„DRL” – Petersen Coil Controller Configuration description (Type: DAUT)

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CONTENTS

1 Configuration description

The ***DRL*** automation device is a member of the ***EuroProt+*** product line, made by Protecta Co. Ltd. The ***EuroProt+*** type complex protection and automation devices are modular in respect of hardware and software. 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 DRL factory configuration.

1.1 Application

The ***DRL*** configurations is a member the DAUT product type. The devices of this type are configured for different type of automation purposes of the electric power system. The ***DRL*** configuration is applied in compensated networks to control the arc suppression coil (Petersen coil). The coil is tuned by moving the position of the iron core to regulate the air gap.

1.1.1 Protection and automation functions

Functions	IEC	ANSI	DRL
DRL – Numerical arc suppression coil controller function			X
Resiudal Overvoltage function (for detection of the earthfaults)	Uo>	59N	X

Table 1-1 Protection and automation functions of the DRL configuration

1.1.2 Measurement functions

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

Measured values	DRL
Currents (I Petersen, I Inj)	X
Voltages (3Uo, 3Uo parallel, Uref)	X
Resistance (of the potentiometer)	X

Table 1-2 Measured values of the DRL configuration

1.1.3 Hardware configuration

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

Hardware configuration	DRL
Mounting	Op.
Current inputs	4
Voltage inputs	4
Digital inputs	24
Digital outputs	24
RTD inputs	4
Injector transformer and controller	1

Table 1-3 *The basic hardware configuration of the DRL configuration*

The basic module arrangement of the DRL configuration is shown below:

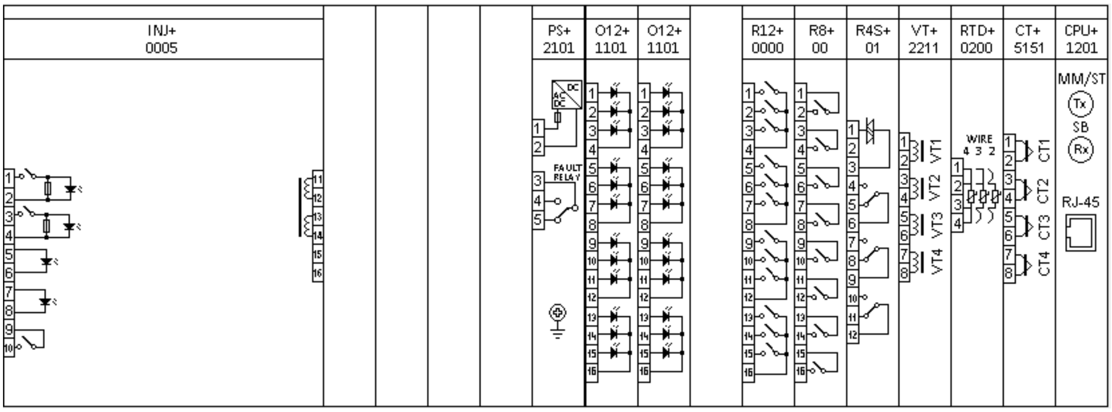


Figure 1-1 Basic module arrangement of the DRL configuration (rear view)

1.1.4 The applied hardware modules

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

Module identifier	Explanation
PS+ 2101	Power supply unit
O12+ 1101	Binary input module
R12+ 00	Signal relay output module (NO)
R8+ 00	Signal relay output module (NO and NC) – to control the injector
R4S+ 01	Signal relay output module (NO and NC, the first contact is a fast-making solid-state relay) - to control the injector
VT+ 2211	Analog voltage input module
CT + 5151*	Analog current input module
CPU+ 1201	Processing and communication module
RTD+0200	***DRL special resistance measuring input module***
INJ+ 0005	***DRL special injector module***

Table 1-4 *The applied modules of the DRL configuration*

1.1.5 DRL specific modules

The DRL configuration contains two special module, which are applied only in that configuration.

The injector transformer and controller unit (INJ+0005) contains a transformer with external $230V_{AC}$ power supply requirement and a special controller with internal checking and protection functions.

The connecting points of this module is summarized in the following table.

Connectors	I/O-channel	I/O-channel type	Explanation
1 2	Injected current	Analogue current input	The injected current flows in this channel for checking purposes. In case of high measured values, the injecting is interrupted
3 4	Transformer primary current	Analogue current input	The transformer primary current flows in this channel for checking purposes. In case of high measured values, the injecting is interrupted
5 6	Voltage	Analogue voltage input	This input measures the voltage of the power coil of the Petersen coil. If this voltage is above 200V then the injecting is interrupted
7 8	Control channel	Binary input	Enabling input for the injection
9 10	Signal	Relay contact	The relay contact is closed if any of the current channels measures current values above the dedicated level, and as a consequence, the injection is interrupted
11 12	Tr. primary	Analogue voltage input	Input voltage of the transformer, rated voltage is $230V_{AC}$
13 14	Tr. secondary	Analogue voltage output	Analogue voltage output Output voltage of the transformer, rated voltage is $110V_{AC}$
15	n.a.	n.a.	n.a.
16	n.a.	n.a.	n.a.

Table 1-5 *The connecting points of the INJ+0005 module*

The second special module is the RTD+/0200. This module is applied to measure the position of the potentiometer, signaling the position of the Petersen coil. The required connection is shown in the following figure:

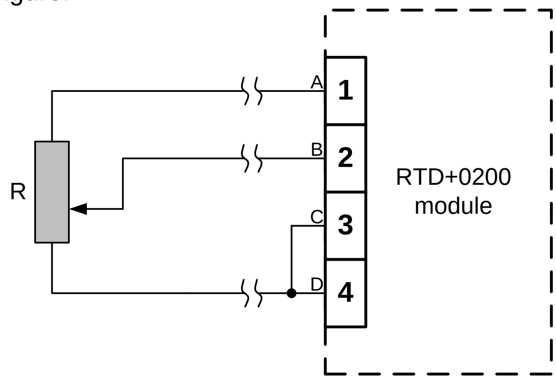


Figure 1-2 Connection of the RTD+0200 module for DRL device

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 1-3 The 84HP rack of ***EuroProt+*** *family*

1.3 Software configuration

1.3.1 Protection and automation functions

The implemented control functions are listed in Table 1-6. The function blocks are described in details in separate documents. These are referred to also in this table.

Code	Name	Document
DRL	DRL	***DRL - Numerical arc suppression coil controller function block description***
TOV59N	Residual Overvoltage	***Residual definite time overvoltage protection function block description***

Table 1-6 Implemented control and protection functions

1.3.2 Measurement 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 displayed values of the DRL and the Line measurement function blocks, which display the measured and calculated primary currents and the measured residual voltage(s) of the network, using the parameter settings of the CT4 module, VT4 module and Petersen Coil Controller function blocks.

Analog value	Explanation
CT4 module	
Current Ch - I Petersen	RMS value of the Fourier fundamental harmonic component of the Petersen coil current. (optional)
Angle Ch - I Petersen	Phase angle of the Fourier fundamental harmonic component of the Petersen coil current.* (optional)
Current Ch - I Inj	RMS value of the Fourier fundamental harmonic component of the injector current.
Angle Ch - I Inj	Phase angle of the Fourier fundamental harmonic component of the injector current.*
VT4 module	
Voltage Ch – 3Uo DRL	RMS value of the Fourier fundamental harmonic component of the residual voltage – sensitive channel for the control process.
Angle Ch – 3Uo DRL	Phase angle of the Fourier fundamental harmonic component of the residual voltage – sensitive channel for the control process.*
Voltage Ch – 3Uo parallel DRL	RMS value of the Fourier fundamental harmonic component of the residual voltage received from the VT of the possible parallel Petersen coil – sensitive channel. (optional)
Angle Ch – 3Uo parallel DRL	Phase angle of the Fourier fundamental harmonic component of the residual voltage received from the VT of the parallel Petersen coil – sensitive channel.* (optional)
Voltage Ch - 3Uo Earthfault	RMS value of the Fourier fundamental harmonic component of the residual voltage – channel for detecting of the earthfault.
Angle Ch - 3Uo Earthfault	Phase angle of the Fourier fundamental harmonic component of the residual voltage – channel for detecting of the earthfault.*
Voltage Ch - Uref 100V	RMS value of the Fourier fundamental harmonic component of the reference voltage.
Angle Ch - Uref 100V	Phase angle of the Fourier fundamental harmonic component of the reference voltage.*

Analog value	Explanation
DRL - Numerical arc suppression coil controller	
I measured	Total measured zero sequence current of the network
Position	Position of the Petersen coil – Expressed in Amperes
PotMeter	Resistance of the potentiometer
I Network	Capacitive zero sequence current of the network
IL fix	Sum of the currents flowing in the fix coils
3Uo voltage input (MXU_U4_1)	
3Uo	3Uo zero sequence voltage, primary RMS value
3Uo parallel voltage input (MXU_U4_2)	
3Uo parallel	3Uo zero sequence voltage received from the VT of the possible parallel Petersen coil, primary RMS value (optional)

Table 1-7 Measured analogue values

NOTE1: The scaling of the Fourier basic component of the voltages is such if pure sinusoid 57V RMS of the rated frequency is injected, the displayed value is 57V.
Similarly, the scaling of the Fourier basic component of the currents 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 vector (vector with angle 0 degree) for all voltage and current vectors is the vector calculated for the first voltage input channel.

