Feeder Protection and Control
REF615 Ver. 2.0
Technical Presentation

Content
REF615 Technical Presentation

- Introduction
- Application examples
- Hardware and options
- Functionality highlights
- Communication
- Mechanical design
- Front panel HMI
- Tools
- Conclusions
Introduction

Relion® 615 series
REF615

REF615 is a member of ABB’s Relion® product family and part of its 615 protection and control product series.

The 615 series IEDs are characterized by their compactness and withdrawable design.

Other members of the 615 product series:
- RET615
- REM615
- RED615
REF615
Description

- REF615 is a dedicated feeder protection IED designed for the protection, measurement and supervision of utility substations and industrial power systems.

Introduction
Application examples
Hardware and options
Functionality
Communication
Mechanical design
Front panel HMI
Tools
Conclusions

REF615
Feeder Protection and Control

- Designed for general applications calling for over-current and earth-fault protection.
- Main application area: cable or overhead line feeders in solidly earthed, resistance earthed, isolated or compensated networks.
- Designed for IEC 61850.
- Optional three-channel arc protection system.

Introduction
Application examples
Hardware and options
Functionality
Communication
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Conclusions
Six different standard configurations available
Possibility to add, delete and change signal connections for binary inputs, binary outputs and between function blocks using PCM600
The number and type of function blocks is fixed

Standard configurations

- Std configuration A
  Non-directional overcurrent and directional E/F protection without CB condition monitoring

- Standard configuration B
  Non-directional overcurrent and directional E/F protection with CB condition monitoring and interlocking schemes

- Standard configuration C
  Non-directional overcurrent and non-directional E/F protection without CB condition monitoring

- Standard configuration D
  Non-directional overcurrent and non-directional E/F protection with CB condition monitoring and interlocking schemes

- Standard configuration E
  Non-directional overcurrent and directional E/F protection with phase-voltage based measurements

- Standard configuration F
  Directional overcurrent and directional earth-fault protection with phase-voltage based measurements, under- / overvoltage and residual overvoltage protection
### REF615
### Standard configurations, page 1(6)

<table>
<thead>
<tr>
<th>Standard configuration</th>
<th>A</th>
<th>B</th>
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<td><strong>Conclusions</strong></td>
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</tbody>
</table>

| Protection functions   |   |   |   |   |   |   |
| 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, high stage, instantaneous stage | ● | ● | ● | ● | ● | ● |
| Three-phase directional overcurrent, low-set stage, instance 1 | - | - | - | - | - | ● |
| Three-phase directional overcurrent, low-set stage, instance 2 | - | - | - | - | - | ● |
| Three-phase directional overcurrent, high-set stage | - | - | - | - | - | ● |
| Non-directional (cross country) earth-fault, using calculated Io | - | - | - | - | - | - |

= included, = optional at the time of order

### REF615
### Standard configurations, page 2(6)

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<tr>
<td><strong>Conclusions</strong></td>
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</tr>
</tbody>
</table>

| Protection functions   |   |   |   |   |   |   |
| Directional earth-fault, low-set stage (SEF), instance 1 | ● | ● | - | - | ● | ● |
| Directional earth-fault, low-set stage, instance 2 | ● | ● | - | - | ● | ● |
| Directional earth-fault, high-set stage | ● | ● | - | - | ● | ● |
| Non-directional (cross country) earth-fault, using calculated Io | ● | ● | - | - | ● | ● |
| Non-directional earth-fault, low-set stage (SEF), instance 1 | - | - | ● | ● | - | - |
| Non-directional earth-fault, low-set stage, instance 2 | - | - | ● | ● | - | - |
| Non-directional earth-fault, high-set stage | - | - | ● | ● | - | - |
| Non-directional earth-fault, instantaneous stage | - | - | ● | ● | - | - |

= included, = optional at the time of order
### REF615
**Standard configurations, page 3(6)**

<table>
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<tr>
<th>Standard configuration</th>
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<td>Negative sequence overcurrent, instance 1</td>
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<td>Negative sequence overcurrent, instance 2</td>
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<td>Phase discontinuity</td>
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<td>●</td>
<td>●</td>
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<tr>
<td>Thermal overload</td>
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<td>●</td>
<td>●</td>
<td>●</td>
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<td>Circuit breaker failure</td>
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<td>Three-phase overvoltage, instance 1</td>
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<td>Negative sequence overvoltage</td>
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- = included, O = optional at the time of order

