

eVD4 – RBX615

Application manual

RBX615 Standard configurations	1		
1. Protection functions	3		
1.1. Overcurrent protection	3		
1.2. Thermal protection	3		
1.3. Motor stall protection	4		
1.4. Loss of load protection	4		
1.5. Earth fault protection	4		
1.6. Phase discontinuity protection	5		
1.7. Unbalance protection	5		
1.8. Overvoltage protection	5		
1.9. Negative phase sequence current	6		
1.10. Undervoltage protection	6		
1.11. Residual overvoltage protection	6		
1.12. Motor startup supervision	7		
2. Protection related functions	8		
2.1. Circuit-breaker failure protection	8		
2.2. K86 master trip	8		
2.3. Emergency start	8		
3. Supervision functions	9		
3.1. Trip coil and current circuit supervisions	9		
4. Condition monitoring functions	10		
4.1. Circuit-breaker monitor alarm	10		
4.2. Motor runtime counter	10		
5. Control functions	11		
5.1. Circuit-breaker control	11		
5.2. Earthing switch control	12		
5.3. Withdrawable motorized truck control	13		
5.4. Autorecloser	13		
6. Measurement function	14		
6.1. Digital fault recorder	14		
7. General logics	15		
7.1. Local/remote selector	15		
7.2. Circuit-breaker open command	15		
7.3. Circuit-breaker close command	16		
7.4. Enable close operation	16		
7.5. Enable close operation with motor	17		
		8. Inputs and Outputs	18
		8.1. Inputs	18
		8.2. Outputs	19
		9. LEDs	20
		9.1. LEDs (feeder protection)	20
		9.2. LEDs (motor protection)	22
		10. Cumulative blocks	23
		10.1. Cumulative start	23
		10.2. Cumulative operate	23
		10.3. Cumulative alarm	23
		11. Variants	24
		11.1. Fixed version	24
		11.2. Motorized truck version	24
		11.3. No auto-reclose function	24



RBX615 Standard configurations

RBX615 is available in five standard configurations: Feeder 1, 2, 3 and Motor 1, 2. The standard signal configuration can be changed by means of the graphical signal matrix or the optional graphical application functionality of the Protection and Control IED Manager PCM600. Further, the application configuration functionality of PCM600 supports the creation of multi-layer logic functions using various logical elements, including timers and flip-flops. By combining protection functions with logic function blocks, the IED configuration can be adapted to user-specific application requirements.

Description	Configuration
Non-directional overcurrent protection and non-directional earth fault protection	Feeder 1 (F1)
Non-directional overcurrent protection and directional earth fault protection based on measurement of the phase voltages	Feeder 2 (F2)
Directional overcurrent protection, directional earth fault protection based on measurement of the phase voltages and undervoltage and overvoltage protection	Feeder 3 (F3)
Motor protection based on the current measurement	Motor 1 (M1)
Motor protection based on the current and voltage measurements	Motor 2 (M2)

Functions	IEC 61850	IEC 60617	IEC-ANSI	Pre-configurations				
				F1	F2	F3	M1	M2
Protections								
Three-phase non-directional overcurrent protection, low stage	PHLPTOC1	3I> (1)	51P-1 (1)	●	●	-	●	●
Three-phase non-directional overcurrent protection, high stage	PHHPPTOC1	3I>> (1)	51P-2 (1)	●	●	-	-	-
	PHHPPTOC2	3I>> (2)	51P-2 (2)	●	●	-	-	-
Three-phase non-directional overcurrent protection, instantaneous stage	PHIPTOC1	3I>>> (1)	50P/51P (1)	●	●	●	●	●
Three-phase directional overcurrent protection, low stage	DPHLPDOC1	3I> → (1)	67-1 (1)	-	-	●	-	-
	DPHLPDOC2	3I> → (2)	67-1 (2)	-	-	●	-	-
Three-phase directional overcurrent protection, high stage	DPHHPDOC1	3I>> →	67-2	-	-	●	-	-
Non-directional earth-fault protection, low stage	EFLPTOC1	I0> (1)	51N-1 (1)	●	-	-	●	-
	EFLPTOC2	I0> (2)	51N-1 (2)	●	-	-	-	-
Non-directional earth-fault protection, high stage	EFHPTOC1	I0>> (1)	51N-2 (1)	●	●	●	●	●
Non-directional earth-fault protection, instantaneous stage	EFIPTOC1	I0>>> (1)	50N/51N (1)	●	-	-	-	-
Directional earth-fault protection, low stage	DEFLPDEF1	I0> → (1)	67N-1 (1)	-	●	●	-	●
	DEFLPDEF2	I0> → (2)	67N-1 (2)	-	●	●	-	-
Directional earth-fault protection, high stage	DEFHPDEF1	I0>> →	67N-2	-	●	●	-	-
Negative-sequence overcurrent protection	NSPTOC1	I2> (1)	46 (1)	●	●	●	●	●
	NSPTOC2	I2> (2)	46 (2)	●	●	●	●	●
Phase discontinuity protection	PDNSPTOC1	I2/I1>	46PD	●	●	●	-	-
Residual overvoltage protection	ROVPTOV1	U0> (1)	59G (1)	-	●	●	-	-
	ROVPTOV2	U0> (2)	59G (2)	-	●	●	-	-
	ROVPTOV3	U0> (3)	59G (3)	-	●	●	-	-
Three-phase undervoltage protection	PHPTUV1	3U< (1)	27 (1)	-	-	●	-	●
	PHPTUV2	3U< (2)	27 (2)	-	-	●	-	-
	PHPTUV3	3U< (3)	27 (3)	-	-	●	-	-
Three-phase overvoltage protection	PHPTOV1	3U> (1)	59 (1)	-	-	●	-	-
	PHPTOV2	3U> (2)	59 (2)	-	-	●	-	-
	PHPTOV3	3U> (3)	59 (3)	-	-	●	-	-
Three-phase positive-sequence undervoltage protection	PSPTUV1	U1<	47U+	-	-	●	-	●
Three-phase negative-sequence overvoltage protection	NSPTOV1	U2>	47O-	-	-	●	-	●
Three-phase thermal protection for feeders, cables and distribution transformers	T1PTTR1	3Ith>F	49F	●	●	●	-	-
Negative-sequence overcurrent protection for motors	MNSPTOC1	I2>M (1)	46M (1)	-	-	-	●	●
	MNSPTOC2	I2>M (2)	46M (2)	-	-	-	●	●
Underpower protection	LOFLPTUC1	3I<	37	-	-	-	●	●
Rotor block	JAMPTOC1	Ist>	51LR	-	-	-	●	●
Motor start-up	STTPMSU1	Ist n<	49,66,48,51LR	-	-	-	●	●
Protection against phase reversal	PREVPTOC	I2>>	46R	-	-	-	●	●
Three-phase thermal overload for motors	MPTTR1	3Ith>M	49M	-	-	-	●	●
Circuit-breaker fault	CCBRBRF1	3I>/I0>BF	51BF/51NBF	●	●	●	●	●
Three-phase inrush current detector	INRPHAR1	3I2f>	68	●	●	●	-	-

- available
- on request

Functions	IEC 61850	IEC 60617	IEC-ANSI	Pre-configurations				
				F1	F2	F3	M1	M2
Control								
Trip management	TRPPTRC1	Master Trip (1)	94/86 (1)	●	●	●	●	●
	TRPPTRC2	Master Trip (2)	94/86 (2)	●	●	●	●	●
Fixed circuit-breaker control	FCBXCBR1	I ↔ O CB	I ↔ O CB	●	●	●	●	●
Withdrawable circuit-breaker control	WCBXCBR1	I ↔ O CB	I ↔ O CB	●	●	●	●	●
Earthing switch indication	ESSXSWI1	I ↔ O ES	I ↔ O ES	●	●	●	●	●
Earthing switch control	MESXSWI1	I ↔ O ES	I ↔ O ES	●	●	●	●	●
Truck control	TRXSWI	I ↔ O DC	I ↔ O DC	●	●	●	●	●
H-Bridge control	HBGAPC1	HBC	HBC	●	●	●	●	●
	HBGAPC2	HBC	HBC	●	●	●	●	●
Emergency startup	ESMGAPC1	ESTART	ESTART	-	-	-	●	●
Auto-reclosing	DARREC1	O → I	79	O	O	O	-	-
Supervision and monitoring								
Circuit-breaker condition monitoring	SSCBR1	CBCM	CBCM	●	●	●	●	●
Coil switch supervision (Open)	OCSSCBR1	TCS (Open)	TCM (Open)	●	●	●	●	●
Coil switch supervision (Close)	CCSSCBR1	TCS (Close)	TCM (Close)	●	●	●	●	●
Fuse failure supervision	SEQRUF1	FUSEF	60	-	-	●	-	●
Motor runtime counter	MDSOPT1	OPTS	OPTM	-	-	-	●	●
Measurement								
Disturbance recorder	RDRE1	-	-	●	●	●	●	●
Three-phase current measurement	CMMXU1	3I	3I	●	●	●	●	●
Sequence current measurement	CSMSQ1	I1, I2, I0	I1, I2, I0	●	●	●	●	●
Residual current measurement	RESCMMXU1	I0	I _n	●	●	●	●	●
Three-phase voltage measurement	VMMXU1	3U	3U	-	●	●	-	●
Residual voltage measurement	RESVMMXU1	U0	V _n	-	●	●	-	●
Sequence voltage measurement	VSMSQ1	U1, U2, U0	U1, U2, U0	-	●	●	-	●
Three-phase power and energy measurement	PEMMXU1	P, E	P, E	-	●	●	-	●
Sensor temperature	VDSTMP	VDTS	VDTM	-	●	●	-	●

