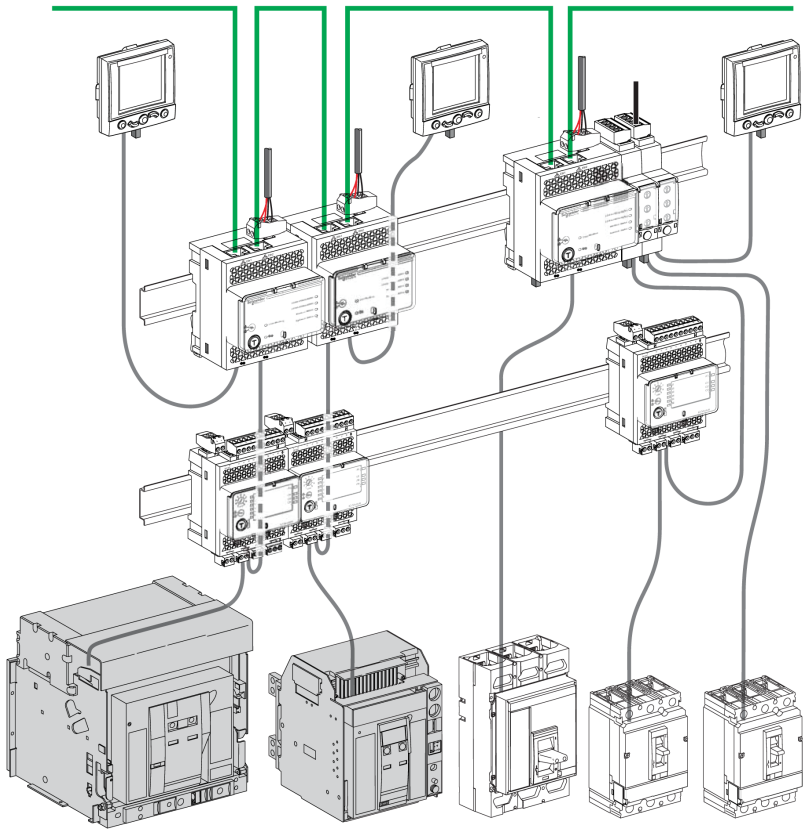
ULP System

ULP (Universal Logic Plug) System User Guide

10/2015



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designated to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

About the Book

At a Glance

Document Scope

The aim of this guide is to provide installers and maintenance personnel with the information needed to set up and operate the ULP (Universal Logic Plug) system.

Validity Note

This document is applicable to ULP system modules and accessories associated with the following ranges:

- PowerPact™ H-frame circuit breakers and switches from 15 to 150 A
- PowerPact™ J-frame circuit breakers and switches from 150 to 250 A
- PowerPact™ L-frame circuit breakers and switches from 250 to 600 A
- PowerPact™ P-frame circuit breakers and switches from 600 to 1200 A
- PowerPact™ R-frame circuit breakers and switches from 1600 to 3000 A
- Masterpact™ NT circuit breakers and switches from 600 to 1600 A
- Masterpact™ NW circuit breakers and switches from 800 to 6000 A

Related Documents

Title of Documentation	Reference Number
PowerPact H-, J-, and L-Frame Circuit Breakers with Micrologic™ Trip Units - User Guide	48940-313-01
PowerPact T- and U-Frame DC Photovoltaic Circuit Breakers and Switches - User Guide	0611IB1306 (EN) 0611IB1307 (ES) 0611IB1308 (FR) 0611IB1309 (ZH)
Micrologic 5 and 6 Electronic Trip Units for PowerPact H-, J-, and L-Frame Circuit Breakers - User Guide	48940-312-01
PowerPact H-, J-, and L-Frame Circuit Breakers - Modbus Communication Guide	0611IB1302 (EN) 0611IB1303 (ES) 0611IB1304 (FR) 0611IB1305 (ZH)
PowerPact H-, J-, and L-Frame Circuit Breakers - Catalog	0611CT1001
PowerPact P-Frame and Compact™ NS 630b–1600 Circuit Breakers - Instruction Sheet	48049-148 (EN, ES, FR)
PowerPact P-Frame Drawout Circuit Breakers - Instruction Sheet	48049-336 (EN, ES, FR)
PowerPact R-Frame and Compact NS 1600b–3200 Circuit Breakers - Instruction Sheet	48049-243 (EN, ES, FR)
Masterpact NT Circuit Breakers and Switches - User Guide	0613IB1209 (EN, ES, FR)
Masterpact NW Circuit Breakers and Switches - User Guide	0613IB1204 (EN, ES, FR)
Masterpact NT/NW and PowerPact P- and R-Frame - Modbus Communication Guide	0613IB1313 (EN) 0613IB1314 (ES) 0613IB1315 (FR) 0613IB1316 (ZH)
IFE Ethernet Interface for LV Circuit Breakers - Instruction Sheet	HRB49218
IFE Ethernet Interface for LV Circuit Breakers - User Guide	1040IB1401 (EN) 1040IB1402 (ES) 1040IB1403 (FR) 1040IB1404 (ZH)
Modbus Interface Module (IFM) for PowerPact H-, J-, and L-Frame Circuit Breakers - Instruction Sheet	48940-326-01

Title of Documentation	Reference Number
Two-Wire RS 485 Isolated Repeater - Instruction Sheet	S1A2181101
IO Input/Output Interface Module for LV Circuit Breaker - Instruction Sheet	HRB49217
IO Input/Output Interface Module for LV Circuit Breaker - User Guide	0613IB1317 (EN) 0613IB1318 (ES) 0613IB1319 (FR) 0613IB1320 (ZH)
FDM121 Display for LV Circuit Breaker - Instruction Sheet	GHD16275AA
FDM121 Display for LV Circuit Breaker - User Guide	DOCA0088EN DOCA0088ES DOCA0088FR DOCA0088ZH
UTA Tester for PowerPact H-, J-, and L-Frame Circuit Breakers - Instruction Sheet	48940-330-01
Masterpact NT/NW, Compact NS, PowerPact P- and R-Frame Communication Option - Installation manual	EAV3608000

You can download these technical publications and other technical information from our website at http://download.schneider-electric.com

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Chapter 1
ULP System

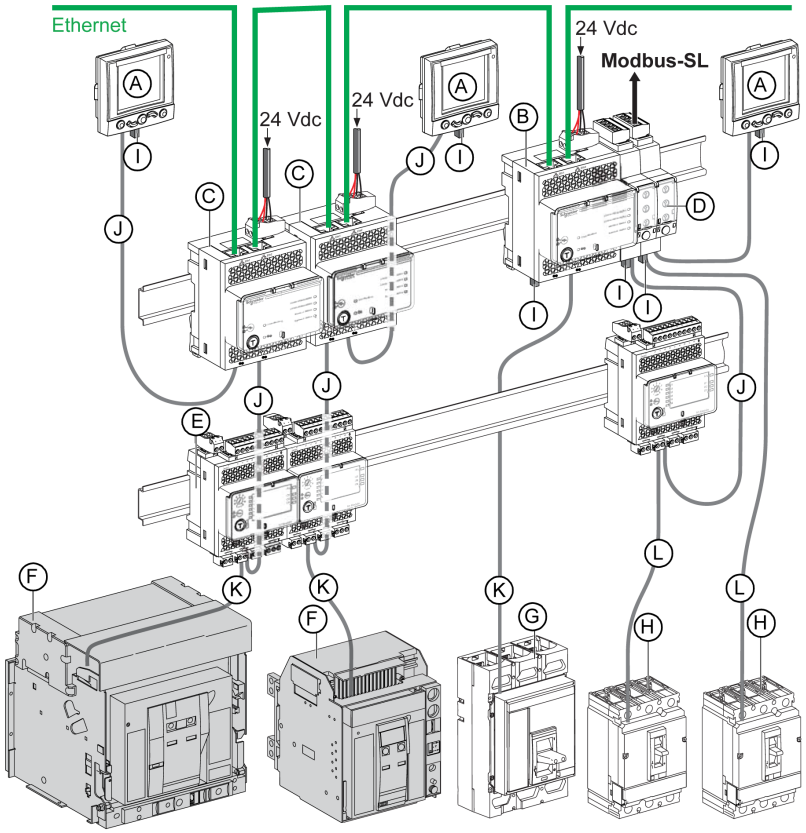
What Is in This Chapter?

This chapter contains the following topics:

ULP System Presentation

Description

Use the ULP (Universal Logic Plug) system to construct an electrical distribution solution which integrates metering, communication, and operating assistance functions for circuit breakers.



A FDM121 ULP display for one circuit breaker
B IFE Ethernet switchboard server
C IFE Ethernet interface for one circuit breaker
D IFM Modbus-SL interface for one circuit breaker
E IO input/output application module for one circuit breaker
F Masterpact NT/NW circuit breaker
G PowerPact P- and R-frame circuit breaker
H PowerPact H-, J-, and L-frame circuit breaker
I ULP line termination
J RJ45 male/male ULP cord
K Circuit breaker BCM ULP cord
L NSX cord

Features

Use the ULP system to enhance the circuit breaker functions by:

- Local display of measurements and operating assistance data with the FDM121 display.
- An Ethernet communication link for access and remote monitoring with the IFE interface.
- Web access to monitor and control the circuit breaker connected to an IFE interface.
- An input/output application with an IO module. It benefits from the extended capability of the IO module to monitor and control position of drawout circuit breakers in the cradle, circuit breaker operation, and custom application, and so on.
- A Modbus communication link for access and remote monitoring with the IFM interface.
- Test, setup, and maintenance functions with the customer engineering tool *(see page 19)*.

The ULP system lets the circuit breakers become a metering and supervision tool to assist energy efficiency and can:

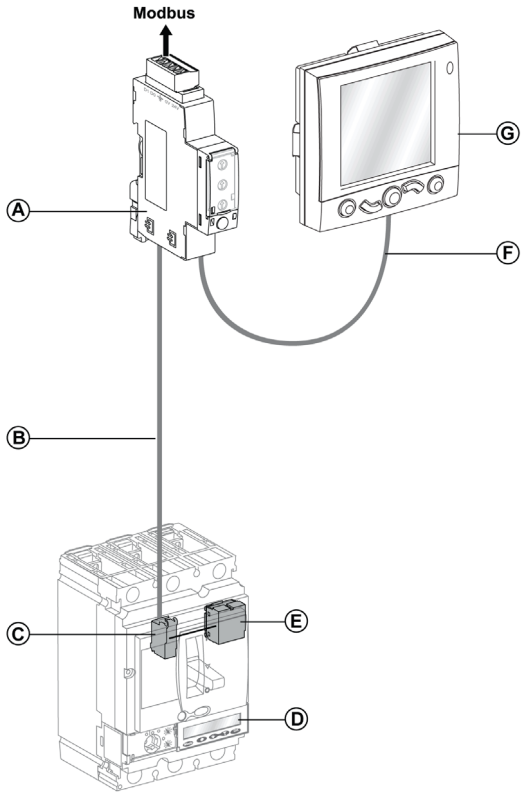
- Optimize energy consumption by zone or by application, according to the load peaks or priority zones.
- Improve electrical equipment management.

Intelligent Modular Unit (IMU)

A modular unit is a mechanical and electrical assembly containing one or more products to perform a function in an electrical equipment (incoming protection, motor command, and control). The modular units are easily installed in the electrical equipment. The circuit breaker with its internal communicating components (for example, Micrologic trip unit) and external ULP modules (FDM121 display, IO module, and so on) connected to one IFM or IFE interface is called an intelligent modular unit (IMU).

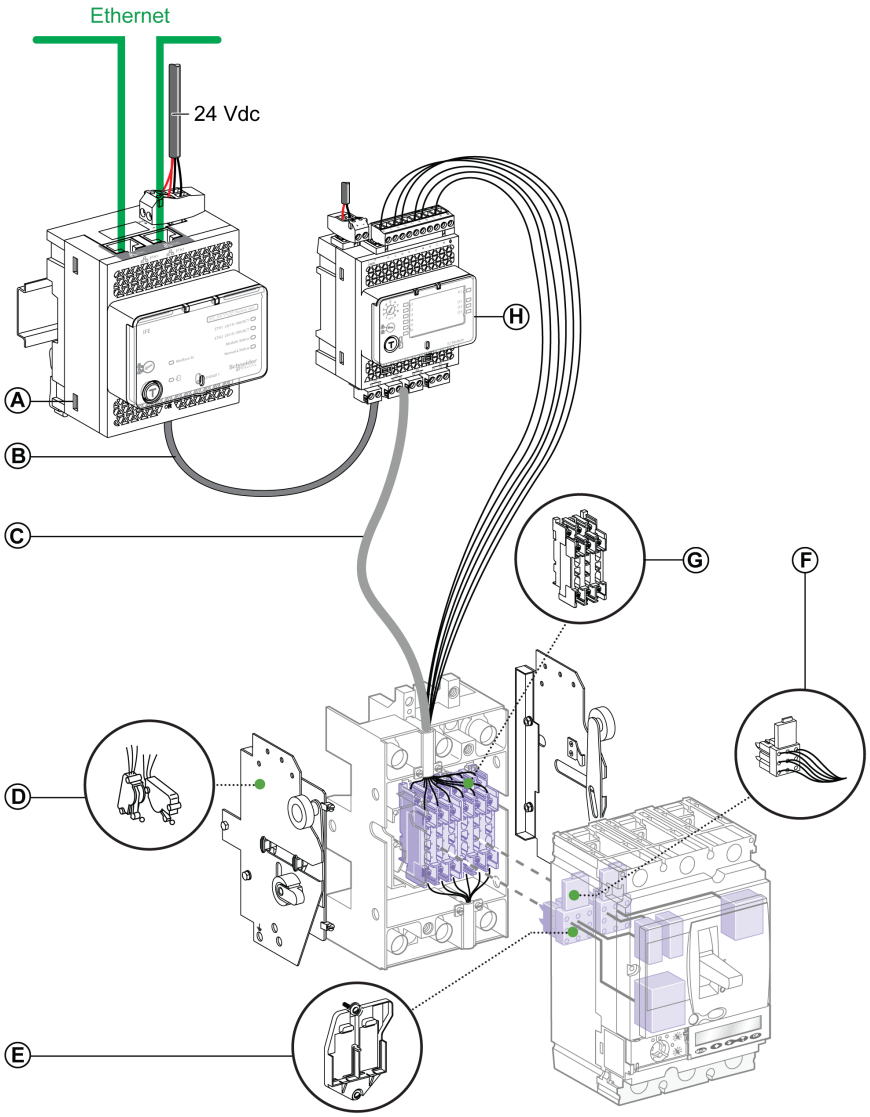
Examples of IMUs with PowerPact Circuit Breaker

Example 1: The IMU is composed of one IFM interface and one FDM121 display connected to a fixed PowerPact H-, J-, and L-frame circuit breaker.



A IFM Modbus-SL interface for one circuit breaker
B NSX cord
C NSX cord terminal block (included with NSX cord)
D Micrologic trip unit
E BSCM circuit breaker status control module
F RJ45 male/male ULP cord
G FDM121 ULP display for one circuit breaker

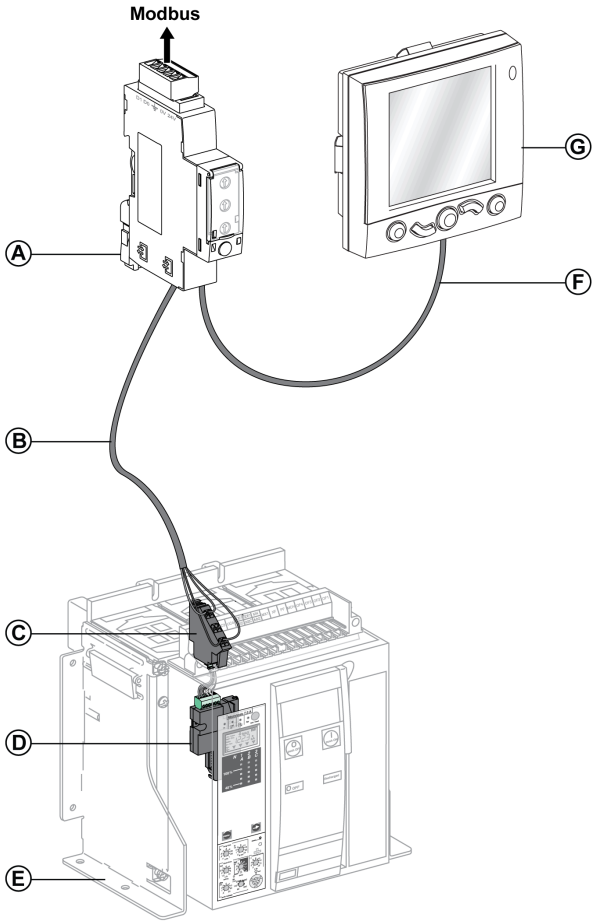
Example 2: The IMU is composed of one IFE interface and one IO module for cradle management connected to a drawout PowerPact H-, J-, and L-frame circuit breaker.



A IFE Ethernet interface for one circuit breaker
B RJ45 male/male ULP cord
C NSX cord
D Two-position CE/CD (connected/disconnected) position auxiliary switches
E Support for two moving connectors
F 9-wires moving connector
G 9-wires fixed connector for base
H IO input/output application module for one circuit breaker

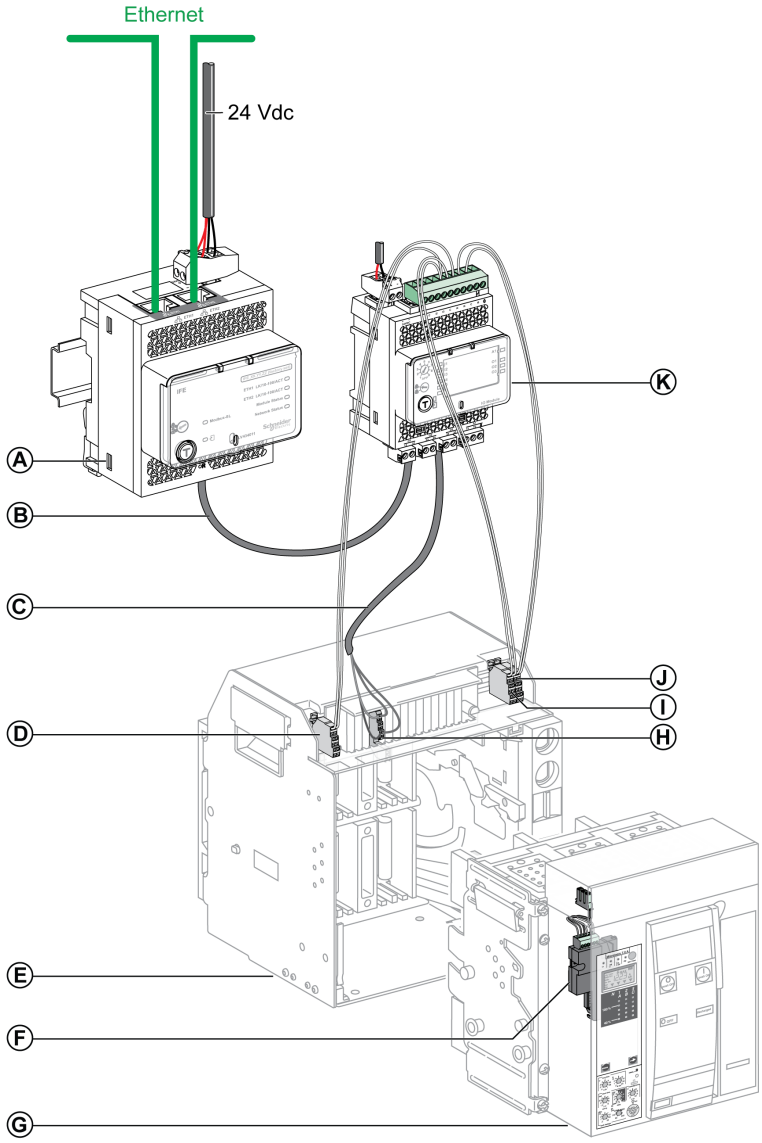
Examples of IMUs with Masterpact NT/NW Circuit Breaker

Example 1: The IMU is composed of one IFM interface and one FDM121 display connected to a fixed electrically-operated Masterpact NT circuit breaker.



A IFM Modbus-SL interface for one circuit breaker
B Circuit breaker BCM ULP cord
C Fixed terminal block
D BCM ULP circuit breaker communication module
E Fixed electrically-operated circuit breaker
F RJ45 male/male ULP cord
G FDM121 ULP display for one circuit breaker

Example 2: The IMU is composed of one IFE interface and one IO module for cradle management connected to a drawout Masterpact NT circuit breaker.

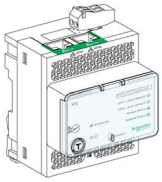
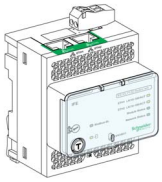
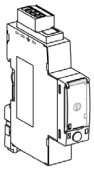


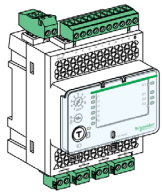
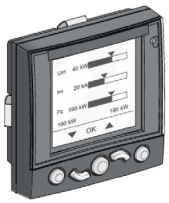
A IFE Ethernet interface for one circuit breaker
B RJ45 male/male ULP cord
C Circuit breaker BCM ULP cord
D Circuit breaker disconnected position contact (CD)
E Circuit breaker cradle
F BCM ULP circuit breaker communication module
G Drawout circuit breaker
H Drawout terminal block
I Circuit breaker connected position contact (CE)
J Circuit breaker test position contact (CT)
K IO input/output application module for one circuit breaker

ULP Modules and Accessories

ULP Modules

ULP modules can be grouped in categories:
- Generic ULP modules which are compliant with all circuit breakers as presented in the following table.
- ULP modules specific to PowerPact H-, J-, and L-frame circuit breakers *(see page 21)*.
- ULP modules specific to Masterpact NT/NW and PowerPact P- and R-frame circuit breakers *(see page 25)*.

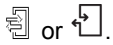
ULP module	Description	Part number
IFE Ethernet interface for one circuit breaker *(see page 98)* 	Ethernet interface for Compact, PowerPact, and Masterpact circuit breakers. The IFE interface enables intelligent modular units containing these circuit breakers to be connected to an Ethernet network. The IFE interface provides an Ethernet access to a single circuit breaker which has a corresponding IP address.	LV434010
IFE Ethernet switchboard server *(see page 98)* 	Ethernet interface for Compact, PowerPact, and Masterpact circuit breakers, and Ethernet switchboard server for Modbus-SL (serial line) connected devices. The IFE server enables IMUs containing these circuit breakers to be connected to an Ethernet network. The IFE server provides an Ethernet access to one or several circuit breakers. Several circuit breakers on a Modbus network are connected via the IFE server master Modbus port. The maximum number of IFM interfaces stacked to one IFE server and the impact on the system are detailed in the composition rules of an intelligent modular unit *(see page 33)*.	LV434011
IFM Modbus-SL interface for one circuit breaker *(see page 102)* 	The IFM interface enables IMUs in the ULP system to communicate by using the Modbus protocol. An IFM interface is required for connection of a Masterpact or PowerPact to a Modbus network as long as this circuit breaker is provided with a ULP port. Once connected, the circuit breaker is considered as a slave by the Modbus master.	STRV00210
Two-wire RS 485 isolated repeater *(see page 106)* 	A two-wire RS 485 isolated repeater is used to insulate between the voltage differences. It creates an interface between the Modbus network and the electrical equipment.	TRV00211

ULP module	Description	Part number
IO input/output application module for one circuit breaker *(see page 107)* 	The IO module is part of a ULP system and offers built-in input/output functions to enhance the application needs. Two IO modules can be connected in the same ULP network.	LV434063
FDM121 ULP display for one circuit breaker *(see page 111)* 	The FDM121 display is a local display unit displaying measurements and operating assistance data from the IMU.	STRV00121
UTA maintenance module *(see page 113)* 	Use the UTA module to set up, test, and maintain the ULP modules, by using the customer engineering tool *(see page 19)*.	STRV00911

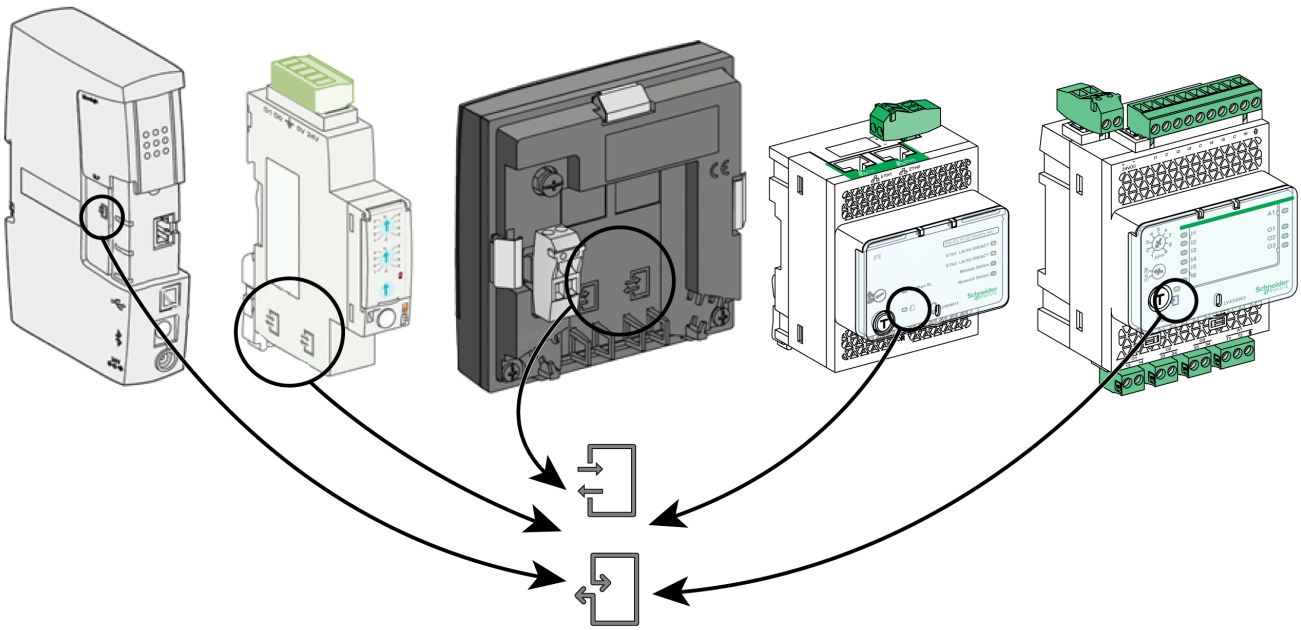
RJ45 ULP Ports

NOTICE
HAZARD OF EQUIPMENT DAMAGE ● Never connect an Ethernet device to an RJ45 ULP port. ● The RJ45 ULP ports are for ULP modules only. ● Any other use can damage the ULP module or the device connected to the ULP module. **Failure to follow these instructions can result in equipment damage.**

ULP modules have RJ45 ports, identified by either one of the pictograms:

 or .

Generally, each ULP module has two identical RJ45 ports in parallel to connect the IMU ULP modules in a daisy chain, in any order, by using RJ45 male/male ULP cords.



Updating the Firmware in ULP Modules

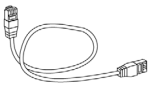
The user can update the firmware of a ULP module (IFM interface or FDM121 display, for example) by using the customer engineering tool *(see page 19)*.

The compatibility matrix embedded in the customer engineering tool helps the user to diagnose and correct the firmware discrepancy issues in the ULP modules by providing recommended actions and diagnostics messages relevant to the detected discrepancies.

NOTE: The firmware of the BSCM circuit breaker status control module for PowerPact H-, J-, and L-frame circuit breakers and the Micrologic trip units for Masterpact or PowerPact P- and R-frame cannot be updated by using the customer engineering tool.

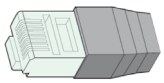
RJ45 Male/Male ULP Cord

Use simple plug-and-play ULP cords to interconnect ULP modules within a single IMU. They have male RJ45 connectors at both ends and are available in several lengths.

Illustration	Description	Part number
	L = 0.3 m (0.98 ft) (10 cords)	TRV00803
	L = 0.6 m (1.98 ft) (10 cords)	TRV00806
	L = 1 m (3.28 ft) (5 cords)	TRV00810
	L = 2 m (6.56 ft) (5 cords)	TRV00820
	L = 3 m (9.84 ft) (5 cords)	TRV00830
	L = 5 m (16.4 ft) (1 cord)	TRV00850

ULP Line Termination

The line termination closes the unused ULP connector on a ULP module. It consists of an RJ45 connector with passive components in a sealed unit.

Illustration	Description	Part number
	Ten ULP line terminations	TRV00880

RJ45 Female/Female Connector

Use the RJ45 female/female connector to connect two ULP cords end-to-end and thus extend them. It consists of two female RJ45 connectors linked by a direct electrical connection.

Illustration	Description	Part number
	Ten RJ45 female/female connectors	TRV00870

The length of extended ULP cord is limited *(see page 39)*.

Customer Engineering Tool

Definition

The customer engineering tool used to configure the ULP modules is Ecoreach, the Electrical Asset Manager software.

Other programs can be used to perform the following features provided by Ecoreach:

- Compact NSX RSU software can be used to:
  - Configure the ULP modules.
  - Update the firmware of the IFE Ethernet interface for one circuit breaker and IFM Modbus-SL interface for one circuit breaker, the IO module, the FDM121 ULP display for one circuit breaker unit, the BCM ULP circuit breaker communication module, the Micrologic 5 or 6 trip unit for PowerPact H-, J-, and L-frame.
  - Reset the IO module to factory settings.
  - Manage the passwords of IFE and IFM interfaces.
  - Set date and time of IFE and IFM interfaces.
- RCU software can be used to:
  - Monitor the status of the inputs and outputs of the IO module.
  - Check the network communication with IFE and IFM interfaces.

The customer engineering tools are available at *www.schneider-electric.com*.

Ecoreach

Ecoreach software enables the user to have the following features in addition to the features provided by Compact NSX RSU, Masterpact RSU, and RCU software:

- Create projects by device discovery or selection of devices from Schneider Electric catalog.
- Monitor the status of protection and IO status.
- Read information (alarms, measurements, parameters).
- Check protection discrimination between two devices.
- Upload and download of configuration or settings in batches.
- Carry out commands and test.
- Generate and print device settings report and communication test report.
- Manage multiple devices with electrical and communication hierarchy model.
- Manage artifacts (project and device documents).
- Check consistency in settings between devices in a communication network.
- Compare configuration settings between the project and device (online).
- Download latest firmware and upgrade devices.
- Safe repository of projects in Schneider Electric Cloud and sharing of projects with other users.

For more information, refer to the *Ecoreach Online Help*.

Compact NSX RSU Software

Compact NSX RSU (Remote Setting Utility) is the PowerPact H-, J-, and L-frame configuration software. It enables the user to:

- Check and set up the Micrologic trip unit parameters:
  - Protection parameters
  - Measurement parameters
  - Alarm parameters
- Display the Micrologic tripping curves.
- Check and set up the SDx module output parameters.
- Check and set up the SDTAM module output parameters.
- Check and set up the circuit breaker status and control module (BSCM circuit breaker status control module) parameters.
- Edit and save configurations.

Compact NSX RSU is used also to configure the intelligent modular units connected to PowerPact H-, J-, and L-frame, PowerPact P- and R-frame, or Masterpact NT/NW circuit breakers, and enables the user to:

- Check and set up the IFM interface parameters.
- Check and set up the IFE interface parameters.
- Modify passwords in the IMU.
- Change IMU identification.
- Get and set the time.
- Configure the IO module assignments.
- Modify the IO module counters.
- Reset the IO module counters (only with **Schneider service** user profile).
- Update firmware of ULP modules (only with **Schneider service** user profile).
- Reset the passwords to their factory values (only with the **Schneider service** user profile).
- Reset the IO module settings to their factory values (only with the **Schneider service** user profile).
- Edit and save configurations.

For more information, refer to the *Compact NSX RSU Online Help*.

Masterpact RSU Software

Masterpact RSU (Remote Setting Utility) is the Masterpact and Compact NS configuration software.

Masterpact RSU enables the user to:

- Check and set up the Micrologic trip unit parameters:
  - Protection parameters
  - Measurement parameters
  - Alarm parameters
- Display the Micrologic tripping curves.
- Edit and save configurations.

For more information, refer to the *Masterpact RSU Online Help*.

RCU Software

RCU (Remote Control Utility) is a simple SCADA software for:

- PowerPact H-, J-, L-, P-, and R-frame circuit breakers.
- Masterpact NT/NW circuit breakers.
- Power meters.

Depending on the equipment the RCU software is connected to, RCU enables the user to:

- Display the measurements of current (I), voltage (U), energy (E), and total harmonic distortion (THD).
- Display the date and time.
- Display the identification and maintenance information of the equipment.
- Control the equipment (only for circuit breakers).
- Log the measurements power (P), power factor (PF), and energy (E) every 5 minutes.
- Display the status of the IO modules.
- Check the network communication with IFM or IFE interface.

The RCU software helps users to monitor and control their equipment and helps installers to check and validate the newly installed equipment.

For more information, refer to the *RCU Online Help*.

Connecting PowerPact H-, J-, and L-Frame Circuit Breakers to the ULP System

Introduction

Use the NSX cord to connect the PowerPact H-, J-, and L-frame circuit breakers to the ULP system. The circuit breaker must have a BSCM circuit breaker status control module or a Micrologic 5 or 6 trip unit.

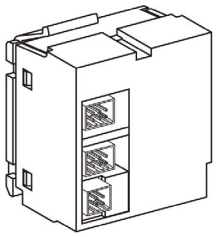
Micrologic Trip Units

Micrologic 5 or 6 trip units provide multiple functions:

- Protecting the electrical distribution system or specific applications
- Metering instantaneous values, metering demand values for electrical quantities
- Kilowatt hour metering
- Operating information (such as peak demand, customized alarms, and operation counter)
- Communication

For more information about the Micrologic trip units, refer to the relevant *Micrologic Trip Units User Guide*.

BSCM Circuit Breaker Status Control Module

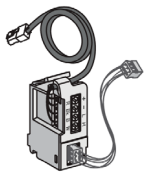
Illustration	Description	Part number
	The BSCM circuit breaker status control module provides: ● Status indication functions for the PowerPact H-, J-, and L-frame circuit breakers. ● Control of the communicating motor mechanism. ● Operating assistance functions. Use the BSCM module with standard and advanced Micrologic electronic trip units. Use the BSCM module with thermal-magnetic and Micrologic electronic trip units.	S434205

For more information about the BSCM module, refer to the circuit breaker instructions shipped with the circuit breaker.

NSX Cord

NSX cords are internal connection blocks used to connect a PowerPact H-, J-, or L-frame circuit breaker equipped with the BSCM module and/or the Micrologic 5 or 6 trip unit to a ULP module with their RJ45 connector.

The NSX cord is suited to applications less than 480 Vac, and it is available in two cable lengths and terminated with a male RJ45 connector for direct connection to a ULP module.

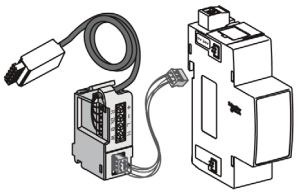
Illustration	Length	Part number
	L = 1.3 m (4.3 ft)	S434201
	L = 3 m (9.8 ft)	S434202

Lengths up to 5 m (16.4 ft) are possible by using RJ45 female/female connectors.

For more information about the NSX cord, refer to the circuit breaker instructions shipped with the circuit breaker.

Isolated NSX Cord

For system voltages greater than 480 Vac, using an insulated NSX cord is mandatory. This is to ensure data integrity on ULP network. The insulated NSX cord is an isolated variant of the NSX cord, terminated by an electronic module with a female RJ45 connector. Use an RJ45 male/male ULP cord to connect the isolated electronic module of the NSX cord to a ULP module.

Illustration	Length	Part number
	L = 1.3 m (4.3 ft)	S434204
	L = 3 m (9.8 ft)	S434303
	L = 4.5 m (14.7 ft)	S434305

The electronic module of the isolated NSX cord must be supplied with 24 Vdc so that the ULP system is isolated.

