MICROENER

DTIVA-M
Operation Manual

PROTECTA HUNGARY

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User's manual version information

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CONTENTS

1 Configuration description

The E7-Feeder protection device is a member of the ***EuroProt+*** product line, made by Protecta Co. Ltd. The ***EuroProt+*** type complex protection in respect of hardware and software is a modular device. The modules are assembled and configured according to the requirements, and then the software determines the functions. This manual describes the specific application of the E7-Feeder factory configuration.

1.1 Application

The members of the DTIVA product line are configured to protect and control the elements of the medium voltage networks.

1.1.1 Protection functions

The E7-Feeder configuration is designed to protect large motors on the medium voltage network. It measures three phase currents, the zero sequence current component and additionally three phase voltages and the zero sequence voltage component. These measurements allow the current- and voltage-based functions.
Additionally to the usual functions as overcurrent and overvoltage functions, this configuration includes special motor protection functions as thermal replica function dedicated for motors, negative sequence overcurrent protection function, asymmetry protection, loss of load protection, motor startup supervision.

Protection functions	IEC	ANSI	E7-Feeder
Three-phase instantaneous overcurrent protection	I >>>	50	X
Three-phase time overcurrent protection	I >, I >>	51	X
Residual instantaneous overcurrent protection	Io >>>	50N	X
Residual time overcurrent protection	Io >, Io >>	51N	X
Residual directional overcurrent protection	Io Dir > >, Io Dir >>	67N	X
Inrush detection and blocking	I_{2h} >	68	X
Negative sequence overcurrent protection	I_2 >	46	X
Thermal protection	T >	49	X
Definite time overvoltage protection	U >, U >>	59	X
Definite time undervoltage protection	U <, U <<	27	X
Residual overvoltage protection	Uo >, Uo >>	59N	X
Negative sequence overvoltage protection	U_2 >	47	X
Positive sequence undervoltage protection	U_1 <	27D	X
Current unbalance protechjtion		60	X
Breaker failure protection	CBFP	50BF	X
Motor startup supervision	$3I_dB$ >	48	X
Undercurrent protection	$3I_dB$ >	37	X
Starts per hour		66	X
*Generator differential protection		87	X

** Optional protection function*

Table 1 The protection functions of the E7-Feeder configuration

The configured functions are drawn symbolically in the Figure below.

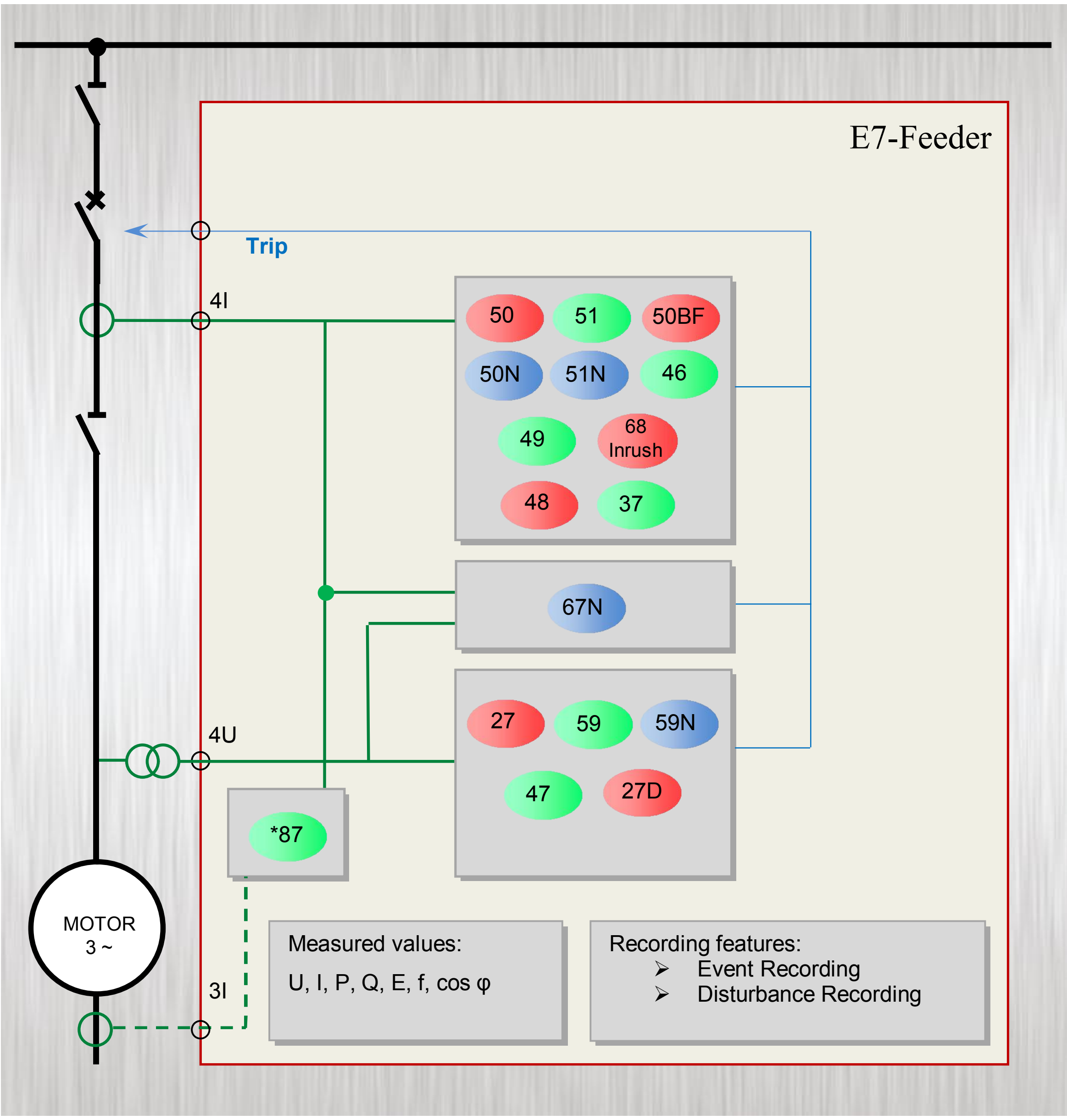


Figure 1 Implemented protection functions

1.1.2 Measurement functions

Based on the hardware inputs the measurements listed in Table below are available.

Measurement functions	E7-Feeder
Current (I1, I2, I3, Io)	X
Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency	X
Power (P, Q, S, pf) and Energy (E+, E-, Eq+, Eq-)	X
Circuit breaker wear	X
Supervised trip contacts (TCS)	X

Table 2 The measurement functions of the E7-Feeder configuration

1.1.3 Hardware configuration

The minimum number of inputs and outputs are listed in the Table below.

Hardware configuration	ANSI	E7-Feeder
Mounting		Op.
Panel instrument case		X
Current inputs (4th channel can be sensitive)		*4
Voltage inputs		4
Digital inputs		12
Digital outputs		8
Fast trip outputs		2
Temperature monitoring (RTDs) *	38 / 49T	Op.

** If the optional differential protection function is chosen in this case the numbers of current inputs is 8*

Table 3 The basic hardware configuration of the E7-Feeder configuration

The basic module arrangement of the E7-Feeder configuration is shown below. (Related to 42TE rack size.)

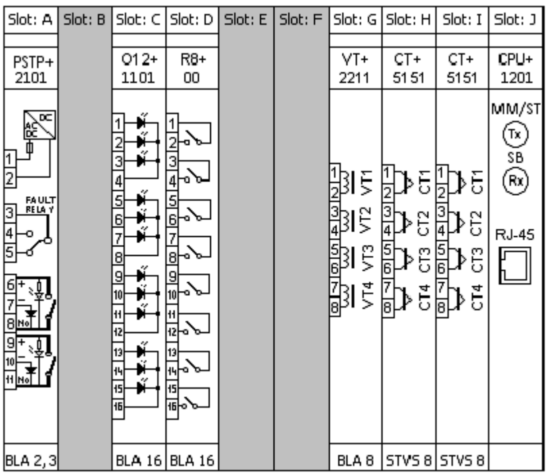


Figure 2 Basic module arrangement of the E7-Feeder configuration (42TE, rear view)

1.1.4 The applied hardware modules

The applied modules are listed in Table 4.
The technical specification of the device and that of the modules are described in the document "***Hardware description***".

Module identifier	Explanation
PSTP+ 2101	Power supply modul with trip contacts
O12+ 1101	Binary input module
R8+ 00	Signal relay output module
VT+ 2211	Analog voltage input module
CT + 5151	Analog current input module
CPU+ 1201	Processing and communication module

Table 4 The applied modules of the E7-Feeder configuration

1.2 Meeting the device

The basic information for working with the ***EuroProt+*** devices are described in the document "***Quick start guide to the devices of the EuroProt+ product line***".

*Figure 3 The 42 inch rack of **EuroProt+** family*

1.3 Software configuration

1.3.1 Protection functions

The implemented protection functions are listed in Table 5. The function blocks are described in details in separate documents. These are referred to also in this table.

Name	Title	Document
IOC50	3ph Instant.OC	***Three-phase instantaneous overcurrent protection function block description***
TOC51_low TOC51_high	3ph Overcurr	***Three-phase overcurrent protection function block description***
IOC50N	Residual Instant.OC	***Residual instantaneous overcurrent protection function block description***
TOC51N_low TOC51N_high	Residual TOC	***Residual overcurrent protection function block description***
TOC67N_low TOC67N_high	Dir.Residual TOC	***Directional residual overcurrent protection function block description***
INR68	Inrush	***Inrush detection and blocking***
TOC46	Neg. Seq. OC	***Negative sequence overcurrent protection function block description***
TTR49M	Motor Overload	***Motor thermal protection function block description***
TOV59_high TOV59_low	Overvoltage	***Definite time overvoltage protection function block description***
TUV27_high TUV27_low	Undervoltage	***Definite time undervoltage protection function block description***
TOC51_low TOC51_high	3ph Overcurr	***Three-phase overcurrent protection function block description***
TOV59N_high TOV59N_low	Overvoltage	***Definite time zero sequence overvoltage protection function block description***
VCB60	Current Unbalance	***Current unbalance function block description***
BRF50	Breaker failure	***Breaker failure protection function block description***
MSS48	Start-up Supervision	***Motor start-up supervision function block description***
TUC37	UnderCurrent	***Undercurrent (loss-of-load) protection function block description***
TRC94	Trip Logic	***Trip logic function block description***
CT4		***Current input function block description***
VT4		***Voltage input function block description***
CB1Pol		***Circuit breaker control function block description***
DisConn		***Disconnector control function block description***
MXU		***Line measurement function block description***
DIF87G		***Generator differential protection function block description***

Table 5 Implemented protection functions

1.3.1.1 Three-phase instantaneous overcurrent protection function (IOC50)

The three-phase instantaneous overcurrent protection function (IOC50) operates immediately if the phase currents are higher than the setting value.

The setting value is a parameter, and it can be doubled by graphic programming of the dedicated input binary signal defined by the user.

The function is based on peak value selection or on the RMS values of the Fourier basic harmonic calculation, according to the parameter setting. The fundamental Fourier components are results of an external function block.

Parameter for type selection has selection range of Off, Peak value and Fundamental value. When Fourier calculation is selected then the accuracy of the operation is high, the operation time however is above one period of the network frequency. If the operation is based on peak values then fast sub-cycle operation can be expected, but the transient overreach can be high.

The function generates trip commands without additional time delay if the detected values are above the current setting value.

The function generates trip commands for the three phases individually and a general trip command as well.

The instantaneous overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function		Accuracy
Using peak value calculation		
Operating characteristic	Instantaneous	<6%
Reset ratio	0.85	
Operate time at 2*I_S	<15 ms	
Reset time *	< 40 ms	
Transient overreach	90 %	
Using Fourier basic harmonic calculation		
Operating characteristic	Instantaneous	<2%
Reset ratio	0.85	
Operate time at 2* I_S	<25 ms	
Reset time *	< 60 ms	
Transient overreach	15 %	

**Measured with signal contacts*

Table 6 Technical data of of the instantaneous overcurrent protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Parameter for type selection			
IOC50_Oper_EPar_	Operation	Off, Peak value, Fundamental value	Peak value

Table 7 The enumerated parameter of the instantaneous overcurrent protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting current parameter:						
IOC50_StCurr_IPar_	Start Current	%	20	3000	1	200

Table 8 The integer parameter of the instantaneous overcurrent protection function

1.3.1.2 Three-phase time overcurrent protection function (TOC51)

The overcurrent protection function realizes definite time or inverse time characteristics according to IEC or IEEE standards, based on three phase currents. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08. This function can be applied as main protection for medium-voltage applications or backup or overload protection for high-voltage network elements.

The definite (independent) time characteristic has a fixed time delay when the current is above the starting current I_s previously set as a parameter.

The standard operating characteristics of the inverse time overcurrent protection function are defined by the following formula:

$$t(G) = TMS\left[\frac{k}{\left(\frac{G}{G_S}\right)^{\alpha} - 1} + c\right] \text{ when } G > G_S$$

where

t(G)(seconds)	theoretical operate time with constant value of G,
k, c	constants characterizing the selected curve (in seconds),
α	constants characterizing the selected curve (no dimension),
G	measured value of the characteristic quantity, Fourier base harmonic of the phase currents (IL1Four, IL2Four, IL3Four),
G_S	preset value of the characteristic quantity (Start current),
TMS	preset time multiplier (no dimension).

	IEC ref	Title	k_r	c	α
1	A	IEC Inv	0,14	0	0,02
2	B	IEC VeryInv	13,5	0	1
3	C	IEC ExtInv	80	0	2
4		IEC LongInv	120	0	1
5		ANSI Inv	0,0086	0,0185	0,02
6	D	ANSI ModInv	0,0515	0,1140	0,02
7	E	ANSI VeryInv	19,61	0,491	2
8	F	ANSI ExtInv	28,2	0,1217	2
9		ANSI LongInv	0,086	0,185	0,02
10		ANSI LongVeryInv	28,55	0,712	2
11		ANSI LongExtInv	64,07	0,250	2

The end of the effective range of the dependent time characteristics (G_D) is:

$$G_D = 20 * G_S$$

Above this value the theoretical operating time is definite:

$$t(G) = TMS\left[\frac{k}{\left(\frac{G_D}{G_S}\right)^{\alpha} - 1} + c\right] \text{ when } G > G_D = 20 * G_S$$

Additionally a minimum time delay can be defined by a dedicated parameter. This delay is valid if it is longer than t(G), defined by the formula above.

Resetting characteristics:

- for IEC type characteristics the resetting is after a fix time delay defined by TOC51_Reset_TPar_ (Reset delay),
- for ANSI types however according to the formula below:

$$t_r(G) = TMS\left[\frac{k_r}{1-\left(\frac{G}{G_S}\right)^{\alpha}}\right] \text{ when } G < G_S$$

where

$t_r(G)$(seconds)	theoretical reset time with constant value of G,
k_r	constants characterizing the selected curve (in seconds),
α	constants characterizing the selected curve (no dimension),
G	measured value of the characteristic quantity, Fourier base harmonic of the phase currents,
G_S	preset value of the characteristic quantity (Start current),
TMS	preset time multiplier (no dimension).

	IEC ref	Title	k_r	α
1	A	IEC Inv	Resetting after fix time delay, according to preset parameter TOC51_Reset_TPar_ “Reset delay”	
2	B	IEC VeryInv		
3	C	IEC ExtInv		
4		IEC LongInv		
5		ANSI Inv	0,46	2
6	D	ANSI ModInv	4,85	2
7	E	ANSI VeryInv	21,6	2
8	F	ANSI ExtInv	29,1	2
9		ANSI LongInv	4,6	2
10		ANSI LongVeryInv	13,46	2
11		ANSI LongExtInv	30	2

The binary output status signals of the three-phase overcurrent protection function are starting signals of the three phases individually, a general starting signal and a general trip command.

The overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Operating accuracy	20 ≤ G_S ≤ 1000	< 2 %
Operate time accuracy		±5% or ±15 ms, whichever is greater
Reset ratio	0,95	
Reset time * Dependent time char. Definite time char.	Approx 60 ms	< 2% or ±35 ms, whichever is greater
Transient overreach		< 2 %
Pickup time *	< 40 ms	
Overshot time Dependent time char. Definite time char.	30 ms 50 ms	
Influence of time varying value of the input current (IEC 60255-151)		< 4 %

** Measured with signal relay contact*

Table 9 Technical data of of the instantaneous overcurrent protection function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Parameter for type selection			
TOC51_Oper_EPar_	Operation	Off, DefinitTime, IEC Inv, IEC VeryInv, IEC ExtInv, IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv	Definit Time

Table 10 The enumerated parameters of the time overcurrent protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting current parameter:						
TOC51_StCurr_IPar_	Start Current	%	20	1000	1	200

Table 11 The integer parameter of the time overcurrent protection function

Float point parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Time multiplier of the inverse characteristics (OC module)						
TOC67_Multip_FPar_	Time Multiplier	sec	0.05	999	0.01	1.0

Table 12 The float point parameter of the time overcurrent protection function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Minimal time delay for the inverse characteristics:						
TOC51_MinDel_TPar_	Min Time Delay *	msec	0	60000	1	100
Definite time delay:						
TOC51_DefDel_TPar_	Definite Time Delay **	msec	0	60000	1	100
Reset time delay for the inverse characteristics:						
TOC51_Reset_TPar_	Reset Time*	msec	0	60000	1	100

**Valid for inverse type characteristics*

***Valid for definite type characteristics only*

Table 13 The timer parameters of the time overcurrent protection function

1.3.1.3 Residual instantaneous overcurrent protection function (IOC50N)

The residual instantaneous overcurrent protection function (IOC50N) block operates immediately if the residual current (3Io) is above the setting value. The setting value is a parameter, and it can be doubled by a dedicated binary input signal defined by the user applying the graphic programming.

The function is based on peak value selection or on the RMS values of the Fourier basic harmonic component of the residual current, according to the parameter setting. The fundamental Fourier component calculation is not part of the IOC50N function.

Parameter for type selection has selection range of Off, Peak value and Fundamental value.

The function generates a trip commands without additional time delay if the detected values are above the current setting value.

The residual instantaneous overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function		Accuracy
Using peak value calculation		
Operating characteristic (I>0.1 In)	Instantaneous	<6%
Reset ratio	0.85	
Operate time at 2*I_S	<15 ms	
Reset time *	< 35 ms	
Transient overreach	85 %	
Using Fourier basic harmonic calculation		
Operating characteristic (I>0.1 In)	Instantaneous	<3%
Reset ratio	0.85	
Operate time at 2*I_S	<25 ms	
Reset time *	< 60 ms	
Transient overreach	15 %	

**Measured with signal contacts*

Table 14 Technical data of the residual instantaneous overcurrent protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Parameter for type selection			
IOC50N_Oper_EPar_	Operation	Off, Peak value, Fundamental value	Peak value

Table 15 The enumerated parameter of the residual instantaneous overcurrent protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting current parameter:						
IOC50N_StCurr_IPar_	Start Current	%	10	400	1	200

Table 16 The integer parameter of the residual instantaneous overcurrent protection function

1.3.1.4 Residual overcurrent protection function (TOC51N)

The residual delayed overcurrent protection function can realize definite time or inverse time characteristics according to IEC or IEEE standards, based on the RMS value of the fundamental Fourier component of a single measured current, which can be the measured residual current at the neutral point (3Io) or the calculated zero sequence current component. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08.

