



# RFL 8021

## Line Distance Relay



### Description:

The **RFL 8021** protection and control IEDs are based on the most advanced digital technology and are designed for maximum flexibility and versatility. They have all the necessary functions to protect, control and meter an HV/MV bay.

They are designed to provide selective, fast and reliable protection in overhead lines with or without series compensation, whether single-phase or three-phase trips are required. The included programmable logic allows defining the operational logic of the protection and control functions to adapt them to the specific bay and system requirements. **RFL 8021** models are complemented by a series of easy-to-use communications and programming tools that provide a user-friendly environment in which to configure applications.

### Features:

- Maximum flexibility and versatility for your application
- Optional IEC 61850 interface for present or future integration into a substation automation system
- Programmable logic allows free combination and configuration of functions
- Simple-to-use configuration and communication tools
- Four zone phase and ground distance protection, all zones sequence
- Instantaneous and time overcurrent elements; phase, ground, negative sequence
- Directional phase, ground and negative sequence overcurrent, voltage or current polarized
- Over-, under- and rate-of-change frequency elements, ideal for load shedding applications
- Undervoltage and overvoltage elements
- Out-of-step blocking/tripping
- Thermal image unit with heating and cooling constants
- Breaker failure protection and breaker monitoring
- Open conductor detection
- All pilot schemes supported weak feed and transient block logic
- Recloser with synch check
- Accurate fault locator
- The **RFL 8021** terminal provides RTU functionality including:
  - Metering and interfacing to transducers
  - Capture of digital inputs
  - Local and remote commands
  - Programmable logic for inputs and outputs with latch control switches
  - Energy meters
  - High accuracy metering functions include:
    - Currents and voltages, measured and calculated
    - Positive, negative and zero sequence components
    - Power factor angle
    - Frequency



## Platform Relay Features

The protective relay family including models **RFL 8021**, **RFL 8051** and **RFL 8087** is based on a common platform featuring the following characteristics:

### Hardware Conveniences

#### Pluggable terminal blocks

The rear panel terminal blocks admit ring lug terminals and can be disconnected from the relay eliminating the need to undo the wiring in case a relay needs to be removed from the panel. Terminal blocks are secured to the chassis with screws to avoid accidental disconnections especially in the CT circuits. Terminal blocks are non self-shorting.

#### USB local connector

The relay has a dual serial interface front port with a traditional RS-232 DB9 port and a USB connection to accommodate modern laptop computers which are usually outfitted with USB connectors only.

### Advance Protection

#### Frequency Tracking

Protection algorithms have been designed to be independent of the system frequency. The functions will adjust themselves for frequency variations between 16 and 81 Hz eliminating relay misoperations due to frequency excursions.

#### 0.1% Metering accuracy

Analog inputs provide revenue metering accuracy, available for all the protection and control functions.

#### 32 samples/cycle

The sampling rate applies to both the protection functions and the built-in oscillography recorder.

#### Integrated Simulator

To facilitate testing of the programmed logic in the relay, it is possible to load a COMTRADE file in this simulator and replay the conditions. The relay will substitute the analog and digital physical inputs by those contained in the file giving the ability to analyze the relay behavior with different settings and logics.

### Substation Automation Friendly

#### Integrated protection and control

These units come programmed with a series of protection functions each with a given number of logic input and output signals. Every signal can be used along with user defined signals, and captured or calculated analog values to create

Relays are designed to interface with other devices in the bay (breakers, transformers, transformer apparatus, disconnect switches, grounding switches, etc.) via digital inputs, auxiliary contacts, transducer inputs and the optional CAN bus input. Gathering all the information of the bay with the relay allows implementation of control functions at the bay level with the following advantages:

- Reduced costs in wiring to RTUs
- Eliminating the need for PLCs
- Increasing the reliability by keeping the decision making locally without communications (distributed intelligence)

All the information required for SCADA or SER functions is available via the provided communication channels

#### Programmable Buttons

To make the control functions accessible from the front panel of the relay there are 7 programmable buttons. One of them is labeled for breaker operations and the other 6 are provided with labels for user definition. These buttons can be programmed for switching between setting groups, select local/remote control, tag the breaker, or block the recloser among other functions.

