Relion® 615 series

Feeder protection and control REF615

Power and productivity
for a better world™

ABB

Compact and versatile solution for utility and industrial power distribution systems

REF615 is a dedicated feeder IED perfectly aligned for the protection, control, measurement and supervision of utility and industrial power distribution systems including radial, looped and meshed networks, also involving possible distributed power generation.

REF615 is a member of ABB's Relion® protection and control product family and its 615 series. The 615 series IEDs characterized by their compactness and withdrawable-unit design. Re-engineered from the ground up, the new 615 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability of substation automation devices.

Application
REF615 provides feeder overcurrent and earth-fault protection for distribution networks, including substation busbar protection applying the reverse interlocking principle, or GOOSE messaging over a switched Ethernet station bus. REF615 fits both isolated neutral networks and networks with resistance or impedance earthed neutrals. Furthermore, making use of the IED's advanced inter-station communication facilities, REF615 can also be applied for protection of ring-type and meshed distribution networks as well of radial networks. The protected networks may also involve multiple infeed and distributed power generation. As of now, the REF615 is available in eight predefined standard configurations to suit the most common feeder protection and control applications.

Protection and control
REF615 offers directional and non-directional overcurrent and earth-fault protection and thermal overload protection. Some standard configurations allow admittance-based earth-fault protection to be used instead of directional earth-fault protection. The admittance-based earth-fault protection ensures a correct operation of the protection even though the connection status information of the Petersen coil would be missing. Furthermore,REF615 features sensitive earth-fault protection, phase discontinuity protection, transient/intermittent earth-fault protection, phase overvoltage, undervoltage and residual overvoltage protection, positive phase-sequence undervoltage and negative-phase sequence overvoltage protection. Overfrequency, underfrequency and frequency gradient-based protection is offered in standard configuration H. The IED also incorporates auto-reclose functions for arc fault clearance on overhead line feeders.

Enhanced with optional hardware and software, the IED also features three light detection channels for arc fault protection of metal-enclosed indoor switchgear. Fast tripping increases personnel safety and limits material damage in an arc fault situation.

A standard configuration IED can be adjusted using the signal matrix functionality (SMT) or the optional graphical application configuration functionality (ACT) of the Protection and Control IED Manager PCM600. The ACT supports creation of multi-layer logic by combining function blocks along with timers and flip-flops. By combining protection and logic functions the IED can be modified to fit the requirements of the application.

REF615 also features control of one circuit breaker via the IED's HMI or a remote control system.

Sensor support
The standard configuration G includes one conventional residual current (I0) input and three sensor inputs for the connection of three combi-sensors with RJ-45 connectors. The sensor inputs allow current and voltage sensors to be used in compact medium voltage (MV) switchgear instead of conventional measuring transformers. Compact MV switchgear such as ABB's SafeRing and SafePlus, are designed for applications, like compact secondary substations, wind turbine power plants, small industry installations and large buildings. As an alternative to combi-sensors, separate current and voltage sensors with adapters can be used.

Standardized communication
REF615 features genuine support for the IEC 61850 standard for inter-device communication in substations. It also supports the DNP3 protocol, the IEC 60870-5-103 protocol, and the industry standard Modbus® protocol.