The definite (independent) time characteristic has a fixed time delay when the current is above the starting current I_s previously set as a parameter.

The standard operating characteristics of the inverse time overcurrent protection function are defined by the following formula:

$$t(G) = TMS\left[\frac{k}{\left(\frac{G}{G_S}\right)^{\alpha} - 1} + c\right] \quad \text{when } G > G_S$$

where

t(G)(seconds)	theoretical operate time with constant value of G,
k, c	constants characterizing the selected curve (in seconds),
α	constant characterizing the selected curve (no dimension),
G	measured value of the characteristic quantity, Fourier base harmonic of the residual current (INFour),
G_S	preset value of the characteristic quantity (Start current),
TMS	preset time multiplier (no dimension).

	IEC ref		k_r	c	α
1	A	IEC Inv	0,14	0	0,02
2	B	IEC VeryInv	13,5	0	1
3	C	IEC ExtInv	80	0	2
4		IEC LongInv	120	0	1
5		ANSI Inv	0,0086	0,0185	0,02
6	D	ANSI ModInv	0,0515	0,1140	0,02
7	E	ANSI VeryInv	19,61	0,491	2
8	F	ANSI ExtInv	28,2	0,1217	2
9		ANSI LongInv	0,086	0,185	0,02
10		ANSI LongVeryInv	28,55	0,712	2
11		ANSI LongExtInv	64,07	0,250	2

The end of the effective range of the dependent time characteristics (G_D) is:

$$G_D = 20 * G_S$$

Above this value the theoretical operating time is definite:

$$t(G) = TMS\left[\frac{k}{\left(\frac{G_D}{G_S}\right)^{\alpha} - 1} + c\right] \quad \text{when } G > G_D = 20 * G_S$$

Additionally a minimum time delay can be defined by a dedicated parameter (Min. Time Delay). This delay is valid if it is longer than t(G), defined by the formula above.

Resetting characteristics:

- for IEC type characteristics the resetting is after a fix time delay,
- for ANSI types however according to the formula below:

$$t_r(G) = TMS\left[\frac{k_r}{1-\left(\frac{G}{G_S}\right)^{\alpha}}\right] \text{ when } G < G_S$$

where

$t_r(G)$(seconds)	theoretical reset time with constant value of G,
k_r	constants characterizing the selected curve (in seconds),
α	constant characterizing the selected curve (no dimension),
G	measured value of the characteristic quantity, Fourier base harmonic of the residual current,
G_S	preset value of the characteristic quantity (Start current),
TMS	preset time multiplier (no dimension).

	IEC ref		k_r	α
1	A	IEC Inv	Resetting after fix time delay, according to preset parameter TOC51_Reset_TPar_ “Reset delay”	
2	B	IEC VeryInv		
3	C	IEC ExtInv		
4		IEC LongInv		
5		ANSI Inv	0,46	2
6	D	ANSI ModInv	4,85	2
7	E	ANSI VeryInv	21,6	2
8	F	ANSI ExtInv	29,1	2
9		ANSI LongInv	4,6	2
10		ANSI LongVeryInv	13,46	2
11		ANSI LongExtInv	30	2

The binary output status signals of the residual overcurrent protection function are the general starting signal and the general trip command if the time delay determined by the characteristics expired.

The residual overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Operating accuracy *	$20 \le G_S \le 1000$	< 3 %
Operate time accuracy		±5% or ±15 ms, whichever is greater
Reset ratio	0,95	
Reset time * Dependent time char. Definite time char.	 Approx 60 ms	< 2% or ±35 ms, whichever is greater
Transient overreach		2 %
Pickup time	≤ 40 ms	
Overshot time Dependent time char. Definite time char.	 30 ms 50 ms	
Influence of time varying value of the input current (IEC 60255-151)		< 4 %

* *Measured in version In = 200 mA*

Table 17 The technical data of the residual overcurrent protection function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Parameter for type selection			
TOC51N_Oper_EPar_	Operation	Off, DefinitTime, IEC Inv, IEC VeryInv, IEC ExtInv, IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv	Definite Time

Table 18 The enumerated parameters of the residual overcurrent protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting current parameter:						
TOC51N_StCurr_IPar_	Start Current *	%	5	200	1	50
TOC51N_StCurr_IPar_	Start Current **	%	10	1000	1	50

* *In = 1 A or 5 A*
** *In = 200 mA or 1 A*

Table 19 The integer parameter of the residual overcurrent protection function

Float point parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Time multiplier of the inverse characteristics (OC module)						
TOC51N_Multip_FPar_	Time Multiplier	sec	0.05	999	0.01	1.0

Table 20 The float parameter of the residual overcurrent protection function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Minimal time delay for the inverse characteristics:						
TOC51N_MinDel_TPar_	Min Time Delay*	msec	0	60000	1	100
Definite time delay:						
TOC51N_DefDel_TPar_	Definite Time Delay**	msec	0	60000	1	100
Reset time delay for the inverse characteristics:						
TOC51N_Reset_TPar_	Reset Time*	msec	0	60000	1	100

**Valid for inverse type characteristics*
***Valid for definite type characteristics only*

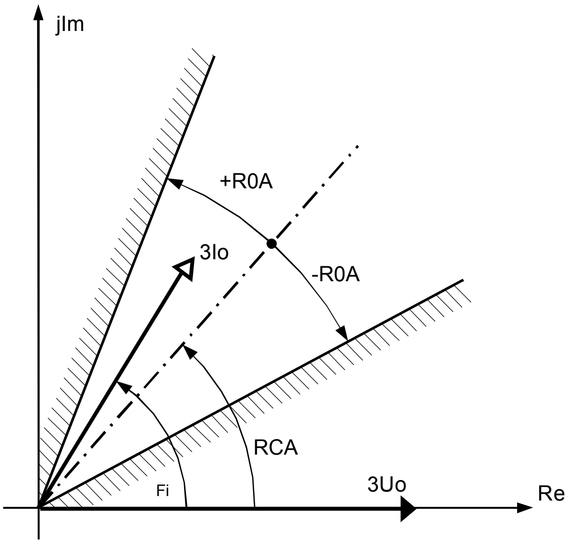
Table 21 The timer parameters of the residual overcurrent protection function

1.3.1.5 Residual directional overcurrent protection function (TOC67N)

The main application area of the directional residual delayed overcurrent protection function is an earth-fault protection.

The inputs of the function are the RMS value of the Fourier basic harmonic components of the zero sequence current (IN=3Io) and those of the zero sequence voltage (UN=3Uo).

The block of the directional decision generates a signal of TRUE value if the UN=3Uo zero sequence voltage and the IN=3Io zero sequence current are above the limits needed for correct directional decision, and the angle difference between the vectors is within the preset range. The decision enables the output start and trip signal of an overcurrent protection function block (TOC51N). This non-directional residual overcurrent protection function block is described in a separate document.



The directional decision module calculates the phase angle between the residual voltage and the residual current. The reference signal is the residual voltage according to the *Figure*.

The output of the directional decision module is OK, namely it is TRUE if the phase angle between the residual voltage and the residual current is within the limit range defined by the preset parameter OR if non-directional operation is selected by the preset parameter (Direction=NonDir).

Technical data

Function	Value	Accuracy
Operating accuracy		< ±2 %
Operate time accuracy		±5% or ±15 ms, whichever is greater
Accuracy in minimum time range		±35 ms
Reset ratio	0,95	
Reset time	Approx 50 ms	±35 ms
Transient overreach	<2 %	
Pickup time	25 – 30 ms	
Angular accuracy Io ≤ 0.1 In 0.1 In < Io ≤ 0.4 In 0.4 In < Io		 < ±10° < ±5° < ±2°
Angular reset ratio Forward and backward All other selection	 10° 5°	

Table 22 The technical data of the residual directional overcurrent protection function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Directionality of the function			
TOC67N_Dir_EPar_	Direction	NonDir,Forward-Angle,Backward-Angle,Forward-I*cos(fi),Backward-I*cos(fi),Forward-I*sin(fi),Backward-I*sin(fi),Forward-I*sin(fi+45),Backward-I*sin(fi+45)	Forward-Angle
Operating characteristic selection of the TOC51N module			
TOC67N_Oper_EPar_	Operation	Off,DefiniteTime,IEC Inv,IEC VeryInv,IEC ExtInv,IEC LongInv,ANSI Inv,ANSI ModInv,ANSI VeryInv,ANSI ExtInv,ANSI LongInv,ANSI LongVeryInv,ANSI LongExtInv	DefiniteTime

Table 23 The enumerated parameters of the residual directional overcurrent protection function

Short explanation of the enumerated parameter "Direction"

Selected value	Explanation
NonDir,	Operation according to non-directional TOC51N
Forward-Angle	See *Figure*, set RCA (Characteristic Angle) and ROA (Operating Angle) as required
Backward-Angle	RCAactual=RCAset+180°, set RCA (Characteristic Angle) and ROA (Operating Angle) as required
Forward-I*cos(fi)	RCA=0°fix, ROA=85°fix, the setting values RCA and ROA are not applied
Backward-I*cos(fi)	RCA=180°fix, ROA=85°fix, the setting values RCA and ROA are not applied
Forward-I*sin(fi)	RCA=90°fix, ROA=85°fix, the setting values RCA and ROA are not applied
Backward-I*sin(fi)	RCA=–90°fix, ROA=85°fix, the setting values RCA and ROA are not applied
Forward-I*sin(fi+45)	RCA=45°fix, ROA=85°fix, the setting values RCA and ROA are not applied
Backward-I*sin(fi+45)	RCA=–135°fix, ROA=85°fix, the setting values RCA and ROA are not applied

Table 24 The short explanation of the enumerated parameters of the residual directional overcurrent protection function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
The threshold value for the 3Uo zero sequence voltage, below which no directionality is possible. % of the rated voltage of the voltage transformer input						
TOC67N_UoMin_IPar_	URes Min	%	1	10	1	2
The threshold value for the 3Io zero sequence current, below which no operation is possible. % of the rated current of the current transformer input						
TOC67N_IoMin_IPar_	IRes Min	%	1	50	1	5
Operating angle (See *Figure*)						
TOC67N_ROA_IPar_	Operating Angle	deg	30	80	1	60
Characteristic angle (See *Figure*)						
TOC67N_RCA_IPar_	Characteristic Angle	deg	-180	180	1	60
Start current (TOC51N module)						
TOC67N_StCurr_IPar_	Start Current	%	5	200	1	50

Table 25 The integer parameters of the residual directional overcurrent protection function

Float point parameter

Parameter name	Title	Unit	Min	Step	Step	Default
Time multiplier of the inverse characteristics (TOC51N module)						
TOC67N_Multip_FPar_	Time Multiplier	sec	0.05	999	0.01	1.0

Table 26 The float point parameter of the residual directional overcurrent protection function

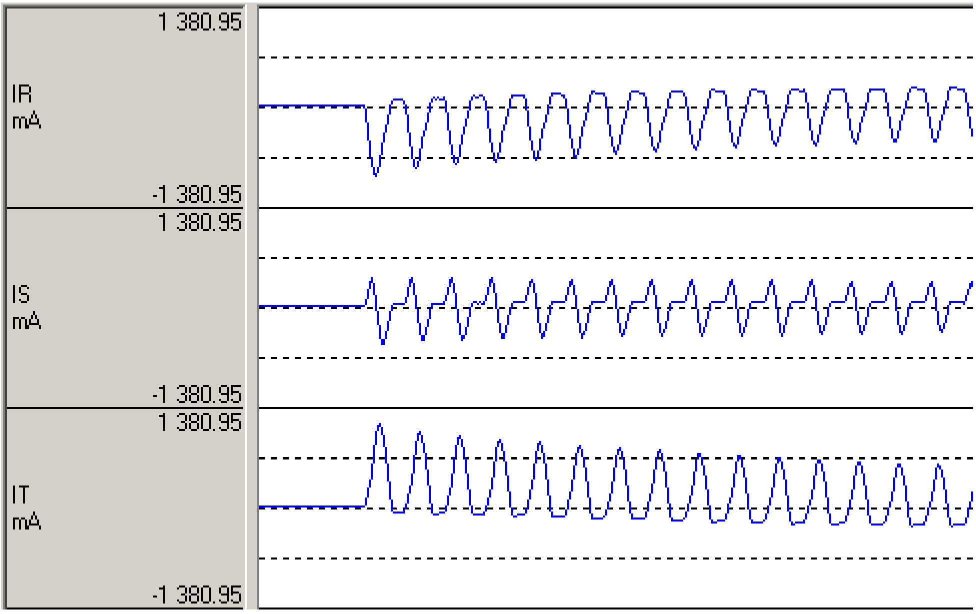
Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Minimal time delay for the inverse characteristics (TOC 51N module):						
TOC67N_MinDel_TPar_	Min Time Delay	msec	50	60000	1	100
Definite time delay (TOC 51N module):						
TOC67N_DefDel_TPar_	Definite Time Delay	msec	0	60000	1	100
Reset time delay for the inverse characteristics (TOC 51N module):						
TOC67N_Reset_TPar_	Reset Time	msec	0	60000	1	100

Table 27 The timer parameters of the residual directional overcurrent protection function

1.3.1.6 Inrush detection function (INR68)

When an inductive element with an iron core (transformer, reactor, etc.) is energized, high current peak values can be detected. This is caused by the transient asymmetric saturation of the iron core as a nonlinear element in the power network. The sizing of the iron core is usually sufficient to keep the steady state magnetic flux values below the saturation point of the iron core, so the inrush transient slowly dies out. These current peaks depend also on random factors such as the phase angle at energizing. Depending on the shape of the magnetization curve of the iron core, the detected peaks can be several times above the rated current peaks. Additionally, in medium or high voltage networks, where losses and damping are low, the indicated high current values may be sustained at length. Figure below shows a typical example for the inrush current shapes of a three-phase transformer.



A typical inrush current

As a consequence, overcurrent relays, differential relays or distance relays may start, and because of the long duration of the high current peaks, they may generate an unwanted trip command.

The inrush current detection function can distinguish between high currents caused by overload or faults and the high currents during the inrush time.

The operating principle of the inrush current detection function is based on the special shape of the inrush current.

The typical inrush current in one or two phases is asymmetrical to the time axis. For example, in IT of the Figure above the positive peaks are high while no peaks can be detected in the negative domain.

The theory of the Fourier analysis states that even harmonic components (2^{nd}, 4^{th} etc.) are dominant in waves asymmetrical to the time axis. The component with the highest value is the second one.

Typical overload and fault currents do not contain high even harmonic components.

The inrush current detection function processes the Fourier basic harmonic component and the second harmonic component of the three phase currents. If the ratio of the second harmonic and the base Fourier harmonic is above the setting value of the parameter *2nd Harm Ratio*, an inrush detection signal is generated.

The signal is output only if the base harmonic component is above the level defined by the setting of the parameter *IPh Base Sens.* This prevents unwanted operation in the event that low currents contain relatively high error signals.

The function operates independently using all three phase currents individually, and additionally, a general inrush detection signal is generated if any of the phases detects inrush current.

The function can be disabled by the binary input *Disable*. This signal is the result of logic equations graphically edited by the user.

Using the inrush detection binary signals, other protection functions can be blocked during the transient period so as to avoid the unwanted trip.

Some protection functions use these signals automatically, but a stand-alone inrush detection function block is also available for application at the user's discretion.

Technical data

Function	Range	Accuracy
Current accuracy	20 … 2000% of In	±1% of In

Table 28 Technical data of the inrush detection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Disabling or enabling the operation of the function			
INR2_Op_EPar_	Operation	Off,On	On

Table 29 The enumerated parameter of the inrush detection function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Ratio of the second and basic harmonic Fourier components						
INR2_2HRat_IPar_,	2nd Harm Ratio	%	5	50	1	15
Basic sensitivity of the function						
INR2_MinCurr_IPar_	IPh Base Sens	%	20	100	1	30

Table 30 The integer parameter of the inrush detection function

1.3.1.7 Negative sequence overcurrent protection function (TOC46)

The negative sequence overcurrent protection function (TOC46) block operates if the negative sequence current is higher than the preset starting value.

In the negative sequence overcurrent protection function, definite-time or inverse-time characteristics are implemented, according to IEC or IEEE standards. The function evaluates a single measured current, which is the RMS value of the fundamental Fourier component of the negative sequence current. The characteristics are harmonized with IEC 60255-151, Edition 1.0, 2009-08.

The definite (independent) time characteristic has a fixed delaying time when the current is above the starting current G_s previously set as a parameter.

The standard dependent time characteristics of the negative sequence overcurrent protection function are as follows.

$$t(G) = TMS\left[\frac{k}{\left(\frac{G}{G_S}\right)^{\alpha}-1}+c\right] \text{ when } G > G_S$$

where

t(G)(seconds)	theoretical operate time with constant value of G,
k, c	constants characterizing the selected curve (in seconds),
α	constant characterizing the selected curve (no dimension),
G	measured value of the characteristic quantity, Fourier base harmonic of the negative sequence current (INFour),
G_S	preset starting value of the characteristic quantity,
TMS	preset time multiplier (no dimension).

	IEC ref		k_r	c	α
1	A	IEC Inv	0,14	0	0,02
2	B	IEC VeryInv	13,5	0	1
3	C	IEC ExtInv	80	0	2
4		IEC LongInv	120	0	1
5		ANSI Inv	0,0086	0,0185	0,02
6	D	ANSI ModInv	0,0515	0,1140	0,02
7	E	ANSI VeryInv	19,61	0,491	2
8	F	ANSI ExtInv	28,2	0,1217	2
9		ANSI LongInv	0,086	0,185	0,02
10		ANSI LongVeryInv	28,55	0,712	2
11		ANSI LongExtInv	64,07	0,250	2

Table 31 The constants of the standard dependent time characteristics

A parameter (Operation) serves for choosing overcurrent function of independent time delay or dependent one with type selection above.

Time multiplier of the inverse characteristics (TMS) is also a parameter to be preset.

The end of the effective range of the dependent time characteristics (G_D) is:

$$G_D = 20 * G_S$$

Above this value the theoretical operating time is definite. The inverse type characteristics are also combined with a minimum time delay, the value of which is set by user parameter TOC46_MinDel_TPar_ (Min. Time Delay).

The negative phase sequence components calculation is based on the Fourier components of the phase currents.

The binary output status signals of the negative sequence overcurrent protection function are the general starting and the general trip command of the function.