#### Graphical HMI (optional)

As an option the front panel can be outfitted with a graphical HMI. This display can be customized with a interactive single line diagram of the bay to monitor status and metering information and to perform local control operations. The display also serves as an alarm annunciator and includes other screens to facilitate commissioning and testing.

#### Multiple Protocols

Every unit includes as a standard feature 3 communication protocols. Each port can be programmed to communicate via DNP 3.0, Modbus or Procome.

DNP 3.0 and Modbus are control protocols mainly for communications with SCADA. Procome integrates protection and control functions based on the definitions of IEC 60870-5-101 and 103. Using a single protocol within the substation eliminates the need for separated communication networks for the different functions. In integrated protection and control systems a substation host or central unit monitors the communication network between relays and can be used as a database manager for the substation SER, to implement substation level logics, to emulate protocols for higher levels, and as a communication gateway.

#### Peer-to-peer binary communications

A fourth protocol is available to enable relay to relay communications. This virtual input/output channel allows



exchange of binary information on the state of up to 16 digital signals and 16 analog magnitudes.

### IEC 61850 (optional)

This protocol is available as an option with an additional Ethernet port with dual interface copper and fiber.

IEC 61850 integrates protection and control with the aim of substituting all the wiring into the relay by the network connection

### CAN Bus (optional)

The Controller Area Network (CAN) is a high-integrity serial data communications bus for real-time control applications

- Operates at data rates of up to 1 Mega bits per second
- Has excellent error detection and confinement capabilities
- Has an OSI session layer known as Time Triggered CAN (TTCAN)
- Has a sub-bus known as the Local Interconnect Network (LIN)

## Protection Functions

21P	4 zone phase distance, mho and selectable quadrilateral characteristic
21G	4 zone ground distance, mho and selectable quadrilateral characteristic
50SU	Distance element overcurrent supervision
50P	Instantaneous phase overcurrent (3 units)
50Q	Instantaneous negative sequence overcurrent (3 units)
50G	Instantaneous ground overcurrent (3 units)
51	Phase time overcurrent (3 units)
51Q	Negative sequence time overcurrent (3 units)
51G	Ground time overcurrent (3 units)
67P	Phase directional unit
67Q	Negative sequence directional unit
67G	Directional ground unit
49	Thermal protection
50BF	Breaker failure protection
27P	Phase undervoltage (3 units)
59P	Phase overvoltage (3 units)
59G	Ground overvoltage (2 units)
81M	Overfrequency (3 units)
81m	Underfrequency (3 units)

81D	Change of rate of frequency (3 units)
46	Broken conductor detection (current imbalance I2/I1)
79	3 shot recloser
25	Synch check element
3	Trip & Close coil circuit monitoring
2	Pole discrepancy

## Application

**RFL 8021** can be used as primary or secondary protection in transmission or subtransmission networks, in underground lines, overhead lines or mixed lines of different characteristics: non-homogenous, one or multiple source, parallel circuits, with or without series compensation, etc. They are designed for applications with single- or three-phase trips and can be used with or without teleprotection schemes.

**RFL 8021** units are designed to work best as part of an integrated protection and control system, although their performance and use offers significant advantages when they are used as stand-alone components of conventional protection systems.

Due to their flexible communications structure, **RFL 8021** units provide great versatility when applied to distributed integrated protection and control systems.

Each unit has two remote communications ports. Dual ports are intended for applications with separated protection and control networks. Each port is connected to the associated network, providing independent control for higher levels of the system.

***This architecture allows the RFL 8021 to operate in different communication networks running different protocols. The IED simultaneously supports multiple protocols.***

## Protection

**RFL 8021** relays include a set of protection functions that meets the maximum needs of the applications above. Each function can be enabled or disabled during configuration or by commands transmitted via the communications ports, operator interface (HMI) or digital inputs.