### REF615
**Standard configurations, page 4(6)**

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<td>Three-phase inrush current detection</td>
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<td>Arc protection with three sensors</td>
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</table>

**Control functions**

- Circuit-breaker control with basic interlocking | ● | ● | ● | ● | ● | ● |
- Circuit-breaker with extended interlocking | ● | ● | ● | ● | ● | ● |

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### REF615 Standard configurations, page 5(6)

<table>
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<td>Circuit breaker conditioning monitoring</td>
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<td>Trip-circuit supervision of two trip circuits</td>
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<td>Three-phase current</td>
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<td>Current sequence components</td>
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● = included, ○ = optional at the time of order

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### REF615 Standard configurations, page 6(6)

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<td>●</td>
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<tr>
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REF615
in isolated networks (std. conf. A or B)

- Main protection: 3I>, I0>
- Directional E/F protection, sensitive E/F protection, core-balance CT connection
- Phase discontinuity protection
- Auto-reclosing
- Thermal overload protection
- Breaker failure protection
- Arc protection for reduced cubicle damage and increased personal safety

REF615 applied for an overhead line feeder in an isolated or compensated network
REF615
in isolated networks (std. conf. A or B)

- Main protection: 3I>, I0>
- Directional E/F protection, sensitive E/F protection, transient/intermittent E/F protection, core balance CT connection
- Thermal overload protection
- Breaker failure protection
- Arc protection for reduced cubicle damage and increased personal safety

REF615 applied for a cable feeder in an isolated or compensated network

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REF615
in isolated networks (std. conf. E)

- Main protection: 3I>, I0>
- Directional E/F protection, sensitive E/F protection, transient/intermittent E/F protection, core-balance CT connection
- Phase discontinuity protection
- Auto-reclosing
- Thermal overload protection
- Breaker failure protection
- Fuse failure supervision
- Current circuit supervision
- Arc protection for reduced cubicle damage and increased personal safety
- Including phase voltage, energy and power measurements

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in isolated networks (std. conf. F)

- Main protection: 3I> →, I0> →
- Directional E/F protection, sensitive E/F protection, transient/intermittent E/F protection, core-balance CT connection
- Phase discontinuity protection
- Auto-reclosing
- Thermal overload protection
- Breaker failure protection
- Fuse failure supervision
- Current circuit supervision
- Arc protection for reduced cubicle damage and increased personal safety

Including phase voltage, energy and power measurements

REF615 for an overhead line or cable feeder in an isolated or compensated network

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REF615

in low-impedance earthed networks (std. conf. C or D)

- Main protection: 3I>, I0>
- Non-dir E/F protection, residual connection
- Phase discontinuity protection
- Breaker failure protection
- Auto-reclosing
- Arc protection for reduced cubicle damage and increased personal safety

REF615 for an overhead line feeder in a directly or low impedance earthed network
REF615
in low-impedance earthed networks
(standard configuration C or D)

- Main protection: \(3I_{>}, I_{>}\)
- E/F protection, residual connection
- Thermal overload protection
- Breaker failure protection
- Arc protection for reduced cubicle damage and increased personal safety

615 series
Supported ABB solutions, page 1(2)

- The 615 series IEDs together with COM600 constitute a genuine IEC 61850 solution for reliable power distribution in utility and industrial power systems
- The native IEC 61850 support offers:
  - Fast software-based communication
  - Continuous supervision of the integrity of the protection and communication system
  - Inherent flexibility for reconfiguration and upgrades
- ABB’s Connectivity Package concept enables:
  - Streamlining of the system engineering and IED configuration
  - Easy integration with COM600 and MicroSCADA Pro

<table>
<thead>
<tr>
<th>Supported ABB solutions</th>
<th>Version</th>
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<tr>
<td>Station Automation COM600</td>
<td>3.3 or later</td>
</tr>
<tr>
<td>MicroSCADA Pro</td>
<td>9.2 SP1 or later</td>
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</table>
The 615 series IEDs complemented with COM600 offer several benefits:

- Enhanced substation level functionality using the data content of the bay level IEDs
- A web HMI providing single-line mimic diagrams for switchgear bay solutions
- COM600 can be used as a local data warehouse for technical documentation and for network data
- Extensive reporting and analyzing of network fault situations
- Seamless connectivity to MicroSCADA Pro and System 800xA
REF615
Hardware modules

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[X000] Communication module (option) with or without arc-protection

[X100] Power supply and binary output module

[X110] Additional binary I/O module (std conf. B and D)

