1W for N: 1N via transformer 2: for A: 2U for B: 2V Item identifiers for current transformers: for A: T1 for B: T2 for C: T3 for N: T4 for voltage transformer 1: for A: T5 for B: T6 for C: T7 for N: T8 for V_{G-N} transformer: T90 for voltage transformer 2: for A: T15
	<u>Change-over contact</u> with item identifier
	<u>Special symbol</u> Output relay in normally-energized arrangement ('closed-circuit operation').

Symbol	Description
	PC interface with pin connections
	Multiplier The output variable is the result of the multiplication of the two input variables.
	Divider The output variable is the result of the division of the two input variables.
	Comparator The output variable becomes 1 only if the input variable(s) are equal to the function in the function block.
	Formula block The output variable becomes 1 only if the input variable(s) satisfy the equation in the function block

A 3 Examples of Signal Names

All settings and signals relevant for protection are shown in the block diagrams of Chapter 3 as follows:

Signal Name	Description
◆ FT_RC: Fault recording n 305 100	Internal signal names are not coded by a data model address. In the block diagrams they are marked with a diamond. The small figure underneath the signal name represents a code that is irrelevant to the user. The internal signal names used and their origins are listed in Appendix B.
DIST: VNG>> triggered [036 015]	Signal names coded by a data model address are represented by their address (shown in square brackets). Their origin is given in Chapters 7 and 8.
MAIN: General reset [003 002] ↗1: Execute	A specific setting to be used later on is shown with its signal name, address, and the setting preceded by the setting arrow.

A 4 Symbols Used

Symbol	Meaning
t	Time duration
V	Voltage, potential difference
$\underline{V}$	Complex voltage
I	Electrical current
$\underline{I}$	Complex current
$\underline{Z}$	Complex impedance
$\lvert\underline{Z}\rvert$	Modulus of complex impedance
f	Frequency
δ	Temperature in °C
Σ	Sum, result
Ω	Unit of electrical resistance
α	Angle
φ	Phase angle. With subscripts: specific angle between a defined current and a defined voltage.
τ	Time constant
ΔT	Temperature difference in K

Appendix B - List of Signals

B 1 Internal Signal Names

ARC: Block/reset HSR	Fig.3-132
ARC: Block/reset TDR	Fig.3-132
ARC: Close request	Fig.3-134
ARC: HSR not permitted	Fig.3-134
ARC: HSR trip t. elapsed	Fig.3-126, 3-128, 3-129, 3-130, 3-131
ARC: HSR trip t. I> runn.	Fig.3-121, 3-135, 3-137
ARC: Starting GFDSS	Fig.3-129
ARC: TDR not permitted	Fig.3-134
ARC: TDR trip t. elapsed	Fig.3-127, 3-128, 3-129, 3-130, 3-131
ARC: TDR trip t. I> runn.	Fig.3-121
COMM1: Selected protocol	Fig.3-7
DTOC: IN	Fig.3-88
DTOC: Pulse prolong. runn.	Fig.3-91
DTOC: Starting A	Fig.3-84
DTOC: Starting B	Fig.3-84
DTOC: Starting C	Fig.3-84
DTOC: Starting N	Fig.3-89
DTOC: t2 N	Fig.3-91
f<>: VMeas	Fig.3-179
f<>: fMeas	Fig.3-180
f<>: No. periods reached	Fig.3-180
FT_DA: IA-kG	Fig.3-75
FT_DA: IB-kG	Fig.3-75
FT_DA: IC-kG	Fig.3-75
FT_DA: IkG	Fig.3-75
FT_DA: Output fault locat.	Fig.3-74
FT_DA: Output meas. values	Fig.3-74
GFDSS: VNG	Fig.3-140
GFDSS: VNG filtered	Fig.3-141, 3-147
GFDSS: Direction BS	Fig.3-141, 3-147
GFDSS: Direction LS	Fig.3-141, 3-147
GFDSS: IN> triggered	Fig.3-145
GFDSS: IN filtered	Fig.3-145
GFDSS: Op. delay IN elapsed	Fig.3-145
GFDSS: Oper.delayY(N)> elaps	Fig.3-151
GFDSS: P	Fig.3-141, 3-147

