DTRV/TR
Operation Manual
E7 configuration

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PROTECTA HUNGARY

MICROENER

User's manual version information

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CONTENTS

1 Configuration description

The DTRV/TR protection device is a member of the ***PROTECTA*** product line. The ***PROTECTA*** 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 DTRV/TR factory configuration.

1.1 Application

The members of the DTRV product line are configured to protect and control high voltage/medium voltage transformers. The main task of this factory configuration is the automatic control of the tap changer.

1.1.1 Protection and control functions

The DTRV/TR configuration is designed to perform the transformer tap-changer controller function. It measures three phase currents and the zero sequence current component and additionally three phase voltages and the zero sequence voltage component from both sides of the transformer. The tap-changer controller function considers also the voltage drop of serial network elements and the healthy state of the supplying high voltage network. Also the voltage limitation functions are included. The realized protection functions are listed in the Table below.

Protection and control functions	IEC	ANSI	DTRV/TR (E7)
Definite time overvoltage protection	U >, U >>	59	X
Definite time undervoltage protection	U <, U <<	27	X
Automatic voltage regulator (AVR)	AVR	90	X

Table 1 The protection and control functions of the E7-TR configuration

The configured functions are drawn symbolically in the Figure below.

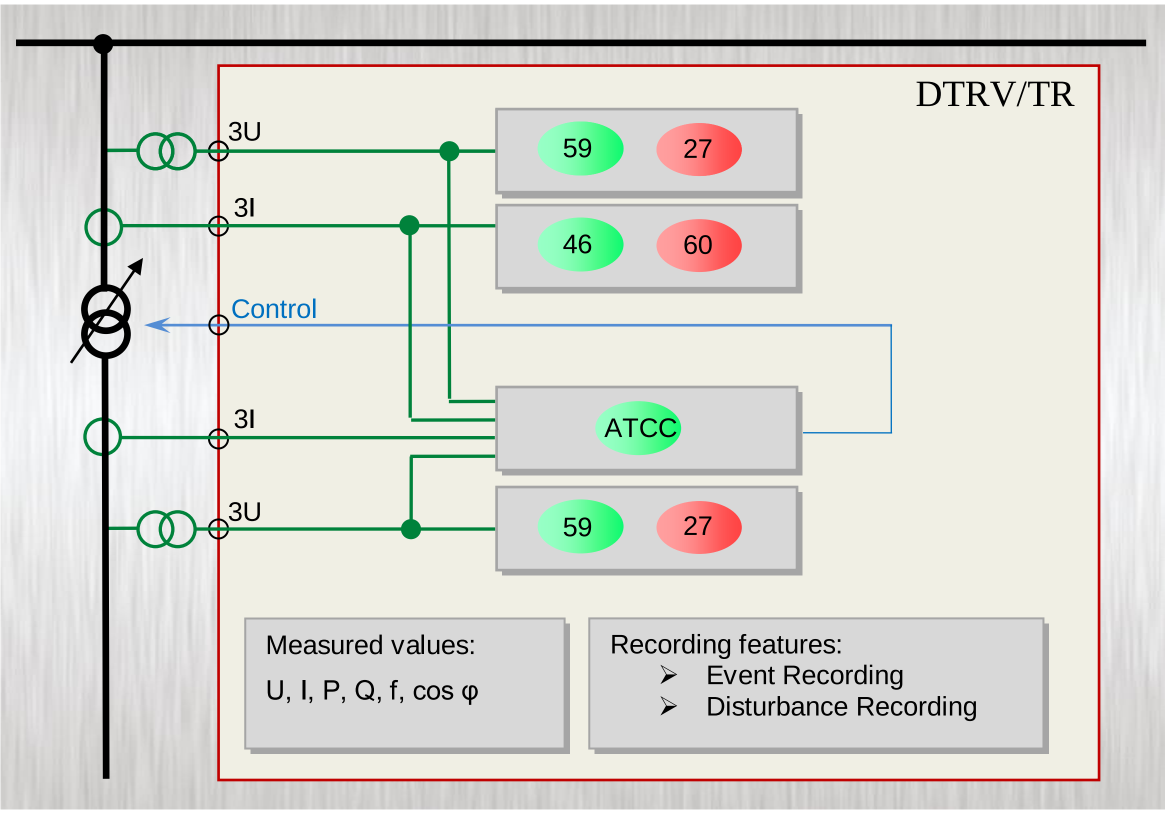


Figure 1-1 Implemented protection and control functions

1.1.2 Measurement functions

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

Measurement functions	DTRV/TR (E7)
Current (I1, I2, I3, Io)	X
Voltage (U1, U2, U3, U12, U23, U31, Uo, Useq) and frequency	X
Power (P, Q, S, pf)	X

Table 2 The measurement functions of the E7-TR configuration

1.1.3 Hardware configuration

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

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

Table 3 The basic hardware configuration of the DTRV/TR configuration

The basic module arrangement of the DTRV/TR configuration is shown below.

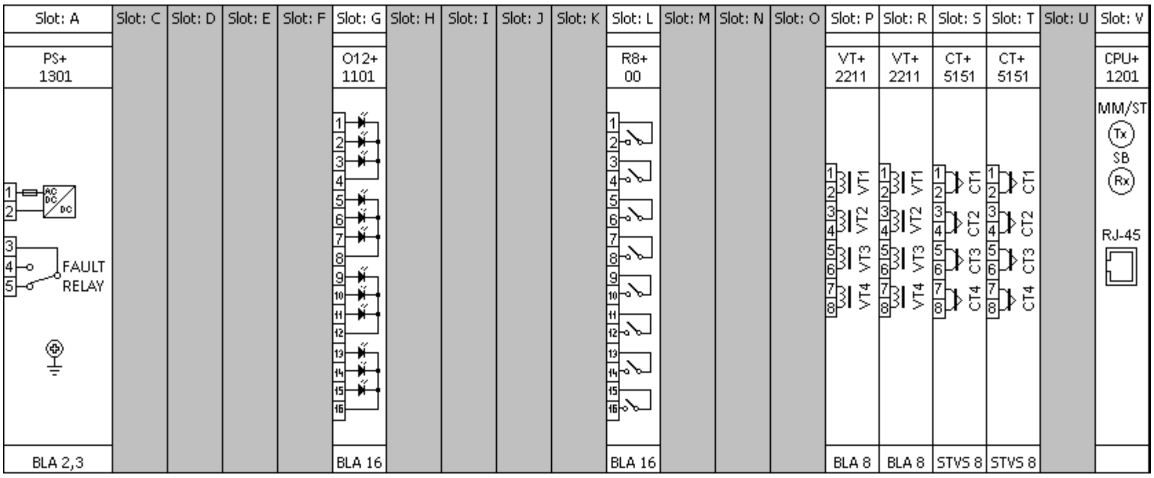


Figure 2 Basic module arrangement of the DTRV/TR configuration (84TE, rear view)

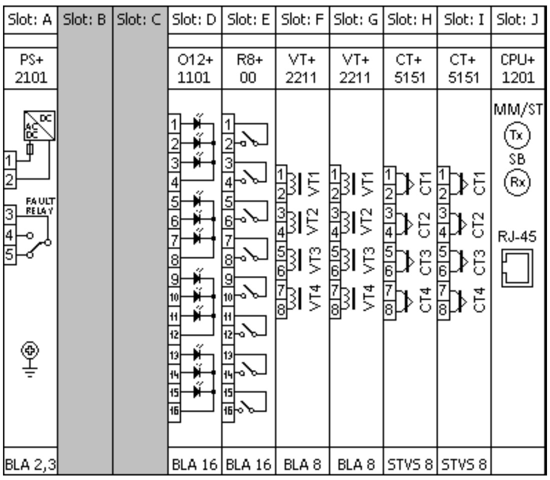


Figure 3 Basic module arrangement of the DTRV/TR configuration (42TE, rear view)

1.1.4 The applied hardware modules

The applied modules are listed in Table 4.