[X120] Basic analog input module

[X130] Optional binary I/O module (std conf. B and D)

or

[X130] Analog voltage input and binary input module (std conf. E and F)

Examples: Ethernet/Serial modules (RJ-45 and LC) with optional arc sensors

REF615
Option: Communication modules [X000]

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- Ethernet options:
  - 100BASE-TX with an RJ-45 connector
  - 100BASE-FX with a fibre-optic LC connector

- Serial options:
  - RS-485 + IRIG-B
    - 9 or 10-pin screw terminal connector
    - 2-wire or 4-wire connection
  - RS-485 / RS-232 + IRIG-B
  - Fibre (ST connector)

- Three arc sensors (option)

Examples: Ethernet/Serial modules (RJ-45 and LC) with optional arc sensors
REF615
Power supply and binary output modules [X100]

- Power supply options:
  - 48 V…250 V DC, 100 V…240 V AC,
  - 24…60 V DC
- Four power output contacts capable of direct CB operation
  - Two contacts with integrated trip circuit supervision; also to be used with double-pole operation
  - The TCS can be disconnected by excluding the resistor from the trip circuit
- Two signal output contacts
  (1 normally open contact, 1 changeover contact)
- IRF output for self-supervision signalling

REF615
Option: Additional binary I/O module [X110]

- 8 binary inputs
  - 6 inputs, grouped (common ground)
  - 2 inputs, separated
- 4 binary outputs
  - 3 outputs, changeover contacts
  - 1 output, normally open
- Selectable binary input thresholds (17 – 186 V DC)
**REF615**

**Basic analog input modules [X120]**

- Four analog current inputs
  - \(I_0, I_{11}, I_{12}, \text{and } I_{13}\), user selectable 1 A or 5 A
  - \(I_0\) optionally user selectable 0.2 A / 1 A
- One voltage input \(U_0\) (std. conf A and B) - alternate fourth binary input with dedicated ground
- Three binary inputs (common ground), thresholds selectable
- Both for ring and pin type wire terminals
- Max. wire 1 x 6 mm\(^2\) or 2 x 2.5 mm\(^2\)

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**REF615**

**Option: Additional binary I/O module [X130]**

- Binary I/O module (std. conf B and D):
  - 6 binary inputs, grouped (common ground)
  - 3 binary outputs, changeover contacts
  - Selectable binary input thresholds (17 – 186 V DC)
- Analog input module (std. conf. E and F):
  - 4 binary inputs
  - 4 analog voltage inputs
  - 1 input reserved for future use
## REF615

### Communication modules

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<tr>
<th>Protocols</th>
<th>With arc protection</th>
<th>Without arc protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td>Serial (RS-485) + IRIG-B + 3 arc sensors</td>
<td>Ethernet (RS-485 or RS-232) + IRIG-B + 3 arc sensors</td>
</tr>
<tr>
<td>Serial</td>
<td>+ IRIG-B + 3 arc sensors</td>
<td>Serial (fibre ST or LC) + IRIG-B</td>
</tr>
</tbody>
</table>

- **IEC 61850-8-1**: •
- **IEC 60870-5-103**: •
- **DNP3 TCP/IP**: •
- **DNP3 serial**: •
- **MODBUS TCP/IP**: •
- **MODBUS RTU/ASCII**: •

- = supported, - = not supported

## REF615

### Input/output overview

<table>
<thead>
<tr>
<th>Standard configuration</th>
<th>Analog Inputs</th>
<th>Binary inputs/outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CT</td>
<td>VT</td>
</tr>
<tr>
<td>Standard configuration A</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Standard configuration B</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Standard configuration C</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Standard configuration D</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Standard configuration E</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Standard configuration F</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

1) With optional binary I/O module ( )
2) One of the five channels is reserved for future applications
Functionality highlights

REF615
Directional overcurrent protection

- Used when the operation has to be fault current direction dependant (more than one fault current source)
- Typical example:
  - Overcurrent protection for parallel running power transformers
  - Can also be used in non-directional mode
- Several polarization modes available:
  - cross polarization
  - negative or positive sequence voltage polarization
  - self polarization
REF615
Transient / intermittent E/F protection

- Intermittent E/F operation mode:
  - Typically used for cable feeders in compensated networks
  - The operation is initiated by a number of transients in the residual current
  - Transients in the residual voltage only for directional comparison

- Transient E/F operation mode:
  - Typically used for mixed cable and overhead line feeders in compensated networks
  - The operation is initiated by the first transient in the residual current and voltage
  - The residual voltage has to be above the set level