Protection elements are complemented by the following auxiliary functions:

- Load encroachment blinders
- Fuse fail detection
- Remote end open breaker detector



- Close-into-fault
- Stub bus protection
- Out-of-step block/trip
- Stepped distance, permissive (PUTT, POTT), Directional comparison unblocking (DCUB) and Directional comparison blocking (DCB) pilot schemes
- Weak feed echo and trip

## Control

RFL 8021 relays can support control functions required in a substation bay with all the characteristics of an intelligent RTU:

- Captured and calculated metering data via analog inputs and transducers
- Status of digital inputs and internal signals
- Local and remote control of substation equipment via auxiliary output contacts
- Input/output logic, blocking functions, control hierarchy and programmable control functions.
- Energy meters
- Communications ports for connections to the substation

## Metering

RFL 8021 relays provide readings of:

- Captured analog values: phase currents, ground current of the parallel line, grounding current. Phase, neutral, and phase-to-ground voltages (phase-ground); line and bus Synchrocheck voltages
- Power values calculated with the previous magnitudes: active, reactive and apparent power
- Ground current and voltage
- Sequence currents and voltages (positive, negative, zero)
- Harmonic content up to the 8th harmonic and total harmonic distortion of current and voltage on phase A
- Cosine Phi
- Frequency
- Thermal image

The sampling frequency of the metering units is 32 samples per cycle (1920 Hz in 60 Hz systems and 1600 Hz in 50 Hz systems). All samples are used for metering and oscillography storage.

Metering values are used as inputs for the protection functions built into the IED. Additionally any reading, whether measured or calculated, can be selected as an input to user-programmed functions (communications, display, logic, etc.).

Phase currents and voltages (simple and between phases)  
Ground current and voltage  
Ground current of offset line  
Grounding current (for polarization)  
Voltage and current harmonics on phase A  
Sequence currents and voltages of (positive, negative and zero)  
Active, reactive and apparent power  
Cosine  
Frequency  
Thermal image  
Harmonics on the phase A current of each winding  
Active input and output energy, and capacitive and

## Curves

The time overcurrent curve can be selected from among several types of curves according to IEEE (IEEE Standard C37.112-1996), IEC standards and commonly used legacy curves:

### IEEE/ANSI CURVES

Moderately inverse curve  
Very inverse curve  
Extremely inverse curve  
Moderately inverse curve + time limit  
Very inverse curve + time limit  
Extremely inverse curve + time limit

### IEC CURVES

Inverse curve  
Very inverse curve  
Extremely inverse curve  
Long-term inverse curve  
Short-term inverse curve  
Inverse curve + time limit  
Very inverse curve + time limit  
Extremely inverse curve + time limit  
Long-term inverse curve + time limit  
Short-term inverse curve + time limit



## US CURVES

- Moderately inverse curve
- Inverse curve
- Very inverse curve
- Extremely inverse curve
- Short-term inverse curve
- Moderately inverse curve + time limit
- Inverse curve + time limit
- Very inverse curve + time limit
- Extremely inverse curve + time limit
- Short-term inverse curve + time limit

In addition to these curves, there is the **RI Inverse Curve**, used primarily to coordinate with electromechanical relays.

## Protection Functions

### Distance Protection

There are four distance zones available, all of them reversible. Each zone has six independent metering elements.

Each zone includes independent timers for phase and ground faults. The reach ( $Z1$ ) and zero sequence compensation ( $K0=Z0/Z1$ ) settings are also independent for each zone both in magnitude and angle. These independent settings provide better accuracy in mixed line applications (overhead + underground).

The distance units have independently selectable mho and quadrilateral characteristics for phase and ground faults.

The mho characteristic is polarized by positive sequence voltage with memory, creating a dynamic expansion that increases the characteristic resistive coverage. This approach provides directional security against three-phase faults with zero voltage, against voltage reversals on lines with series compensation and against disturbances in the presence of capacitive voltage transformers.