GFDSS:	Q	Fig.3-141, 3-147
GFDSS:	VNG> triggered	Fig.3-141, 3-147
IDMT:	IN	Fig.3-102
IDMT:	Starting A	Fig.3-99
IDMT:	Starting B	Fig.3-99
IDMT:	Starting C	Fig.3-99
LOGIC:	Output n	Fig.3-198, 3-199, 3-200, 3-201, 3-202
LOGIC:	Output n (t)	Fig.3-198, 3-199, 3-200, 3-201, 3-202
MAIN:	Vmeas	Fig.3-76
MAIN:	Blck.1 sel.functions	Fig.3-40
MAIN:	Blck.2 sel.functions	Fig.3-40
MAIN:	Block start. signal	Fig.3-45
MAIN:	Block tim.st. IN,neg	Fig.3-45
MAIN:	Block. I>,kIref,P>	Fig.3-46
MAIN:	General starting int.	Fig.3-46
MAIN:	Inrush stabil. trigg	Fig.3-39
MAIN:	Imeas	Fig.3-76
MAIN:	Protection active	Fig.3-36
MAIN:	Reset LED	Fig.3-52
MAIN:	Sel. meas. loop A-B	Fig.3-76
MAIN:	Sel. meas. loop A-G	Fig.3-76
MAIN:	Sel. meas. loop B-C	Fig.3-76
MAIN:	Sel. meas. loop B-G	Fig.3-76
MAIN:	Sel. meas. loop C-A	Fig.3-76
MAIN:	Sel. meas. loop C-G	Fig.3-76
MAIN:	Sel. meas. loop PG	Fig.3-76
MAIN:	Sel. meas. loop PP	Fig.3-76
MAIN:	Starting A int.	Fig.3-45
MAIN:	Starting B int.	Fig.3-45
MAIN:	Starting C int.	Fig.3-45
MAIN:	Starting Ineg	Fig.3-45
MAIN:	Starting N int.	Fig.3-45
MAIN:	Time tag	Fig.3-51
MP:	Block. replica THERM	Fig.3-159
MP:	IP,max r.m.s./Iref	Fig.3-154
MP:	Istup>	Fig.3-159
MP:	Machine stopped	Fig.3-159
MP:	St. kP*Iref>/Istup>	Fig.3-154

OL_RC::	Overload recording n	Fig.3-63
P<>:	P	Fig.3-184
P<>:	P-	Fig.3-184
P<>:	P+	Fig.3-184
P<>:	Q	Fig.3-184
P<>:	Q-	Fig.3-184
P<>:	Q+	Fig.3-184
SCDD:	Block. dir. tkINref>	Fig.3-114
SCDD:	Block. dir. tkIref>	Fig.3-110
SCDD:	Block. direct. tI>	Fig.3-110
SCDD:	Block. direct. tI>>	Fig.3-110
SCDD:	Block. direct. tIN>	Fig.3-114
SCDD:	Block. direct. tIN>>	Fig.3-114
SCDD:	Determin. N enabled	Fig.3-112
SCDD:	Determin. P enabled	Fig.3-108
SCDD:	Phase curr.stage bl.	Fig.3-108
SCDD:	Resid. curr.stage bl.	Fig.3-112
SOTF:	Bl. ARC by close cmd	Fig.3-116
THERM:	I	Fig.3-165
V<>:	Vneg	Fig.3-173
V<>:	VNG	Fig.3-176
V<>:	Vpos	Fig.3-173

B 2 Telecontrol Interface per EN 60870-5-101 or IEC 870-5-101 (Companion Standard)

This section incorporates Section 8 of EN 60870-5-101 (1996), which includes a general definition of the telecontrol interface for substation control systems.

B 2.1 Interoperability

This application-based standard (companion standard) specifies parameter sets and other options from which subsets are to be selected in order to implement specific telecontrol systems. Certain parameters such as the number of octets in the COMMON ADDRESS of the ASDU are mutually exclusive. This means that only one value of the defined parameter is allowed per system. Other parameters, such as the listed set of different process information in the command and monitor direction, permit definition of the total number or of subsets that are suitable for the given application. This section combines the parameters given in the previous sections in order to facilitate an appropriate selection for a specific application. If a system is made up of several system components supplied by different manufacturers ("equipment stemming"), then it is necessary for all partners to agree on the selected parameters.

The boxes for the selected parameters should be checked.

Note: The overall definition of a system may also require individual selection of certain parameters for specific parts of a system such as individual selection of scaling factors for individually addressable measured values.

B 2.1.1 Network Configuration (Network-Specific Parameters)

- [✓] Point-to-point configuration
- [✓] Multipoint-party line configuration
- [✓] Multiple point-to-point configuration
- [ ] Multipoint-star configuration

B 2.1.2 Physical Layer (Network-Specific Parameters)

Transmission Rate (Control Direction) [1]

Unbalanced interface V.24/V.28 Standardized		Unbalanced interface V.24/V.28 Recommended with > 1 200 bit/s		Balanced interface X.24/X.27			
☐	100 bit/s	☑	2 400 bit/s	☐	2 400 bit/s	☐	56 000 bit/s
☐	200 bit/s	☑	4 800 bit/s	☐	4 800 bit/s	☐	64 000 bit/s
☐	300 bit/s	☑	9 600 bit/s	☐	9 600 bit/s	☐	
☑	600 bit/s			☐	19 200 bit/s	☐	
☑	1 200 bit/s			☐	38 400 bit/s	☐	

Transmission Rate (Monitor Direction) [2]

Unbalanced interface V.24/V.28 Standardized		Unbalanced interface V.24/V.28 Recommended with > 1 200 bit/s		Balanced interface X.24/X.27			
☐	100 bit/s	☑	2 400 bit/s	☐	2 400 bit/s	☐	56 000 bit/s
☐	200 bit/s	☑	4 800 bit/s	☐	4 800 bit/s	☐	64 000 bit/s
☐	300 bit/s	☑	9 600 bit/s	☐	9 600 bit/s	☐	
☐	600 bit/s			☐	19 200 bit/s	☐	
☑	1 200 bit/s			☐	38 400 bit/s	☐	

[1] The transmission rates for control direction and monitor direction must be identical.