REF615
Phase discontinuity protection

- Used to detect unbalance situations caused by a broken conductor
- Phase discontinuity situations may:
  - Be hard to detect by means of E/F protection schemes
  - Pose danger to human life if the conductors are live and fall on the ground
  - Operation based on the ratio between the negative and positive sequence current
  - The ratio is approximately constant under normal conditions despite varying load
  - A constant ratio enables lower settings and increases protection sensitivity
**REF615**

Arc protection (option)

- Increases safety during maintenance work
- Reduces material damage
- Minimizes system downtime
- Continuously supervises the CB, cable and busbar compartment of metal-enclosed switchgear
- Same lens and optic fibre as for REA 107
- Automatic reference level adjustment based on background-light intensity

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**REF615**

Arc protection (option), cont’d

- Arc trip based on:
  - Current and light
  - Current and binary input signal
  - Light only
- Separate trip value settings for phase currents and earth-fault current
- Operate time typically
  - 12 ms (current and light)
  - 10 ms (light only)
- Possible to block the function or change operation mode via a binary input
REF615
Voltage based measurements

- Phase to phase voltages
- Residual voltage
- Power factor
- Apparent, active and reactive power, with an accuracy of 1.5%
- Active and reactive energy, with an accuracy of 1.5%
- Accumulated energy values registered bi-directionally
- Values shown in primary quantities
- VT connections can be either phase to phase, or phase to earth

REF615
Fuse failure supervision

- Detects failures between the voltage measurement circuit and the IED
- Failures are detected by the negative-sequence based algorithm or by the delta voltage and delta current algorithm
- The fuse failure supervision activates an alarm and blocks voltage-dependent protection functions from unintended operation
- Note: the term fuse failure is somewhat misleading since a blown fuse is just one of many possible reasons for a broken circuit
**REF615**

**Current circuit supervision**

- Detects faults in the transformer secondaries and wiring
- Calculates the sum of the phase currents and compares the sum with the measured single reference current from a core balance current transformer or from an other set of current transformers
- Activates an alarm and/or blocks certain protection functions to avoid unintended operation

---

**REF615**

**Control functions**

- Control of one circuit-breaker via the IED’s HMI or a remote control system
- Dedicated push-buttons for opening and closing of the CB
- Interlocking schemes
- Multi-shot auto-reclosing of one CB
**REF615**

**Optional auto-reclosing**

- Clears most transient and semi-transient faults on overhead line feeders
- De-energization of the fault spot for a defined period of time, followed by an automatic reclosure
- Five independently programmable auto-reclose shots
- Can be used with any CB suitable for auto-reclosing
- Can be coordinated with external synchro-checking and remote-end auto-reclosing

---

**REF615**

**Operation traceability**

- For pre and post fault analysis
- Data is stored in non-volatile memory
  - Setting values
  - Configuration
  - Trip lock-out
  - Disturbance recorder data
  - Up to 50 event codes
  - Recorded data of the four latest events with time stamp
  - CB conditioning monitoring values
  - Thermal loading
  - Number of AR shots and starts/trips of the protection stages
- Operation indications and alarm LEDs show the status of the IED
**REF615**

**Disturbance recorder**

- Records up to 12 analog channels and 64 binary channels
- Triggering by:
  - Analog or binary channel
  - Manual or periodic command
- Recording modes:
  - Wave form or trend
  - Selectable sampling rate, 32/16/8 samples per cycle
  - Max 2 x 10 sec with the highest sampling rate and the maximum number of recorded channels.
  - Max 4 x 10 sec if six analog channels are recorded

**Self-supervision**

Continuous monitoring of:
- Memory circuits (RAM, ROM, EEPROM)
- CPU operation and program execution
- Internal supply voltages
- Output relay supervision
- External trip circuit (TCS)
- Light sensor inputs
- Hardware and software configuration
REF615
CB condition monitoring

- Provides information for scheduling CB maintenance
- Monitors the wear and tear of the circuit-breaker
- Circuit-breaker gas pressure
- Circuit-breaker spring charging
- Circuit-breaker travel time
- Circuit-breaker operation counter
- Scheduled maintenance

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Access control

- Individual user accounts with role-based access control protects the IED from unauthorized access
- Four access levels: viewer, operator, engineer and administrator
- Applies to:
  - Front-panel user interface
  - Web browser based user interface
  - PCM600
- Passwords programmable by the administrator

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615 series
Designed for IEC 61850

