

Feeder Protection REF615

Product Guide



Contents

1. Description	3	14. Inputs and outputs	9
2. Standard configurations	3	15. Communication	10
3. Protection functions	4	16. Technical data	12
4. Application	6	17. Display options	28
5. Control.	8	18. Mounting methods	29
6. Measurement.	8	19. Relay case and relay plug-in unit	29
7. Disturbance recorder.	8	20. Selection and ordering data	30
8. Event log	8	21. Accessories and ordering data	33
9. Recorded data.	8	22. Tools	33
10. Circuit-breaker monitoring	9	23. Terminal diagrams	35
11. Trip-circuit supervision	9	24. Certificates	37
12. Self-supervision.	9	25. References	37
13. Access control.	9	26. Functions, codes and symbols	38

Disclaimer

The information in this document is subject to change without notice and should not be construed as a commitment by ABB Oy. ABB Oy assumes no responsibility for any errors that may appear in this document.

© Copyright 2008 ABB Oy

All rights reserved.

Trademarks

ABB is a registered trademark of ABB Group. All other brand or product names mentioned in this document may be trademarks or registered trademarks of their respective holders.

1. Description

REF615 is a dedicated feeder protection relay designed for the protection, measurement and supervision of utility substations and industrial power systems. Re-engineered from the ground up, the relay has been guided by the IEC 61850 standard for communication and interoperability of substation automation devices.

The relay provides main protection for overhead lines and cable feeders in distribution networks. The relay is also used as back-up protection in applications, where an independent and redundant protection system is required.

Depending on the preconfiguration made, the relay is adapted for the protection of overhead line and cable feeders in isolated neutral, resistance earthed, compensated and

solidly earthed networks. Once the standard configuration relay has been given the application-specific settings, it can directly be put into service.

The 615 series relays support a range of communication protocols including IEC 61850 with GOOSE messaging and Modbus®.

2. Standard configurations

The feeder protection relay REF615 is available with four alternative standard configurations. The table below indicates the functions supported by the different relay configurations.

Standard configuration functionality	Overcurrent and directional earth-fault protection		Overcurrent and non-directional earth-fault protection	
	Std. conf. A	Std. conf. B	Std. conf. C	Std. conf. D
Protection				
Three-phase non-directional overcurrent, low-set stage	•	•	•	•
Three-phase non-directional overcurrent, high-set stage, instance 1	•	•	•	•
Three-phase non-directional overcurrent, high-set stage, instance 2	•	•	•	•
Three-phase non-directional overcurrent, instantaneous stage	•	•	•	•
Directional earth-fault, low-set stage, instance 1	•	•	-	-
Directional earth-fault, low-set stage, instance 2	•	•	-	-
Directional earth-fault, high-set stage	•	•	-	-
Non-directional earth-fault, high-set stage (cross country earth-fault)	•	•	-	-
Transient/intermittent earth-fault	•	•	-	-
Non-directional earth-fault, low-set stage	-	-	•	•
Non-directional earth-fault, high-set stage	-	-	•	•
Non-directional earth-fault, instantaneous stage	-	-	•	•

Protection, continued

Non-directional sensitive earth-fault	-	-	•	•
Negative-sequence overcurrent, instance 1	•	•	•	•
Negative-sequence overcurrent, instance 2	•	•	•	•
Phase discontinuity	•	•	•	•
Thermal overload	•	•	•	•
Circuit breaker failure protection	•	•	•	•
Three-phase inrush current detection	•	•	•	•
Arc protection with three sensors	o	o	o	o
Control				
Circuit breaker control with basic interlocking ¹⁾	•	•	•	•
Circuit breaker control with extended interlocking ²⁾	-	•	-	•
Auto-reclosing of one circuit breaker	o	o	o	o
Supervision and Monitoring				
Circuit breaker condition monitoring	-	•	-	•
Trip-circuit supervision of two trip circuits	•	•	•	•
Measurement				
Transient disturbance recorder	•	•	•	•
Three-phase current measurement	•	•	•	•
Current sequence components	•	•	•	•
Residual current measurement	•	•	•	•
Residual voltage measurement	•	•	-	-

• = Included, o = Optional at the time of the order

- 1) Basic interlocking functionality: Closing of the circuit breaker can be enabled by a binary input signal. The actual interlocking scheme is implemented outside the relay. The binary input serves as a "master interlocking input" and when energized it will enable circuit breaker closing.
- 2) Extended interlocking functionality: The circuit breaker interlocking scheme is implemented in the relay configuration, based on primary equipment position information (via binary inputs) and the logical functions available. The signal matrix tool of PCM600 can be used for modifying the interlocking scheme to suit your application.