1.3.2.1 Voltage input function (VT4 module)

A voltage transformer hardware module is equipped with four special intermediate voltage transformers. (See Chapter 6 of the EuroProt+ hardware description document.) In the DRL the applications of these inputs are the followings:

- the first receives the 3Uo residual voltage for control purpose with sensitive measurement range,
- the second receives the 3Uo residual voltage from the open delta connected coils of the voltage transformers from the possible parallel connected Petersen coil, with sensitive measurement range. It is the 3Uo measurement of the slave, and it is needed only for the master.
- the third receives the same 3Uo residual voltage as the first input, but with higher measurement range for detecting the earthfaults,
- the fourth is for measuring the 100V reference voltage.

Note: the first and the third input receives the same zero sequence voltage component from the open delta connected coils of the voltage transformers. The scaling of them and of the second channel are expected to be so that in case of earth fault, these voltages should be 100V.

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.

If needed, the phase voltages can be inverted by setting the parameters “Direction 3Uo DRL/parallel”, “Direction 3Uo Earth-fault” or “Direction Uref”.

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.

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 “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%.

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.

Technical data

Function	Range	Accuracy
Voltage accuracy	30% … 130%	< 0.5 %

Table 1-8 Technical data of the voltage input

Parameters

Enumerated parameters

Parameter name	Title	Selection range	Default
Definition of the positive direction of the voltage input channels, given as normal or inverted.			
VT4_Ch12Dir_EPar_	Direction 3Uo DRL/parallel	Normal,Inverted	Normal
VT4_Ch3Dir_EPar_	Direction 3Uo Earth-fault	Normal,Inverted	Normal
VT4_Ch4Dir_EPar_	Direction Uref	Normal,Inverted	Normal

Table 1-9 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 1-10 The integer parameter of the voltage input function

Floating point parameter

Parameter name	Title	Dim.	Min	Max	Default
Rated primary voltage of channel 3 (3Uo Earthfault)					
VT4_PriU12_FPar	Rated Primary 3Uo DRL	kV	1	1000	100
VT4_PriU3_FPar	Rated Primary 3Uo Earthfault	kV	1	1000	100

Table 1-11 The floating point parameter 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.

The on-line measured values of the function are listed in the Table 1-7.

1.3.2.2 Current input function (CT4 module)

A current transformer hardware module is equipped with four special intermediate current transformers. (See Chapter 5 of the EuroProt+ hardware description document.) The first two current inputs are not applied in this configuration, the third receives the current of the Petersen coil and the fourth the injected current.

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 parameter “Rated Secondary I Petersen”. The options to choose from are 1A or 5. 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 parameters “Direction I Petersen”, “Direction I Injector”.

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.

Technical data

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

Table 1-12 Technical data of the current input

Parameters

Enumerated parameters

Parameter name	**Title**	**Selection range**	**Default**
Rated secondary current of the third input channel. 1A or 5A is selected by parameter setting, no hardware modification is needed.			
CT4_Ch3Nom_EPar_	Rated Secondary I Petersen	1A,5A	1A
Definition of the positive direction of the third and fourth input channels, given as normal or inverted.			
CT4_Ch3Dir_EPar_	Direction I Petersen	Normal, Inverted	Normal
CT4_Ch4Dir_EPar_	Direction I Injector	Normal, Inverted	Normal

Table 1-13 The enumerated parameters of the current input function

The on-line measured values of the function are listed in the Table 1-7.

1.3.3 „DRL” – Petersen Coil Controller

The ***Petersen Coil Controller function***, configured in ***EuroProt+*** devices by Protecta is applied in compensated networks to control the arc suppression coil (Petersen coil). The coil is tuned by moving the position of the iron core to regulate the air gap.

The compensation of the earth-fault current in distribution network is an effective method to clear the most frequent fault types, the single phase-to-neutral faults automatically. This is performed by the inductance, connected between the star point of the supplying transformer or that of the neutral grounding transformer and the ground. This inductance is the arc suppression coil or Petersen coil, which compensates the zero sequence capacitance of the network. This compensation increases the chance of clearing earth faults only, if the inductive reactance value of the coil is near to the zero sequence capacitive reactance value of the network. As a consequence of this tuned near-resonance state, the earth fault current is small. The Petersen Coil Controller function controls the tuning procedure in case of any changes in the network configuration.

For the tuning, the Petersen Coil Controller function measures and calculates the zero sequence parameters of the network, using the method of current injection. The applied method offers the following advantages:

- Fast tuning procedure.
- The tuning (moving the iron core) is performed only if the network has changed. This increases the life-span of the drive.
- There is only one crossing the resonance point, if this change is needed.
- The method can be applied also in case if the zero sequence voltage (Uo) is small and the resonance curve is relatively “flat”.

The controller injects the current needed for the measurement via isolating transformer into the power coil of the Petersen coil, using the auxiliary AC power supply of the substation. The controller and the current injector unit is housed in a single box (rack).

The actual position of the iron core is detected by measuring the resistance value of the position indicator potentiometer. This resistance value is usually a nonlinear function of the current in the coil. To cover the nonlinearity, a 10 point linear approximation is applied to minimize the measuring error. The module of the EuroProt+ device for resistance measurement measures the resistance value directly.

It is possible to control two Petersen-coils which are parallel connected on the same network. In this case one DRL device is the Master, the other the Slave and they communicate with each other via Ethernet-network.

The tuning of the arc suppression coil is performed in three steps. This method increases accuracy even in case if the actual position of the iron core is far from the calculated optimum. The first step approaches the required position, the second one performs the refinement and the third step is usually a confirmation only.

The required degree of under- or overcompensation can be defined in “per unit” or in percent value.

A parallel connected fix coil can also be considered. The value of this coil is defined as a parameter value. The user can define the condition of the connected or disconnected state of the fix coil during the configuration procedure.

An additional parameter value defines the zero sequence reactance of the neutral grounding transformer to be considered in the calculations.

Details about the operation and the meanings of the parameters can be found in the description of the function block.

The analogue inputs of the function

The ***Petersen Coil Controller*** function needs the following analogue input signals:

Title	Explanation
3Uo DRL	The zero sequence voltage component, received from the open delta connected coils of the voltage transformers. The scaling is expected to be so that in case of earth fault, this voltage should be 100V.
3Uo parallel DRL	The zero sequence voltage component, received from the open delta connected coils of the voltage transformers from the possible parallel connected Petersen coil. It is the 3Uo measurement of the slave, and it is needed only for the master. The scaling is expected to be so that in case of earth fault, this voltage should be 100V.
U ref 100V	This reference voltage is a line-to-line voltage, applied by the measuring algorithm. If this value drops below 50% of the rated voltage then the tuning is disabled.
I injected	This is the injected current, which flows in the power coils of the arc suppression coil. This is another basic signal, used by the measuring algorithm.
I Petersen	This is the current of the arc suppression coil for orientation purposes only.
Potentiometer	This is the connection of the potentiometer, indicating the actual position of the iron core.