- Native support for IEC 61850 communication between devices in substations
- IEC 61850 enables "GOOSE" (Generic Object Oriented Substation Event) horizontal communication between IEDs
- REF615 can simultaneously report events to five different clients on the station bus
- REF615 also supports:
  - Modbus TCP/IP and RTU / ASCII
  - DNP3 TCP/IP and serial
  - IEC 60870-5-103
615 series
IEC 61850 GOOSE communication

- Standardized horizontal communication enables interoperability between any IEDs supporting GOOSE communication
- Used for transmitting binary process data to peer IEDs within a substation
- Ethernet technology offers a fast and reliable station bus for the transfer of data
- The publisher-subscriber principle allows the IEDs to send and/or receive time critical data

615 series
GOOSE communication benefits

- Expandability and flexibility:
  - Flexible modifications without changing the wiring between the IEDs
  - No IED IOs are needed for the transfer of data between the IEDs
  - Reduced wiring between the IEDs
  - Possible to add functionality like interlocking schemes between the cubicles in existing switchgear (retrofit)
- Supervised data transfer (connection and data quality)
- REF615 meets the GOOSE performance requirements for tripping applications in distribution substations, as defined by the IEC 61850 standard
REF615
GOOSE - Arc protection

Both IED A (incoming feeder) and IED B (outgoing feeder) are equipped with three arc sensors.
- IED B detects an arc in the busbar compartment via sensor 1 and sends a related GOOSE message to IED A.
- After receiving the GOOSE message IED A checks the current level and issues a trip command to breaker A.
- GOOSE communication enables fast and stationwide supervised arc protection schemes.

GOOSE - Breaker failure protection

On detecting a fault on the outgoing feeder IED B sends a trip command to CB “B” and initiates the CB failure protection function.
- CB “B” fails to open.
- The CB failure protection function of IED B sends a trip command to IED A using GOOSE.
- The use of GOOSE communication eliminates the need for dedicated wiring.
- CB failure protection can be added without renewing the wiring and with minimum disturbance to the process.
REF615
Time synchronization methods

- Ethernet-based time synchronization:
  - SNTP (Simple Network Time Protocol)
- With special time synchronization wiring:
  - IRIG-B (Inter-Range Instrumentation Group - Time Code Format B)
- Time stamp resolution: 1 ms
- Serial protocol based:
  - Modbus
  - DNP3
  - IEC60870-5-103

REF615
Front port communication

- RJ-45 Ethernet connector
- IED configuration using PCM600
- IED access using the web-browser-based HMI
- LED indication on the local HMI during data transfer
- Both crossover and regular cables can be used
615 series
Patented and compact plug-in design

- Speeds up installation, maintenance and testing of the protection
- Contributes to a shortened MTTR (mean time to repair)
- Allows the cases to be installed and wired before the plug-in units are delivered
- Mechanical coding system for preventing insertion of a wrong plug-in unit in a case
- Sealable pull-out handle to prevent accidental (or unauthorized) withdrawal of the plug-in unit
615 series
IED case and plug-in unit

- **Height**: frame 177 mm, case 164 mm
- **Width**: frame 177 mm (4U), case 160 mm
- **Depth**: case 155 mm

<table>
<thead>
<tr>
<th>IP classification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IP54</td>
<td>When panel-mounted</td>
</tr>
<tr>
<td>IP20</td>
<td>Rear side</td>
</tr>
</tbody>
</table>

615 series
Flush and semi flush mounting

- **Flush mounting**
  - The same cut-out on the cubicle front as for the 610 series IEDs (height: 161.5 ± 1, width: 165.5 ± 1)
- **Semi-flush mounting**
  - With a 50 mm rising frame
615 series
Semi flush and wall mounting

- Semi-flush mounting in a 25° angle
  - With special accessories
- Wall mounting
  - The IED can be tilted for easy access to the connectors

615 series
Panel and rack mounting

- Mounting using a 19” mounting panel
  - One or two IEDs
- Mounting with an RTXP test switch in a 19” rack
  - For routine testing purposes
Front panel HMI

615 series
Front panel HMI

- Three dedicated LEDs: Ready, Start, Trip
- 4 x 16 character display (LCD)
- 11 programmable LEDs
- CB Control, OPEN and CLOSE buttons
- ENTER button
- CLEAR button
- Front communication port
- MENU button
- LOCAL/REMOTE button, HELP
- ESC button
- Navigation buttons
- AUTHORIZATION
615 series
Display options