B 2.1.3 Link Layer (Network-Specific Parameters)

Frame format FT 1.2, single character 1, and the fixed time-out interval are used exclusively in this companion standard.

Link Transmission Procedure	Address Field of the Link
✓ Balanced transmission	✓ Not present (balanced transmission only)
✓ Unbalanced transmission	✓ One octet
	✓ Two octets [1]
Frame Length	✓ Structured
240 Maximum length L (number of octets)	✓ Unstructured

[1] Balanced only.

B 2.1.4 Application Layer

Transmission mode for application data

Mode 1 (least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common Address of ASDU (System-Specific Parameter)

- [✓] One octet
- [✓] Two octets

Information Object Address (System-Specific Parameter)

- [✓] One octet
- [✓] Structured
- [✓] Two octets
- [✓] Unstructured
- [✓] Three octets
- [ ]

Cause of Transmission (System-Specific Parameter)

- [✓] One octet
- [✓] Two octets (with originator address)

Selection of Standard ASDUs

Process Information in Monitor Direction (Station-Specific Parameter)

☑	<1>	=	Single-point information	M_SP_NA_1
☑	<2>	=	Single-point information with time tag	M_SP_TA_1
☑	<3>	=	Double-point information	M_DP_NA_1
☑	<4>	=	Double-point information with time tag	M_DP_TA_1
		=		
☑	<5>	=	Step position information	M_ST_NA_1
☑	<6>	=	Step position information with time tag	M_ST_TA_1
☑	<7>	=	Bit string of 32 bit	M_BO_NA_1
☑	<8>	=	Bit string of 32 bit with time tag	M_BO_TA_1
☑	<9>	=	Measured value, normalized value	M_ME_NA_1
☑	<10>	=	Measured value, normalized value with time tag	M_ME_TA_1
☑	<11>	=	Measured value, scaled value	M_ME_NB_1
☑	<12>	=	Measured value, scaled value with time tag	M_ME_TB_1
☐	<13>	=	Measured value, short floating point value	M_ME_NC_1
☐	<14>	=	Measured value, short floating point value with time tag	M_ME_TC_1
☑	<15>	=	Integrated totals	M_IT_NA_1
☑	<16>	=	Integrated totals with time tag	M_IT_TA_1
☑	<17>	=	Event of protection equipment with time tag	M_EP_TA_1

☑	<18>	=	Packed start events of protection equipment with time tag	ME_EP_TB_1
☑	<19>	=	Packed output circuit information of protection equipment with time tag	M_EP_TC_1
☐	<20>	=	Packed single-point information with status change detection	M_PS_NA_1
☐	<21>	=	Measured value, normalized value without quality descriptor	M_ME_ND_1

Process Information in Monitor Direction [1] (Station-Specific Parameter)

✓	<45>	=	Single command	C_SC_NA_1
✓	<46>	=	Double command	C_DC_NA_1
✓	<47>	=	Regulating step command	C_IT_NA_1
	<48>	=	Set point command, normalized value	C_RC_NA_1
	<49>	=	Set point command, scaled value	C_SE_NB_1
	<50>	=	Set point command, short floating point value	C_SE_NC_1
	<51>	=	Bit string of 32 bit	C_BO_NA_1

System Information in Monitor Direction (Station-Specific Parameter)

✓	<70>	=	End of initialization	ME_EI_NA_1

[1] Incorrectly identified with control direction in IEC 870-5-101.

Appendix B - List of Signals
(continued)

System Information in Control Direction (Station-Specific Parameter)

☑	<100>	=	Interrogation command	C_IC_NA_1
☑	<101>	=	Counter interrogation command	C_CI_NA_1
☑	<102>	=	Read command	C_RD_NA_1
☑	<103>	=	Clock synchronization command [1]	C_CS_NA_1
☑	<104>	=	Test command	C_TS_NB_1
☐	<105>	=	Reset process command	C_RP_NC_1
☐	<106>	=	Delay acquisition command	C_CD_NA_1

[1] The command procedure is formally processed, but there is no change in the local time in the station.

Parameter in Control Direction (Station-Specific Parameter)

✓	<110>	=	Parameter of measured value, normalized value	P_ME_NA_1
✓	<111>	=	Parameter of measured value, scaled value	P_ME_NB_1
	<112>	=	Parameter of measured value, short floating point value	P_ME_NC_1
	<113>	=	Parameter activation	P_AC_NA_1

File Transfer (Station-Specific Parameter)

	<120>	=	File ready	F_FR_NA_1
	<121>	=	Section ready	F_SR_NA_1
	<122>	=	Call directory, select file, call file, call section	F_SC_NA_1
	<123>	=	Last section, last segment	F_LS_NA_1
	<124>	=	Ack file, ack section	F_AF_NA_1
	<125>	=	Segment	F_SG_NA_1
	<126>	=	Directory	F_DR_TA_1

B 2.1.5 Basic Application Functions

Station Initialization (Station-Specific Parameter)

- [x] Remote initialization

General Interrogation (System- or Station-Specific Parameter)

- [x] Global

☑ Group 1	☑ Group 7	☑ Group 13
☑ Group 2	☑ Group 8	☑ Group 14
☑ Group 3	☑ Group 9	☑ Group 15
☑ Group 4	☑ Group 10	☑ Group 16
☑ Group 5	☑ Group 11	
☑ Group 6	☑ Group 12	Addresses per group have to be defined.