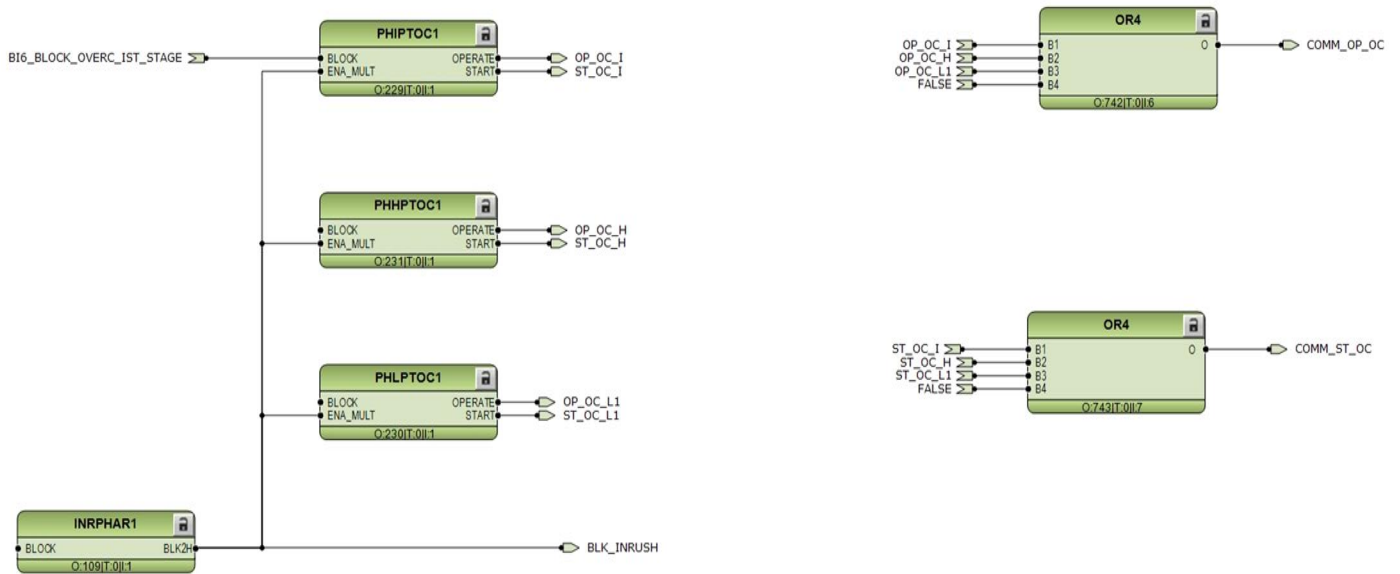
- available
- on request

Presentation of standard configurations

The functional diagrams describe the IED's functionality from the protection, measuring, condition monitoring, disturbance recording, control and interlocking perspectives. The diagrams show the default functionality with simple symbol logics forming principle diagrams. Protection function blocks are part of the functional diagrams; they are identified on the basis of their IEC 61850 name. Some function blocks, such as PHHPTOC, are used several times in the configuration. To separate the blocks from each other, the IEC 61850 name, IEC symbol and ANSI function number are appended with a running number, that is, an instance number, from one upwards. With the Signal Matrix and Application Configuration in PCM600, it is possible to modify the standard configuration according to the actual needs. The IED is delivered from the factory with default connections described in the functional diagrams for binary inputs, binary outputs, function-to-function connections and alarm LEDs. The Signal Matrix is used for GOOSE signal input engineering and for making cross-references between the physical I/O signals and the function blocks. The Signal Matrix tool cannot be used for adding or removing function blocks, for example, GOOSE receive function blocks.

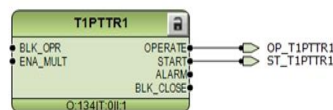
1. Protection functions

1.1. Overcurrent protection



The overcurrent protection function has a sub-function for every protection: PH IPTOC for instantaneous stage, PH HP TOC for high stage and PH LPTOC for low stage overcurrent. Moreover, there is the transformer inrush detection INRP HAR. If the overcurrent threshold value is reached, an output signal of start (ST_XX_X) is given out, if the imposed time DT is also reached then an operate command (OP_XX_X) is created. In the first case a recorder registers the analogic measured values of the parameter; in the second case a protection trip switches on. These outputs actually go into trip or recorder functions that will be shown later on. All the start and operate outputs are then collected in a common operate command (COMM_OP_CMD) and in the start one (COMM_ST_CMD)

1.2. Thermal protection



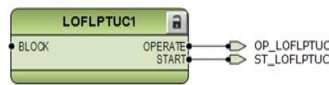
The increased utilization of power systems closer to the thermal limits has generated a need for a thermal overload function also for power lines. A thermal overload is in some cases not detected by other protection functions, and the introduction of the thermal overload function T1PTTR allows the protected circuit to operate closer to the thermal limits. An alarm level gives an early warning to allow operators to take action before the line trips. The early warning is based on the three-phase current measuring function using a thermal model with first order thermal loss with the settable time constant. If the temperature rise continues the function will operate based on the thermal model of the line. The outputs of this function are operate and start signals.

1.3. Motor stall protection



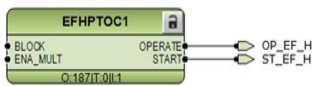
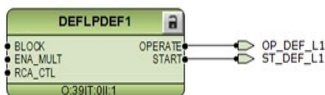
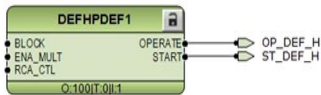
The stalled motor protection JAMPTOC is used for protecting the motor in stall or mechanical jam situations during the running state. When the motor is started, a separate function is used for the startup protection (STTPMSU) and JAMPTOC is normally blocked during the startup period. When the motor has passed the starting phase, JAMPTOC monitors the magnitude of phase currents. The function starts when the measured current exceeds the breakdown torque level, that is, above the set limit.

1.4. Loss of load protection



The loss of load protection LOFLPTUC is used to detect a sudden load loss which is considered as a fault condition. LOFLPTUC starts when the current is less than the set limit. It operates with the definite time (DT) characteristics, which means that the function operates after a predefined operate time and resets when the fault current disappears.

1.5. Earth fault protection



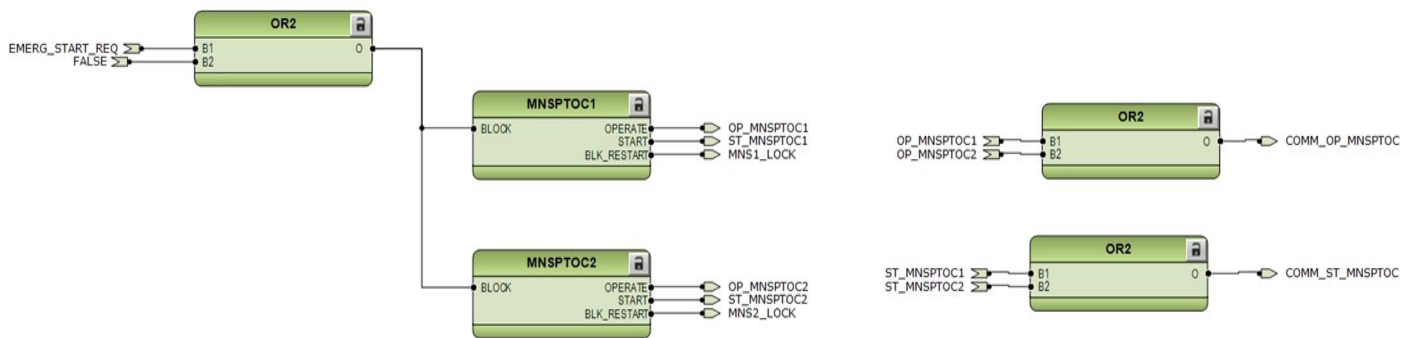
The earth fault protection is divided in three sub-functions, each one for a specific protection code: DEFHPDEF for directional earth-fault protection high stage, DEFLPDEF for directional earth-fault protection low stage and EFHPTOC for non-directional earth-fault protection high stage. As usual there are the operate and start commands which are later collected in the common ones.

1.6. Phase discontinuity protection



The phase discontinuity protection PDNSPTOC is used for detecting unbalance situations caused by broken conductors. The function starts and operates when the unbalance current $I2/I1$ exceeds the set limit. $I1$ and $I2$ represent positive and negative phase sequence currents. As before, it gives out start and operate commands.