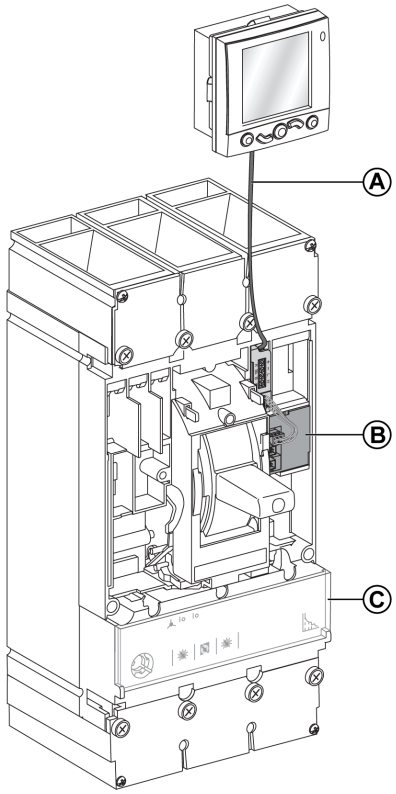
The following table summarizes the electronic module characteristics:

Characteristic	Value
Dimensions	27 x 27 x 27 mm (1 x 1 x 1 in)
Mounting	On DIN rail
Degree of protection of the installed module	• On the front panel (wall-mounted enclosure): IP40 • On the connections (behind the enclosure door): IP20
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Power supply voltage	24 Vdc -20%/+10% (19.2–26.4 Vdc)
Consumption	• Typical: 20 mA/24 Vdc at 20 °C (68 °F) • Maximum: 30 mA/19.2 Vdc at 60 °C (140 °F)

Connection to the ULP System with NSX Cord

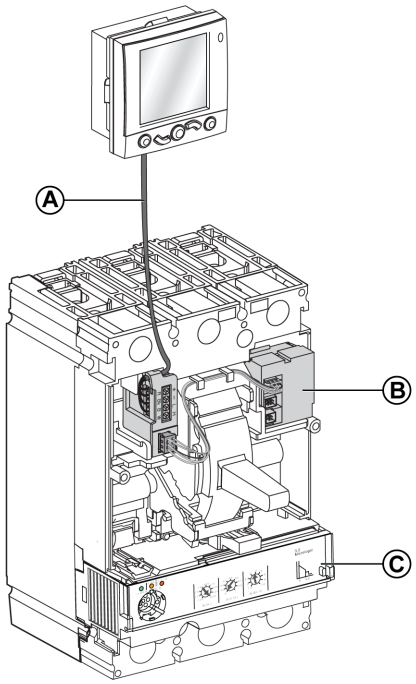
The following figures show connection of the PowerPact H-, J-, and L-frame circuit breaker to the IMU with the NSX cord.

PowerPact L-frame circuit breaker with standard Micrologic trip unit



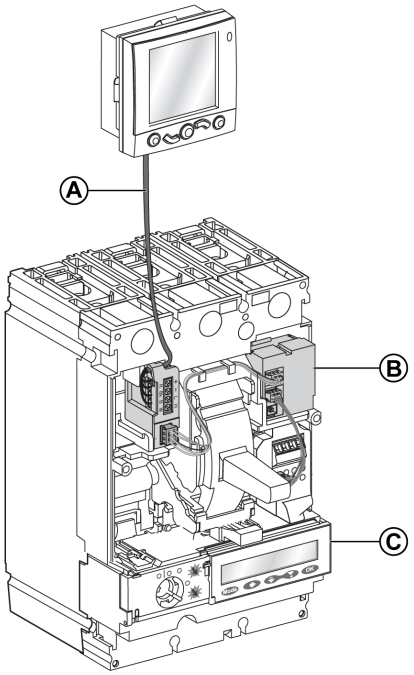
A NSX cord
B BSCM module
C Micrologic 2 or 3 trip unit

PowerPact H- or J-frame circuit breaker with BSCM module, and standard Micrologic trip unit



A NSX cord
B BSCM module
C Micrologic 2 or 3 trip unit

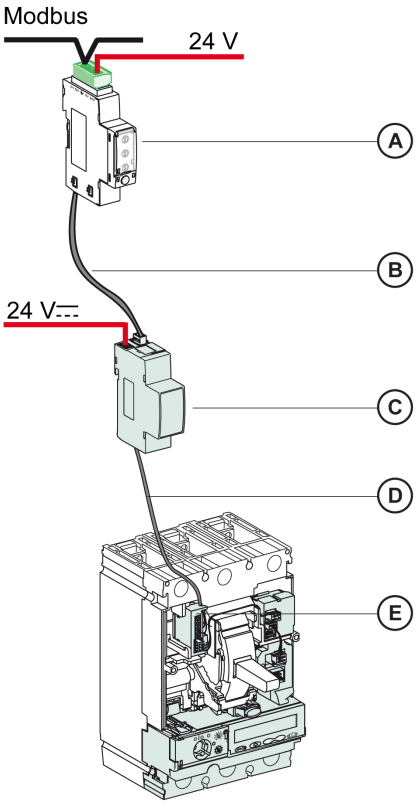
PowerPact H- or J-frame circuit breaker with BSCM module, and Micrologic 5 or 6 trip unit



A NSX cord
B BSCM module
C Micrologic 5 or 6 trip unit

Connection to the ULP System with Isolated NSX Cord

The following figure shows connection of the PowerPact H-, J-, and L-frame circuit breaker to the IMU with the isolated NSX cord:



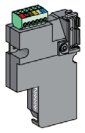
A IFM Modbus-SL interface for one circuit breaker
B RJ45 male/male ULP cord
C Insulated ULP module for system voltage greater than 480 Vac
D Circuit breaker ULP cord for system voltage greater than 480 Vac
E Connector for PowerPact H-, J-, and L-frame circuit breakers internal connection

Connecting Masterpact NT/NW and PowerPact P- and R-Frame Circuit Breakers to the ULP System

Introduction

Use the circuit breaker BCM ULP cord to connect the Masterpact NT/NW and PowerPact P- or R-frame circuit breakers to the ULP system. The circuit breaker must have a BCM ULP circuit breaker communication module.

BCM ULP Circuit Breaker Communication Module

Illustration	Description	Part number
	The BCM ULP circuit breaker communication module sends to and receives information from: ● The ULP system. ● The Micrologic trip unit via an infra-red link. ● The circuit breaker, via its microswitches. ● MX1 and XF communicating voltage releases.	● 33106 (spare part) ● The part number depends on the circuit breaker type. For details, refer to a selector program of Schneider Electric products.

For more information about the BCM ULP module, refer to the circuit breaker instructions shipped with the circuit breaker.

Circuit Breaker BCM ULP Cord

The circuit breaker BCM ULP cord is used to connect a Masterpact NT/NW or PowerPact P- or R-frame circuit breaker equipped with the BCM ULP module and/or the Micrologic trip unit to a ULP module with its RJ45 connector.

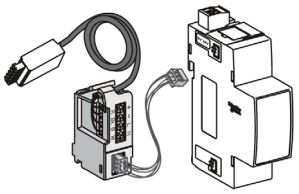
It is available in three lengths and terminated with a male RJ45 connector for direct connection to a ULP module.

Illustration	Length	Part number
	L = 0.35 m (1.15 ft)	LV434195
	L = 1.3 m (4.26 ft)	LV434196
	L = 3 m (9.84 ft)	LV434197

For more information about the BCM ULP cord, refer to the circuit breaker instructions shipped with the circuit breaker.

Isolated NSX Cord

For system voltages greater than 480 Vac, using an insulated NSX cord is mandatory. This is to ensure data integrity on ULP network. The insulated NSX cord is an isolated variant of the NSX cord, terminated by an electronic module with a female RJ45 connector. Use an RJ45 male/male ULP cord to connect the isolated electronic module of the NSX cord to a ULP module.

Illustration	Length	Part number
	L = 1.3 m (4.3 ft)	S434204
	L = 3 m (9.8 ft)	S434303

The electronic module of the isolated NSX cord must be supplied with 24 Vdc so that the ULP system is isolated.

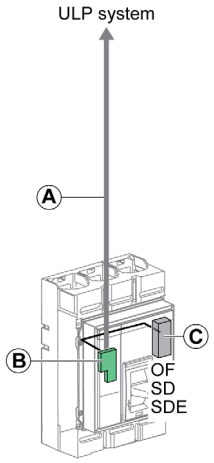
The following table summarizes the electronic module characteristics:

Characteristic	Value
Dimensions	27 x 27 x 27 mm (1 x 1 x 1 in)
Mounting	On DIN rail
Degree of protection of the installed module	• On the front panel (wall-mounted enclosure): IP40 • On the connections (behind the enclosure door): IP20
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Power supply voltage	24 Vdc -20%/+10% (19.2–26.4 Vdc)
Consumption	• Typical: 20 mA/24 Vdc at 20 °C (68 °F) • Maximum: 30 mA/19.2 Vdc at 60 °C (140 °F)

Connection to the ULP System with Circuit Breaker BCM ULP Cord

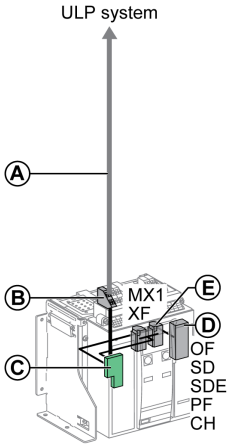
The following figures show connection of the Masterpact NT/NW or PowerPact P- or R-frame circuit breaker to the IMU with the BCM ULP cord.

Fixed manually-operated PowerPact P- or R-frame circuit breaker



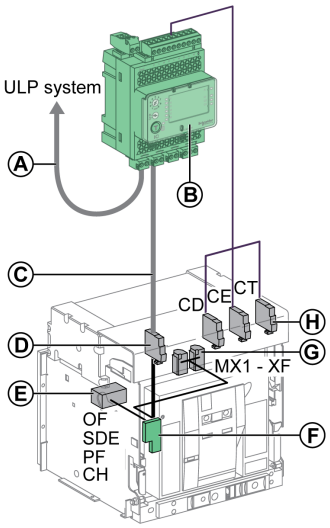
A BCM ULP cord
B BCM ULP module
C OF, SD, SDE microswitches

Fixed electrically-operated PowerPact P-frame or Masterpact NT/NW circuit breaker



A BCM ULP cord
B COM terminal block (E1 to E6)
C BCM ULP module
D OF, SD, SDE, PF, CH microswitches
E MX1 and XF communicating voltage releases

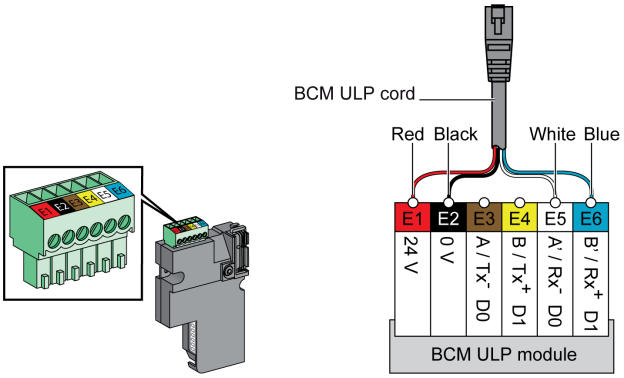
Drawout electrically-operated PowerPact P-frame or Masterpact NT/NW circuit breaker



A RJ45 male/male ULP cord
B IO module
C BCM ULP cord
D COM terminal block
E OF, SDE, PF, CH microswitches
F BCM ULP module
G MX1 and XF communicating voltage releases
H CE, CD, and CT contacts

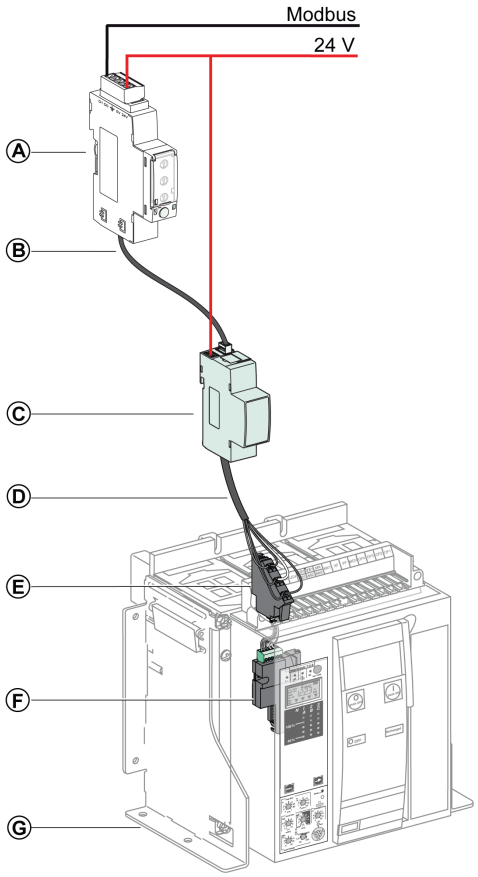
BCM ULP Circuit Breaker Communication Module Connection

The figure shows connection of the BCM ULP cord to the BCM ULP module.



Connection to the ULP System with Isolated NSX Cord

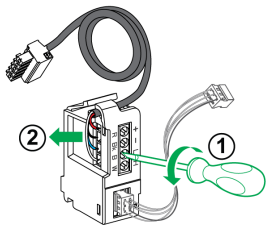
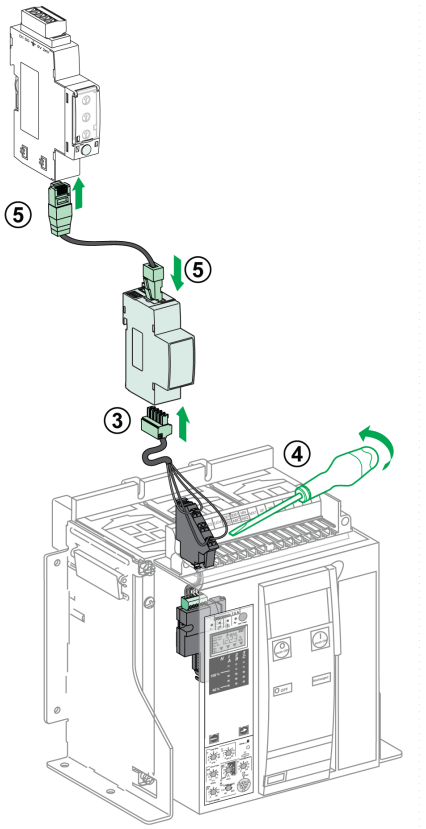
The following figure shows how to connect a fixed electrically-operated Masterpact NT/NW or Compact NS circuit breaker to the IMU with the isolated NSX cord:



A IFM Modbus-SL interface for one circuit breaker
B RJ45 male/male ULP cord
C Electronic module for system voltage greater than 480 Vac
D Cord for system voltage greater than 480 Vac
E Fixed terminal block
F BCM ULP circuit breaker communication module
G Fixed electrically-operated circuit breaker

Isolated NSX Cord Connection

Proceed as follow to connect the isolated NSX cord to the connector of a fixed electrically-operated Masterpact NT/NW or Compact NS circuit breaker.

Step	Action	
1	Unscrew the four terminal screws of the red, black, blue, and white wires connected onto the connector for circuit breaker internal connection.	
2	Remove the wires from the connector.	
3	Connect the 5-pin connector of this cable to the insulation module.	
4	Connect the four wires on the fixed terminal block that is installed in the circuit breaker.	
5	Connect the ULP ports of the Modbus repeater and the ULP module (for example, IFM interface, FDM121 display) by using an RJ45 male/male ULP cord.	

Chapter 2
Design Rules of ULP System

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
Rules for ULP Connection and Power Supply

What Is in This Section?

This section contains the following topics:

Composition Rules for Intelligent Modular Units (IMUs)

Introduction

Connection of an IMU in the ULP system is simple, but must comply with the rules concerning composition, RJ45 male/male ULP cords, and the ULP module power supply.

General Rule: Composition of an IMU

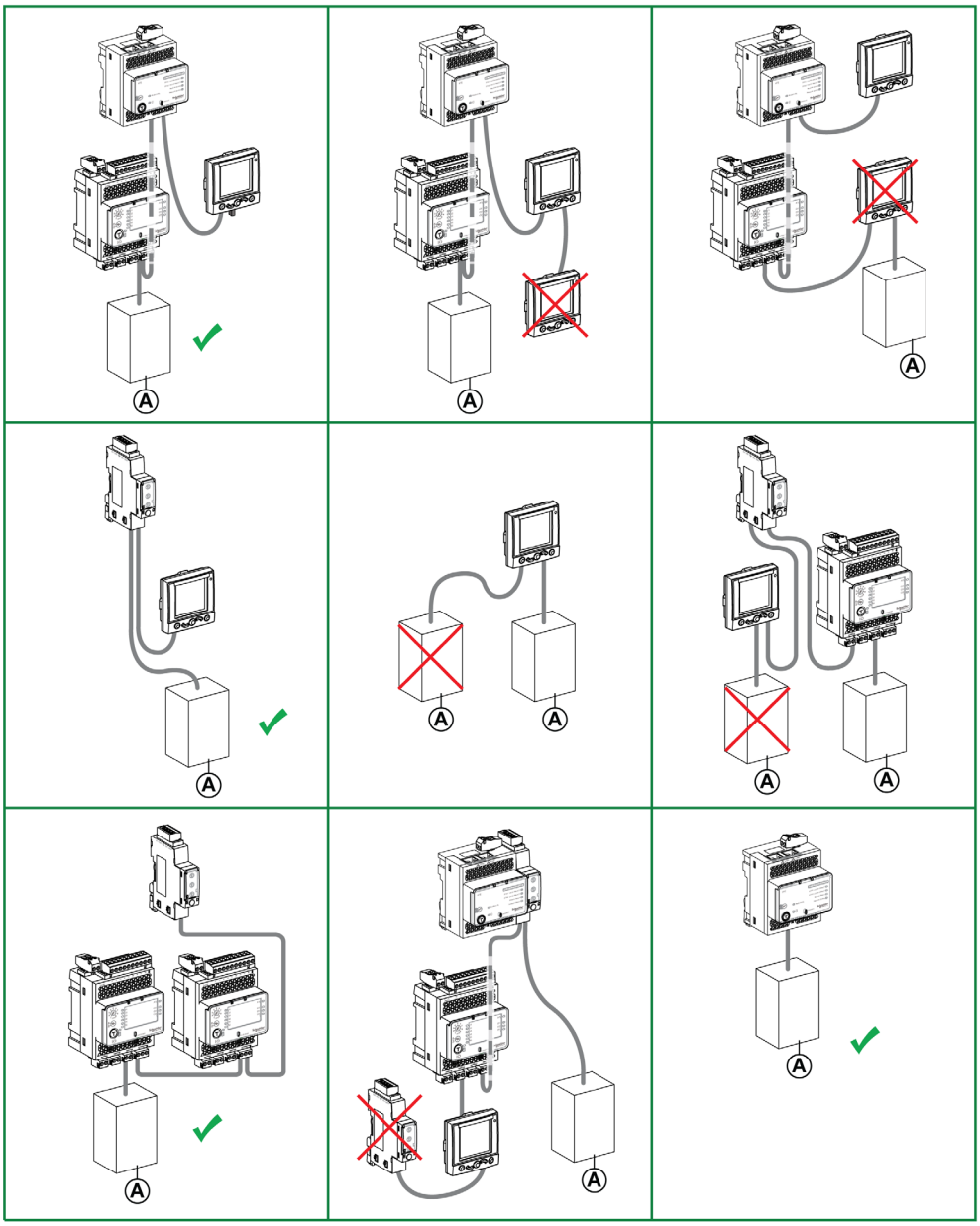
An IMU is composed of the following two device types:

- One circuit breaker:
  - A PowerPact H-, J-, and L-frame circuit breaker with a BSCM circuit breaker status control module or Micrologic 5 or 6 trip unit,
  - or a PowerPact P- and R-frame circuit breaker with a BCM ULP circuit breaker communication module,
  - or a Masterpact NT/NW circuit breaker with a BCM ULP circuit breaker communication module.
- At least one of these ULP modules:
  - FDM121 ULP display for one circuit breaker.
  - IO input/output application module for one circuit breaker.
  - IFM Modbus-SL interface for one circuit breaker or
    IFE Ethernet interface for one circuit breaker or
    IFE Ethernet switchboard server.

The following table presents the number of allowed ULP modules per IMU.

ULP module	Number of modules per IMU
FDM121 display	0 or 1.
IO module	0, 1, or 2.
IFM or IFE interface	0 or 1.
IFE server with stacked IFM interfaces	One IFE server with stacked IFM interfaces: ● In terms of power supply, to limit voltage drop, the maximum number of IFM interfaces stacked to one IFE server is 12. ● In terms of Modbus communication, it depends on the performance requirement. As it takes approximately 500 ms at 19,200 Baud per device to refresh 100 registers, the more interfaces added the longer the minimum refreshment period. The minimum refreshment period depends on the number of IFM interfaces stacked to one IFE server. Multiply the time to refresh one device by the number of devices to find the minimum refreshment period expected in the application. For instance, an installation with eight IFM interfaces stacked to one IFE server at 19,200 Baud would take approximately 4 seconds to be read. For good communication performance, a maximum of eight IFM interfaces stacked to one IFE server is recommended.

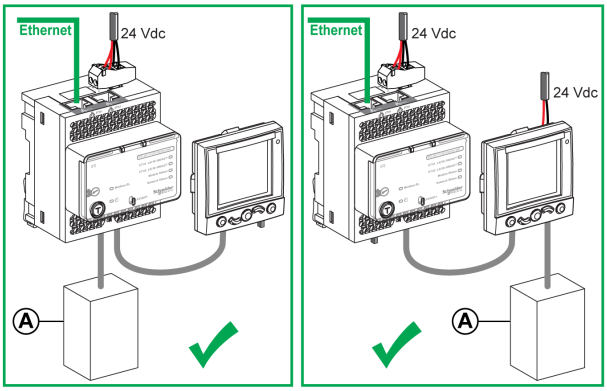
These examples illustrate the rule of the composition of an IMU.



A Circuit breaker (PowerPact H-, J-, L-, P-, or R-frame or Masterpact NT/NW)

General Rule: Order of ULP Modules in an IMU

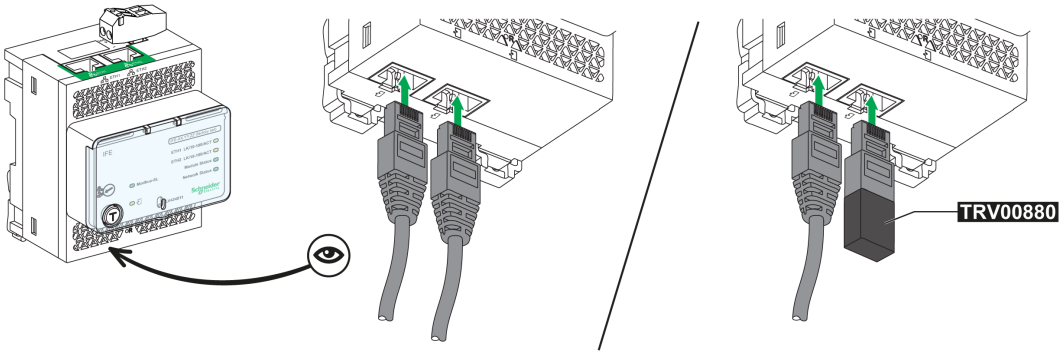
Connect the ULP modules in a single IMU in any order. Base the connection on the cable routing and the desired layout for the ULP modules in the electrical equipment.



A Circuit breaker (PowerPact H-, J-, L-, P-, or R-frame or Masterpact NT/NW)

General Rule: ULP Line Termination

The ULP modules placed at the end of the ULP line take a ULP line termination (part number TRV00880) on the unused ULP RJ45 connector.



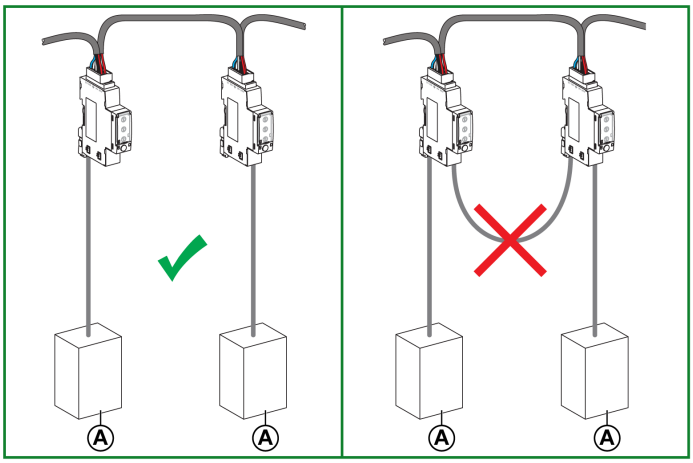
Place the ULP modules which have an internal ULP line termination at the end of the ULP line, that is:

- BSCM module or Micrologic 5 or 6 trip unit for PowerPact H-, J-, and L-frame circuit breakers.
- BCM ULP module for PowerPact P- and R-frame or Masterpact NT/NW circuit breakers.

General Rule: Cables to Interconnect IMUs on Communication Networks

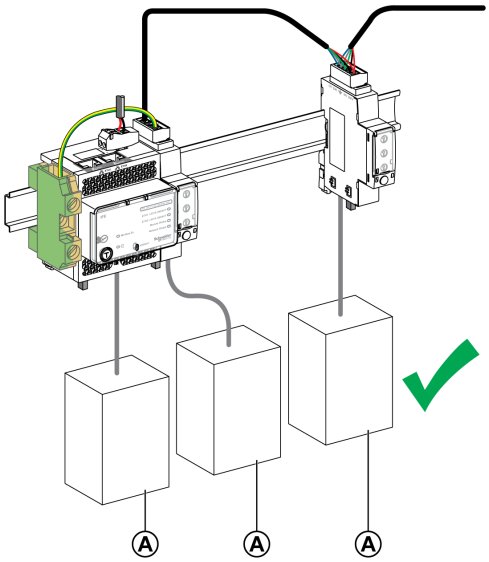
Do not connect the IMUs to one another by ULP cords.

- Use only the Modbus cable or stacking connector to interconnect IMUs connected to a Modbus network.



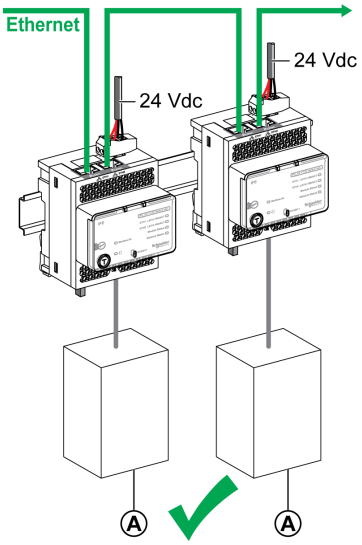
A Circuit breaker (PowerPact H-, J-, L-, P-, or R-frame or Masterpact NT/NW)

The 0 V terminal on IFM interfaces is connected to a protective ground terminal block at only one point of the Modbus line (first stacked IFM or at the Modbus master if IFM interfaces are not stacked with IFE server). No other devices must have 0 V connected to ground.



A Circuit breaker (PowerPact H-, J-, L-, P-, or R-frame or Masterpact NT/NW)

- Use only the Ethernet cable to interconnect IMUs connected to an Ethernet network.



A Circuit breaker (PowerPact H-, J-, L-, P-, or R-frame or Masterpact NT/NW)

General Rule: Limitation of Number of PowerPact H-, J-, and L-Frame Circuit Breakers

In case of floating power supply and without IFM interface installed in the ULP system, the number of PowerPact H-, J-, and L-frame circuit breakers is limited by earth leakage currents as described in the following table.

The limitation is valid for all PowerPact H-, J-, and L-frame circuit breakers used with a ULP connection.

The formula to calculate the number of circuit breakers on a complete architecture is:

Number of circuit breakers = 500 µA / circuit breakers ratio

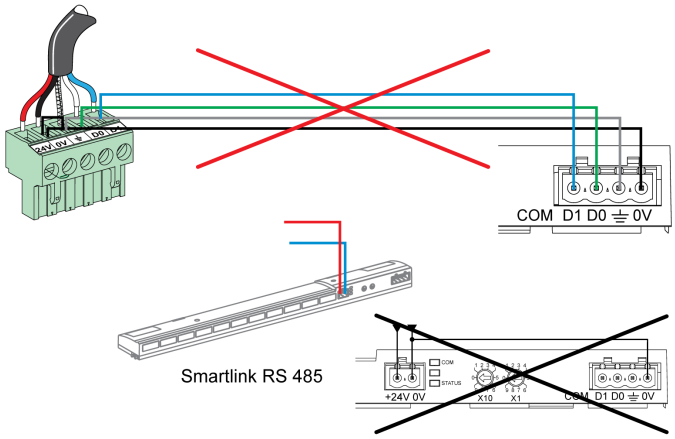
Ue (V L-N / U L-L) (Vac)	PowerPact H-, J-, and L-frame circuit breakers ratio
66 / 115	9
127 / 220	17
230 / 400	31
347 / 600	47
400 / 690	57
1,000	–

Example: If the PowerPact H-, J-, and L-frame circuit breakers are 690 Vac, then the maximum number of available circuit breakers on the complete ULP system is 500 µA / 57 = 8.

General Rule: Modbus Devices Connected to IFM Interfaces

No Modbus device with dedicated 0 V Modbus (for example, Acti 9 Smartlink device) must be connected to an IFM interface. The IFM interface has indeed no dedicated 0 V Modbus.

The following diagram illustrates this rule for Acti 9 Smartlink devices:

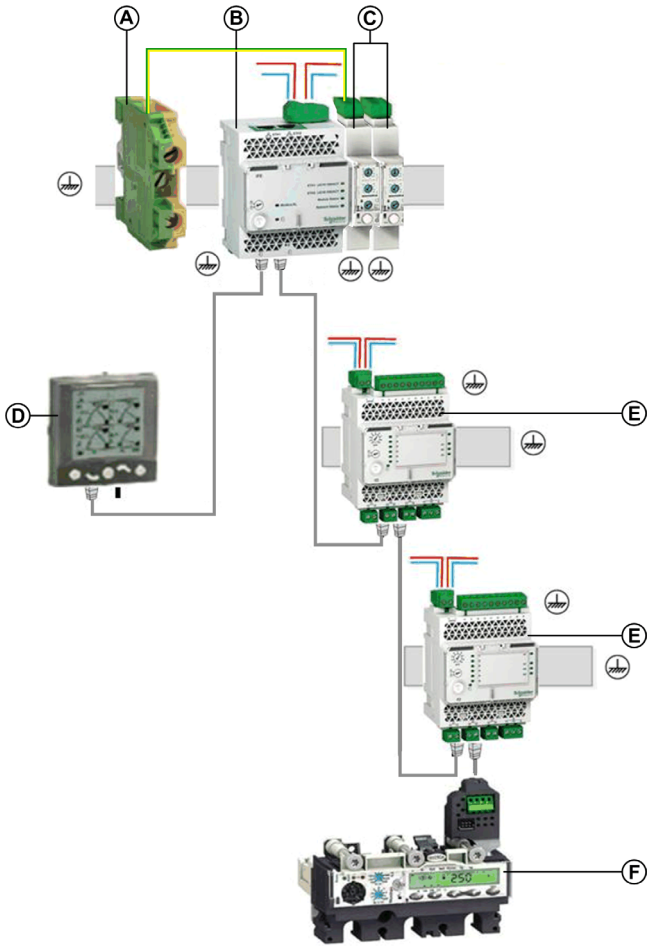


General Rule: Power Supply Through the ULP Cord

Only one device can be powered through the ULP cord. This device must be at the end of the ULP line. It can be done only for the following devices:

- FDM121 display.
- BSCM module and Micrologic trip unit for PowerPact H-, J-, and L-frame circuit breakers.
- BCM ULP module for Masterpact NT/NW circuit breakers.

Example: In the diagram, only the FDM121 display and the PowerPact H-, J-, and L-frame Micrologic trip unit are supplied through ULP. The IFE server and the IO modules get a direct connection with the power supply. As IFM interfaces are stacked on the IFE server, they are already supplied.



A Protective ground terminal block
B IFE server
C IFM interfaces stacked on IFE server
D FDM121 display
E IO module
F Micrologic trip unit in PowerPact H-, J-, and L-frame circuit breaker

Length of ULP Cords

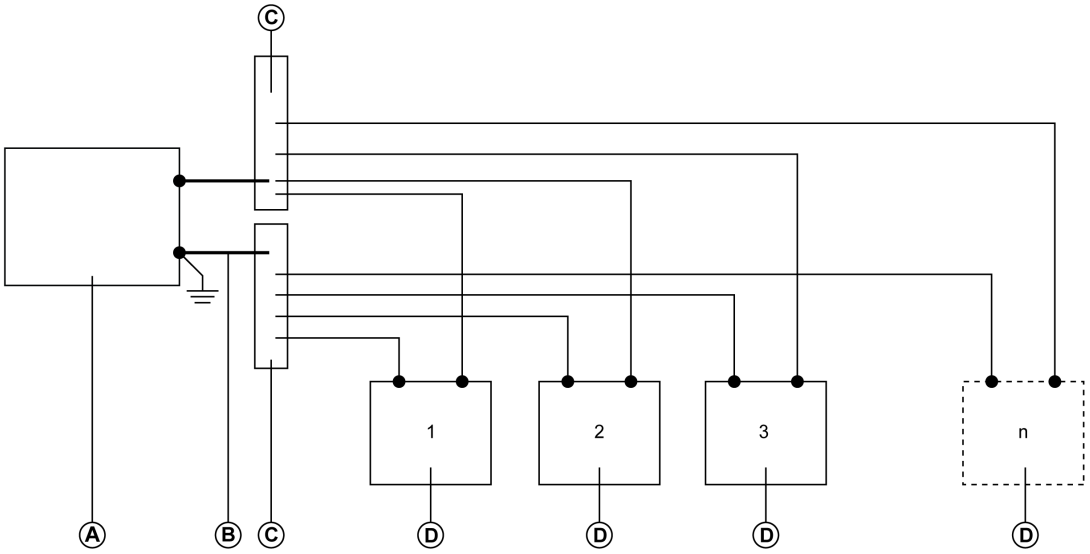
ULP cord length rules are as follows:

- The maximum length of the ULP cord between two IMU ULP modules is 5 m (16.4 ft).
- The maximum length of all the ULP cords on a single IMU is 20 m (65.6 ft).
- In the case of an installation with a withdrawable drawer, the total length of the ULP cords for the fixed part must be less than 12 m (39.4 ft) to ensure that the fixed part operates correctly when the drawer is drawn out.
- The bending radius of the ULP cords must be 50 mm (1.97 in) minimum.

Power Supply Connection

Power supply distribution systems can be one of the following:

- Star connection:
  This power supply distribution system is recommended to minimize EMC disturbances due to common impedance.
  The following diagram shows how to design a power distribution (DC or AC). In this configuration, the common impedance is minimized. Only the link between the main power supply and the terminal distribution is common impedance. If this length is very short, the common impedance is low. The wiring of each device must be done with twisted pair cables to avoid loops and radiated emissions. It is possible to supply power to three or four devices by line if the current consumption is low (less than 500 mA) and the total length is less than 5 m.



A Power supply
B Very short cable
C Terminal distribution
D Circuit breaker

- Daisy chain:
  The power connectors between each device in the system can be distributed in a daisy chain with a loop and the last device must be connected directly to the power supply. This way a device can be disconnected without impact on the others and the voltage drop on the devices is limited.
  Cables between the daisy chain and the loop for reconnecting the power supply must be close together to avoid current loop and to avoid generation of EMC disturbances.
  For more information, refer to power supply in architectures with IFM interfaces *(see page 46)*.

24 Vdc Power Supply Connections

The Phaseo ABL8 external 24 Vdc power supply is compatible with IFE and IFM interfaces, IO module, FDM121 display, BCM ULP module, BSCM module, and Micrologic trip units for PowerPact H-, J-, and L-frame circuit breakers.

It is recommended to use the AD power supply for Micrologic trip unit in PowerPact P- and R-frame and Masterpact NT/NW circuit breakers due to its low stray primary secondary capacitance. Good operation of the Micrologic trip unit in noisy environment is not guaranteed with other power supplies.

