Relion® 615 series

Transformer protection and control RET615

Power and productivity
for a better world™

Compact and versatile solution for utility and industrial power distribution systems

RET615 is a dedicated transformer protection and control IED for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industry power distribution systems.

RET615 is a member of ABB's Relion® protection and control product family and its 615 series. The 615 series IEDs are characterized by their compactness and withdrawable-unit design. Re-engineered from the ground up, the 615 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability between substation automation devices.

Application

RET615 is an advanced protection and control IED for two-winding power transformers and power generator-transformer blocks. RET615 is available in eight standard configurations to match the most commonly employed power transformer vector groups and to coordinate the applied transformer neutral earthing principles with the relevant earth-fault protection schemes.

Protection and control

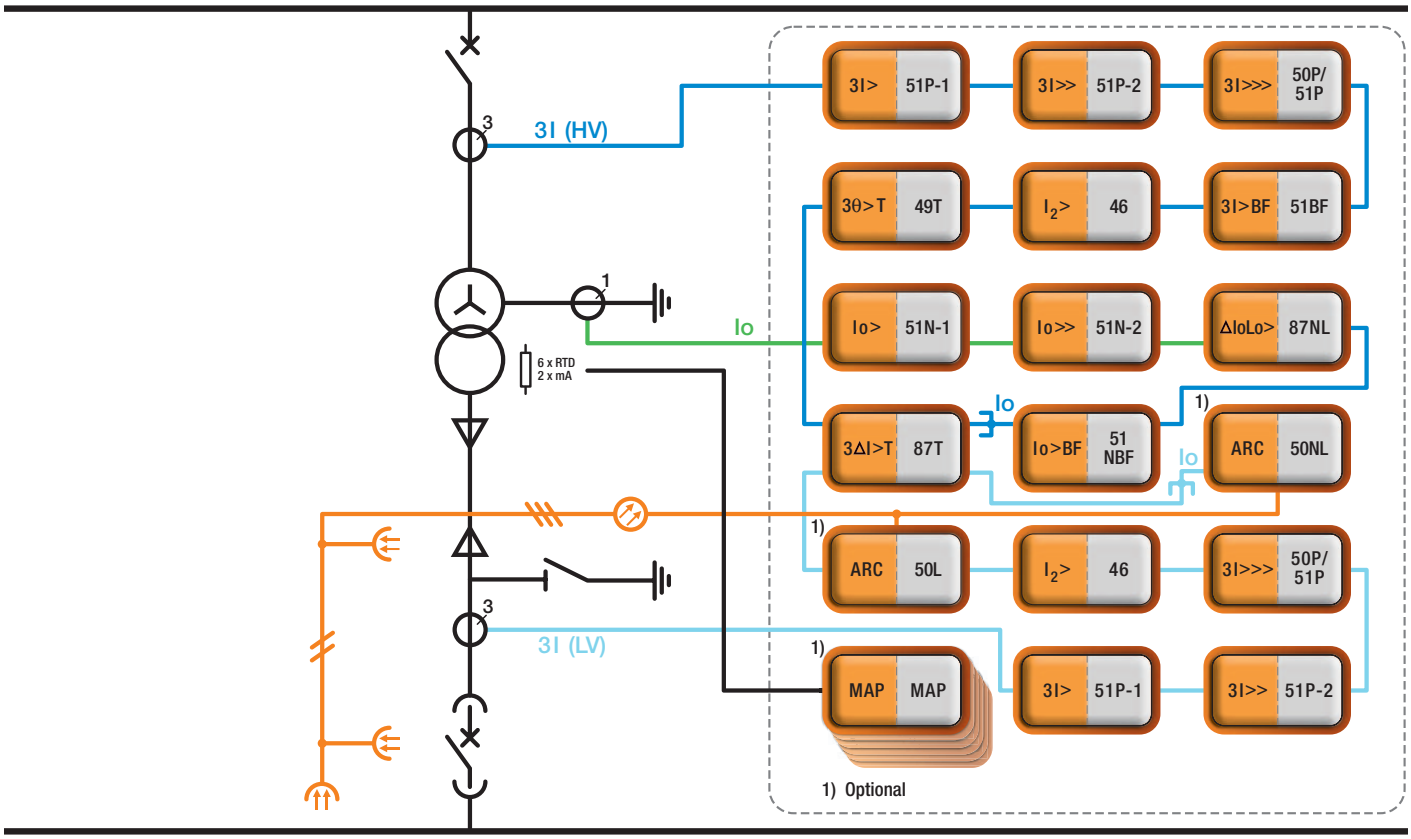
RET615 features, three-phase, multi-slope stabilized (biased) stage transformer differential protection and an instantaneous stage to provide fast and selective phase-to-phase short-circuit, winding interturn fault and bushing flash-over protection. Besides second harmonic restraint an advanced waveform-based blocking algorithm ensures stability at transformer energization and a fifth harmonic restraint function ensures good protection stability at moderate overexcitation of a power transformer. Sensitive restricted earth-fault protection (REF) completes the overall differential protection providing detection of even single phase-to-earth faults close to the earthed neutral point of the transformer. Either the conventional high-impedance scheme or a numerical low-impedance scheme can be selected for protection of the transformer windings. When low-impedance REF protection is used, neither stabilizing resistors nor varistors are needed. As a further benefit the transforming ratio of the neutral earthing CT may differ from that of the phase current transformers. Due to its unit protection character and absolute selectivity the REF protection does not need to be time graded with other protection schemes, and therefore high-speed fault clearance can be achieved.