The negative sequence overcurrent protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Operating accuracy	$10 \leq G_s$ [%] ≤ 200	< 2 %
Operate time accuracy		±5% or ±15 ms, whichever is greater
Reset ratio	0,95	
Reset time * Dependent time charact. Definite time charact.	 approx. 60 ms	<2 % or ±35 ms, whichever is greater
Transient overreach		< 2 %
Pickup time at 2* G_s	<40 ms	
Overshot time Dependent time charact. Definite time charact.	 25 ms 45 ms	
Influence of time varying value of the input current (IEC 60255-151)		< 4 %

* *Measured with signal contacts*

Table 32 Technical data of the negative sequence overcurrent protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Parameter for type selection			
TOC46_Oper_EPar_	Operation	Off, DefinitTime, IEC Inv, IEC VeryInv, IEC ExtInv, IEC LongInv, ANSI Inv, ANSI ModInv, ANSI VeryInv, ANSI ExtInv, ANSI LongInv, ANSI LongVeryInv, ANSI LongExtInv	Definit Time

Table 33 The enumerated parameter of the negative sequence overcurrent protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting current parameter:						
TOC46_StCurr_IPar_	Start Current	%	5	200	1	50

Table 34 The integer parameter of the negative sequence overcurrent protection function

Timer parameters

Parameter name	**Title**	**Unit**	**Min**	**Max**	**Step**	**Default**
Minimal time delay for the inverse characteristics:						
TOC46_MinDel_TPar_	Min Time Delay*	msec	0	60000	1	100
Definite time delay:						
TOC46_DefDel_TPar_	Definite Time Delay**	msec	0	60000	1	100
Reset time delay for the inverse characteristics:						
TOC46_Reset_TPar_	Reset Time*	msec	0	60000	1	100
Time multiplier for the inverse characteristics:						
TOC46_Multip_TPar_	Time Multiplier*	msec	100	60000	1	100

**Valid for inverse type characteristics*

***Valid for definite type characteristics only*

Table 35 The timer parameter of the negative sequence overcurrent protection function

1.3.1.8 Motor thermal protection function

Basically, the motor thermal protection function measures the three sampled phase currents. Positive sequence and negative sequence basic harmonic components are calculated. The temperature calculation is based on the weighted sum of the positive and negative sequence current components.

$$I = \sqrt{I_1^2 + k * I_2^2}$$

where

- I_1 positive sequence current component
- I_2 negative sequence current component
- k weighting factor (parameter “INeg Scale”)

NOTE: I_2 is limited to 1.5 I_n. Above this value it is considered as I_2=1.5 I_n and the k weighting factor is constant 500%.

The weighting factor is defined by the user applying the required parameter setting (INeg. Scale). The purpose of weighting is to take into consideration the increased heating of the rotor due to inverse rotating (nearly double speed) negative sequence magnetic field.

The setting allows two different thermal time constants to be considered: one for the rotating state (heating-cooling) – “Time constant” - and one for the still stand (cooling), which is defined by parameter “Cooling/Heating” as a percentage of the heating time constant.

The temperature calculation is based on the step-by-step solution of the thermal differential equation. This method yields “overtemperature”, meaning the temperature above the ambient temperature. Accordingly, the temperature of the protected object is the sum of the calculated “overtemperature” and the ambient temperature.

The ambient temperature can be measured using e.g. a temperature probe generating electric analog signals proportional to the temperature. In the absence of such measurement, the temperature of the environment can be set using the dedicated parameter “Ambient Temperature”. The selection between parameter value and direct measurement is made by setting the binary parameter “Temperature sensor“.

If the calculated temperature (calculated “overtemperature” + ambient temperature) is above the threshold values, status signals are generated. There are three different status signals:

Alarm temperature
Trip temperature
Unlock temperature

For correct setting, the following values must be measured and set as parameters (the measurement for settings is dealed with the complete description in details):

Rated LoadCurrent	the measuring continuous current
Rated Temperature	the steady state overtemperature at rated load current
Base Temperature	the temperature of the environment during the measurement of the rated values
Time constant	separately measured heating/cooling time constant of the exponential temperature functions.

When energizing the protection device, the algorithm permits the definition of the starting temperature as the initial value of the calculated temperature:

Startup Temp.	initial temperature above the temperature of the environment as compared to the rated temperature above the temperature of the environment.

For motors with heavy starting conditions a binary signal can decrease the calculated heat to the half value ($I^2/2$), preventing trip command for overheating during motor starting.

The application of thermal protection of the motor is a better solution than simple overcurrent-based overload protection because thermal protection "remembers" the preceding load state of the motor, consequently, the delaying of the thermal protection does not need such a high fixed value, and the pick-up current value does not need such a high security margin between the permitted current and the permitted continuous thermal current of the motor. In case of varied previous load states and in a broad range of ambient temperatures this permits the better exploitation of the thermal and consequently current carrying capacity of the motor.

The thermal differential equation to be solved is:

$$\frac{d\Theta}{dt} = \frac{1}{T}\left(\frac{I^2(t)R}{hA} - \Theta\right)$$

The definition of the heat time constant is:

$$T = \frac{cm}{hA}$$

The theory of solving the thermal differential equation is described and explained in detail in a separate document ["The thermal differential equation"].

The solution of the thermal differential equation for constant current is the temperature as the function of time.

$$\Theta(t) = \frac{I^2 R}{hA}\left(1 - e^{-\frac{t}{T}}\right) + \Theta_o e^{-\frac{t}{T}}$$

where:

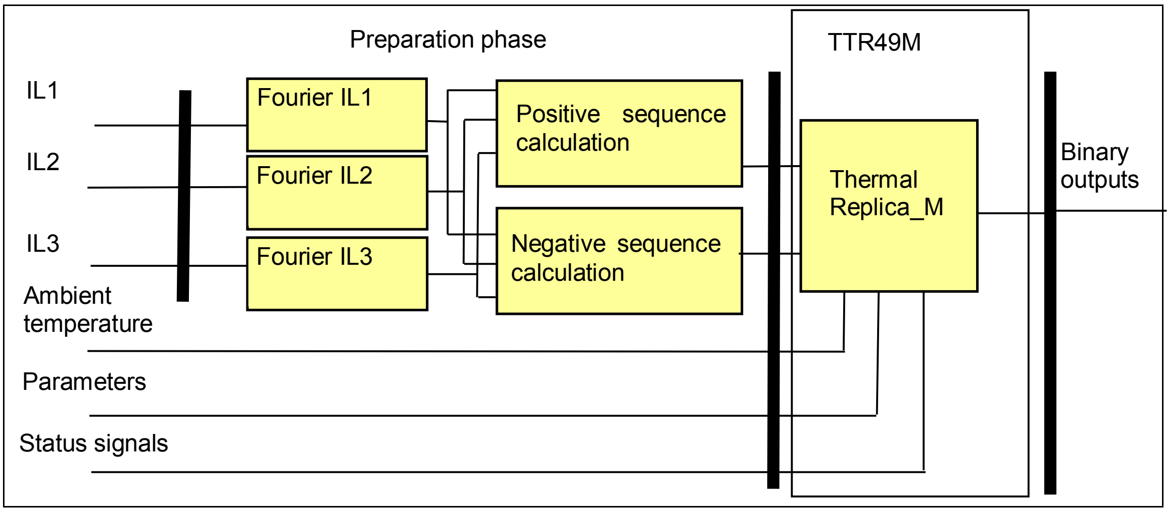
I, I(t)	(RMS) heating current, the RMS value usually changes over time;
R	resistance of the motor;
c	specific heat capacity of the conductor;
Θ, Θ(t)	rise of the temperature above the temperature of the environment;
h	heat transfer coefficient of the surface of the conductor;
A	area of the surface of the conductor;
t	time;
T	time constant.

The calculation of the measurable temperature is as follows:

Temperature(t) = Θ(t) + Ambient Temperature

The function applies a numerical solution of the thermal differential equation.

Figure below shows the preparation phase and the thermal overload function algorithm part (TTR49M).



For the preparation phase the inputs are the sampled values of three primary phase currents (IL1, IL2, IL3).

The inputs of the thermal replica module are the positive and negative sequence currents, the ambient temperature, the parameters and the binary input status signals.

The thermal replica module solves the first order thermal differential equation using a simple step-by-step method and compares the calculated temperature to the threshold values set by parameters.

The outputs of the function are the binary output status signals. These indicate the alarm status signal, the unlock status signal and the generated trip command if the temperature is above the current setting value.

Technical data

Function	Accuracy
Current in range of 20 - 2000% of In	< ± 1% of In
Operate time at I>1.5*Itrip	< 5 %

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Parameter for mode of operation			
TTR49M_Oper_EPar_	Operation	Off, Pulsed, Locked	Pulsed

The meaning of the enumerated values is as follows:

Off — The function is switched off; no output status signals are generated;
Pulsed — The function generates a trip pulse if the calculated temperature exceeds the trip value
Locked — The function generates a trip signal if the calculated temperature exceeds the trip value. It resets only if the temperature cools below the “Unlock temperature”.

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Alarm Temperature						
TTR49M_Alm_IPar_	Alarm Temperature	deg	60	200	1	80
Trip Temperature						
TTR49M_Trip_IPar_	Trip Temperature	deg	60	200	1	100
Rated Temperature						
TTR49M_Max_IPar_	Rated Temperature	deg	60	200	1	100
Base Temperature						
TTR49M_Ref_IPar_	Base Temperature	deg	0	40	1	25
Unlock Temperature						
TTR49M_Unl_IPar_	Unlock Temperature	deg	20	200	1	60
Ambient Temperature						
TTR49M_Amb_IPar_	Ambient Temperature	deg	0	40	1	25
Startup Temperature						
TTR49M_Str_IPar	Startup Temp.	%	0	60	1	0
Rated LoadCurrent						
TTR49M_Inom_IPar_	Rated LoadCurrent	%	20	150	1	100
Idle Current, below which the “cooling” time constant is valid						
TTR49M_Imin_IPar_	Idle Current	%	1	30	1	5
Time constant						
TTR49M_pT_IPar_	Time constant	min	1	999	1	10
Cooling/Heating						
TTR49M_cpT_IPar_	Cooling/Heating	%	100	400	1	200
Neg.Seq. scale (k)						
TTR49M_NegScale_IPar_	INeg Scale	%	100	500	1	200

Boolean parameter

Boolean parameter	Signal title	Selection range	Default
Parameter for ambient temperature sensor application			
TTR49M_Sens_BPar_	Temperature Sensor	No, Yes	No

Binary output status signals

Binary output status signals	Signal title	Explanation
TTR49M_Alarm_GrI_	Alarm	Alarm signal of the motor thermal protection function
TTR49M_GenTr_GrI_	General Trip	General trip signal of the motor thermal protection function
TTR49M_Lock_GrI_	Reclose locked	Motor restart blocking signal of the motor thermal protection function

Binary input status signals

All the three binary input status signals are defined by the user, applying the graphic equation editor.

Binary input status signal	Signal title	Explanation
TTR49M_Blk_GrO_	Block	Output status of a graphic equation defined by the user to disable the motor thermal protection function.
TTR49M_Reset_GrO_	Reset	Output status of a graphic equation defined by the user to reset the accumulated heat and set the temperature to the defined value for the subsequent heating test procedure. Resetting serves test purposes only, if the heating calculation needs to start at a clearly defined temperature. Using this signal, the testing engineer need not wait until the cooling reaches the required starting temperature of the subsequent heating test.
TTR49M_StartUp_GrO_	Heavy start	For motors with heavy starting conditions the presence of this signal decreases the generated heat amount to the half value ($I^2/2$). Output status of a graphic equation defined by the user.

1.3.1.9 Definite time overvoltage protection function (TOV59)

The definite time overvoltage protection function measures three voltages. The measured values of the characteristic quantity are the RMS values of the basic Fourier components of the phase voltages.

The Fourier calculation inputs are the sampled values of the three phase voltages (UL1, UL2, UL3), and the outputs are the basic Fourier components of the analyzed voltages (UL1Four, UL2Four, UL3Four). They are not part of the TOV59 function; they belong to the preparatory phase.

The function generates start signals for the phases individually. The general start signal is generated if the voltage in any of the three measured voltages is above the level defined by parameter setting value.

The function generates a trip command only if the definite time delay has expired and the parameter selection requires a trip command as well.

The overvoltaget protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Pick-up starting accuracy		< ± 0,5 %
Blocking voltage		< ± 1,5 %
Reset time U< → Un U< → 0	 60 ms 50 ms	
Operate time accuracy		< ± 20 ms
Minimum operate time	50 ms	

Table 1 Technical data of the definite time overvoltage protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Enabling or disabling the overvoltage protection function			
TOV59_Oper_EPar_	Operation	Off, On	On

Table 2 The enumerated parameter of the definite time overvoltage protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Voltage level setting. If the measured voltage is above the setting value, the function generates a start signal.						
TOV59_StVol_IPar_	Start Voltage	%	30	130	1	63

Table 3 The integer parameter of the definite time overvoltage protection function

Boolean parameter

Parameter name	Title	Default
Enabling start signal only:		
TOV59_StOnly_BPar_	Start Signal Only	FALSE

Table 4 The boolean parameter of the definite time overvoltage protection function

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Time delay of the overvoltage protection function.						
TOV59_Delay_TPar_	Time Delay	ms	0	60000	1	100

Table 5 The timer parameter of the definite time overvoltage protection function

1.3.1.10 Definite time undervoltage protection function (TUV27)

The definite time undervoltage protection function measures the RMS values of the fundamental Fourier component of three phase voltages.

The Fourier calculation inputs are the sampled values of the three phase voltages (UL1, UL2, UL3), and the outputs are the basic Fourier components of the analyzed voltages (UL1Four, UL2Four, UL3Four). They are not part of the TUV27 function; they belong to the preparatory phase.

The function generates start signals for the phases individually. The general start signal is generated if the voltage is below the preset starting level parameter setting value and above the defined blocking level.

The function generates a trip command only if the definite time delay has expired and the parameter selection requires a trip command as well.

The operation mode can be chosen by the type selection parameter. The function can be disabled, and can be set to “1 out of 3”, “2 out of 3”, and “All”.

The overvoltage protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Pick-up starting accuracy		< ± 0,5 %
Blocking voltage		< ± 1,5 %
Reset time		
U> → Un	50 ms	
U> → 0	40 ms	
Operate time accuracy		< ± 20 ms
Minimum operate time	50 ms	

Table 6 Technical data of the definite time undervoltage protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Parameter for type selection			
TUV27_Oper_EPar_	Operation	Off, 1 out of 3, 2 out of 3, All	1 out of 3

Table 7 The enumerated parameter of the definite time undervoltage protection function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Starting voltage level setting						
TUV27_StVol_IPar_	Start Voltage	%	30	130	1	52
Blocking voltage level setting						
TUV27_BlkVol_IPar_	Block Voltage	%	0	20	1	10

Table 8 The integer parameters of the definite time undervoltage protection function

Boolean parameter

Parameter name	Title	Default
Enabling start signal only:		
TUV27_StOnly_BPar_	Start Signal Only	FALSE

Table 9 The boolean parameter of the definite time undervoltage protection function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Time delay of the undervoltage protection function.						
TUV27_Delay_TPar_	Time Delay	ms	0	60000	1	100

Table 10 The timer parameter of the definite time undervoltage protection function

1.3.1.11 Residual definite time overvoltage protection function (TOV59N)

The residual definite time overvoltage protection function operates according to definite time characteristics, using the RMS values of the fundamental Fourier component of the zero sequence voltage (UN=3Uo).

The Fourier calculation inputs are the sampled values of the residual or neutral voltage (UN=3Uo) and the outputs are the RMS value of the basic Fourier components of those.

The function generates start signal if the residual voltage is above the level defined by parameter setting value.

The function generates a trip command only if the definite time delay has expired and the parameter selection requires a trip command as well.

The residual overvoltage protection function has a binary input signal, which serves the purpose of disabling the function. The conditions of disabling are defined by the user, applying the graphic equation editor.

Technical data

Function	Value	Accuracy
Pick-up starting accuracy	2 – 8 % 8 – 60 %	< ± 2 % < ± 1.5 %
Reset time U> → Un U> → 0	 60 ms 50 ms	
Operate time	50 ms	< ± 20 ms

Table 11 Technical data of the residual definite time overvoltage protection function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Parameter for enabling/disabling:			
TOV59N_Oper_EPar_	Operation	Off, On	On

Table 12 The enumerated parameter of the residual definite time overvoltage protection function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Starting voltage parameter:						
TOV59N_StVol_IPar_	Start Voltage	%	2	60	1	30

Table 13 The integer parameter of the residual definite time overvoltage protection function

Boolean parameter

Parameter name	Title	Default
Enabling start signal only:		
TOV59N_StOnly_BPar_	Start Signal Only	FALSE

Table 14 The boolean parameter of the residual definite time overvoltage protection function

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Definite time delay:						
TOV59N_Delay_TPar_	Time Delay	ms	0	60000	1	100

Table 15 The time parameter of the residual definite time overvoltage protection function

1.3.1.12 Current unbalance function (VCB60)

The current unbalance protection function (VCB60) can be applied to detect unexpected asymmetry in current measurement.

The applied method selects maximum and minimum phase currents (RMS value of the fundamental Fourier components). If the difference between them is above the setting limit, the function generates a start signal. It is a necessary precondition of start signal generation that the maximum of the currents be above 10 % of the rated current and below 150% of the rated current.

The Fourier calculation modules calculate the RMS value of the basic Fourier current components of the phase currents individually. They are not part of the VCB60 function; they belong to the preparatory phase.

The analog signal processing module processes the RMS value of the basic Fourier current components of the phase currents to prepare the signals for the decision. It calculates the maximum and the minimum value of the RMS values and the difference between the maximum and minimum of the RMS values of the fundamental Fourier components of the phase currents as a percentage of the maximum of these values (ΔI>). If the maximum of the currents is above 10 % of the rated current and below 150% of the rated current and the ΔI> value is above the limit defined by the preset parameter (Start Current Diff) an output is generated to the decision module.

The decision logic module combines the status signals to generate the starting signal and the trip command of the function.

The trip command is generated after the defined time delay if trip command is enabled by the Boolean parameter setting.

The function can be disabled by parameter setting, and by an input signal programmed by the user with the graphic programming tool.

Technical data

Function	Value	Accuracy
Pick-up starting accuracy at In		< 2 %
Reset ratio	0.95	
Operate time	70 ms	

Table 16 Technical data of the current unbalance function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Selection of the operating mode			
VCB60_Oper_EPar_	Operation	Off, On	On

Table 17 The enumerated parameter of the current unbalance function

Boolean parameter

Parameter name	Title	Explanation	Default
Selection for trip command			
VCB60_StOnly_BPar_	Start Signal Only	0 to generate trip command	0

Table 18 The boolean parameter of the current unbalance function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Phase difference current setting						
VCB60_StCurr_IPar_	Start Current Diff	%	10	90	1	50

Table 19 The integer parameter of the current unbalance function

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Time delay						
VCB60_Del_TPar_	Time Delay	msec	100	60000	100	1000

Table 20 The timer parameter of the current unbalance function

1.3.1.13 Breaker failure protection function (BRF50)

After a protection function generates a trip command, it is expected that the circuit breaker opens and the fault current drops below the pre-defined normal level.

If not, then an additional trip command must be generated for all backup circuit breakers to clear the fault. At the same time, if required, a repeated trip command can be generated to the circuit breakers which are a priori expected to open.

The breaker failure protection function can be applied to perform this task.

The starting signal of the breaker failure protection function is usually the trip command of any other protection function assigned to the protected object. The user has the task to define these starting signals using the graphic equation editor, or if the operation of the individual phases is needed, then the start signals for the phases individually.

Two dedicated timers start at the rising edge of the start signals at the same time, one for the backup trip command and one for the repeated trip command, separately for operation in the individual phases. During the running time of the timers the function optionally monitors the currents, the closed state of the circuit breakers or both, according to the user's choice. The selection is made using an enumerated parameter.

If current supervision is selected by the user then the current limit values must be set correctly. The binary inputs indicating the status of the circuit breaker poles have no meaning.

If contact supervision is selected by the user then the current limit values have no meaning. The binary inputs indicating the status of the circuit breaker poles must be programmed correctly using the graphic equation editor.

If the parameter selection is "Current/Contact", the current parameters and the status signals must be set correctly. The breaker failure protection function resets only if all conditions for faultless state are fulfilled.

If at the end of the running time of the backup timer the currents do not drop below the pre-defined level, and/or the monitored circuit breaker is still in closed position, then a backup trip command is generated.