Clock Synchronization (Station-Specific Parameter)

- [x] Clock synchronization

Command Transmission (Object-Specific Parameter)

- [x] Direct command transmission
- [ ] Select and execute command
- [ ] Direct set point command transmission
- [ ] Select and execute set point command
- [ ] C_SE ACTTERM used

- [x] No additional definition
- [ ] Short pulse duration
(Execution duration determined by a system parameter in the outstation)
- [ ] Long pulse duration
(Execution duration determined by a system parameter in the outstation)
- [ ] Persistent output

Transmission of Integrated Totals (Station- or Object-Specific Parameter)

- [ ] Counter request
- [x] General request counter
- [x] Counter freeze without reset
- [x] Request counter group 1
- [ ] Counter freeze with reset
- [x] Request counter group 2
- [ ] Counter reset
- [x] Request counter group 3
- [x] Request counter group 4

Addresses per group have to be specified

Parameter Loading (Object-Specific Parameter)

- [x] Threshold value
- [ ] Smoothing factor
- [ ] Low limit for transmission of measured value
- [ ] High limit for transmission of measured value

Parameter Activation (Object-Specific Parameter)

- [ ] Act/deact of persistent cyclic or periodic transmission of the addressed object

File Transfer (Station-Specific Parameter)

☐	File transfer in monitor direction]	F_FR_NA_1
☐	File transfer in control direction]	F_FR_NA_1

B 3 Communication Interface per IEC 60870-5-103

This section incorporates Section 8 of IEC 60870-5-103, including definitions applicable to the PQ 7x2.

B 3.1 Interoperability

B 3.1.1 Physical Layer

B 3.1.1.1 Electrical Interface

- [x] EIA RS 485
- [x] No. of loads 32 for one device

Note: EIA RS 485 defines the loads in such a way that 32 of them can be operated on one line. For detailed information see EIA RS 485, Section 3.

B 3.1.1.2 Optical Interface

- [x] Glass fiber
- [x] Plastic fiber
- [x] F-SMA connector
- [ ] BFOC/2.5 connector

B 3.1.1.3 Transmission Rate

- [x] 9 600 bit/s
- [x] 19 200 bit/s

B 3.1.2 Link Layer

There are no selection options for the link layer.

B 3.1.3 Application Layer

B 3.1.3.1 Transmission Mode for Application Data

Mode 1 (least significant octet first) as defined in clause 4.10 of IEC 60870-5-4 is used exclusively in this companion standard.

B 3.1.3.2 Common Address of ASDU

☑ One COMMON ADDRESS of ASDU (identical to the station address)

☐ More than one COMMON ADDRESS of ASDU

B 3.1.3.3 Selection of Standard Information Numbers in Monitor Direction

B 3.1.3.3.1 System Functions in Monitor Direction

	INF	Description
☑	<0>	End of general interrogation
☑	<0>	Time synchronization
☑	<2>	Reset FCB
☑	<3>	Reset CU
☑	<4>	Start / restart
☐	<5>	Power on

B 3.1.3.3.2 Status Indications in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8 [1] INF	Semantics	Designations as in the Device Address List Address	Descriptor
✓	<16>	Auto-recloser active	015 064	ARC: Enabled
✓	<17>	Teleprotection active	015 008	PSIG: Enabled
✓	<18>	Protection active	003 030	MAIN: Protection enabled
✓	<19>	LED reset	021 010	MAIN: Reset indicat. USER
✓	<20>	Monitor direction blocked	037 075	COMM1: Sig./meas.val.block.
✓	<21>	Test mode	037 071	MAIN: Test mode
☐	<22>	Local parameter setting		
✓	<23>	Characteristic 1	036 090	PSS: PS 1 active
✓	<24>	Characteristic 2	036 091	PSS: PS 2 active
✓	<25>	Characteristic 3	036 092	PSS: PS 3 active
✓	<26>	Characteristic 4	036 093	PSS: PS 4 active
✓	<27>	Auxiliary input 1	034 000	LOGIC: Input 1 EXT
✓	<28>	Auxiliary input 2	034 001	LOGIC: Input 2 EXT
✓	<29>	Auxiliary input 3	034 002	LOGIC: Input 3 EXT
✓	<30>	Auxiliary input 4	034 003	LOGIC: Input 4 EXT

[1] Different designations are used, for example, in IEC 60870-5-103 Annex A (phase A rather than L1).