For increased communication availability and reliability the IED offers an optional second and third Ethernet network interface. The self-healing Ethernet solution constitutes a cost efficient communication loop controlled by a managed switch. The managed switch controls the consistency of the loop, routes the data and corrects the flow of data in communication disturbance situations. The self-healing Ethernet ring can be built on the Ethernet based IEC 61850, Modbus® and DNP3 protocols.
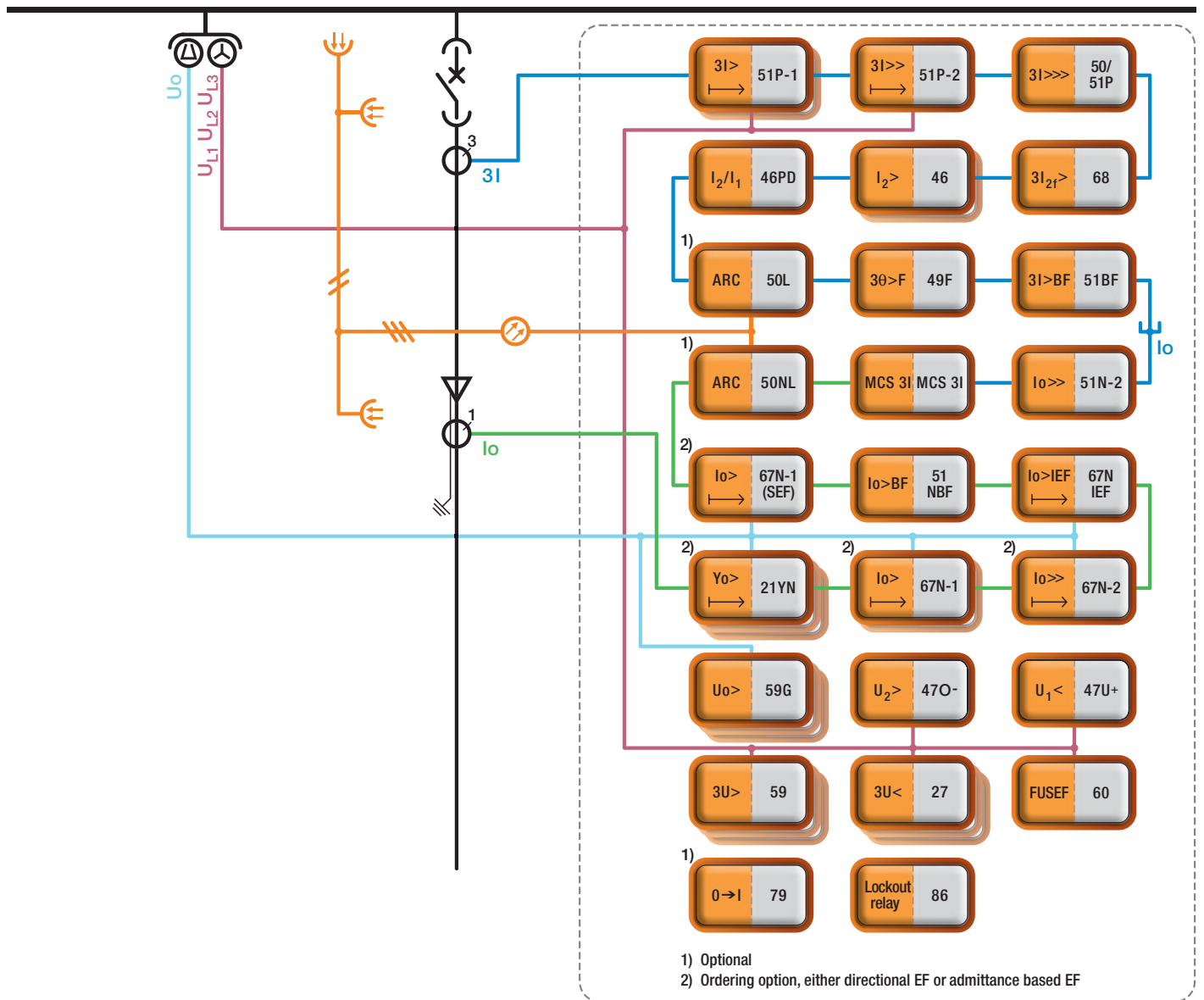
Protection function overview of the F configuration of REF615.

The implementation of the IEC 61850 standard in REF615 covers both vertical and horizontal communication, including GOOSE messaging with binary and analog signals and parameter setting according to IEC 61850-8-1. For time-critical applications REF615 supports synchronization over Ethernet using SNTP or over a separate bus using IRIG-B.