If repeated trip command is to be generated for the circuit breakers that are expected to open, then the enumerated parameter Retrip must be set to "On". In this case, at the end of the retrip timer(s) a repeated trip command is also generated in the phase(s) where the retrip timer(s) run off.

The pulse duration of the trip command is not shorter than the time defined by setting the parameter Pulse length.

The breaker failure protection function can be disabled by setting the enabling parameter to "Off".

Dynamic blocking (inhibition) is possible using the binary input Block. The conditions are to be programmed by the user, using the graphic equation editor.

Technical data

Function	**Effective range**	**Accuracy**
Current accuracy		<2 %
Retrip time	approx. 15 ms	
BF time accuracy		± 5 ms
Current reset time	20 ms	

Table 21 Technical data of the breaker failure protection function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Selection of the operating mode			
BRF50_Oper_EPar_	Operation	Off, Current, Contact, Current/Contact	Current
Switching on or off of the repeated trip command			
BRF50_ReTr_EPar_	Retrip	Off, On	On

Table 22 The enumerated parameters of the breaker failure protection function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Phase current setting						
BRF50_StCurrPh_IPar_	Start Ph Current	%	20	200	1	30
Neutral current setting						
BRF50_StCurrN_IPar_	Start Res Current	%	10	200	1	20

Table 23 The integer parameters of the breaker failure protection function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Time delay for repeated trip command generation						
BRF50_TrDel_TPar_	Retrip Time Delay	msec	0	10000	1	200
Time delay for trip command generation for the backup circuit breaker(s)						
BRF50_BUDel_TPar_	Backup Time Delay	msec	60	10000	1	300
Trip command impulse duration						
BRF50_Pulse_TPar_	Pulse Duration	msec	0	60000	1	100

Table 24 The timer parameters of the breaker failure protection function

1.3.1.14 Motor startup supervision function (MSS48)

The available functions of the motor startup supervision provide optimal protection during the startup procedure.

The starting process, which is an extreme stress for the motor, is automatically detected based on the fact that the current is zero before starting (below the “idle current” limit), then it increases above that level. During the motor starting process, the duration of which is determined by the „starting time” setting, a dedicated binary signal indicates the startup process. This signal can be applied, for instance, to activate the startup overcurrent protection function, which takes over the protection tasks from the normal overcurrent protection functions. During the starting time the normal overcurrent protection function is not effective, but the special overcurrent function can operate without any considerable time delay: if the current rises above the increased current setting, the function generates an immediate trip command for the circuit breaker. Based on the starting signal at the end of the successful starting process, the normal overcurrent function is activated again, the setting of which can be below the starting current, providing optimal protection for the motor.

If the starting process of the motor lasts too long, the motor is subject to a harmful overstress. If the starting current in excess of the motor startup current can be detected after the defined starting time, the function generates a trip command.

As the basic setting, the rated current of the motor must be defined as a percent of the rated current of the current transformer. The parameter is MSS48_CTRatio_IPar_ (InMotor/InCT).

The starting state is recognized by the algorithm if the current changes from zero value (below the “idle current” limit) to a higher current. The parameter is MSS48_IdleCurr_IPar_ (Idle Current). This event triggers a timer, which is in „running” state for the starting time set, then it changes to the „time-out” state. The parameter is MSS48_StrTime_IPar_ (StartUp Time). The output signal is MSS48_Starting_GrI_ (Starting).

If the current is above the “idle current” limit, then the motor is considered to be in running state, which is indicated by the signal MSS48_Running_GrI_ (Running).

If the timer runs out, then the current must be below a level defined by the parameter MSS48_StrCurr_IPar_ (StartUp Current). If the current remains above this level, it is an indication of prolonged startup time or a locked rotor. In this case, the function generates a signal, which can be applied to interrupt the starting procedure by tripping the circuit breaker. The output signal is MSS48_LongStr_GrI_ (Long Start).

When the startup timer runs out, another independent timer is started. During the running time of this second timer no restarting is allowed because the increased starting current could cause overheating in the motor. The parameter is MSS48_ReStrTime_IPar (Restart Time). The restart inhibition time is also started if the starting process is interrupted and the current falls below the “idle current” limit. The restart inhibition signal is MSS48_ReStrInh_GrI_ (Restart Inh.).

The **inputs** of the motor startup supervision function are

- the Fourier components of three phase currents,
- binary input,
- parameters.

The **output** of the motor startup supervision function is

- binary output status signals.

Technical data

Function	Range	Accuracy
Current accuracy	20 – 2000% of In	±1% of In
Reset ratio	0.95 at startup current (0.7 at idle current)	
Operating time accuracy		±5% or ±15 ms, whichever is greater
Reset time	<60 ms	

Table 25 Technical data of the motor startup supervision

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Disabling or enabling the operation of the function			
MSS48_Oper_EPar_	Operation	Off,On	On

Table 26 The enumerated parameter of the motor startup supervision function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Motor rated current as percent of the CT rated current						
MSS48_CTRatio_IPar_	InMotor/InCT	%	20	150	1	100
Startup current limit as percent of the motor rated current						
MSS48_StrCurr_IPar_	StartUp Current	%	50	1000	1	200
Idle current before startup as percent of the motor rated current						
MSS48_IdleCurr_IPar_	Idle Current	%	5	50	1	10
Maximum allowed startup time						
MSS48_StrTime_IPar_	StartUp Time	sec	1	100	1	5
Restart inhibition time after a starting procedure						
MSS48_ReStrTime_IPar_	Restart Time	sec	10	5000	1	20

Table 27 The integer parameters of the motor startup supervision function

1.3.1.15 Undercurrent protection function (TUC37)

The loss-of-load (undercurrent) protection function operates when the current decreases below a predetermined value.

This protection function can be applied for fan or pump drives, where the flowing media provides cooling for the motor itself. If this cooling stops, the motor must not remain in operation. In these cases the protection against low load after a given time delay disconnects the motor from the power supply.

It can also stop a motor in case of a failure in a mechanical transmission (e.g. conveyor belt).

A time delay may be required after pickup of the element to prevent operation during transients of the power systems.

The advantage of this function is its simplicity: no voltage measurement is needed, no power calculations are performed. The operation is based on phase currents only.

The function starts if the current is between the start current as upper limit, defined by the parameter TUC37_StCurr_IPar_ (Start Current) and the minimal current as lower limit, defined by the parameter TUC37_Idle_IPar (Idle Current). These limit values are given in percent of the rated current of the protected object. This is defined by the parameter TUC37_CTRatio_IPar_ (InMotor/InCT). This parameter is also given as a percentage.

The function operates in all three phases individually but the general start signal is output if the conditions are satisfied in all three phases.

At starting, a time counter is triggered. The function generates a trip command if the time delay defined by the parameter TUC37_Delay_TPar (Time Delay) expires.

The timers operate in all three phases individually but the general trip command is output if the timers expire in all three phases.

The **inputs** of the loss-of-load protection function are

- the Fourier components of three phase currents,
- binary input,
- parameters.

The **outputs** of the loss-of-load protection function are

- the general start status signal,
- the general trip command.

Technical data

Function	Range	Accuracy
Current accuracy	20 – 2000% of In	±1% of In
Reset ratio At idle current	0.95 0.70	
Operating time accuracy		±5% or ± 15 ms Whichever is greater
Minimum operating time	<60 ms	
Reset time	<60 ms	

Table 28 Technical data of the loss-of-load protection

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Disabling or enabling the operation of the function			
TUC37_Oper_EPar_	Operation	Off,On	On

Table 29 The enumerated parameter of the loss-of-load protection function

Boolean parameter

Parameter name	Title	Default	Explanation
Disabling trip command			
TUC37_StOnly_BPar_	Start Signal Only	0	If this parameter is set to logic True, then no trip command is generated, only a start signal.

Table 30 The Boolean parameter of the loss-of-load protection function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Ratio of the rated current of the protected object and that of the current input of the device						
TUC37_CTRatio_IPar_	InMotor/InCT	%	20	150	1	100
Start current, below which the function operates						
TUC37_StCurr_IPar_	Start Current	%	20	100	1	40
Minimal current, above which the function operates						
TUC37_Idle_IPar_	Idle Current	%	1	20	1	10

Table 31 The integer parameters of the loss-of-load protection function

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Time delay for the trip command:						
TUC37_Delay_TPar_	Time Delay	msec		60000	1	100

Table 32 The timer parameter of the loss-of-load protection function

1.3.1.16 Trip logic (TRC94)

The simple trip logic function operates according to the functionality required by the IEC 61850 standard for the "Trip logic logical node". This simplified software module can be applied if only three-phase trip commands are required, that is, phase selectivity is not applied.

The function receives the trip requirements of the protective functions implemented in the device and combines the binary signals and parameters to the outputs of the device.

The trip requirements are programmed by the user, using the graphic equation editor. The aim of the decision logic is

- to define a minimal impulse duration even if the protection functions detect a very short-time fault.
-

Technical data

Function		Accuracy
Impulse time duration	Setting value	<3 ms

Table 33 Technical data of the simple trip logic function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
Selection of the operating mode			
TRC94_Oper_EPar_	Operation	Off, On	On

Tables 34 The enumerated parameter of the decision logic

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Minimum duration of the generated impulse						
TRC94_TrPu_TPar_	Min Pulse Duration	msec	50	60000	1	150

Table 35 Timer parameter of the decision logic

1.3.1.17 Dead line detection function (DLD)

The "Dead Line Detection" (DLD) function generates a signal indicating the dead or live state of the line. Additional signals are generated to indicate if the phase voltages and phase currents are above the pre-defined limits.

The task of the "Dead Line Detection" (DLD) function is to decide the Dead line/Live line state.

Criteria of "Dead line" state: all three phase voltages are below the voltage setting value AND all three currents are below the current setting value.

Criteria of "Live line" state: all three phase voltages are above the voltage setting value.

The details are described in the document ***Dead line detection protection function block description.***

Technical data

Function	Value	Accuracy
Pick-up voltage		1%
Operation time	<20ms	
Reset ratio	0.95	

Table 36 Technical data of the dead line detection function

Parameters

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Integer parameters of the dead line detection function						
DLD_ULev_IPar_	Min. Operate Voltage	%	10	100	1	60
DLD_ILev_IPar_	Min. Operate Current	%	2	100	1	10

Table 37 The integer parameters of the dead line detection function

1.3.1.18 Generator differential protection function

The generator differential protection function provides main protection for generators or large motors. The application needs current transformers in all three phases both on the network side and on the neutral side. It is a simplified version, based on the Protecta general differential protection function, using less parameter values to be set.

The inputs of the function are

- the sampled values of three phase currents measured at the network side,
- the sampled values of three phase currents measured at the neutral connection,
- parameters,
- status signal.

The outputs of the function are

- the binary output status signals,
- the measured values for displaying.

The current base harmonic module of the differential protection function calculates the basic Fourier components of the phase currents both for the network side and for the neutral side. The result is needed to calculate the Ibias for the differential characteristic evaluation.

The differential base harmonic module calculates the differential currents in the phases as the difference between the currents measured on the network side and those on the neutral side (see the formula below, “Idiff”) and the basic Fourier components of the three differential currents. These results are needed also for the high-speed differential current decision.

$$\begin{bmatrix} IdL1 \\ IdL2 \\ IdL3 \end{bmatrix} = \begin{bmatrix} InetworkL1 \\ InetworkL2 \\ InetworkL3 \end{bmatrix} - \begin{bmatrix} IneutralL1 \\ IneutralL2 \\ IneutralL3 \end{bmatrix}$$

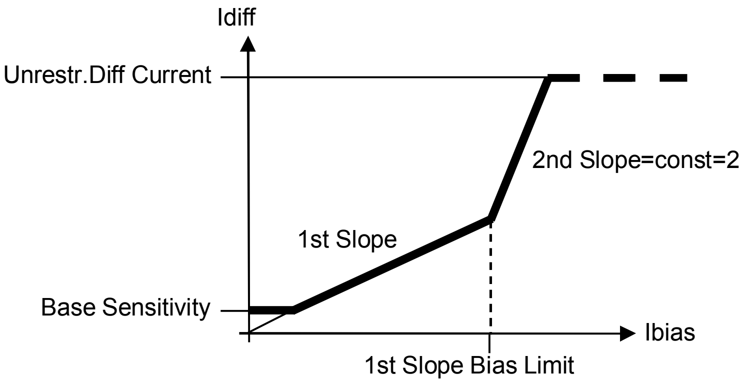
The differential characteristics module performs the necessary calculations for the evaluation of the “percentage differential characteristics”. The module evaluates the differential characteristics. It compares the magnitude of the differential currents and those of the restraint currents. The restraint currents (“Ibias”) are calculated using the following formulas:

$$F1IbiasL1 = \frac{F1InetworkL1 + F1IneutralL1}{2}$$

$$F1IbiasL2 = \frac{F1InetworkL2 + F1IneutralL2}{2}$$

$$F1IbiasL3 = \frac{F1InetworkL3 + F1IneutralL3}{2}$$

The generator differential protection characteristics are shown in *Figure* below: The characteristics compares the magnitude of the differential currents and those of the restraint currents.



The high-speed differential current decision is applied if the calculated differential current is very high. Then the differential characteristic is not considered anymore, because separate status-signals for the phases are set to "true" value if the differential currents in the individual phases are above the limit (Unrestr.Diff Current), defined by parameter setting.

The decision logic module combines enabling parameter and blocking signal with the status signals of the differential decision to generate output trip signals and commands.

Technical data

Function	Value	Accuracy
Operating characteristic	2 breakpoints	
Reset ratio	0,95	
Characteristic accuracy		<2%
Operate time, unrestrained	Typically 20 ms	
Reset time, unrestrained	Typically 25 ms	
Operate time, restrained	Typically 30 ms	
Reset time, restrained	Typically 25 ms	

The measured values

Measured value	Dim.	Explanation
Idiff. L1	In %	The calculated differential current in phase L1
Idiff. L2	In %	The calculated differential current in phase L2
Idiff. L3	In %	The calculated differential current in phase L3
Ibias L1	In %	The calculated restraint current in phase L1
Ibias L2	In %	The calculated restraint current in phase L2
Ibias L3	In %	The calculated restraint current in phase L3

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Parameter to enable the differential protection function:			
DIF87G_Op_EPar_	Operation	Off, On	On

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Parameters of the percentage characteristic curve:						
Base sensitivity:						
DIF87G_f1_IPar_	Base Sensitivity	% *	10	50	1	20
Slope of the second section of the characteristics:						
DIF87G_f2_IPar_	1st Slope	% **	10	50	1	20
Bias limit of the first slope:						
DIF87G_f3_IPar_	1st Slope Bias Limit	% *	200	2000	1	200
Unrestrained differential protection current level:						
DIF87G_HCurr_IPar_	Unrestr.Diff Current	% *	800	2500	1	800

* % related to the phase current

** % related to the bias current

Binary output status signals

Binary output status signals	Signal title	Explanation
Restrained differential protection function		
DIF87G_L1St_GrI_	Start L1	Start of the restrained differential protection function in phase L1
DIF87G_L2St_GrI_	Start L2	Start of the restrained differential protection function in phase L2
DIF87G_L3St_GrI_	Start L3	Start of the restrained differential protection function in phase L3
DIF87G_GenSt_GrI	General Start	General start of the restrained differential protection function
Unrestrained differential protection function		
DIF87G_UnRL1St_GrI_	Start L1 unrestr.	Start of the unrestrained differential protection function in phase L1
DIF87G_UnRL2St_GrI_	Start L2 unrestr.	Start of the unrestrained differential protection function in phase L2
DIF87G_UnRL3St_GrI_	Start L3 unrestr.	Start of the unrestrained differential protection function in phase L3
DIF87G_UnRGenSt_GrI_	General Start unrest.	General start of the unrestrained differential protection function

Binary input status signals

The binary input signal conditions of disabling the generator differential protection function is defined by the user, applying the graphic equation editor.

Binary input status signal	Explanation
DIF87G_Blk_GrO	Output status of a graphic equation defined by the user to disable the differential protection function.

1.3.2 Control functions

1.3.2.1 Circuit breaker control function block (CB1Pol)

The Circuit breaker control function block can be used to integrate the circuit breaker control of the EuroProt+ device into the station control system and to apply active scheme screens of the local LCD of the device.

The Circuit breaker control function block receives remote commands from the SCADA system and local commands from the local LCD of the device, performs the prescribed checking and transmits the commands to the circuit breaker. It processes the status signals received from the circuit breaker and offers them to the status display of the local LCD and to the SCADA system.

Main features:

- Local (LCD of the device) and Remote (SCADA) operation modes can be enabled or disabled individually.
- The signals and commands of the synchro check / synchro switch function block can be integrated into the operation of the function block.
- Interlocking functions can be programmed by the user applying the inputs “EnaOff” (enabled trip command) and “EnaOn” (enabled close command), using the graphic equation editor.
- Programmed conditions can be used to temporarily disable the operation of the function block using the graphic equation editor.
- The function block supports the control models prescribed by the IEC 61850 standard.
- All necessary timing tasks are performed within the function block:
    - Time limitation to execute a command
    - Command pulse duration
    - Filtering the intermediate state of the circuit breaker
    - Checking the synchro check and synchro switch times
    - Controlling the individual steps of the manual commands
- Sending trip and close commands to the circuit breaker (to be combined with the trip commands of the protection functions and with the close command of the automatic reclosing function; the protection functions and the automatic reclosing function directly gives commands to the CB). The combination is made graphically using the graphic equation editor
- Operation counter
- Event reporting

The Circuit breaker control function block has binary input signals. The conditions are defined by the user applying the graphic equation editor. The signals of the circuit breaker control are seen in the binary input status list.

Technical data

Function	Accuracy
Operate time accuracy	±5% or ±15 ms, whichever is greater

Table 38 Technical data of the circuit breaker control function

Parameters

Enumerated parameter

Parameter name	Title	Selection range	Default
The control model of the circuit breaker node according to the IEC 61850 standard			
CB1Pol_ctlMod_EPar_	ControlModel*	Direct normal, Direct enhanced, SBO enhanced	Direct normal

**ControlModel*

- Direct normal: only command transmission
- Direct enhanced: command transmission with status check and command supervision
- SBO enhanced: Select Before Operate mode with status check and command supervision

Table 39 Enumerated parameter of the circuit breaker control function

Boolean parameter

Boolean parameter	Title	Explanation
CB1Pol_DisOverR_BPar_	Forced check	If true, then the check function cannot be neglected by the check attribute defined by the IEC 61850 standard

Table 40 Boolean parameter of the circuit breaker control function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Timeout for signaling failed operation						
CB1Pol_TimOut_TPar_	Max.Operating time	msec	10	1000	1	200
Duration of the generated On and Off impulse						
CB1Pol_Pulse_TPar_,	Pulse length	msec	50	500	1	100
Waiting time, at expiry intermediate state of the CB is reported						
CB1Pol_MidPos_TPar_	Max.Intermediate time	msec	20	30000	1	100
Length of the time period to wait for the conditions of the synchron state. After expiry of this time, the synchro switch procedure is initiated (see synchro check/ synchro switch function block description)						
CB1Pol_SynTimOut_TPar_	Max.SynChk time	msec	10	5000	1	1000
Length of the time period to wait for the synchro switch impulse (see synchro check/ synchro switch function block description). After this time the function resets, no switching is performed						
CB1Pol_SynSWTimOut_TPar_	Max.SynSW time*	msec	0	60000	1	0
Duration of the waiting time between object selection and command selection. At timeout no command is performed						
CB1Pol_SBOTimeout_TPar_	SBO Timeout	msec	1000	20000	1	5000

* If this parameter is set to 0, then the "StartSW" output is not activated

Table 41 Timer parameters of the circuit breaker control function

Available internal status variable and command channel
To generate an active scheme on the local LCD, there is an internal status variable indicating the state of the circuit breaker. Different graphic symbols can be assigned to the values. (See Chapter 3.2 of the document “EuroCAP configuration tool for EuroProt+ devices”).