Module identifier	Explanation
PS+ 1301	Power supply unit (in 84TE)
PS+ 2101	Power supply unit (in 42TE)
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 DTRV/TR configuration

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

1.2 Meeting the device

The basic information for working with the ***PROTECTA*** devices are described in the document “***Quick start guide to the devices of the PROTECTA product line***”.

*Figure 4 The 84 inch rack of **PROTECTA** family*

*Figure 5 The 42 inch rack of **PROTECTA** family*

*Figure 6 The double 42 inch rack of **PROTECTA** family*

1.3 Software configuration

1.3.1 Protection and control functions

The implemented protection and control 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
TOV59	Overvoltage	***Definite time overvoltage protection function block description***
TUV27	Undervoltage	***Definite time undervoltage protection function block description***
ATCC	Tap Change Control	***Automatic tap-changer controller function block description***

Table 5 Implemented protection and control functions

1.3.1.1 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 6 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 7 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 8 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 9 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 10 The timer parameter of the definite time overvoltage protection function

1.3.1.2 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 U> → 0	 50 ms 40 ms	
Operate time accuracy		< ± 20 ms
Minimum operate time	50 ms	

Table 11 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 12 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 13 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 14 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 15 The timer parameter of the definite time undervoltage protection function

1.3.1.3 Automatic tap-changer controller function (ATCC)

One criterion for power quality is to keep the voltage of selected points of the networks within the prescribed limits. The most common mode of voltage regulation is the application of transformers with on-load tap changers. When the transformer is connected to different taps, its turns ratio changes and supposing constant primary voltage, the secondary voltage can be increased or decreased as required.

Voltage control can take the actual load state of the transformer and the network into consideration. As a result, the voltage of a defined remote point of the network is controlled assuring that neither consumers near the busbar nor consumers at the far ends of the network get voltages out of the required range.

The voltage control function can be performed automatically or, in manual mode of operation, the personnel of the substation can set the network voltage according to special requirements.

The automatic tap changer controller function can be applied to perform this task.

The automatic tap changer controller function receives the following analog inputs:

UL1L2	Line-to-line voltage of the controlled secondary side of the transformer
IL1L2	Difference of the selected line currents of the secondary side of the transformer for voltage drop compensation
IHV	Maximum of the phase currents of the primary side of the transformer for limitation purposes

The parameter “U Correction” permits fine tuning of the measured voltage.

The function performs the following internal checks before control operation (see Figure below):

- If the voltage of the controlled side UL1L2 is above the value set by the parameter “U High Limit”, then control to increase the voltage is disabled.
- If the voltage of the controlled side UL1L2 is below the value set by the parameter “U Low Limit”, then control to decrease the voltage is disabled.
- If the voltage of the controlled side UL1L2 is below the value set by the parameter “U Low Block”, then the transformer is considered to be de-energized and automatic control is completely disabled.
- If the current of the supply side IHV is above the limit set by the parameter “I Overload”, then both automatic and manual controls are completely disabled. This is to protect the switches inside the tap changer.

<u>**Automatic control mode**</u>

Voltage compensation in automatic control mode

The function gets the Fourier components of the busbar voltage and those of the current:

- $UL1L2_{Re}$ and $UL1L2_{Im}$
- $IL1L2_{Re}$ and $IL1L2_{Im}$

In automatic control mode the voltage of the controlled side *UL1L2* is compensated by the current of the controlled side *IL1L2*. This means that the voltage of the “load center” of the network is controlled to be constant, in fact within a narrow range. This assures that neither the voltage near to the busbar is too high, nor the voltage at far-away points of the network is too low. The voltage of the "load center", i.e. the controlled voltage is calculated as:

$$|Ucontrol| = |Ubus - Udrop|$$

There are two compensation modes to be selected: "AbsoluteComp" and "ComplexComp".

- If the parameter "Compensation" is set to **"AbsoluteComp",** the calculation method is as follows:

In this simplified method the vector positions are not considered correctly, the formula above is approximated with the magnitudes only:

$$|Ucontrol| = |Ubus - Udrop| \approx |Ubus| - |Udrop| \approx |Ubus| - |I| * (R)CompoundFactor$$

where

(R) Compound Factor is a parameter value.

If the current is above the value defined by the parameter "I Comp Limit", then in the formulas above this preset value is considered instead of the higher values measured.

The method is based on the experiences of the network operator. Information is needed: how much is the voltage drop between the busbar and the "load center" if the load of the network is the rated load. The parameter "(R) Compound Factor" means in this case the voltage drop in percent.

- If the parameter "Compensation" is set to **"ComplexComp",** the calculation method is as follows:

In this simplified method the vector positions are partly considered. In the formula above the voltage drop is approximated with the component of the voltage drop, the direction of which is the same as the direction of the bus voltage vector. (This is "length component" of the voltage drop; the "perpendicular component" of the voltage drop is neglected.)

$$|Ucontrol| = |Ubus - [IL1L2_{Re} * (R)CompoundFactor - IL1L2_{Im} * XCompoundFactor]|$$

where

(R) Compound Factor is a parameter value
X Compound Factor is a parameter value

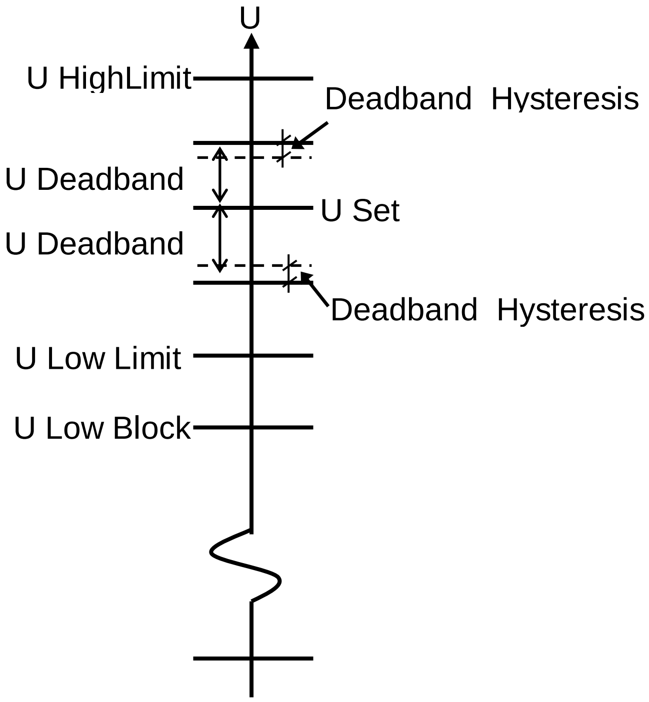
The voltage of the "load center" of the network is controlled to be within a narrow range. This assures that neither the voltage near to the busbar is too high, nor the voltage at far-away points of the network is too low.

The method is based on the estimated complex impedance between the busbar and the "load center".

The parameter *"(R) Compound Factor*" means in this case the voltage drop in percent, caused by the real component of the rated current.

The parameter *"X Compound Factor"* means in this case the voltage drop in percent, caused by the imaginary component of the rated current.

NOTE: if the active power flows from the network to the busbar then in "AbsoluteComp" mode no compounding is performed.



Voltage checking in automatic control mode

In automatic control mode the calculated | *Ucontrol* | voltage is checked to see if it is outside the limits. The limits are defined by parameter values:

U Set	is the setting value defining the centre of the permitted range
U Deadband	is the width of the permitted range in both + and – directions
Deadband Hysteresis	is the hysteresis decreasing the permitted range of the „U Deadband" after the generation of the control command.

If the calculated | *Ucontrol* | voltage is outside the limits, then timers are started.