Pre-emptive condition monitoring
For continuous control of its operational availability REF615 features a comprehensive set of monitoring functions to supervise the IED itself, the CB trip circuit and the circuit breaker. Depending on the chosen device configuration, the IED monitors the wear and tear of the circuit breaker, the spring charging time of the CB operating mechanism and

the gas pressure of the breaker chambers. The IED also supervises the breaker travel time and the number of CB operations to provide basic information for scheduling CB maintenance.

Single line diagram
The 615 series IEDs with large graphical display offer customizable single line mimic diagrams (SLD) with position indication for the switching devices. The IED can also display measured values provided by the chosen standard configuration. The SLD is also available via the web-browser based HMI. The default SLD can be modified according to user needs using the graphical display editor of PCM600.

Standard configurations

Standard configurations

Description	Standard configuration
Non-directional overcurrent and directional earth-fault protection	**A and B**
Non-directional overcurrent and non-directional earth-fault protection	**C and D**
Non-directional overcurrent and directional earth-fault protection with phase-voltage based measurements	**E**
Directional overcurrent and directional earth-fault protection with phase-voltage based measurements, undervoltage and overvoltage protection	**F**
Directional overcurrent and directional earth-fault protection, phase-voltage based protection and measurement functions, sensor inputs	**G**
Non-directional overcurrent and non-directional earth-fault protection, phase-voltage and frequency based protection and measurement functions, synchro check	**H**

● = included, o = optional

Supported functions, codes and symbols

Functionality	IEC 61850	IEC 60617	IEC-ANSI	A	B	C	D	E	F	G	H
Protection											
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	3I> (1)	51P-1 (1)	●	●	●	●	●	-	-	●
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	3I>> (1)	51P-2 (1)	●	●	●	●	●	-	-	●
Three-phase non-directional overcurrent protection, high stage, instance 2	PHHPTOC2	3I>> (2)	51P-2 (2)	●	●	●	●	●	-	-	●
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	PHIPTOC1	3I>>> (1)	50P/51P (1)	●	●	●	●	●	●	●	●
Three-phase directional overcurrent protection, low stage, instance 1	DPHLPDOC1	3I> → (1)	67-1 (1)	-	-	-	-	-	●	●	-
Three-phase directional overcurrent protection, low stage, instance 2	DPHLPDOC2	3I> → (2)	67-1 (2)	-	-	-	-	-	-	●	-
Three-phase directional overcurrent protection, high stage	DPHHPDOC1	3I>> →	67-2	-	-	-	-	-	●	●	-
Non-directional earth-fault protection, low stage, instance 1	EFLPTOC1	Io> (1)	51N-1 (1)	-	-	●[2]	●[2]	-	-	-	●[2]
Non-directional earth-fault protection, low stage, instance 2	EFLPTOC2	Io> (2)	51N-1 (2)	-	-	●[2]	●[2]	-	-	-	●[2]
Non-directional earth-fault protection, high stage, instance 1	EFHPTOC1	Io>> (1)	51N-2 (1)	-	-	●[2]	●[2]	-	-	-	●[2]
Non-directional earth-fault protection, instantaneous stage	EFIPTOC1	Io>>>	50N/51N	-	-	●[2]	●[2]	-	-	-	●[2]
Directional earth-fault protection, low stage, instance 1	DEFLPDEF1	Io> → (1)	67N-1 (1)	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Directional earth-fault protection, low stage, instance 2	DEFLPDEF2	Io> → (2)	67N-1 (2)	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Directional earth-fault protection, high stage	DEFHPDEF1	Io>> →	67N-2	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Admittance based earth-fault protection, instance 1	EFPADM1	Yo> → (1)	21YN (1)	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Admittance based earth-fault protection, instance 2	EFPADM2	Yo> → (2)	21YN (2)	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Admittance based earth-fault protection, instance 3	EFPADM3	Yo> → (3)	21YN (3)	●[1,2,6]	●[1,2,6]	-	-	●[1,2,4]	●[1,2,4]	●[1,2,5]	-
Transient / intermittent earth-fault protection	INTRPTEF1	Io> → IEF	67NIEF	●[6,7]	●[6,7]	-	-	●[6,7]	●[6,7]	-	-
Non-directional (cross-country) earth fault protection, using calculated Io	EFHPTOC1	Io>> (1)	51N-2 (1)	●[3]	●[3]	-	-	●[3]	●[3]	●[3]	-
Negative-sequence overcurrent protection, instance 1	NSPTOC1	I2> (1)	46 (1)	●	●	●	●	●	●	●	●