Status variable	Title	Explanation
CB1Pol_stVal_Ist_	Status	Can be: 0: Intermediate 1: Off 2: On 3: Bad

The available control channel to be selected is:

Command channel	Title	Explanation
CB1Pol_Oper_Con_	Operation	Can be: On Off

Using this channel, the pushbuttons on the front panel of the device can be assigned to close or open the circuit breaker. These are the “Local commands”.

Disconnector control function (DisConn)

The Disconnector control function block can be used to integrate the disconnector control of the EuroProt+ device into the station control system and to apply active scheme screens of the local LCD of the device.

The Disconnector control function block receives remote commands from the SCADA system and local commands from the local LCD of the device, performs the prescribed checking and transmits the commands to the disconnector. It processes the status signals received from the disconnector and offers them to the status display of the local LCD and to the SCADA system.

Main features:

- Local (LCD of the device) and Remote (SCADA) operation modes can be enabled or disabled individually.
- Interlocking functions can be programmed by the user applying the inputs "EnaOff" (enabled trip command) and "EnaOn" (enabled close command), using the graphic equation editor.
- Programmed conditions can be used to temporarily disable the operation of the function block using the graphic equation editor.
- The function block supports the control models prescribed by the IEC 61850 standard.
- All necessary timing tasks are performed within the function block:
  - Time limitation to execute a command
  - Command pulse duration
  - Filtering the intermediate state of the disconnector
  - Controlling the individual steps of the manual commands
- Sending trip and close commands to the disconnector
- Operation counter
- Event reporting

The Disconnector control function block has binary input signals. The conditions are defined by the user applying the graphic equation editor. The signals of the disconnector control are seen in the binary input status list.

Technical data

Function	Accuracy
Operate time accuracy	±5% or ±15 ms, whichever is greater

Table 42 Technical data of the disconnector control function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
The control model of the disconnector node according to the IEC 61850 standard			
DisConn_ctlMod_EPar_	ControlModel*	Direct normal, Direct enhanced, SBO enhanced	Direct normal
Type of switch			
DisConn_SwTyp_EPar_	Type of Switch	N/A,Load break, Disconnector, Earthing Switch, HS Earthing Switch	Disconnector

**ControlModel*

- Direct normal: only command transmission
- Direct enhanced: command transmission with status check and command supervision
- SBO enhanced: Select Before Operate mode with status check and command supervision

Table 43 Enumerated parameters of the disconnector control function

Boolean parameter

Boolean parameter	Title	Explanation
DisConn_DisOverR_BPar_	Forced check	If true, then the check function cannot be neglected by the check attribute defined by the IEC 61850 standard

Table 44 Boolean parameter of the disconnector control function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Timeout for signaling failed operation						
DisConn_TimOut_TPar_	Max.Operating time	msec	10	20000	1	1000
Duration of the generated On and Off impulse						
DisConn_Pulse_TPar_	Pulse length	msec	50	30000	1	100
Waiting time, at expiry intermediate state of the disconnector is reported						
DisConn_MidPos_TPar_	Max.Intermediate time	msec	20	30000	1	100
Duration of the waiting time between object selection and command selection. At timeout no command is performed						
DisConn_SBOTimeout_ TPar_	SBO Timeout	msec	1000	20000	1	5000

Table 45 Timer parameters of the disconnector control function

Available internal status variable and command channel

To generate an active scheme on the local LCD, there is an internal status variable indicating the state of the disconnector. Different graphic symbols can be assigned to the values. (See Chapter 3.2 of the document "EuroCAP configuration tool for EuroProt+ devices").

Status variable	Title	Explanation
DisConn I_stVal_Ist_	Status	Can be: 0: Intermediate 1: Off 2: On 3:Bad

The available control channel to be selected is:

Command channel	Title	Explanation
DisConn _Oper_Con_	Operation	Can be: On Off

Using this channel, the pushbuttons on the front panel of the device can be assigned to close or open the disconnector. These are the "Local commands".

1.3.3 Measuring functions

The measured values can be checked on the touch-screen of the device in the "On-line functions" page, or using an Internet browser of a connected computer. The displayed values are secondary currents, except the blocks "Current and Line Measurement". This specific blocks display the measured values in primary units, using the CT and VT primary value settings.

Analog value	Explanation
VT4 module	
Voltage Ch – U1	RMS value of the Fourier fundamental harmonic voltage component in phase L1
Angle Ch – U1	Phase angle of the Fourier fundamental harmonic voltage component in phase L1*
Voltage Ch – U2	RMS value of the Fourier fundamental harmonic voltage component in phase L2
Angle Ch – U2	Phase angle of the Fourier fundamental harmonic voltage component in phase L2*
Voltage Ch – U3	RMS value of the Fourier fundamental harmonic voltage component in phase L3
Angle Ch – U3	Phase angle of the Fourier fundamental harmonic voltage component in phase L3*
Voltage Ch – U4	RMS value of the Fourier fundamental harmonic voltage component in Channel U4
Angle Ch – U4	Phase angle of the Fourier fundamental harmonic voltage component in Channel U4*
CT4 module	
Current Ch - I1	RMS value of the Fourier fundamental harmonic current component in phase L1
Angle Ch - I1	Phase angle of the Fourier fundamental harmonic current component in phase L1*
Current Ch - I2	RMS value of the Fourier fundamental harmonic current component in phase L2
Angle Ch - I2	Phase angle of the Fourier fundamental harmonic current component in phase L2*
Current Ch - I3	RMS value of the Fourier fundamental harmonic current component in phase L3
Angle Ch - I3	Phase angle of the Fourier fundamental harmonic current component in phase L3*
Current Ch - I4	RMS value of the Fourier fundamental harmonic current component in Channel I4
Angle Ch - I4	Phase angle of the Fourier fundamental harmonic current component in Channel I4*
CT4_2 module	**optional*
Current Ch - I1	RMS value of the Fourier fundamental harmonic current component in phase L1
Angle Ch - I1	Phase angle of the Fourier fundamental harmonic current component in phase L1*
Current Ch - I2	RMS value of the Fourier fundamental harmonic current component in phase L2
Angle Ch - I2	Phase angle of the Fourier fundamental harmonic current component in phase L2*
Current Ch - I3	RMS value of the Fourier fundamental harmonic current component in phase L3
Angle Ch - I3	Phase angle of the Fourier fundamental harmonic current component in phase L3*
Current Ch - I4	RMS value of the Fourier fundamental harmonic current component in Channel I4
Angle Ch - I4	Phase angle of the Fourier fundamental harmonic current component in

	Channel I4*
Motor Overload function block (TTRL49M)	
°C	Calculated Temperature
Line measurement (MXU_MVL) (here the displayed information means primary value)	
Active Power – P	Three-phase active power
Reactive Power – Q	Three-phase reactive power
Apparent Power – S	Three-phase power based on true RMS voltage and current measurement
Current L1	True RMS value of the current in phase L1
Current L2	True RMS value of the current in phase L2
Current L3	True RMS value of the current in phase L3
Voltage L1	True RMS value of the voltage in phase L1
Voltage L2	True RMS value of the voltage in phase L2
Voltage L3	True RMS value of the voltage in phase L3
Voltage L12	True RMS value of the voltage between phases L1 L2
Voltage L23	True RMS value of the voltage between phases L2 L3
Voltage L31	True RMS value of the voltage between phases L3 L1
Residual voltage	True RMS value of the residual voltage
Frequency	Frequency
Start-up Supervision (MSS48)	
Last Start-up Inrush	
Last Start-up Time	
Metering function (MTR)	
Forward kWh	Active power supply
Backward kWh	Active power consumption
Forward kVArh	Reactive power supply
Backward kVArh	Reactive power consumption
Differential protection function (DIF87)	**optional*
I Diff L1	RMS value of the Fourier fundamental harmonic current component of the differential current in phase L1
I Diff L2	RMS value of the Fourier fundamental harmonic current component of the differential current in phase L2
I Diff L3	RMS value of the Fourier fundamental harmonic current component of the differential current in phase L3
I Bias L1	RMS value of the Fourier fundamental harmonic current component of the restraint current in phase L1
I Bias L2	RMS value of the Fourier fundamental harmonic current component of the restraint current in phase L2
I Bias L3	RMS value of the Fourier fundamental harmonic current component of the restraint current in phase L3

* *The reference angle is the phase angle of “Voltage Ch - U1”*

Table 46 Measured analog values

1.3.3.1 Current input function (CT4)

If the factory configuration includes a current transformer hardware module, the current input function block is automatically configured among the software function blocks. Separate current input function blocks are assigned to each current transformer hardware module.

A current transformer hardware module is equipped with four special intermediate current transformers. (See Chapter 5 of the EuroProt+ hardware description document.) As usual, the first three current inputs receive the three phase currents (IL1, IL2, IL3), the fourth input is reserved for zero sequence current, for the zero sequence current of the parallel line or for any additional current. Accordingly, the first three inputs have common parameters while the fourth current input needs individual setting.

The role of the current input function block is to

- set the required parameters associated to the current inputs,
- deliver the sampled current values for disturbance recording,
- perform the basic calculations
    - Fourier basic harmonic magnitude and angle,
    - True RMS value;
- provide the pre-calculated current values to the subsequent software modules,
- deliver the basic calculated values for on-line displaying.

Operation of the current input algorithm

The current input function block receives the sampled current values from the internal operating system. The scaling (even hardware scaling) depends on parameter setting. See parameters CT4_Ch13Nom_EPar_ (Rated Secondary I1-3) and CT4_Ch4Nom_EPar_ (Rated Secondary I4). The options to choose from are 1A or 5A (in special applications, 0.2A or 1A). This parameter influences the internal number format and, naturally, accuracy. (A small current is processed with finer resolution if 1A is selected.)

If needed, the phase currents can be inverted by setting the parameter CT4_Ch13Dir_EPar_ (Starpoint I1-3). This selection applies to each of the channels IL1, IL2 and IL3. The fourth current channel can be inverted by setting the parameter CT4_Ch4Dir_EPar (Direction I4). This inversion may be needed in protection functions such as distance protection, differential protection or for any functions with directional decision.

These sampled values are available for further processing and for disturbance recording.

The performed basic calculation results the Fourier basic harmonic magnitude and angle and the true RMS value. These results are processed by subsequent protection function blocks and they are available for on-line displaying as well.

The function block also provides parameters for setting the primary rated currents of the main current transformer. This function block does not need that parameter setting. These values are passed on to function blocks such as displaying primary measured values, primary power calculation, etc.

Technical data

Function	Range	Accuracy
Current accuracy	20 – 2000% of In	±1% of In

Table 47 Technical data of the current input

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Rated secondary current of the first three input channels. 1A or 5A is selected by parameter setting, no hardware modification is needed.			
CT4_Ch13Nom_EPar_	Rated Secondary I1-3	1A,5A	1A
Rated secondary current of the fourth input channel. 1A or 5A is selected by parameter setting, no hardware modification is needed.			
CT4_Ch4Nom_EPar_	Rated Secondary I4	1A,5A (0.2A or 1A)	1A
Definition of the positive direction of the first three currents, given by location of the secondary star connection point			
CT4_Ch13Dir_EPar_	Starpoint I1-3	Line,Bus	Line
Definition of the positive direction of the fourth current, given as normal or inverted			
CT4_Ch4Dir_EPar_	Direction I4	Normal,Inverted	Normal

Table 48 The enumerated parameters of the current input function

Floating point parameters

Parameter name	Title	Dim.	Min	Max	Default
Rated primary current of channel1					
CT4_PriI1_FPar_	Rated Primary I1	A	100	4000	1000
Rated primary current of channel2					
CT4_PriI2_FPar_	Rated Primary I2	A	100	4000	1000
Rated primary current of channel3					
CT4_PriI3_FPar_	Rated Primary I3	A	100	4000	1000
Rated primary current of channel4					
CT4_PriI4_FPar_	Rated Primary I4	A	100	4000	1000

Table 49 The floating point parameters of the current input function

NOTE: The rated primary current of the channels is not needed for the current input function block itself. These values are passed on to the subsequent function blocks.

The **measured values** of the current input function block.

Measured value	Dim.	Explanation
Current Ch - I1	A(secondary)	Fourier basic component of the current in channel IL1
Angle Ch - I1	degree	Vector position of the current in channel IL1
Current Ch – I2	A(secondary)	Fourier basic component of the current in channel IL2
Angle Ch – I2	degree	Vector position of the current in channel IL2
Current Ch – I3	A(secondary)	Fourier basic component of the current in channel IL3
Angle Ch – I3	degree	Vector position of the current in channel IL3
Current Ch – I4	A(secondary)	Fourier basic component of the current in channel I4
Angle Ch – I4	degree	Vector position of the current in channel I4

Table 50 The measured analogue values of the current input function

NOTE1: The scaling of the Fourier basic component is such that if pure sinusoid 1A RMS of the rated frequency is injected, the displayed value is 1A. (The displayed value does not depend on the parameter setting values "Rated Secondary".)

NOTE2: The reference of the vector position depends on the device configuration. If a voltage input module is included, then the reference vector (vector with angle 0 degree) is the vector calculated for the first voltage input channel of the first applied voltage input module. If no voltage input module is configured, then the reference vector (vector with angle 0 degree) is the vector calculated for the first current input channel of the first applied current input module.

Figure 1 shows an example of how the calculated Fourier components are displayed in the on-line block. (See the document "EuroProt+ Remote user interface description".)

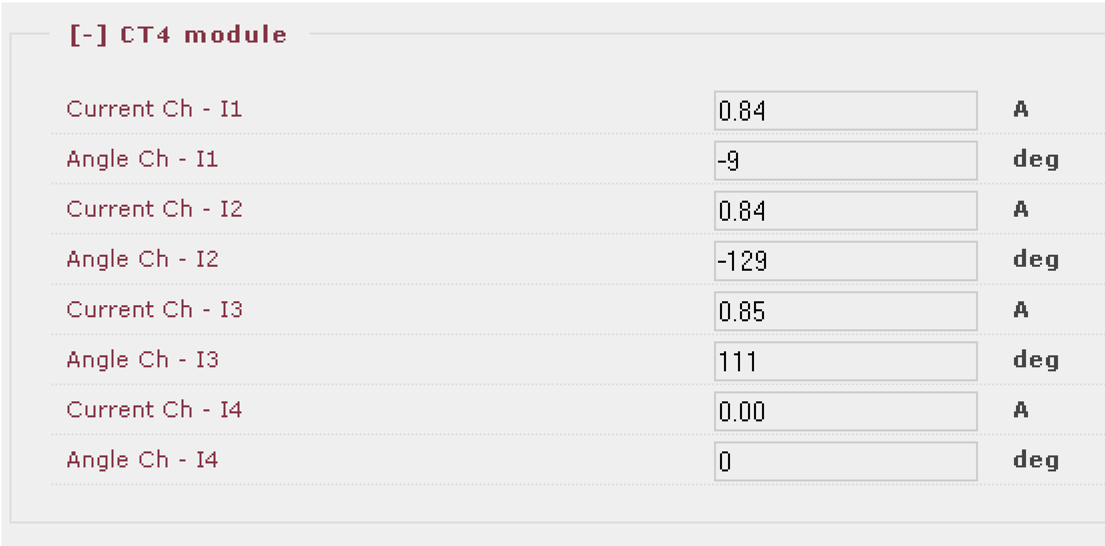


Figure 1 Example: On-line displayed values for the current input module

1.3.3.2 Voltage input function (VT4)

If the factory configuration includes a voltage transformer hardware module, the voltage input function block is automatically configured among the software function blocks. Separate voltage input function blocks are assigned to each voltage transformer hardware module.

A voltage transformer hardware module is equipped with four special intermediate voltage transformers. (See Chapter 6 of the EuroProt+ hardware description document.) As usual, the first three voltage inputs receive the three phase voltages (UL1, UL2, UL3), the fourth input is reserved for zero sequence voltage or for a voltage from the other side of the circuit breaker for synchron switching. All inputs have a common parameter for type selection: 100V or 200V.

Additionally, there is a correction factor available if the rated secondary voltage of the main voltage transformer (e.g. 110V) does not match the rated input of the device.

The role of the voltage input function block is to

- set the required parameters associated to the voltage inputs,
- deliver the sampled voltage values for disturbance recording,
- perform the basic calculations
  - Fourier basic harmonic magnitude and angle,
  - True RMS value;
- provide the pre-calculated voltage values to the subsequent software modules,
- deliver the basic calculated values for on-line displaying.

Operation of the voltage input algorithm

The voltage input function block receives the sampled voltage values from the internal operating system. The scaling (even hardware scaling) depends on parameter setting. See the parameter VT4_Type_EPar_ (Range). The options to choose from are 100V or 200V. This parameter influences the internal number format and, naturally, accuracy. (A small voltage is processed with finer resolution if 100V is selected.)

The connection of the first three VT secondary winding must be set to reflect actual physical connection. The associated parameter is VT4_Ch13Nom_EPar_ (Connection U1-3). The selection can be: Ph-N, Ph-Ph or Ph-N-Isolated.

The Ph-N option is applied in solidly grounded networks, where the measured phase voltage is never above 1.5-Un. In this case the primary rated voltage of the VT must be the value of the rated PHASE-TO-NEUTRAL voltage.

The Ph-N option is applied in compensated or isolated networks, where the measured phase voltage can be above 1.5-Un even in normal operation. In this case the primary rated voltage of the VT must be the value of the rated PHASE-TO-PHASE voltage.

If phase-to-phase voltage is connected to the VT input of the device, then the Ph-Ph option is to be selected. Here, the primary rated voltage of the VT must be the value of the rated PHASE-TO-PHASE voltage. This option must not be selected if the distance protection function is supplied from the VT input.

The fourth input is reserved for zero sequence voltage or for a voltage from the other side of the circuit breaker for synchron switching. Accordingly, the connected voltage must be identified with parameter setting VT4_Ch4Nom_EPar_ (Connection U4). Here, phase-to-neutral or phase-to-phase voltage can be selected: Ph-N,Ph-Ph

If needed, the phase voltages can be inverted by setting the parameter VT4_Ch13Dir_EPar_ (Direction U1-3). This selection applies to each of the channels UL1, UL2 and UL3. The fourth voltage channel can be inverted by setting the parameter VT4_Ch4Dir_EPar_ (Direction U4). This inversion may be needed in protection functions such as distance protection, differential protection or for any functions with directional decision, or for checking the voltage vector positions.

Additionally, there is a correction factor available if the rated secondary voltage of the main voltage transformer (e.g. 110V) does not match the rated input of the device. The related parameter is VT4_CorrFact_IPar_ (VT correction). As an example: if the rated secondary voltage of the main voltage transformer is 110V, then select Type 100 for the parameter “Range” and the required value to set here is 110%.

These sampled values are available for further processing and for disturbance recording.

The performed basic calculation results the Fourier basic harmonic magnitude and angle and the true RMS value of the voltages. These results are processed by subsequent protection function blocks and they are available for on-line displaying as well.

The function block also provides parameters for setting the primary rated voltages of the main voltage transformer. This function block does not need that parameter setting. These values are passed on to function blocks such as displaying primary measured values, primary power calculation, etc. Concerning the rated voltage, see the instructions related to the parameter for the connection of the first three VT secondary winding.