1.7. Unbalance protection



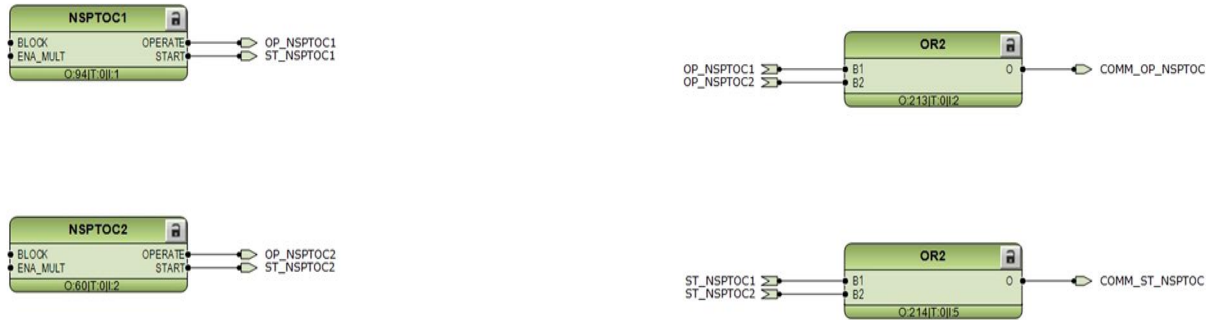
The unbalance protection, based on negative-phase-sequence current function MNSPTOC, protects electric motors from phase unbalance. A small voltage unbalance can produce a large negative-sequence current flow in the motor. For example, a 5 percent voltage unbalance produces a stator negative-sequence current of 30 percent of the full load current, which can severely heat the motor. MNSPTOC detects the large negative-sequence current and disconnects the motor.

1.8. Overvoltage protection



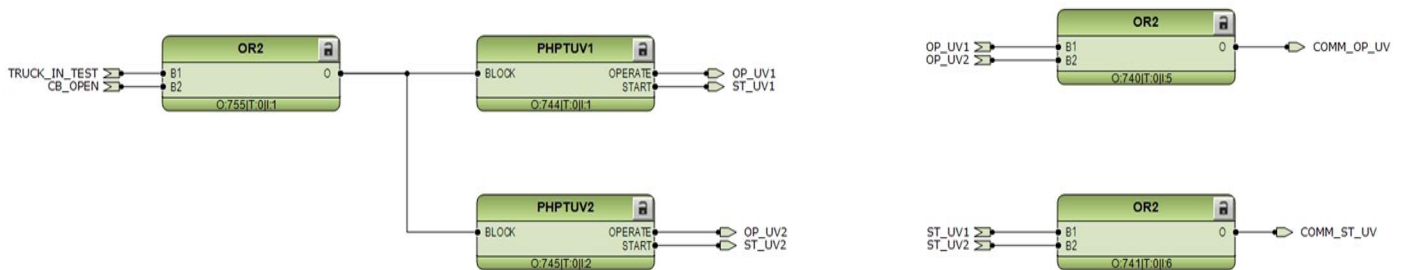
The three-phase overvoltage protection PHPTOV is applied on power system elements, such as generators, transformers, motors and power lines, to protect the system from excessive voltages that could damage the insulation and cause insulation breakdown. The three-phase overvoltage function includes a settable value for the detection of overvoltage either in a single phase, two phases or three phases. PHPTOV includes both definite time (DT) and inverse definite minimum time (IDMT) characteristics for the delay of the trip. As with the other protection blocks, it has 2 outputs signals of operate and start.

1.9. Negative phase sequence current



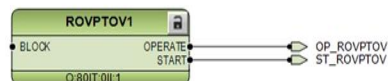
The negative phase-sequence current protection NSPTOC is used for increasing sensitivity to detect single phase and phase-to-phase faults, unbalanced loads due to, for example, broken conductors or to unsymmetrical feeder voltages. Similarly to the other protection functions, there are start and operate commands which are collected later in common ones.

1.10. Undervoltage protection



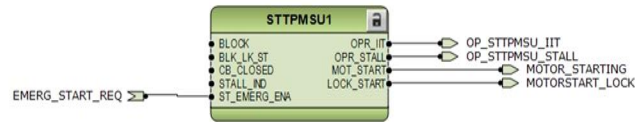
The three-phase undervoltage protection PHPTUV is used to disconnect from the network devices, for example electric motors, which are damaged when subjected to service under low voltage conditions. PHPTUV includes a settable value for the detection of undervoltage either in a single phase, two phases or three phases.

1.11. Residual overvoltage protection



The residual overvoltage protection ROVPTOV is used in distribution networks where the residual overvoltage can reach non-acceptable levels, for example, in high impedance earthing. The function starts when the residual voltage exceeds the set limit. As usual, the outputs are start and operate commands.

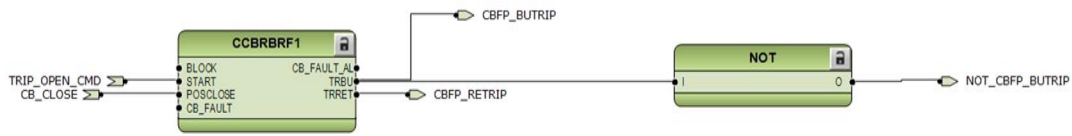
1.12. Motor startup supervision



The motor startup supervision function STTPMSU is designed for protection against excessive starting time and locked rotor conditions of the motor during starting. For good and reliable operation of motor, the thermal stress during the motor starting is maintained within the allowed limits. The starting of motor is supervised by monitoring the TRMS magnitude of all the phase currents or by monitoring the status of the circuit-breaker connected to the motor. STTPMSU also protects the motor from an excessive number of startups. Upon exceeding the specified number of startups within a certain duration, STTPMSU blocks further starts. The restart of the motor is also inhibited after each start and continues to be inhibited for a set duration. When the motor start lock is enabled, STTPMSU gives the time remaining until the restart of the motor. In the case of an emergency start, the logic does not block the motor startup. The outputs of this block deal with the operate/trip signals due to thermal stress and stalling protection (OPR_IIT and OPR_STALL), the signal of motor startup in progress (MOT_START) and the lockout condition (LOCK_START).

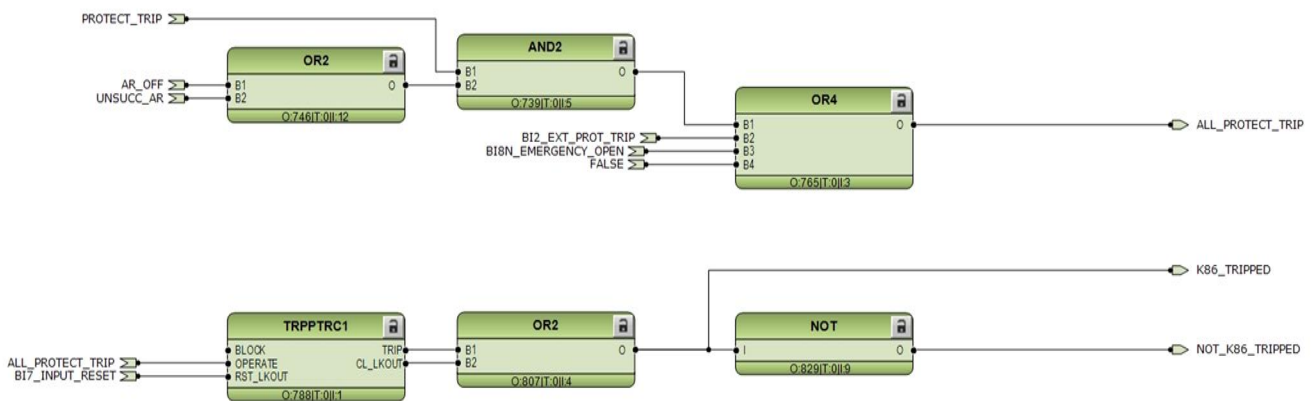
2. Protection related functions

2.1. Circuit-breaker failure protection



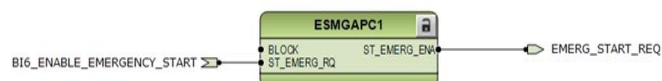
The CCBRBRF function is the protection which acts in case of failure of the CB in opening the circuit. It is possible to see from the logic blocks that if there are, at the same time, the trip opening command, coming from a protection trip, and the closed status of the CB, it means that the CB is not opening the circuit. In this case the CCBRBRF function gives out the CB failure alarm (CB_FAULT_ALM) and the two inside timers run until the set re-trip time value has elapsed (TRRET) and until the set CB failure delay value has elapsed (TRBU). In the first case a re-trip command (CBFP_RETRIP) is sent to the CB itself, in the second case a backup command (CBFP_BUTRIP) is sent to the chosen backup breakers, normally upstream ones.

2.2. K86 master trip



The K86 master trip function is the one responsible for putting the CB in locked-out status. In fact, if the PROTECT_TRIP command is incoming and at the same time the auto-reclose function is not acting (it is off or unsuccessful) it means that the CB should trip. Otherwise, if a protection trips, the CB should not lock out because the auto-reclose function has to be able to re-close the circuit. Also, the inputs of external trip (#2) and of emergency open (#8) can open the CB giving the ALL_PROTECT_TRIP command. This command gives the operate command to the TRPPTRC function which means tripping the CB putting it in the lock-out status. The aim of this function is to lock out the tripped CB until a general reset command (input #7) deletes this status, recorded in CL_LKOUT. Therefore, in case of incoming ALL_PROTECT_TRIP command, the TRPPTRC function puts the CB in K86_TRIPPED status, that means in a lock-out one. In case of K86-tripped CB, it is possible to unlock the functionality of the CB via the HMI. Press the Clear button, select TRPPTRC and cancel it; then move into the LEDs page and deactivate them.