- **Large LCD**, mono-spaced 10 x 20 characters, variable width 8 x 8 (or more) characters
- **Small LCD**, mono-spaced 4 x 20 characters, variable width 4 x 8 (or more) characters
- Background light with power-saving mode

**Option:** Small LCD

**Large LCD**

### REF615
Display readouts

- IEC 61850 naming, “classic” IEC symbols or ANSI codes: *(PHLPTOC1, 3I>, 51P-1)*
- Fault indications
- Four fault recordings with time stamp
- Measurements:
  - Currents
  - Historical data
  - Number of auto-reclosures (ARs) etc.
Display readouts, cont'd

- Name or code of protected objects
- Settings in 4 setting groups
- Configurations such as protocol settings etc.
- Product information, serial number, software version, identification etc.
**REF615**

**Tools**

<table>
<thead>
<tr>
<th>Tools</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCM600</td>
<td>2.0 SP2 or later</td>
</tr>
<tr>
<td>Web-browser-based user interface</td>
<td>IE 7.0 or later</td>
</tr>
<tr>
<td>REF615 connectivity package</td>
<td>2.5 or later</td>
</tr>
</tbody>
</table>

**PCM600**

**Protection and control IED Manager**

- A common tool for new and existing protection IEDs and terminals
- IED-specific connectivity packages enable the use PCM600 for different ABB protection IEDs and terminals
- Supports IEC 61850
- GOOSE messaging configuration (PCM600 Engineering Pro)
- IED interaction using:
  - Corporate LAN/WAN
  - The IED’s communication port
PCM600 Tools

- All tools needed to manage REF615 are included in PCM600:
  - Signal matrix
  - Signal monitoring
  - IED parameter setting
  - Disturbance recorder handling and viewing
  - IEC 61850 (GOOSE) communication configuration
  - Modbus communication configuration
  - DNP3 communication configuration
  - IEC 60870-5-103 communication configuration
  - Access control management

PCM600 Power system overview

- PCM600 offers the possibility to create a tree-structure representing your individual power system, including:
  - Project name
  - Substations
  - Voltage levels
  - Bays
  - IEDs/terminals
615 series
Web-browser based user interface

- Local or remote IED access using an IE 7.0 (or later) web browser
- Disabled by default, enabled by PCM600 or the local front-panel interface
- Functions:
  - Viewing of alarm LEDs and event lists
  - Saving of event data
  - Parameter setting
  - Signal monitoring
  - Measurement viewing
  - Phasor diagram viewing
  - Reading of disturbance records
  - User access level authentication

Conclusions
REF615
Product summary

- IEC 61850 communication including GOOSE messaging
- Comprehensive earth-fault protection functionality
- Directional and non-directional overcurrent protection
- Phase voltage based protection and measurements
- Optional arc protection with three sensors
- CB control buttons on the HMI
- Rapid set-up and commissioning, six standard configurations
- Patented plug-in / draw-out design
- Optimized size - suitable for retrofit purposes
- Versatile tools

REF615
Selection and ordering data, digit 1-3
## REF615
### Selection and ordering data, digit 4-8

The standard configuration determines the 110 hardware and available options. Choose the digits from one of the three standard configurations below to define the correct digits for 4-8. The example below shows standard configuration "C" with some options.

<table>
<thead>
<tr>
<th>Serial options</th>
<th>Ethernet options</th>
<th>Protocol options</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = RS-485 (KO-B)</td>
<td>B = Ethernet (RS-485)</td>
<td>C = USB (80980-3-10)</td>
</tr>
<tr>
<td>N = None</td>
<td>D = Ethernet (80980-3-10)</td>
<td>E = USB (80980-3-10)</td>
</tr>
</tbody>
</table>

## REF615
### Selection and ordering data, digit 9-11

The communication module hardware determines the available communication protocols. Choose the digits from one of the four communication rows below to define the correct digits for 9-11. Note that the communication options are not dependent on the chosen standard configuration.

<table>
<thead>
<tr>
<th>Serial options</th>
<th>Ethernet options</th>
<th>Protocol options</th>
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<td>E = USB (80980-3-10)</td>
</tr>
</tbody>
</table>
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Selection and ordering data, digit 9-11

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**REF615**
Selection and ordering data, digit 12-18

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Selection and ordering data, ordering code

Example code: 4BFCACABNBB1ACN1X

Your ordering code:

<table>
<thead>
<tr>
<th>Digit (n)</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
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<td></td>
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</tbody>
</table>

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Product pages on the web
Please visit our website for the latest product information

www.abb.com/substationautomation

Power and productivity for a better world™