The dedicated AD power supplies must be used for Micrologic trip units in PowerPact P- and R-frame and Masterpact NT/NW circuit breakers. If the COM option is used, a second dedicated power supply must be used to power the COM option.

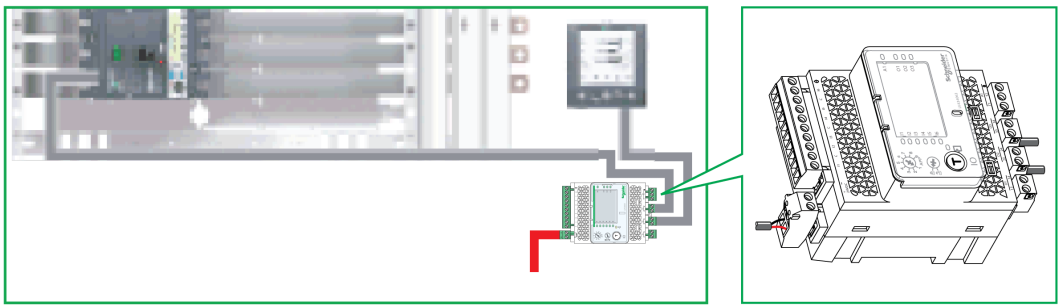
To reduce electromagnetic interference, follow these rules regarding the AD power supply for Micrologic trip units:

- The input and output wires of the 24 Vdc power supply must be physically separated as much as possible.
- The 24 Vdc wires (output of the 24 Vdc power supply) must be twisted together.
- The 24 Vdc wires (output of the 24 Vdc power supply) must cross all power cables perpendicularly.
- Power supply conductors must be cut to length. Do not loop excess conductor.

Add an external 24 Vdc power supply (AD module) in cases of a Micrologic trip unit in PowerPact P- and R-frame or Masterpact NT/NW circuit breakers.

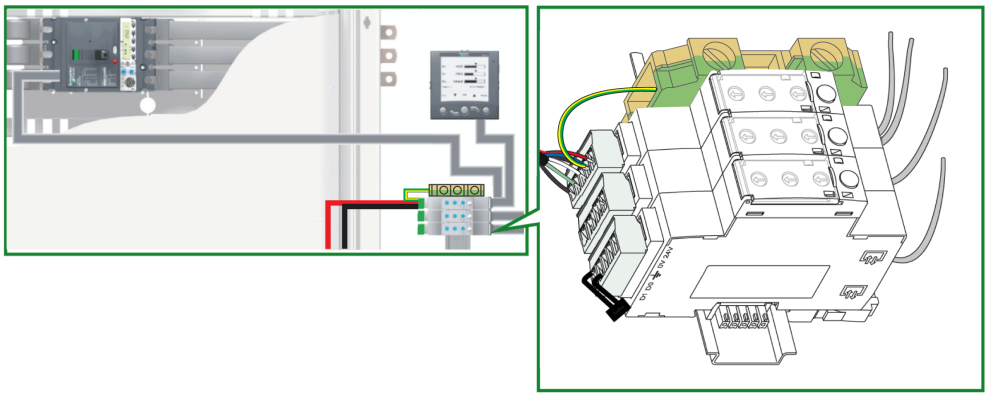
The 24 Vdc power supply can be connected in either of two ways:

- In a standalone architecture *(see page 61)*, the ULP module of the IMU is the FDM121 display or IO module. Connect the 24 Vdc power supply to one of the supply terminal blocks of the ULP module of the IMU.
  Add an external 24 Vdc power supply (AD module) in case of Micrologic trip unit in PowerPact P- and R-frame or Masterpact NT/NW circuit breakers.

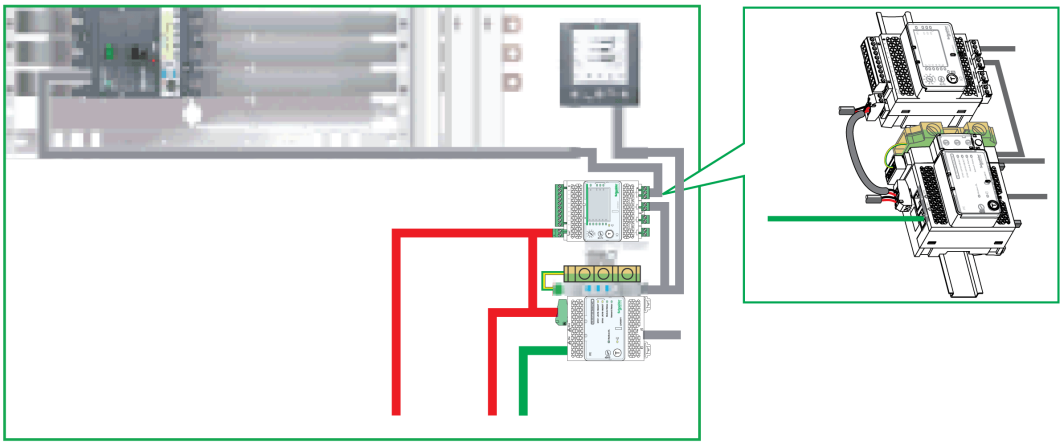


Cable color	Description
Gray	ULP network
Red	24 Vdc power supply

- In all other architectures *(see page 49)*, connect one 24 Vdc power supply to these devices:
  - All IFE interfaces and IO modules must have a direct connection with the power supply and cannot be supplied through ULP port.
  - If several stacked IFM interfaces are not stacked with an IFE server, only one of the IFM interfaces must get a direct connection with the power supply.



  - The Micrologic trip unit in Masterpact NT/NW circuit breakers must be supplied by a dedicated AD power supply.
  - The BSCM module and Micrologic trip unit in PowerPact H-, J-, and L-frame circuit breakers or the BCM ULP module in Masterpact NT/NW and PowerPact P- and R-frame circuit breakers are directly supplied through one of the two RJ45 ULP ports of the IFE or IFM interface or IO module.



Cable color	Description
Gray	ULP network
Red	24 Vdc power supply
Green	Ethernet network

For more information about supplying power to the IMUs, refer to ULP system power supply *(see page 43)*.

Summary of Connection Rules

Characteristic	Value
Connection	Daisy-chaining of ULP cords and ULP line termination at the end of the ULP line
Maximum length	• 20 m (65.6 ft) in total for the IMU • 5 m (16.4 ft) between two ULP modules • 12 m (39.4 ft) for the fixed part in the case of an installation with a withdrawable drawer
Voltage range supported	24 Vdc -10%/+10% (21.6–26.4 Vdc)
Current limitation on each ULP RJ45 port	300 mA *(see page 43)*

ULP System Power Supply

ULP Module Consumption

Power ULP modules by a 24 Vdc voltage distributed through the RJ45 male/male ULP cords.

To limit voltage drops on the ULP cords and the Modbus cable, the consumption of each ULP RJ45 port is limited to 300 mA.

The following table lists the ULP module consumption.

Module	Typical consumption (24 Vdc at 20 °C / 68 °F)	Maximum consumption (19.2 Vdc at 60 °C / 140 °F)
IFE Ethernet interface for one circuit breaker	80 mA	150 A
IFE Ethernet switchboard server	80 mA	150 mA
IFM Modbus-SL interface for one circuit breaker	21 mA	30 mA
Two-wire RS 485 isolated repeater	15 mA	19 mA
IO input/output application module for one circuit breaker	35 mA	150 mA
FDM121 ULP display for one circuit breaker	21 mA	30 mA
Micrologic 5 or 6 trip unit for PowerPact H-, J-, and L-frame circuit breakers	30 mA	55 mA
BSCM circuit breaker status control module for PowerPact H-, J-, and L-frame circuit breakers	9 mA	15 mA
BCM ULP circuit breaker communication module for Masterpact NT/NW and PowerPact P- and R-frame circuit breakers	40 mA	65 mA
UTA maintenance module	0 mA (the UTA module has its own power supply)	0 mA (the UTA module has its own power supply)

Power Supply Connection Rules

- All IFE interfaces and IO modules must have a direct connection with the power supply and cannot be supplied through ULP system.
- The BSCM module and Micrologic trip unit in PowerPact H-, J-, and L-frame circuit breakers or the BCM ULP module in PowerPact P- and R-frame and Masterpact NT/NW circuit breakers are directly supplied through one of the two RJ45 ULP ports of the IFE or IFM interface or IO module.
- The Micrologic trip unit in PowerPact P- and R-frame and Masterpact NT/NW circuit breakers must be supplied by a dedicated AD power supply.
- The 0 V terminal on IFM interfaces is connected to a protective ground terminal block at only one point of the Modbus line (first stacked IFM or at the Modbus master if IFM interfaces are not stacked with IFE server). No other devices must have 0 V connected to ground.
- If no IFM interface is installed on the ULP system, 0 V must be connected to a ground terminal block at power supply level. No other devices must have 0 V connected to ground.
- If no IFM interface or PowerPact H-, J-, and L-frame circuit breaker is installed on the ULP system, it is recommended to have a floating auxiliary power supply. Do not connect terminals + and - of the 24 Vdc auxiliary power supply output to the ground.

Power Supply Rating

Power supply rating rules are as follows:

- To design the power supply dedicated to communication modules, check the maximum short-circuit current (Icc). It must not exceed 20 A, that is, the maximum short circuit current which can be withstood by the ULP modules. For example, the Icc of the ABL8 power supply is limited to 14 A for a 10 A nominal current.
- The rating of the 24 Vdc power supply voltage for the furthest ULP module must be 24 Vdc +/-10% (21.6–26.4 Vdc).
  To comply with this range at the end of a Modbus cable distributing power, the 24 Vdc power supply output voltage must be regulated at:
  - +/-3% (23.3–24.7 Vdc) for 3 A power supplies.
  - +/-5% (22.8–25.2 Vdc) for 1 A power supplies.
- It is recommended to use the 24 Vdc external power supply AD module for PowerPact P- and R-frame Micrologic trip units due to its low stray primary secondary capacitance: +/-5% (22.8–25.2 Vdc) for 1 A power supplies.
  Good operation of the Micrologic trip unit in noisy environment is not guaranteed with other power supplies.

Examples of 24 Vdc Power Supplies

The following table gives examples of the 24 Vdc power supplies to be used depending on the type of installation.

Type of installation	Rating	Description	Part number
Installation limited to a few IMUs or used to supply Micrologic	1 A	24/30 Vdc - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685823
		48/60 Vdc - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685824
		100/125 Vdc - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685825
		110/130 Vac - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685826
		200/240 Vac - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685827
		380/415 Vac - 24 Vdc - 1 A Primary overvoltage category IV Temperature: -25 °C to +70 °C (-13 ºF to +158 °F)	685829
Large installation	3 A	100/500 Vac - 24 Vdc - 3 A Primary overvoltage category II Temperature: 0–60 °C (0–140 °F) (derated to 80% of the current above 50 °C (122 ºF))	ABL8RPS24030

Segmented Power Supply

Segmented power supplies are required in the following cases:

- When the IMUs are divided between a number of electrical equipments, each electrical equipment must have its dedicated 24 Vdc power supply.
- To design the power supply dedicated to communication modules, check the maximum short-circuit current (Icc). It must not exceed 20 A, that is, the maximum short circuit current which can be withstood by the ULP modules. For example, the Icc of the ABL8 power supply is limited to 14 A for a 10 A nominal current.
- When the IMUs communicate over Modbus by using the IFM interface, the Modbus cable distributes the 24 Vdc power.
  If the length of the Modbus cable is such that the voltage drop is excessive (for example, cable longer than 15 m (49.2 ft) with a 3 A power supply), independently powered Modbus cable segments must be created:
  - **Only the 24 Vdc wire is interrupted between two segments**.
  - **The continuity of the 0 V wire (which is also the Modbus common) must be assured along the entire length of the Modbus network.**

  The maximum number of power supply segments is three for a single Modbus network.
- When an installation consists of a number of Modbus networks, one 24 Vdc power supply must be used for each Modbus network.
  Since the 0 V of the 24 Vdc power supply is also the Modbus common, the power supplies must be separated to make the Modbus networks independent from one another.
  The 24 Vdc external power supply for the Micrologic 2.• and 3.• trip units for PowerPact H-, J-, and L-frame circuit breakers may be shared with the ULP/communications system. This supply is connected to the protective ground as described below *(see page 46)*.
  NOTE: The 24 Vdc external power supply for Micrologic 0.• A/P/H trip units for Masterpact NT and NW and PowerPact P and R-frame circuit breakers must be a separate power supply than the ULP/communications power supply. Use one 24 Vdc external power supply per Micrologic 0.• A/P/H trip unit for Masterpact NT and NW and PowerPact P and R-frame circuit breakers. This supply is NOT connected to protective ground.
- Up to five devices (Micrologic trip units with M2C or M6C) can be connected to the same external 24 Vdc power supply module for Micrologic. Add another AD power supply for more than five devices.
  For Micrologic trip units alone, up to 10 devices can be connected to the same AD power supply. Add another AD power supply for more than 10 Micrologic trip units.

Connection of the 0 V Circuit

⚠ WARNING

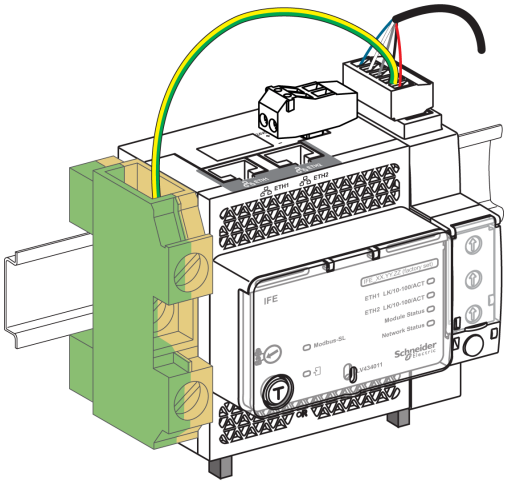
HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Connect the 0 V circuit (Modbus common and 0 V of the 24 Vdc power supply) to the protective earth ground.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The rules for connection of the 0 V circuit must be followed:

- For the power supply and for all ULP modules of an IMU, a stainless steel DIN rail is recommended rather than an aluminum one in order to provide the most consistent ground. Each DIN rail must be connected to the protective ground.
- If no IFM interface is installed on the ULP system, 0 V must be connected to a ground terminal block at power supply level. No other devices must have 0 V connected to ground.
- If there is at least one IFM interface in the architecture, connection on IFM interfaces must be done as follows:
  - If one or several IFM interfaces are stacked on an IFE server, then at least one of the IFM interfaces must have a jumper on its connector between the 0 V terminal and the protective ground.



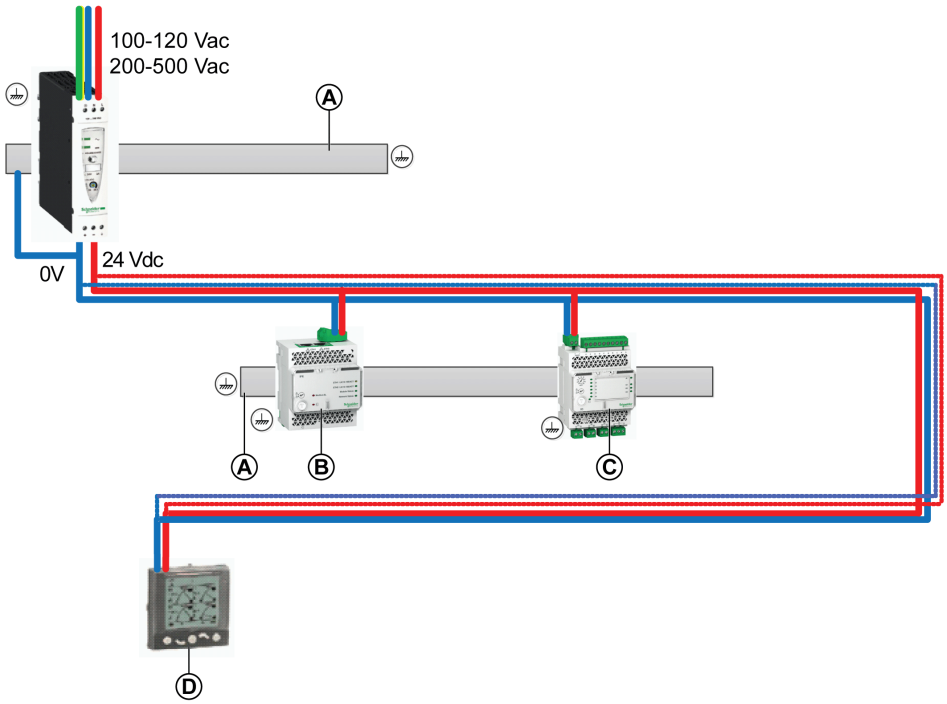
NOTICE

HAZARD OF SIGNIFICANT CURRENT LOOP ON THE SYSTEM

When IFM interfaces are present in the architecture, do not connect the 0 V of the power supply on the stainless steel DIN rail.

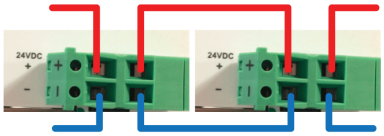
Failure to follow these instructions can result in equipment damage.

- Do not connect the 24 Vdc of the 24 Vdc power supply to the protective ground.
- In architectures with one or several IFM interfaces, no power supply should be grounded if there are one or several power supply segments on a single Modbus network.



A Stainless steel DIN rail
B IFE interface or IFE server
C IO module
D FDM121 display

The following figure shows the daisy-chain power supply:



Segments of the Modbus network that are isolated from the main trunk line and that are all located within one piece of equipment must be protective grounded within that section of equipment.

- In architectures without IFM interface, the power supply on the second and third segments should be grounded.

Section 2.2
Rules for Connection to the Communication Network

What Is in This Section?

This section contains the following topics:

Connection to the Modbus-SL Network with IFM Interface

Introduction

Connect intelligent modular units to the Modbus network with the IFM Modbus-SL interface for one circuit breaker *(see page 102)*.

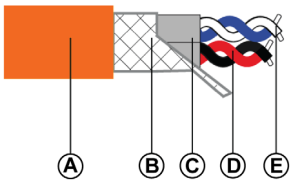
Use the Modbus cable to interconnect the IMUs, supply them with power, and connect them to the Modbus master.

In terms of power supply, to limit voltage drop, the maximum number of IFM interfaces stacked to one IFE server is 12.

In terms of Modbus communication, it depends on the performance requirement. As it takes approximately 500 ms at 19,200 Baud per device to refresh 100 registers, the more interfaces added the longer the minimum refreshment period. The minimum refreshment period depends on the number of IFM interfaces stacked to one IFE server. Multiply the time to refresh one device by the number of devices to find the minimum refreshment period expected in the application. For instance, an installation with eight IFM interfaces stacked to one IFE server at 19,200 Baud would take approximately 4 seconds to be read.

Composition of the Modbus Cable

The following figure shows the Modbus cable:



A Outer sheath
B Shielding braid
C Twisted-pair sheaths
D Communication pair (white/blue)
E Power supply pair (red/black)

This cable construction is not used with the two-wire RS 485 isolated repeater.

The characteristics of the Modbus cable are as follows:

- Shielded cable with two twisted-pairs:
  - One pair with 0.25 mm^2 (24 AWG) cross-section for the RS 485 signal (D0, D1).
  - One pair with 0.5 mm^2 (20 AWG) cross-section for the power supply (0 V, 24 Vdc).
- Shielding braid to be connected to the ground terminal of the 5-pin connector on the IFM interface.
- External diameter: 8.7–9.6 mm (0.35–0.38 in).
- Color of outer sheath: orange.

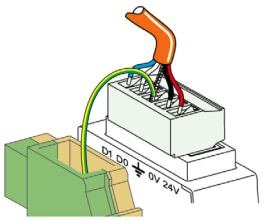
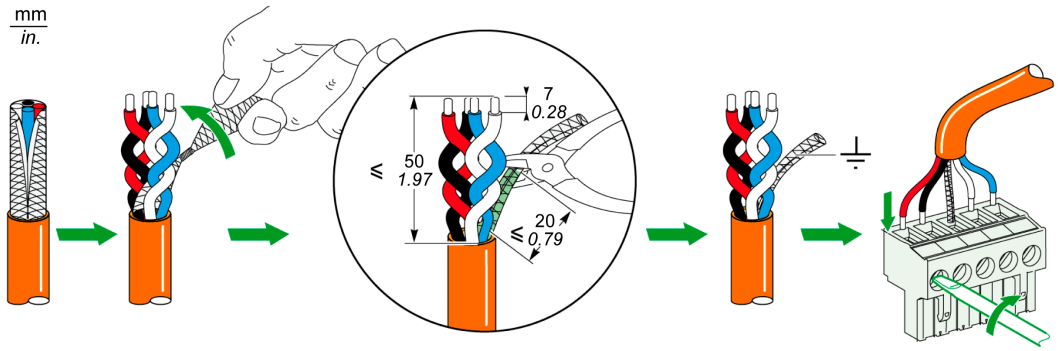
The 0 V terminal of the power supply pair is also the Modbus common, that is, the 0 V for the RS 485 signal (D0, D1).

The 0 V cable (Modbus common) must be distributed along the entire length of the network, right up to the Modbus master.

Other Modbus cable part numbers are given in appendix *(see page 143)*.

Connection of Modbus Cable to the IFM Interface

Each point on the 5-pin connector on the IFM interface has a specific marking to make it easier to connect the Modbus cable.

Connector	Marking	Color	Description	Unsheathed length	Stripped length
	**D1**	Blue	RS 485 B/B' or Rx+/Tx+ signal	5 cm (1.99 in) maximum	7 mm (0.28 in)
	D0	White	RS 485 A/A' or Rx-/Tx- signal		
	⏚	–	Modbus cable shielding braid, connected to the local machine ground in the IFM interface	2 cm (0.79 in) maximum(1)	7 mm (0.28 in)
	0V	Black	0 V for Modbus common and power supply	5 cm (1.99 in) maximum	7 mm (0.28 in)
	24V	Red	24 Vdc for the power supply		
					

(1) To ensure that the shielding is effective against high-frequency disturbances, keep the shielding braid between the Modbus cable and the ground terminal as short as possible.

NOTE: Do not connect more than two wires in the same terminal on the 5-pin connector on the IFM interface.

Connection of the 0 V Terminal on IFM Interface to the Protective Ground Terminal Block

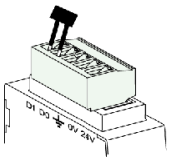
The 0 V terminal on IFM interfaces is connected to the protective ground terminal block at only one point of the Modbus line (first stacked IFM interface or at the Modbus master if IFM interfaces are not stacked with IFE server). No other devices must have 0 V connected to ground.

Modbus Line Termination

The Modbus cable communication pair has a typical impedance of 120 Ω. The Modbus cable must therefore be terminated at each end by a Modbus line termination with a 120 Ω impedance.

The Modbus master is at one end of the Modbus cable and usually has a switchable termination impedance. At the other end of the Modbus cable, a Modbus line termination with a 120 Ω impedance must be connected.

To obtain a 120 Ω impedance at high frequency without loading the cable with DC, optimize the Modbus line termination in the form of an RC cell: 120 Ω in series with a 1 nF capacitor and two 10 cm (32.8 in) wires for direct connection (between D0 and D1) to the 5-pin connector on the last IFM interface.

Illustrations	Description	Part number
	Two Modbus line termination (120 Ω + 1 nF)	VW3A8306DRC

General Rules for Modbus Cable Length

The maximum permitted length for the Modbus network (for the trunk cable, excluding derivations) is 500 m (1,640 ft) at 38,400 Baud and 1,000 m (3,281 ft) at 19,200 Baud.

The Modbus cable connecting the IFM interfaces in the ULP system incorporates both the Modbus communication network and the 24 Vdc power supply. Because of the stresses caused by a drop in the supply voltage, more restrictive limitations are imposed:

- The voltage drop between the power supply and the furthest point, both on the +24 V wire and on the 0 V wire, must be limited to 4 Vdc (2 Vdc on the +24 Vdc wire and 2 Vdc on 0 V wire).
  A minimum supply of 24 Vdc -20% (19.2 Vdc) is thus obtained on the last IFM interface, with a 24 Vdc power supply regulated at:
  - +/-3% (23.3–24.7 Vdc) for 3 A power supplies.
  - +/-5% (22.8–25.2 Vdc) for 1 A power supplies.
- For optimum quality of the Modbus communication, the voltage on the 0 V terminal on each IFM interface (Modbus common) must not vary by more than +/-4 Vdc compared to the 0 V voltage of any other Modbus product in the installation. This restriction further limits length when the Modbus equipment is divided between a number of power supply segments.

For more details of the Modbus cable lengths for each architecture in the ULP system, refer to the presentation of the ULP system architectures *(see page 59)*.

Connection to the Modbus Master

Introduction

Connection to the Modbus master varies according to whether:
- The Modbus-SL network is contained within the electrical equipment.
- The Modbus-SL network is not contained within the electrical equipment.

Modbus-SL Network Contained In Electrical Equipment

The Modbus-SL network is contained within the electrical equipment when both conditions below are fulfilled:
- The Modbus-SL network between the IFM Modbus-SL interfaces for one circuit breaker is connected to the Modbus master or to an IFE Ethernet switchboard server integrated in the electrical equipment (a PLC, for example).
- The Modbus-SL network between the IFM interfaces does not exit the electrical equipment to extend to another electrical equipment.

In this case, the Modbus master or the IFE server can be connected directly to the Modbus-SL network of the IFM interfaces in the electrical equipment.

An example of a Modbus-SL network contained within the electrical equipment is provided in Ethernet Connection Linking Two Electrical Equipments *(see page 53)*.

Modbus-SL Network Not Contained in Electrical Equipment

⚠ WARNING

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Do not connect the Modbus network inside the electrical equipment to a Modbus network outside the electrical equipment without inserting an isolation barrier.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The Modbus-SL network is not contained within the electrical equipment when either:
- The Modbus-SL network between the IFM interfaces is connected to a Modbus master outside the electrical equipment.
- The Modbus-SL network between the IFM interfaces exits the electrical equipment to extend to another electrical equipment.

In this case, an isolation barrier must be inserted at the Modbus entry of each electrical equipment, between the Modbus-SL network outside the electrical equipment and the Modbus-SL network inside the electrical equipment.

This isolation barrier can be:
- The two-wire RS 485 isolated repeater module *(see page 106)*.
- A fiber-optic link interface.

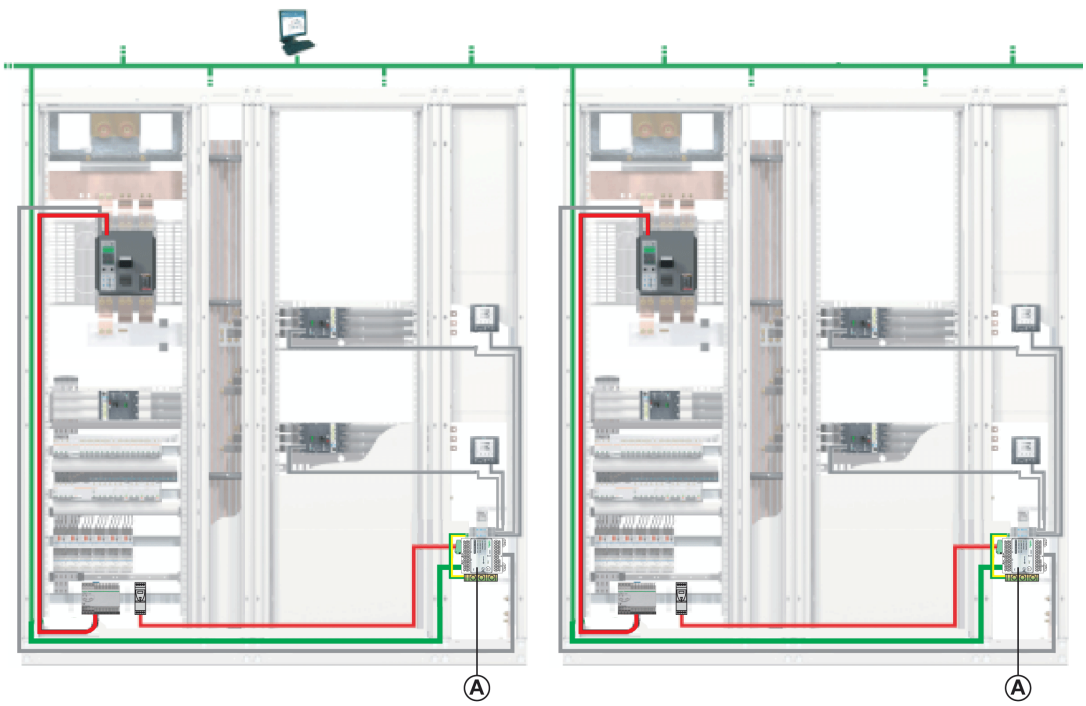
An example of a Modbus-SL network not contained within the electrical equipment is provided in Modbus Connection Linking Two Electrical Equipments *(see page 54)*.

Ethernet Connection Linking Two Electrical Equipments

Two remote electrical equipments can be linked by an Ethernet connection, regardless of the distance or the ground equipotentiality between the two electrical equipments. In this case, the Modbus-SL network is contained within the electrical equipments.

This solution is preferable to the isolation barrier (two-wire RS 485 isolated repeater module or fiber-optic link interface).

The following figure shows an Ethernet link connecting two electrical equipments, via IFE servers.



A IFE server

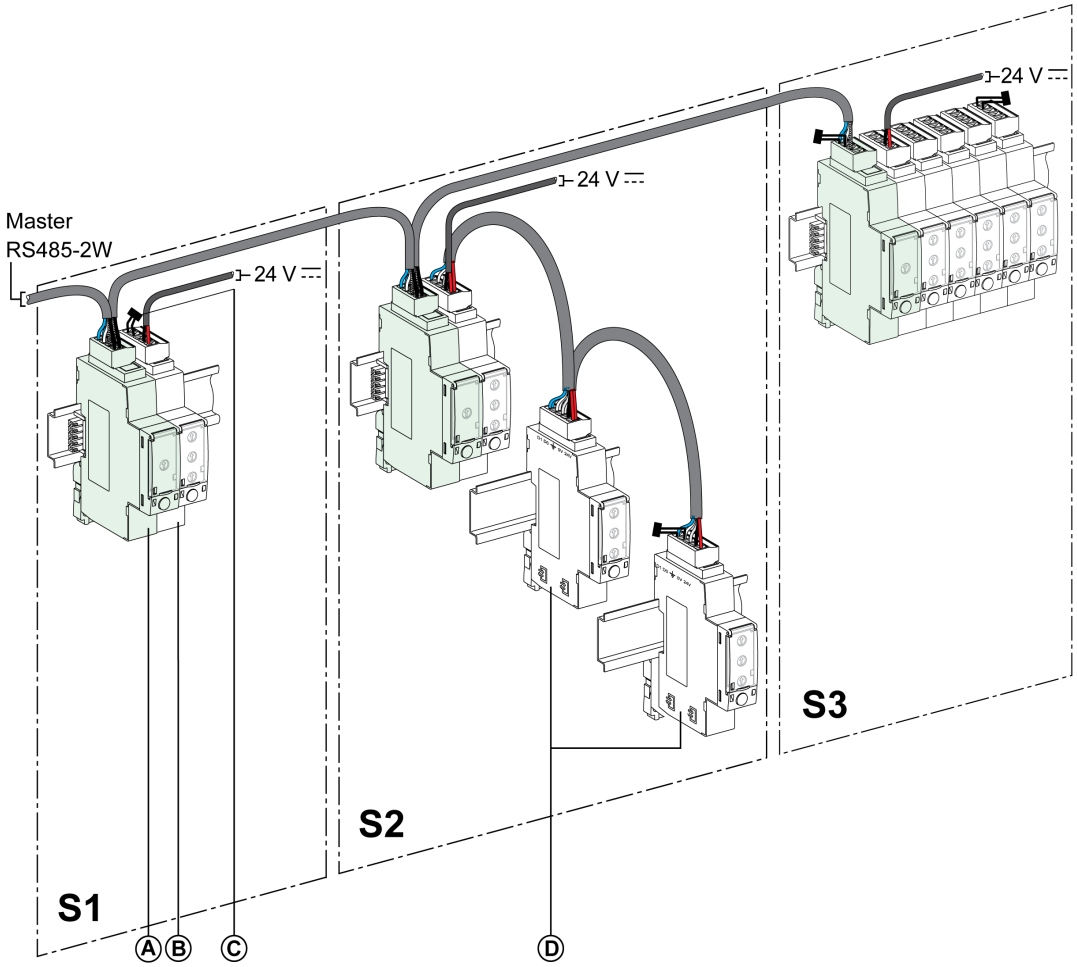
Cable color	Description
Green	Ethernet network
Gray	ULP network
Red	24 Vdc power supply

Connection of the IFE server to the Modbus-SL network inside the electrical equipment is shown in detail in the wiring diagram for Ethernet server *(see page 65)*.

Modbus Connection Linking Two Electrical Equipments

When the Modbus network is not contained within the electrical equipment, the two-wire RS 485 isolated repeater module must be inserted between the Modbus network inside the electrical equipment and the Modbus network outside the electrical equipment.

The following figure shows a Modbus link connecting three electrical equipments **S1**, **S2**, and **S3** via two-wire RS 485 isolated repeater modules. In this example, the Modbus 0 V terminal must be connected to the Modbus master at only one point of the Modbus line, and no other devices must have 0 V connected to ground.



A Two-wire RS 485 isolated repeater module
B IFM interfaces grouped in islands with the stacking accessory
C Modbus line termination
D IFM interfaces daisy-chained with the Modbus cable

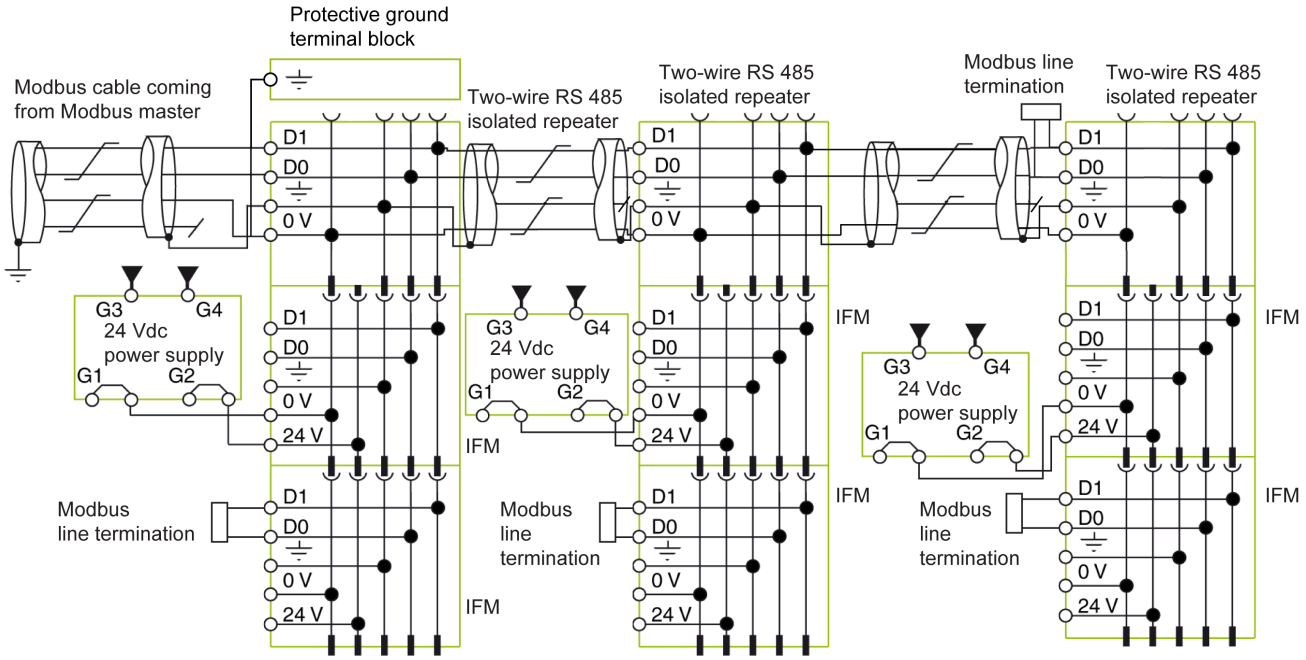
The rules below must be followed:

- Each isolated Modbus segment must include a polarization at one point, and a Modbus line termination at each end:
  - On the segment outside the electrical equipment, the line polarization and a termination are integrated in the Modbus master, and a Modbus line termination must be connected at the other end, that is, on the last two-wire RS 485 isolated repeater module (the one on electrical equipment **S3** in this case).
  - On the segment inside the electrical equipment, the polarization and a Modbus line termination must be integrated in the two-wire RS 485 isolated repeater module.
    A Modbus line termination must be connected at the other end, that is, on the last IFM interface or other Modbus slave (on the last IFM interface in electrical equipments **S1** and **S2** in this case).
- L is the length of the Modbus trunk cable (excluding derivations):
  - Lmax = 500 m (1,640 ft) at 38,400 Baud
  - Lmax = 1,000 m (3,281 ft) at 19,200 Baud

Case of Several Power Supply Segments In Several Electrical Equipments

It is mandatory to install a two-wire RS 485 isolated repeater in each electrical equipment when the Modbus network is distributed in several electrical equipments.