Table 1-14 Analogue inputs of the Petersen Coil Controller function

Parameters

Enumerated parameters

Parameter name	Title	Choice	Default
Setting the mode of operation**:**			
DRL_Oper_EPar_	Operation	Off, On	Off
Selection of the controm mode:			
DRL_CtrlMode_EPar_	Control Mode	RelativeOver, AbsoluteOver, RelativeUnder, AbsoluteUnder	RelativeOver.
Setting the mode of parallel operation**:**			
DRL_ParaMod_EPar_	Parallel Mode	Off, Master mode 1, Master mode 2, Slave mode 1, Slave mode 2	Off
Setting the detection mode**:**			
DRL_DetMode_EPar_	Detection Mode	External, Auto, Both*	Off

Table 1-15 Enumerated parameters of the Petersen Coil Controller function

Integer parameters

Parameter name	Title	Unit	Min.	Max.	Step	Default
Rated voltage of the Petersen coil						
DRL_UnPet_IPar_	Un Petersen	V	1000	32000	1	10000
Rated voltage of the power coil of the Petersen coil in low end position						
DRL_UnLow_IPar_	Un power coil Low	V	100	1000	1	500
Rated voltage of the power coil of the Petersen coil in high end position						
DRL_UnHigh_IPar_	Un power coil High	V	100	1000	1	800
Primary rated voltage of the voltage transformer						
DRL_UnVT_IPar_	Un VT(phase)	V	1000	32000	1	10000

Parameter name	Title	Unit	Min.	Max.	Step	Default
Time delay to start the control process (See automatic start and periodic start)						
DRL_TriggTime_IPar_	Trigger Time	sec	1	6000	1	1000
Fix currents of the parallel connected coils						
DRL_IFix1_IPar_	I Fix Coil 1	A	0	500	1	0
DRL_IFix2_IPar_	I Fix Coil 2	A	0	500	1	0
DRL_IFix3_IPar_	I Fix Coil 3	A	0	500	1	0
DRL_IFix4_IPar_	I Fix Coil 4	A	0	500	1	0
Parameters of the potentiometer characteristic						
DRL_ILow_IPar_	Potentiometer Char I0 - Low	A	10	500	1	50
DRL_IHigh_IPar_	Potentiometer Char I0 - High	A	10	500	1	100
DRL_I1_IPar_	Potentiometer Char I1	A	10	500	1	50
DRL_I2_IPar_	Potentiometer Char I2	A	10	500	1	50
DRL_I3_IPar_	Potentiometer Char I3	A	10	500	1	50
DRL_I4_IPar_	Potentiometer Char I4	A	10	500	1	50
DRL_I5_IPar_	Potentiometer Char I5	A	10	500	1	50
DRL_I6_IPar_	Potentiometer Char I6	A	10	500	1	50
DRL_I7_IPar_	Potentiometer Char I7	A	10	500	1	50
DRL_I8_IPar_	Potentiometer Char I8	A	10	500	1	50
Time cycle for checking measurement						
DRL_Hourly_IPar_	Hourly period	hour	0	24	1	0
Maximum duration of the control command						
DRL_MaxCtrlTime_IPar_	Max.Control Time	sec	1	600	1	100
VLAN ID of the device (it can be used for parallel operation)						
DRL_vlanID_IPar_	VLAN ID	-	1	4094	1	1
Addresses of the communicating DRL devices						
DRL_OwnAddr_IPar_	Own address	-	0	255	1	0
DRL_RemAddr_IPar_	Remote address	-	0	255	1	1
The limit for the Uo-coincidence for parallel operation detection						
DRL_AutoDet_IPar_	Auto Detection Level	%	5	50	1	10
The delay for automatic parallel operation detection						
DRL_DetDelay_IPar_	Detection Delay	sec	1	600	1	5

Table 1-16 Integer parameters of the Petersen Coil Controller function

Floating point parameters

Parameter name	Title	Unit	Min.	Max.	Step	Default
Limits of the valid potentiometer range						
DRL_RangeLow_FPar_	R Min Alarm	Ohm	3	300	1	5
DRL_RangeHigh_FPar_	R Max Alarm	Ohm	5	300	1	250
Degree of compensation for p.u. calculation						
DRL_OCRatio_FPar_	Relative Comp	%	1.0	100.0	0.1	5.0
Degree of compensation for current calculation						
DRL_OCAbs_FPar_	Absolute Comp	A	1.0	100.0	0.1	5.0
Target current for manual control						
DRL_PresetPos_FPar_	Preset Position	A	10.0	500.0	1	100.0

Cange in Uo to start coil control						
DRL_UoTrigg_FPar_	dUo trigger	%	10.0	100.0	0.1	20.0
Limit for periodic measurement						
DRL_UoLow_FPar_	Uo Low	%	0.10	5.00	0.01	0.2
Zero sequqnce reactance of the neutral grounding transformer						
DRL_XoTR_FPar_	Xo Transformer	Ohm	0.00	50.00	0.01	0.00
Upper limit of the zero sequence voltage at the end of the control process to disable automatic coil control						
DRL_UoEndHigh_FPar_	UoEnd High	%	1.0	100.0	0.1	40.0
Parameters of the potentiometer characteristic						
DRL_RLow_FPar_	Potentiometer Char R0 - Low	Ohm	5.0	250.0	0.1	10.0
DRL_RHigh_FPar_	Potentiometer Char R9 - High	Ohm	5.0	250.0	0.1	200.0
DRL_R1_FPar_	Potentiometer Char R1	Ohm	5.0	250.0	0.1	10.0
DRL_R2_FPar_	Potentiometer Char R2	Ohm	5.0	250.0	0.1	10.0
DRL_R3_FPar_	Potentiometer Char R3	Ohm	5.0	250.0	0.1	10.0
DRL_R4_FPar_	Potentiometer Char R4	Ohm	5.0	250.0	0.1	10.0
DRL_R5_FPar_	Potentiometer Char R5	Ohm	5.0	250.0	0.1	10.0
DRL_R6_FPar_	Potentiometer Char R6	Ohm	5.0	250.0	0.1	10.0
DRL_R7_FPar_	Potentiometer Char R7	Ohm	5.0	250.0	0.1	10.0
DRL_R8_FPar_	Potentiometer Char R8	Ohm	5.0	250.0	0.1	10.0
Overrun of the drive to be compensated						
DRL_OverRun_FPar_	Overrun	A	0.0	20.0	0.1	0.0
Minimum value of Uo difference, below which no measurement is started						
DRL_UoAbsTrigg_FPar_	dUo trigger min	V	0.0	10.0	0.1	5.0

Table 1-17 Floating point parameters of the Petersen Coil Controller function

Boolean parameter

Parameter name	Title	Default	Explanation
DRL_VLAN_BPar_	UseVLAN	0	Enabling VLAN communication

Table 1-18 Boolean parameter of the Petersen Coil Controller function

1.3.4 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). In this configuration the function receives the same residual voltage which is assigned to the ***Petersen Coil Controller*** function, but on the third input of the voltage module, which has higher measurement range (100V).

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. This start signal is used in the DRL factory configuration for disabling the Petersen Coil Controller function. The disabled state of the ***Petersen Coil Controller*** function remains after the start signal dropped for a time which can be set with the parameter “Disabling by earth-fault”.

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 – 100 %	< ± 2 % < ± 1.5 %
Reset time U> → Un U> → 0	 60 ms 50 ms	
Operate time	50 ms	< ± 20 ms

Table 1-19 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	Off

Table 1-20 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	100	1	50

Table 1-21 The integer parameter of the residual definite time overvoltage protection function

Timer parameter (Among the user defined objects!)

Parameter name	Title	Unit	Min	Max	Step	Default
Delay time of disabling the ***Petersen Coil Controller*** function after dropping the start signal of the TOV59N function						
EFDrop_TPar_	Disabling by earthfault	ms	100	300000	1	5000

Table 1-22 The time parameter of the residual definite time overvoltage protection function

1.3.5 Event recorder

The events of the device and those of the protection functions of this configuration are listed in the table below. All of them can be sent to the SCADA system. The events in which rows the HMI column is ‘Yes’ can be checked also on the touch-screen of the device in the “Events” page, or using an Internet browser of a connected computer.