In an emergency state of the network, when the network elements are overloaded, the Uset value can be driven to two lower values defined by the parameters "Voltage Reduction 1" and "Voltage Reduction 2". "U Set" is decreased by the parameter values if the binary inputs "VRed 1" or "VRed 2" enter into active state. These inputs must be programmed graphically by the user.

Time delay in automatic control mode

In automatic control mode the first and every subsequent control command is processed separately.

For the first control command:

The voltage difference is calculated:

Udiff= |Ucontrol- Uset|

If this difference is above the U Deadband value, and depending on the setting of parameter “T1 Delay Type”, three different timing modes can be selected:

- “Definite” this definite time delay is defined by parameter T1
- “Inverse” standard IDMT characteristic defined by the parameters:
    - T1 maximum delay defined by the parameter
    - U Deadband is the width of the permitted range in both + and – directions
    - Min Delay minimum time delay

$$Tdelay = \frac{T1}{\left(\frac{Udiff}{Udeadband}\right)}, but\ minimum\ Min\ Delay$$

- “2powerN”

$$Tdelay = T1 * 2^{\left(1-\frac{Udiff}{Udeadband}\right)}$$

The binary parameters “Fast Lower Enable” and/or “Fast Higher Enable” enable fast command generation if the voltage is above the parameter value “U High Limit” or below the “U Low Limit”. In this case, the time delay is a definite time delay defined by parameter “T2”.

For subsequent control commands:

In this case, the time delay is always a definite time delay defined by parameter “T2” if the subsequent command is generated within the „Reclaim time” defined by a parameter.

The automatic control mode can be blocked by a binary signal received via binary input „AutoBlk” and generates a binary output signal “AutoBlocked (ext)”

Manual control mode

In manual mode, the automatic control is blocked. The manual mode can be “Local” or “Remote”. For this mode, the input “Manual” needs to be in active state (as programmed by the user).

In the local mode, the input “Local” needs to be in active state. The binary inputs “ManHigher” or “ManLower” must be programmed graphically by the user.

In the remote mode, the input “Remote” needs to be in active state as programmed by the user. In this case manual commands are received via the communication interface.

Command generation and tap changer supervision

The software module “CMD&TC SUPERV” is responsible for the generation of the “HigherCmd” and “LowerCmd” command pulses, the duration of which is defined by the parameter “Pulse Duration”. This is valid both for manual and automatic operation.

The tap changer supervision function receives the information about the tap changer position in six bits of the binary inputs “Bit0 to Bit5”. The value is decoded according to the enumerated parameter “CodeType”, the values of which can be: Binary, BCD or Gray. During switchover, for the transient time defined by the parameter “Position Filter”, the position is not evaluated.

The parameters “Min Position” and “Max Position” define the upper and lower limits. In the upper position, no further increasing command is generated and the output “Max Pos Reached” becomes active. Similarly, in the lower position, no further decreasing command is generated and the output “Min Pos Reached” becomes active.

The function also supervises the operation of the tap changer. Depending on the setting of parameter “TC Supervision”, three different modes can be selected:

- TCDrive the supervision is based on the input “TCRun”. In this case, after command generation the drive is expected to start operation within one quarter of the value defined by the parameter “Max Operating Time” and it is expected to perform the command within “Max Operating Time”
- Position the supervision is based on the tap changer position in six bits of the binary inputs “Bit0 to Bit5”. It is checked if the tap position is incremented in case of a voltage increase, or the tap position is decremented in case of a voltage decrease, within the “Max Operating Time”.
- Both in this mode the previous two modes are combined.

In case of an error detected in the operation of the tap changer, the “Locked” input becomes active and no further commands are performed. To enable further operation, the input “Reset” must be programmed for an active state by the user.

Technical data

Function	Range	Accuracy
Voltage measurement	50 % < U < 130 %	<1%
Definite time delay		<2% or ±20 ms, whichever is greater
Inverse and “2powerN” time delay	12 % < U < 25%	<5%
	25 % < U < 50%	<2% or ±20 ms, whichever is greater

Table 16 Technical data of the automatic tap-changer controller function

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Control model, according to IEC 61850			
ATCC_ctlMod_EPar_	ControlModel	Direct normal, Direct enhanced, SBO enhanced	Direct normal
Select before operate class, according to IEC 61850			
ATCC_sboClass_EPar_	sboClass	Operate-once, Operate-many	Operate-once
Parameter for general blocking of the function			
ATCC_Oper_EPar_	Operation	Off,On	Off
Parameter for time delay mode selection			
ATCC_T1Type_EPar_	T1 Delay Type	Definite, Inverse, 2powerN	Definite
Selection for compensation mode			
ATCC_Comp_EPar_	Compensation	Off, AbsoluteComp, ComplexComp	Off
Tap changed supervision mode selection			
ATCC_TCSuper_EPar_	TC Supervision	Off, TCDrive, Position, Both	Off
Decoding of the position indicator bits			
ATCC_CodeType_EPar	CodeType	Binary, BCD, Gray	Binary

Table 17 The enumerated parameters of the automatic tap-changer controller function

Boolean parameters

Parameter name	Title	Explanation	Default
ATCC_FastHigh_BPar_	Fast Higher Enable	Enabling fast higher control command	0
ATCC_FastLow_BPar_	Fast Lower Enable	Enabling fast lower control command	0

Table 18 The boolean parameters of the automatic tap-changer controller function

Integer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Code value of the minimum position						
ATCC_MinPos_Ipar_	Min Position		1	32	1	1
Code value of the maximum position						
ATCC_MaxPos_Ipar_	Max Position		1	32	1	32

Table 19 The integer parameters of the automatic tap-changer controller function

Timer parameters

Parameter name	Title	Unit	Min	Max	Step	Default
Time limit for tap-change operation						
ATCC_TimOut_TPar_	Max Operating Time	msec	1000	30000	1	5000
Command impulse duration						
ATCC_Pulse_TPar_	Pulse Duration	msec	100	10000	1	1000
Time overbridging the transient state of the tap changer status signals						
ATCC_MidPos_TPar_	Position Filter	msec	1000	30000	1	3000
Select before operate timeout, according to IEC 61850						
ATCC_SBOTimeout_TPar_	SBO Timeout	msec	1000	20000	1	5000

Table 20 *The timer parameters of the automatic tap-changer controller function*

Float point parameters

Parameter name	**Title**	**Unit**	**Min**	**Max**	**Digits**	**Default**
Factor for fine tuning the measured voltage:						
ATCC_Ubias_FPar_	U Correction	-	0.950	1.050	3	1.000
Set-point for voltage regulation, related to the rated voltage (valid at I=0):						
ATCC_USet_FPar_	U Set	%	80.0	115.0	1	100.0
Dead band for voltage regulation, related to the rated voltage:						
ATCC_UDead_FPar_	U Deadband	%	0.5	9.0	1	3.0
Hysteresis value for the dead band, related to the dead band:						
ATCC_DeadHyst_FPar_	Deadband Hysteresis	%	60	90	0	85
Parameter for the current compensation:						
ATCC_URinc_FPar_	(R) Compound Factor	%	0.0	15.0	1	5.0
Parameter for the current compensation:						
ATCC_UXinc_FPar_	X Compound Factor	%	0.0	15.0	1	5.0
Reduced set-point 1 for voltage regulation (priority), related to the rated voltage:						
ATCC_VRed1_FPar_	Voltage Reduction 1	%	0.0	10.0	1	5.0
Reduced set-point 2 for voltage regulation, related to the rated voltage:						
ATCC_VRed2_FPar_	Voltage Reduction 2	%	0.0	10.0	1	5.0
Maximum current value to be considered in current compensation formulas:						
ATCC_ICompLim_FPar_	I Comp Limit	%	0.00	150	0	1
Current upper limit to disable all operation:						
ATCC_IHVOC_FPar_	I Overload	%	50	150	0	100
Voltage upper limit to disable step up:.						
ATCC_UHigh_FPar_	U High Limit	%	90.0	120.0	1	110.0
Voltage lower limit to disable step down:						
ATCC_ULow_FPar_	U Low Limit	%	70.0	110.0	1	90.0
Voltage lower limit to disable all operation:						
ATCC_UBlock_FPar_	U Low Block	%	50.0	100.0	1	70.0
Time delay for the first control command generation:						
ATCC_T1_FPar_	T1	sec	1.0	600.0	1	10.0
Definite time delay for subsequent control command generation or fast operation (if it is enabled):						
ATCC_T2_FPar_	T2	sec	1.0	100.0	1	10.0
In case of dependent time characteristics, this is the minimum time delay						
ATCC_MinDel_FPar_	Min Delay	sec	1.0	100.0	1	10.0
After a control command, if the voltage is out of the range within the reclaim time, then the command is generated after T2 time delay						
ATCC_Recl_FPar_	Reclaim Time	sec	1.0	100.0	1	10.0