B 3.1.3.3.3 Monitoring Signals (Supervision Indications) in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8		Designations as in the Device Address List	
	INF	**Semantics**	**Address**	**Descriptor**
✓	<32>	Measurand supervision I	040 087	MCMON: Meas. circ. I faulty
✓	<33>	Measurand supervision V	038 023	MCMON: Meas. circ. V faulty
✓	<35>	Phase sequence supervision	038 049	MCMON: Phase sequ. V faulty
✓	<36>[1]	Trip circuit supervision	041 200	SFMON: Relay Kxx faulty
☐	<37>	I>> back-up operation		
✓	<38>	VT fuse failure	004 061	MAIN: M.c.b. trip V EXT
✓	<39>	Teleprotection disturbed	036 060	PSIG: Telecom. faulty
✓	<46>	Group warning	036 100	SFMON: Warning (relay)
✓	<47>	Group alarm	004 065	MAIN: Blocked/faulty

[1] The message content is formed from the OR operation of the individual signals

B 3.1.3.3.4 Earth Fault Indications in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8 [1]		Designations as in the Device Address List	
	INF	Semantics	Address	Descriptor
✓	<48>	Earth fault L1	041 054	MAIN: Ground fault A
✓	<49>	Earth fault L2	041 055	MAIN: Ground fault B
✓	<50>	Earth fault L3	041 056	MAIN: Ground fault C
✓	<51>	Earth fault forward, i.e. line	041 088	MAIN: Gnd. fault forw./LS
✓	<52>	Earth fault reverse, i.e. busbar	041 089	MAIN: Gnd. fault backw./BS

[1] Different designations are used, for example, in IEC 60870-5-103 Annex A (phase A rather than L1).

B 3.1.3.3.5 Fault Indications in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8 [1]		Designations as in the Device Address List	
	INF	Semantics	Address	Descriptor
✓	<64>	Start /pick-up L1	040 005	MAIN: Starting A
✓	<65>	Start /pick-up L2	040 006	MAIN: Starting B
✓	<66>	Start /pick-up L3	040 007	MAIN: Starting C
✓	<67>	Start /pick-up N	040 008	MAIN: Starting GF
✓	<68>	General trip	036 071	MAIN: Gen. trip command 1
	<69>	Trip L1		
	<70>	Trip L2		
	<71>	Trip L3		
	<72>	Trip I>> (back-up operation)		
✓	<73>	Fault location X in ohms	004 029	FT_DA: Fault react., prim.
✓	<74>	Fault forward/line	036 018	SCDD: Fault P forward
✓	<75>	Fault reverse/busbar	036 019	SCDD: Fault P backward
✓	<76>	Teleprotection signal transmitted	036 035	PSIG: Send (signal)
✓	<77>	Teleprotection signal received	037 029	PSIG: Receive (signal)
	<78>	Zone 1		
	<79>	Zone 2		
	<80>	Zone 3		
	<81>	Zone 4		
	<82>	Zone 5		

[1] Different designations are used, for example, in IEC 60870-5-103 Annex A (phase A rather than L1).

	Designations as in IEC 60870-5-103 Section 8 [1] INF	Semantics	Designations as in the Device Address List Address	Descriptor
☐	<83>	Zone 6		
☑	<84>	General start/pick-up	040 000	MAIN: General starting
☑	<85>	Breaker failure	036 017	CBF: CB failure
☐	<86>	Trip measuring system L1		
☐	<87>	Trip measuring system L2		
☐	<88>	Trip measuring system L3		
☐	<89>	Trip measuring system E		
☑	<90>	Trip I>	040 042	MAIN: TripSig. tI>/tIrefP>
☑	<91>	Trip I>>	040 011	DTOC: Trip signal tI>>
☑	<92>	Trip IN>	040 043	MAIN: TripSig tIN>/tIrefN>
☑	<93>	Trip IN>>	040 028	DTOC: Trip signal tIN>>

B 3.1.3.3.6 Auto-Reclosure Indications in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8 INF	Semantics	Designations as in the Device Address List Address	Descriptor
✓	<128>	CB 'on' by AR	037 007	ARC: (Re)close signal HSR
✓	<129>	CB 'on' by long-time AR	037 006	ARC: (Re)close signal TDR
✓	<130>	AR blocked	037 008	ARC: Not ready

B 3.1.3.3.7 Measurands in Monitor Direction

	Designations as in IEC 60870-5-103 Section 8 INF	Semantics	Designations as in the Device Address List Address	Descriptor
✓	<144>[1]	Measurand I	006 041	MAIN: Current B p.u.
✓	<145>[2]	Measurands I, V	006 041 005 045	MAIN: Current B p.u. MAIN: Voltage A-B p.u.
✓	<146>[3]	Measurands I, V, P, Q	006 041 005 045 004 051 004 053	MAIN: Current B p.u. MAIN: Voltage A-B p.u. MAIN: Active power P p.u. MAIN: Reac. power Q p.u.
✓	<147>[4]	Measurands I_N, V_{EN}	005 011 005 013	MAIN: Current Σ(IP) p.u. MAIN: Volt. Σ(VPG)/√3 p.u.
✓	<148>[5]	Measurands $I_{L1,2,3}$, $V_{L1,2,3}$, P, Q, f	005 041 006 041 007 041 005 043 006 043 007 043 004 051 004 053 004 040	MAIN: Current A p.u. MAIN: Current B p.u. MAIN: Current C p.u. MAIN: Voltage A-G p.u. MAIN: Voltage B-G p.u. MAIN: Voltage C-G p.u. MAIN: Active power P p.u. MAIN: Reac. power Q p.u. MAIN: Frequency f