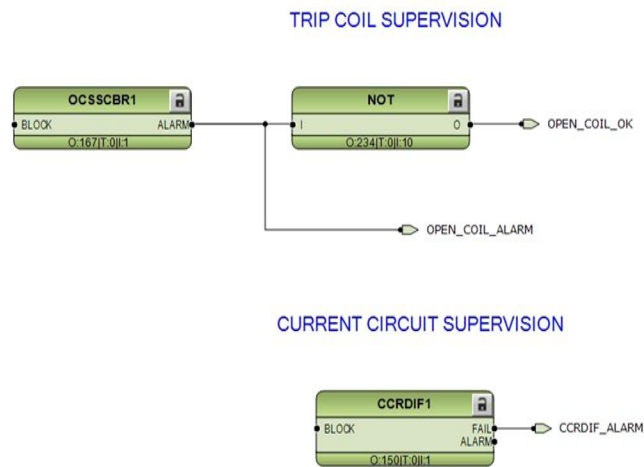
2.3. Emergency start



An emergency condition can arise in cases where the motor needs to be started despite knowing that this can increase the temperature above limits or cause a thermal overload that can damage the motor. The emergency start function ESMGAPC allows motor startups during such emergency conditions. ESMGAPC is only to force the IED to allow the restarting of the motor. After the emergency start input is activated, the motor can be started normally. ESMGAPC itself does not actually restart the motor.

3. Supervision functions

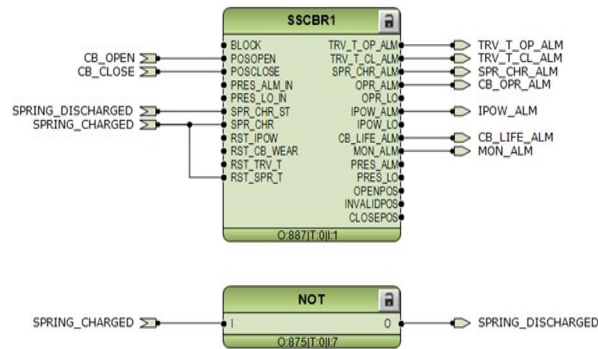
3.1. Trip coil and current circuit supervisions



The open coil switch supervision function OCSSCBR is designed to supervise control circuits. A dedicated circuit verifies the continuity of the coil to detect any invalidity in the control circuit. A coil switch failure is reported to the corresponding function block in the IED configuration and gives out in case the related alarm. On the other hand the current circuit supervision function CCRDIF, is used for monitoring residual current transformer secondary circuits. CCRDIF internally calculates the sum of phase currents (I_A , I_B and I_C) and compares the sum against the measured single reference current (I_{REF}). If the CCRDIF detects a fault in the measurement circuit, it issues an alarm.

4. Condition monitoring functions

4.1. Circuit-breaker monitor alarm



The circuit-breaker condition monitoring function (SSCBR) is used to monitor different parameters of the circuit-breaker. The breaker requires maintenance when the number of operations has reached a predefined value. For proper functioning of the circuit-breaker, it is essential to monitor the circuit-breaker operation, spring charge indication, breaker wear, travel time, number of operation cycles and accumulated energy. The energy is calculated from the measured input currents as the sum of current phases values. Alarms are generated when the calculated values exceed the threshold settings. Specifically, the inputs of this function are the information on the CB status coming from the CB function, such as the position of the CB (open or closed) and the condition of the spring (charged, discharged). The SSCBR function monitors a large variety of parameters and gives out an alarm for every warning condition. For example, alarms related to excessive travel time of CB opening or closing (TRV_T_OP_ALM, TRV_T_CL_ALM), failure in spring recharging (SPR_CHR_ALM), threshold value of operations done by the CB (CB_OPR_ALM), residual life based on tripping current value (CB_LIFE_ALM), long CB non-operating time (MON_ALM). All these outputs are therefore the alarms related to the good operability of the CB and the need for some maintenance.

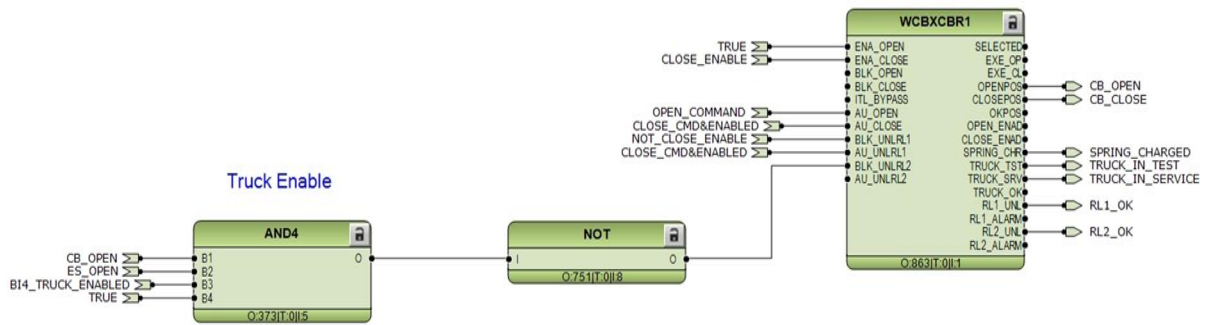
4.2. Motor runtime counter



The motor runtime counter function MDSOPT calculates the accumulated operation time of the motor. The unit of time for accumulation is hour. The function generates a warning and an alarm when the accumulated operation time exceeds the set limits.

5. Control functions

5.1. Circuit-breaker control



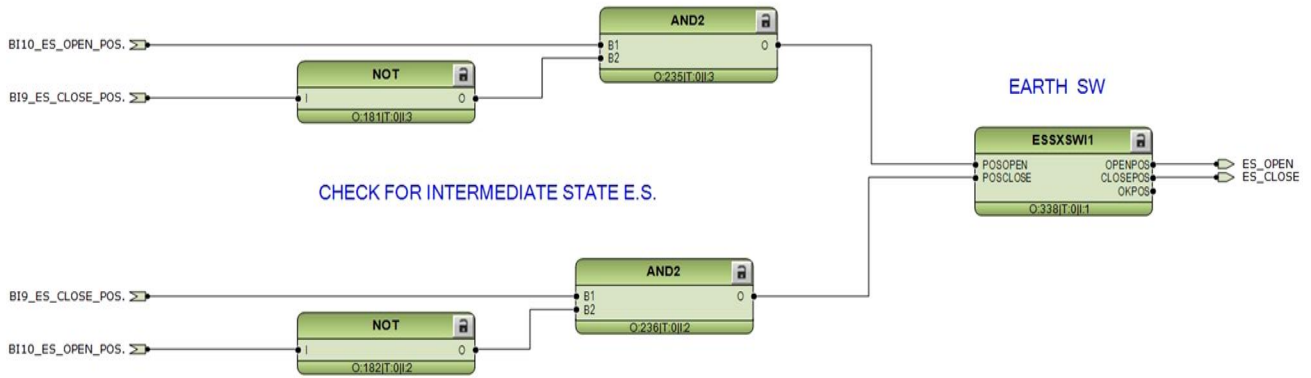
The circuit-breaker control function WCBXCBR is intended for withdrawable circuit-breaker control and status information purposes. This function executes commands and evaluates block conditions and different time supervision conditions. The function performs an execution command only if all the conditions indicate that a switch operation is allowed. The actuation of the command consists of operating the open and closed shunt releases. WCBXCBR is also assigned to monitor the truck status. Actually, if all the conditions to operate the truck are satisfied (CB and earthing switch open, truck moving input command enabled), the truck itself is allowed to move. Otherwise the CB function will block the RL2 not permitting the insertion of the truck. Other commands are the possibility to open ENA_OPEN (always on) or to close, depending on the admission of the CLOSE_ENABLE command; these two operations can also be blocked. The previously analyzed open command, on the other hand, gives the signal of the CB opening, whereas the close command will be explained later on. All these signals, however, act on the authorization of opening or closing the CB along with the right of blocking or unlocking the RL1 and RL2 coils. Regarding the outputs of this WCBXCBR function, there are mainly the ones related to the CB position (CB_OPEN and CB_CLOSE), which is detected by inductive position sensors and checked by the OKPOS (see the table), the charged spring indicator, the truck position (test or service, see the picture) checked by the TRUCK_OK and the status of the coils acting on RL1 and RL2 (released/not released).