RET615 also incorporates a thermal overload protection function, which supervises the thermal stress of the transformer windings to prevent premature aging of the insulation of the windings. Multiple stages of short-circuit, phase-overcurrent, negative-phase-sequence and earth-fault back-up protection are provided for both the high voltage and the low voltage side of the transformer. Depending on the standard configuration the IED also includes three-phase overvoltage protection, three-phase undervoltage protection and earth fault protection based on a measured or calculated residual voltage. Furthermore, RET615 also offers circuit-breaker failure protection. Enhanced with an optional communication card, RET615 offers a fast three-channel arc-fault protection system for arc flash supervision of the circuit-breaker, busbar and cable compartment of metal-enclosed air-insulated switchgears.

The optional RTD/mA module offered for the standard configurations A – D allow up to six temperature signals to be measured via the RTD inputs and two transducer derived analog signals via the mA inputs. The RTD and mA inputs can be used for measuring the oil temperature at the bottom and top of the transformer. Furthermore, the RTD/mA inputs can be used for measuring the ambient air temperature. The RTD inputs also offer thermal protection of dry-type power transformers fitted with Pt-100 temperature sensors. Temperature measurement over the RTD /mA inputs extends the function of the three-phase thermal overload protection of the IED. An RTD input can also be used as a direct resistance measuring input for position tracking of an on-load tap changer. Alternatively, tap changer position can be obtained via a mA-transducer. The analog temperature or tap changer position values can, if required, be sent using analog horizontal GOOSE messaging to other IEDs.

RET615 also integrates functionality for the control of the HV-side circuit breaker via the front panel HMI or by means of remote controls. RET615 also features two control blocks which are intended for motor-operated control of disconnectors or circuit-breaker trucks and their position indications. Further, RET615 offers a control block which is intended for motor-operated control of one earthing switch control and it's position indication. The number of controllable primary devices depends on the number of available inputs and outputs in the selected configuration.

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



Protection function overview of the A configuration of RET615.

Standardized communication

RET615 features genuine support for the new IEC 61850 standard for inter-device communication in substations. It also supports the DNP3 and the IEC 60870-5-103 protocol, as also the industry standard Modbus® protocol.

For a self-healing Ethernet solution the IED offers an optional fibre-optic communication module providing two optical and one galvanic Ethernet network interfaces. Alternatively, the IED features an optional galvanic communication module with two galvanic and one optical Ethernet network interfaces or three galvanic interfaces. The third Ethernet interface provides connectivity of any other Ethernet devices to an IEC 61850 station bus inside of a switchgear bay. 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.

The implementation of the IEC 61850 substation communication standard in RET615 covers both vertical and horizontal communication, including GOOSE messaging with both binary and analog signals and parameter setting according to IEC 61850-8-1. The substation configuration language enables the use of engineering tools for efficient configuration and commissioning of substation devices. For accurate time stamping RET615 supports synchronization over Ethernet using SNTP or over a separate bus using IRIG-B.

Preventive condition monitoring

For continuous control of its operational availability RET615 features a comprehensive set of monitoring functions to supervise the IED itself, the CB trip circuit and the circuit breaker. 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 to support asset management.

Single line diagram

The 615 series IEDs with large graphical display offer customizable visual single line mimic diagrams (SLD) with position indication for the relevant circuit breaker, disconnectors and the earthing switch. Apart from the default single line diagram, the IED may display related measured values, as provided by the chosen standard configuration. The SLD view can also be accessed through the web-browser based user interface. The default SLD can be modified according to user requirements using the graphical display editor of PCM600.