The following figure shows an example of a centralized Modbus architecture installed in three electrical equipments:



Connection to the Ethernet Network with IFE Interface and IFE Server

Introduction

Connect intelligent modular units to the Ethernet network with an IFE:
- IFE Ethernet interface for one circuit breaker
- IFE Ethernet switchboard server

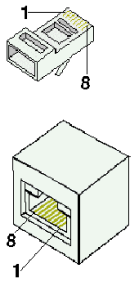
General Rules for Ethernet Cable

10Base-T/100Base-T Ethernet cable uses only two pairs of the four twisted pairs of wires that compose an Ethernet cable. These two pairs are orange (pins 1 and 2) and green (pins 3 and 6).

An Ethernet line cable must be screened (overall braided screen) and also screened by a foil (SF/UTP, that is, shielded foiled twisted pair).

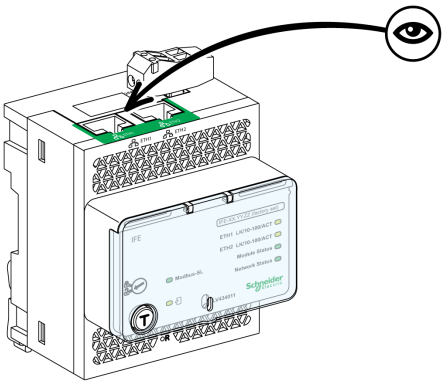
The rules for standard Ethernet topology are as follows:
- There is no maximum number of devices per network.
- Transmission rate: 10–100 Mbps.
- Maximum permitted length between two IFE interfaces (in case of daisy chain): 100 m (328 ft).
- Cable type: Category 5e SFTP (shielded foiled twisted pair) or Category 6 SFTP.

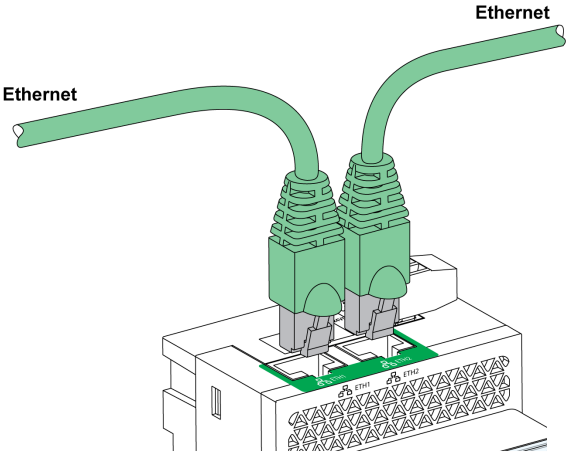
Ethernet RJ45 Pin Connection

RJ45 connector	Pin number	Pair number	Wire color
	1	Pair 1	White-orange
	2	Pair 1	Orange
	3	Pair 2	White-green
	4	Pair 3	Reserved
	5		
	6	Pair 2	Green
	7	Pair 4	Reserved
	8		

Ethernet Connection

NOTICE
HAZARD OF EQUIPMENT DAMAGE ● The ULP RJ45 connectors located under the IFE interface are for ULP modules only. ● Any other use can damage the IFE interface or the device connected to the IFE interface. ● To check if a ULP module is compatible with the RJ45 ports on the IFE interface. **Failure to follow these instructions can result in equipment damage.**





General Wiring Recommendations

- Do not bend or damage the cables.
- Minimum bending radius is 10 times the cable diameter.
- Avoid sharp angles of paths or passages of the cable.
- The connection of the cable shield must be as short as possible.
- Several shields can be connected together.
- Identify the logical name and the logical address of each device.

Section 2.3
ULP System Architectures

What Is in This Section?

This section contains the following topics:

Presentation of ULP System Architectures

Introduction

The ULP system architecture is defined by the way in which the Ethernet or Modbus-SL network interconnects the intelligent modular units (IMUs).

The various possible ULP system connections define four architectures.

- Standalone architecture: the IMUs are not communicating to communication interfaces (IFE or IFM interfaces).
- Centralized Modbus architecture: the IMUs are communicating to communication interfaces (IFE or IFM interfaces). The IFM Modbus-SL interfaces for one circuit breaker and IFE Ethernet switchboard servers are grouped in islands, mounted side-by-side on a DIN rail and interconnected by the stacking accessory.
- Distributed Modbus architecture: the IMUs are communicating to communication interfaces (IFE or IFM interfaces). The IFM interfaces are distributed as close as possible to their IMU ULP modules and linked by the Modbus cable.
  There are two possible configurations for the distributed Modbus architecture:
  - Daisy-chained distributed Modbus architecture
  - Tap-linked distributed Modbus architecture

  Both these distributed architectures can be combined to form a mixed architecture.
- Daisy-chained Ethernet architecture: the IMUs are communicating to IFE servers. The IFE servers are distributed as close as possible to the ULP modules in the IMU and linked by the Ethernet cable.
- Star Ethernet architecture: the IMUs are communicating to IFE interfaces. The IFE interfaces are distributed as close as possible to the ULP modules in the IMU and linked by the Ethernet cable to the switch.

The distributed and centralized architectures can be combined to adapt to the electrical installation and its restrictions.

Choice of Architecture

The following table lists the advantages and disadvantages of ULP system architectures:

Architecture	Advantages	Disadvantages
Centralized Modbus	● Ease of wiring due to the stacking accessory. ● Ease of maintenance due to the grouping of IFM interfaces in the islands. ● Option of connecting other Modbus products through derivations, on the unused connectors of IFM interfaces in the islands. ● Minimized Modbus cable length. ● IFM interfaces could be stacked to an IFE server to get Modbus data through Ethernet.	● Need for a dedicated place in the cubicle where the IFM interfaces can be grouped. ● Vertical distribution of RJ45 male/male ULP cords between the IFM interfaces and their associated ULP modules.
Daisy-chained distributed Modbus	● No need for a dedicated place in the cubicle where the IFM interfaces can be grouped.	● Additional wiring needed for daisy-chaining the Modbus cable between the IFM interfaces. ● Longer Modbus cable. ● Space taken up in the cubicle by the upstream Modbus cables and downstream ULP cords.
Derivated distributed Modbus	● No need for a dedicated place in the cubicle where the IFM interfaces can be grouped.	● Additional wiring needed for daisy-chaining the Modbus cable between the IFM interfaces. ● Need for a shunt terminal block at the top of each cubicle.
Daisy-chained Ethernet	● Ease of wiring by using only an Ethernet cable. ● Plug-and-play. ● No need of a dedicated place in the cubicle.	● Additional wiring needed for daisy-chaining the Ethernet cable between the IFE interfaces. ● Long Ethernet cable. ● Space taken up in the cubicle by the upstream Ethernet cables and downstream ULP cords. ● Need two Ethernet ports (like on the IFE interface). ● Dependability in case of device failure.
Star Ethernet	● Dependability in case of device failure ● Ease of wiring by using only an Ethernet cable. ● Plug-and-play. ● No need of a dedicated place in the cubicle. ● Need only one Ethernet port.	● Long cables and space taken by Ethernet cables in the cubicle. ● Space taken up in the cubicle upstream by the Ethernet cables and downstream by the RJ45 male/male ULP cords.

Standalone Architecture

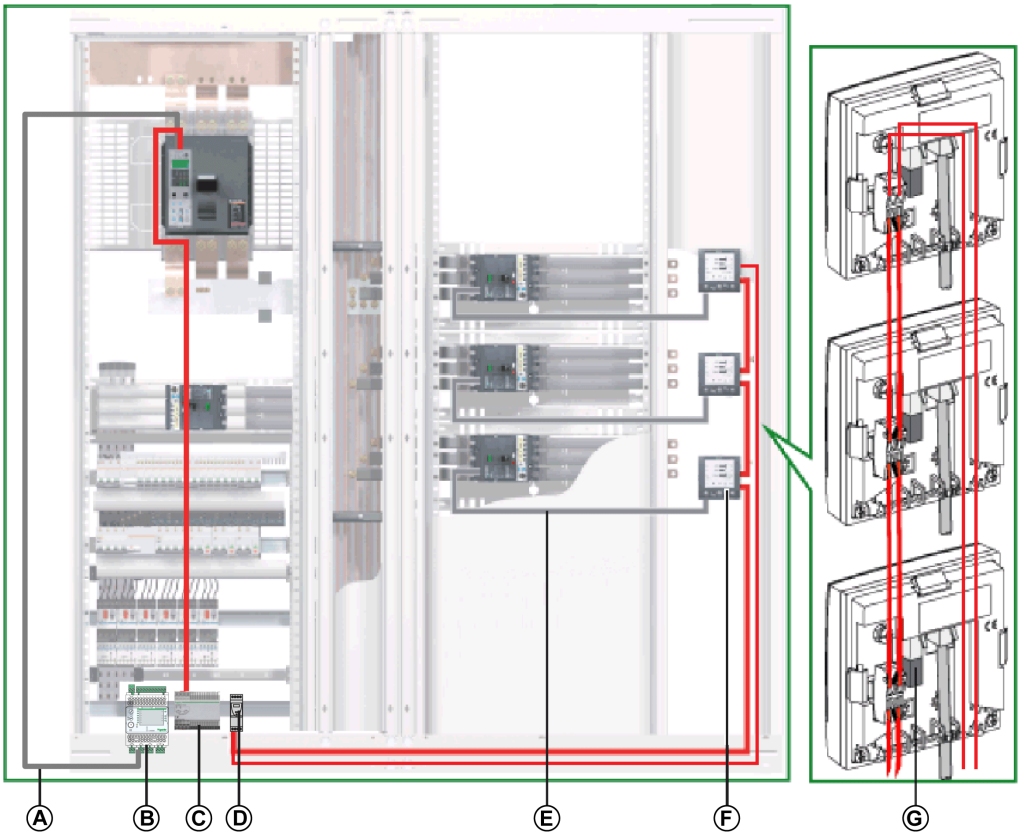
Introduction

When the intelligent modular units are not communicating to communication interfaces (IFE or IFM interfaces), the architecture is classified as standalone.

Standalone Architecture

The following figure shows an example of a standalone architecture with IMUs consisting of an FDM121 ULP display for one circuit breaker or an IO input/output application module for one circuit breaker and a circuit breaker equipped with a Micrologic trip unit.

The IMUs do not communicate to communication interfaces and do not therefore include an IFM or IFE interface. Power the IMUs by using an external power supply connected to the FDM121 display.



A Circuit breaker BCM ULP cord
B IO module
C External 24 Vdc power supply module
D ABL8 power supply
E NSX cord
F FDM121 display
G ULP line termination

Cable color	Description
Gray	ULP network
Red	24 Vdc power supply

For FDM121 display mounting options, refer to the *FDM121 ULP Display for One Circuit Breaker Instruction Sheet*.

The 24 Vdc power supply is selected from the list supplied in the examples of 24 Vdc power supplies *(see page 43)*. The power supply rating must be selected according to IMU consumption.

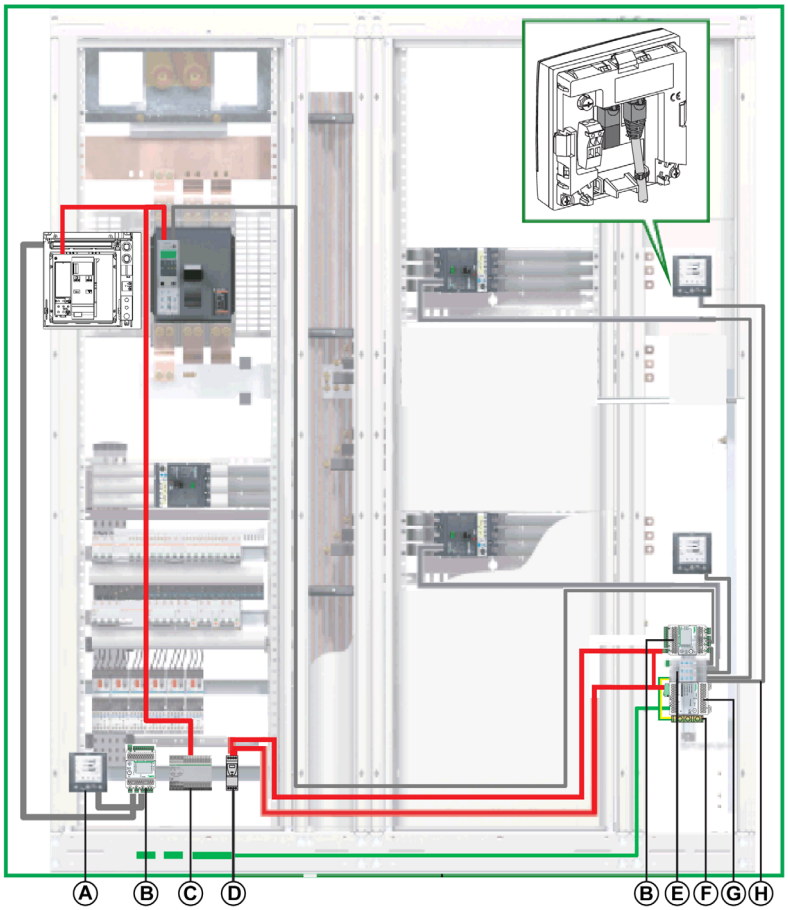
Centralized Modbus Architecture

Introduction

In a centralized Modbus architecture, the intelligent modular units (IMUs) are communicating to communication interfaces (IFE or IFM interfaces). The IFM Modbus-SL interfaces for one circuit breaker are grouped in islands, mounted side-by-side on a DIN rail, and interconnected by the stacking accessory *(see page 106)*.

Centralized Modbus Architecture

The following figure shows an example of a centralized Modbus architecture with IMUs: an IMU consisting of a Masterpact circuit breaker, an IO module, and an FDM121 display; an IMU with a PowerPact P- or R-frame circuit breaker, an IO module, and an IFM interface; an IMU with a PowerPact H-, J-, or L-frame circuit breaker, an IFM interface, an FDM121 display; an IMU with a PowerPact H-, J-, or L-frame circuit breaker, an IFM interface, an FDM121 display, and an IFE Ethernet switchboard server to get an Ethernet connection.

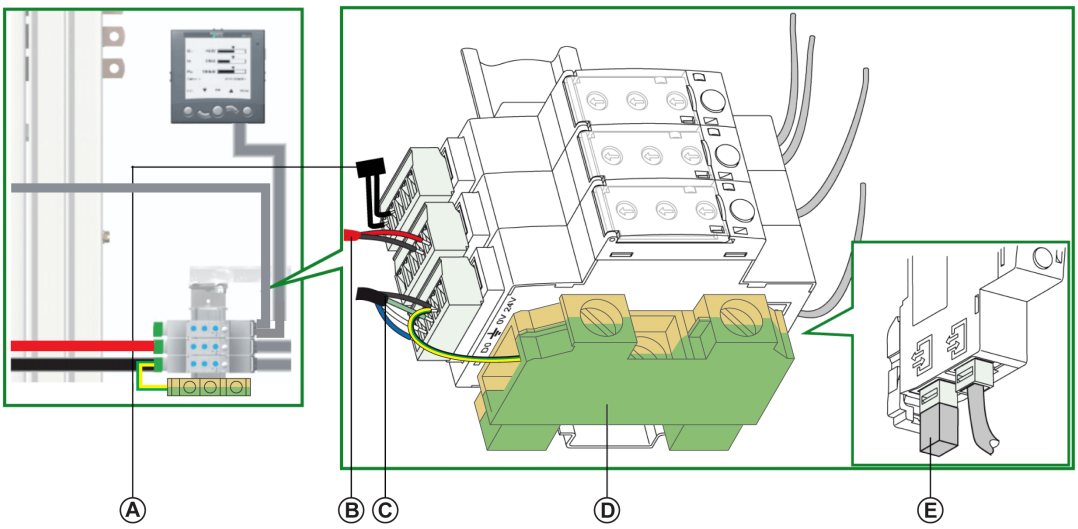


A FDM121 display
B IO module
C External 24 Vdc power supply module
D ABL8 power supply
E IFM interfaces grouped with stacking accessories
F Protective ground terminal block
G IFE server
H RJ45 male/male ULP cord

Cable color	Description
Green	Ethernet network
Gray	ULP network
Red	24 Vdc power supply

Modbus Cable Connection

If there is no IFE server in the centralized architecture, connect the Modbus cable as shown in the following figure.



A Modbus line termination
B 24 Vdc power supply
C Modbus cable coming from the Modbus master
D Protective ground terminal block
E ULP line termination

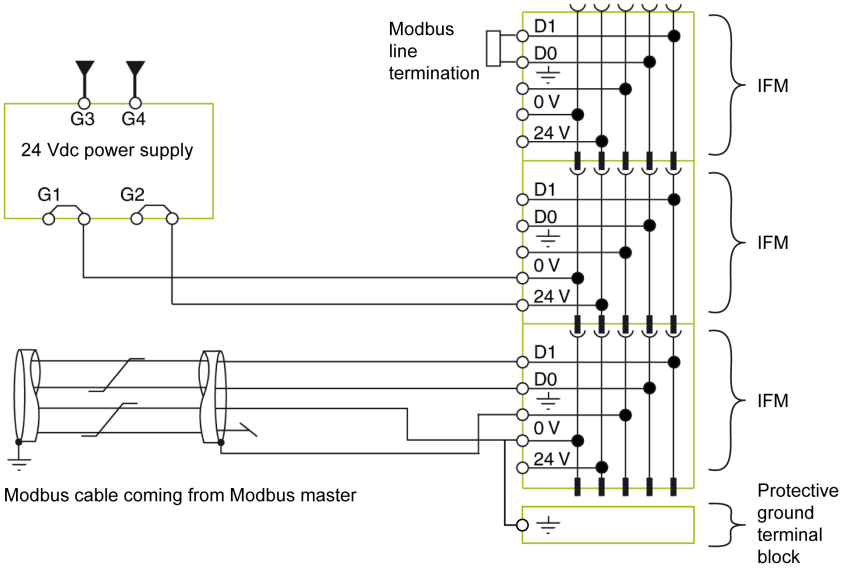
Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

The Modbus cable coming from the Modbus master is connected to an IFM interface. It ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected when the master is powered separately.

Unused 5-pin connectors can be used to connect a Modbus derivation cable to another Modbus product (such as PM800 communicating power meter) or to connect the 24 Vdc power supply.

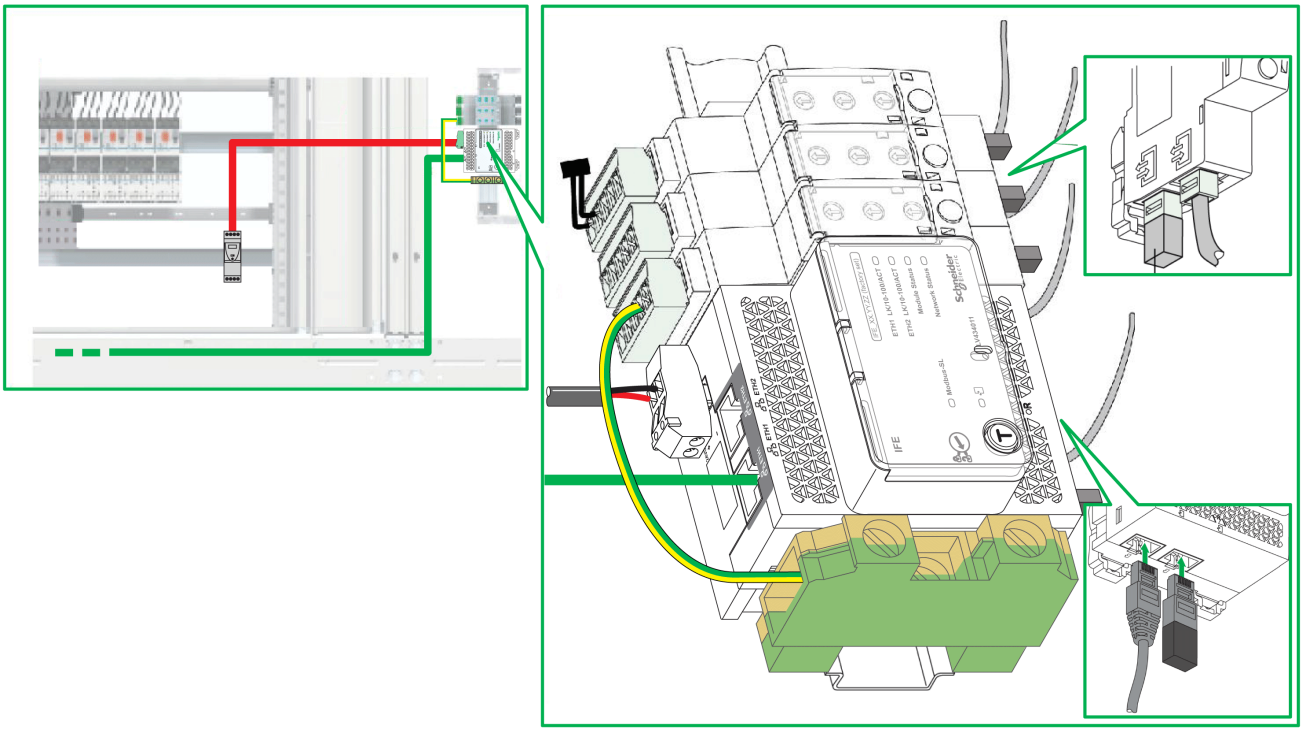
Wiring Diagram

The following wiring diagram shows the connections for the Modbus cable and the 24 Vdc power supply:



IFE Ethernet Switchboard Server Power Supply

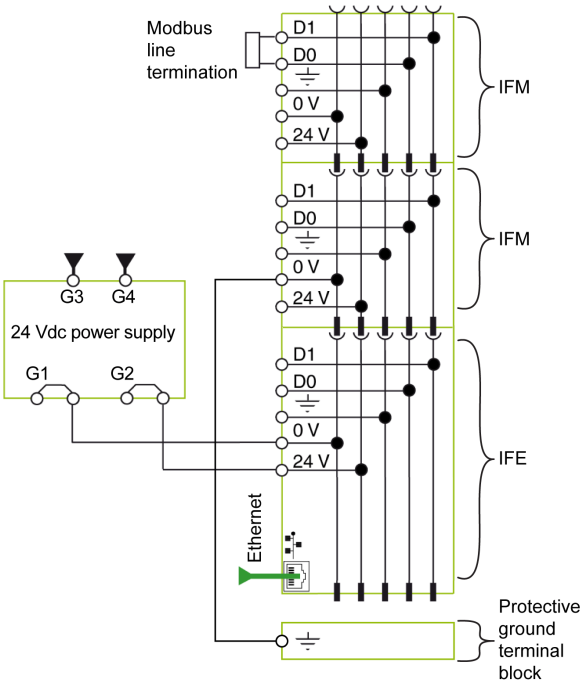
When the IFE server is stacked to the IFM interfaces, the 24 Vdc power supply of the IFE server and the serial line Modbus communication are distributed to the IFM interfaces.



Cable color	Description
Green	Ethernet network
Gray	ULP network
Red	24 Vdc power supply

Wiring Diagram for IFE Ethernet Switchboard Server

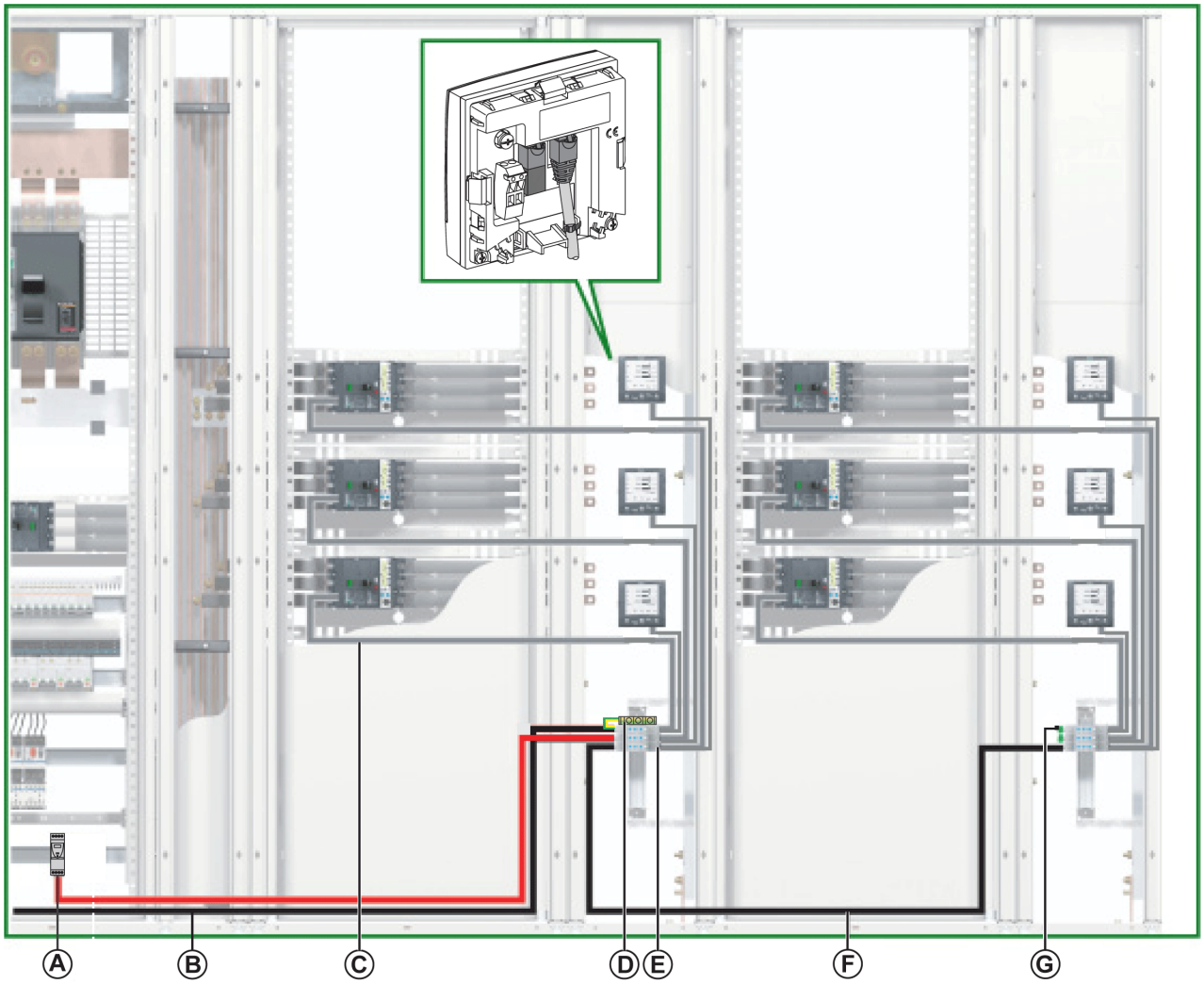
The following wiring diagram shows the connections for the IFE server and the 24 Vdc power supply in detail:



The 0 V terminal on IFM interfaces is connected to a protective ground terminal block at only one point of the Modbus line (first stacked IFM or at the Modbus master if IFM interfaces are not stacked with IFE server). No other devices must have 0 V connected to ground.

Case of a Single Power Supply Segment

The following figure shows a centralized Modbus architecture with two cubicles and a single power supply segment:



A ABL8 power supply
B Modbus cable coming from the Modbus master
C NSX cord
D Protective ground terminal block
E IFM interface
F Modbus cable running to the second cubicle
F Modbus line termination

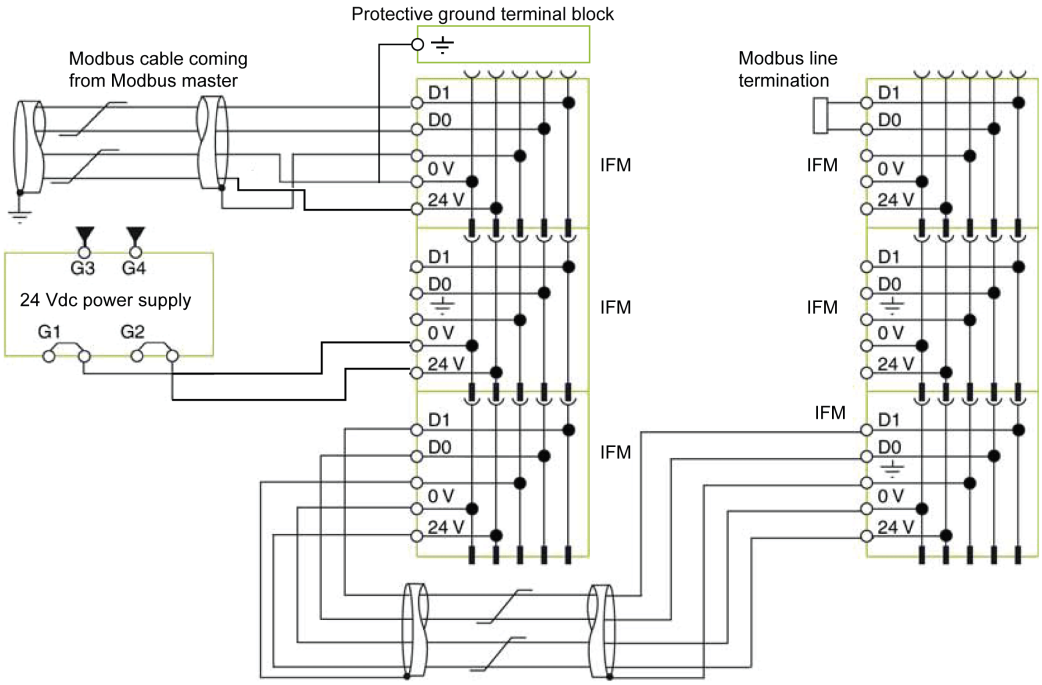
Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

Modbus Cable Connection with a Single Power Supply Segment

- The Modbus cable coming from the Modbus master is connected to an IFM interface. It ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected when the master is powered separately.
- The Modbus cable running to the second cubicle can be connected to any IFM interface in the group. It ensures the continuity of the Modbus signal and the 24 Vdc power supply to the second cubicle.

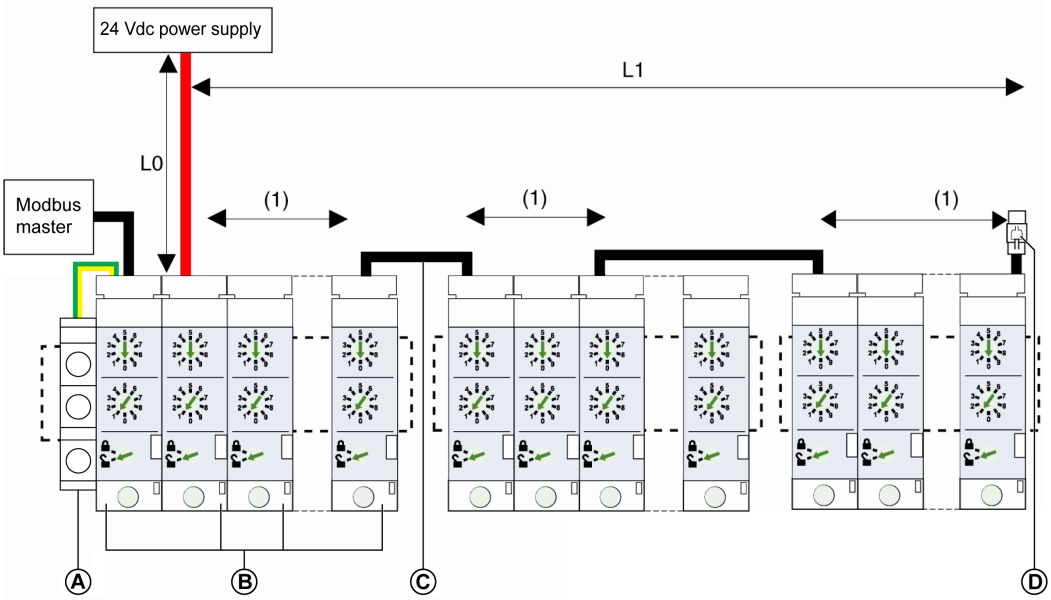
Wiring Diagram with a Single Power Supply Segment

The following wiring diagram shows the connections for the Modbus cables and the 24 Vdc power supply in the case of a single power supply segment:



Modbus Cable Lengths for a Single Power Supply Segment

The following figure shows the Modbus cable lengths in detail, in the case of a centralized Modbus architecture with a single power supply segment:



A Protective ground terminal block
B IFM interfaces grouped with stacking accessories
C Modbus cable ensuring continuity of the Modbus signal and the 24 Vdc power supply
D Modbus line termination

(1) Count the contact resistance between two 5-pin connectors in the group of IFM interfaces as 1 m (3.28 ft) of Modbus cable when both Modbus cables are connected to two of the first seven IFM interfaces, and as 2 m (6.56 ft) of Modbus cable thereafter.

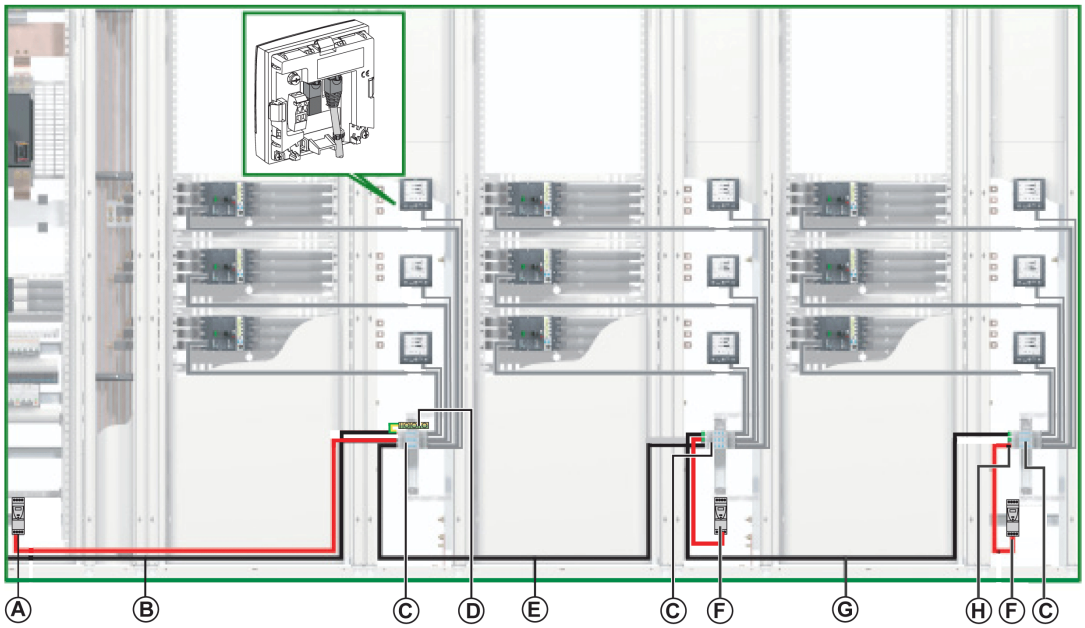
The following table summarizes the maximum lengths of Modbus cable for the centralized Modbus architecture with a single power supply segment. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1
1 A	5 m (16.4 ft)	45 m (147.6 ft)
3 A	3 m (9.84 ft)	15 m (49.2 ft)

Case of Several Power Supply Segments

When more than one 24 Vdc power supply is needed *(see page 45)*, then several power supply segments are used along the Modbus cable.