Status (POSITION)	OPENPOS	CLOSEPOS	OKPOS
1=Open	1=True	0=False	1=True
2=Closed	0=False	1=True	1=True
3=Faulty/Bad (11)	1=True	1=True	0=False
0=Intermediate (00)	0=False	0=False	0=False



ANSI truck symbols for the intermediate, service, test and faulty position

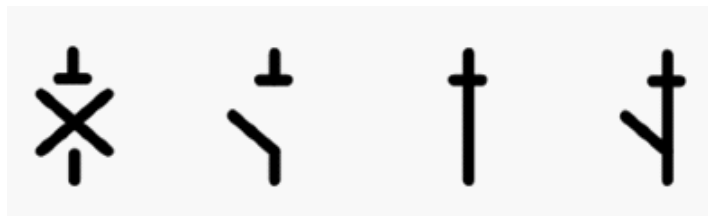
5.2. Earthing switch control



The earthing switch indication function ESSXSWI indicates the open, closed and undefined states of the earthing switch. Before this function acts, there is a check for intermediate position of the earthing switch. Basically, it verifies that the command given is either “open position” or “closed position” to avoid intermediate status. In fact, the ESSXSWI function receives the signals and checks that there are not intermediate or faulty situations by comparing the values. As can be seen in the table, if the signals are coherent, the OKPOS check will give the output of open (ES_OPEN) or closed (ES_CLOSE), otherwise it will indicate the presence of an intermediate status or a faulty/bad execution.

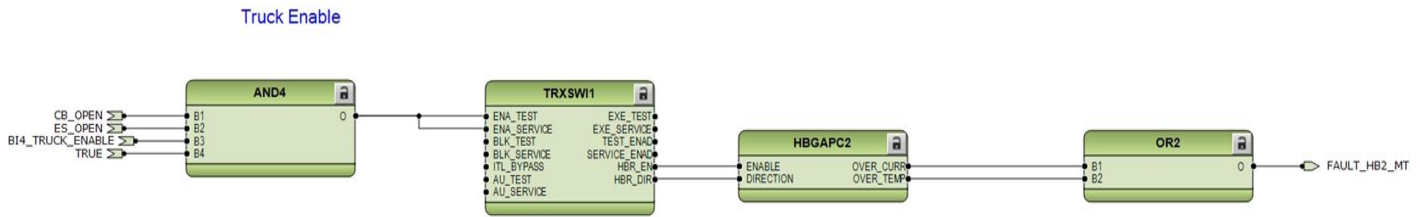
Status (POSITION)	OPENPOS	CLOSEPOS	OKPOS
1=Open	1=True	0=False	1=True
2=Closed	0=False	1=True	1=True
3=Faulty/Bad (11)	1=True	1=True	0=False
0=Intermediate (00)	0=False	0=False	0=False

These statuses are displayed on the HMI by means of standard single line diagram symbols, as shown below.



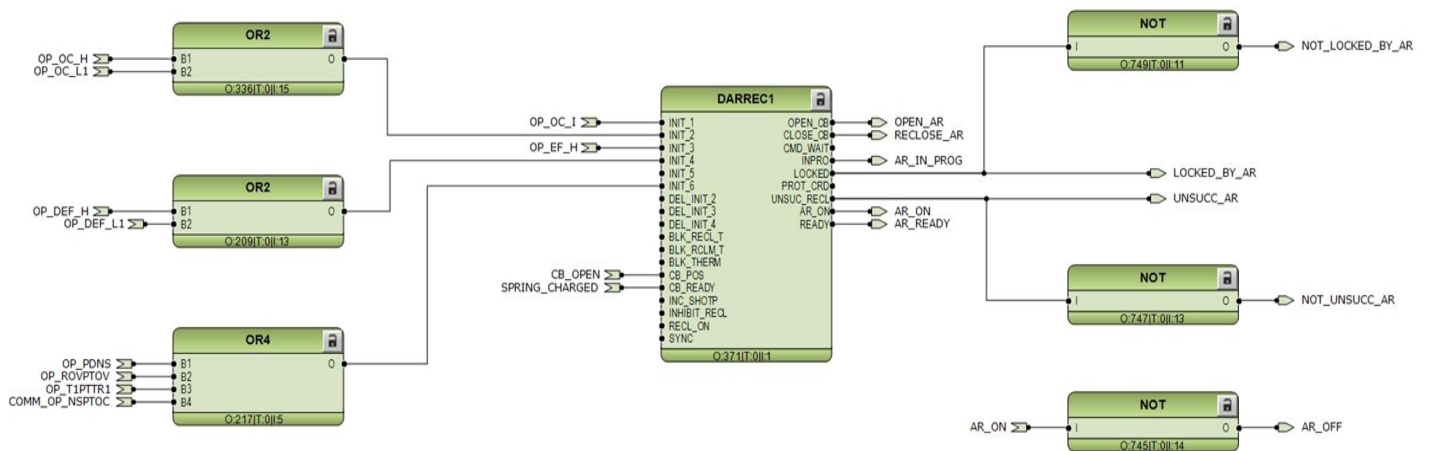
Earth Switch symbols for the intermediate, open, closed and faulty position

5.3. Withdrawable motorized truck control



The truck control function TRXSWI is intended for truck control purposes. TRXSWI executes commands and evaluates block conditions and different time supervision conditions. The function performs an execution command only if all conditions indicate that a switch operation is allowed. The actuation of the command consists in controlling the H-Bridge driving the truck motor. The condition to operate the motor is the status of the truck: it should be enabled. So CB and ES should be open and the respective input #4 enabled. Once these conditions are satisfied, the TRXSWI function enables the H-Bridge and gives the moving direction. These commands are read by the HBGAPC function: this is a switching circuit used to apply a controlled voltage to a DC motor. The voltage applied across the motor can be either positive, that is, forward operation, or negative, that is, reverse operation. In case of an overcurrent or over-temperature signal, the function launches a fault alarm signal.

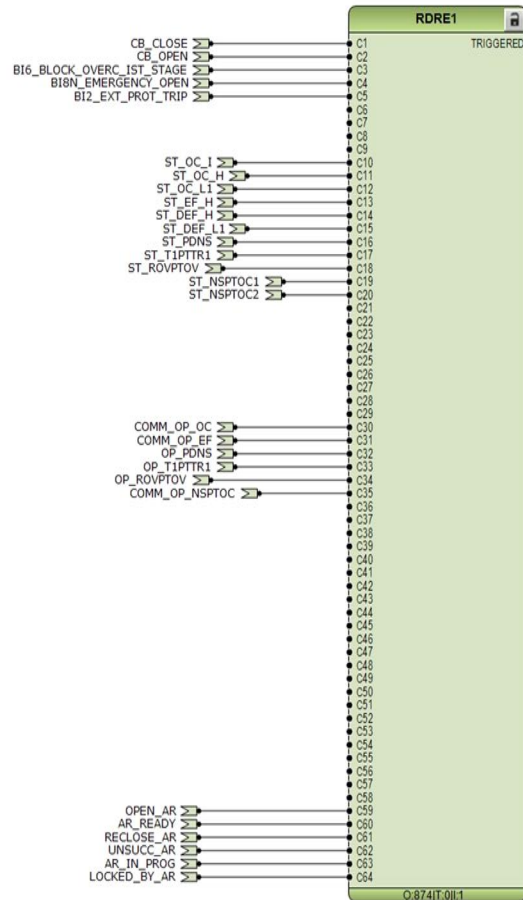
5.4. Autorecloser



About 80 to 85 percent of faults in MV overhead lines are transient and automatically cleared with a momentary de-energization of the line. The rest of the faults, 15 to 20 percent, can be cleared by longer interruptions. The de-energization of the fault location for a selected time period is implemented through automatic reclosing, during which most of the faults can be cleared. In case of a permanent fault, the automatic reclosing is followed by final tripping. A permanent fault must be located and cleared before the fault location can be re-energized. The function provides five programmable auto-reclose shots which can perform one to five successive auto-reclosings of desired type and duration, for instance one high-speed and one delayed auto-reclosing. This DARREC function receives as inputs the operate command from the different protection functions and some information related to the CB status, such as spring and open/closed statuses. The different operate commands are separated because in this way it is possible to set different delay times for the AR function. The output of this function is related to the AR operations themselves, such as the open command (OPEN_AR), the reclose one (RECLOSE_AR), the in progress status (AR_IN_PROG) and the status (AR_ON, AR_READY). Moreover, it also indicates the possible faults in the AR procedure, such as the locked status and the unsuccessful action.

6. Measurement function

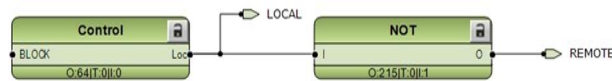
6.1. Digital fault recorder



The RDRE function is the one responsible for recording the signals coming from the transducers once the set threshold is elapsed: that is why it has as inputs the start commands of the various protections, along with the operate ones. Moreover, it also considers the status of the auto-reclose function and its possible commands.