The directional element associated with the quadrilateral characteristic is also polarized by positive sequence voltage with memory.

The reactance unit that limits the quadrilateral characteristic compensates for the load during phase faults as well as ground faults. It is polarized by a phasor parallel to the fault current, thus avoiding the effects of overreach and underreach in resistive faults. It also compensates non-homogenous systems with an internally calculated tilt angle.

The quadrilateral characteristic allows independent resistive ranges for phase and ground faults.

### Distance Protection Schemes

**RFL8021** relays can complement the distance elements with protection schemes to speed up trips outside of zone 1 and inside the protected line. There are seven selectable schemes that work in parallel with the distance step scheme:

- **Zone 1 extension**
- **Permissive underreach transfer trip (PUTT)**
- **Direct transfer trip**
- **Permissive overreach transfer trip (POTT)**
- **Directional comparison unblocking**
- **Directional comparison blocking**

These schemes can be complemented by **transient blocking logic** to avoid false trips when current reversals occur in double circuits. In addition to the available protection schemes, any protection scheme can be configured with the programmable logic built into the IED. The user can generate teleprotection schemes that require the exchange of several signals between both ends of the line (indication of the faulted phase, single-phase and three-phase permissions, etc.). The communication medium can be a digital peer-to-peer network.

### Weak Infeed

**RFL8021** relays include **echo logic** to avoid time delay trips in permissive schemes when one of the ends of the line has weak infeed conditions. This scheme allows the weak end to re-send the trip command signal received to produce the instantaneous trip of the strong end. **Trip logic for weak infeed** can be enabled. It will work together with the echo logic to trip the weak end.

### Block and/or Trip due to Power Swing

**RFL8021** relays have a power oscillation detector to avoid inappropriate operations of the distance elements when there are stable power oscillations (block due to power swing) and to allow controlled trips in the event of unstable power swings (trip due to loss of stability) as required.

**RFL8021** relays also have an algorithm for detecting faults originating during power swings in order to unblock the distance elements.

### Load Limiters (Load Encroachment)

The purpose of these elements is to avoid trips in high-load conditions. They block the operation of the distance elements if the calculated positive sequence impedance stays within the range set for the limiters.

### Switch-on-to-fault

The switch-on-to-fault detector permits instantaneous tripping in the event of faults detected at breaker closing.



Manual close and reclose commands activate this algorithm whether the commands are internal or external. It has non-directional phase overcurrent units with second harmonic restraint (to avoid operations on transformers energization). These units work in parallel with the zone 1 extension function.

### **Breaker Failure**

**RFL8021** relays have breaker failure protection with two time steps to retrip (single or three-phase) the faulted breaker, if required, before generating the trip command for the adjacent breakers.

The breaker failure protection has independent overcurrent timers and levels for single- and three-phase trips. The pickups generated by single phase trips have overcurrent detectors and timers segregated by phase in order to act correctly in the event of evolving faults. Overcurrent detectors feature very fast reset.

This function also protects against breaker failures without overcurrent and detect the existence of internal arcing.

### **Overcurrent Elements**

The list of functions indicates the different overcurrent elements built into **RFL8021** relays. All the overcurrent elements can be made directional through the configuration settings (including distance zone 2 as a directional element).

The directional characteristic polarizing algorithms provide the security required in the protection of lines with series compensation and systems with strong zero sequence or negative sequence sources, where very small polarization voltages would be obtained.

### **Protection Schemes for Ground Overcurrent Elements**

The following protection schemes can complement the directional elements of ground or negative sequence overcurrent:

- **Permissive underreach transfer trip**
- **Direct transfer trip**
- **Permissive overreach transfer trip**
- **Directional comparison blocking**
- **Directional comparison unblocking**

All these schemes are independent of those associated with the distance elements. Therefore, they can use different communication channels. Also, the user can create customized protection schemes with the programmable logic.

The complementary schemes of weak infeed and transient blocking due to current reversal are also available to work in parallel with these protection schemes.