The following figure shows a centralized Modbus architecture with three power supply segments:



A ABL8 power supply
B Modbus cable coming from the Modbus master
C IFM interfaces grouped with stacking accessories
D Protective ground terminal block
E Modbus cable running to the second cubicle
F Insertion of an ABL8 power supply
G Modbus cable running to the third cubicle
H Modbus line termination

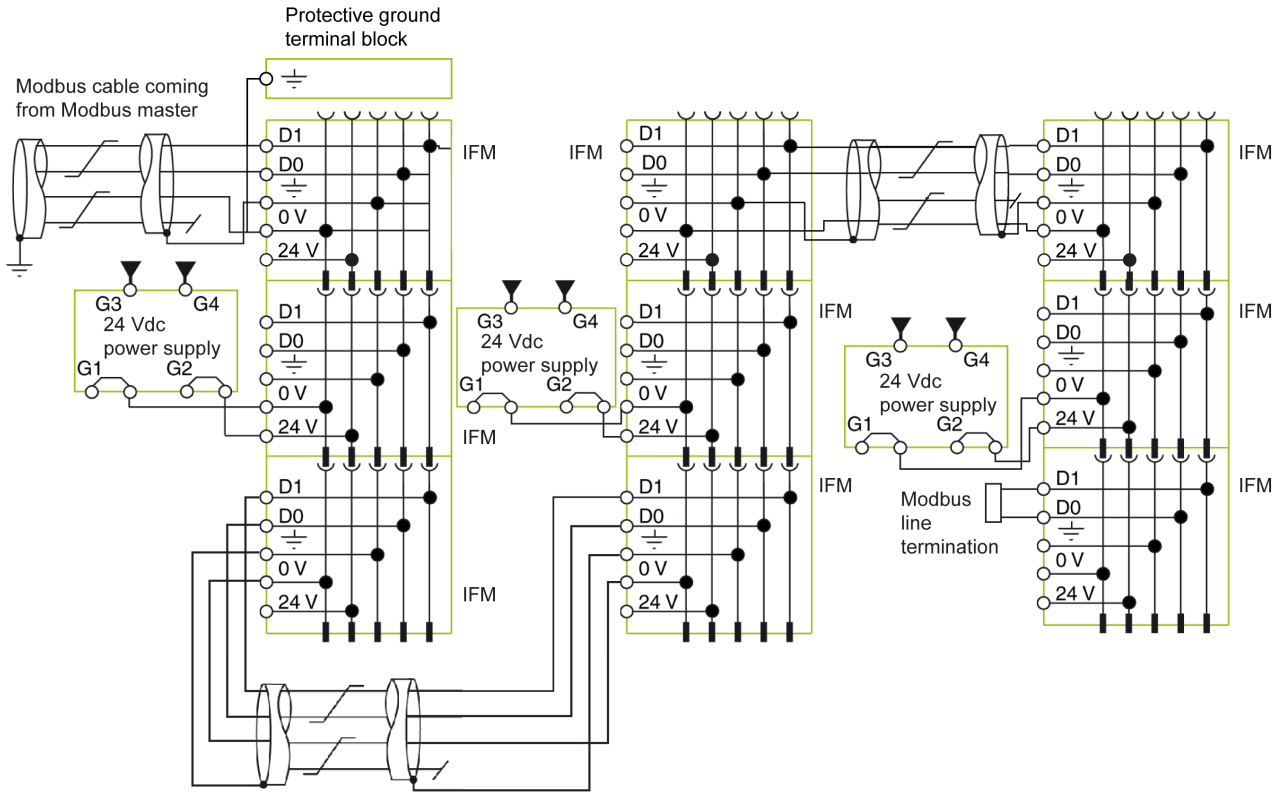
Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

Connection of Modbus Cable with Several Power Supply Segments

- The Modbus cable coming from the Modbus master ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected when the master is powered separately.
- The Modbus cable running to the second cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected since a new 24 Vdc power supply is connected for the second cubicle.
- The Modbus cable running to the third cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected since a new 24 Vdc power supply is connected for the third cubicle.

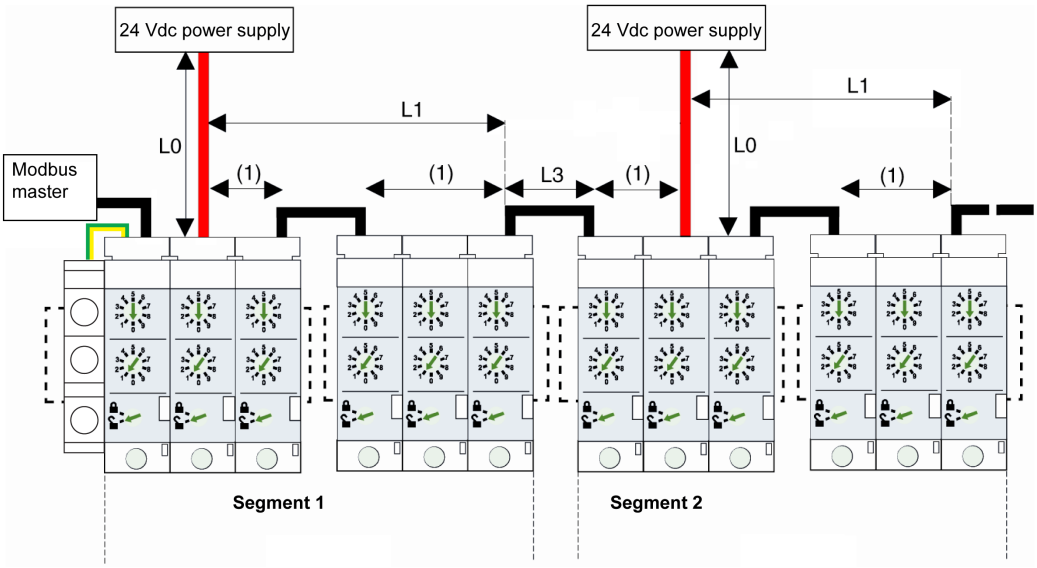
Wiring Diagram with Several Power Supply Segments

The following wiring diagram shows the connections for the Modbus cables and the 24 Vdc power supply in the case of several power supply segments:



Modbus Cable Lengths for Several Power Supply Segments

The following figure shows the Modbus cable lengths in detail, in the case of a centralized Modbus architecture with several power supply segments:



(1) Count the contact resistance between two 5-pin connectors in the group of IFM interfaces as 1 m (3.28 ft) of Modbus cable when both Modbus cables are connected to 2 of the first 7 IFM interfaces, and as 2 m (6.56 ft) of Modbus cable thereafter.

Modbus cable L3 ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected since the power supply is connected separately.

The following table summarizes the maximum lengths of Modbus cable for the centralized architecture with several power supply segments. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	Sum of the L1s (for all power supply segments)	Sum of the L1s and L3s (total length)
1 A	5 m (16.4 ft)	45 m (147.6 ft)	105 m (344.5 ft)	500 m (1,640 ft)
3 A	3 m (9.84 ft)	15 m (49.2 ft)	35 m (114.8 ft)	500 m (1,640 ft)

NOTE: The maximum number of power supply segments is three segments for a single Modbus network *(see page 45)*.

Daisy-Chained Distributed Modbus Architecture

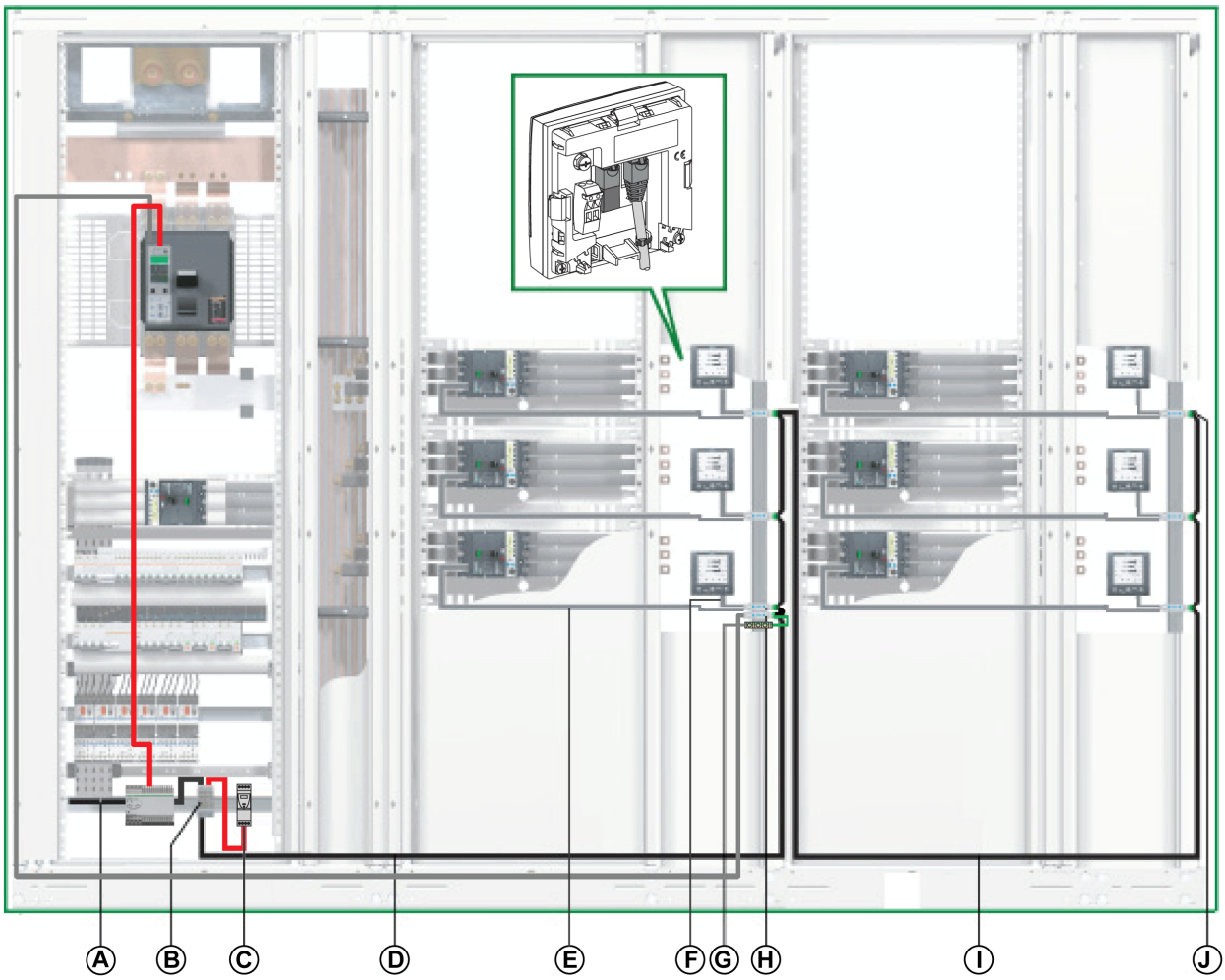
Introduction

In the distributed Modbus architecture, the IFM Modbus-SL interfaces for one circuit breaker are distributed as close as possible to their IMU ULP modules and linked by the Modbus cable.

For a daisy-chained distributed Modbus architecture, the main segment of the Modbus cable rises and falls directly in each cubicle of the electrical equipment.

Daisy-Chained Distributed Modbus Architecture

The following figure shows an example of a daisy-chained distributed Modbus architecture with IMUs: an IMU consisting of a PowerPact P- or R-frame circuit breaker and an IFM interface, and six IMUs consisting of a PowerPact H-, J-, or L-frame circuit breaker, an IFM interface, and an FDM121 display each.



A Modbus cable coming from the Modbus master
B Shunt terminal block on the incoming supply
C ABL8 power supply
D Modbus cable running to the first cubicle
E NSX cord
F RJ45 male/male ULP cord
G Protective ground terminal block
H IFM interface
I Modbus cable running to the second cubicle
J Modbus line termination

Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

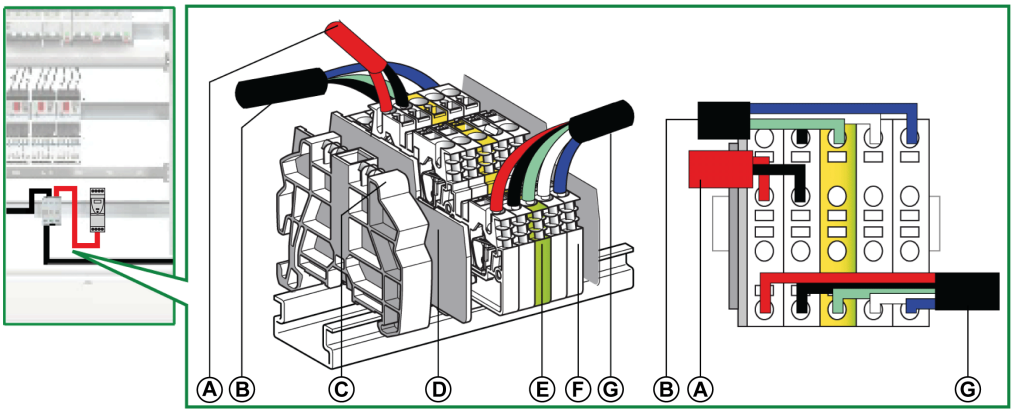
For a distributed Modbus architecture, the 5-pin connector on an IFM interface can be used to connect the upstream Modbus cable and the downstream Modbus cable in the same screw terminal.

Shunt Terminal Block on the Incoming Supply

The shunt terminal block on the incoming supply can connect the Modbus cable and the power supply for all the IMUs.

The shunt terminal block consists of four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail.

The following figure shows the shunt terminal block on the incoming supply in detail:



A 24 Vdc power supply
B Modbus cable coming from the Modbus master
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
F Spring terminal block
G Modbus cable running to the first cubicle

The following table lists the part numbers for the shunt terminal block:

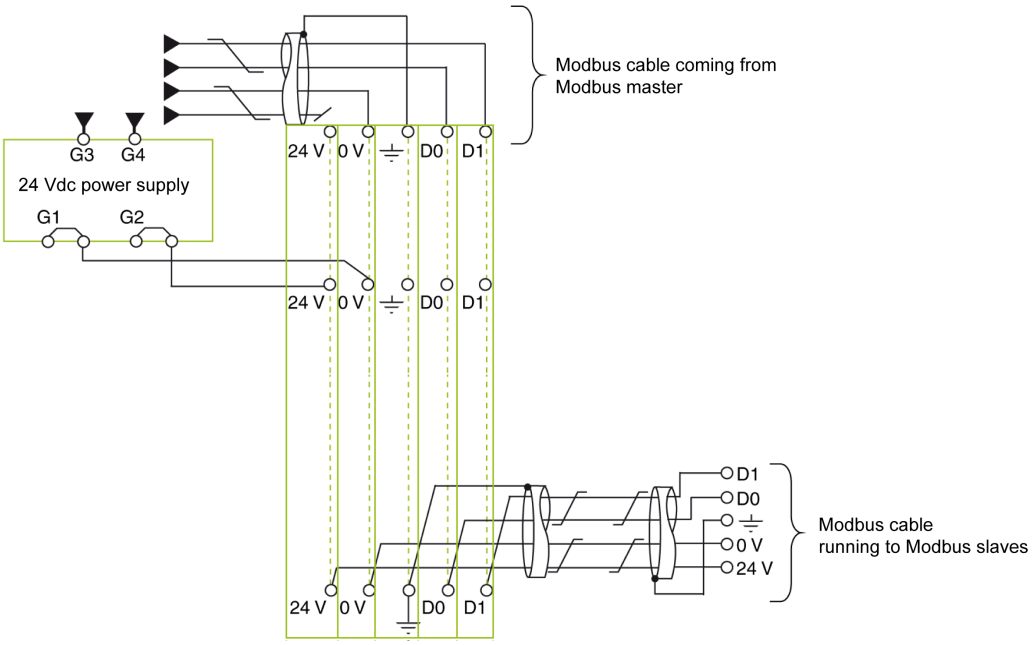
Component	Nominal cross-section	Part number
4-channel spring terminal block	2.5 mm^2 (14 AWG)	NSYTRR24D+NSYTRALV24 (gray)
Protective ground terminal block	2.5 mm^2 (14 AWG)	AB1 RRNETP235U4 (green/yellow)
Protective ground screw terminal block	2.5 mm^2 (14 AWG)	NSYTRV22PE (green/yellow)
End plate	–	AB1 RRNACE244
Clip-on plastic end stop	–	AB1 AB8R35

Modbus Cable Connection

- The Modbus cable coming from the Modbus master ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected when the master is powered separately.
- The Modbus cable running to the first cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the cubicle.
- The unused channel on the shunt terminal block can be used to connect another Modbus slave in the electrical equipment (a PM800 communicating power meter, for example).

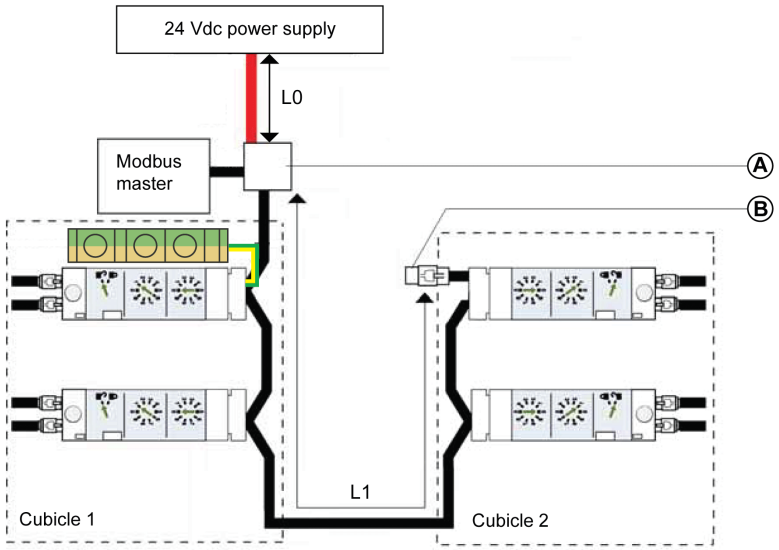
NOTE: The same rules apply when connecting the Modbus cable to a terminal block as for its connection to the 5-pin connector on the IFM interface (same order of connection, same unsheathed length, and same stripped length). For more information, see the connection of IFM interface *(see page 49)*.

Wiring Diagram of Shunt Terminal Block on the Incoming Supply



Modbus Cable Lengths for a Single Power Supply Segment

The following figure shows the Modbus cable lengths in detail for a daisy-chained distributed Modbus architecture with a single power supply segment:



A Shunt terminal block on the incoming supply
B Modbus line termination

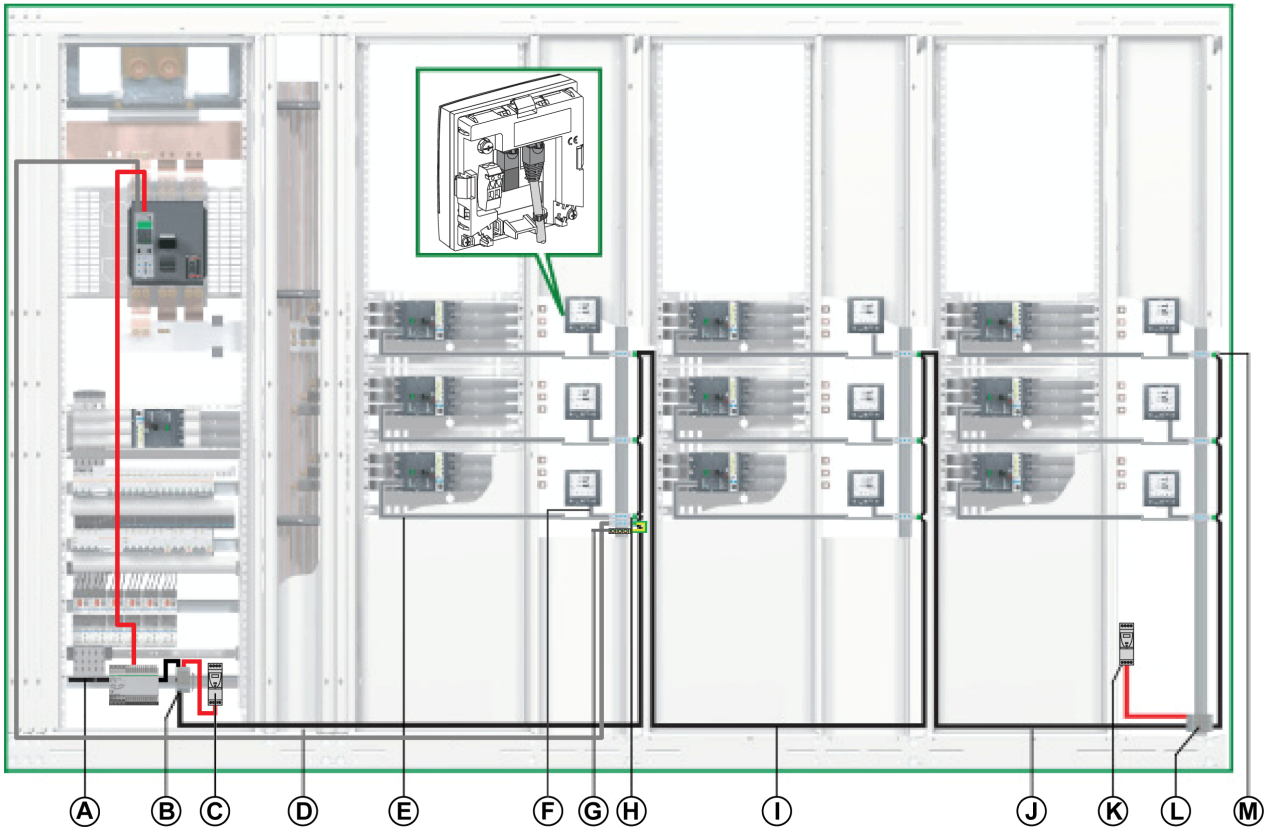
The following table summarizes the maximum Modbus cable lengths for the daisy-chained distributed Modbus architecture with a single power supply segment. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1
1 A	5 m (16.4 ft)	45 m (147.6 ft)
3 A	3 m (9.8 ft)	15 m (49.2 ft)

Case of Several Power Supply Segments

When more than one 24 Vdc power supply is needed *(see page 45)*, then several power supply segments are used along the Modbus cable.

The following figure shows a daisy-chained distributed Modbus architecture with two power supply segments:



A Modbus cable coming from the Modbus master
B Shunt terminal block on the incoming supply
C ABL8 power supply
D Modbus cable running to the first cubicle
E NSX cord
F RJ45 male/male ULP cord
G Protective ground terminal block
H IFM interface
I Modbus cable running to the second cubicle
J Modbus cable running to the third cubicle
K Insertion of an ABL8 power supply
L Shunt terminal block on the cubicle incomer
M Modbus line termination

Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

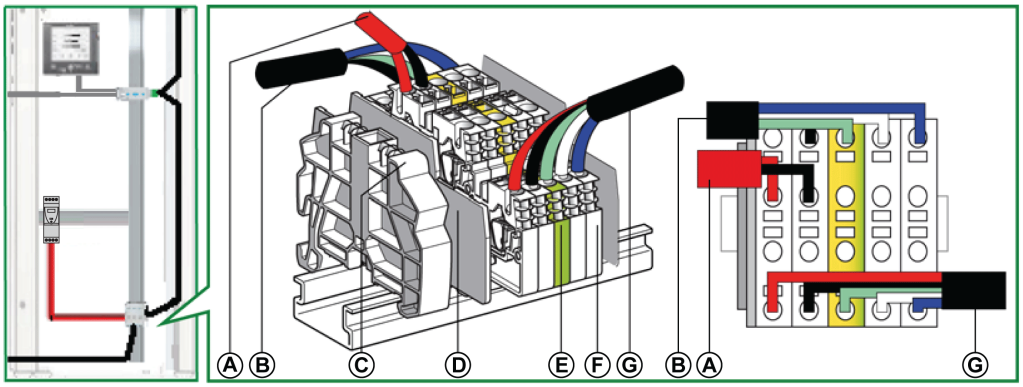
Shunt Terminal Block on the Incomer of the Third Cubicle

The shunt terminal block on the incomer of the third cubicle can be used to connect a new 24 Vdc power supply to power the IMUs in the third cubicle.

The shunt terminal block consists of four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail *(see page 74)*.

It is possible to create shunt terminal blocks by using pluggable terminal blocks to make it easier to transport the electrical equipment *(see page 90)*.

The following figure shows the shunt terminal block on the incomer of the third cubicle in detail:

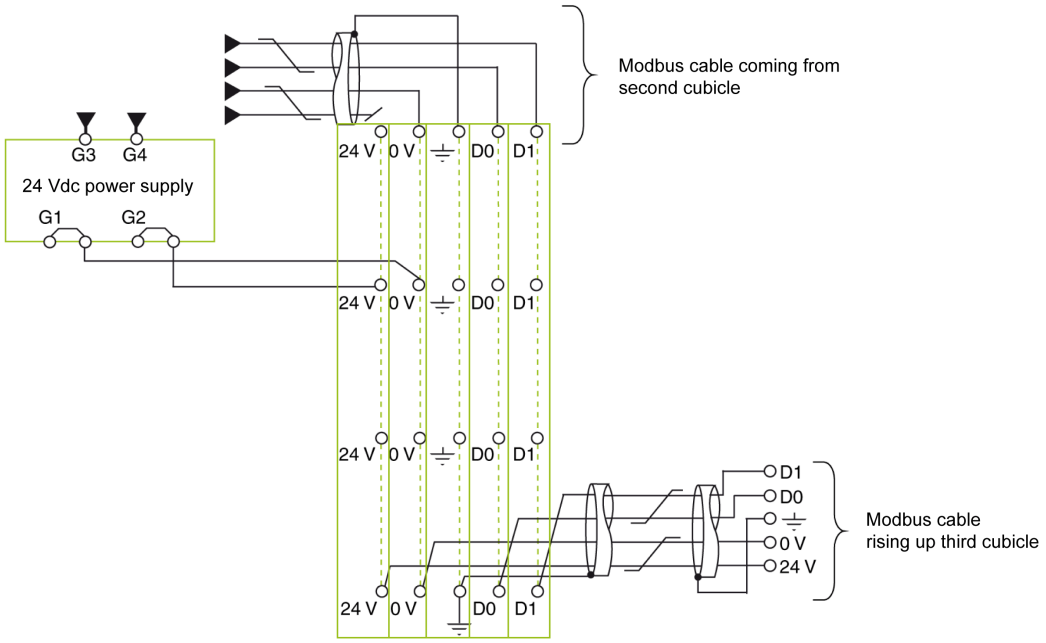


A 24 Vdc power supply
B Modbus cable coming from the second cubicle
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
D Spring terminal block
G Modbus cable rising up the third cubicle

Modbus Cable Connection

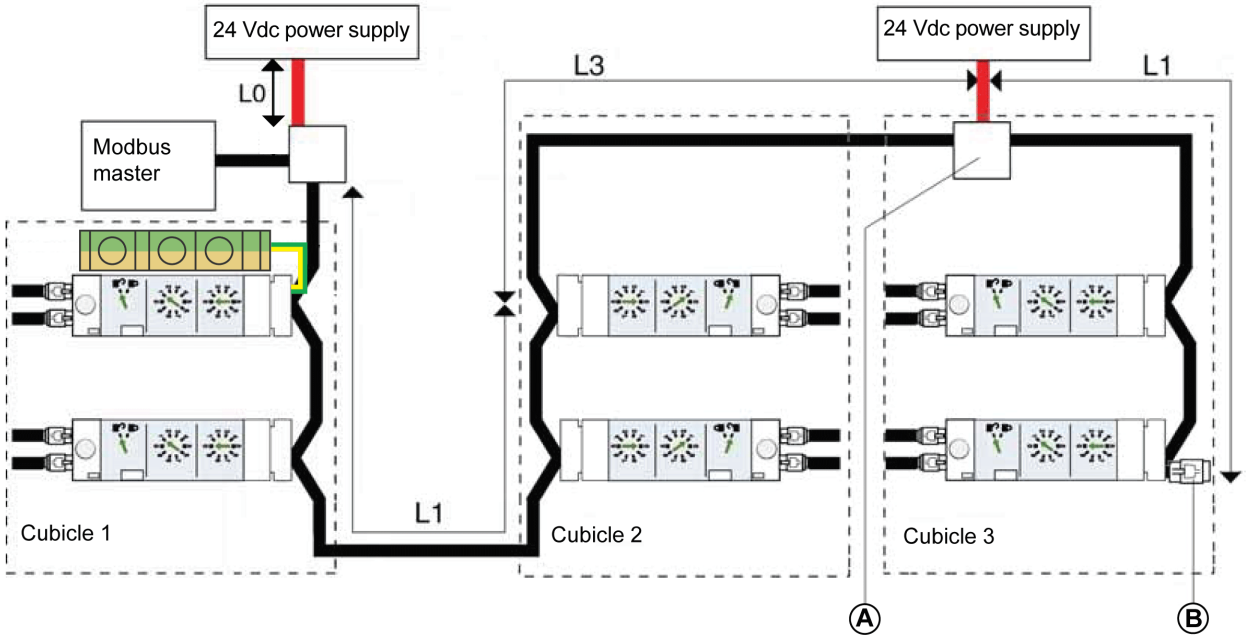
- The Modbus cable from the Modbus master ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected when the master is powered separately.
- The Modbus cable running to the first cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the cubicle.
- The Modbus cable running to the second cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the second cubicle.
- The Modbus cable running to the third cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected since the power supply is connected separately for the third cubicle.

Wiring Diagram of Shunt Terminal Block on the Incomer of the Third Cubicle



Modbus Cable Lengths for Several Power Supply Segments

The following figure shows the Modbus cable lengths in detail for a daisy-chained distributed Modbus architecture with several power supply segments:



A Shunt terminal block on the cubicle incomer
B Modbus line termination

Modbus cable L3 ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected since the power supply is connected separately on the shunt terminal block on the cubicle incomer.

The following table summarizes the maximum Modbus cable lengths for the daisy-chained distributed Modbus architecture with several power supply segments. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	Sum of the L1s (for all power supply segments)	Sum of the L1s and L3s (total length)
1 A	5 m (16.4 ft)	45 m (147.6 ft)	105 m (344.5 ft)	500 m (1,640 ft)
3 A	3 m (9.8 ft)	15 m (49.2 ft)	35 m (114.8 ft)	500 m (1,640 ft)

NOTE: The maximum number of power supply segments is three segments for a single Modbus network *(see page 45)*.

Derivated Distributed Modbus Architecture

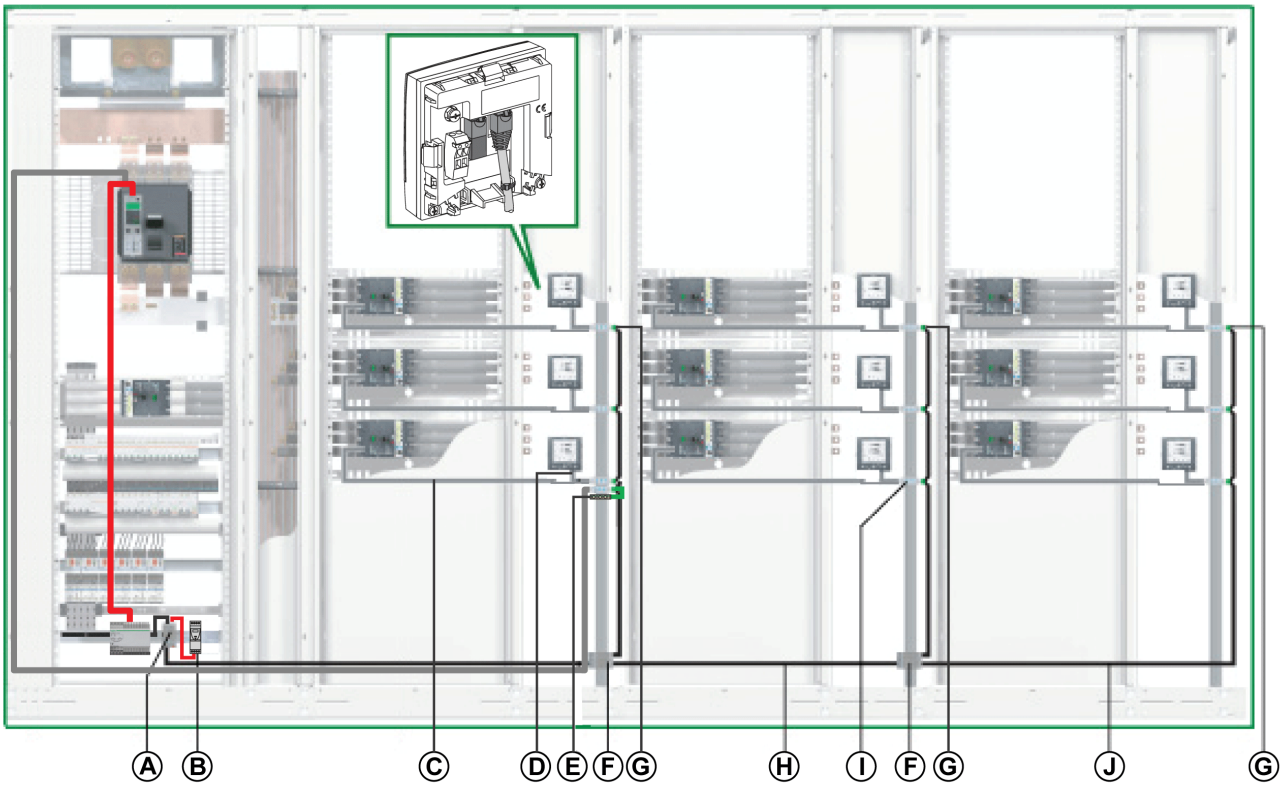
Introduction

In the distributed Modbus architecture, the IFM Modbus-SL interfaces for one circuit breaker are distributed as close as possible to their IMU ULP modules and linked by the Modbus cable.

For a derivated distributed Modbus architecture, the main segment of the Modbus cable has a derivation terminal block on the incomer of each cubicle and the IFM interfaces are connected on a derivation cable.

Derivated Distributed Modbus Architecture

The following figure shows an example of a derivated distributed Modbus architecture with IMUs: an IMU consisting of a PowerPact P- or R-frame circuit breaker and an IFM interface, and nine IMUs consisting of a PowerPact H-, J-, or L-frame circuit breaker, an IFM interface, and an FDM121 display each.



A Shunt terminal block on the incoming supply
B ABL8 power supply
C NSX cord
D RJ45 male/male ULP cord
E Protective ground terminal block
F Shunt terminal block on the cubicle incomer
G Modbus line termination
H Modbus cable running to the second cubicle
I IFM interface
J Modbus cable running to the third cubicle

Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

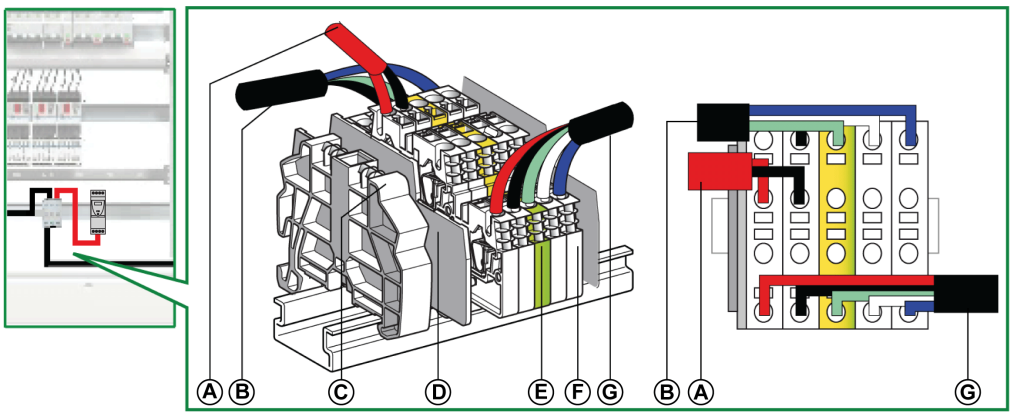
For a distributed Modbus architecture, the 5-pin connector on the IFM interface can be used to connect the upstream Modbus cable and the downstream Modbus cable in the same screw terminal.