[1] Only when COMM1: Transm. enab. cycl. data is set at "*ASDU 3.1 per IEC*"
[2] Only when COMM1: Transm. enab. cycl. data is set at "*ASDU 3.2 per IEC*"
[3] Only when COMM1: Transm. enab. cycl. data is set at "*ASDU 3.3 per IEC*"
[4] Only when COMM1: Transm. enab. cycl. data is set at "*ASDU 3.4 per IEC*"
[5] Only when COMM1: Transm. enab. cycl. data is set at "*ASDU 9 per IEC*"

B 3.1.3.3.8 Generic Functions in Monitor Direction

Designations as in IEC 60870-5-103 Section 8

	INF	Semantics
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	End of general interrogation of generic data
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry aborted

B 3.1.3.4 Selection of Standard Information Numbers in Control Direction

B 3.1.3.4.1 System Functions in Control Direction

	Designations as in IEC 60870-5-103 Section 8	
	INF	Semantics
☑	<0>	Initiation of general interrogation
☑	<0>	Time synchronization

B 3.1.3.4.2 General Commands in Control Direction

	Designations as in IEC 60870-5-103 Section 8		Designations as in the Device Address List	
	INF	Semantics	Address	Descriptor
☑	<16>	Auto-recloser on/off	015 060	ARC: General enable USER
☑	<17>	Teleprotection on/off	015 004	PSIG: General enable USER
☑	<18>	Protection on/off	003 030	MAIN: Protection enabled
☑	<19>	LED reset	021 010	MAIN: Reset indicat. USER
☑	<23>[1]	Activate characteristic 1	003 060	PSS: Param.subs.sel. USER
☑	<24>[2]	Activate characteristic 2	003 060	PSS: Param.subs.sel. USER
☑	<25>[3]	Activate characteristic 3	003 060	PSS: Param.subs.sel. USER
☑	<26>[4]	Activate characteristic 4	003 060	PSS: Param.subs.sel. USER

[1] Switches PSS: Select PS USER to "*Parameter set 1*"
[2] Switches PSS: Select PS USER to "*Parameter set 2*"
[3] Switches PSS: Select PS USER to "*Parameter set 3*"
[4] Switches PSS: Select PS USER to "*Parameter set 4*"

B 3.1.3.4.3 Generic Functions in Control Direction

Designations as in IEC 60870-5-103 Section 8

	INF	Semantics
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	General interrogation of generic data
☐	<248>	Write entry
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry abort

B 3.1.3.5 Basic Application Functions

- [x] Test mode
- [x] Blocking of monitor direction
- [x] Disturbance data
- [ ] Generic services
- [x] Private data