Supported functions, codes and symbols

Functionality	IEC 61850	IEC 60617	IEC-ANSI	A	B	C	D	E	F	G	H
Protection											
Negative-sequence overcurrent protection, instance 2	NSPTOC2	I2> (2)	46 (2)	●	●	●	●	●	●	●	●
Phase discontinuity protection	PDNSPTOC1	I2/I1>	46PD	●	●	●	●	●	●	●	●
Residual overvoltage protection, instance 1	ROVPTOV1	Uo> (1)	59G (1)	●6)	●6)	-	-	●4)	●4)	●5)	●4)
Residual overvoltage protection, instance 2	ROVPTOV2	Uo> (2)	59G (2)	●6)	●6)	-	-	●4)	●4)	●5)	●4)
Residual overvoltage protection, instance 3	ROVPTOV3	Uo> (3)	59G (3)	●6)	●6)	-	-	●4)	●4)	●5)	●4)
Three-phase undervoltage protection, instance 1	PHPTUV1	3U< (1)	27 (1)	-	-	-	-	●	●	●	●
Three-phase undervoltage protection, instance 2	PHPTUV2	3U< (2)	27 (2)	-	-	-	-	●	●	●	●
Three-phase undervoltage protection, instance 3	PHPTUV3	3U< (3)	27 (3)	-	-	-	-	●	●	●	●
Three-phase overvoltage protection, instance 1	PHPTOV1	3U> (1)	59 (1)	-	-	-	-	●	●	●	●
Three-phase overvoltage protection, instance 2	PHPTOV2	3U> (2)	59 (2)	-	-	-	-	●	●	●	●
Three-phase overvoltage protection, instance 3	PHPTOV3	3U> (3)	59 (3)	-	-	-	-	●	●	●	●
Positive-sequence undervoltage protection, instance 1	PSPTUV1	U1< (1)	47U+ (1)	-	-	-	-	●	●	●	-
Negative-sequence overvoltage protection, instance 1	NSPTOV1	U2> (1)	47O- (1)	-	-	-	-	●	●	●	●
Frequency protection, instance 1	FRPFRQ1	f>/f<,df/dt (1)	81 (1)	-	-	-	-	-	-	-	●
Frequency protection, instance 2	FRPFRQ2	f>/f<,df/dt (2)	81 (2)	-	-	-	-	-	-	-	●
Frequency protection, instance 3	FRPFRQ3	f>/f<,df/dt (3)	81 (3)	-	-	-	-	-	-	-	●
Three-phase thermal protection for feeders, cables and distribution transformers	T1PTTR1	3Ith>F	49F	●	●	●	●	●	●	●	-
Circuit breaker failure protection	CCBRBRF1	3I>/Io>BF	51BF/51NBF	●	●	●	●	●	●	●	●
Three-phase inrush detector	INRPHAR1	3I2f>	68	●	●	●	●	●	●	●	●
Master trip, instance 1	TRPPTRC1	Master Trip (1)	94/86 (1)	●	●	●	●	●	●	●	●
Master trip, instance 2	TRPPTRC2	Master Trip (2)	94/86 (2)	●	●	●	●	●	●	●	●
Arc protection, instance 1	ARCSARC1	ARC (1)	50L/50NL (1)	o	o	o	o	o	o	o	o
Arc protection, instance 2	ARCSARC2	ARC (2)	50L/50NL (2)	o	o	o	o	o	o	o	o
Arc protection, instance 3	ARCSARC3	ARC (3)	50L/50NL (3)	o	o	o	o	o	o	o	o
Control											
Circuit-breaker control	CBXCBR1	I ↔ O CB	I ↔ O CB	●	●	●	●	●	●	●	●
Disconnector position indication, instance 1	DCSXSWI1	I ↔ O DC (1)	I ↔ O DC (1)	-	●	-	●	●	●	●	●
Disconnector position indication, instance 2	DCSXSWI2	I ↔ O DC (2)	I ↔ O DC (2)	-	●	-	●	●	●	●	●