7. General logics

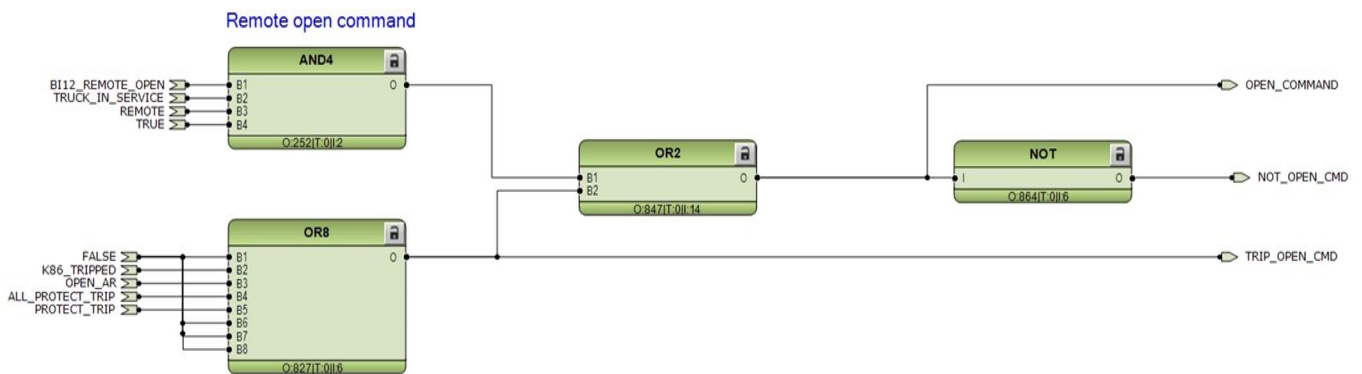
7.1. Local/remote selector



The local/remote selector function defines the type of control chosen, that is, whether we act from remote (e.g. digital inputs) or from local (HMI). The respective outputs specify this choice. To change this status from remote to local (and vice versa) use the R/L button on the HMI.

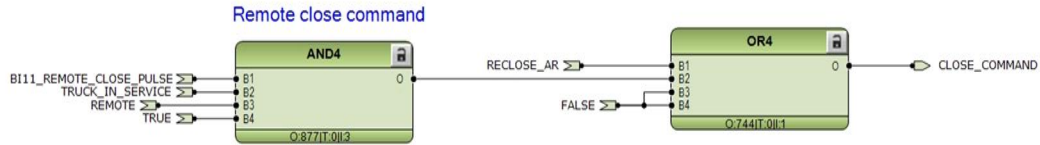


7.2. Circuit-breaker open command



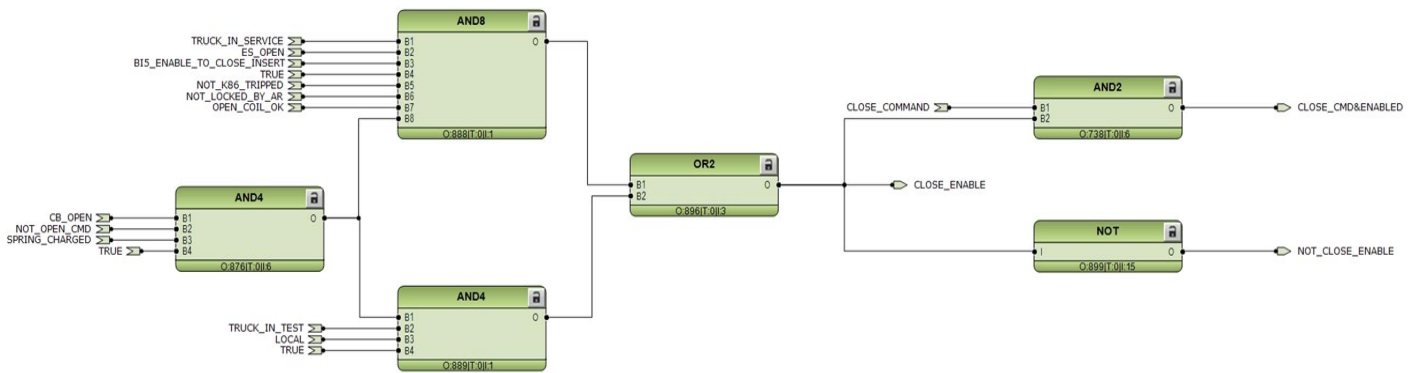
The function that supervises the circuit-breaker open command is made up of two different blocks which may give that signal: the remote command and the trip due to the protections. In the first case, there should firstly be the remote opening input signal, then the truck in the service position and the remote status selected. In the case of protection trip, on the other hand, just one signal due to a protection system is enough to give the open command, such as the K86 master trip, the open phase of the auto-reclose function, or the PROTECTION_TRIP command (linked to various protections). If one of the two cases is on, there is the output of OPEN_COMMAND signal; in the specific case of open command due to a protection trip, there is also the TRIP_OPEN_CMD signal.

7.3. Circuit-breaker close command



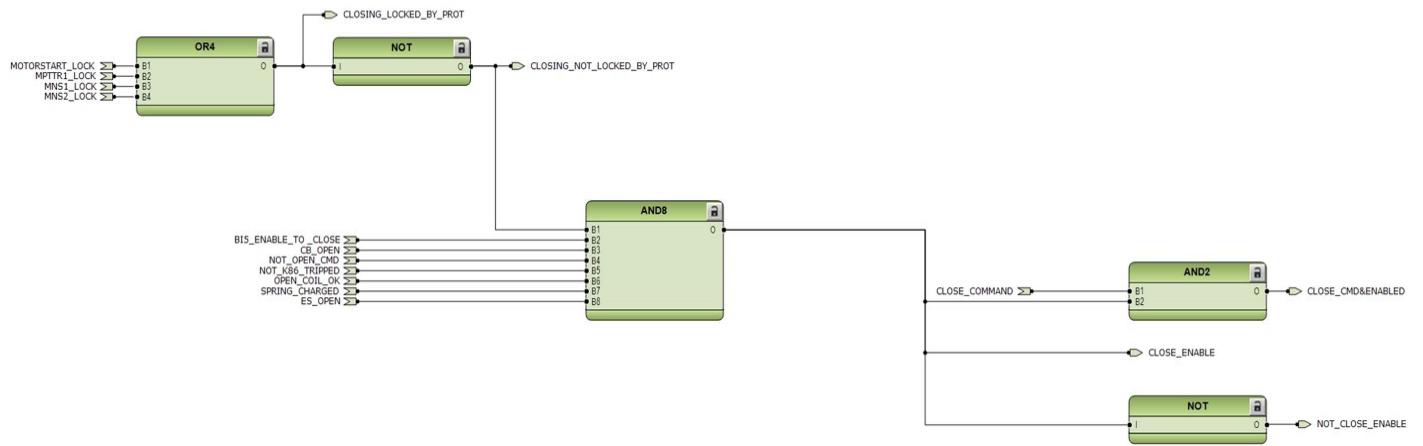
The close CB command is similar to the open one but it is not related to protection function. In fact, the close command can just be given by a remote input (along with the truck in the service position and the remote selection) or by the reclose phase of the auto-reclose function. If one of the two cases is on, there will be a CLOSE_COMMAND output signal.

7.4. Enable close operation



This function enables the CB closing output signal (CLOSE_CMD&ENABLED), which goes into the WCBXCBR function launching the closing command (AU_CLOSE) and unlocking the RL1 (AU_UNLRL1). This function starts with the common rights necessary to open the CB, which are the status of CB open, the charged spring and the absence of an opening command. There are also two possible truck conditions: the service and the test ones. In the first case, different rights are needed to operate the closing command: first of all, of course, the truck in the service position, then the earthing switch open, the input that enables the closure of the CB on, the good status of the opening coil and the absence of the K86 master trip and of the auto-reclosing procedure. In the case of the truck in the test position, on the other hand, just the position itself and the local selection are needed. Be aware that in test position the CB can only be operated from local. Once one of these two conditions is fulfilled, the function gives out a CLOSE_ENABLE output that, along with the previously seen CLOSE_COMMAND coming from a remote input, gives the CLOSE_CMD&ENABLED.