Table 21 The float point parameters of the automatic tap-changer controller function

1.3.2 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 voltages and currents, except the block "Line measurement". This specific block displays the measured values in primary units, using CT and VT primary value settings.

Analog value	Explanation
CT4 module 1	
Current Ch - I1	RMS value of the Fourier fundamental harmonic current component in phase L1 on HV side
Angle Ch - I1	Phase angle of the Fourier fundamental harmonic current component in phase L1* on HV side
Current Ch - I2	RMS value of the Fourier fundamental harmonic current component in phase L2 on HV side
Angle Ch - I2	Phase angle of the Fourier fundamental harmonic current component in phase L2* on HV side
Current Ch - I3	RMS value of the Fourier fundamental harmonic current component in phase L3 on HV side
Angle Ch - I3	Phase angle of the Fourier fundamental harmonic current component in phase L3* on HV side
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 module 2	
Current Ch - I1	RMS value of the Fourier fundamental harmonic current component in phase L1 on MV side
Angle Ch - I1	Phase angle of the Fourier fundamental harmonic current component in phase L1* on MV side
Current Ch - I2	RMS value of the Fourier fundamental harmonic current component in phase L2 on MV side
Angle Ch - I2	Phase angle of the Fourier fundamental harmonic current component in phase L2* on MV side
Current Ch - I3	RMS value of the Fourier fundamental harmonic current component in phase L3 on MV side
Angle Ch - I3	Phase angle of the Fourier fundamental harmonic current component in phase L3* on MV side
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*
VT4 module 1	
Voltage Ch – U1	RMS value of the Fourier fundamental harmonic voltage component in phase L1 on HV side
Angle Ch – U1	Phase angle of the Fourier fundamental harmonic voltage component in phase L1* on HV side
Voltage Ch – U2	RMS value of the Fourier fundamental harmonic voltage component in phase L2 on HV side
Angle Ch – U2	Phase angle of the Fourier fundamental harmonic voltage component in phase L2* on HV side
Voltage Ch – U3	RMS value of the Fourier fundamental harmonic voltage component in phase L3 on HV side

Angle Ch – U3	Phase angle of the Fourier fundamental harmonic voltage component in phase L3* on HV side
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*
VT4 module 2	
Voltage Ch – U1	RMS value of the Fourier fundamental harmonic voltage component in phase L1 on MV side
Angle Ch – U1	Phase angle of the Fourier fundamental harmonic voltage component in phase L1* on MV side
Voltage Ch – U2	RMS value of the Fourier fundamental harmonic voltage component in phase L2 on MV side
Angle Ch – U2	Phase angle of the Fourier fundamental harmonic voltage component in phase L2* on MV side
Voltage Ch – U3	RMS value of the Fourier fundamental harmonic voltage component in phase L3 on MV side
Angle Ch – U3	Phase angle of the Fourier fundamental harmonic voltage component in phase L3* on MV side
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*
Line measurement 1 (MXU_MVL) (here the displayed information means primary value) (Primary side of the transformer)	
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
Line measurement 1 (MXU_MVL) (here the displayed information means primary value) (Secondary side of the transformer)	
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
Voltage control (ATCC)	
Ubus	True RMS value of the voltage between phases L1 L2 on MV bus
Ucontrolled	

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

Table 22 Measured analog values

1.3.2.1 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 PROTECTA 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 23 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 24 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 25 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.

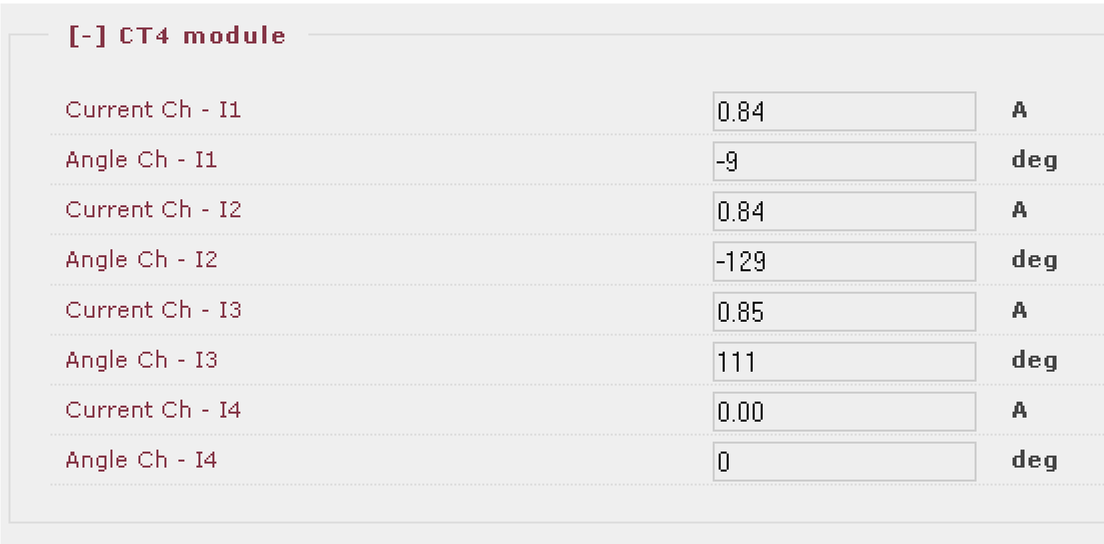
Measured value	Dim.	Explanation
Current Ch - I1	A(secondary)	Fourier basic component of the current in channel IL1
Angle Ch - I1	degree	Vector position of the current in channel IL1
Current Ch – I2	A(secondary)	Fourier basic component of the current in channel IL2
Angle Ch – I2	degree	Vector position 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 26 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.

Erreur ! Source du renvoi introuvable. shows an example of how the calculated Fourier components are displayed in the on-line block. (See the document “PROTECTA Remote user interface description”.)



[-] CT4 module

Current Ch - I1	0.84	A
Angle Ch - I1	-9	deg
Current Ch - I2	0.84	A
Angle Ch - I2	-129	deg
Current Ch - I3	0.85	A
Angle Ch - I3	111	deg
Current Ch - I4	0.00	A
Angle Ch - I4	0	deg

Figure 7 Example: On-line displayed values for the current input module

1.3.2.2 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 PROTECTA 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 27 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 28 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 29 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 30 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 31 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 PROTECTA “Remote user interface description”.)