Source	Event	HMI	Value
Common	Mode of device	Yes	N/A,on,blocked,test, test/blocked,off
	Health of device	Yes	N/A,Ok,Warning,Alarm
DRL	I measured	No	float
	Position	No	float
	I Fix Coil	No	float
	I Network	No	float
	Lower Command	Yes	off,on
	Higher Command	Yes	off,on
	Command Failure	Yes	off,on
	Potentiometer Failure	Yes	off,on
	Injector Failure	Yes	off,on
	AutoControl Blocked	Yes	off,on
	Uref OK	Yes	off,on
	UoEnd high	Yes	off,on
	Blocked	Yes	off,on
	Local Mode	No	off,on
	Periodic Mode	Yes	off,on
	Control Stopped	Yes	off,on
	Measurement Started	Yes	off,on
	Master mode active	Yes	off,on
	Slave mode active	Yes	off,on
	Communication failure	Yes	off,on
	Parallel state detection	Yes	off,on
Residual Overvoltage	General Start	Yes	off,on
	General Trip	No	off,on
16Ch Event	Bucholz warning (input)	Yes	off,on
	Bucholz trip (input)	Yes	off,on
	Thermal prot. trip (input)	Yes	off,on
	Manual higher (input)	Yes	off,on
	Manual lower (input)	Yes	off,on
	DRL disable (input)	Yes	off,on
	Measurement start (input)	Yes	off,on
	Input08	Yes	off,on
	Lower end (input)	Yes	off,on
	Upper end (input)	Yes	off,on
	Reset (input)	Yes	off,on
	L1 fix on (input)	Yes	off,on
	L2 fix on (input)	Yes	off,on
	L3 fix on (input)	Yes	off,on
	L4 fix on (input)	Yes	off,on
	Input16	Yes	off,on
16Ch Event	MV CB Closed (input)	Yes	off,on
	Input02	Yes	off,on
	Fuse trip (input)	Yes	off,on
	Input04	Yes	off,on
	Motor running (input)	Yes	off,on
	Input06	Yes	off,on
	Input07	Yes	off,on
	Input08	Yes	off,on

	Input09	Yes	off,on
	Input10	Yes	off,on
	Input11	Yes	off,on
	Local control	Yes	off,on
	Aut. tuning blocked	Yes	off,on
	Aut. tuning disabled	Yes	off,on
	Manual and aut. tuning latched disabled	Yes	off,on
	Reset latch of blocking	Yes	off,on
16Ch Event	Successful tuning process	Yes	off,on
	Lack of inductance at the end of the tuning process	Yes	off,on
	Too much inductance at the end of the tuning process	Yes	off,on
	Manual higher cmd. succeed	Yes	off,on
	Manual higher cmd. unsucceed	Yes	off,on
	Manual lower cmd. succeed	Yes	off,on
	Manual lower cmd. unsucceed	Yes	off,on
	Manual upper cmd. (LCD/SCADA)	Yes	off,on
	Manual lower cmd. (LCD/SCADA)	Yes	off,on
	L1 fix On cmd.	Yes	off,on
	L1 fix Off cmd.	Yes	off,on
	L2 fix On cmd.	Yes	off,on
	L2 fix Off cmd.	Yes	off,on
	Continue control process	Yes	off,on
	Uref error	Yes	off,on
	Arc sup. coil tuning failure	Yes	off,on
4Ch Counter -Control	Counter_1	No	integer
	Counter_2	No	integer
	Counter_3	No	integer
	Counter_4	No	integer
4Ch Counter -ArcSupp	Counter_1	No	integer
	Counter_2	No	integer
	Counter_3	No	integer
	Counter_4	No	integer
4Ch Control	Status Ch1	No	off,on
	Status Ch2	No	off,on
	Status Ch3	No	off,on
	Status Ch4	No	off,on

Table 1-23 Factory configured events of the DRL configuration

1.3.6 Disturbance recorder

The disturbance recorder function can record analog signals and binary status signals. These signals are configured using the EuroCAP software tool.

The disturbance recorder function has a binary input signal, which serves the purpose of starting the function**. The conditions of starting are defined by the user, applying the graphic equation editor.** The disturbance recorder function keeps on recording during the active state of this signal but the total recording time is limited by the timer parameter setting.

The pre-fault time, max recording time and post-fault time can be defined by parameters.

If the triggering conditions defined by the user - using the graphic equation editor – are satisfied and the function is enabled by parameter setting, then the disturbance recorder starts recording the sampled values of configured analog signals and binary signals.

The analog signals can be sampled values (voltages and currents) received via input modules or they can be calculated analog values (such as negative sequence components, etc.)

The number of the configured binary signals for recording is limited to 64, and up to 32 analog channels can be recorded.

The available memory for disturbance records is 12 MB.

The function applies 20 sampling in a network period. Accordingly for 50 Hz, the sampling frequency is 1 kHz. (For 60 Hz the sampling frequency is 1.2 kHz.)

As an example, for 50 Hz, if the duration of the record is 1000 ms then one analog channel needs about 7 kB and a binary channel needs 2 kB, Using the following formula the memory size can be estimated:

Memory size of a record = (n*7 kB+ m*2 kB)*record duration(s)

Here n,m: are the number of analog and binary channels respectively.

During the operation of the function, the pre-fault signals are preserved for the time duration as defined by the parameter “PreFault”.

The recording duration is limited by the parameter “Max Recording Time” but if the triggering signal resets earlier, this section is shorter.

The post-fault signals are preserved for the time duration as defined by the parameter “PostFault”.

During or after the running of the recording, the triggering condition must be reset for a new recording procedure to start.

The records are stored in standard COMTRADE format.

- The configuration is defined by the file .cfg,
- The data are stored in the file .dat,
- Plain text comments can be written in the file .inf.

The procedure for downloading the records is described in detail in the EuroProt+ manual “Remote user interface description”, Chapter 4.7. The three files are zipped in a file .zip. This procedure assures that the three component files (.cfg, .dat and .inf) are stored in the same location.

The evaluation can be performed using any COMTRADE evaluator software. Protecta offers the **“srEval”** software for this purpose. The application of this software is described in detail in the “srEval manual”. This manual can be downloaded from the following Internet address: http://www.softreal.hu/product/sreval_en.shtml.

Parameters

Enumerated parameter

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

Table 1-24 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	100	1000	1	200
Post-fault time:						
DRE_PostFault_TPar_	PostFault	msec	100	1000	1	200
Overall-fault time limit:						
DRE_MaxFault_TPar_	Max Recording Time	msec	500	10000	1	1000

Table 1-25 The timer parameters of the disturbance recorder function

NOTE.: The device gets automatically in "Warning" state and sends the following warning message if the sum of the pre-fault time and post-fault time is longer than the overall-fault time. The corresponding message in the RDSP log file is: „Wrong DR settings. PreFault + "PostFault" must be less than "MaxFault". Check the parameters."

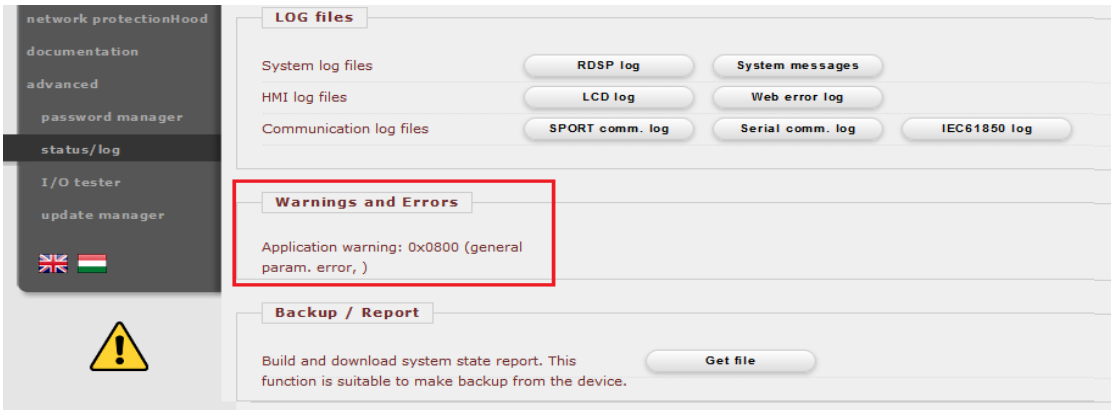


Figure 1-4 „Warnings and Errors" messages on the website of the device

More details about the function are described in the ***Disturbance recorder function block description.***

Recorded signals

Recorded analogue signal	Explanation
Uref	The reference voltage
3Uo	Residual voltage (measured on the first channel with sensitive range).
3Uo parallel	Residual voltage received from the VT of the parallel Petersen coil (measured on the second channel with sensitive range).
I inj	The injected current (secondary).
I Petersen	The measured current of the Petersen-coil (secondary).