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Rated secondary voltage of the input channels. 100 V or 200V is selected by parameter setting, no hardware modification is needed.			
VT4_Type_EPar_	Range	Type 100,Type 200	Type 100
Connection of the first three voltage inputs (main VT secondary)			
VT4_Ch13Nom_EPar_	Connection U1-3	Ph-N, Ph-Ph, Ph-N-Isolated	Ph-N
Selection of the fourth channel input: phase-to-neutral or phase-to-phase voltage			
VT4_Ch4Nom_EPar_	Connection U4	Ph-N,Ph-Ph	Ph-Ph
Definition of the positive direction of the first three input channels, given as normal or inverted			
VT4_Ch13Dir_EPar_	Direction U1-3	Normal,Inverted	Normal
Definition of the positive direction of the fourth voltage, given as normal or inverted			
VT4_Ch4Dir_EPar_	Direction U4	Normal,Inverted	Normal

Table 51 The enumerated parameters of the voltage input function

Integer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
Voltage correction						
VT4_CorrFact_IPar_	VT correction	%	100	115	1	100

Table 52 The integer parameter of the voltage input function

Floating point parameters

Parameter name	Title	Dim.	Min	Max	Default
Rated primary voltage of channel1					
VT4_PriU1_FPar	Rated Primary U1	kV	1	1000	100
Rated primary voltage of channel2					
VT4_PriU2_FPar	Rated Primary U2	kV	1	1000	100
Rated primary voltage of channel3					
VT4_PriU3_FPar	Rated Primary U3	kV	1	1000	100
Rated primary voltage of channel4					
VT4_PriU4_FPar	Rated Primary U4	kV	1	1000	100

Table 53 The floating point parameters of the voltage input function

NOTE: The rated primary voltage of the channels is not needed for the voltage input function block itself. These values are passed on to the subsequent function blocks.

Function	Range	Accuracy
Voltage accuracy	30% … 130%	< 0,.5 %

Table 54 Technical data of the voltage input

Measured values

Measured value	Dim.	Explanation
Voltage Ch - U1	V(secondary)	Fourier basic component of the voltage in channel UL1
Angle Ch - U1	degree	Vector position of the voltage in channel UL1
Voltage Ch – U2	V(secondary)	Fourier basic component of the voltage in channel UL2
Angle Ch – U2	degree	Vector position of the voltage in channel UL2
Voltage Ch – U3	V(secondary)	Fourier basic component of the voltage in channel UL3
Angle Ch – U3	degree	Vector position of the voltage in channel UL3
Voltage Ch – U4	V(secondary)	Fourier basic component of the voltage in channel U4
Angle Ch – U4	degree	Vector position of the voltage in channel U4

Table 55 The measured analogue values of the voltage input function

NOTE1: The scaling of the Fourier basic component is such if pure sinusoid 57V RMS of the rated frequency is injected, the displayed value is 57V. (The displayed value does not depend on the parameter setting values “Rated Secondary”.)

NOTE2: The reference vector (vector with angle 0 degree) is the vector calculated for the first voltage input channel of the first applied voltage input module.

The figure below shows an example of how the calculated Fourier components are displayed in the on-line block. (See the document EuroProt+ “Remote user interface description”.)

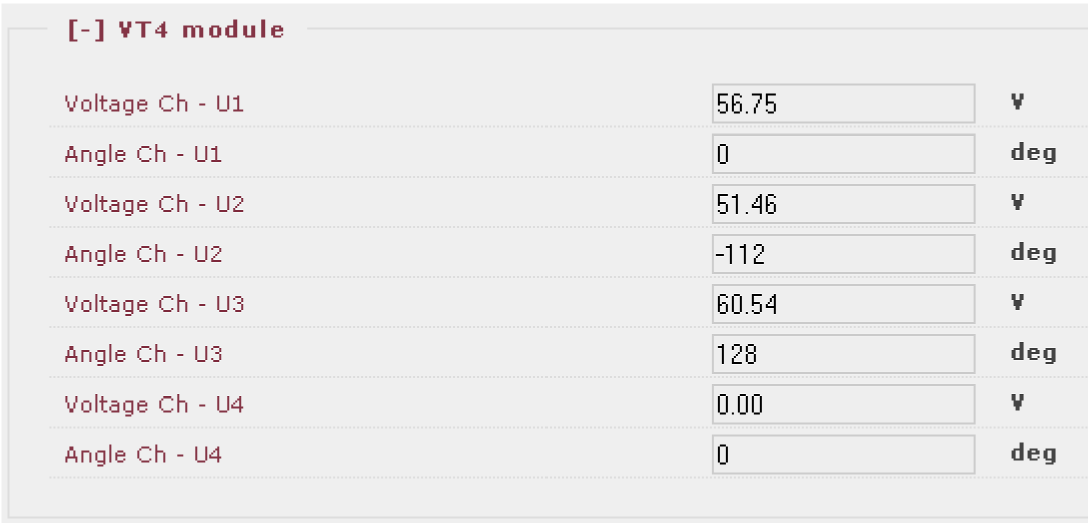


Figure 2 Example: On-line displayed values for the voltage input module

1.3.3.3 Line measurement function (MXU)

The measurement

The input values of the EuroProt+ devices are the secondary signals of the voltage transformers and those of the current transformers.

These signals are pre-processed by the "Voltage transformer input" function block and by the "Current transformer input" function block. These function blocks are described in separate documents. The pre-processed values include the Fourier basic harmonic phasors of the voltages and currents and the true RMS values. Additionally, it is in these function blocks that parameters are set concerning the voltage ratio of the primary voltage transformers and current ratio of the current transformers.

Based on the pre-processed values and the measured transformer parameters, the "Line measurement" function block calculates - depending on the hardware and software configuration - the primary RMS values of the voltages and currents and some additional values such as active and reactive power, symmetrical components of voltages and currents. These values are available as primary quantities and they can be displayed on the on-line screen of the device or on the remote user interface of the computers connected to the communication network and they are available for the SCADA system using the configured communication system.

Reporting the measured values and the changes

It is usual for the SCADA systems that they sample the measured and calculated values in regular time periods and additionally they receive the changed values as reports at the moment when any significant change is detected in the primary system. The "Line measurement" function block is able to perform such reporting for the SCADA system.

Operation of the line measurement function block

The **inputs** of the line measurement function are

- the Fourier components and true RMS values of the measured voltages and currents,
- frequency measurement,
- parameters.

The **outputs** of the line measurement function are

- displayed measured values,
- reports to the SCADA system.

NOTE: the scaling values are entered as parameter setting for the "Voltage transformer input" function block and for the "Current transformer input" function block.

The measured values

The **measured values** of the line measurement function depend on the hardware configuration. As an example, Table *56* shows the list of the measured values available in a configuration for solidly grounded networks.

Measured value	Explanation
MXU_P_OLM_	Active Power – P (Fourier base harmonic value)
MXU_Q_OLM_	Reactive Power – Q (Fourier base harmonic value)
MXU_S_OLM_	Apparent Power – S (Fourier base harmonic value)
MXU_I1_OLM_	Current L1
MXU_I2_OLM_	Current L2
MXU_I3_OLM_	Current L3
MXU_U1_OLM_	Voltage L1
MXU_U2_OLM_	Voltage L2
MXU_U3_OLM_	Voltage L3
MXU_U12_OLM_	Voltage L12
MXU_U23_OLM_	Voltage L23
MXU_U31_OLM_	Voltage L31
MXU_f_OLM_	Frequency

Table 56 Example: Measured values in a configuration for solidly grounded networks

Another example is Figure *3*, where the measured values available are shown as on-line information in a configuration for compensated networks.

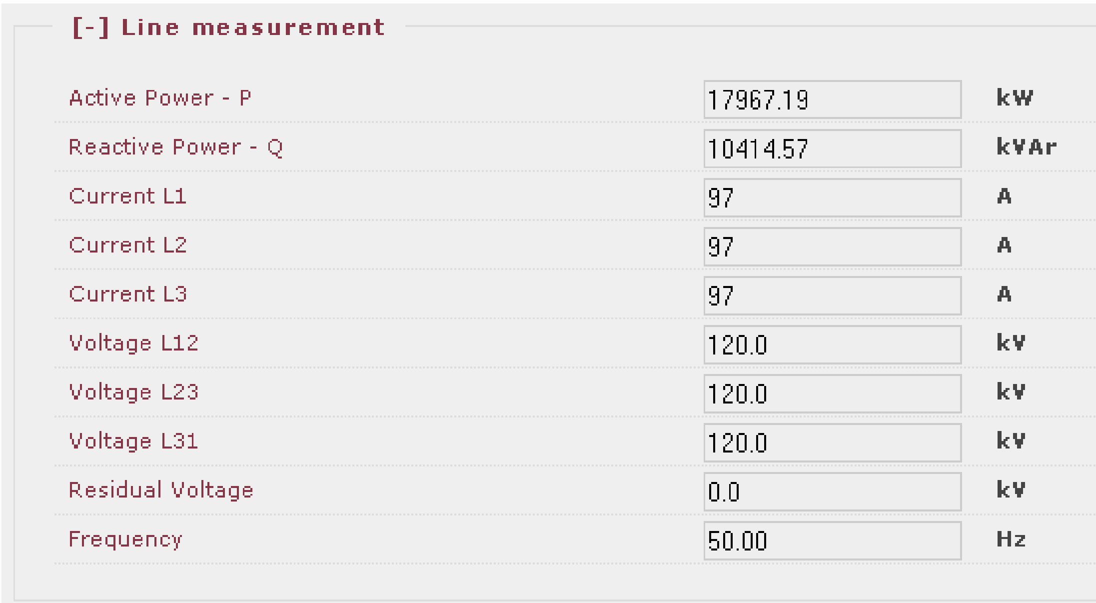


Figure 3 Example: Measured values in a configuration for compensated networks

The available quantities are described in the configuration description documents.

Reporting the measured values and the changes

For reporting, additional information is needed, which is defined in parameter setting.
As an example, in a configuration for solidly grounded networks the following parameters are available:

Enumerated parameters

Parameter name	Title	Selection range	Default
Selection of the reporting mode for active power measurement			
MXU_PRepMode_EPar_	Operation ActivePower	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for reactive power measurement			
MXU_QRepMode_EPar_	Operation ActivePower	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for apparent power measurement			
MXU_SRepMode_EPar_	Operation ApparPower	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for current measurement			
MXU_IRepMode_EPar_	Operation Current	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for voltage measurement			
MXU_URepMode_EPar_	Operation Voltage	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for frequency measurement			
MXU_fRepMode_EPar_	Operation Frequency	Off, Amplitude, Integrated	Amplitude

Table 57 The enumerated parameters of the line measurement function

The selection of the reporting mode items is explained in Figure *4* and in Figure *5*.

"Amplitude" mode of reporting

If the "Amplitude" mode is selected for reporting, a report is generated if the measured value leaves the deadband around the previously reported value. As an example, Figure *4* shows that the current becomes higher than the value reported in "report1" PLUS the Deadband value, this results "report2", etc.

For this mode of operation, the Deadband parameters are explained in Table *58*.

The "Range" parameters in Table *58* are needed to evaluate a measurement as "out-of-range".

Floating point parameters

Parameter name	Title	Dim.	Min	Max	Step	Default
Deadband value for the active power						
MXU_PDeadB_FPar_	Deadband value - P	MW	0.1	100000	0.01	10
Range value for the active power						
MXU_PRange_FPar_	Range value - P	MW	1	100000	0.01	500
Deadband value for the reactive power						
MXU_QDeadB_FPar_	Deadband value - Q	MVAr	0.1	100000	0.01	10
Range value for the reactive power						
MXU_QRange_FPar_	Range value - Q	MVAr	1	100000	0.01	500
Deadband value for the apparent power						
MXU_SDeadB_FPar_	Deadband value - S	MVA	0.1	100000	0.01	10
Range value for the apparent power						
MXU_SRange_FPar_	Range value - S	MVA	1	100000	0.01	500
Deadband value for the current						
MXU_IDeadB_FPar_	Deadband value - I	A	1	2000	1	10
Range value for the current						
MXU_IRange_FPar_	Range value - I	A	1	5000	1	500
Deadband value for the phase-to-neutral voltage						
MXU_UPhDeadB_ FPar_	Deadband value – U ph-N	kV	0.1	100	0.01	1
Range value for the phase-to-neutral voltage						
MXU_UPhRange_ FPar_	Range value – U ph-N	kV	1	1000	0.1	231
Deadband value for the phase-to-phase voltage						
MXU_UPPDeadB_ FPar_	Deadband value – U ph-ph	kV	0.1	100	0.01	1
Range value for the phase-to-phase voltage						
MXU_UPPRange_ FPar_	Range value – U ph-ph	kV	1	1000	0.1	400
Deadband value for the current						
MXU_fDeadB_FPar_	Deadband value - f	Hz	0.01	1	0.01	0.02
Range value for the current						
MXU_fRange_FPar_	Range value - f	Hz	0.05	10	0.01	5

Table 58 The floating-point parameters of the line measurement function

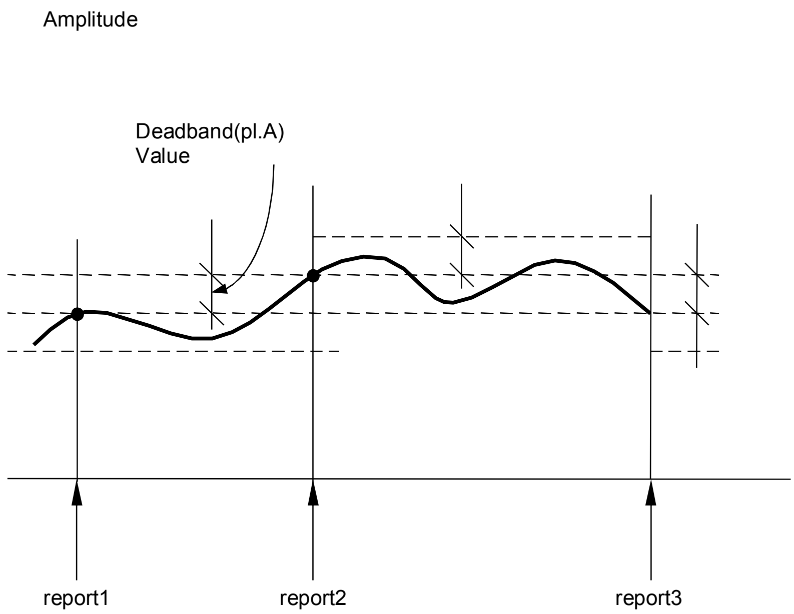


Figure 4 Reporting if "Amplitude" mode is selected

"Integral" mode of reporting

If the "Integrated" mode is selected for reporting, a report is generated if the time integral of the measured value since the last report gets becomes larger, in the positive or negative direction, then the (deadband*1sec) area. As an example, Figure *5* shows that the integral of the current in time becomes higher than the Deadband value multiplied by 1sec, this results "report2", etc.

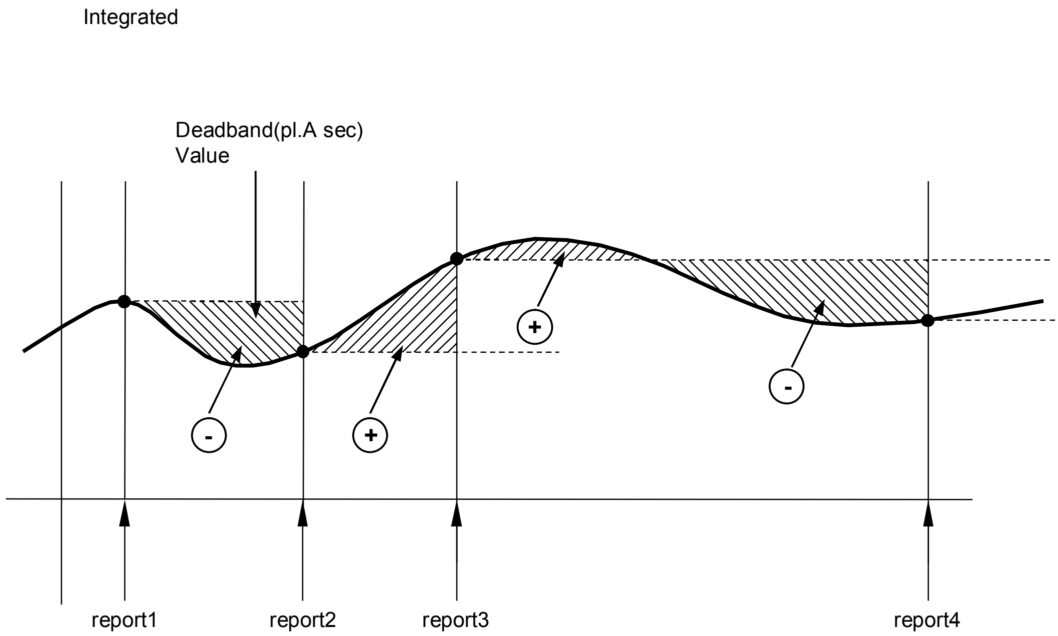


Figure 5 Reporting if "Integrated" mode is selected

Periodic reporting

Periodic reporting is generated independently of the changes of the measured values when the defined time period elapses. The required parameter setting is shown in Table *59*.

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Reporting time period for the active power						
MXU_PIntPer_IPar_	Report period P	sec	0	3600	1	0
Reporting time period for the reactive power						
MXU_QIntPer_IPar_	Report period Q	sec	0	3600	1	0
Reporting time period for the apparent power						
MXU_SIntPer_IPar_	Report period S	sec	0	3600	1	0
Reporting time period for the voltage						
MXU_UIntPer_IPar_	Report period U	sec	0	3600	1	0
Reporting time period for the current						
MXU_IIntPer_IPar_	Report period I	sec	0	3600	1	0
Reporting time period for the frequency						
MXU_fIntPer_IPar_	Report period f	sec	0	3600	1	0

Table 59 The integer parameters of the line measurement function

If the reporting time period is set to 0, then no periodic reporting is performed for this quantity.

All reports can be disabled for a quantity if the reporting mode is set to "Off". See Table *57*.

Technical data

Function	**Range**	**Accuracy**
Current accuracy		
with CT/5151 or CT/5102 modules	0,2 In – 0,5 In	±2%, ±1 digit
	0,5 In – 20 In	±1%, ±1 digit
with CT/1500 module	0,03 In – 2 In	±0,5%, ±1 digit
Voltage accuracy	5 – 150% of Un	±0.5% of Un, ±1 digit
Power accuracy	I>5% In	±3%, ±1 digit
Frequency accuracy	U>3.5%Un 45Hz – 55Hz	2mHz

Table 60 *Technical data of line measurement*

1.3.3.4 Metering function

The input values of the EuroProt+ devices are the secondary signals of the voltage transformers and those of the current transformers. These signals are pre-processed by the “Voltage transformer input” function block and by the “Current transformer input” function block. These function blocks are described in separate documents. The pre-processed values include the Fourier basic harmonic phasors of the voltages and currents. Additionally, it is in these function blocks that parameters are set concerning the voltage ratio of the primary voltage transformers and current ratio of the current transformers.

Based on the pre-processed values and the transformer parameters, the “Metering” function block calculates the active and reactive power supply and consumption. These values are accumulated to obtain, separately,

- Active power consumption,
- Active power supply,
- Reactive power consumption.
- Reactive power supply,

This means that the positive and negative values are accumulated separately.