3. Protection functions

The relay offers overcurrent and thermal overload protection, directional and nondirectional earth-fault protection, sensitive earth-fault protection, phase discontinuity protection, transient/intermittent earth-fault protection and three-pole multi-shot auto-reclose functions for overhead line feeders.

Enhanced with optional hardware and software, the relay also features three light

detection channels for arc fault protection of the circuit breaker, busbar and cable compartment of metal-enclosed indoor switchgear.

The arc-fault protection sensor interface is available on the optional communication module. Fast tripping increases personal safety and limits material damage within the switchgear in an arc fault situation.

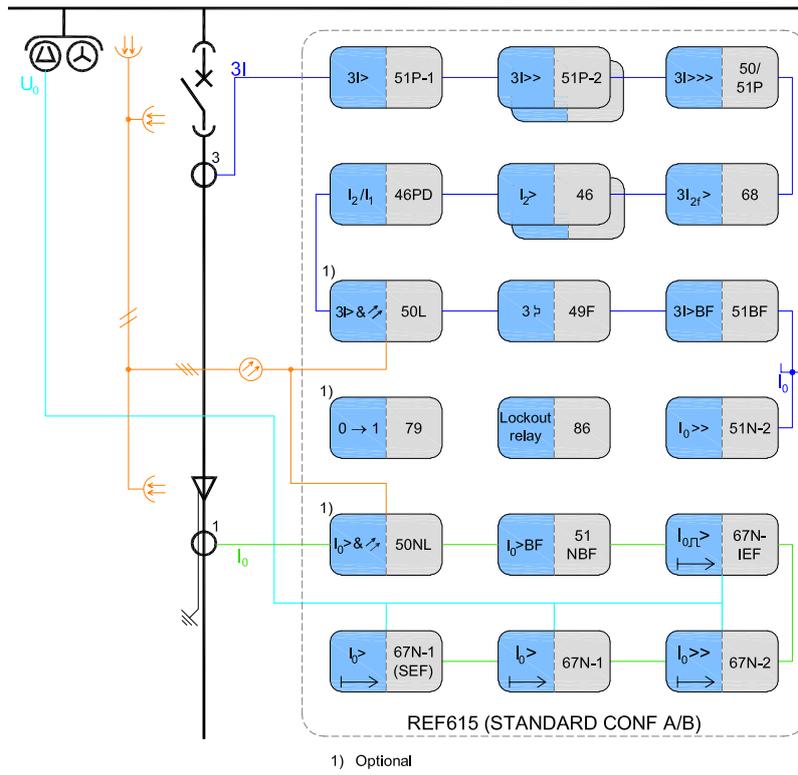


Fig. 1 Protection function overview of standard configuration A and B

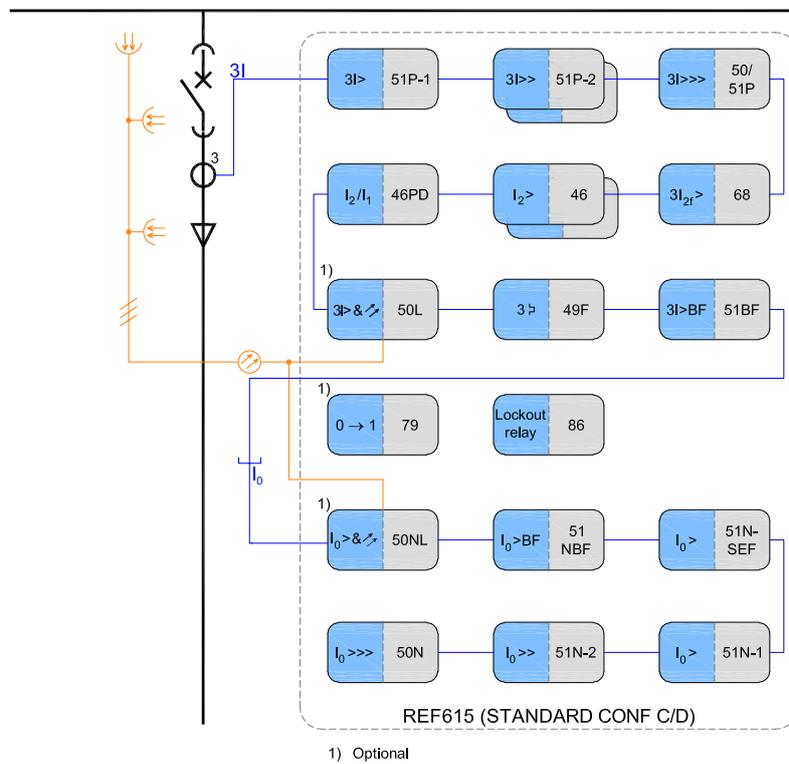


Fig. 2 Protection function overview of standard configuration C and D

4. Application

The feeder protection relay REF615 can be supplied either with directional or non-directional earth-fault protection. Directional earth-fault protection is mainly used in isolated or compensated networks, whereas non-directional earth-fault protection is intended for directly or low impedance earthed networks.

The standard configurations A and B offer directional earth-fault protection, if the outgoing feeder includes phase current transformers, a core-balance current transformer and residual voltage measurement. The residual current calculated from the phase currents can be used for double (cross country) earth-fault protection. The relay further features transient/intermittent earth-fault protection. The standard configurations C and D offer non-directional earth-fault protection for outgoing feeders including phase current trans-