Table 1-26 The recorded analogue channels of the disturbance recorder in the DRL configuration

Recorded binary signal	Explanation
Higher cmd.	Higher (tuning up) command
Lower cmd.	Lower (tuning down) command
L1 fix On	L1 fix coil switched on
L2 fix On	L2 fix coil switched on
L3 fix On	L3 fix coil switched on
L4 fix On	L4 fix coil switched on
R1	Control signal of one of the contacts which serve the polarity change of the injection – for checking during commissioning.
R2	Control signal of one of the contacts which serve the polarity change of the injection – for checking during commissioning.
R3	Control signal of one of the contacts which serve the polarity change of the injection – for checking during commissioning.
R4	Control signal of one of the contacts which serve the polarity change of the injection – for checking during commissioning.
Injection enabled	This signal is active from the start of the measuring until the end of the tuning process.
Injector failure	Injector failure
Uo>30V inj. stop	The injection has been stopped because the res. voltage exceeded 30V.
IInj>1A inj.stop	The injection has been stopped because the injected current exceeded 1A for over 3 seconds.

Table 1-27 The recorded binary channels of the disturbance recorder in the DRL configuration

The condition of the starting the disturbance recorder can be defined by the user with a matrix. The possible conditions are:

- Injection
- Unsuccessful arc suppression
- Injector failure

- IInj> (The injection has been stopped because the injected current exceeded 1A for over 3 seconds.)
- Uo>30V (The injection has been stopped because the res. voltage exceeded 30V)
- Earthfault
- Buchholz warning
- Buchholz trip
- Thermal prot. trip
- Higher command
- Lower command
- Control stopped (at the end states of the Petersen-coil)

1.3.7 Counter functions

Counter functions are applied for counting of specific binary events. These events have to be defined and connected to the inputs of the counter functions in the graphical Logic Editor of the EuroCAP configuration tool. The state of the counter channels 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, or these can be displayed also on the user defined LCD screens. The counter channels can be reset in the on-line data menu of the webpage of the device, and these are reset also after every configuration download process.

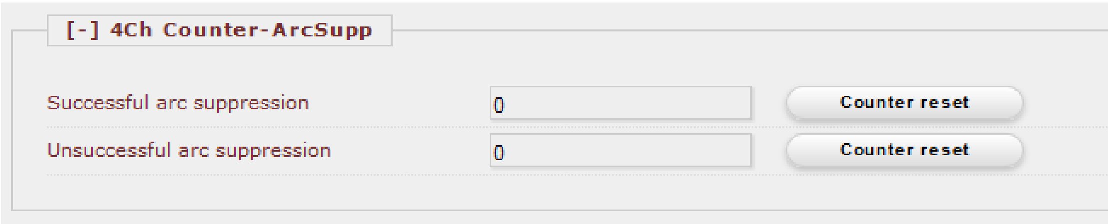


Figure 1-5 4 Channel counter function in the on-line data (the 3rd and 4th channels are not applied)

The counter functions and the channels of them in the DRL factory configuration are:

Title of the counter	Displayed channels
4Ch Counter – Control	Succed tuning process
	Lack of inductance at the end of the tuning process
	Too much inductance at the end of the tuning
4Ch Counter - ArcSupp	Successful arc suppression
	Unsuccessful arc suppression

Table 1-28 The counter functions and the channels of them in the DRL configuration

1.3.8 The man-machine interface of the function block

1.3.8.1 Application of the local LCD

In each EuroProt+ device configurations, the local LCD can display device identifiers, on-line information, recorded events and can guide parameter setting for the configured functions (like Petersen Coil Controller) and those for the system. Additionally, special screens can be configured to extend functionality of the device (e.g. operation of the primary switchgear, special control commands, etc.) This chapter describes special screens usually available in

DRL configurations. Except of the DRL bellcurve screen, the user can redesign them or create other screens with the EuroCAP configuration tool.

Displaying the resonance curve

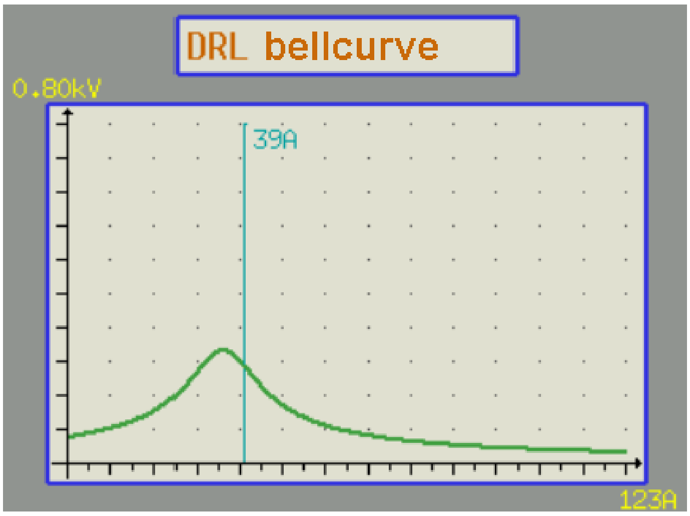


Figure 1-6 Resonance curve, displayed in the LCD (Example)

The Petersen coil controller function updates this display after each measurement to show the current resonance curve. The state of the tuning is indicated by a vertcal cursor and the current value of the Petersen coil. The scaling of both axes can be identified by dynamically changing end-value. This screen cannot be modified by the user.

Manual control functions

The basic manual control functions can be initiated using this screen, shown in Figure 3-3.

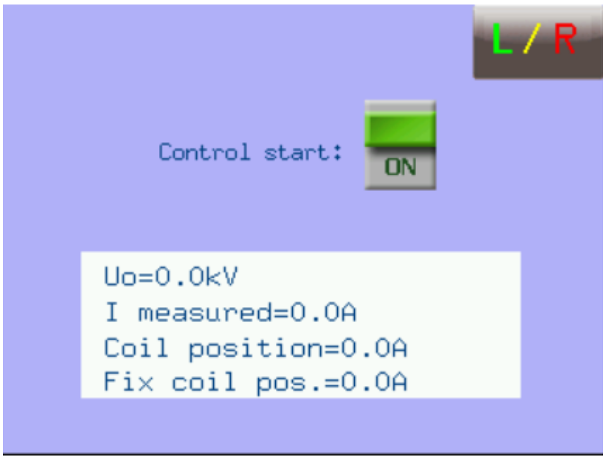


Figure 1-7 Local control functions, displayed in the LCD

Control start: when touching this button and then pressing the 'I' hardware button, a measuring cycle can be started manually. For this command the screen must be in „Local" mode, and the function may not be blocked.

Toggling Local/Remote mode of operation: The operation mode of the device can be toggled by touching the button „Local/Remote" at the upper right corner of the screen. In local mode, also the yellow LED with title „Local" lights up. NOTE: command can also be initiated using the WEB site of the device or applying the SCADA system. (See below.)

The lower half of the screen displays measured and calculated values, informing immediately about the effect of the control commands.