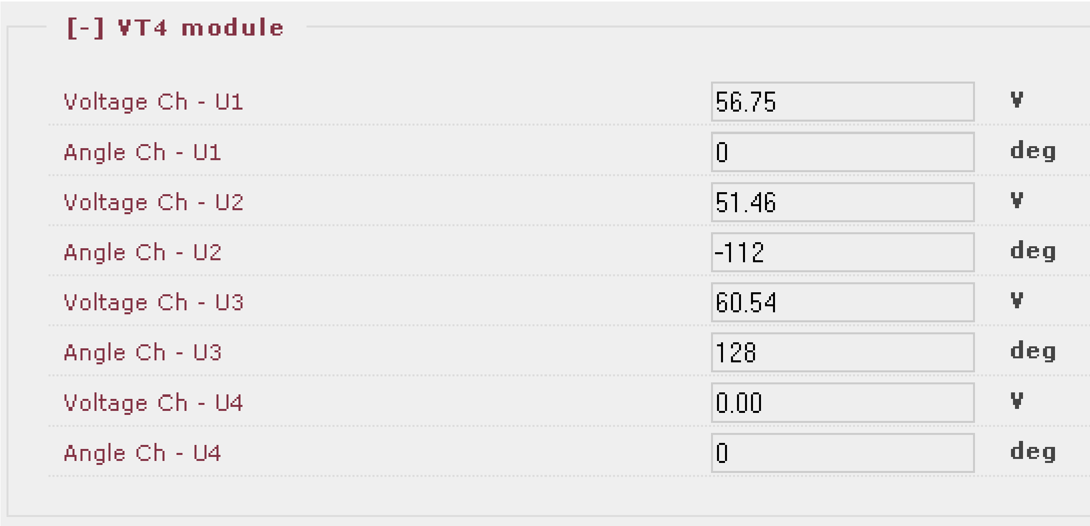


Figure 8 Example: On-line displayed values for the voltage input module

1.3.2.3 Line measurement function (MXU)

The input values of the PROTECTA 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 components of the voltages and currents and the true RMS values. Additionally, it is in these functions 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.

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.

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

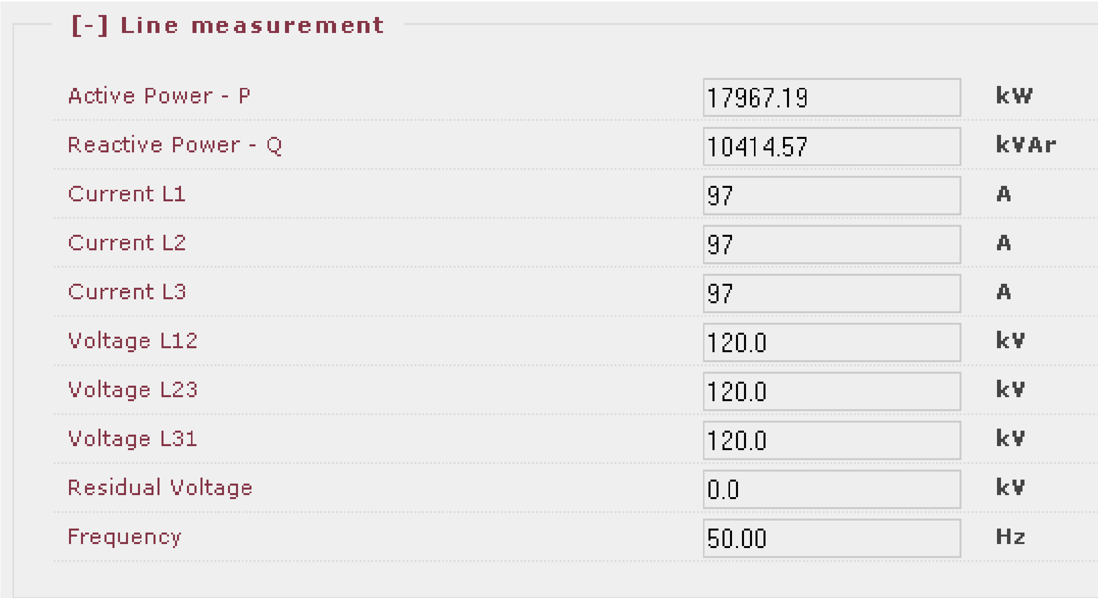
- displayed measured values,
- reports to the SCADA system.

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

The measured values of the line measurement function depend on the hardware configuration.

The available quantities are described in the relevant configuration description documents.

As an example, the Figure below shows the list of the measured values available in a configuration for compensated networks.



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

Parameters

Enumerated parameters

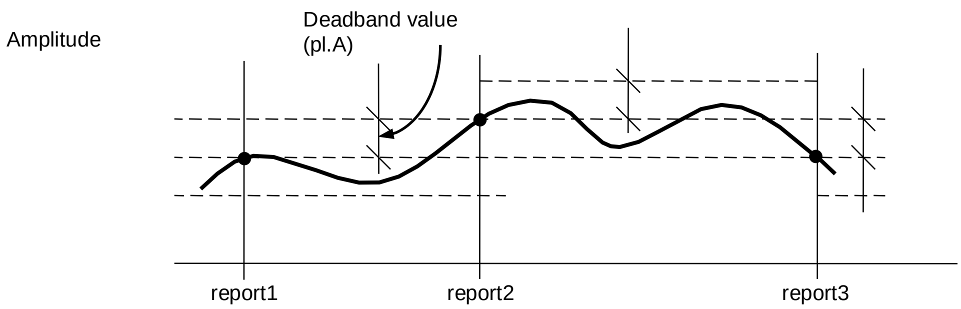
Parameter name	**Title**	**Selection range**	**Default**
Selection of the reporting mode for active power measurement			
MXU_PRepMode_EPar_	Operation ActivePower	Off, Amplitude, Integrated	Amplitude
Selection of the reporting mode for current measurement			
MXU_IRepMode_EPar_	Operation Current	Off, Amplitude, Integrated	Amplitude

Table 32 *Enumerated parameters of the line measurement function*

Floating point parameters

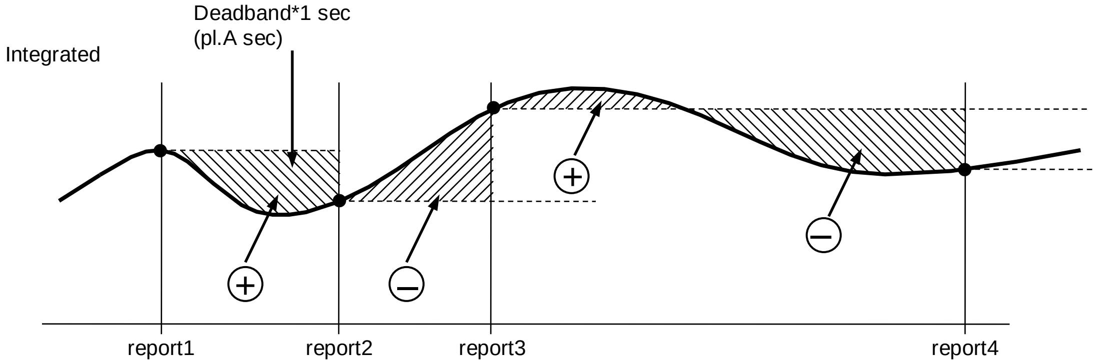
Parameter name	**Title**	**Dim.**	**Min**	**Max**	**Step**	**Default**
Deadband value for the active power						
MXU_PDeadB_FPar_	Deadband value - P	MW	0.1	100000	0.01	10
Range value for the active power						
MXU_PRange_FPar_	Range value - P	MW	1	100000	0.01	500
Deadband value for the current						
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

Table 33 *Floating point parameters of the line measurement function*



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 above shows that the current becomes higher than the value reported in "report1" plus the deadband value, this results "report2", etc.

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



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

Periodic reporting is generated independently of the changes of the measured values when the defined time period elapses. As an example, the required parameter setting is shown in Table below.

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 current						
MXU_IIntPer_IPar_	Report period I	sec	0	3600	1	0

Table 34 *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" by the Selection parameter.