Levels 1 and 2 of instantaneous ground overcurrent can be set to produce single phase trips using the IED's phase selector.

## **Voltage and Frequency Elements**

### **Stub Bus Protection**

This unit is applied in breaker-and-a-half and ring substations. Its purpose is to protect the section between the two current transformers and the disconnect switch when the latter is open. This definite time phase overcurrent element is activated when the line disconnect switch opens.

### **Lines with Series Compensation**

On lines with series compensation, a reverse directional fault can cause erroneous directional decisions once the voltage memory time has lapsed. To avoid false trips with reverse faults cleared with time delays, the RFL8021 has an algorithm that temporarily blocks the forward directional elements. This blocking signal is generated by the activation of the distance and directional overcurrent elements that monitor the reverse directional current.

## **Monitoring Functions**

### **Fuse Failure**

This function can block the operation of the distance elements, the synchrocheck unit and the weak infeed if it detects a failed VT secondary fuse.

### **Synchrocheck**

The synchronism check is made up of various elements: line and bus voltage (type of energizing can be set), voltage difference, phase difference and frequency difference.

This unit can inhibit the recloser function and prevent the execution closing commands under lack of synchronism conditions.

The synchronism unit can supervise two breakers simultaneously. Therefore, it is very useful in breaker-and-a-half or ring substations.

### **Breaker monitoring**

To assist in breaker maintenance, the IED's protection includes an element that sums and accumulates the  $kA^2$



making an excessive number of trips in a given period of time to prevent damage.

### Open Pole and Pole Discordance Detector

The open pole detection algorithm operation is based on the status of the breaker auxiliary contacts and on independent phase current detectors. Due to the special conditions that generate pole opening, the protection elements take the output of this algorithm into account.

The IED can also detect pole discordance. This can trigger a trip if it persists during the set time.

### Breaker Coil Circuit Monitoring

The IED can monitor up to 6 trip or close coil circuits of the breaker.

## Control Functions

### Recloser

The **RFL8021** recloser may be coordinated with an external protection device in addition to the IED's built-in protection.

Reclosing is selectable up to a maximum of three attempts with independent settings for recloser timers and reset times. The breaker position controls the reclosing sequence with the reclose initiate signal. Settings can select the unit or units that enable the start of the reclosure sequence.

Reclosing sequences can be set independently for single and three-phase trips.

The following operational modes are selectable:

- **1p mode**: reclosing only in the event of a single phase trip
- **3p mode**: reclosing only in the event of a three-phase trip
- **1p/3p mode**: reclosing for both types of trip
- **Dependent mode**: only one reclosing shot if the first trip is three-phase and a set number of reclosing shots if it is single-phase

The following operational modes are selectable:

- **1p mode**: reclosing only in the event of a single-phase trip
- **3p mode**: reclosing only in the event of a three-phase trip
- **1p/3p mode**: reclosing for both types of trip set number of reclosing shots if it is single-phase

The recloser function can monitor two breakers with resul-

### Programmable Logic

The inputs to the logic functions can be any of the signals or readings generated by the following functions:

- Protection units
- Digital inputs
- Communications
- Command functions
- Analog inputs

The user can define a logical operation using primitive logic functions (AND, OR, XOR, NOT, etc.), flip-flops, timers, comparators, etc.

The programming function allows the user to define trip logic, control logic, interlocks, functional modules and control hierarchy required for complete protection and operation of a bay.

The logical outputs produced when processing input signals can be assigned to auxiliary outputs, HMI display, communications, external HMI, etc.

## Recording and Information Functions

### Fault Locator

The included fault locator obtains the distance to the fault in miles, km or in percentage of the total length of the parallel line. For double circuits, zero sequence mutual coupling compensation can be enabled. This function is based on the residual current measurement of the line offset.

### Event Recording and Programmable Event Logs

A 400-record-capacity sequence of event log is stored in non-volatile memory. The user can generate event-triggering signals. The events are recorded with a 1-ms resolution. The log can include up to 12 selectable analog quantities per event.