Blocking the DRL control function

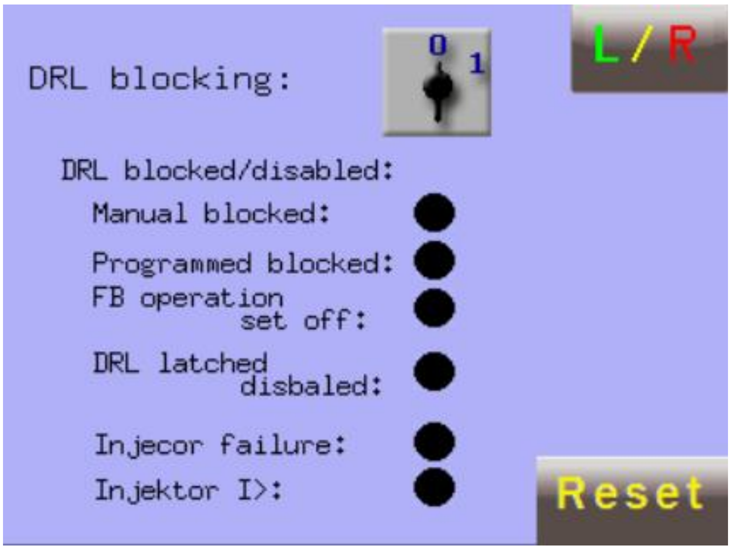


Figure 1-8 The DRL blocking switch and the different blocked/disabled states

Using the symbolic switch in *Figure 1-8*, the automatic control mode can be blocked. For this, touch the switch, then press the hardware button 'I'. This command can be performed in local mode of the screen. The blocked function can be enabled again in local mode, when touching the switch symbol and pressing the hardware button '0'. The switch shows the enabled/blocked state also if the setting is performed from the SCADA system or by the WEB site of the device.

In latched disabled state, caused by any conditions, the Reset command can be generated by touching this script, then pressing the hardware button 'I', if the conditions for disabling are not valid any more. This button is active both in local and in remote state of the screen.

The symbolic LED-s of the screen change color from black to red, indicating the event.

Toggling Local/Remote mode of operation: The operation mode of the device can be toggled by touching the button „Local/Remote" at the upper right corner of the screen. In local mode, also the yellow LED with title „Local" lights up.

1.3.8.2 Remote control

The remote control functions are available in the WEB site of the device and from the SCADA system. For both directions, the local screen of the device must be in “Remote” mode. *Figure 1-9* shows the WEB “Commands” menu.

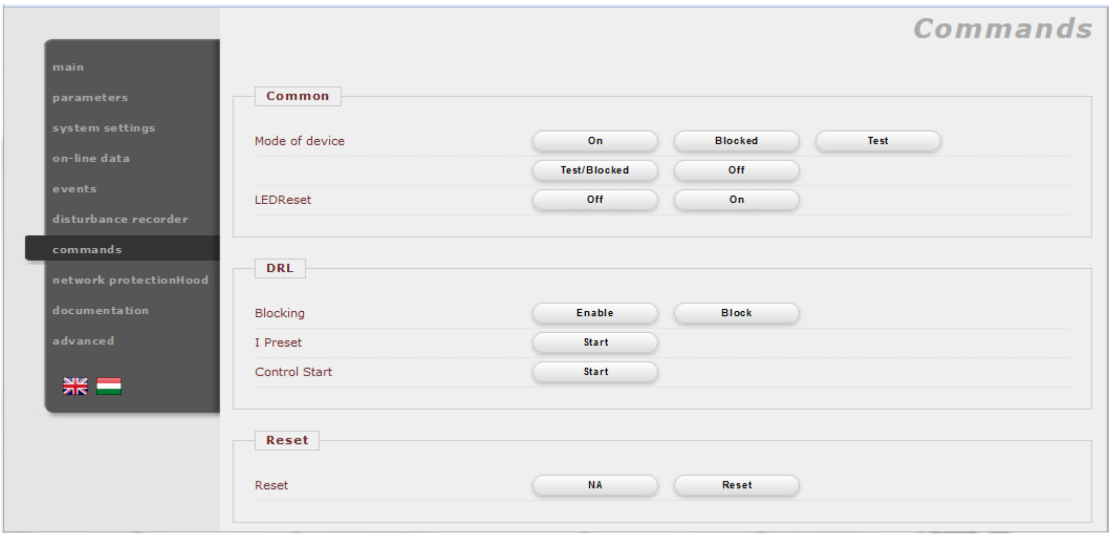


Figure 1-9 The DRL control commands (Example)

The factory configured SCADA command channel assignment is presented in *Table 1-29*:

Function block	Channel	Title	Command	Explanation
DRL	DRL_Blk_Con_	Aut. control	Blocking, Enabling	When blocking, the ***Petersen Coil Controller*** function is fully blocked. The enabling releases blocked state.
	DRL_Preset_Con_	Manual command	Start	When generating this command, the ***Petersen Coil Controller*** function drives the iron core of the coil to the pre-defined position (Parameter “Preset Position”) At the same time, the automatic control is disabled.
	DRL_StartMeas_Con_	Measurement	Start	Starts a measurement cycle
Reset	Reset_Oper_Con_	Reset	Reset	This command releases the latched or disabled blocked state.
4 channel general control	Con4Ch_Oper1_Con_	Lower	Stop, Start	Manual command to tune lower.
	Con4Ch_Oper2_Con_	Higher	Stop, Start	Manual command to tune higher.

Table 1-29 Command channels in the DRL factory configuration

1.4 LED assignment

On the front panel of the device there are “User LED”-s with changeable LED description labels (see the document “**Quick start guide to the devices of the EuroProt+ product line**”). Some LED-s are factory assigned, but all of them can be (re)defined by the user. The following tables shows the LED assignment of the DRL configuration.

No.	LED	Explanation	Color	Latch
1	Blocked	DRL Blocked	r	No
2	Disabled	DRL Disabled	r	No
3	Latched disabled	DRL Latched disabled	r	No
4	Command failure	The duration of the command execution has exceeded the given limit, so it has been stopped.	r	No
5	Injector failure	Failure in the injector or in its control circuit.	r	No
6	Pot.meter failure	The measured resistance of the potentiometer is out of the valid range which is defined by parameters.	r	No
7	Uref failure	Uref<50%	r	No
8	Fuse trip	The fuse of the injection controller has tripped.	y	No
9	Inj. enable	This LED blinks from the start of the measuring until the end of the tuning process.	y	No
10	Higher cmd.	Higher cmmand.	y	No
11	Lower cmd.	Lower command	y	No
12	Upper end	Upper end state of the Petersen coil.	y	No
13	Lower end	Lower end state of the Petersen coil.	y	No
14	Periodic mode	The ***Petersen Coil Controller*** functio has stepped into Periodic mode.	y	No
15	Parallel state	The ***Petersen Coil Controller*** function has detected parallel state of the two Petersen coils.	y	No
16	Local mode	The device in local control mode.	y	No

Table 1-30 LED assignment

2 Connection assignment

"A" INJ+/0005

Clamp	Name
1	Inj.circuit->
2	Inj.circuit<-
3	Tr.prim.current->
4	Tr.prim.current<-
5	Switch off.->
6	Switch off.<-
7	Inj.control->
8	Inj.control<-
9	Singaling->
10	Singaling<-
11	Tr. primary
12	Tr. primary
13	Tr. secondary
14	Tr. secondary
15	N.a.
16	

"K" PS+/2101

Clamp	Name
1	AuxPS+
2	AuxPS-
3	Fault Relay Common
4	Fault Relay NO
5	Fault Relay NC

"L" O12+/1101

Clamp	Name
1	Bucholz warning
2	Bucholz trip
3	Thermal prot. trip
4	Opto-(1-3)
5	Lower end
6	Upper end
7	Parallel connection
8	Opto-(4-6)
9	Manual higher
10	Manual lower
11	Motor running
12	Opto-(7-9)
13	Fuse trip
14	Block automatic control
15	Start measurement
16	Opto-(10-12)

"M" O12+/1101

Clamp	Name
1	Fix Coil 1 On
2	Fix Coil 2 On
3	Fix Coil 3 On
4	Opto-(1-3)
5	Fix Coil 4 On
6	Reset
7	BIn_M06
8	Opto-(4-6)
9	BIn_M07
10	BIn_M08
11	BIn_M09
12	Opto-(7-9)
13	BIn_M10
14	BIn_M11
15	BIn_M12
16	Opto-(10-12)

"O" R12+/0000

Clamp	Name
1	Inj. transformer primary open NO
2	Inj. transformer primary short circuit NO
3	Not applicable NO
4	Common (1-3)
5	Fix Coil 1 open cmd. NO
6	Fix Coil 1 close cmd. NO
7	Fix Coil 2 open cmd. NO
8	Common (4-6)
9	Fix Coil 2 close cmd. NO
10	Aut. control blocked NO
11	Aut. control disabled NO
12	Common (7-9)
13	Aut. and manual control latched disabled NO
14	BOut_O11 NO
15	BOut_O12 NO
16	Common (10-12)