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 35 Technical data of the line measurement function

1.3.3 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
Definite time overvoltage protection function (TOV59_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
Definite time overvoltage protection function (TOV59_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
Definite time undervoltage protection function (TUV27_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
Definite time undervoltage protection function (TUV27_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
(Con4Ch)	
Status Ch1	Control status in channel 1
Status Ch2	Control status in channel 2
Status Ch3	Control status in channel 3
Status Ch4	Control status in channel 4
(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
Measurement function (MXU_L) primary side of transformer	
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
Measurement function (MXU_MVL) secondary side of transformer	
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
Automatic tap change controller function (ATCC)	
Status	Position status
Min Pos Reached	Signaling the minimal position
Max Pos Reached	Signaling the maximal position
ATCC local mode	Local state of the manual operation
AutoMode	Automatic control enabled
Blocked	Blocked
Voltage Reduction 1	Controlling to reduced voltage 1
Voltage Reduction 2	Controlling to reduced voltage 2

Table 36 List of the possible events

1.3.4 Disturbance recorder

The DTRV/TR configuration contains a disturbance recorder function. The details are described in the document shown in Table 37.

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

Table 37 Implemented disturbance recorder function

The recorded analog channels:

Recorded analog signal	Explanation
IL1	Measured current of HV side in line 1
IL2	Measured current of HV side in line 2
IL3	Measured current of HV side in line 3
IL1	Measured current of MV side in line 1
IL2	Measured current of MV side in line 2
IL3	Measured current of MV side in line 3
UL1	Measured voltage of HV side in line 1
UL2	Measured voltage of HV side in line 2
UL3	Measured voltage of HV side in line 3
UL1	Measured voltage of MV side in line 1
UL2	Measured voltage of MV side in line 2
UL3	Measured voltage of MV side in line 3

Table 38 Disturbance recorder, recorded analog channels

The recorded binary channels:

Recorded binary signal	Explanation
U> Start	Start signal of the OV prot. function
U> Trip	Trip command of the OV prot. function
U< Start	Start signal of the UV prot. function
U< Trip	Trip command of the UV prot. function
ATCC U High	High voltage value of the automatic tap change controller
ATCC U Low	Low voltage value of the automatic tap change controller
ATCC VRed	Voltage reduction of the automatic tap change controller

Table 39 Disturbance recorder, recorded binary channels

Enumerated parameter

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

Table 40 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 41 The timer parameters of the disturbance recorder function