Shunt Terminal Block on the Incoming Supply

The shunt terminal block on the incoming supply can be used to connect the Modbus cable and the power supply for all the IMUs.

The shunt terminal block consists of four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail.

The following figure shows the shunt terminal block on the incoming supply.



A 24 Vdc power supply
B Modbus cable coming from the Modbus master
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
F Spring terminal block
G Modbus cable running to the first cubicle

The following table lists the part numbers for the shunt terminal block:

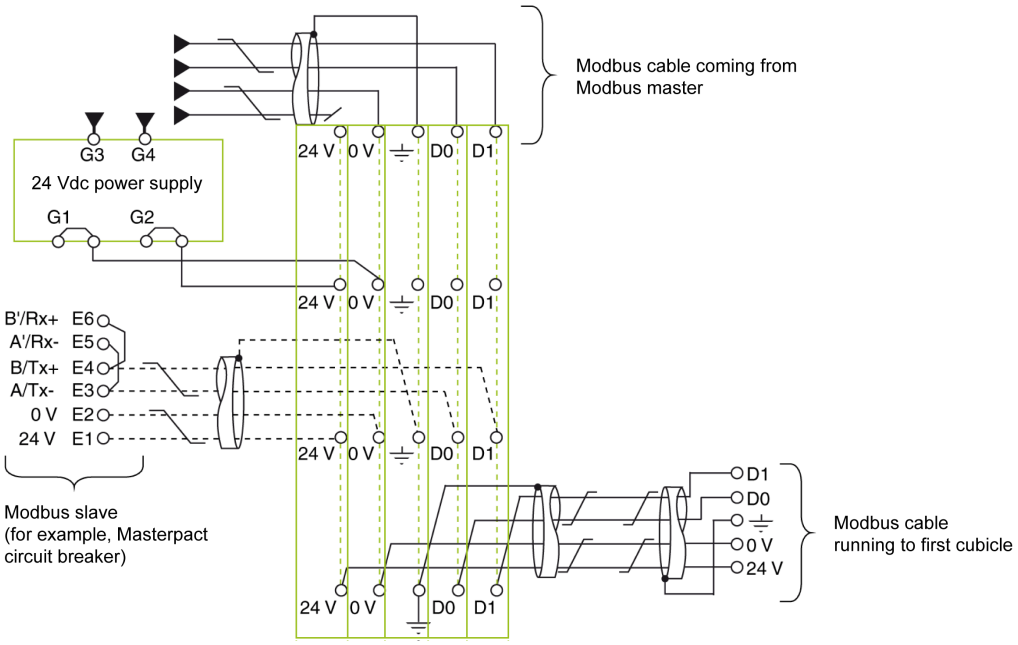
Component	Nominal cross-section	Part number
4-channel spring terminal block	2.5 mm^2 (14 AWG)	NSYTRR24D+NSYTRALV24 (gray)
Protective ground terminal block	2.5 mm^2 (14 AWG)	AB1 RRNETP235U4 (green/yellow)
Protective ground screw terminal block	2.5 mm^2 (14 AWG)	NSYTRV22PE (green/yellow)
End plate	–	AB1 RRNACE244
Clip-on plastic end stop	–	AB1 AB8R35

Modbus Cable Connection

- The Modbus cable coming from the Modbus master ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected when the master is powered separately.
- The Modbus cable running to the first cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the cubicle.
- The unused channel on the shunt terminal block can be used to connect another Modbus slave in the electrical equipment (a PM800 communicating power meter, for example).

NOTE: The same rules apply when connecting the Modbus cable to a terminal block as for its connection to the 5-pin connector on the IFM interface (same order of connection, same unsheathed length, and same stripped length). For more information, see the connection of IFM interface *(see page 49)*.

Wiring Diagram of Shunt Terminal Block on the Incoming Supply

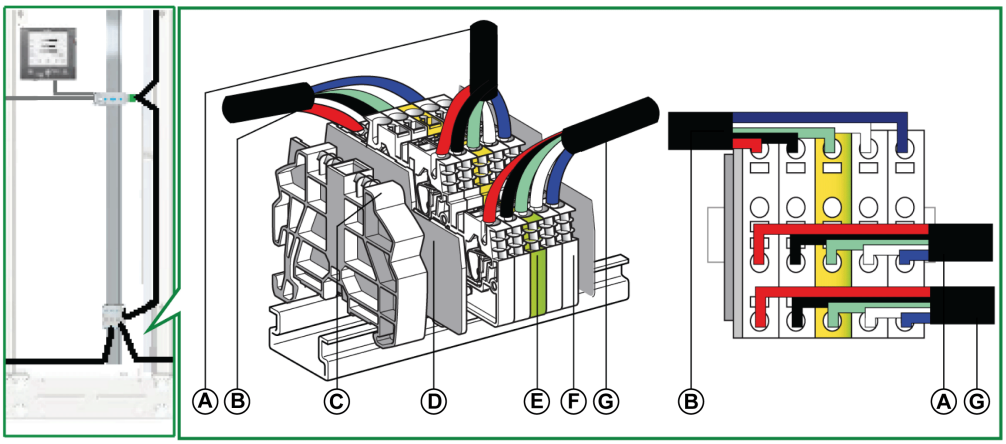


Shunt Terminal Block on the Cubicle Incomer

The shunt terminal block on the cubicle incomer distributes the Modbus signal and the 24 Vdc power supply to the cubicles in the electrical equipment.

The shunt terminal block is created using four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail component *(see page 81)*.

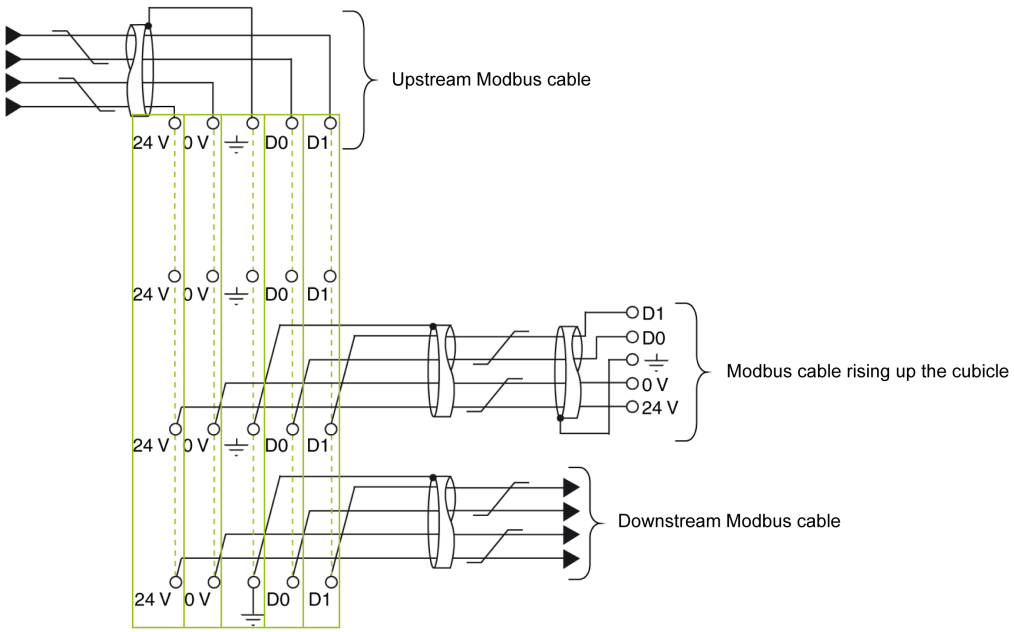
The following figure shows the shunt terminal block on the cubicle incomer.



A Modbus cable rising up the cubicle
B Upstream Modbus cable
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
F Spring terminal block
G Downstream Modbus cable

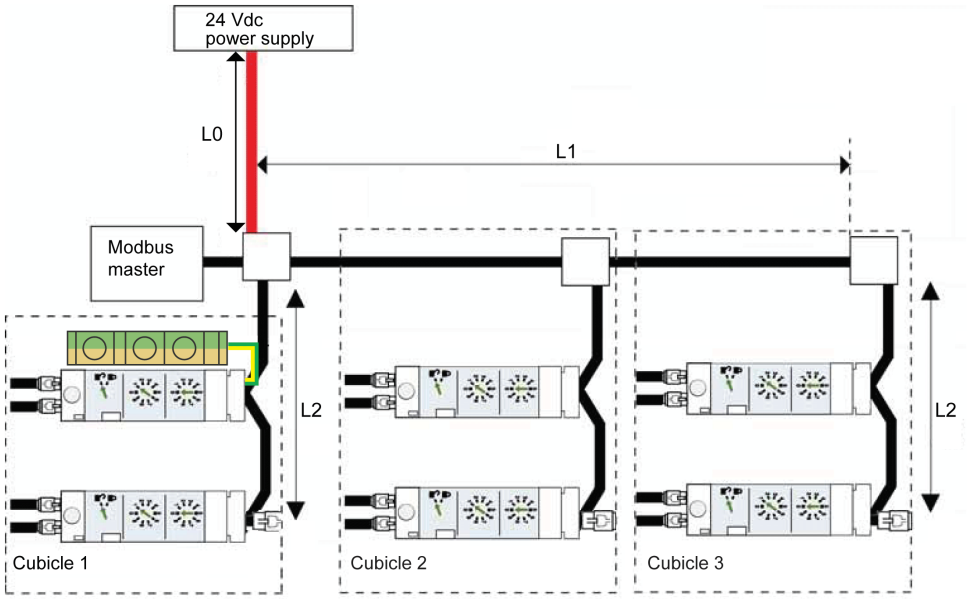
It is possible to create shunt terminal blocks by using pluggable terminal blocks to make it easier to transport the electrical equipment *(see page 90)*.

Wiring Diagram of Shunt Terminal Block on the Cubicle Incomer



Modbus Cable Lengths for a Single Power Supply Segment

The following figure shows the Modbus cable lengths in detail for a derivated distributed Modbus architecture with a single power supply segment:



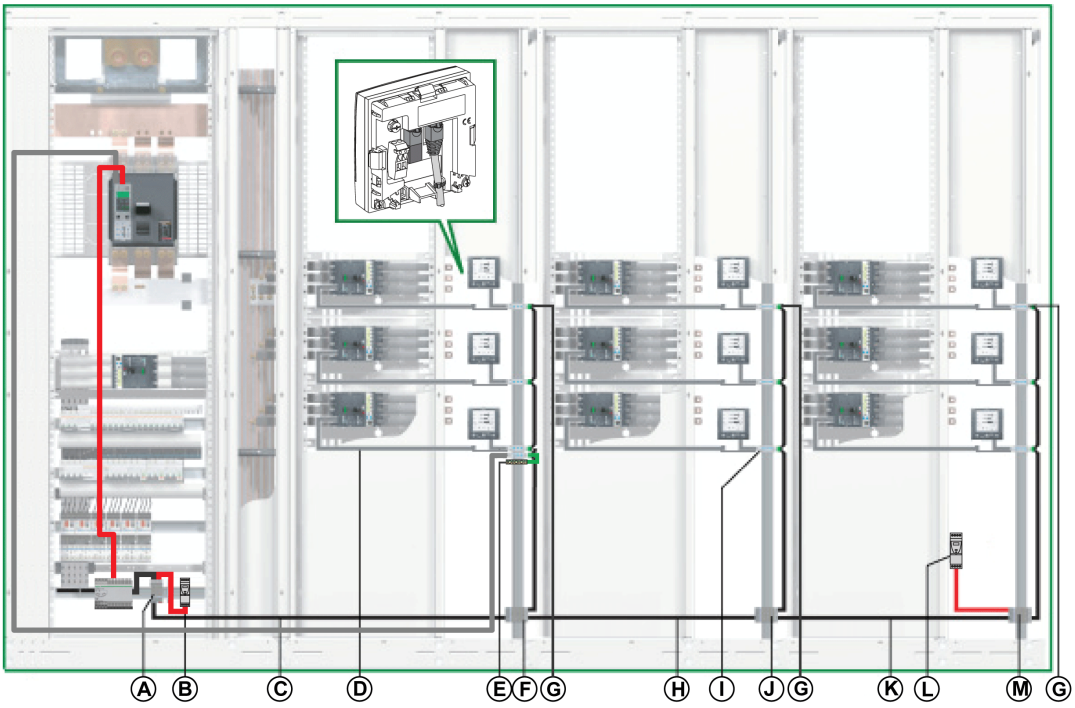
The following table summarizes the maximum Modbus cable lengths for the derivated distributed Modbus architecture with a single power supply segment. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	L2	Sum of the L2s (for all derivations)
1 A	5 m (16.4 ft)	45 m (147.6 ft)	10 m (32.8 ft)	40 m (131.2 ft)
3 A	3 m (9.84 ft)	15 m (49.2 ft)	5 m (16.4 ft)	40 m (131.2 ft)

Case of Several Power Supply Segments

When more than one 24 Vdc power supply is needed (see segmented power supply *(see page 45)*), then several power supply segments are used along the Modbus cable.

The following figure shows a derivated distributed Modbus architecture with two power supply segments in detail:



A Shunt terminal block on the incoming supply
B 24 Vdc power supply
C Modbus cable running to the first cubicle
D NSX cord
E RJ45 male/male ULP cord
F Shunt terminal block on the incomer of the first cubicle
G Modbus cable running to the second cubicle
H IFM interface
I Shunt terminal block on the incomer of the second cubicle
J Modbus cable running to the third cubicle
K Insertion of a new 24 Vdc power supply unit
L Shunt terminal block on the incomer of the third cubicle
M Modbus line termination

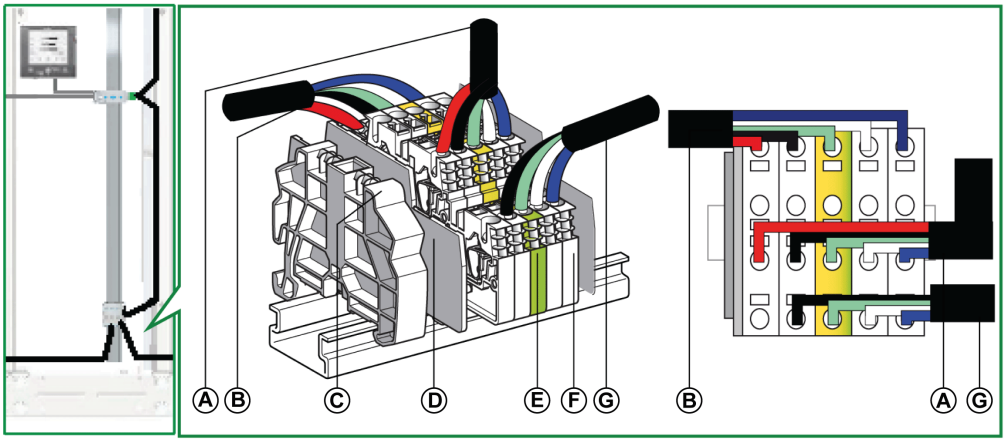
Cable color	Description
Black	Modbus network
Gray	ULP network
Red	24 Vdc power supply

Shunt Terminal Block on the Incomer of the Second Cubicle

The shunt terminal block on the incomer of the second cubicle is created using four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail.

For the shunt terminal block part numbers, see the appropriate component *(see page 81)*.

The following figure shows the shunt terminal block on the incomer of the second cubicle in detail:



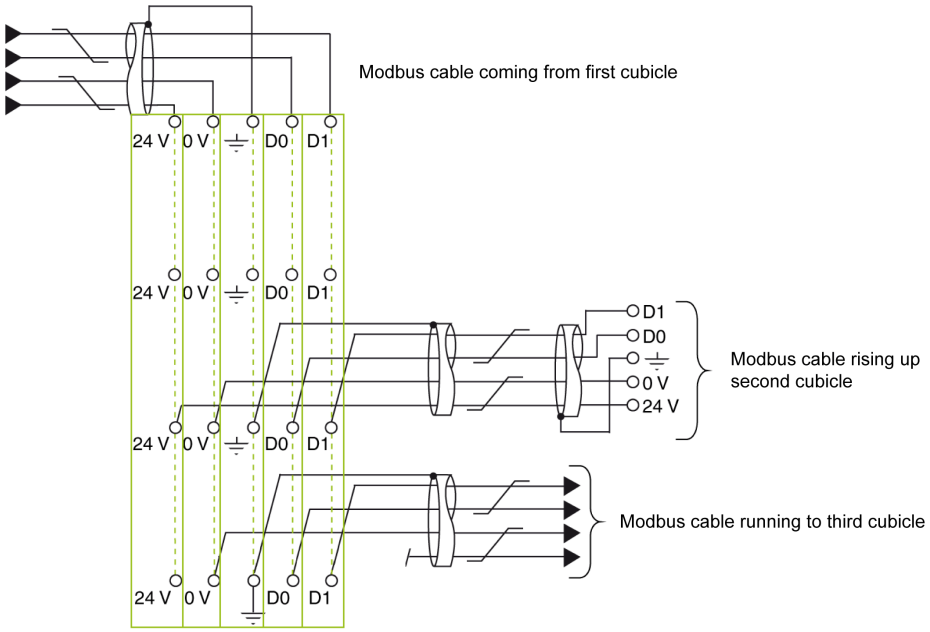
A Modbus cable rising up the second cubicle
B Modbus cable coming from the first cubicle
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
F Spring terminal block
G Modbus cable running to the third cubicle

It is possible to create shunt terminal blocks by using pluggable terminal blocks to make it easier to transport the electrical equipment. For more information, see the specific topic *(see page 90)*.

Modbus Cable Connection

- The Modbus cable coming from the shunt terminal block on the incomer of the first cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the second cubicle.
- The Modbus cable running to the third cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected since the power supply for the third cubicle is connected separately.

Wiring Diagram of Shunt Terminal Block on the Incomer of the Second Cubicle

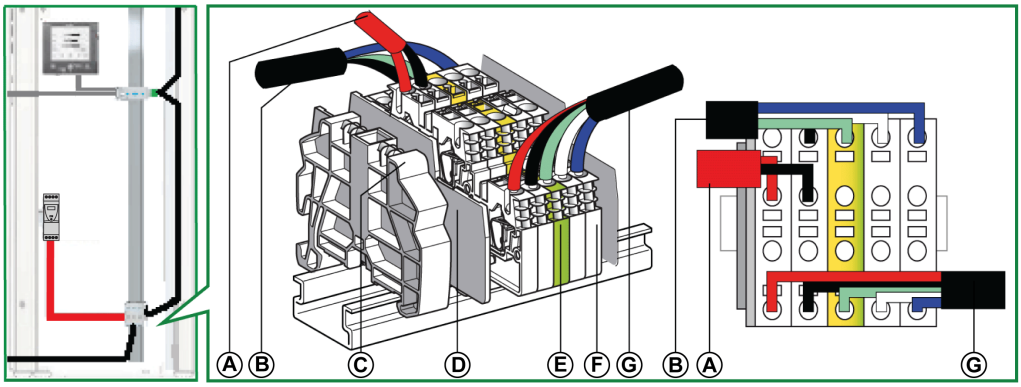


Shunt Terminal Block on the Incomer of the Third Cubicle

The shunt terminal block on the incomer of the third cubicle can be used to connect a new 24 Vdc power supply to power the IMUs in the third cubicle.

The shunt terminal block is created using four 4-channel spring terminal blocks and one protective ground terminal block offering grounding of the Modbus cable shielding by connection to the DIN rail.

The following figure shows the shunt terminal block on the incomer of the third cubicle.



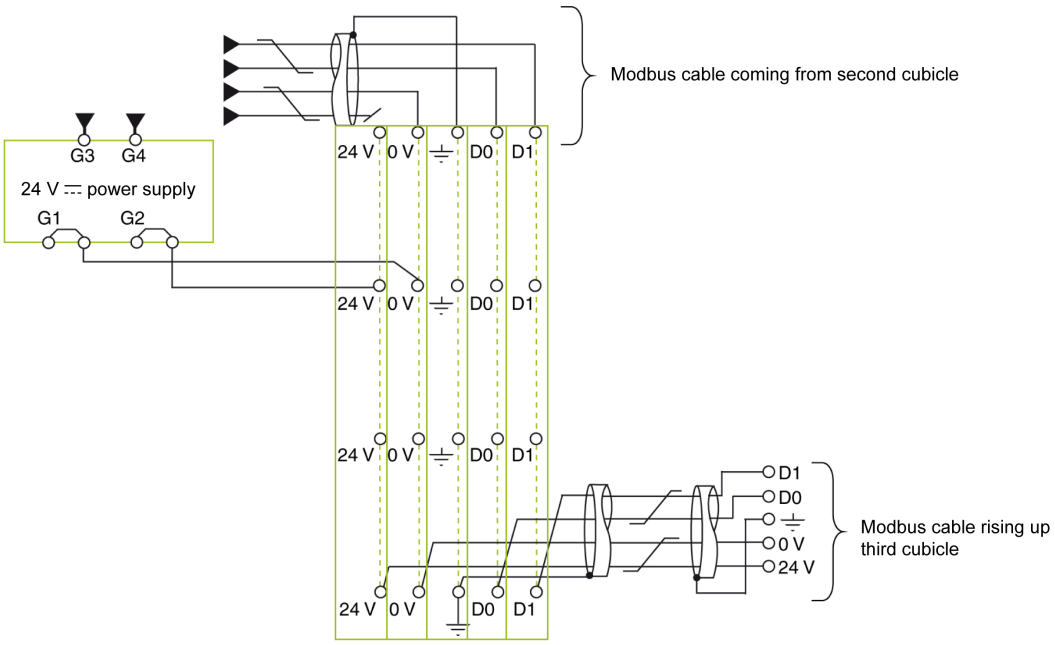
A 24 Vdc power supply
B Modbus cable coming from the shunt terminal block on the incomer of the second cubicle
C Clip-on plastic end stop
D End plate
E Protective ground terminal block
F Spring terminal block
G Modbus cable rising up the third cubicle

It is possible to create shunt terminal blocks by using pluggable terminal blocks to make it easier to transport the electrical equipment. For more information, see the specific topic *(see page 90)*.

Modbus Cable Connection

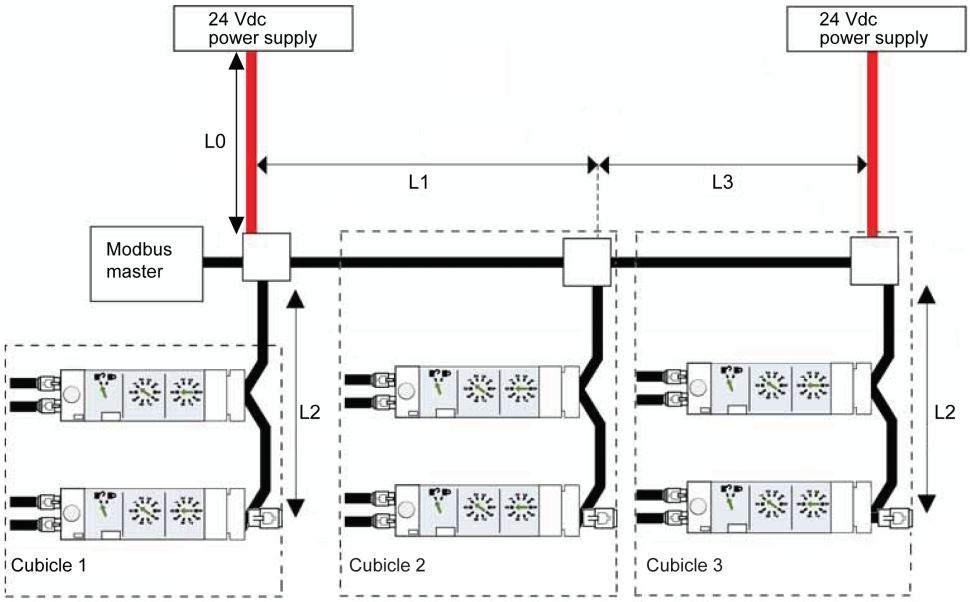
- The Modbus cable coming from the shunt terminal block on the incomer of the second cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 V wire is not connected since the power supply for the third cubicle is connected separately.
- The Modbus cable rising up the third cubicle ensures continuity of the Modbus signal (D0, D1, and 0 V) and the 24 Vdc power supply for the third cubicle.

Wiring Diagram of Shunt Terminal Block on the Incomer of the Third Cubicle



Modbus Cable Lengths for Several Power Supply Segments

The following figure shows the Modbus cable lengths in detail for a derivated distributed Modbus architecture with several power supply segments:



Modbus cable L3 ensures continuity of the Modbus signal (D0, D1, and 0 V). The 24 Vdc wire is not connected since the power supply is connected separately on the shunt terminal block on the incomer of the third cubicle.

The following table summarizes the maximum Modbus cable lengths for the derivated distributed Modbus architecture with several power supply segments. The Modbus cable under consideration is described in the connection of IFM interface *(see page 49)*.

24 Vdc rating	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	L2	Sum of the L2s (for all derivations)	Sum of the L1s, L2s, and L3s (total length)
1 A	5 m (16.4 ft)	35 m (114.8 ft)	10 m (32.8 ft)	40 m (131.2 ft)	500 m (1,640 ft)
3 A	3 m (9.8 ft)	10 m (32.8 ft)	5 m (16.4 ft)	40 m (131.2 ft)	500 m (1,640 ft)

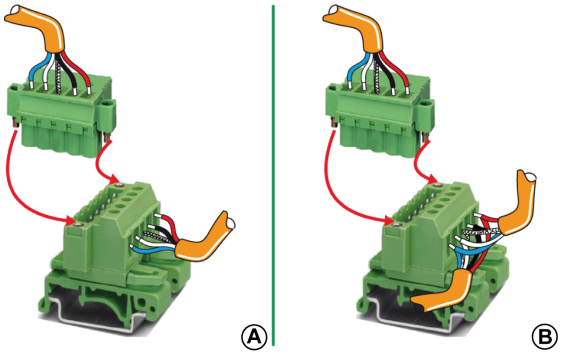
NOTE: The maximum number of power supply segments is 3 segments for a single Modbus network *(see page 45)*.

Pluggable Terminal Block

The following part numbers illustrate how to create a pluggable terminal block to make it easier to transport the electrical equipment.

Component	Nominal cross-section	Phoenix Contact part number
Pluggable connector MSTB 2.5/5-STF-5.08 	2.5 mm^2 (14 AWG)	1778014
Base unit on DIN rail UMSTBVK 2.5/5-GF-5.08 	2.5 mm^2 (14 AWG)	1787953
Optional cable cover for pluggable connector KGG-MSTB 2.5/5 	–	1803895

The following figure shows two examples of pluggable terminal blocks. The order of connection is the same as for the 5-pin connector on the IFM interface (D1, D0, shielding braid, 0 V, and 24 V):



A Pluggable terminal block

B Pluggable terminal block used as a tee (2 Modbus cables on the fixed base and one Modbus cable on the pluggable connector)

Ethernet Architectures

Introduction

Choosing an Ethernet topology depends on the requirements of the communication architecture:

- A star communication network offers an architecture with high dependability.
- A daisy-chain architecture offers a competitive architecture.

Ethernet High Dependability

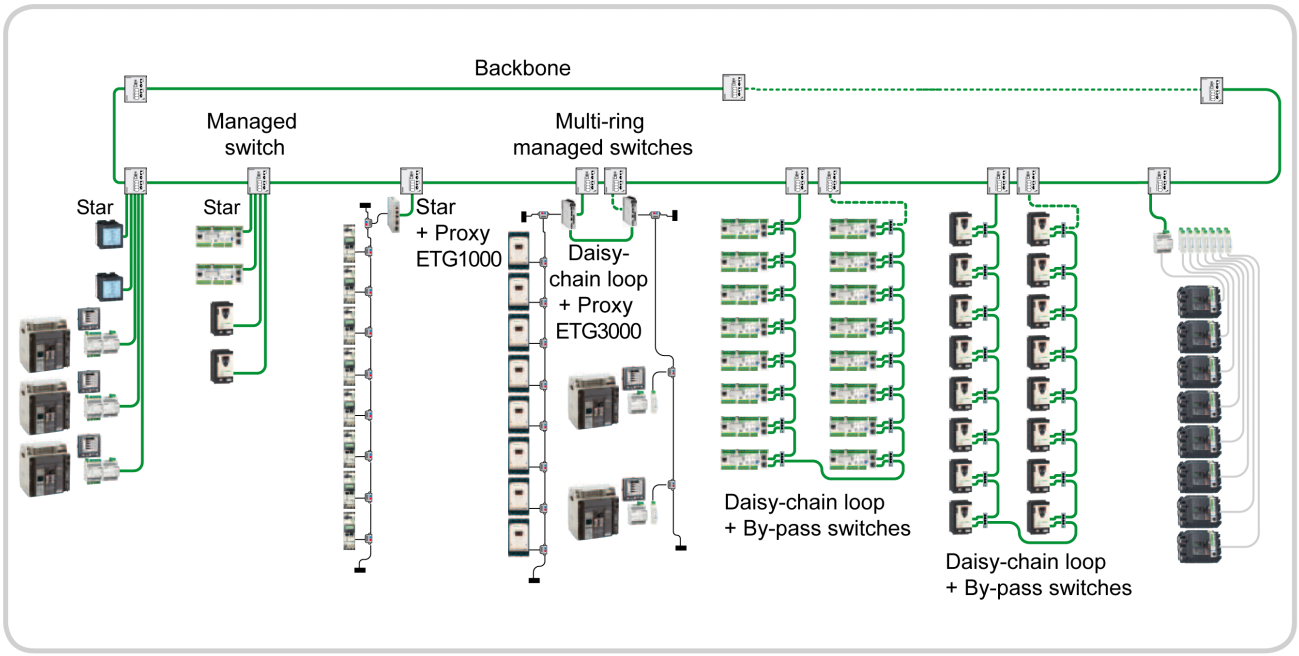
In the case of Ethernet high dependability, the architecture is fault tolerant.

A high dependability Ethernet architecture is based around a fault tolerant backbone ring (either optic fiber or copper) to which all the subsystems are connected via managed switches.

This communication architecture solution increases process availability with a high level of redundancy and performance. It is entirely based on devices with native Ethernet TCP or Ethernet/IP protocols, for power and motor management architecture. This architecture embeds the best performance for supporting RSTP protocols, and covers all detected faults in communication.

This solution also allows power monitoring facilities with new communicating devices supporting web servers.

The following diagram shows an example of a high dependability architecture:



Cable color	Description
Green	Ethernet network
Black	Modbus RTU network
Gray	ULP network

Star Communication Architecture

The star communication architecture has a high level of dependability.

A star network is a local area network (LAN) in which all nodes (that is, devices) are directly connected to a common central node (that is, the managed switch). Every device is indirectly connected to every other through the managed switch. In a star network, a cable failure isolates the device that links it to the switch, but only that device is isolated. All the other devices continue to function normally, except that they are not able to communicate with the isolated device.

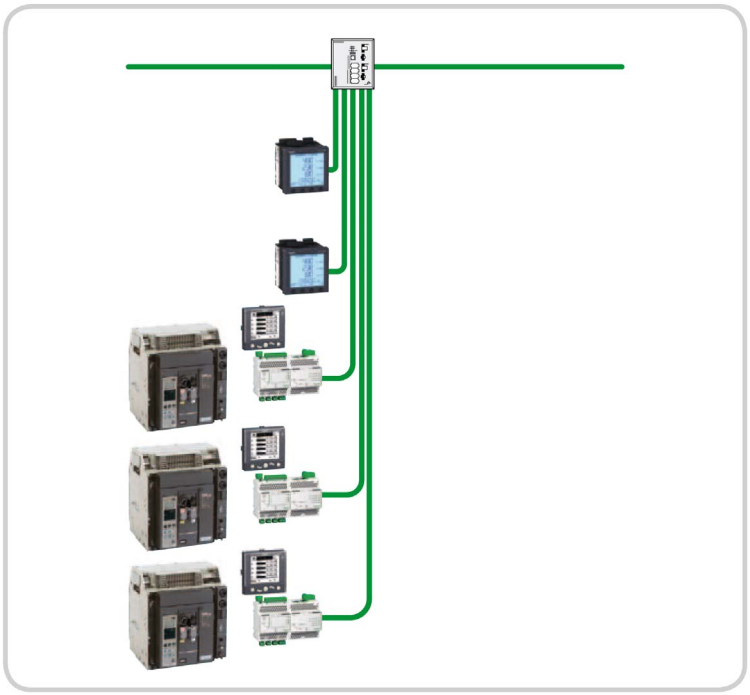
If any device is inoperative, none of the other devices are affected. But if the switch is inoperative, the entire network suffers degraded performance or complete failure.

The example of the star architecture in the following diagram uses IFE interfaces and power meters which are directly connected to the managed switch. This switch is the central node and provides a common connection point for all devices (peripheral nodes) connected in the star.

The star topology reduces the damage caused by line failure. If this occurs, a failure of a transmission line linking any peripheral node to the central node results in the isolation of that peripheral node from all others, but the remaining systems are unaffected.

The managed switch makes the connection between the devices and the HiPER-Ring managed backbone.

The following diagram shows a star architecture:



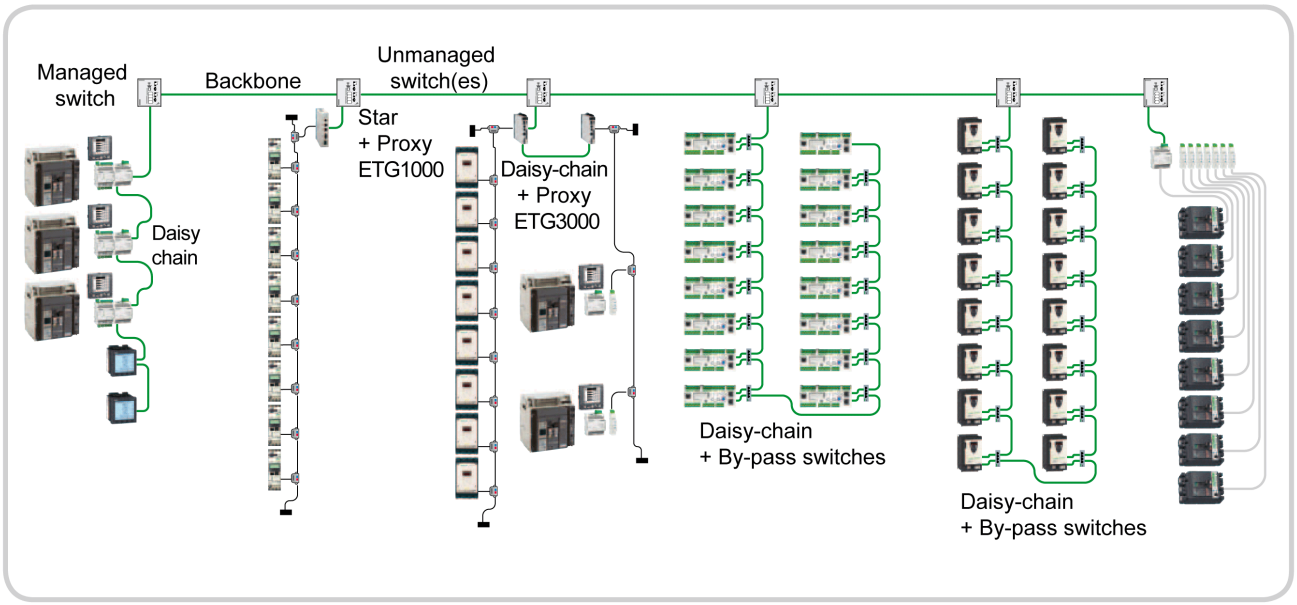
The following table presents the benefits of a star architecture for the user:

User values	Characteristics	Validity in the architecture	Benefit for the user
Dependability	Tolerant to first switch failure	–	√
	Tolerant to first node failure	√	
	Tolerant to second node failure	√	
	Tolerant to several nodes failures	√	
	One or more common modes	–	
	Additional failure modes	√	
Operability	Withdrawability of one functional unit	√	√
	Withdrawability of two functional units	√	
	Withdrawability of several functional units	√	

Ethernet Competitive Architecture

A competitive architecture is an optimized and recommended reference for some dedicated applications where redundancy is not required.