Standard configurations

Standard configurations	
Description	**Standard configuration**
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the high-voltage (HV) side, CB control (HV side) and optional RTD/mA inputs	**A**
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the low-voltage (LV) side, CB control (HV side), optional RTD/mA inputs	**B**
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the high-voltage (HV) side, CB control (HV side) and optional RTD/mA inputs	**C**
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the low-voltage (LV) side, CB control (HV side) and optional RTD/mA inputs	**D**
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the high-voltage (HV) side, phase-voltage based protection and measurement functions and CB control (HV side)	**E**
Three-phase transformer differential protection for two-winding transformers, numerical restricted earth-fault protection for the low-voltage (LV) side, phase-voltage based protection and measurement functions and CB control (HV side)	**F**
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the high-voltage (HV) side, phase-voltage based protection and measurement functions and CB control (HV side)	**G**
Three-phase transformer differential protection for two-winding transformers, high-impedance based restricted earth-fault protection for the low-voltage (LV) side, phase-voltage based protection and measurement functions and CB control (HV side)	**H**

Supported functions, codes and symbols
Functionality
Protection
Stabilized and instantaneous differential protection for two-winding transformers
Multi-purpose protection [9]
Master trip
HV-side protection
Numerical stabilized low impedance restricted earth-fault protection
High impedance based restricted earth-fault protection
Three-phase non-directional overcurrent protection, low stage
Three-phase non-directional overcurrent protection, high stage
Three-phase non-directional overcurrent protection, instantaneous stage
Non-directional earth-fault protection, low stage
Non-directional earth-fault protection, high stage
Negative-sequence overcurrent protection
Residual overvoltage protection [5]
Three-phase undervoltage protection
Three-phase overvoltage protection
Three-phase thermal overload protection for power transformers, two time constants
Circuit-breaker failure protection [2]
LV-side protection
Numerical stabilized low impedance restricted earth-fault protection
High impedance based restricted earth-fault protection
Three-phase non-directional overcurrent protection, low stage
Three-phase non-directional overcurrent protection, high stage
Three-phase non-directional overcurrent protection, instantaneous stage
Non-directional earth-fault protection, low stage
Non-directional earth-fault protection, high stage
Negative-sequence overcurrent protection
Arc protection [4]

1, 2,... = number of included instances / I/Os
( ) = optional

	IEC 61850	IEC 60617	IEC-ANSI	A	B	C	D	E	F	G	H
	TR2PTDF	3dI>T	87T	1	1	1	1	1	1	1	1
	MAPGAPC	MAP	MAP	(6)	(6)	(6)	(6)	-	-	-	-
	TRPPTRC	Master Trip	94/86	2	2	2	2	2	2	2	2
	LREFPNDF	dIoLo>	87NL	1	-	-	-	1	-	-	-
	HREFPDIF	dIoHi>	87NH	-	-	1	-	-	-	1	-
	PHLPTOC	3I>	51P-1	1	1	1	1	1	1	1	1
	PHHPTOC	3I>>	51P-2	1	1	1	1	1	1	1	1
	PHIPTOC	3I>>>	50P/51P	1	1	1	1	1	1	1	1
	EFLPTOC	Io>	51N-1	1 [1)]	-	1 [2)]	-	1 [1)]	-	1 [2)]	-
	EFHPTOC	Io>>	51N-2	1 [1)]	-	1 [2)]	-	1 [1)]	-	1 [2)]	-
	NSPTOC	I2>	46	1	1	1	1	1	1	1	1
	ROVPTOV	Uo>	59G	-	-	-	-	2	2	2	2
	PHPTUV	3U<	27	-	-	-	-	2	2	2	2
	PHPTOV	3U>	59	-	-	-	-	2	2	2	2
	T2PTTR	3Ith>T	49T	1	1	1	1	1	1	1	1
	CCBRBRF	3I>/Io>BF	51BF/51NBF	1	1	1	1	1	1	1	1
	LREFPNDF	dIoLo>	87NL	-	1 [7)]	-	-	-	1 [7)]	-	-
	HREFPDIF	dIoHi>	87NH	-	-	-	1 [6)]	-	-	-	1 [6)]
	PHLPTOC	3I>	51P-1	1	1	1	1	1	1	1	1
	PHHPTOC	3I>>	51P-2	1	1	1	1	1	1	1	1
	PHIPTOC	3I>>>	50P/51P	1	1	1	1	1	1	1	1
	EFLPTOC	Io>	51N-1	-	1 [8)]	-	1 [3)]	-	1 [8)]	-	1 [3)]
	EFHPTOC	Io>>	51N-2	-	1 [8)]	-	1 [3)]	-	1 [8)]	-	1 [3)]
	NSPTOC	I2>	46	1	1	1	1	1	1	1	1
	ARCSARC	ARC	50L/50NL	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