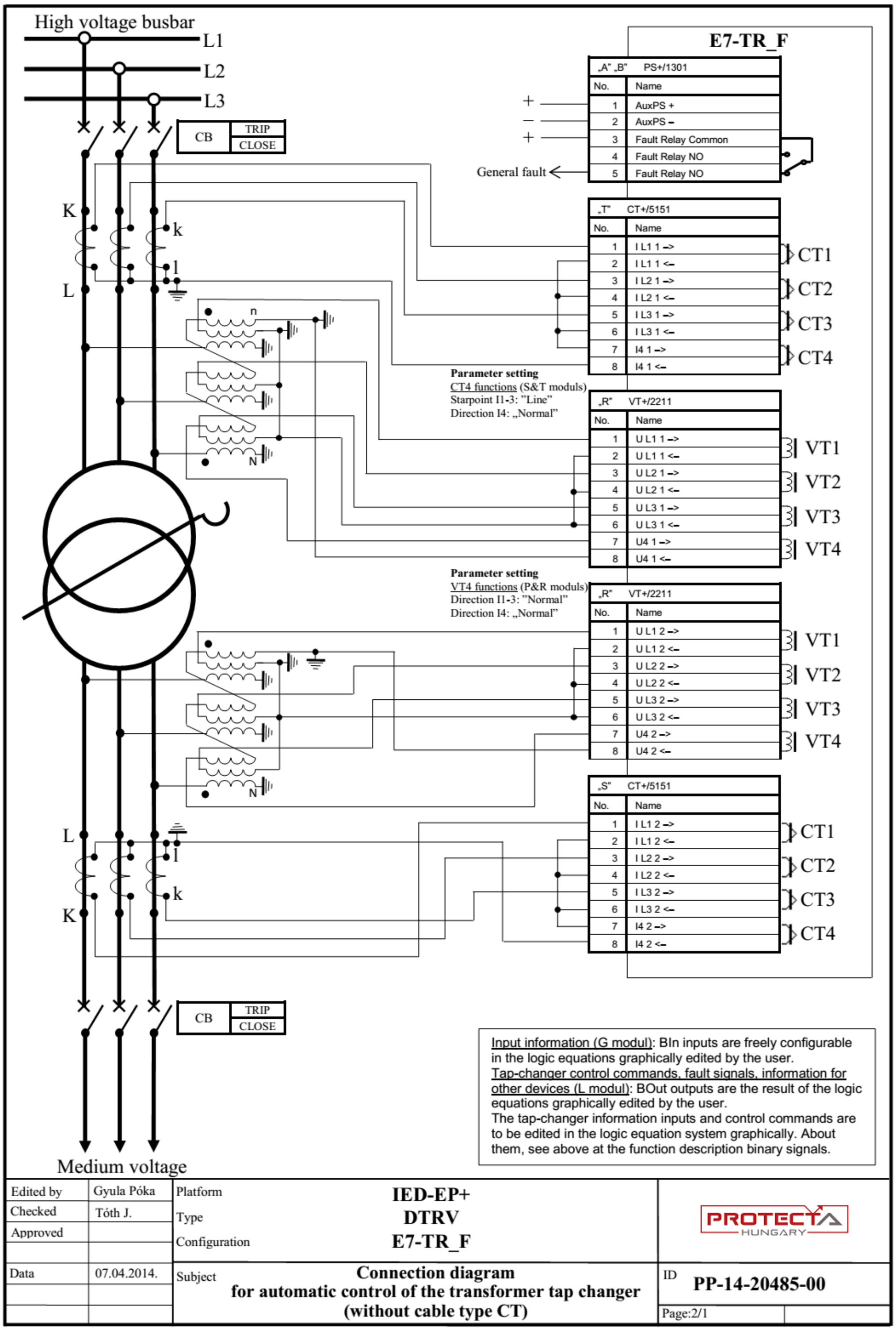
1.3.5 LED assignment

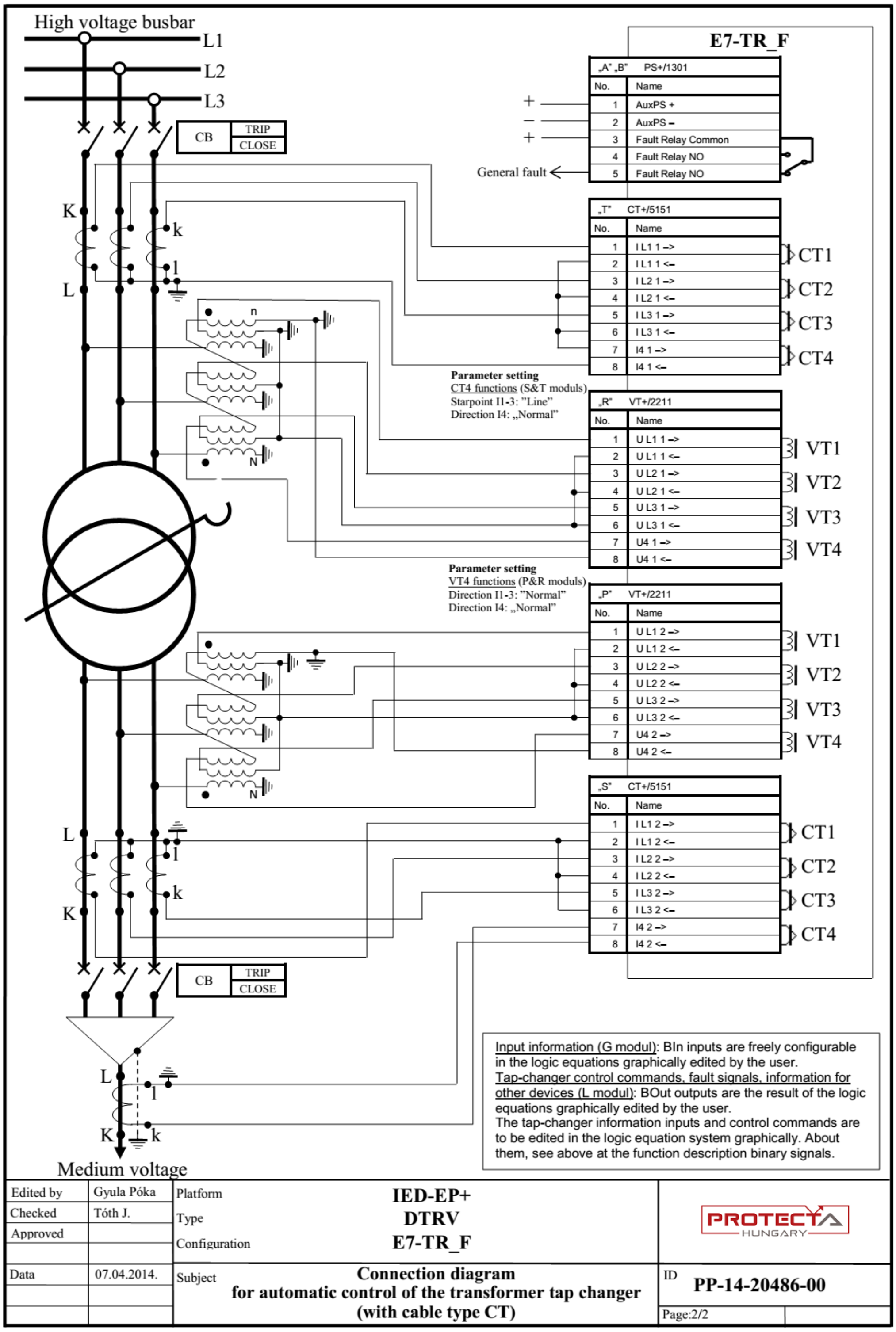
On the front panel of the device there are “User LED”-s with the “Changeable LED description label”. Some LED-s are factory assigned, some are free to be defined by the user.

LED	Explanation
Locked	Automatic tap change controller locked
Manual	Automatic tap change controller in manual mode
HigherCmd	Automatic tap change controller higher command
LowerCmd	Automatic tap change controller lower command
VRed	Automatic tap change controller voltage reduction
LED06	Free LED
LED07	Free LED
LED08	Free LED
LED09	Free LED
LED10	Free LED
LED11	Free LED
LED12	Free LED
LED13	Free LED
LED14	Free LED
LED15	Free LED
LED16	Free LED