The following diagram shows a competitive architecture:



Cable color	Description
Green	Ethernet network
Black	Modbus RTU network
Gray	ULP network

Daisy Chain Communication Architecture

A daisy chain communication architecture is a competitive architecture.

A daisy chain is an interconnection of devices, peripherals, or network nodes in series, one after another. It is connected to the BUS backbone via an unmanaged switch.

The daisy chain is a simple architecture, but devices must have two Ethernet communication ports.

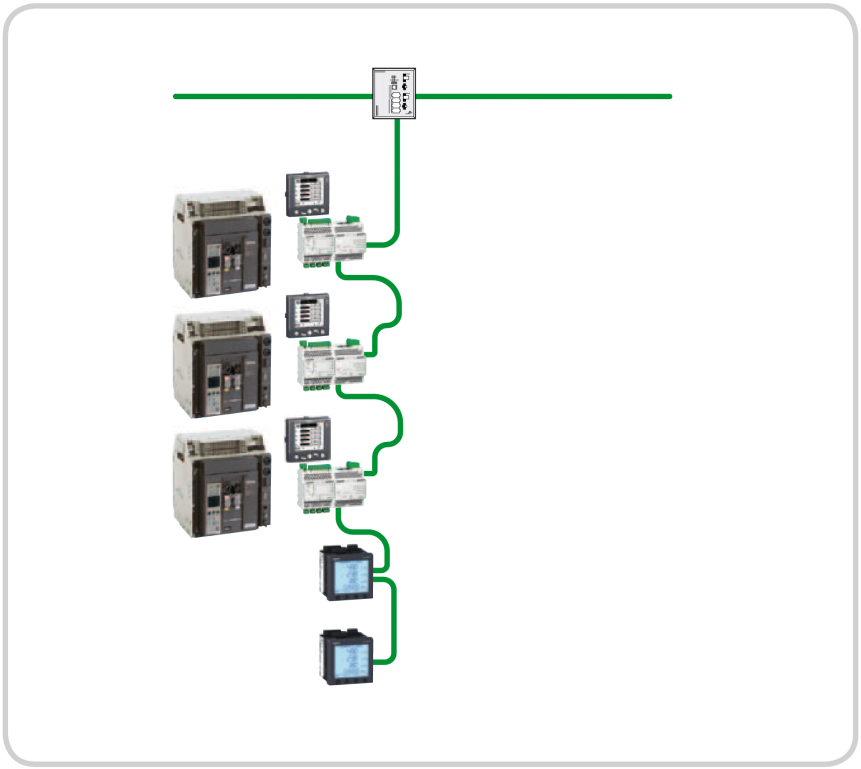
If any device becomes inoperative, or if a cable failure occurs, it will isolate devices that are connected after the failure. The remaining devices (between the switch and the cable failure) continue to operate normally, but they are not able to communicate with the isolated devices.

But if the switch is inoperative, the entire daisy chain network suffers a complete failure.

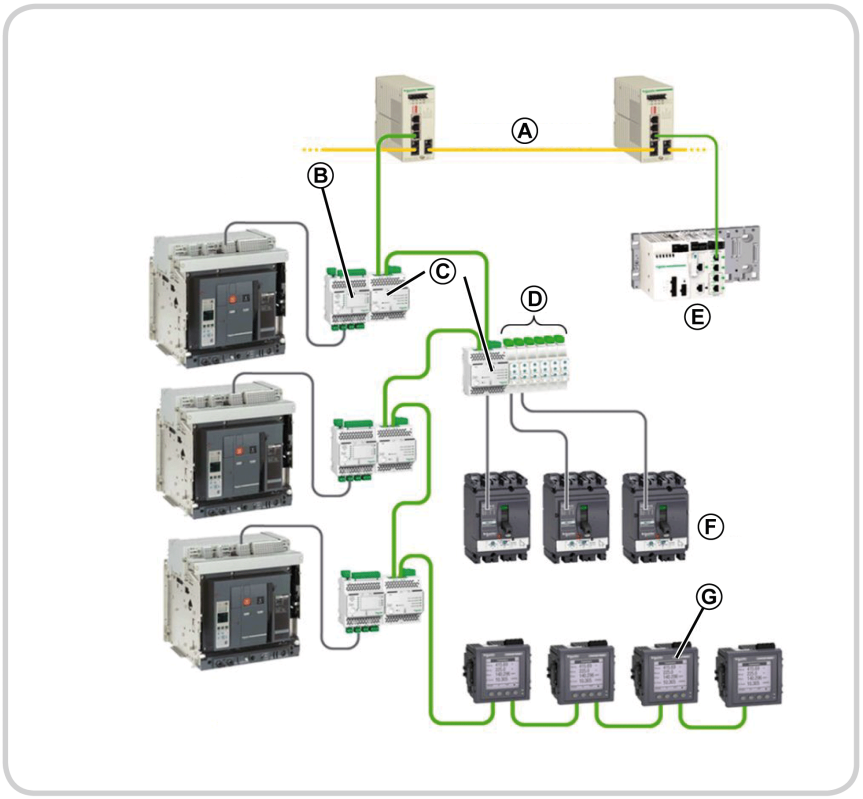
This type of architecture for connecting devices is recommended in the case of competitive global architecture.

NOTE: Power meters are always connected at the end of the daisy chain, after the LIFE, so that if a loss of communication occurs at the power meter level, there is no impact on communication with low voltage circuit breakers.

The following diagram shows a daisy-chain architecture:



The following diagram shows a daisy-chain architecture built using the following devices:
- Three Masterpact circuit breakers connected to an IO module and an IFE interface.
- Seven PowerPact H-, J-, and L-frame circuit breakers with one directly connected to the IFE interface and the six others connected to the IFM interface.
- Four power meters PM5560.
- Two unmanaged switches connected to each other via an optical fiber bus backbone.
- One PLC.



A BUS backbone
B IO module
C IFE interface
D IFM interface
E PLC
E Seven PowerPact H-, J-, and L-frame circuit breakers
G PowerLogic PM5560 power meter

Cable color	Description
Green	Ethernet network
Gray	ULP network

The following table presents the benefits of a daisy-chain architecture for the user:

User values	Characteristics	Validity in the architecture	Benefit for the user
Dependability	Tolerant to first switch failure	–	–
	Tolerant to first node failure	–	
	Tolerant to second node failure	–	
	Tolerant to several nodes failures	–	
	One or more common modes	–	
	Additional failure modes	–	
Operability	Withdrawability of one functional unit	√	√
	Withdrawability of two functional units	√	
	Withdrawability of several functional units	√	

Chapter 3
ULP Modules

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
IFE Ethernet Interfaces for Circuit Breaker

IFE Ethernet Interfaces

Introduction

An IFE Ethernet interface enables an intelligent modular unit (IMU), for example a Masterpact NT or PowerPact H-, J-, and L-frame circuit breaker to be connected to an Ethernet network. Each circuit breaker has its own IFE interface and a corresponding IP address.

For installation information, refer to the *IFE Ethernet Interface for One Circuit Breaker Instruction Sheet*.

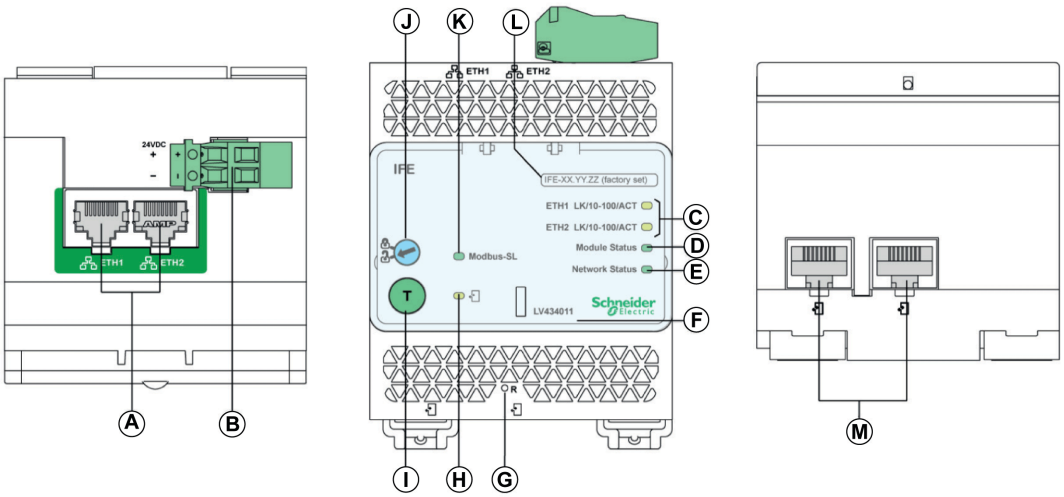
For detailed information, refer to the *IFE Ethernet Interface for One Circuit Breaker User Guide*.

Types of IFE

There are two commercial references of the IFE interface:

- LV434010 - IFE Ethernet interface for one circuit breaker
  This type of IFE is an Ethernet interface for Compact, PowerPact, and Masterpact circuit breakers.
- LV434011 - IFE Ethernet switchboard server
  This type of IFE is an Ethernet interface for Compact, PowerPact, and Masterpact circuit breakers and a gateway for Modbus-SL (serial line) connected devices.

Hardware Description



A Ethernet 1 and Ethernet 2 RJ45 communication ports
B 24 Vdc power supply terminal block
C Ethernet communication LEDs
D Module status LED
E Network status LED
F Sealable transparent cover
G Reset button
H ULP status LED
I Test button (accessible with cover closed)
J Locking pad
K Modbus traffic status LED (IFE server only)
L Device name label
M Two RJ45 ULP ports

IFE Interface Features

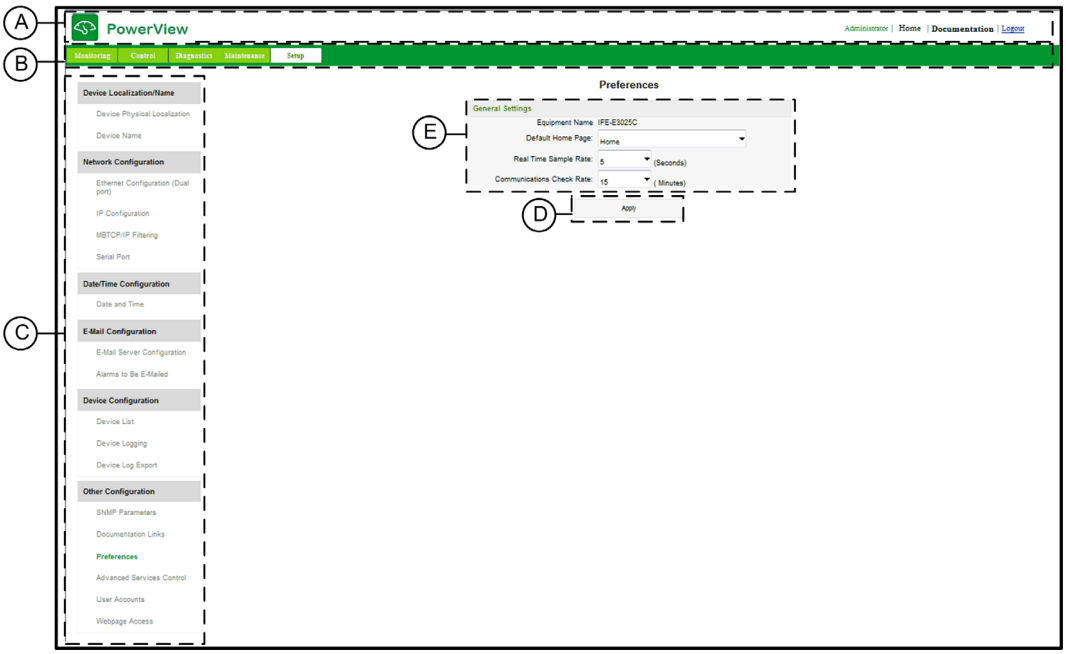
The main features of IFE interface are:

- Dual Ethernet port for simple daisy chain connection.
- Device profile Web service for discovery of the IFE interface on the local area network (LAN).
- ULP compliant for localization of the IFE interface in the electrical equipment.
- Ethernet interface for Compact, PowerPact, and Masterpact circuit breakers.
- Gateway for Modbus-SL connected devices (only for the IFE Ethernet switchboard server with the commercial reference LV434011).
- Embedded setup webpages.
- Embedded monitoring webpages.
- Embedded control webpages.
- Built-in email alarm notification.

NOTE: IFE interface in-built switch does not support the ring topology as it does not have the feature of the loop back protection.

IFE Interface Web Server Interface Layout

This graphic shows the user interface layout of the IFE interface.



A Banner
B Menu tabs
C Subtabs
D Action button
E Display zone

Monitoring Webpage

Monitoring submenu	Webpage	Description
Real Time Data	**Single Device Pages**	The single device page table view provides basic readings of selected devices.
	Summary Device Pages	The summary device page table view provides summaries of one or more selected devices.
	Trending	The trending page view provides real-time graphic and table trending of common topics across multiple devices.
Device Logging	**Single Device Pages**	The single device pages provide the graphic and table trending logs of user-selectable quantities for selected devices.
	Summary Device Pages	The summary device pages provide graphic trending logs of multiple devices with a common topic.

Control Webpage

Resets and controls the connected slave devices.

Diagnostics Webpage

Diagnostics submenu	Webpage	Description
General	**Statistics**	Displays diagnostic data used to troubleshoot the network-related problems.
Product Information	**Device Information**	• Displays the IFE interface basic information to set the IFE interface device name and helps in the device physical localization. • Contains information about the product name, serial number, model number, firmware version, unique identifier, MAC address, IPv4 address, and IPv6 link local address.
	IMU Information	Displays the list of the IMU devices connected to the ULP port.
Device Health Check	**Read Device Registers**	Displays register data connected locally to the IFE interface.
	Communication Check	Verifies the communications health of all the slave devices connected to IFE interface.
IO Readings	**IO Module**	Displays the status of ULP IO module of the selected device. Displays **No IO modules connected** if the selected device is not connected to a IO module.

NOTE: ULP IO Module refers to the slave device name defined in the **Device List** page.

Maintenance Webpage

Maintenance submenu	Webpage	Description
General	**Maintenance Log**	Shows the date, time, and user who last performed maintenance on the equipment, and provides entry detail on the maintenance performed.
Maintenance Counters	**Maintenance Counters**	Displays the maintenance counters of the connected devices.
Restore the Smartlink's	**Devices to be restored**	Moves the configuration settings from IFE interface to the Smartlink devices.

Configuration & Settings Webpage

Configuration & settings submenu	Webpage	Description
Device Physical Localization/Name	**Device Physical Location**	• Localizes the device IFE-XXYYZZ • Click **Blink ON**. • The ULP LED of the selected device IFE-XXYYZZ blinks and is active for 15 s (Test mode: 1 s ON, 1 s OFF).
	Device Name	Configures the IFE interface device name.
Network Configuration	**Ethernet Configuration (Dual port)**	Configures the Ethernet.
	IP Configuration	Configures the IP parameters.
	Modbus TCP/IP Filtering	Configures the maximum number of Modbus TCP/IP server connections. Configures the IP addresses that can access the IFE interface through Modbus TCP/IP.
	Serial Port	Configures serial communication parameters.
Date/Time Configuration	**Date and Time**	Sets the date and time manually.
Email Configuration	**Email Server Configuration**	Configures the alarms to be emailed. Configures the SMTP parameter for mailing purpose.
	Alarms To Email	Configures the alarms to be sent through email.
Device Configuration	**Device List**	Configures local serial devices on the Modbus serial daisy chain and IMU core product connected to the ULP port.
	Device Logging	Configures device logging parameters.
	Device Log Export	Configures device logging export options.
Other Configuration	**SNMP Parameters**	Configures Simple Network Management Protocol (SNMP).
	Documentation Links	Configures file and URL documentation links.
	Preferences	Configures IFE interface preferences.
	Advanced Services Control	Configures the advanced service control parameters.
	User Accounts	Creates and edits groups and users. Configures email accounts.
	Webpage Access	Configures webpage user rights for each user group.

Section 3.2
IFM Modbus-SL Interface for One Circuit Breaker

IFM Modbus-SL Interface for One Circuit Breaker

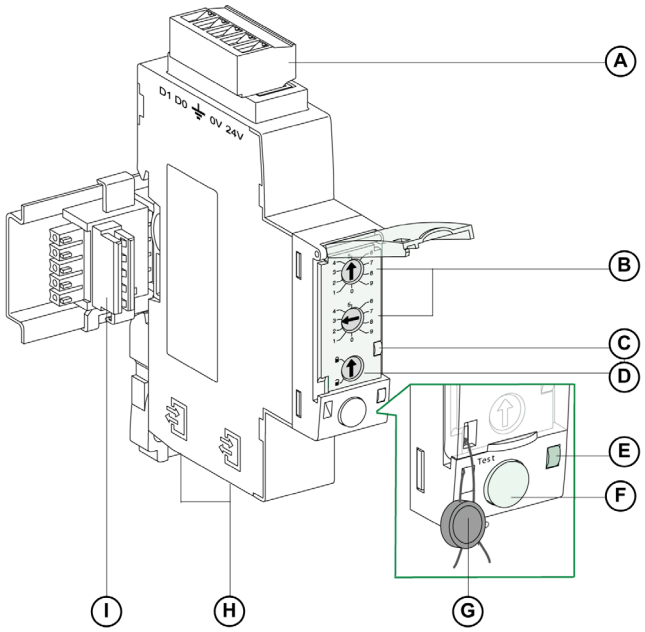
Introduction

The IFM Modbus-SL interface for one circuit breaker enables an intelligent modular unit (for example a Masterpact NT or a PowerPact H-, J-, and L-frame circuit breaker) to be connected to a 2-wire Modbus-SL network. Each IMU has its own IFM interface and a corresponding Modbus address.

For installation information, refer to the *IFM Modbus-SL Interface for One Circuit Breaker Instruction Sheet*.

The Modbus-SL connection recommendations are in the present guide *(see page 49)*.

Hardware Description



A 5-pin screw type connector (Modbus connection and power supply)
B Modbus address rotary switches
C Modbus traffic LED
D Modbus locking pad
E ULP LED
F Test button
G Mechanical lock
H Two ULP RJ45 ports
I Stacking accessory

Modbus Address Rotary Switches

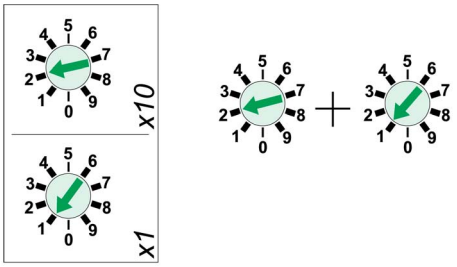
The IFM interface bears the Modbus address of the intelligent modular unit to which it is connected.

The user defines the Modbus address by using the two address rotary switches on the front panel of the IFM interface.

The address range is 1 to 99. Value 0 is forbidden because it is reserved for broadcasting commands.

The IFM interface is initially configured with address 99.

Example of the configuration of the address rotary switches for address 21:



NOTE: When the IFM interface is connected to a BCM ULP circuit breaker communication module, the Modbus address range is limited from 1 to 47.
Furthermore, do not use the addresses x+50, x+100, x+200 for any other Modbus slaves connected on the same Modbus network. For example, if the IFM interface is set at the Modbus address 22, therefore do not set any other Modbus slaves at the address 72 or 122 or 222.

Modbus Traffic LED

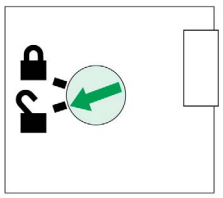
The Modbus traffic yellow LED informs the user about the traffic transmitted or received by the IMU over the Modbus network.

- When the Modbus address rotary switches are on value 0, the LED is steady ON.
- When the Modbus address rotary switches are on value anywhere between 1 and 99, the LED is ON during the transmission and reception of messages, OFF otherwise.

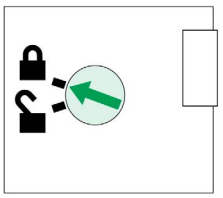
NOTE: When the IFM interface is connected to a BCM ULP module, the LED is steady ON if the Modbus address rotary switches are on value above 47.

Modbus Locking Pad

The Modbus locking pad on the front panel of the IFM interface enables or disables remote control commands to be sent over the Modbus network to the IFM interface itself, and to the other modules of the connected IMU.



Remote control commands enabled



Remote control commands disabled

- If the arrow points to the open padlock (factory setting), remote control commands are enabled.
- If the arrow points to the closed padlock, remote control commands are disabled.
  The only remote control commands that are enabled even if the arrow points to the closed padlock are the Set Absolute Time and Get Current Time commands.
  For more information about these commands, refer to the *Masterpact NT/NW and PowerPact P- and R-Frame Modbus Communication Guide*.

NOTE: For IFM interface slaves connected to an IFE Ethernet switchboard server, the locking pad of the IFE interface does not disable the remote control commands in IFM interface.

Test Button

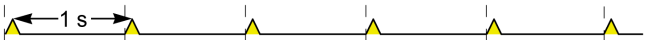
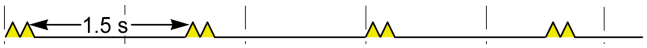
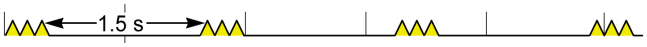
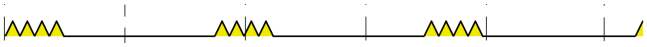
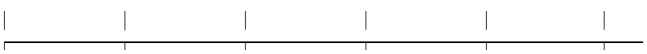
The test button tests the connection between all the ULP modules connected to the IFM interface.

Pressing the test button launches the connection test for 15 seconds.

During the test, all the ULP modules keep working normally.

ULP LED

The yellow ULP LED describes the mode of the ULP module.

ULP LED	Mode	Action
	Nominal	None
	Conflict	Remove extra ULP module
	Degraded	Replace ULP module at the next maintenance operation
	Test	None
	Non-critical firmware discrepancy	Upgrade firmware at the next maintenance operation
	Non-critical hardware discrepancy	Replace ULP module at the next maintenance operation
	Configuration discrepancy	Install missing features
	Critical firmware discrepancy	Upgrade firmware
	Critical hardware discrepancy	Replace ULP module
	Stop	Replace ULP module
	Power off	Check power supply

Configuration

Configure the IFM interface in one of two ways:

- Automatic configuration (**Auto-Speed sensing** On): When a Modbus master is communicating on the Modbus communication network, the IFM interface automatically detects the speed and parity of the Modbus connection (default configuration).
- Custom configuration: By deactivating the IFM interface **Auto-Speed sensing** option with the customer engineering tool *(see page 19)*, the user can customize the speed and parity of the Modbus connection.

Automatic Configuration

The user defines the Modbus address for the IFM interface with the two address switches. When the IFM interface is connected to the Modbus network, it automatically detects the connection parameters. The **Auto-Speed sensing** algorithm automatically tests the possible speeds and parities and detects the speed and parity of the connection.

The transmission format is related to the parity:

- The transmission format is binary with one start bit, eight data bits, one stop bit in the case of even or odd parity.
- The transmission format is two stop bits if there is no parity.

Custom Configuration

Use the two address switches to define the Modbus address for the IFM interface.

The user can customize the communication parameters with the customer engineering tool.

- The supported speeds are 4800, 9600, 19,200, and 38,400 Baud.
- The supported parities are even, odd, and no parity.

NOTE: The Modbus address and locking pad status cannot be modified with the customer engineering tool.

Section 3.3
Two-Wire RS 485 Isolated Repeater Module

Two-Wire RS 485 Isolated Repeater Module

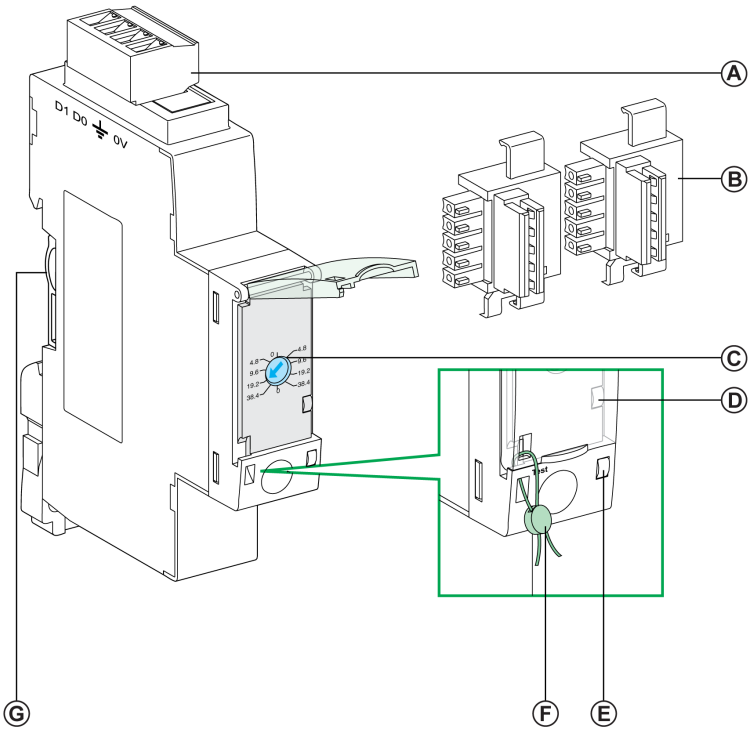
Introduction

The two-wire RS 485 isolated repeater module electrically isolates a 2-wire RS 485 Modbus network inside the electrical equipment from a two-wire RS 485 Modbus network outside the electrical equipment. This module must be used in this case because the IFM Modbus-SL interface for one circuit breaker is not isolated.

For installation information, refer to the *Two-Wire RS 485 Isolated Repeater Instruction Sheet*.

The Modbus-SL connection recommendations are in the present guide *(see page 49)*.

Hardware Description



A Modbus 4-pin connector
B 2 stacking accessories (supplied with the repeater)
C Rotary switch (to set the transmission speed and format)
D Modbus traffic LED
E Status LED
F Mechanical lock
G Stacking accessory connection

Section 3.4
IO Input/Output Application Module for One Circuit Breaker

IO Input/Output Application Module for One Circuit Breaker

Introduction

The IO input/output application module for one circuit breaker is part of an ULP system with built-in functionalities and applications.

The IO module is a component of the ULP system and is compliant with the ULP system specifications.

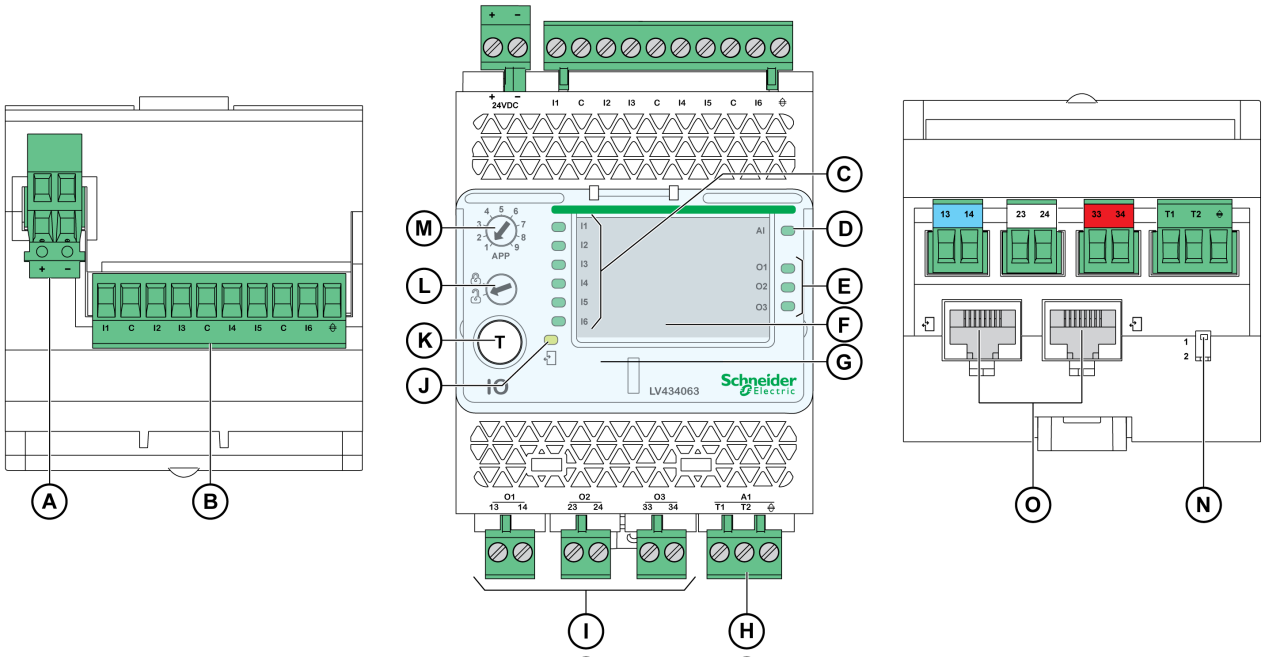
The ranges of LV circuit breakers compatible with the IO module are:
- Masterpact NW circuit breakers
- Masterpact NT circuit breakers
- PowerPact R-frame circuit breakers
- PowerPact P-frame circuit breakers
- PowerPact H-, J-, and L-frame circuit breakers

The IO module resources are:
- Six digital inputs that are self-powered for either NO or NC dry contact or pulse counter.
- Three digital outputs that are bistable relays (5 A maximum).
- One analog input for Pt100 temperature sensor.

For installation information, refer to the *IO Input/Output Application Module for One Circuit Breaker Instruction Sheet*.

For detailed information, refer to the *IO Input/Output Application Module for One Circuit Breaker User Guide*.

Hardware Description



A 24 Vdc power supply terminal block
B Digital input terminal block: six inputs, three commons, and one shield
C Six input status LEDs
D Analog input status LED
E Three output status LEDs
F I/O identification labels
G Sealable transparent cover
H Analog input terminal block
I Digital output terminal block
J ULP status LED
K Test/reset button (accessible with cover closed)
L Setting locking pad
M Application rotary switch: 1 to 9
N Switch for IO module addressing (IO module 1 or IO module 2)
O Two RJ45 ULP ports

Predefined Applications

Predefined applications add new functions to the IMU:

- Selection by the application rotary switch on the IO module, defining the application with a predefined input/output assignment and wiring diagram.
- No additional setting by the customer is required.

The resources not assigned to the predefined application are available for additional user-defined applications.

List of Predefined Applications

Application rotary switch position	Predefined application	Description
1	Cradle management	Monitors the position of the circuit breaker in the cradle.
2	Circuit breaker operation	Controls the opening and closing of the circuit breaker by using the control mode (local or remote) and the close inhibit order.
3	Cradle management and Energy Reduction Maintenance Setting (ERMS)	Monitors the position of inputs and controls the ERMS mode of the circuit breaker.
4	Light and load control	Controls the light and load application.
5-8	Spare	—
9	Custom	Performs the user-defined applications with the IO module.

User-Defined Applications

User-defined applications are processed by the IO module in addition to the predefined applications selected.

The user-defined applications are available depending on:
- The predefined applications selected.
- The IO module resources (inputs and outputs) not used by the application.

The resources required by user-defined applications are assigned using the customer engineering tool *(see page 19)*.

List of User-Defined Applications

The following table provides the list of user-defined applications available according to the predefined applications selected with the application rotary switch on the IO module.

Function	User-defined applications	Predefined application selected									
		1	2	3	4	5	6	7	8	9 (IO1)	9 (IO2)
Protection	Energy Reduction Maintenance Settings (FRMS)	X	—	X	X	—	—	—	—	—	—
Control	Enable/inhibit close order	X	—	X	X	—	—	—	—	X	—
	User-defined output	X	X	X	X	—	—	—	—	X	X
Energy Management	Energy counter reset	X	—	X	X	—	—	—	—	X	X
	User-defined pulse counters	X	—	X	X	—	—	—	—	X	X
Monitoring	Cradle management	X	—	X	—	—	—	—	—	—	X
	Drawer management	—	—	—	—	—	—	—	—	X	X
	Cooling system	X	—	X	X	—	—	—	—	X	X
	Predefined input acquisition	X	—	X	X	—	—	—	—	X	X
	User-defined input acquisition	X	—	X	X	—	—	—	—	X	X
	Input indicator	X	X	X	X	—	—	—	—	X	X
	Threshold overrun of input counter indicator	X	X	X	X	—	—	—	—	X	X
	Breaker status indicator	X	X	X	X	—	—	—	—	X	X
	Maintenance indicator	X	X	X	X	—	—	—	—	X	X
	Trip indicator	X	X	X	X	—	—	—	—	X	X
	Pre-alarm indicator	X	X	X	X	—	—	—	—	X	X
	User-defined alarm indicator	X	X	X	X	—	—	—	—	X	X
X = user-defined application available — = user-defined application not available											

Section 3.5
FDM121 ULP Display for One Circuit Breaker

FDM121 ULP Display for One Circuit Breaker

Introduction

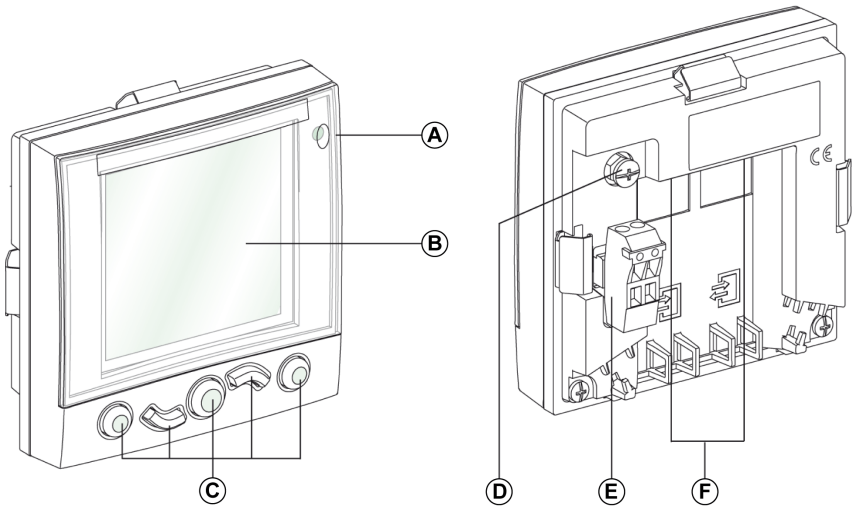
The FDM121 ULP display for one circuit breaker unit displays the measurements, alarms, and operating assistance data from the intelligent modular unit. The FDM121 display can control:

- the circuit breaker equipped with a motor mechanism, or
- pre-defined applications performed by an IO module.

For installation information, refer to the *FDM121 ULP Display for One Circuit Breaker Instruction Sheet*.

For detailed information, refer to the *FDM121 ULP Display for One Circuit Breaker User Guide*.

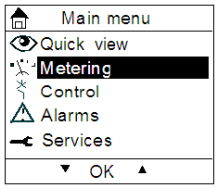
Hardware Description



A Alarm Indicator LED
B LCD screen
C Navigation keys
D Functional ground
E 24 Vdc power supply terminal block
F Two RJ45 ULP ports

Main Menu

The **Main menu** offers five menus for monitoring and using the ULP system IMUs.



The description and content of the menus depend on the IMU. For more information, refer to the documentation for the device connected to the FDM121 display.

For example, if you have an FDM121 display connected to a PowerPact H-, J-, and L-frame, refer to the *Micrologic 5 and 6 Trip Units User Guide*.

The menus available in the **Main menu** are as follows:

Menu	Description
Quick view	**Quick view** menu The **Quick view** menu provides quick access to the information essential for operation.
Metering	**Metering** menu The **Metering** menu displays the data made available by the Micrologic trip unit: ● Current, voltage, power, energy, and harmonic distortion measurements ● Minimum and maximum metering values
Control	**Control** menu The **Control** menu is used to control a circuit breaker equipped with a communicating motor mechanism from the FDM121 display. The proposed commands are: ● Circuit breaker opening ● Circuit breaker closing with or without self-timer ● Circuit breaker reset after trip ● IO module lighting control ● IO module load control
Alarms	**Alarms** menu The **Alarms** menu is used to display: ● The event log file for the last 40 events and alarms detected by the devices connected to the FDM121 display since the last power-up of the FDM121 display. ● The alarm history (for example, alarms, trips, maintenance, and control status) for the device connected to the FDM121 display.
Services	**Services** menu The **Services** menu contains all the FDM121 display setup functions and the operating assistance information: ● Reset (peak demand values, energy meters) ● Setup (display module date and time, parameters) ● Maintenance (operation counters, load profile) ● Product version (identification of the IMUs) ● Language (choice of language display) ● Monitoring and controlling the IO modules (IO status, forcing command, and counters) ● Setup of the IP address of the IFE Ethernet interface for one circuit breaker

Section 3.6
UTA Maintenance Module

What Is in This Section?