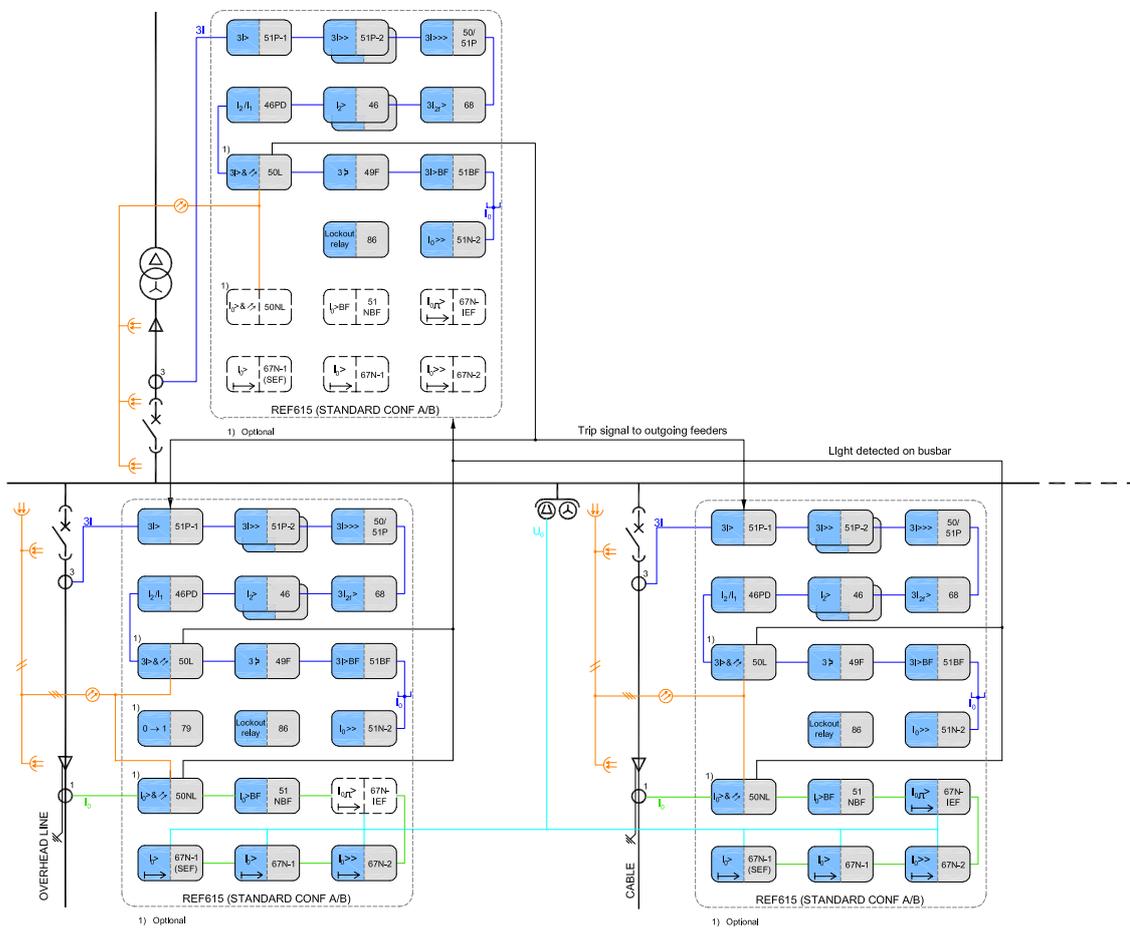


Fig. 3 Substation O/C and E/F protection using the standard configuration A or B with relevant options. In the incoming feeder bay, the protection functions not used are uncoloured and indicated with a dashed block outline. The relays are equipped with optional arc protection functions, enabling fast and selective arc protection throughout the switchgear.

formers. The residual current for the earth-fault protection is derived from the phase currents. When applicable, the core-balance current transformers can be used for measuring the residual current, especially when sensitive earth-fault protection is required.