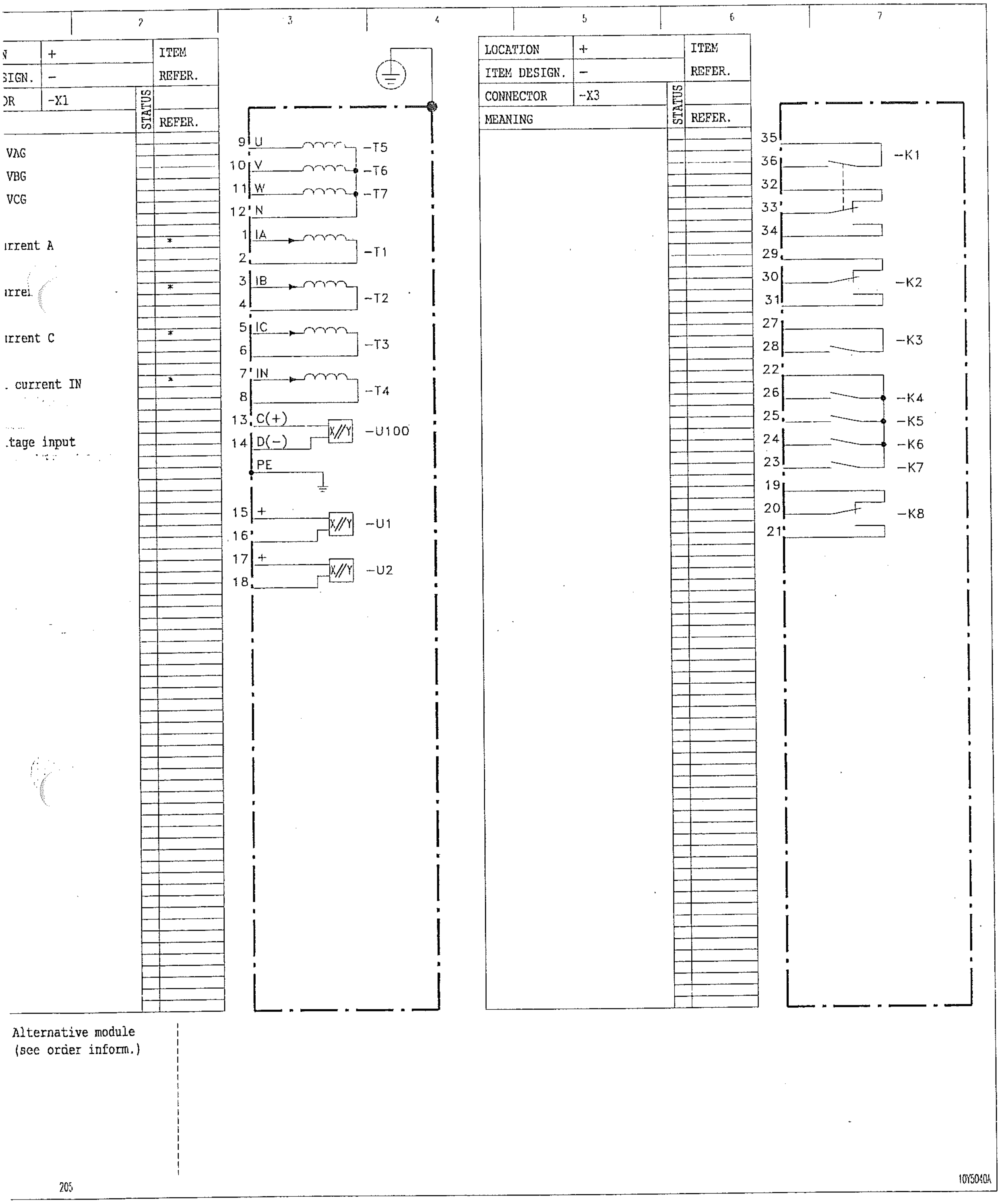
3.1.3.6 Miscellaneous

Measured values are transmitted both with ASDU 3 and ASDU 9. As defined in Sec. 7.2.6.8, the maximum MVAL can be either 1.2 or 2.4 times the rated value. In ASDU 3 and ASDU 9, different ratings may not be used; in other words, there is only one choice for each measurand.

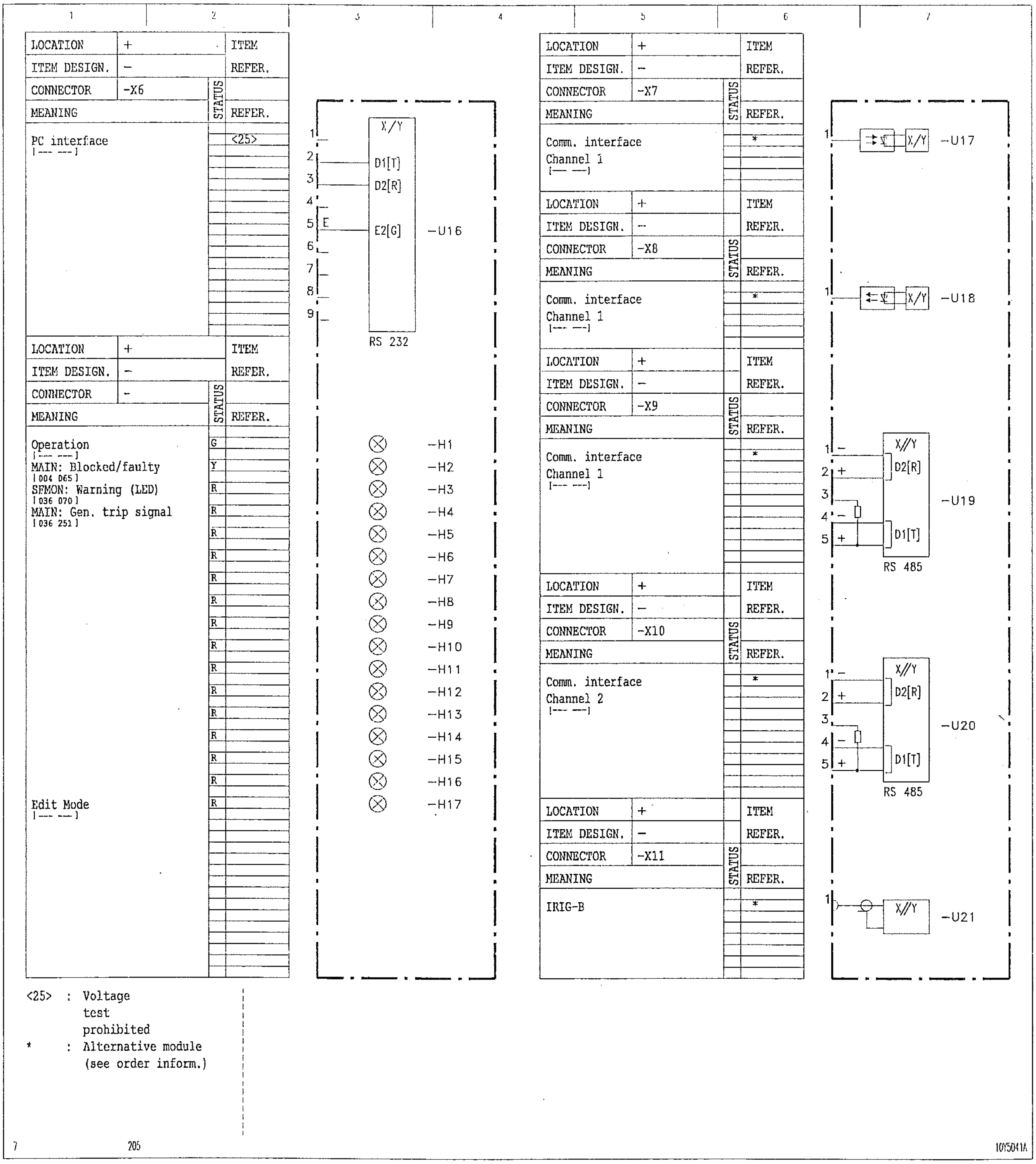
Measurand Designations as in IEC 60870-5-103 Section 8[1]	**Measured value** Designations as in the Device Address List	**Max. MVAL = nom. value multiplied by** 1.2	or	2.4
Current L1	Current A	☐		☑
Current L2	Current B	☐		☑
Current L3	Current C	☐		☑
Voltage L1-E	Voltage A-G	☐		☑
Voltage L2-E	Voltage B-G	☐		☑
Voltage L3-E	Voltage C-G	☐		☑
Active power P	Active power P	☐		☑
Reactive power Q	Reactive power Q	☐		☑
Frequency f	Frequency f	☐		☑
Voltage L1-L2	Voltage A-B	☐		☑