### Fault Reporting

Capacity for storing up to 15 fault reports with relevant data, such as picked-up units, tripped units, pre-fault metering, fault metering, current interrupted, etc.

### Oscillographic Recording

The oscillography record allows up to 64 oscillographs to be saved in a cyclical memory. Sampling frequency is 32 samples per cycle, with a total recording time of 15 seconds. The records are saved for at least 27 days in the event of a sustained loss of auxiliary power.

Recordable values include analog signal metering, digital



IEDs are supplied with a complete display and analysis software package that allows the waveform records to be converted to COMTRADE format.

### **Metering Logs**

Up to twelve minimum and maximum values will be stored for each selected quantity in the metering logs for each time slot. Time slot resolution can be adjusted to the needs of the application by configuring day and recording intervals. Up to 1000 records can be stored.

## **Additional Functions**

### **Integrated Simulator**

**RFL 8021** models include a special test and simulation mode that allows operations to be simulated using waveforms loaded in via the front-panel communications port.

### **Time Synchronization**

The relays include an internal clock with a resolution of 1 ms. This can be synchronized via GPS (IRIG-B protocol) or by communications through the remote communications port (DNP 3.0 or other protocols).

**Operator Interface Consisting of**  
**Alphanumeric Display and Keypad**  
**4 Selectable Setting Groups**  
**Programmable Push-buttons (6) for Control Operations**  
**4 LED Targets**  
**Configurable Digital Inputs**  
**Configurable Auxiliary Outputs**

## **Human-Machine Interface**

The operator interface (HMI) allows flexible configuration. The HMI includes an alphanumeric display (4 rows of 20 characters each) with a keypad that can be used to interact with the relay.

### **Alphanumeric Display**

This interface provides the following operations:

- Display and modify settings
- Display captured and calculated metering values
- Control operations
- Change setting groups
- Display events configured for communication protocols

### **Programmable Buttons**

The front panel has three columns of buttons for control operations of on the system's elements (breaker control, fan control, motor operated sectionalizing switches, programmable control functions, local/remote, etc.).

These push-buttons allow local control of substation apparatuses or IED functions, and six of them are fully programmable. Each of these push-buttons has an associated multicolor LED indicator to display the state of the element associated with the button.

The push-button group has a general blocking function that can be configured from the HMI or via the communications ports providing the security required for proper operation.

## **Communications**

All **RFL 8021** IEDs include two communications ports on the rear panel for remote access, plus a front panel port for local access.

As a standard feature, **RFL 8021** models include three communication protocols: PROCOME, MODBUS and DNP 3.0.

PROCOME protocol complies with the IEC 870-5 series of standards and is used for both protection and control data.

DNP 3.0 and MODBUS protocols are used exclusively to communicate control data.

Each communications port can be used simultaneously, with independently selectable baud rates up to 38,400 bps.

Some models can optionally include a 100 FX port (Ethernet over fiber optic) and/or an RJ45 port, as physical support for the IEC 61850 protocol. This protocol allows interchange of data of all types, both with the higher hierarchical levels and with other IEDs. IEC 61850 is based on accepted open standards and supports self-description.

## **Construction**

**RFL 8021** units are designed for mounting in 19" racks, and are two, three or four units high (depending on the number of analog inputs and digital inputs/outputs). The electronic cards, or modules, are mounted horizontally and can be extracted by removing the front panel. External connections use plug-in terminal blocks on the rear panel of the enclosure, with ring lug connectors.

The enclosure is provided with a ground terminal. It is essential that this terminal be properly connected to the



ground to enable correct operation of the filters that protect the IED from external electromagnetic disturbances.

### Voltage and Current Analog Inputs

The units include up to 10 analog inputs divided into two non self-shortening ring lug terminal blocks (block A and B). Connectors accept lugs for wires up to AWG 12 (6 mm<sup>2</sup>).

### Contact Inputs and Outputs

Two-unit high models have 10 status contact inputs, 10 digital outputs and one in-service output. The connectors accept ring lug terminals. Connectors accept lugs for AWG wires 17 to 13.