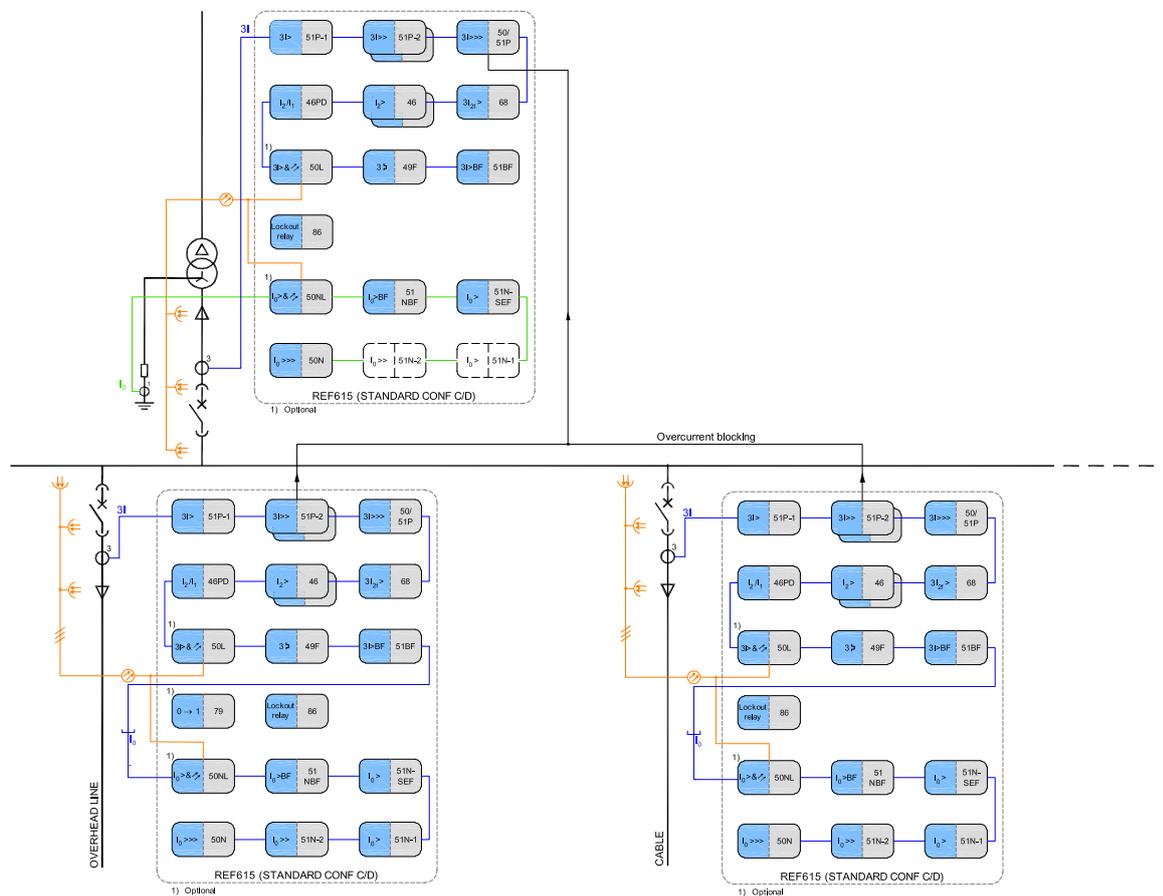


Fig. 4 Substation O/C and E/F protection using the standard configuration C or D with relevant options. In the incoming feeder bay the unemployed protection functions are uncoloured and indicated with a dashed block outline. The busbar protection is based on the interlocking principle, where the start of the O/C protection of the outgoing feeder sends a blocking signal to the instantaneous O/C stage of the incoming feeder. In the absence of the blocking signal, the O/C protection of the incoming feeder will clear the internal switchgear (busbar) fault.

5. Control

The relay offers control of one circuit breaker with dedicated push-buttons for opening and closing. Interlocking schemes required by the application are configured with the signal matrix tool in PCM600.

6. Measurement

The relay continuously measures the phase currents, the symmetrical components of the currents and the residual current. If the relay includes directional earth-fault protection, it also measures the residual voltage. In addition, the relay calculates the maximum demand value over a user-selectable pre-set time frames, the thermal overload of the protected object, and the phase unbalance value based on the ratio between the negative sequence and positive sequence current.

The values measured can be accessed locally via the user interface on the relay front panel or remotely via the communication interface of the relay. The values can also be accessed locally or remotely using the web-browser based user interface.

7. Disturbance recorder

The relay is provided with a disturbance recorder featuring up to 12 analog and 64 binary signal channels. The analog channels can be set to record either the waveform or the trend of the currents and voltage measured.

The analog channels can be set to trigger the recording function when the measured value falls below or exceeds the set values. The