"P" R8+/00

Clamp	Name
1	Inj. switch R1 Common
2	Inj. switch R1 NO
3	Inj. switch R2 Common
4	Inj. switch R2 NO
5	Inj. switch R3 Common
6	Inj. switch R3 NO
7	Inj. switch R4 Common
8	Inj. switch R4 NO
9	BOut_P05 Common
10	BOut_P05 NO
11	BOut_P06 Common
12	BOut_P06 NO
13	BOut_P07 Common
14	BOut_P07 NO
15	BOut_P08 Common
16	BOut_P08 NO

"R" R4S+/01

Clamp	Name
1	Inj. switch NO
2	Inj. switch NC
3	Inj. switch Common
4	Higher cmd. NO
5	Higher cmd. NC
6	Higher cmd. Common
7	Lower cmd. NO
8	Lower cmd. NC
9	Lower cmd. Common
10	BOut_R04 NO
11	BOut_R04 NC
12	BOut_R04 Common

"S" VT+/2211

Clamp	Name
1	3Uo DRL->
2	3Uo DRL<-
3	3Uo parallel->
4	3Uo parallel <-
5	3Uo Earthfault->
6	3Uo Earthfault<-
7	Uref 100V->
8	Uref 100V<-

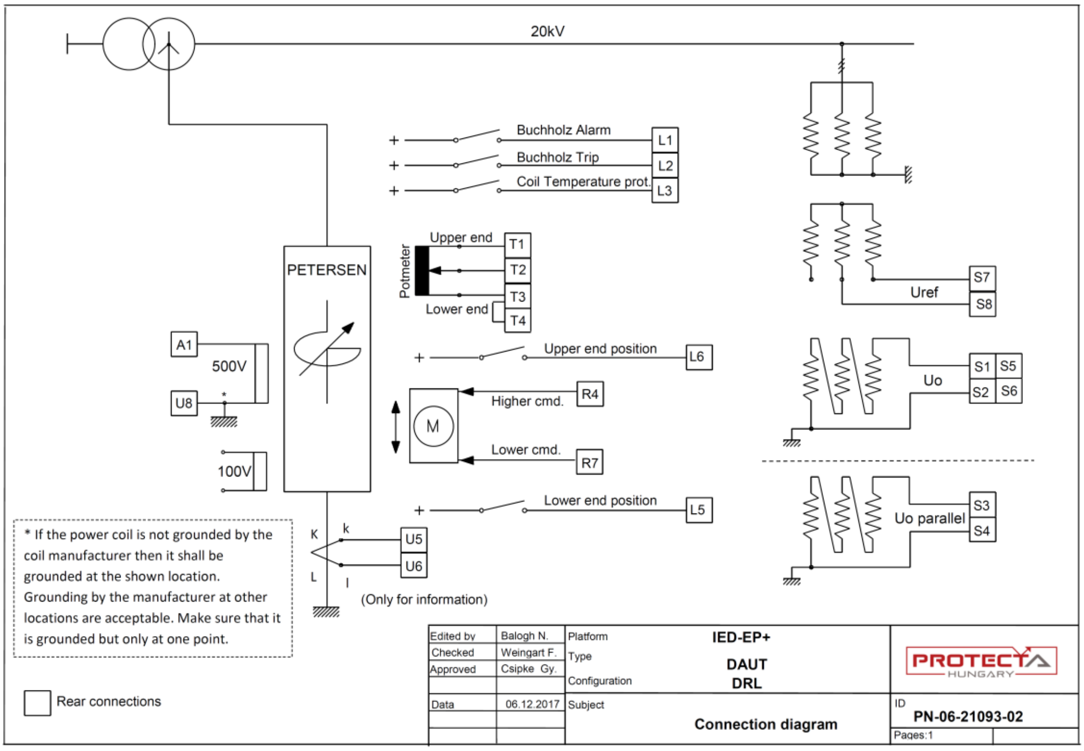
"T" RTD+/0200

Clamp	Name
1	Potmeter H_Curr
2	Potmeter H_Pot
3	Potmeter L_Pot
4	Potmeter L_Curr

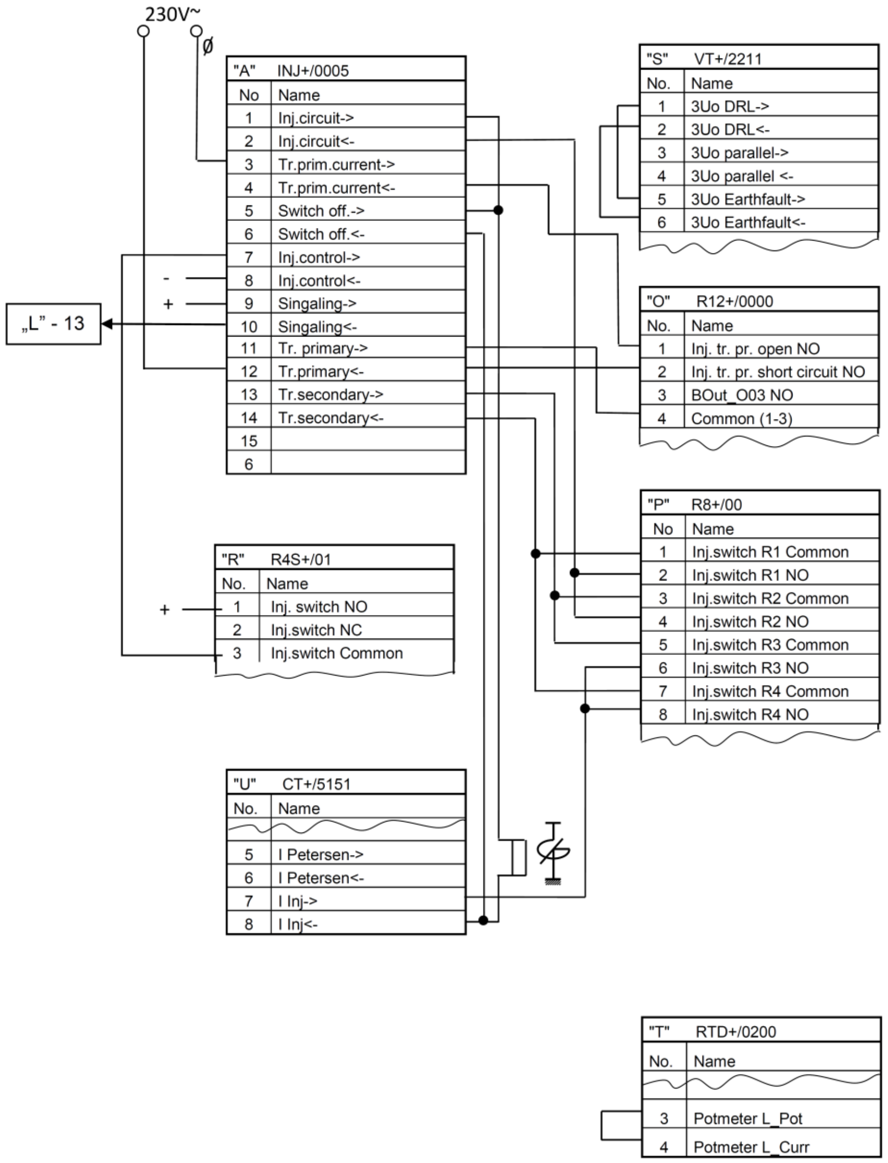
"U" CT+/5151

Clamp	**Name**
1	MAn_U01->
2	MAn_U01<-
3	MAn_U02->
4	MAn_U02<-
5	I Petersen->
6	I Petersen<-
7	I Inj->
8	I Inj<-

3 External connections



Connections between the modules of the DRL device



4 Factory made logics

There are some logics connected to the DRL arc suppression coil controller function which are not defined in the function block but in external logic equations in the graphical logic editor of the EuroCAP configuration tool.

These logics can be removed or modified by the user who has password for Master view of the EuroCAP. Please contact Protecta Support Line to get a serial number!