The time period of the accumulation is defined by parameter setting. It can be selected in a broad range. The start of the accumulation is based on the integrated real-time clock of the device. For example, for the “Time Interval” setting of 15min, the trigger is: at 0h0min, 0h15min, 0h30min, 0h45 min, 1h0min, etc.

When the accumulation time is over, the calculated values are reported to the SCADA system. The displayed values change continuously.

The calculated values are available as primary quantities and they can be displayed on the on-line screen of the device or on the remote user interface of the computers connected to the communication network and they are available for the SCADA system using the configured communication system.

The inputs of the metering function are
- the Fourier components of the measured voltages and currents,
- parameters.

The output of the metering function is
- displayed measured values.

NOTE: the scaling values are entered as parameter setting for the “Voltage transformer input” function block and for the “Current transformer input” function block.

Technical data

Function	**Range**	**Accuracy**
Current accuracy	20 – 2000% of In	±1% of In
Voltage accuracy	5 – 150% of Un	±0.5% of Un
Power accuracy	*I>5% In*	±3%

The measured values

Measured value	**Explanation**
MTR_BwP_OLM_	Backward kWh – active power consumption
MTR_FwP_OLM_	Forward kWh – active power supply
MTR_BwQ_OLM_	Backward kVArh – reactive power consumption
MTR_FwQ_OLM_	Forward kVArh – reactive power supply

The measured values available are shown as on-line information.

Parameters

Enumerated parameter

Parameter name	**Title**	**Selection range**	**Default**
Selection of the time period for power metering			
MTR_TimInt_EPar_	Time Interval	Off, 5min, 10min, 15min, 30min, 60min	30min

1.3.4 Event recorder

The events of the device and those of the protection functions are recorded with a time stamp of 1 ms time resolution. This information with indication of the generating function can be checked on the touch-screen of the device in the “Events” page, or using an Internet browser of a connected computer.

Event	**Explanation**
Common	
Mode of device	Operating mode of the device
Health of device	Health state of the device
Three-phase instantaneous overcurrent protection function (IOC50)	
Trip L1	Trip command in phase L1
Trip L2	Trip command in phase L2
Trip L3	Trip command in phase L3
General Trip	General trip command
Three-phase overcurrent protection function (TOC51_1)	
Start L1	Low setting stage start signal in phase L1
Start L2	Low setting stage start signal in phase L2
Start L3	Low setting stage start signal in phase L3
General Start	Low setting stage general start signal
General Trip	Low setting stage general trip command
Three-phase overcurrent protection function (TOC51_2)	
Start L1	High setting stage start signal in phase L1
Start L2	High setting stage start signal in phase L2
Start L3	High setting stage start signal in phase L3
General Start	High setting stage general start signal
General Trip	High setting stage general trip command
Residual instantaneous overcurrent protection function (IOC50N)	
General Trip	General trip command
Residual overcurrent protection function (TOC51N_1)	
General Start	Low setting stage general start signal
General Trip	Low setting stage general trip command
Residual overcurrent protection function (TOC51N_2)	
General Start	High setting stage general start signal
General Trip	High setting stage general trip command
Residual directional overcurrent protection function (TOC67N_1)	
General Start	Low setting stage general start signal
General Trip	Low setting stage general trip command
Residual directional overcurrent protection function (TOC67N_2)	
General Start	High setting stage general start signal
General Trip	High setting stage general trip command
Inrush detection and blocking (INR2)	
2.Harm Restraint	Second harmonic restraint
Negative sequence overcurrent protection (TOC46)	
General Start	General start signal
General Trip	General trip command
Motor overload protection function (TTR49M)	
Alarm	Alarm signal
General Trip	General trip command

Breaker failure protection function (BRF50MV)	
Backup Trip	Repeated trip command
***Breaker failure protection function (BRF50MV_2)*	
Backup Trip	Repeated trip command
Current unbalance function (VCB60_1)	
General Start	Current unbalance general start signal
General Trip	Current unbalance general trip command
***Current unbalance function (VCB60_2)*	
General Start	Current unbalance general start signal
General Trip	Current unbalance general trip command
Circuit breaker (CB1Pol)	
Status	State of the circuit breaker function
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
CB OPCap	
Disconnecto 1 (DisConn_1)	
Status	Status of the bus disconnector
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
DC OPCap	
Disconnecto 2 (DisConn_2)	
Status	Status of the bus disconnector
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
DC OPCap	
Disconnector 1 (DisConn_3)	
Status	Status of the bus disconnector
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
DC OPCap	
Disconnector 1 (DisConn_4)	
Status	Status of the bus disconnector
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
DC OPCap	
(GGIO16)	
Input01	Event channel, free programmable by the user
Input02	Event channel, free programmable by the user
Input03	Event channel, free programmable by the user
Input04	Event channel, free programmable by the user
Input05	Event channel, free programmable by the user
Input06	Event channel, free programmable by the user

Input07	Event channel, free programmable by the user
Input08	Event channel, free programmable by the user
Input09	Event channel, free programmable by the user
Input10	Event channel, free programmable by the user
Input11	Event channel, free programmable by the user
Input12	Event channel, free programmable by the user
Input13	Event channel, free programmable by the user
Input14	Event channel, free programmable by the user
Input15	Event channel, free programmable by the user
Input16	Event channel, free programmable by the user
Directional residual overcurrent protection function (TOC67N_1)	
Start	Low setting stage general start signal
Trip	Low setting stage general trip command
Directional residual overcurrent protection function (TOC67N_2)	
Start	High setting stage general start signal
Trip	High setting stage general trip command
Definite time overvoltage protection function (TOV59)	
Start L1	Start signal in phase L1
Start L2	Start signal in phase L2
Start L3	Start signal in phase L3
General Start	General start signal
Definite time undervoltage protection function (TUV27)	
Start L1	Start signal in phase L1
Start L2	Start signal in phase L2
Start L3	Start signal in phase L3
General Start	General start signal
General Trip	General trip command
Definite time zero sequence overvoltage protection function (TOV59N)	
General Start	General start signal
General Trip	General trip command
Measurement function (MXU_MVL)	
Current L1	Current violation in phase L1
Current L2	Current violation in phase L2
Current L3	Current violation in phase L3
Voltage L12	Voltage violation in loop L1-L2
Voltage L23	Voltage violation in loop L2-L3
Voltage L31	Voltage violation in loop L3-L1
Residual Voltage	Residual Voltage
Residual Current	Residual Current
Active Power – P	Active Power – P violation
Reactive Power – Q	Reactive Power – Q violation
Apparent Power – S	Apparent Power – S violation
Power factor	Power factor
Frequency	Frequency violation
Simplified trip logic (TRC94)	
General Trip	General trip command
***Simplified trip logic (TRC94_2)*	
General Trip	General trip command
**Transformer differential protection function (DIF87M)*	
2.Harm Restraint	2. harmonic restraint
5.Harm Restraint	5. harmonic restraint
Start L1	Start signal in phase L1
Start L2	Start signal in phase L2

Start L3	Start signal in phase L3
General Start	General start signal
Start L1 unrestraint	Unrestraint start signal in phase L1
Start L2 unrestraint	Unrestraint start signal in phase L2
Start L3 unrestraint	Unrestraint start signal in phase L3
General Start unrest	Unrestraint general start signal
***Circuit breaker (CB1Pol_2)*	
Status	State of the circuit breaker function
Enable Close	Close command is enabled
Enable Open	Open command is enabled
Local	Local mode of operation
Operation counter	Operation counter
CB OPCap	
Measurement function (MXU_C)	
Current L1	Current violation in phase L1
Current L2	Current violation in phase L2
Current L3	Current violation in phase L3
Residual Current	

** Optional protection function*
*** It is an additional function if the differential protection is selected.*

Table 61 List of the possible events

1.3.5 Disturbance recorder

The E7-Feeder configuration contains a disturbance recorder function. The details are described in the document shown in Table 62.

Name	Title	Document
DRE	Disturbance Rec	***Disturbance recorder function block description***

Table 62 Implemented disturbance recorder function

The recorded analog channels:

Recorded analog signals	Explanation
UL1	Measured voltage of line 1
UL2	Measured voltage of line 2
UL3	Measured voltage of line 3
U4	Measured voltage of the fourth voltage input channel (Uo)
I L1 Prim.	Measured current for the primary side in line 1
I L2 Prim.	Measured current for the primary side in line 2
I L3 Prim.	Measured current for the primary side in line 3
I4 Prim.	Measured current of the fourth current input channel (Io) for primary side
**I L1 Sec.	Measured current for the secondary side in line 1
**I L2 Sec.	Measured current for the secondary side in line 2
**I L3 Sec.	Measured current for the secondary side in line 3
**I4 Sec.	Measured current of the fourth current input channel (Io) for secondary side

*** It is additional recorded analog channel if the differential protection is selected.*

Table 63 Disturbance recorder, recorded analog channels

The recorded binary channels:

Recorded binary signal	Explanation
Gen. Trip	General trip command
Backup Trip	Backup trip command
Trip. Idiff>	Trip command of transformer differential protection function
Motor Starting	Trip command of motor start-up supervision prot. function
Neg. Seq. OC Trip	Trip command of neg. sequence overcurrent prot. function
Undercurrent Trip	Trip command of undercurrent prot. function
3Ph OC Trip 1	Trip command of the low setting stage three-phase overcurrent function
3Ph OC Trip 2	Trip command of the high setting stage three-phase overcurrent function
Res OC Trip 1	Trip command of the low setting stage residual overcurrent function
Res OC Trip 2	Trip command of the high setting stage residual overcurrent function
Res Dir OC Trip 1	Trip command of the low setting stage residual dir. overcurrent function
Res Dir OC Trip 2	Trip command of the high setting stage residual dir. overcurrent function

Motor Overload Trip	Trip command of motor overload protection function
Overvoltage Trip 1	Trip command of overvoltage protection function
Overvoltage Trip 2	Trip command of overvoltage protection function
Undervoltage Trip 1	Trip command of undervoltage protection function
Undervoltage Trip 2	Trip command of undervoltage protection function
Current Unbalance Trip 1	Trip command of current unbalance function
**Current Unbalance Trip 2	Trip command of current unbalance function
VT failure	Tip command of voltage supervision function

*** It is additional recorded binary channel if the differential protection is selected.*

Table 64 Disturbance recorder, recorded binary channels

Enumerated parameter:

Parameter name	Title	Selection range	Default
Parameter for activation			
DRE_Oper_EPar_	Operation	Off, On	Off

Table 65 The enumerated parameter of the disturbance recorder function

Timer parameters:

Parameter name	Title	Unit	Min	Max	Step	Default
Pre-fault time:						
DRE_PreFault_TPar_	PreFault	msec	50	500	1	200
Post-fault time:						
DRE_PostFault_TPar_	PostFault	msec	50	1000	1	200
Overall-fault time limit:						
DRE_MaxFault_TPar_	MaxFault	msec	200	5000	1	1000

Table 66 The timer parameters of the disturbance recorder function

1.3.6 TRIP contact assignment

The procedures of command processing are shown in the following symbolical figure.

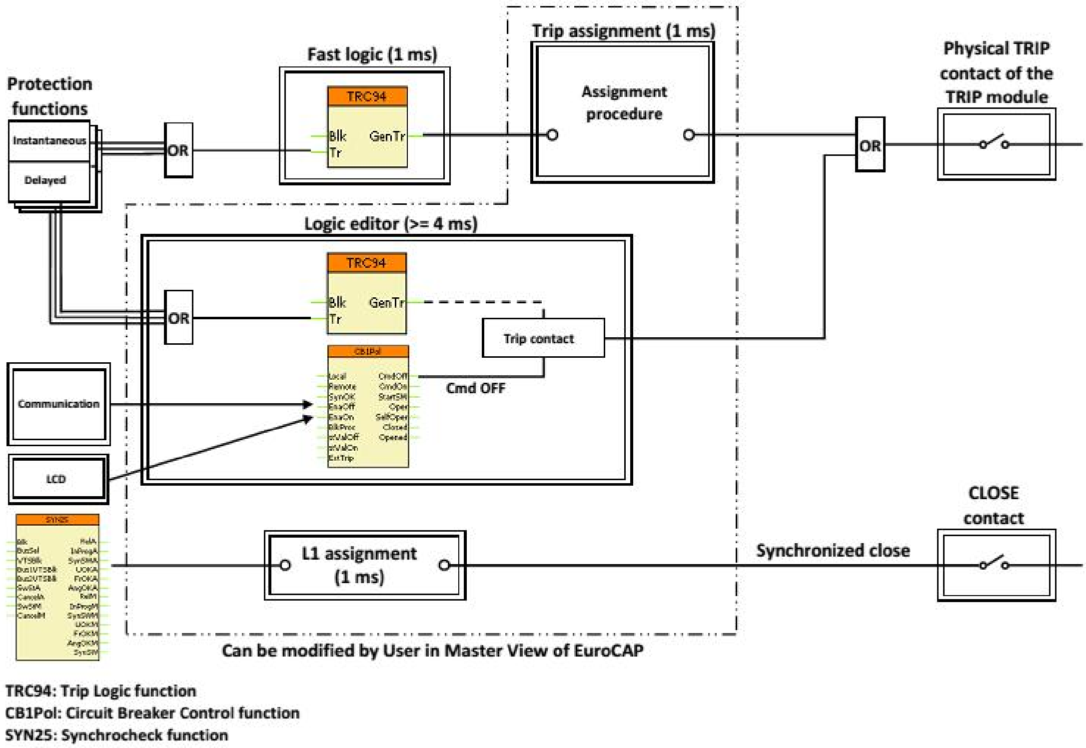


Figure 6 Principle of TRIP command processing

The left side of the Figure shows the available sources of the trip commands:

- The function blocks, configured in the device,
- The communication channels to the SCADA system,
- Commands generated using the front panel LCD of the device,
- Any other binary signals, e.g. signals from the binary inputs of the device.

The right side of the Figure shows one of the TRIP relays symbolically. The Figure provides a survey of the configured trip command processing methods. In the middle of the Figure, the locations indicated by “User” shows the possibilities for the user to modify the procedures. All other parts are factory programmed. The detailed description of the TRIP command processing can be found on the website in the following document: “**Application of high – speed TRIP contacts”**.

The outputs of the “trip logic functions” are connected directly to the contacts of the PSTP+/2101 module in position “**A**”.

Binary status signal	**Title**	Connected to the contact PSTP+/2101 module in position A
TRC94_GenTr_TLO_1	General Trip	TripContact_A02
**TRC94_GenTr_TLO_2	General Trip	TripContact_A04

*** It is additional trip function if the differential protection is selected.*

Table 67 The connected signals of the trip logic functions

To the inputs of the "trip logic function" some signals are assigned during factory configuration, some signals however depend on the programming by the user**. The conditions are defined by the user applying the graphic equation editor.** The factory defined inputs and the user defined inputs are in "**OR**" relationship.

Input	Binary status signal	Explanation
Trip	IOC50_GenTr_Grl_ OR *DIFF87_GenTr_Grl_ OR *DIFF87_UnrGenTr_Grl_ OR *DIFF87N_GenTr_Grl_	Trip command of the instantaneous overcurrent protection function OR Trip command of the transformer differential protection function OR Trip command of the unrestraint transformer differential protection function OR Trip command of the restricted earth-fault protection function
Block	n.a.	Blocking the outputs of the phase-selective trip logic function

**Optional*

Table 68 The factory defined binary input signals of the "TRC94_1" trip logic function

Input	Binary status signal	Explanation
Trip	IOC50_GenTr_Grl_ OR IOC50N_GenTr_Grl_ OR *DIFF87_GenTr_Grl_ OR *DIFF87_UnrGenTr_Grl_ OR *DIFF87N_GenTr_Grl_	Trip command of the instantaneous overcurrent protection function OR Trip command of the residual instantaneous overcurrent protection function OR Trip command of the transformer differential protection function OR Trip command of the unrestraint transformer differential protection function OR Trip command of the restricted earth-fault protection function
Block	n.a.	Blocking the outputs of the phase-selective trip logic function

**Optional*

Table 69 The factory defined binary input signals of the "TRC94_2" trip logic function

The user defined signals are listed in the table below:

Input	Binary status signal	Explanation
Trip	TOC51_GenTr_Grl_1 OR TOC51_GenTr_Grl_2 OR TOC51N_GenTr_Grl_1 OR TOC51N_GenTr_Grl_2 OR TOV59_GenTr_Grl_ OR TUV27_GenTr_Grl_ OR TOV59N_GenTr_Grl_ OR TTR49L_GenTr_Grl_ OR TOC67N_GenTr_Grl_1 OR TOC67N_GenTr_Grl_2 OR TOV47_GenTr_Grl_	General trip command of the overcurrent protection function for the low setting stage OR General trip command of the overcurrent protection function for the high setting stage OR General trip command of the Res. overcurrent protection function for the low setting stage OR General trip command of the Res. overcurrent protection function for the high setting stage OR General trip command of the directional overcurrent protection function for the low setting stage OR General trip command of the overvoltage protection function OR General trip command of the overvoltage protection function OR General trip command of the Res. overvoltage protection function OR General trip command of the line thermal protection function OR General trip command of the directional Res. overcurrent protection function for the low setting stage OR General trip command of the directional Res. overcurrent protection function for the high setting stage OR General trip command of the neg. seq. overvoltage protection function
Block	n.a.	Blocking the outputs of the trip logic function

*Table 70 The user defined binary input signals of the "TRC94_1" and *"TRC94_2" trip logic functions*

* "TRC94_2" trip logic function is used if the optional differential protection function is selected.