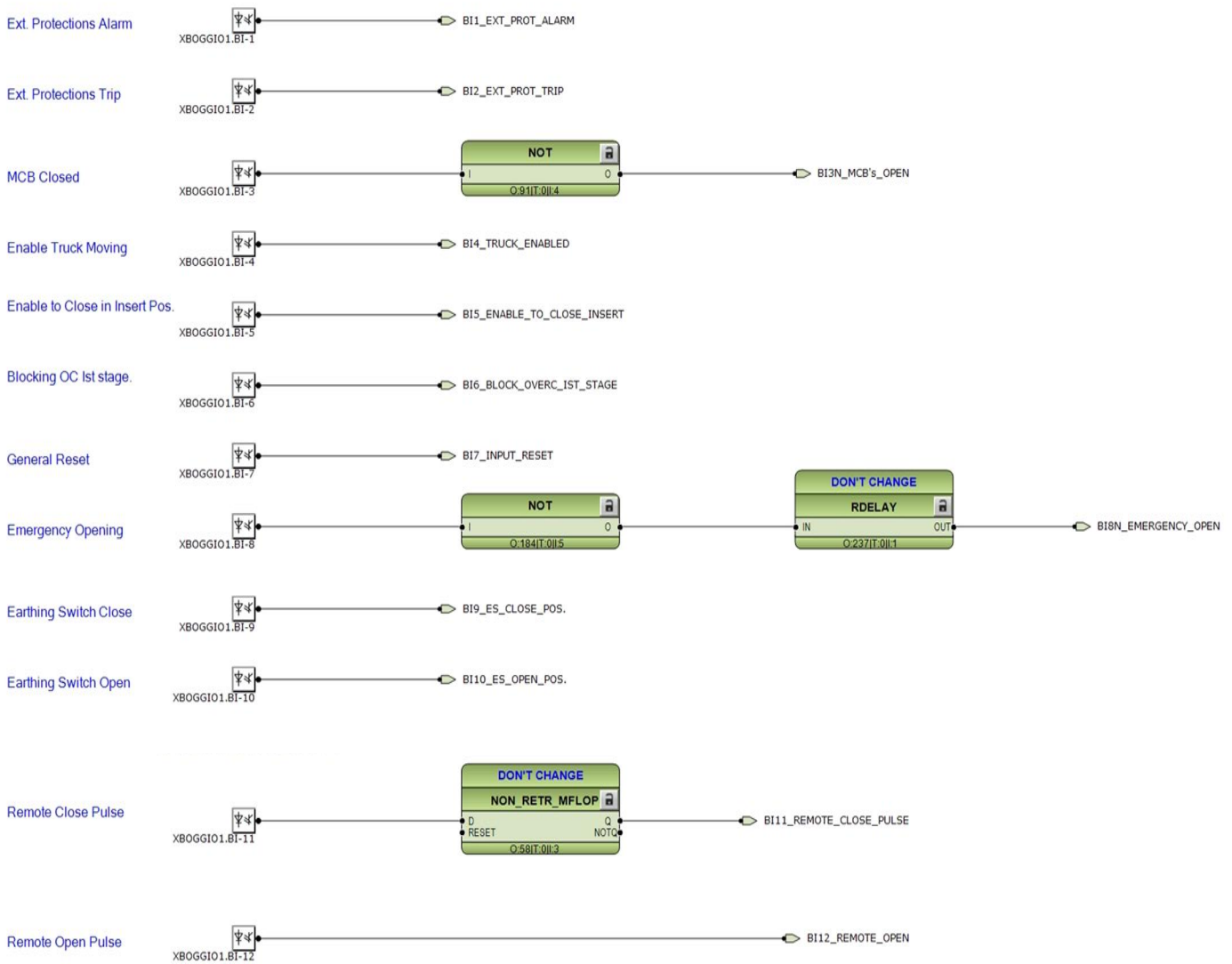
7.5. Enable close operation with motor



In case of motorized truck, other rights dealing with the motor condition are necessary to give the close command. Mainly, the motor should not be locked out and there should not be a thermal lock protection on.

8. Inputs and outputs

8.1. Inputs



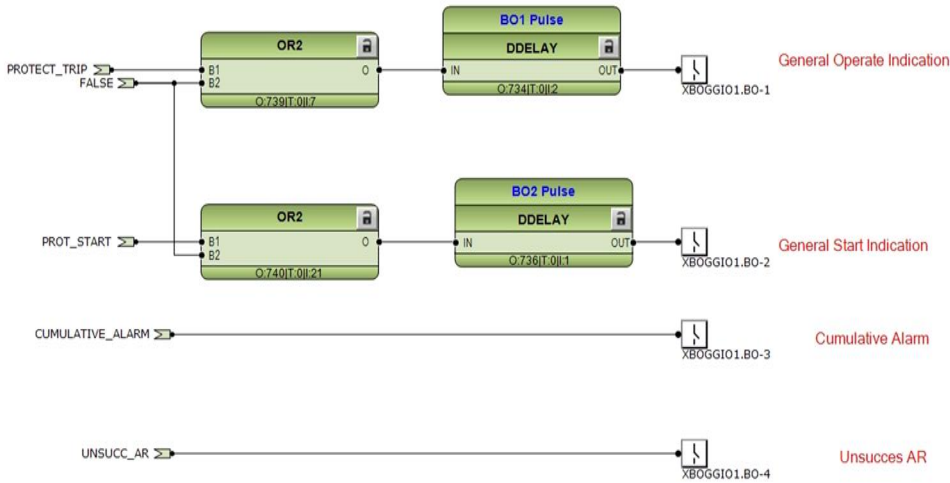
There are twelve digital inputs available in the plug. Each of them gives the related command used by the functions.

I/O Description

eVD4 - Binary Inputs						
BI Number	Without I/O expansion module	With I/O expansion module	Card	Function	Configurable	Available in plug
BI 1	–	•	I/O expansion (-X200)	Ext. Protections Alarm	yes	yes
BI 2	–	•	I/O expansion (-X200)	Ext. Protections Trip	yes	yes
BI 3	–	•	I/O expansion (-X200)	MCB closed	yes	yes
BI 4	–	•	I/O expansion (-X200)	Enable truck moving	yes	yes
BI 5	–	•	I/O expansion (-X200)	Enable to close in insert pos.	yes	yes
BI 6	–	•	I/O expansion (-X200)	Blocking OC inst. stage	yes	yes
BI 7	–	•	I/O expansion (-X200)	General Reset	yes	yes
BI 8	–	•	I/O expansion (-X200)	Emergency opening	yes	yes
BI 9	–	•	I/O expansion (-X200)	Earthing switch close	yes	yes
BI 10	–	•	I/O expansion (-X200)	Earthing switch open	yes	yes
BI 11	•	•	Basic Card (-X300)	CB remote closing	no	yes
BI 12	•	•	Basic Card (-X300)	CB remote opening	no	yes
BI 13	•	•	Basic Card (-X300)	CB closed signalling	no	no
BI 14	•	•	Basic Card (-X300)	CB open signalling	no	no
BI 15	•	•	Basic Card (-X300)	Springs charged signalling	no	no
BI 16	•	•	Power Supply (-X100)	Truck in test position	no	no
BI 17	•	•	Power Supply (-X100)	Truck in service position	no	no

8.2. Outputs

EXTENDED INTERFACE OUTPUT



BASE INTERFACE OUTPUT



In case of absence of the auto-reclose function, the respective output is available.

eVD4 - Binary Outputs

BO Number	Without I/O expansion module	With I/O expansion module	Card	Function	Configurable	Available in plug
BO 1	–	•	I/O expansion (-X200)	General operate indication	yes	yes
BO 2	–	•	I/O expansion (-X200)	General start indication	yes	yes
BO 3	–	•	I/O expansion (-X200)	Cumulative Alarm	yes	yes
BO 4	–	•	I/O expansion (-X200)	Unsuccess AR	yes	yes
BO 5	•	•	Power Supply (-X100)	K86 tripped	yes	yes
BO 6	•	•	Power Supply (-X100)	CBFP open upstream	yes	yes
BO 7	•	•	Power Supply (-X100)	Locking electromagnet on operating mechanism (-RLE1)	no	no
BO 8	•	•	Power Supply (-X100)	Shunt closing release (-MBC)	no	no
BO 9	•	•	Power Supply (-X100)	Shunt opening release (-MBO1)	no	no
BO 10	•	•	Power Supply (-X100)	Watchdog	no	yes
BO 11	•	•	Power Supply (-X100)	CB ready	no	yes
BO 12	•	•	Basic Card (-X300)	Locking electromagnet on truck (-RLE2)	no	no