This chapter describes the factory made logics.

4.1 Blocked, disabled and latched disabled states

In the DRL factory configuration there are three independent states defined in which the operation of the ***Petersen Coil Controller*** function is totally or partially not enabled. These states are: blocked, disabled and latched disabled. Different LED-s, events and LCD indications are assigned to these different states.

By *blocking* it is meant when

- the dispatcher intentionally does not enable the automatic control of the ***Petersen Coil Controller*** function via the SCADA system, the LCD-screen or the webpage of the device, OR
- the ***Petersen Coil Controller*** function is switched off by parameter.

The blocked state remains until the dispatcher enables again the function, or if it was switched off by parameter, then after switching on. Details about the blocking and enabling process via the LCD screen can be read in chapter 1.3.8.1, and via the SCADA-system and webpage of the device in chapter 1.3.8.2.

The function gets to *disabled* state when the automatic or both of the automatic and manual control are not enabled because of the following reasons, and from this state the function will be immediately and automatically enabled when the cause of the disabling disappears. The possible causes for the disabled state can be:

- there are some conditions under which the ***Petersen Coil Controller*** function itself does not enable the control (see the chapter “Blocking and disabling the function” of the detailed description of the ***Petersen Coil Controller*** function). These conditions are:
    - failure of the potentiometer or the wires of the potentiometer,
    - the reference voltage is not healthy (<50%)
- there is an earthfault: these conditions are defined to the Blk and BlkAuto inputs of the Petersen Coil Controller function in the Logic Editor of the EuroCAP. The start signal of the Residual overvoltage function disables both of the manual and automatic control, the drop-delayed[1], start signal of the Residual overvoltage function disables only the automatic control.

The function gets to *latched disabled* state when both of the automatic and manual control are not enabled because of the following reasons, and from this state the function will be enabled only in case when the cause of the disabling disappears AND the dispatcher resets intentionally the disabled state via the SCADA system, the LCD-screen or the webpage of the device. The possible causes for the disabled state can be:

- there are some conditions under which the Petersen Coil Controller function itself does not enable the control (see the chapter “Blocking and disabling the function” of the detailed description of the Petersen Coil Controller function). These conditions are:
    - Injector failure
    - Command failure

[1] The delay time of the drop delay can be set by the “Disabling by earthfault” user defined timer parameter.

If at the end of a control process the Uo zero sequence measured voltage gets above the level defined by the parameter “UoEnd High”[2].

- mechanical protection trips (Bucholz or thermal): these conditions are defined to the Blk input of the Petersen Coil Controller function in the Logic Editor of the EuroCAP.

Details about the resetting process via the LCD screen can be read in chapter 1.3.8.1, and via the SCADA-system and webpage of the device in chapter 1.3.8.2.

4.2 Controlling the fix coils

The Petersen Coil Controller function gives the possibility of the controlling (switching on and off) the fix coils on the network. By fix coils are meant coils which can not be tuned. This is useful in cases if the Petersen-coil gets in upper end state and the Petersen Coil Controller function measures lack of inductance or if the Petersen-coil gets in lower end state and the function measures too much inductance on the network, compared to the set compensation level. The Petersen Coil Controller function can take into calculation the inductance of maximum 4 fix coils (see the chapter “Measurement procedure” in the detailed description of the Petersen Coil Controller function). In the DRL factory configuration the controlling of maximum two fix coils is realized above this taking into calculation. Of course the logic of the controlling can be extended up to 4 coils by the user, based on the realized logic.

The number of the coils to be controlled can be set by the parameter “Fix Coil Control” (User defined objects).

When the Petersen-coil reaches its upper- or lower end state, the Petersen Coil Controller function stops the control process and signs that on the DRL_ControlStop_GrI (Control stop) output. If the control of minimum one of the fix coils is enabled, nor of them is switched on and the Petersen-coil gets to upper end state then the device gives close command to the first fix coil on the BOut_O05 (L1 fix close) contact for the time defined by the timer parameter “Fix coil command pulse”. If the closed state of first fix coils arrives in the following 5 seconds, the function terminates the stopped state of the controlling and starts a new measurement process. If this state signal does not arrive, the stopped state remains and the function will start a measurement process ten minutes later. If the network has not changed in this 10 minutes (e.g. a fix coil can be switched on manually in this time), then the function will start measurements in every 10 minutes until a lower command is needed. A measurement can be started manually in the control stopped state also by blocking and then enabling the function (see chapter 4.1).

If the first fix coil has been switched on successfully, the control of the second fix coil is also enabled and the Petersen-coil has reached the upper end state again, then the device gives close command to the second fix coil on the BOut_O07 (L2 fix close). If the closing of the second fix coil has been successfully executed then similarly to the first fix coil the function starts a new measurement process. In opposite case the function continues the Control stop case and starts new measurements in every 10 minutes until lower command is needed.

If two fix coils are enabled to control and both are switched on then the device gives open command to the second fix coil on the BOut_O06 (L2 fix open) in lower end state. If only one fix coil is enabled to control or/and only one is switched on then the device gives open command to the first fix coil on the BOut_O04 (L1 fix open) in lower end state. The open commands are given for the time defined by the timer parameter “Fix Coil ommand pulse”, similarly to the close commands.

The opening process of the fix coils is similar to the close process: when the Petersen-coil reaches its lower end state, the Petersen Coil Controller function stops the control process and after giving the open command of the fix coil the device waits for the open state of the fix coil. If it arrives in 5 seconds, the control stop state will be terminated and a new

[2] The disabled state can be reset in this case when the residual voltage drop down between the 80% and the 100% of the value set by the mentioned parameter. If the residual voltage drops down under 80%, then the function will be automatically enabled.

measurement will be started. In other case the control stop state remains and the Petersen Coil Controller function starts measurement every 10 minutes until higher command is needed.

The related parameters are:

Enumerated parameter

Parameter name	Title	Selection range	Default
The number of the fix coils to control (Among the user defined objects!):			
FixCoilControl_EPar_	Fix coil control	Off, L1, L1 and L2	Off

Table 4-1 The enumerated parameters of the controlling of the fix coils

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
The length of the impulse of the commands to the fix coils (Among the user defined objects!):						
ILFixPulse_TPar_	Fix coil command impulse	ms	100	10000	1	2000

Table 4-2 The timer parameters of the controlling of the fix coils

4.3 The hysteresis range of the automatic control process

The Petersen Coil Controller function compares the ideal Petersen-coil current to the current which is calculated from the actual coil position at the end of every measurement process. If the difference is inside of a range then no tuning will be executed. This range is ±2% or ±n A, which ever is greater, where n=1..4. This value “n” can be set in the configuration on requirement, the default value of it is 1.

4.4 Distinction of the successful and unsuccessful arc suppressions

The successful and unsuccessful arc suppressions are calculated by a 4-channel general counter (see chapter 1.3.7!). The device states that an arc suppression process was successful if the start signal of the Residual definite time overvoltage function drops while the time defined by the parameter “Successful arc suppression”. If the start signal is longer then this time then it will be counted as an unsuccessful arc suppression.

The related parameter is:

Timer parameter

Parameter name	Title	Unit	Min	Max	Step	Default
The timer condition for the successful arc suppression						
SuccessfulArcSupp_TPar_	Successful arc suppression	ms	10	60000	1	1000

Table 4-3 The „Successful arc suppression” timer parameter

4.5 Definition of the lack of inductance and the too much inductance

The device counts with a 4-channel general counter the control processes at which end lack of inductance has been stated and those at which end too much inductance. Lack of inductance is stated if at the end of a control process the Petersen-coil gets to upper end state, and too much inductance if the coil gets to lower end case – independently from the fact whether controllable fix coils will be switched on or not.

5 Other documents about the handling and maintenance of the device

Other general documents about the device can be found in the document library on the website of Protecta Ltd: www.protecta.hu -> Downloads -> EuroProt+

The following documents are highly recommended to study or just to know about:

- Quick start guide to the devices of the EuroProt+ product line
- Europrot+ Maintenance guide
- Error and warning messages of Europrot+ devices
- Remote user interface description
- EuroCAP configuration tool for EuroProt+ devices
- Hardware description
- Commissioning guide to the DRL function