Additional digital inputs and outputs are available in the three unit high models with 22 inputs and 23 outputs (4 of which are fast) or in the four-unit high models with 34 inputs and 36 outputs (4 of which are fast).

All the outputs from the IED are trip rated. Therefore, any of them can be used as switching output (CB open or close).

## Programming Tools

The communication software package provides an user-friendly interface for all of the necessary parameter setting operations and for accessing the data recorded by the equipment. The program can be installed and used on a PC with any of the following operating systems: Windows 95, Windows 98, Windows 2000 or Windows XP.

The program allows to perform the following functions via serial communications between the IED and a PC:

- Upload or download settings
- Edit settings
- Store settings for future editing
- Information retrieval:
  - o Captured and calculated metering
  - o Contact input status
  - o State of the auxiliary and control outputs: trip and close
  - o State of the protection elements
  - o State of the signals used by the programmed logic functions
  - o State of the self-test functions
- Synchronize with PC date and time
- Retrieval, display and storage of the generated reports:
  - o Sequence of events

- o Fault reports
- o Oscillography
- o Metering logs

- Load and retrieve logic configuration files

Off-line programming is available for the following tasks:

- Edit settings files
- Program digital inputs, auxiliary outputs and targets
- Edit logic functions via graphical user interface.
- Define signals to be recorded in the event log and the metering quantities to be stored with these records
- Define the signals to be stored in the oscillographs
- Define the display names of the user defined settings
- Define the signals to be transmitted over the communications protocols
- Convert retrieved oscillographs to COMTRADE format
- Update the IED firmware

The software includes an oscillography display and analysis tool that can use waveforms captured by the IED. It can also import and display data files in COMTRADE format created

## Standards and Type Tests

The equipment satisfies the standards indicated below.

**Insulation Test (Dielectric Strength) IEC -255-5**

Common mode between circuit terminals and ground:

2 kV, 50/60 Hz for 1 min

Common mode between independent circuits:

2 kV, 50/60 Hz for 1 min

**Voltage impulse test IEC-255-5 (UNE 21-136-83/5)**

Common mode and differential mode

5 kV; 1.2/50 s; 0.5 J

**Surge Immunity Test IEC-1000-4-5 (UNE 61000-4-5)**

Between conductors

1 kV

Between conductors and ground

2 kV

**1 MHz burst test IEC-255-22-1 Class III (UNE 21-136-92/22-1)**

Common mode: 2.5 kV

Differential mode: 1.0 kV

**Fast transient IEC -255-22-4 Class IV (UNE 21-136-92/22-4) (IEC 1000-4-4)**

**Disturbance test 4 kV<**



*Radiated Electromagnetic Field disturbance*

IEC -1000-4/IEC 1000-4-3

Amplitude modulated (EN 50140) 10 V/m

Pulse modulated (EN 50204) 10 V/m

*Conducted Electromagnetic* EN 50141

*Field Disturbance*

Amplitude modulated 10 V

*Electrostatic* IEC -255-22-2 Class IV (UNE 21-136-92/22-2)

(IEC 1000-4-2)

*Discharge Test*

On contact  $\pm 8$  KV<

In air  $\pm 15$  KV<

*Radio Frequency Emissivity*

*Radiated and Conducted* EN 55011 (IEC 1000-4-6)

*Temperature* IEC 255-6 / IEC 60068-2

Operating range: From -40°C to +85°C

Storage range: From -40°C to +85°C

Humidity: 95 % (non-condensing)

*Power Supply Ripple* IEC-255-11 / UNE 21-136-83  
(11)