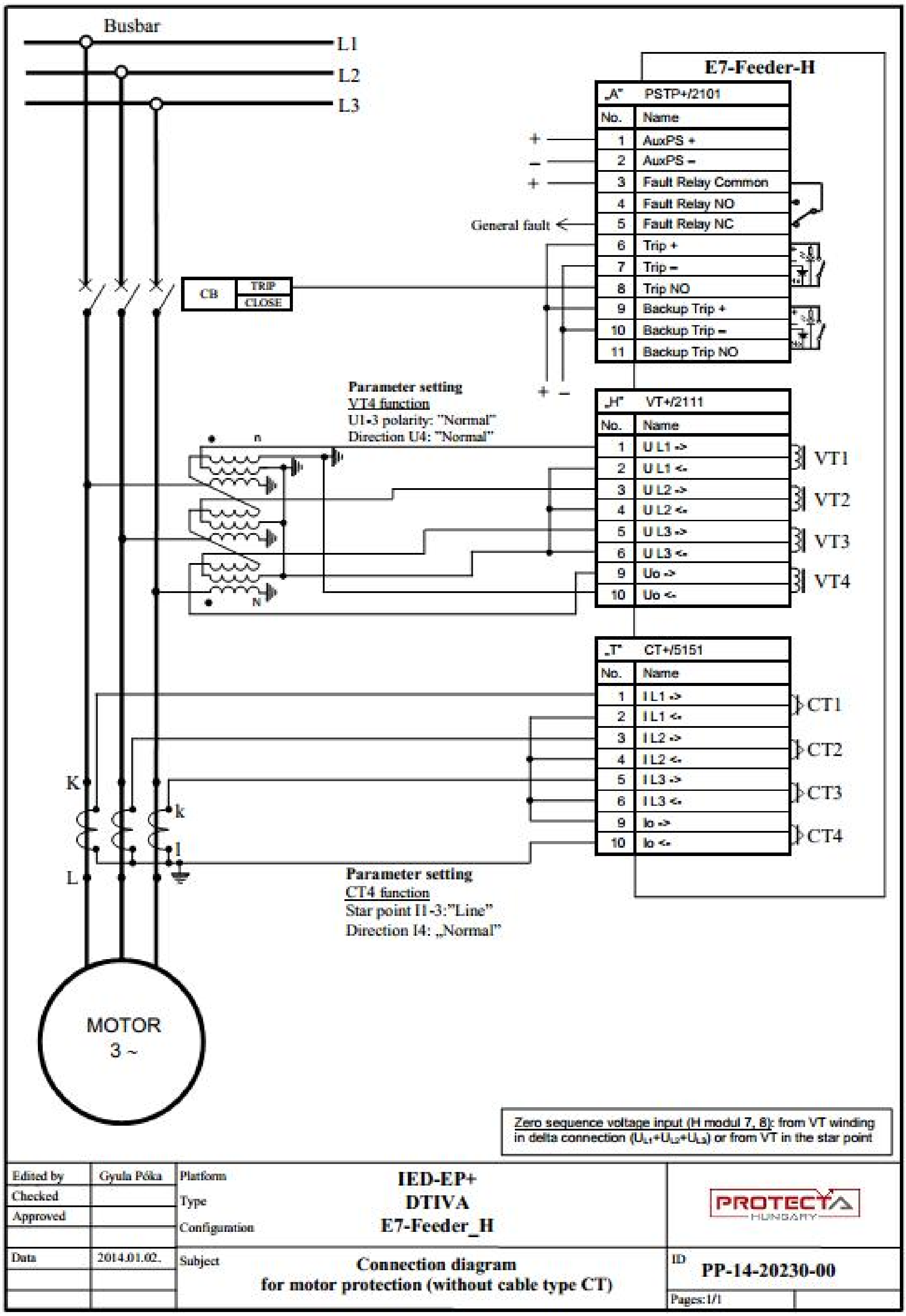
1.4 LED assignment

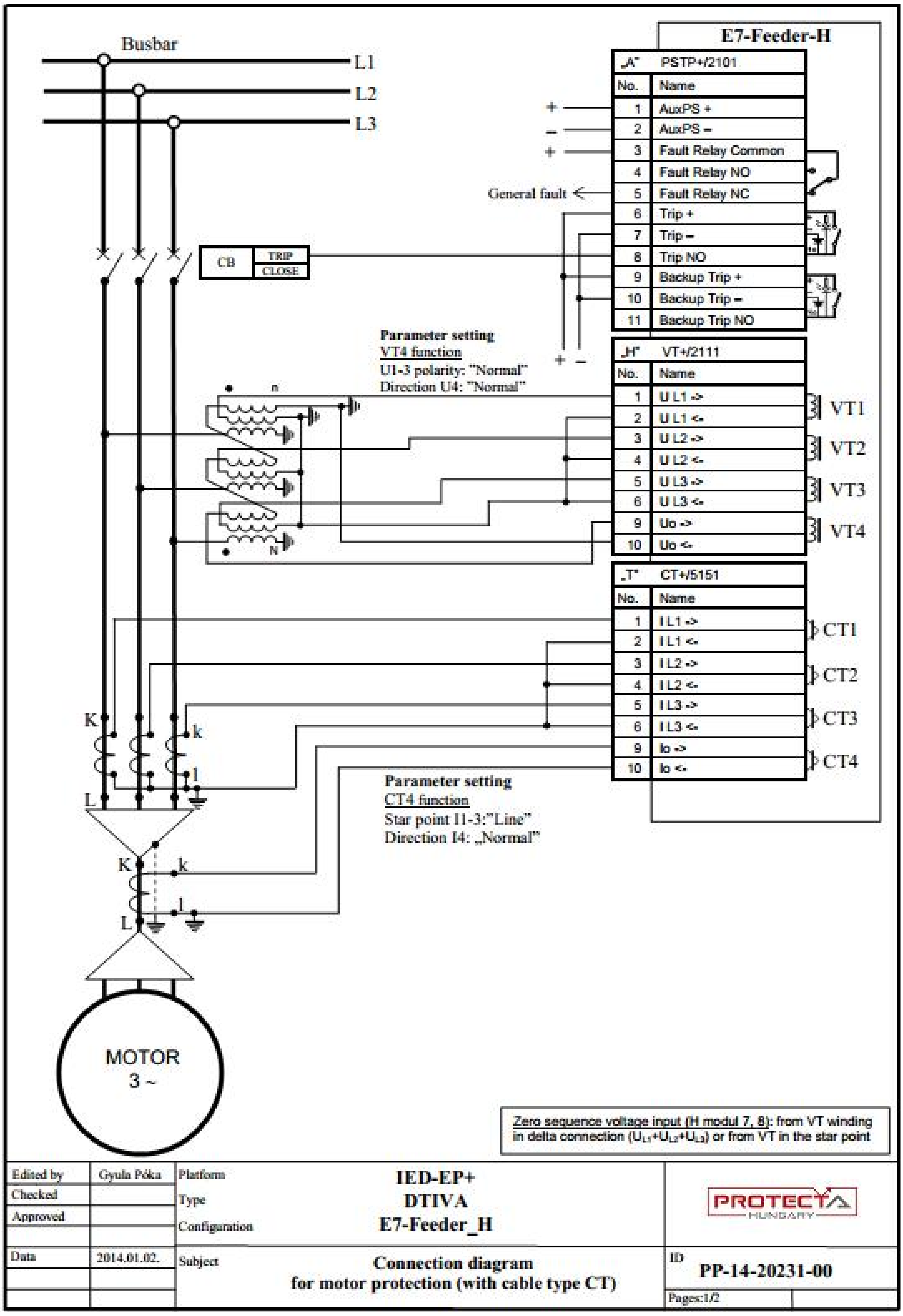
On the front panel of the device there are "User LED"-s with the "Changeable LED description label" (See the document "**Quick start guide to the devices of the EuroProt+ product line**"). Some LED-s are factory assigned, some are free to be defined by the user. The following tables shows the LED assignment of the E7-Feeder configuration.

LED	**Explanation**
General Trip	General Trip command
Diff. Trip	Trip command of differential protection function
Motor Starting	Motor Starting
Neg. Seq. OC Trip	Genaral trip of the neg. seq. OC function
3Ph OC Trip	Genaral trip of the 3phase OC function
Res OC Trip	Genaral trip of the residual OC function
Thermal Trip	Genaral trip of the thermal prot. function
Overvoltage Trip	General trip of the overvoltage trip function
Undervoltage Trip	General trip of the undervoltage trip function
Res. Overvolt. Trip	General trip of the residual overvoltage trip function
LED11	Free LED
LED12	Free LED
LED13	Free LED
LED14	Free LED
LED15	Free LED
LED16	Free LED

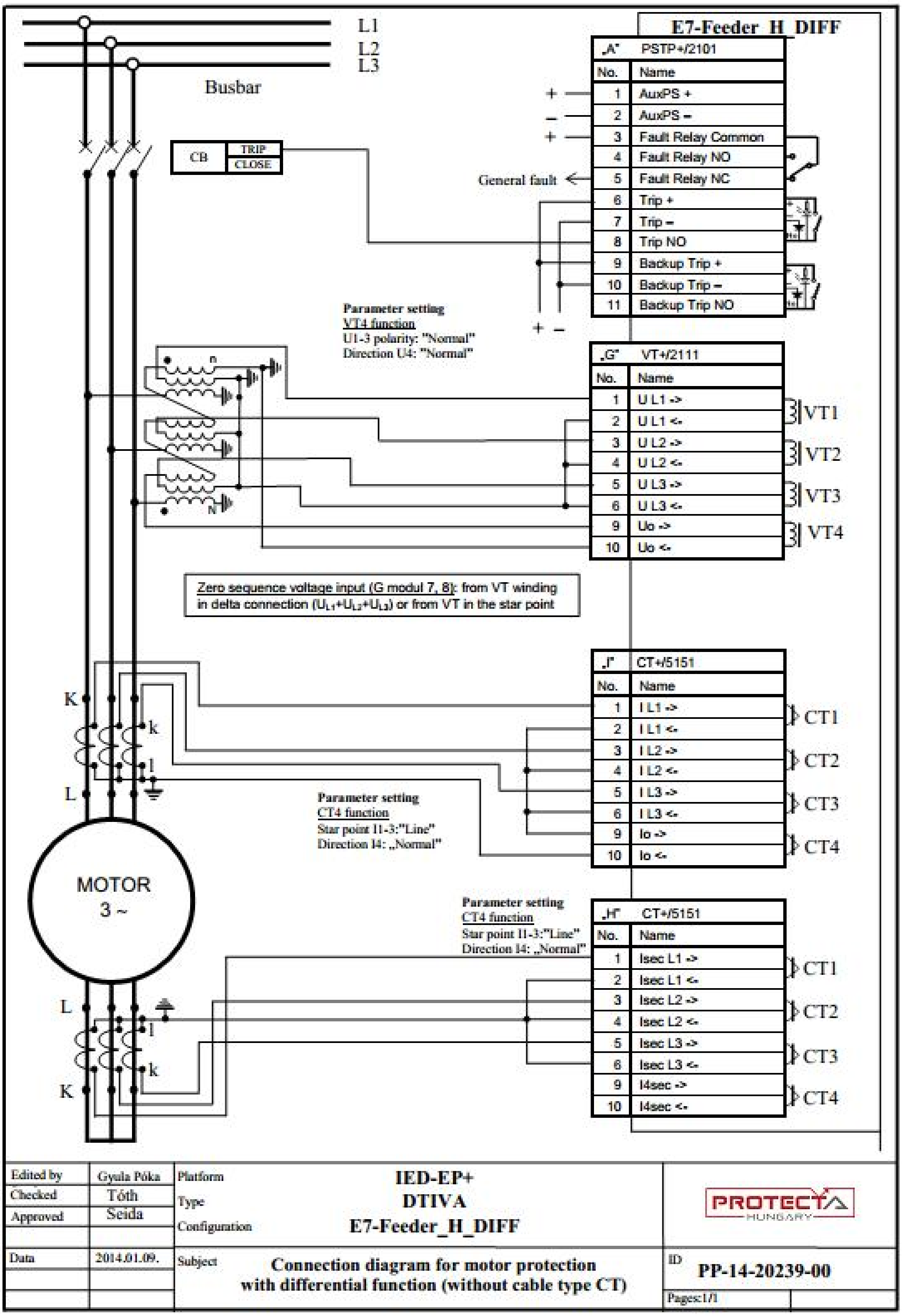
Table 71 The LED assignment

2 External connections

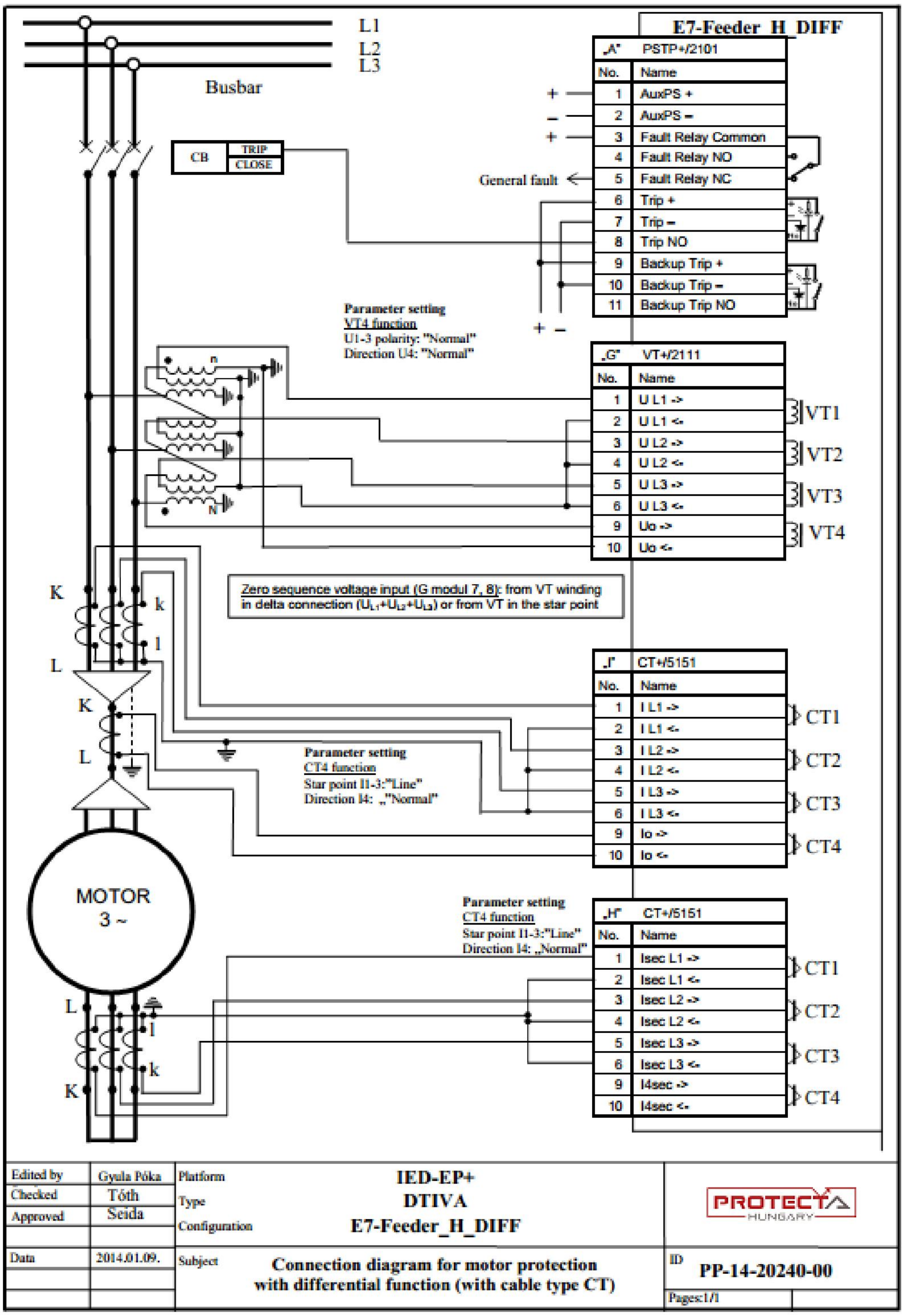




Busbar
L1
L2
L3
E7-Feeder-H
„A" PSTP+/2101
No. Name
1 AuxPS +
2 AuxPS –
3 Fault Relay Common
4 Fault Relay NO
5 Fault Relay NC
6 Trip +
7 Trip –
8 Trip NO
9 Backup Trip +
10 Backup Trip –
11 Backup Trip NO
General fault
CB
TRIP
CLOSE
Parameter setting
VT4 function
U1-3 polarity: "Normal"
Direction U4: "Normal"
„H" VT+/2111
No. Name
1 U L1 ->
2 U L1 <-
3 U L2 ->
4 U L2 <-
5 U L3 ->
6 U L3 <-
9 Uo ->
10 Uo <-
VT1
VT2
VT3
VT4
„T" CT+/5151
No. Name
1 I L1 ->
2 I L1 <-
3 I L2 ->
4 I L2 <-
5 I L3 ->
6 I L3 <-
9 Io ->
10 Io <-
CT1
CT2
CT3
CT4
Parameter setting
CT4 function
Star point I1-3:"Line"
Direction I4: „Normal"
MOTOR
3 ~
Zero sequence voltage input (H modul 7, 8): from VT winding in delta connection (UL1+UL2+UL3) or from VT in the star point
Edited by Gyula Póka
Checked
Approved
Data 2014.01.02.
Platform IED-EP+
Type DTIVA
Configuration E7-Feeder_H
Subject Connection diagram for motor protection (with cable type CT)
ID PP-14-20231-00
Pages:1/2
PROTECTA HUNGARY



L1
L2
L3
Busbar
E7-Feeder_H_DIFF
„A" PSTP+/2101
No. Name
1 AuxPS +
2 AuxPS –
3 Fault Relay Common
4 Fault Relay NO
5 Fault Relay NC
6 Trip +
7 Trip –
8 Trip NO
9 Backup Trip +
10 Backup Trip –
11 Backup Trip NO
CB
TRIP
CLOSE
General fault
Parameter setting
VT4 function
U1-3 polarity: "Normal"
Direction U4: "Normal"
„G" VT+/2111
No. Name
1 U L1 ->
2 U L1 <-
3 U L2 ->
4 U L2 <-
5 U L3 ->
6 U L3 <-
9 Uo ->
10 Uo <-
VT1
VT2
VT3
VT4
Zero sequence voltage input (G modul 7, 8): from VT winding in delta connection (UL1+UL2+UL3) or from VT in the star point
„I" CT+/5151
No. Name
1 I L1 ->
2 I L1 <-
3 I L2 ->
4 I L2 <-
5 I L3 ->
6 I L3 <-
9 Io ->
10 Io <-
CT1
CT2
CT3
CT4
K
k
l
L
Parameter setting
CT4 function
Star point I1-3:"Line"
Direction I4: „Normal"
MOTOR
3 ~
„H" CT+/5151
No. Name
1 Isec L1 ->
2 Isec L1 <-
3 Isec L2 ->
4 Isec L2 <-
5 Isec L3 ->
6 Isec L3 <-
9 I4sec ->
10 I4sec <-
Edited by Gyula Póka
Checked Tóth
Approved Seida
Data 2014.01.09.
Platform IED-EP+
Type DTIVA
Configuration E7-Feeder_H_DIFF
Subject Connection diagram for motor protection with differential function (without cable type CT)
PROTECTA HUNGARY
ID PP-14-20239-00
Pages:1/1


E7-Feeder_H_DIFF
L1
L2
L3
Busbar
CB
TRIP
CLOSE
General fault
„A" PSTP+/2101
No. Name
1 AuxPS +
2 AuxPS –
3 Fault Relay Common
4 Fault Relay NO
5 Fault Relay NC
6 Trip +
7 Trip –
8 Trip NO
9 Backup Trip +
10 Backup Trip –
11 Backup Trip NO
Parameter setting
VT4 function
U1-3 polarity: "Normal"
Direction U4: "Normal"
„G" VT+/2111
No. Name
1 U L1 ->
2 U L1 <-
3 U L2 ->
4 U L2 <-
5 U L3 ->
6 U L3 <-
9 Uo ->
10 Uo <-
VT1
VT2
VT3
VT4
Zero sequence voltage input (G modul 7, 8): from VT winding in delta connection (UL1+UL2+UL3) or from VT in the star point
K
k
l
L
„J" CT+/5151
No. Name
1 I L1 ->
2 I L1 <-
3 I L2 ->
4 I L2 <-
5 I L3 ->
6 I L3 <-
9 Io ->
10 Io <-
CT1
CT2
CT3
CT4
Parameter setting
CT4 function
Star point I1-3:"Line"
Direction I4: „"Normal"
MOTOR
3 ~
Parameter setting
CT4 function
Star point I1-3:"Line"
Direction I4: „Normal"
„H" CT+/5151
No. Name
1 Isec L1 ->
2 Isec L1 <-
3 Isec L2 ->
4 Isec L2 <-
5 Isec L3 ->
6 Isec L3 <-
9 I4sec ->
10 I4sec <-
Edited by Gyula Póka
Checked Tóth
Approved Seida
Data 2014.01.09.
Platform IED-EP+
Type DTIVA
Configuration E7-Feeder_H_DIFF
Subject Connection diagram for motor protection with differential function (with cable type CT)
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