Standard configurations

Supported functions, codes and symbols
Functionality
Control
Disconnector control
Earthing switch control
Disconnector position indication
Earthing switch indication
Tap changer position indication
Circuit-breaker control (HV-side)
Condition Monitoring
Circuit-breaker condition monitoring
Trip circuit supervision
Fuse failure supervision
Runtime counter for machines and devices
Measurement
Disturbance recorder
RTD/mA measurement
HV-side measurement
Three-phase current measurement
Sequence current measurement
Residual current measurement
Three-phase voltage measurement
Residual voltage measurement
Sequence voltage measurement
Three-phase power, energy measurement, including power factor
LV-side measurement
Three-phase current measurement
Residual current measurement
Inputs/Outputs
Analog inputs
CT
VT
RTD inputs [13)]
mA inputs [13)]
Binary outputs/inputs
BI [13)]
BO [13)]

1, 2,... = number of included instances / I/Os
( ) = optional

IEC 61850	IEC 60617	IEC-ANSI	A	B	C	D	E	G	F	H
DCXSWI	I ↔ O DCC	I ↔ O DCC	2	2	2	2	2	2	2	2
ESXSWI	I ↔ O ESC	I ↔ O ESC	1	1	1	1	1	1	1	1
DCSXSWI	I ↔ O DC	I ↔ O DC	3	3	3	3	3	3	3	3
ESSXSWI	I ↔ O ES	I ↔ O ES	2	2	2	2	2	2	2	2
TPOSSLTC	TPOSM	84M	1	1	1	1	1	1	1	1
CBXCBR	I ↔ O CB	I ↔ O CB	1	1	1	1	1	1	1	1
SSCBR	CBCM	CBCM	1	1	1	1	1	1	1	1
TCSSCBR	TCS	TCM	2	2	2	2	2	2	2	2
SEQRFUF	FUSEF	60	-	-	-	-	1	1	1	1
MDSOPT	OPTS	OPTM	1	1	1	1	1	1	1	1
RDRE	-	-	1	1	1	1	1	1	1	1
XRGGIO130	X130 (RTD)	X130 (RTD)	(1)	(1)	(1)	(1)	-	-	-	-
CMMXU	3I	3I	1	1	1	1	1	1	1	1
CSMSQI	I1, I2, I0	I1, I2, I0	1	1	1	1	1	1	1	1
RESCMMXU	Io	In	1	-	1	-	1	-	1	-
VMMXU	3U	3U	-	-	-	-	1	1	1	1
RESVMMXU	Uo	Vn	-	-	-	-	1	1	1	1
VSMSQI	U1, U2, U0	U1, U2, U0	-	-	-	-	1	1	1	1
PEMMXU	P, E	P, E	-	-	-	-	1	1	1	1
CMMXU	3I(B)	3I(B)	1	1	1	1	1	1	1	1
RESCMMXU	Io(B)	In(B)	-	1	-	1	-	1	-	1
			7	7	7	7	7	7	7	7
			-	-	-	-	5 [10]	5 [10]	5 [10]	5 [10]
			(6) [11]	(6) [11]	(6) [11]	(6) [11]	-	-	-	-
			(2) [11]	(2) [11]	(2) [11]	(2) [11]	-	-	-	.
			8 (14) [12]	8 (14) [12]	8 (14) [12]	8 (14) [12]	12	12	12	12
			10 (13) [12]	10 (13) [12]	10 (13) [12]	10 (13) [12]	10	10	10	10

[1] Io selectable by parameter and the default value is Io measured
[2] Io calculated is always used
[3] IoB calculated is always used
[4] IoB calculated and 3IB are always used
[5] Uo selectable by parameter, Uo measured as default
[6] IoB measured is always used
[7] IoB measured and 3IB are always used
[8] IoB selectable by parameter, IoB measured as default
[9] Multi-purpose protection is used for, for example, RTD/mA based protection
[10] One of the five inputs is reserved for future applications
[11] With optional RTD/mA module
[12] With optional binary I/O module ( )
[13] The optional I/O module and the optional RTD/mA modules are mutually exlusive

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 RET615 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

www.abb.com/substationautomation

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