binary signal channels can be set to start a recording on the rising or the falling edge of the binary signal or both.

By default, the binary channels are set to record external or internal relay signals, e.g. the start or trip signals of the relay stages, or external blocking or control signals. Binary relay signals such as a protection start or trip signal, or an external relay control signal over a binary input can be set to trigger the recording. The recorded information is stored in a non-volatile memory and can be uploaded for subsequent fault analysis.

8. Event log

To collect sequence-of-events (SoE) information, the relay incorporates a non-volatile memory with a capacity of storing 50 event codes with associated time stamps. The non-volatile memory retains its data also in case the relay temporarily loses its auxiliary supply. The event log facilitates detailed pre- and post-fault analyses of feeder faults and disturbances.

The SoE information can be accessed locally via the user interface on the relay front panel or remotely via the communication interface of the relay. The information can further be accessed, either locally or remotely, using the web-browser based user interface.

9. Recorded data

The relay has the capacity to store the records of four fault events. The records enable the user to analyze the four most recent power system events. Each record includes the current and voltage values, the start times of the protection blocks, time stamp, etc. The fault recording can be triggered by the

start signal or the trip signal of a protection block, or by both. The available measurement modes include DFT, RMS and peak-to-peak. In addition, the maximum demand current with time stamp is separately recorded. By default, the records are stored in a non-volatile memory.