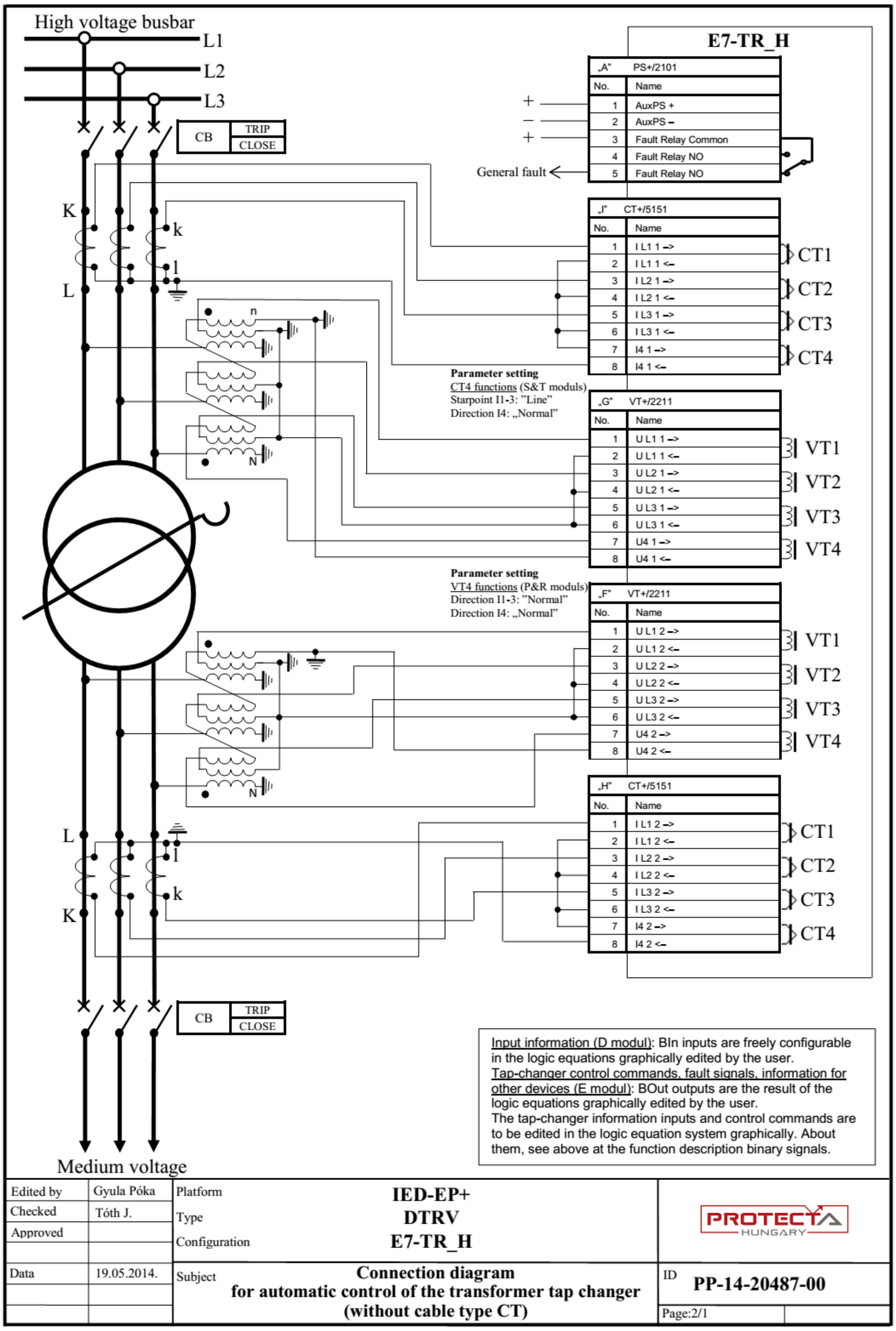
Table 42 LED assignment

2 External connections

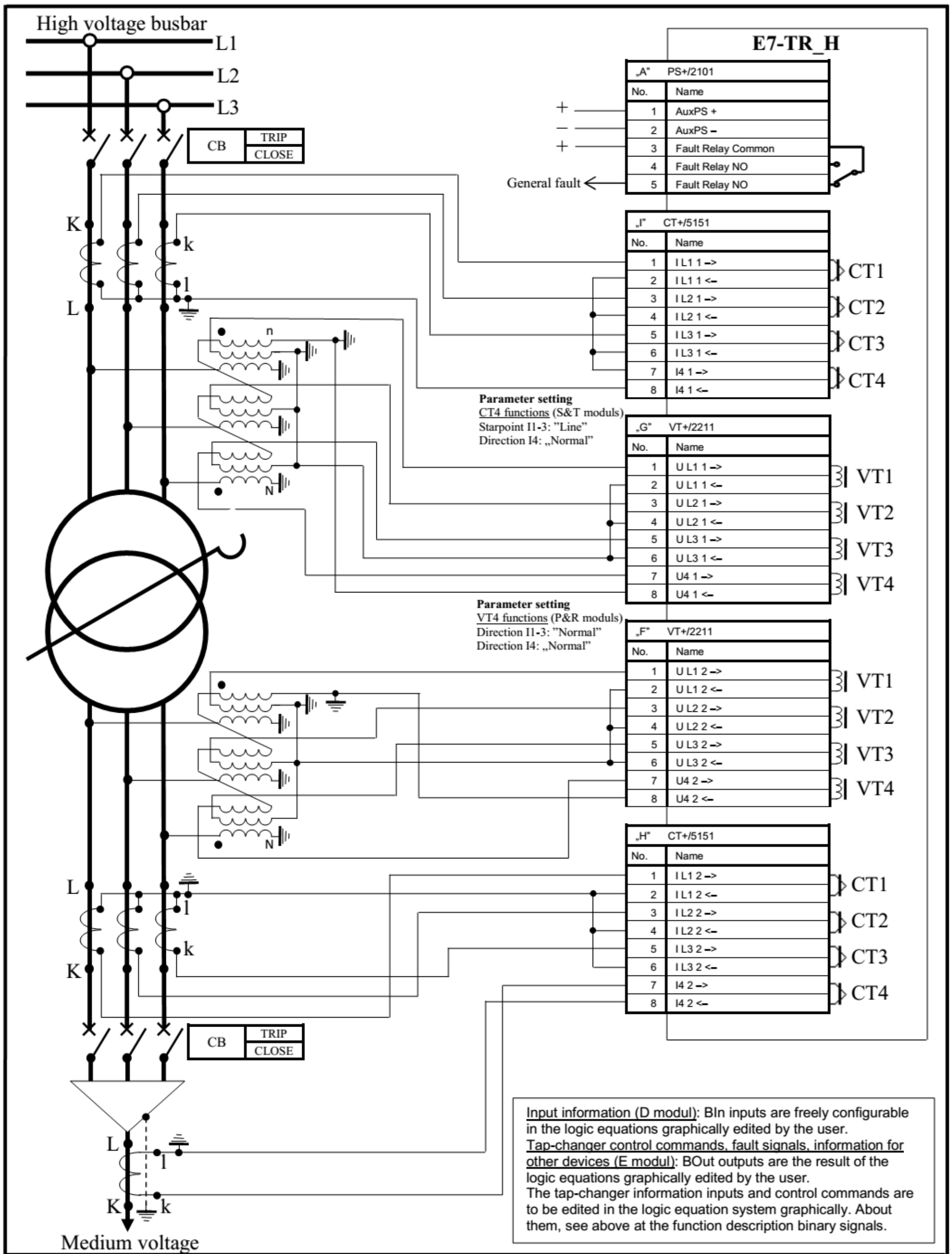




High voltage busbar
L1
L2
L3
CB
TRIP
CLOSE
K
k
l
L
n
N
E7-TR_F
„A" „B" PS+/1301
No. Name
1 AuxPS +
2 AuxPS –
3 Fault Relay Common
4 Fault Relay NO
5 Fault Relay NO
General fault
„T" CT+/5151
No. Name
1 I L1 1 –>
2 I L1 1 <–
3 I L2 1 –>
4 I L2 1 <–
5 I L3 1 –>
6 I L3 1 <–
7 I4 1 –>
8 I4 1 <–
CT1
CT2
CT3
CT4
Parameter setting
CT4 functions (S&T moduls)
Starpoint I1-3: "Line"
Direction I4: „Normal"
„R" VT+/2211
No. Name
1 U L1 1 –>
2 U L1 1 <–
3 U L2 1 –>
4 U L2 1 <–
5 U L3 1 –>
6 U L3 1 <–
7 U4 1 –>
8 U4 1 <–
VT1
VT2
VT3
VT4
Parameter setting
VT4 functions (P&R moduls)
Direction I1-3: "Normal"
Direction I4: „Normal"
„P" VT+/2211
No. Name
1 U L1 2 –>
2 U L1 2 <–
3 U L2 2 –>
4 U L2 2 <–
5 U L3 2 –>
6 U L3 2 <–
7 U4 2 –>
8 U4 2 <–
VT1
VT2
VT3
VT4
„S" CT+/5151
No. Name
1 I L1 2 –>
2 I L1 2 <–
3 I L2 2 –>
4 I L2 2 <–
5 I L3 2 –>
6 I L3 2 <–
7 I4 2 –>
8 I4 2 <–
CT1
CT2
CT3
CT4
Input information (G modul): BIn inputs are freely configurable in the logic equations graphically edited by the user.
Tap-changer control commands, fault signals, information for other devices (L modul): BOut outputs are the result of the logic equations graphically edited by the user.
The tap-changer information inputs and control commands are to be edited in the logic equation system graphically. About them, see above at the function description binary signals.
Medium voltage
Edited by Gyula Póka
Checked Tóth J.
Approved
Data 07.04.2014.
Platform IED-EP+
Type DTRV
Configuration E7-TR_F
PROTECTA HUNGARY
Subject Connection diagram
for automatic control of the transformer tap changer
(with cable type CT)
ID PP-14-20486-00
Page:2/2



High voltage busbar
L1
L2
L3
CB
TRIP
CLOSE
K
L
k
l
n
N
E7-TR_H
„A" PS+/2101
No. Name
1 AuxPS +
2 AuxPS –
3 Fault Relay Common
4 Fault Relay NO
5 Fault Relay NO
General fault
„I" CT+/5151
1 I L1 1 –>
2 I L1 1 <–
3 I L2 1 –>
4 I L2 1 <–
5 I L3 1 –>
6 I L3 1 <–
7 I4 1 –>
8 I4 1 <–
CT1
CT2
CT3
CT4
Parameter setting
CT4 functions (S&T moduls)
Starpoint I1-3: "Line"
Direction I4: „Normal"
„G" VT+/2211
1 U L1 1 –>
2 U L1 1 <–
3 U L2 1 –>
4 U L2 1 <–
5 U L3 1 –>
6 U L3 1 <–
7 U4 1 –>
8 U4 1 <–
VT1
VT2
VT3
VT4
Parameter setting
VT4 functions (P&R moduls)
Direction I1-3: "Normal"
Direction I4: „Normal"
„F" VT+/2211
1 U L1 2 –>
2 U L1 2 <–
3 U L2 2 –>
4 U L2 2 <–
5 U L3 2 –>
6 U L3 2 <–
7 U4 2 –>
8 U4 2 <–
„H" CT+/5151
1 I L1 2 –>
2 I L1 2 <–
3 I L2 2 –>
4 I L2 2 <–
5 I L3 2 –>
6 I L3 2 <–
7 I4 2 –>
8 I4 2 <–
Input information (D modul): BIn inputs are freely configurable in the logic equations graphically edited by the user.
Tap-changer control commands, fault signals, information for other devices (E modul): BOut outputs are the result of the logic equations graphically edited by the user.
The tap-changer information inputs and control commands are to be edited in the logic equation system graphically. About them, see above at the function description binary signals.
Medium voltage
Edited by Gyula Póka
Checked Tóth J.
Approved
Data 19.05.2014.
Platform IED-EP+
Type DTRV
Configuration E7-TR_H
Subject Connection diagram for automatic control of the transformer tap changer (without cable type CT)
PROTECTA HUNGARY
ID PP-14-20487-00
Page:2/1



Edited by	Gyula Póka	Platform	IED-EP+	PROTECTA HUNGARY
Checked	Tóth J.	Type	DTRV	
Approved		Configuration	E7-TR_H	
Data	19.05.2014.	Subject	Connection diagram for automatic control of the transformer tap changer (with cable type CT)	ID PP-14-20488-00
				Page:2/2

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