Disconnector position indication, instance 3	DCSXSWI3	I ↔ O DC (3)	I ↔ O DC (3)	-	●	-	●	●	●	●	●
Earthing switch indication	ESSXSWI1	I ↔ O ES	I ↔ O ES	-	●	-	●	●	●	●	●
Auto-reclosing	DARREC1	O → I	79	o	o	o	o	o	o	o	o
Synchronism and energizing check	SECRSYN1	SYNC	25	-	-	-	-	-	-	-	●
Condition Monitoring											
Circuit-breaker condition monitoring	SSCBR1	CBCM	CBCM	-	●	-	●	●	●	●	●
Trip circuit supervision, instance 1	TCSSCBR1	TCS (1)	TCM (1)	●	●	●	●	●	●	●	●
Trip circuit supervision, instance 2	TCSSCBR2	TCS (2)	TCM (2)	●	●	●	●	●	●	●	●
Current circuit supervision	CCRDIF1	MCS 3I	MCS 3I	-	-	-	-	●	●	●	●
Fuse failure supervision	SEQRFUF1	FUSEF	60	-	-	-	-	●	●	●	●
Measurement											
Disturbance recorder	RDRE1	-	-	●	●	●	●	●	●	●	●
Three-phase current measurement, instance 1	CMMXU1	3I	3I	●	●	●	●	●	●	●	●
Sequence current measurement	CSMSQI1	I1, I2, I0	I1, I2, I0	●	●	●	●	●	●	●	●
Residual current measurement, instance 1	RESCMMXU1	Io	In	●	●	●	●	●	●	●	●
Three-phase voltage measurement	VMMXU1	3U	3U	-	-	-	-	●	●	●	●
Residual voltage measurement	RESVMMXU1	Uo	Vn	●	●	-	-	●	●	-	●
Sequence voltage measurement	VSMSQI1	U1, U2, U0	U1, U2, U0	-	-	-	-	●	●	●	●
Three-phase power and energy measurement, including power factor	PEMMXU1	P, E	P, E	-	-	-	-	●	●	●	●
Frequency measurement	FMMXU1	f	f	-	-	-	-	-	-	-	●

1) Admittance based E/F can be selected as an alternative to directional E/F when ordering
2) Io selectable by parameter, Io measured as default
3) Io selectable by parameter, Io calculated as default
4) Uo selectable by parameter, Uo measured as default
5) Uo calculated is always used
6) Uo measured is always used
7) Io measured is always used

Note that all directional protection functions can also be used in non-directional mode. The instances of a protection function represent the number of identical function blocks available in a standard configuration. By setting the application specific parameters of an instance, a protection function stage can be established.

Contact us

For more information see REF615 Product Guide
or contact us:

ABB Oy, Distribution Automation
P.O. Box 699
FI-65101 VAASA, Finland
Phone: +358 10 22 11
Fax: +358 10 22 41094

ABB Limited, Distribution Automation
Maneja, Vadodara – 390013, India
Phone: +91 265 260 4386
Fax: +91 265 263 8922

ABB Industrial Park
Torch Hi-tech Industrial Development Zone
Xiamen, Fujian, 361006, P.R.China
Phone: +86 592 570 2288
Fax: +86 592 571 8598

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