< 20 %

*Resistance of Ground Connection* IEC -1131  
£ 0.1 W

*Polarity Inversion of the Power Supply* IEC -1131

*External Protection Levels* IEC -529

*Vibration Test (Sinusoidal)* IEC-255-21-1 Class I

*Shock and Bump Test* IEC-255-21-2 Class I

**RFL 8021** models conform with the Directive 89/336/EEC  
Electromagnetic Compatibility.



# Model Selection

Functions	
21(3F) + 79 + 25 + 3x(3x27) + 3x(3x59) + 2x59N + 3x(3x67-3x50/51) + 3x(67N-50N/51N) + 3x(67Q-50Q/51Q) + 27WI + 3x81M + 3x81m + 3x81D + 49 + 68/78 + 46 + 50SOF 50Sup + 50STUB + 85 + 50BF + 6x3 + 2 + FL + OSC	A
21(1F/3F) + 79 + 25 + 3x(3x27) + 3x(3x59) + 2x59N + 3x(3x67-3x50/51) + 3x(67N-50N/51N) + 3x(67Q-50Q/51Q) + 27WI + 3x81M + 3x81m + 3x81D + 49 + 68/78 + 46 + 50SOF 50Sup + 50STUB + 85 + 50BF(1F/3F) + 6x3 + 2 + FL + OSC	B
A+(25+79+50BF) and HW for breaker and a half <sup>(1)</sup>	C
B+(25+79+50BF) and HW for breaker and a half <sup>(1)</sup>	D
21(3F) + 79 + 25 + 3x(3x27) + 3x(3x59) + 2x59N + 3x(3x67-3x50/51) + 3x(67N-50N/51N) + 3x(67Q-50Q/51Q) + 49 + 68 + 50SOF + 50Sup + 2 + FL + OSC <sup>(2)</sup>	E

  

Options	
Standard model	1
Ports 100FX - Ethernet F.O. (MT-RJ) and RJ45 (IEC-61850/UCA2.0) <sup>(2)</sup>	2
Ports 100FX - 2x RJ45 (IEC 61850 / UCA 2.0) <sup>(3)</sup>	3

  

Rated Values	
1A / 5A and 50Hz / 60Hz	N

  

Power Supply Voltage	
24 Vac / Vdc (±20%)	1
48 - 250 Vac / Vdc (±10%)	2

  

Voltage of the Digital Inputs			
24 Vdc	0	250 Vdc	3
48 Vdc	1	125 Vdc (activat. >65%)	6
125 Vdc	2		

  

Ports				
COM1 (LOC)	COM2 (REM-P1)	COM3 (REM-P2)	COM4 (REM-P3)	
RS232 + USB	RS232	RS232 / RS485	--	5
RS232 + USB	--	--	--	6
RS232 + USB	FOC (ST)	FOC (ST)	--	7
RS232 + USB	FOC (ST)	RS232 / RS485	--	8
RS232 + USB	FOP	FOP	--	9
RS232 + USB	FOP	RS232 / RS485	--	A
RS232 + USB	RS232 / RS485	RS232 / RS485	--	B
RS232 + USB	FOC (ST)	FOC (ST)	RS232 / RS485	C

  

Number of Inputs and Outputs <sup>(4)</sup>	
Basic model (10 DI / 10 AO) (only model A)	0
Standard model (22 DI / 23 AO)	1
Ampliated model (34 DI / 36 AO)	2
Special model (25 DI / 31 AO) (only models C and D)	3
Ampliated model with current inputs (39 DI / 29 AO / 2 Transducer inputs 4-20 mA)	4

  

Spare	
As default	00

  

Enclosure	
2U	M
3U	S
4U	Q

  

Protocols				
COM1 (LOCAL)	COM2 (REM)	COM3 (REM)	COM4 (REM)	
PROCOME	PROCOME/DNP3.0	PROCOME/MODBUS	--	A

  

Finishing	
Stainless steel + printed circuit board not tropicalized	--
Stainless steel + tropicalized printed circuit board	L

  

Vertical construction to be ordered as: 3RFL8021-□□N-□□□□□□□□□□

(1) Only for 4U high models.  
 (2) Only for 2U high models.  
 (3) Incompatible with options 1, 2, 3 and 4 of "Ports".  
 (4) Close and Trip outputs included.



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