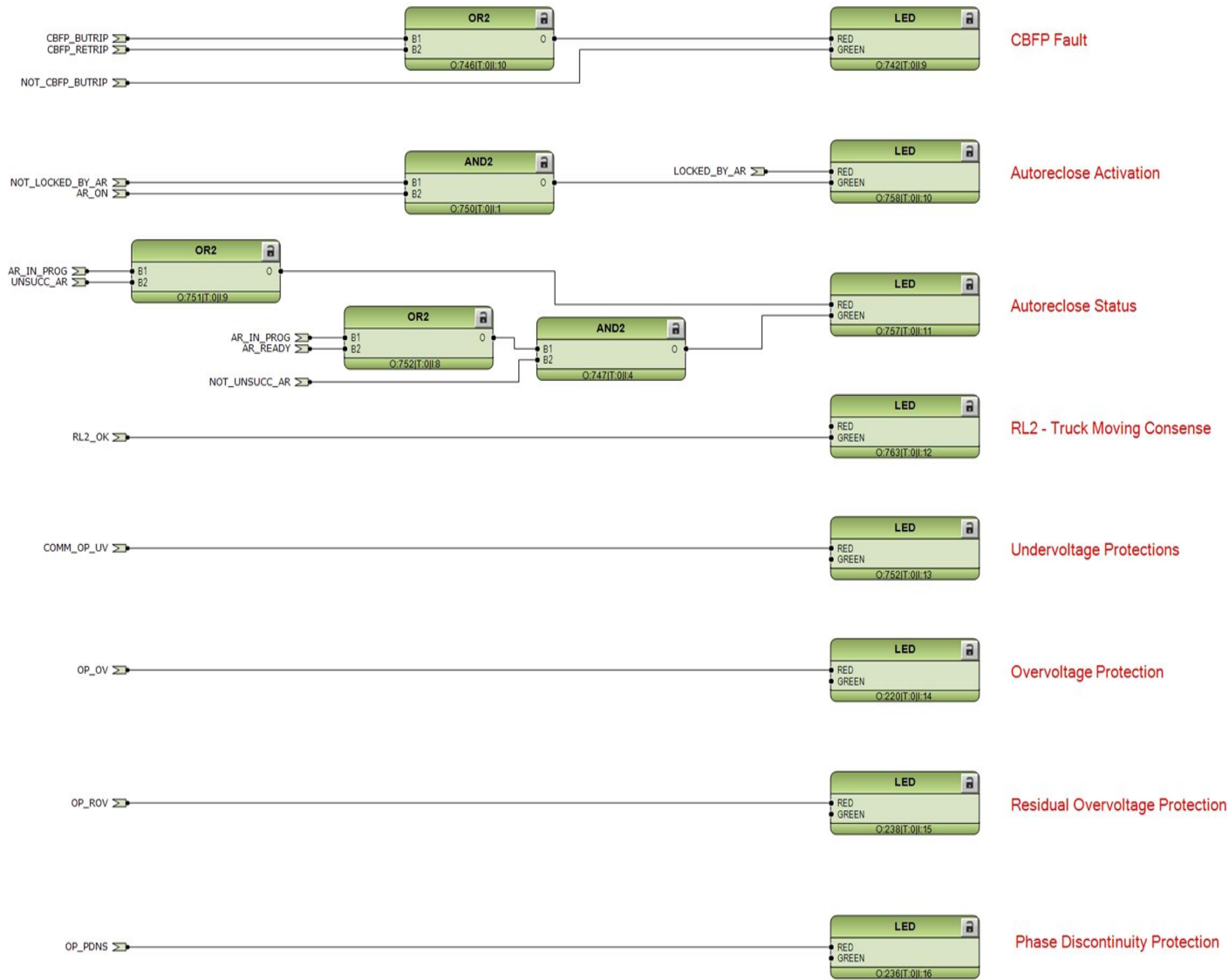
9. LEDs

9.1. LEDs (feeder protection)

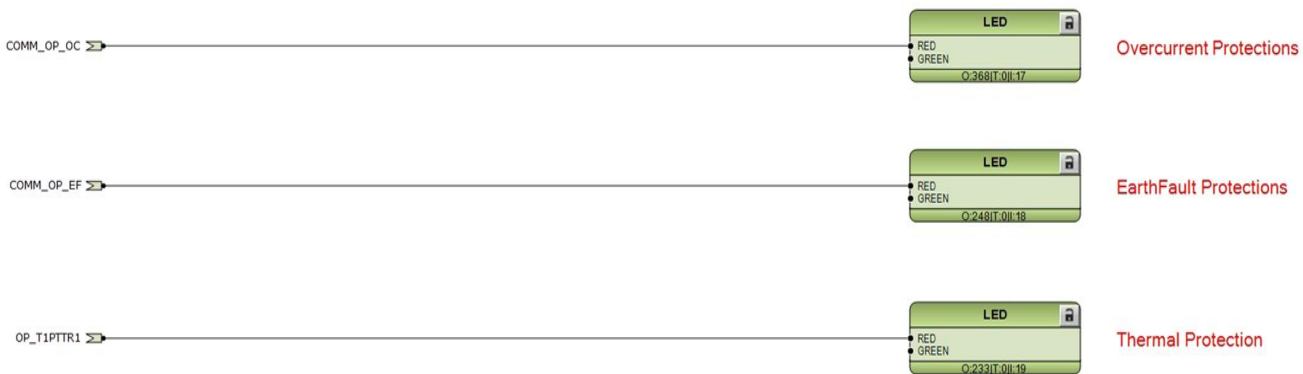
LED PAGE n° 1



LED PAGE n°2

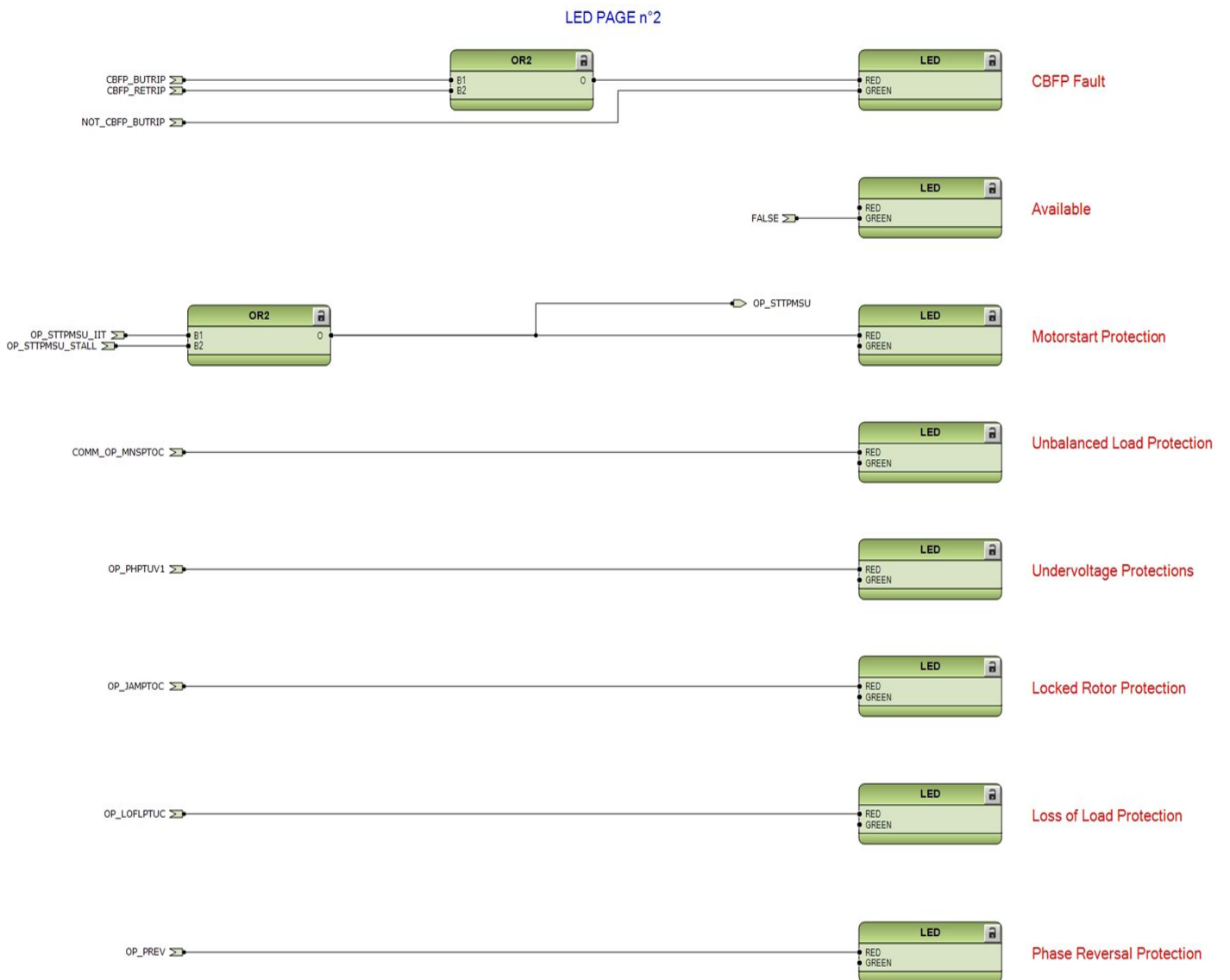


LED PAGE n° 3



9.2. LEDs (motor protection)

LED Pages 1 and 3 are the same as the ones of Feeder protection. LED Page 2 is however different, as can be seen below.



10. Cumulative blocks

10.1. Cumulative start



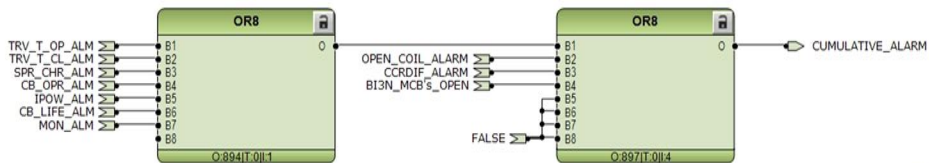
This function collects all the start commands coming from the different protection functions and gives out the PROT_START command if any of them is launched by the respective protection.

10.2. Cumulative operate



This function gives a PROTECT_TRIP output which is driven by any of the operate commands of the various protection functions. This command goes into the K86 master trip function causing the CB protection trip.

10.3. Cumulative alarm



The cumulative alarm function has as inputs all the possible alarm signals coming from the various diagnostic functions, and if one of them is on, it gives out the CUMULATIVE_ALARM signal.

11. Variants

The blocks shown in this manual are as comprehensive as possible, however you may find some small differences with your configuration. But, the only variants you should be aware of regard the availability of some outputs or LEDs.

11.1. Fixed version

If you have an eVD4 - fixed version:

- LEDs: there is no LED related to -RLE2. This LED is then available.
- Input: #4 is available as there is no truck.

11.2. Motorized truck version

If you have an eVD4 with motorized truck:

- Input: #4 is available as the motor is responsible for moving the truck.

11.3. No auto-reclose function

If you do not have the auto-reclose function configured:

- Output: 1 is available as there no need for auto-reclose operation status.
- LEDs: 2 are available for the same reason given in the previous point.

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