10. Circuit-breaker monitoring

The condition monitoring functions of the relay constantly monitors the performance and the condition of the circuit breaker. The monitoring comprises the spring charging time, SF₆ gas pressure, the travel-time and the inactivity time of the circuit breaker.

The monitoring functions provide operational CB history data, which can be used for scheduling preventive CB maintenance.

11. Trip-circuit supervision

The trip-circuit supervision continuously monitors the availability and operability of the trip circuit. It provides open-circuit monitoring both when the circuit breaker is in its closed and in its open position. It also detects loss of circuit-breaker control voltage.

12. Self-supervision

The relay's built-in self-supervision system continuously monitors the state of the relay hardware and the operation of the relay software. Any fault or malfunction detected will be used for alerting the operator. A per-

manent relay fault will block the protection functions of the relay to prevent incorrect relay operation.

13. Access control

To protect the relay from unauthorized access and to maintain information integrity, the relay is provided with a four-level, role-based authentication system with administrator-programmable individual passwords for the viewer, operator, engineer and administrator level. The access control applies to the front-panel user interface, the web-browser based user interface and the PCM600 tool.

14. Inputs and outputs

Depending on the standard configuration selected, the relay is equipped with three phase-current inputs and one residual-current input for non-directional earth-fault protection, or three phase-current inputs, one residual-current input and one residual voltage input for directional earth-fault protection.

The phase-current inputs are rated 1/5 A. Two optional residual-current inputs are available, i.e. 1/5 A or 0.2/1 A. The 0.2/1 A input is normally used in applications requiring sensitive earth-fault protection and featuring core-balance current transformers. The residual-voltage input covers the rated voltages 100, 110, 115 and 120 V.

The phase-current input 1 A or 5 A, the residual-current input 1 A or 5 A, alternatively 0.2 A or 1 A, and the rated voltage of the residual voltage input are selected in the relay software. In addition, the binary input thresholds 18...176 V DC are selected by adjusting the relay's parameter settings.

All binary input and output contacts are freely configurable with the signal matrix tool in PCM600.

Relay analog input and binary input/output overview:

- Four current inputs
- One optional voltage input (for directional E/F protections applications)
- Three binary inputs with U_0 measurement and four binary inputs without U_0 measurement
- Two heavy-duty output relays with normally-open contact
- Two changeover signal-output contacts
- Two double-pole power-output contacts with trip-circuit supervision
- One dedicated IRF output contact

I/O extension module:

- Seven binary control inputs
- Three signaling-output contacts

Optional I/O extension module:

- Six binary control inputs
- Three signaling-output contacts

15. Communication

The relay supports two different communication protocols: IEC 61850 and Modbus®. Operational information and controls are available through these protocols. However, some communication functionality, for example, horizontal communication between the relays, is only enabled by the IEC 61850 communication protocol.

The IEC 61850 communication implementation supports all monitoring and control functions. Additionally, parameter setting and disturbance file records can be accessed using the IEC 61850-8-1 protocol. Further, the relay can send and receive binary signals from other relays (so called horizontal communication) using the IEC61850-8-1 GOOSE profile,

where the highest performance class with a total transmission time of 3 ms is supported. The relay can simultaneously report events to five different clients on the station bus.

All communication connectors, except for the front port connector, are placed on integrated optional communication modules. The relay can be connected to Ethernet-based communication systems via the RJ-45 connector (100BASE-TX) or the fibreoptic LC connector (100BASE-FX). If connection to a RS-485 network is required, the 10-pin screw-terminal connector can be used.

Modbus implementation supports RTU, ASCII and TCP modes. Besides standard Modbus functionality, the relay supports retrieval of time-stamped events, uploading of disturbance files and storing of the latest fault records. If a Modbus TCP connection is used, five clients can be connected to the relay simultaneously.

When the relay uses the RS-485 bus for the Modbus RTU/ASCII communication, both two- and four wire connections are supported. Termination and pull-up/down resistors can be configured with jumpers on the communication card so external resistors are not needed.

The relay supports the following time synchronization method with a time-stamping resolution of +/-1 ms:

Ethernet based:

- SNTP

With special time synchronization wiring:

- IRIG-B