[1] IEC 60870-5-103 Annex also uses phase A rather than L1.

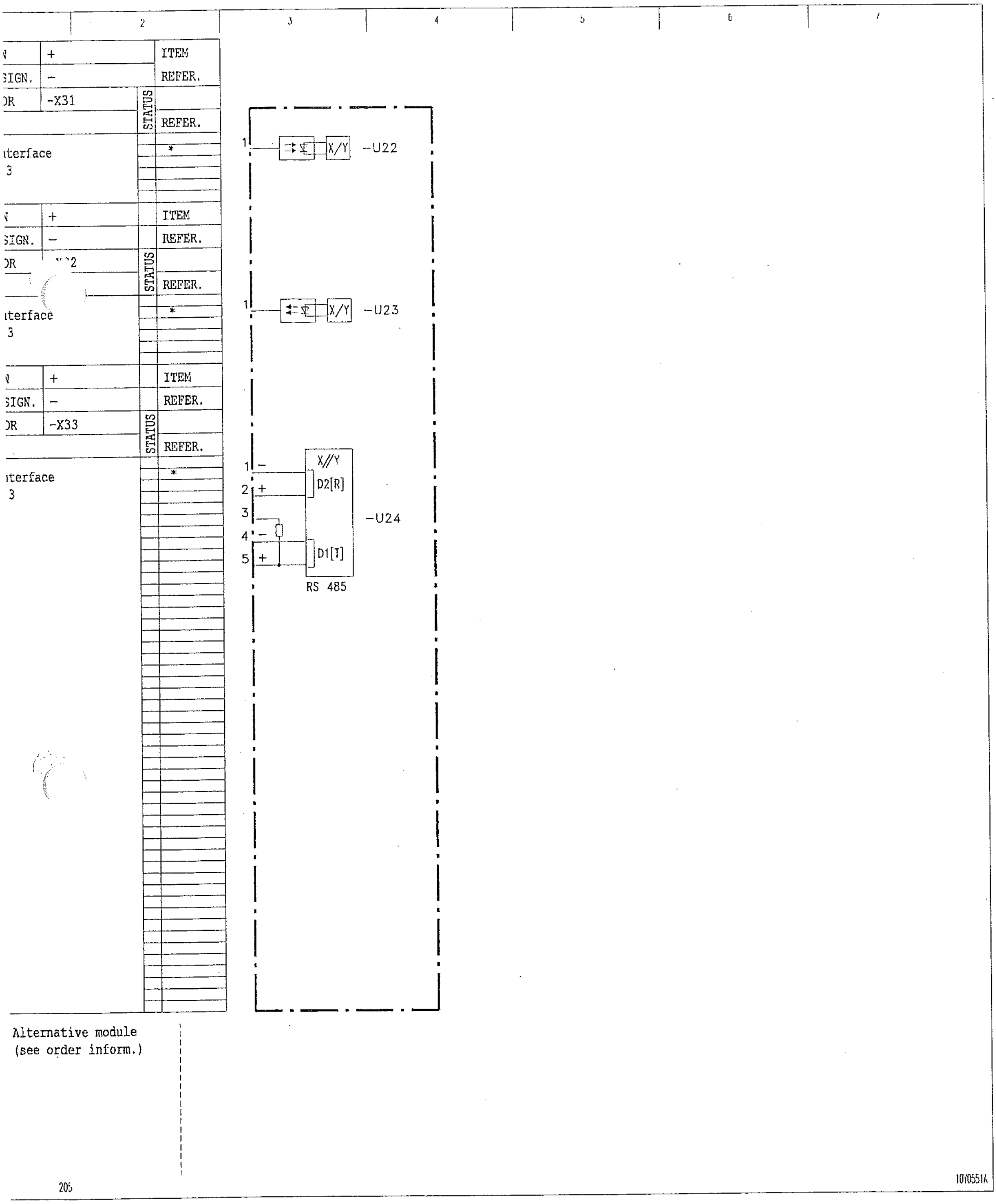
inal Connection Diagrams



'nal connection diagram P130C, diagram P130C.401, (part 1 of 3)



C-2 *Terminal connection diagram P130C, diagram P130C.401, (part 2 of 3)*



inal connection diagram P130C, diagram P130C.401, (part 3 of 3)

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