This section contains the following topics:

Presentation of the UTA Maintenance Module

Introduction

The UTA maintenance module is used to test and maintain the ULP modules and their accessories.

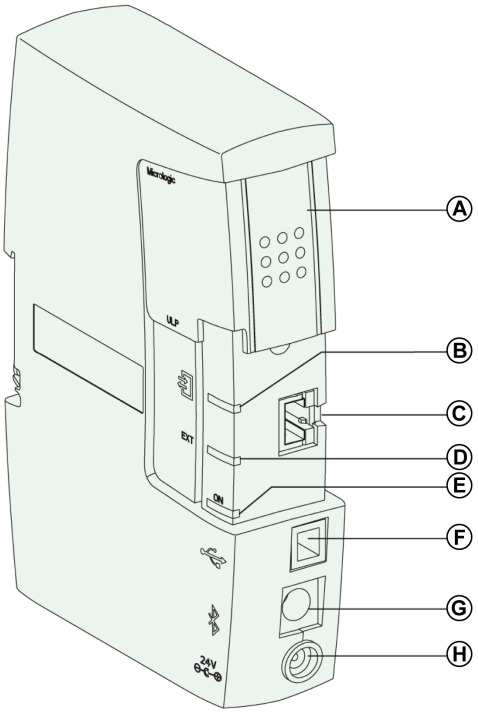
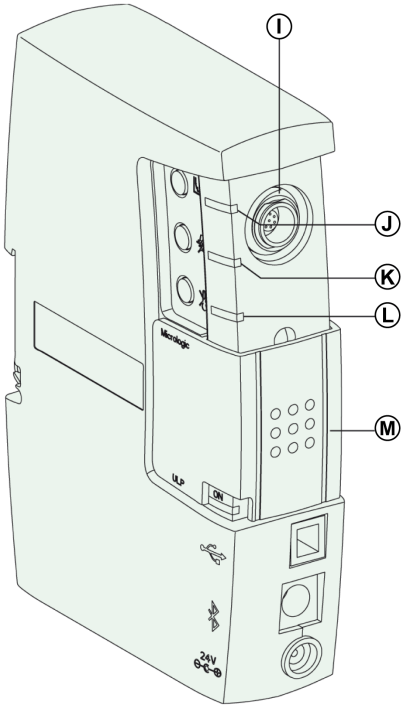
The UTA maintenance module is connected to the IMU by:

- Connection to the test port on the Micrologic trip unit in PowerPact H-, J-, and L-frame circuit breakers, which allows connection on the front of the electrical equipment.
- ULP connection, where the UTA module connects to a ULP port on one of the ULP modules of the IMU.

For installation information, refer to the *Maintenance Kit Instruction Sheet*.

Hardware Description

The following table describes the two types of connection for the UTA module, depending on the position of the sliding mechanical cap.

ULP connection	Connection to the test port on the Micrologic trip unit
	
A Sliding mechanical cap in ULP position **B** ULP communication LED **C** ULP RJ45 port **D** LED indicating that the 24 Vdc external power supply is not connected **E** **ON** LED **F** USB connector **G** Bluetooth adapter connector **H** 24 Vdc external power supply unit input	**I** Connection socket for special cable connecting UTA module to test port on Micrologic trip unit **J** Electrical push-to-trip **Test** button and LED indicator **K** Inhibit ground fault protection button and LED indicator **L** Inhibit thermal memory button and LED indicator **M** Sliding mechanical cap in test position

Operating Modes

The UTA module operates in either of two modes:

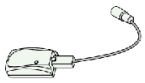
- In offline mode (not connected to a computer), the UTA module connects to the test port on the Micrologic trip unit and as such can be used to perform:
  - Tripping tests
  - The inhibit functions required for tripping tests by primary current injection
- In online mode (connected to a computer with USB or Bluetooth) with LTU (Local Test Utility) and RSU (Remote Setting Utility) software, the UTA module can be used to perform the following actions:
  - Set the protection parameters (RSU)
  - Display the protection parameters (RSU and LTU)
  - Set the alarm parameters (RSU)
  - Display the alarm parameters (RSU and LTU)
  - Display the settings curves (RSU and LTU)
  - Simulate alarms and tripping on the PowerPact H-, J-, and L-frame circuit breaker (LTU)
  - Check discrimination and the ZSI (Zone Selective Interlocking) function (LTU)
  - Store all the operating data and maintenance tests in a dedicated file for each PowerPact H-, J-, and L-frame circuit breaker (LTU)
  - Set the IFM Modbus-SL interface for one circuit breaker parameters (RSU)
  - Update the firmware in the ULP modules (RSU)
  - Reset passwords associated with the IMU (RSU)

NOTE: The LTU software only works with a connection to the test port on the Micrologic trip unit. The RSU software works with both types of connection.
For more information about the RSU and LTU software, refer to the *RSU and LTU Online Helps*.

Bluetooth Option

If desired, the user can order the optional Bluetooth connection.

The Bluetooth option consists of a Bluetooth module which connects to the UTA module. The Bluetooth key for the computer is not supplied.



Part Numbers

The following table lists the part numbers for the components in the maintenance kit:

Product	Description	Part number
Maintenance kit	Case, UTA module, external power supply unit, and associated cables	STRV00910
UTA module	–	STRV00911
24 Vdc power supply for UTA module	–	TRV00915
Micrologic test cable	Cable for connecting the UTA module to the test port on the Micrologic trip unit	TRV00917
Bluetooth option	Bluetooth module for connection to the UTA module	VW3A8114

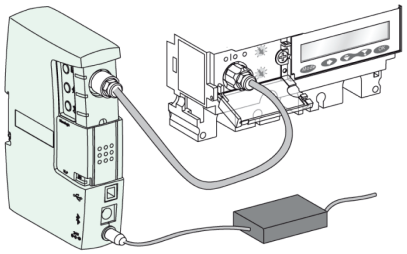
Connection to the Test Port on the Micrologic Trip Unit in PowerPact H-, J-, and L-Frame Circuit Breakers

Introduction

Connect the UTA maintenance module to the test port on the PowerPact H-, J-, and L-frame Micrologic trip unit by using the test cable supplied in the maintenance kit. Place the sliding mechanical cap of the UTA module in the Micrologic position.

Connection in Offline Mode

In offline mode, the UTA module is not connected to a computer. The UTA module is connected to the test port on the PowerPact H-, J-, and L-frame Micrologic trip unit and must be powered by the 24 Vdc external power supply unit provided in the maintenance kit.



In offline mode, the UTA module can be used to perform the PowerPact H-, J-, and L-frame circuit breaker tripping tests and the inhibit ground fault protection and thermal memory tests. For more information on these three functions, see the test functions *(see page 118)*.

Connection to a Computer

The UTA module connected to a computer can carry out the complete range of checks, tests, and adjustments on the IMUs by using the customer engineering tool *(see page 19)*.

There are two possible configurations for connecting the UTA module to a computer:

- By using the USB port
- By using the Bluetooth option

Connection to the ULP System

Introduction

⚠ WARNING

RISK OF ELECTROCUTION, ELECTRIC ARC OR BURNS

Do not connect the internal Modbus network of the electrical equipment to an external Modbus network without inserting an isolation barrier.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

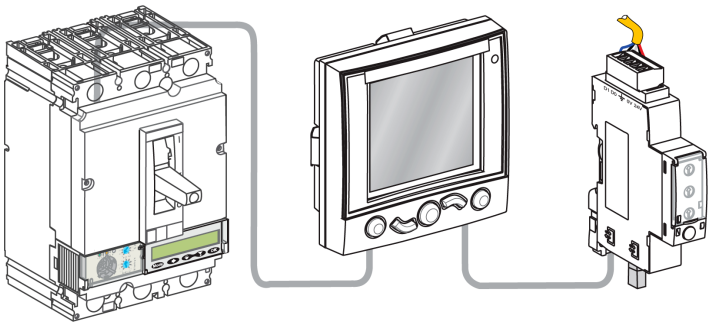
Connect the UTA maintenance module ULP to the IMU by using the RJ45 male/male ULP cord provided in the maintenance kit. Place the UTA module sliding mechanical cap in the ULP position.

When the UTA module ULP is connected to a communicating IMU over Modbus, it is important that the Modbus connection rules are followed.

For more information, see how to connect to the Modbus master *(see page 52)*.

Example of ULP Connection

The following example shows an IMU consisting of an IFM Modbus-SL interface for one circuit breaker, a PowerPact H-, J-, and L-frame circuit breaker, and an FDM121 ULP display for one circuit breaker.



The UTA module ULP is connected to an unused ULP connector on one of the ULP modules.

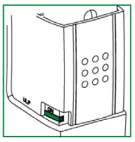
Using the UTA Maintenance Module Connected to the Test Port on the Micrologic Trip Unit in PowerPact H-, J-, and L-Frame Circuit Breakers

Offline Mode

In offline mode, the UTA maintenance module is not connected to a computer. It is connected to the test port on the PowerPact H-, J-, and L-frame Micrologic trip unit and is powered by the 24 Vdc external power supply unit provided in the maintenance kit.

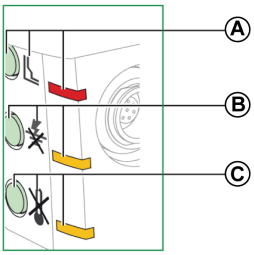
ON LED

The green **ON** LED indicates that the UTA module is supplied with power and operating correctly.



Test Functions

Carry out tests by using the three test buttons. A pictogram and a LED are associated with each button.



A Push-to-trip
B Inhibit ground fault protection
C Inhibit thermal memory

The following table describes the functions possible with the UTA module connected in offline mode to the test port on the Micrologic trip unit:

Function	Description
Push-to-trip	• Press the push-to-trip button to trip the PowerPact H-, J-, and L-frame circuit breaker. • The behavior of the associated LED is described in the specific topic *(see page 118)*.
Inhibit ground fault protection	• Press the inhibit ground fault protection button to inhibit ground fault protection and the thermal memory for 15 minutes. • The behavior of the associated LED is described in the specific topic *(see page 119)*.
Inhibit thermal memory	• Press the inhibit thermal memory button to inhibit the thermal memory for 15 minutes. • The behavior of the associated LED is described in the specific topic *(see page 119)*.

NOTE: Pressing any other test button during the 15 minutes stops the test in progress and starts the test associated with the test button that has been pressed.

Push-to-Trip LED

The red push-to-trip LED shows execution of the electronic trip test:

LED status	Meaning
ON for 2 s then OFF	The trip command is sent to the Micrologic trip unit.
Always OFF	The trip command is refused by the Micrologic trip unit.

Inhibit Ground Fault Protection LED

The orange inhibit ground fault protection LED shows execution of the inhibit ground fault protection test:

LED status	Meaning
ON for 15 minutes then OFF	● Pressing the inhibit ground fault protection button starts the test and lights up the LED for 15 minutes (inhibit duration). At the end of the inhibit test, the LED goes off. ● Pressing the inhibit ground fault protection button during the 15 minutes stops the test and extinguishes the LED. ● The LED goes off and the test stops if the test cable is disconnected during the 15 minutes.
Flashing for 3 s	The ground fault protection function is not available while the Micrologic trip unit is in test mode.

Inhibit Thermal Memory LED

The orange inhibit thermal memory LED shows execution of the inhibit thermal memory test:

LED status	Meaning
ON for 15 minutes then OFF	● Pressing the inhibit thermal memory button starts the test and lights up the LED for 15 minutes (inhibit duration). At the end of the inhibit test, the LED goes off. ● Pressing the inhibit thermal memory button during the 15 minutes stops the test and extinguishes the LED. ● The LED goes off and the test stops if the test cable is disconnected during the 15 minutes.

NOTE: Pressing any other test button during the 15 minutes stops the test in progress and starts the test associated with the test button that has been pressed.

Connection to a Computer

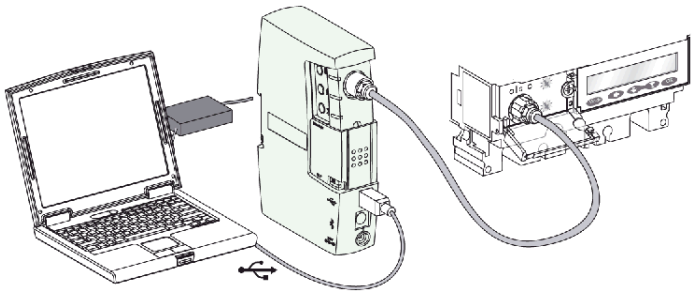
In addition to the test functions described above, the UTA module connected to a computer by using a USB port or Bluetooth connection can be used to carry out the complete range of checks, tests, and adjustments on the IMU ULP modules by using the RSU and LTU software:

- Use the LTU software to test the protection functions (such as short time, long time, and instantaneous), simulate the Micrologic trip unit alarms, display the currents, and test the ZSI (Zone Selective Interlocking) function.
- Use the RSU software to check and configure the protection, metering, and alarm parameters. It can also be used to check and configure the parameters of the IFM Modbus-SL interface for one circuit breaker, the BSCM circuit breaker status control module, and the SDx module.

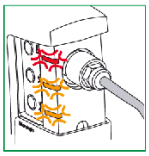
For more information about the RSU and LTU software functions, refer to the *LTU and RSU Online Helps*.

USB Connection

For a USB connection, the UTA module is powered through the USB port.



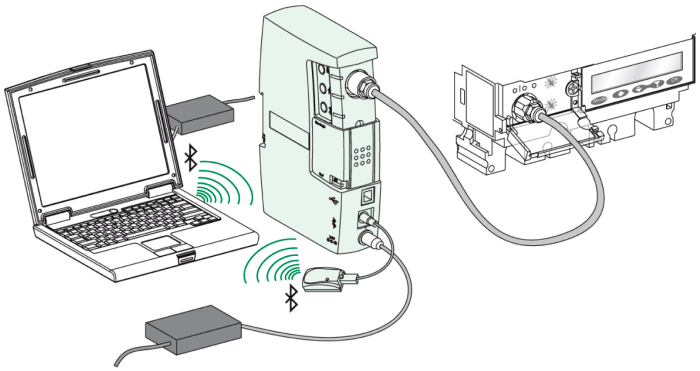
NOTE: If the USB port cannot supply power to the UTA module (computer running on low battery), the three test LEDs blink.



In this case, power the UTA module with the 24 Vdc external power supply unit provided in the maintenance kit. Connect the 24 Vdc external power supply unit to a 110/230 V power supply, overvoltage category II, in accordance with standard IEC 60664 for the protection of persons.

Bluetooth Connection

For a Bluetooth connection, power the UTA module with the 24 Vdc external power supply unit provided in the maintenance kit.



Using the UTA Maintenance Module Connected to the ULP System

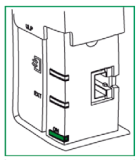
Introduction

When the sliding mechanical cap is in the ULP position, the UTA maintenance module allows communication between the IMU ULP modules and the RSU software.

The LTU software only works with a connection to the test port on the PowerPact H-, J-, and L-frame Micrologic trip unit.

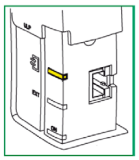
ON LED

The green **ON** LED indicates that the UTA module is supplied with power and operating correctly.



ULP LED

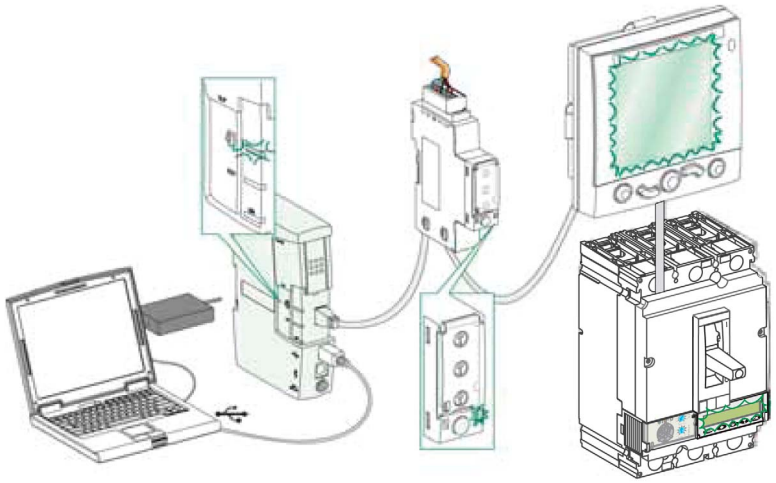
The yellow ULP LED describes the connection between the ULP modules and the UTA module.



The following table describes the ULP LED status.

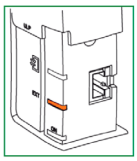
LED status	Meaning
ON: 50 ms/OFF: 950 ms	Nominal operation: The UTA module is supplied with power and the ULP connection is operating correctly.
ON: 250 ms/OFF: 250 ms	Prohibited configuration: Two identical modules are connected to the UTA module in a daisy chain.
ON: 500 ms/OFF: 500 ms	Degraded mode (EEPROM off, faulty button)
ON: 1,000 ms/OFF: 1,000 ms	Test mode
Steady ON	The UTA module is supplied with power but the ULP connection is not functioning.
Steady OFF	The UTA module is not supplied with power.

The following figure shows an IMU in test mode. In test mode, the backlighting on the FDM121 ULP display for one circuit breaker unit and the Micrologic trip unit, the test LED on the IFM Modbus-SL interface for one circuit breaker and the ULP LED on the UTA module blink simultaneously (ON: 1,000 ms/OFF: 1,000 ms).



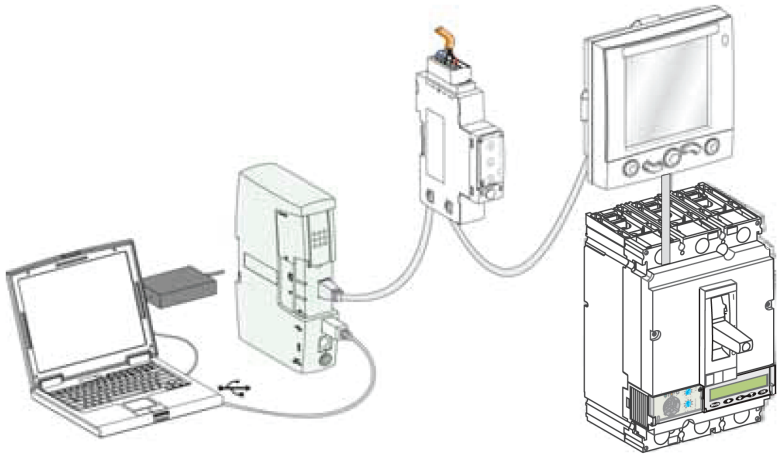
External Power Supply LED

The orange external power supply LED lights up when the UTA module does not have enough power (for example, with USB connection on a computer running on low battery). In this case, it is necessary to use the external power supply unit provided in the maintenance kit. The LED goes off when the external power supply unit is connected.



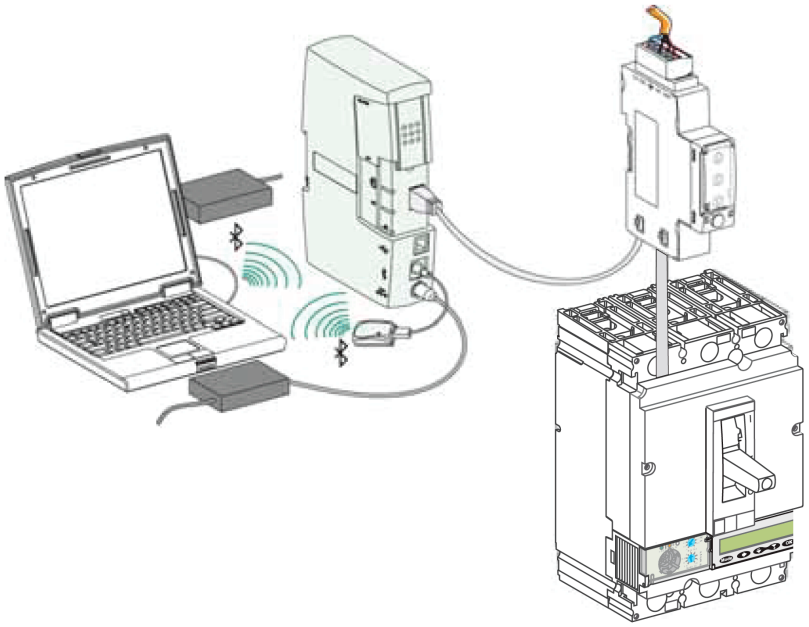
USB Connection

In the case of a USB connection, the UTA module is powered through the USB port.



Bluetooth Connection

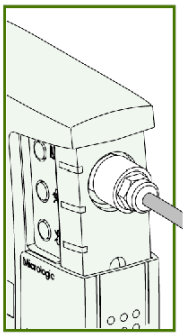
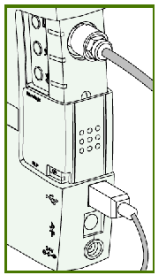
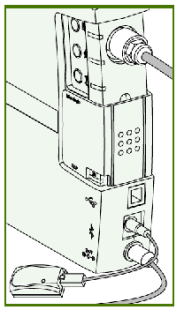
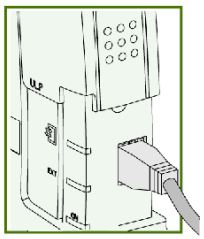
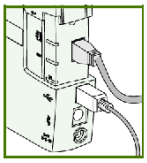
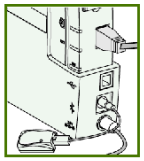
For a Bluetooth connection, power the UTA module with the 24 Vdc external connection power supply unit provided in the UTA module kit.



Use - Summary

Summary of Connection and Power Supply Procedures

The following table summarizes the connection and the power supply procedures:

Connection to the IMU	Connection to the computer	Associated functions
Connection to the test port on the Micrologic trip unit in PowerPact H-, J-, and L-frame circuit breakers 	No connection to the computer	• The UTA maintenance module is in offline mode. • The UTA module is powered by its 24 Vdc external power supply unit. • The user can test PowerPact H-, J-, and L-frame circuit breaker tripping, thermal memory inhibition, and ground fault protection inhibition.
	USB connection 	• The UTA module is powered through the USB port. • The three test LEDs blink if the power supply through the USB port is inadequate. In this case, use the 24 Vdc external power supply unit of the UTA module. • The offline mode functions are available. • The user can test PowerPact H-, J-, and L-frame circuit breaker tripping and simulate alarms with LTU. • The user can check and configure the parameters of the Micrologic trip unit and the IMU ULP modules with RSU.
	Bluetooth connection 	• The UTA module is powered by its 24 Vdc external power supply unit. • The offline mode functions are available. • The user can test PowerPact H-, J-, and L-frame circuit breaker tripping and simulate alarms with LTU. • The user can check and configure the parameters of the Micrologic trip unit and the IMU ULP modules with RSU.
ULP connection 	USB connection 	• The UTA module is powered through the USB port. • The external power supply LED blinks if the power supply through the USB port is inadequate. If so, use the 24 Vdc external power supply unit of the UTA module. • The user can check and configure the parameters of the Micrologic trip unit and the IMU ULP modules with the RSU software.
	Bluetooth connection 	• The UTA module is powered by its 24 Vdc external power supply unit. • The user can check and configure the parameters of the Micrologic trip unit and the IMU ULP modules with the RSU software.

ULP Module Power Supplies

- If the UTA module is connected to an IMU powered by the electrical equipment, the USB port or the 24 Vdc external power supply unit (in the case of a Bluetooth connection) only power the UTA module.
- If the UTA module is connected to an IMU without a power supply, use the 24 Vdc external power supply unit of the UTA module to power all the ULP modules.
- If the UTA module is connected to a ULP module without a power supply, the USB port is capable of supplying power to the UTA module and the ULP module. If not, use the 24 Vdc external power supply unit of the UTA module.

Appendices

Appendix A
ULP System Appendices

What Is in This Chapter?

This chapter contains the following topics:

Technical Characteristics of IFE Ethernet Interfaces for Circuit Breakers

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC 60950 • IEC 60947-6-2
		• UL508 • UL60950 • IACS E10
Certification		CE, cULus, EAC, and FCC marking
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to +185 °F)
	Operation	-25 °C to +70 °C (-13 °F to +158 °F)
Protective treatment		ULV0, conforming to IEC/EN 60068-2-30
Pollution		Level 3

Mechanical Characteristics

Characteristic	Value
Shock resistance	Conforming to IEC 60068-2-27 15 g/11 ms, 1/2 sinusoidal
Resistance to sinusoidal vibrations	Conforming to IEC/EN 60068-2-6

Electrical Characteristics

Characteristics		Value
Power supply		24 Vdc, -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	24 Vdc, 120 mA at 20 °C
	Maximum with IFE Ethernet switchboard server	19.2 Vdc, 140 mA at 60 °C

Physical Characteristics

Characteristic	Value
Dimensions	72 x 105 x 71 mm (2.83 x 4.13 x 2.79 in)
Mounting	DIN rail
Weight	182.5 g (0.41 lb)
Degree of protection of the installed module	• On the front panel (wall-mounted enclosure): IP4• • Connectors: IP2• • Other parts: IP3•
Connections	Screw type terminal blocks

24 Vdc Power Supply Characteristics

It is recommended to use an UL listed/UL recognized limited voltage/limited current or a class 2 power supply with a 24 Vdc.

Characteristic	Value
Power supply type	Regulated switch type
Rated power	72 W
Input voltage	100–120 Vac for single phase
	200–500 Vac phase-to-phase
PFC filter	With IEC 61000-3-2
Output voltage	24 Vdc
Power supply output current	3 A

Technical Characteristics of IFM Modbus-SL Interface for One Circuit Breaker

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC/EN 60947-1 • IACS E10 • UL 508 • CSA C22.2 no.14-10
Certification		• CE and C-Tick marking • UL • CSA
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to +185 °F)
	Operation	-25 °C to +70 °C (-13 °F to +158 °F)
Relative humidity	Conforming to IEC/EN 60068-2-78	4 days, 40 °C (104 °F), 93% RH, energized
Protective treatment	Conforming to IEC/EN 60068-2-30	6 cycles of 24 hours, 25/55 °C (77/131°F), 95% RH, energized
Pollution		3
Corrosive atmosphere	Conforming to IEC 60068-2-60	4 gases (H_2S, SO_2, NO_2, Cl_2)
Level of pollution	Access to hazardous parts and water penetration	Splashing outside the protective cover: IP4•
	Conforming to IEC/EN 60947-1 and IEC/EN 60529	Connectors: IP2•
		Other module parts: IP3•
	Conforming to IEC 62262/EN 50102	External mechanical impacts: IK05
Flame resistance	Conforming to IEC/EN 60947-1 and IEC/EN 60695-2-11	• 650 °C (1202 °F) 30 s/30 s on de-energized insulating parts • 960 °C (1760 °F) 30 s/30 s on de-energized insulating parts
	Conforming to UL94	V0

Mechanical Characteristics

Characteristic		Value
Shock resistance	Conforming to NF EN 22248 (free fall, in packaging)	H = 90 cm (35.4 in)
	Conforming to IEC 60068-2-27	15 g (0.53 oz)/11 ms 1/2 sinusoidal
Resistance to sinusoidal vibration	Conforming to IEC/EN 60068-2-6	1 g (0.035 oz)/5-150 Hz

Electrical Characteristics

Characteristics		Value
Power supply		24 Vdc -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	21 mA/24 Vdc at 20 °C (68 °F)
	Maximum	30 mA/19.2 Vdc at 60 °C (140 °F)
Resistance to electromagnetic discharges	Conforming to IEC/EN 61000-4-2	● 4 kV (direct) ● 8 kV (air)
Immunity to radiated electromagnetic interference	Conforming to IEC/EN 61000-4-3	10 V/m
Immunity to electrical fast transients/burst	Conforming to IEC/EN 61000-4-4	● 2 kV (power) ● 8 kV (signal)
Immunity to radiated fields	Conforming to IEC/EN 61000-4-6	10 V
Immunity to surges	Conforming to IEC/EN 61000-4-5	● Input and Output DC power ports: ❍ Differential mode: 0.5 kV ❍ Common mode: 0.5 kV ● Signal ports: Common mode: 1 kV

Physical Characteristics

Characteristic		Value
Dimensions (W x D x H)	Without power supply terminal block	18 x 72 x 89 mm (0.7 x 2.8 x 3.5 in)
	With power supply terminal block	18 x 72 x 99 mm (0.7 x 2.8 x 3.9 in)
Mounting		DIN rail
Weight		90 g (3.17 oz)

Technical Characteristics of Two-Wire RS 485 Isolated Repeater

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC/EN 60947-1 • IACS E10 • UL 508 • CSA C22.2 no.14-10
Certification		• CE and C-Tick marking • UL 508 - Industrial Control Equipment • CSA no. 142-M1987 - Process Control Equipment • CAN/CSA C22.2 no. 0-M91 - General requirements - Canadian Electrical Code Part • CAN/CSA C22.2 no. 14-05 - Industrial Control Equipment
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to +185 °F)
	Operation	-25 °C to +70 °C (-13 °F to +158 °F)
Relative humidity	Conforming to IEC/EN 60068-2-78	4 days, 40 °C (104 °F), 93% RH, energized
Protective treatment	Conforming to IEC/EN 60068-2-30	6 cycles of 24 hours, 25/55 °C (77/131°F), 95% RH, energized
Pollution		3
Corrosive atmosphere	Conforming to IEC 60068-2-60	4 gases (H_2S, SO_2, NO_2, Cl_2)
Level of pollution	Access to hazardous parts and water penetration	Splashing outside the protective cover: IP4•
	Conforming to IEC/EN 60947-1 and IEC/EN 60529	Connectors: IP2•
		Other module parts: IP3•
	Conforming to IEC 62262/EN 50102	External mechanical impacts: IK05
Flame resistance	Conforming to IEC/EN 60947-1 and IEC/EN 60695-2-11	• 650 °C (1202 °F) 30 s/30 s on de-energized insulating parts • 960 °C (1760 °F) 30 s/30 s on de-energized insulating parts
	Conforming to UL94	V0

Mechanical Characteristics

Characteristic		Value
Shock resistance	Conforming to NF EN 22248 (free fall, in packaging)	H = 90 cm (35.4 in)
	Conforming to IEC 60068-2-27	15 g (0.53 oz)/11 ms 1/2 sinusoidal
Resistance to sinusoidal vibration	Conforming to IEC/EN 60068-2-6	1 g (0.035 oz)/5-150 Hz

Electrical Characteristics

Characteristics		Value
Power supply		24 Vdc -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	15 mA/24 Vdc at 20 °C (68 °F)
	Maximum	19 mA/19.2 Vdc to 24 Vdc at 60 °C (140 °F)
Resistance to electromagnetic discharges	Conforming to IEC/EN 61000-4-2	● 4 kV (direct) ● 8 kV (air)
Immunity to radiated electromagnetic interference	Conforming to IEC/EN 61000-4-3	10 V/m
Immunity to electrical fast transients/burst	Conforming to IEC/EN 61000-4-4	● 2 kV (power) ● 8 kV (signal)
Immunity to radiated fields	Conforming to IEC/EN 61000-4-6	10 V
Immunity to surges	Conforming to IEC/EN 61000-4-5	● Input and Output DC power ports: ❍ Differential mode: 0.5 kV ❍ Common mode: 0.5 kV ● Signal ports: Common mode: 1 kV

Physical Characteristics

Characteristic		Value
Dimensions (W x D x H)	Without power supply terminal block	18 x 72 x 89 mm (0.7 x 2.8 x 3.5 in)
	With power supply terminal block	18 x 72 x 99 mm (0.7 x 2.8 x 3.9 in)
Mounting		DIN rail
Weight		90 g (3.17 oz)

Technical Characteristics of IO Input/Output Application Module for One Circuit Breaker

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC/EN 60947-1 • IACS E10
		• UL508 • UL60950
		IACS E10
Certification		CE, cULus, EAC, and FCC marking
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to +185 °F)
	Operation	-25 °C to +70 °C (-13 °F to +158 °F)
Protective treatment		ULV0, conforming to IEC/EN 60068-2-30
Pollution		Level 3

Mechanical Characteristics

Characteristic	Value
Shock resistance	Conforming to IEC 60068-2-27 15 g/11 ms, 1/2 sinusoidal
Resistance to sinusoidal vibrations	Conforming to IEC/EN 60068-2-6

Electrical Characteristics

Characteristics		Value
Power supply		24 Vdc, -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	24 Vdc, 165 mA at 20 °C
	Maximum with ULP	19.2 Vdc, 420 mA at 60 °C

Physical Characteristics

Characteristic	Value
Dimensions	72 x 115 x 71 mm (2.83 x 4.52 x 2.79 in)
Mounting	DIN rail
Weight	229.5 g (0.51 lb)
Degree of protection of the installed module	• On the front panel (wall-mounted enclosure): IP4• • IO module parts: IP3• • Connectors: IP2•
Connections	Screw type terminal blocks

24 Vdc Power Supply Characteristics

It is recommended to use an UL listed/UL recognized limited voltage/limited current or a Class 2 power supply with a 24 Vdc.

Digital Inputs Characteristics

Characteristic	Value
Digital input type	Self-powered digital input with current limitations as per IEC 61131-2 type 2 standards (7 mA)
Input limit values at state 1 (close)	19.8–25.2 Vdc
	6.1–8.8 mA
Input limit values at state 0 (open)	0–19.8 Vdc
	0 mA
Maximum cable length	10 m (33 ft) **NOTE:** For a length between 10 m (33 ft) and 300 m (1,000 ft), it is mandatory to use a shielded twisted cable. The shield cable is connected to the functional ground of the IO module.

Digital Outputs Characteristics

Characteristic	Value
Digital output type	Bistable relay
Rated load	5 A at 250 Vac
Rated carry current	5 A
Maximum switching voltage	380 Vac, 125 Vdc
Maximum switch current	5 A
Maximum switching power	1250 VA, 150 W
Minimum permissible load	10 mA at 5 Vdc
Contact resistance	30 mΩ
Maximum operating frequency	• 18,000 operations/hour (mechanical) • 1,800 operations/hour (electrical)
Digital output relay protection	External fuse of 5 A or less
Maximum cable length	10 m (33 ft)

Analog Inputs Characteristics

The IO module analog input can be connected to a Pt100 temperature sensor.

Characteristic	Values	
Range	-30 to 200 °C	-22 to 392 °F
Accuracy	• ± 2 °C from -30 to 20 °C • ± 1 °C from 20 to 140 °C • ± 2 °C from 140 to 200 °C	• ± 3.6 °F from -22 to 68 °F • ± 1.8 °F from 68 to 284 °F • ± 3.6 °F from 284 to 392 °F
Refresh interval	5 seconds	5 seconds

Technical Characteristics of FDM121 ULP Display for One Circuit Breaker

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC/EN 60947-1 • IACS E10
		• UL508 - Industrial Control Equipment • No. 142-M1987 - Process Control Equipment ❍ CAN/CSA C22.2 No. 0-M91 - General requirements - Canadian Electrical Code Part ❍ CAN/CSA C22.2 No. 14-05 - Industrial Control Equipment ❍ CSA C22.2 No.14-10
Certification		• CE and C-Tick marking
		• UL • CSA
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to 85 °F)
	Operation	-10 °C to +55 °C (14–131 °F) (on the front panel)
Relative humidity	Conforming to IEC/EN 60068-2-78	Four days, 40 °C (104 °F), 93% RH, energized
Protective treatment	Conforming to IEC/EN 60068-2-30	Six cycles of 24 hours, 25/55 °C (77/131°F), 95% RH, energized
Pollution		3
Corrosive atmosphere	Conforming to IEC 60068-2-60	Four gases (H_2S, SO_2, NO_2, Cl_2)
Level of pollution	Access to hazardous parts and water penetration	IP53 (splashing outside the protective cover)
	Conforming to IEC/EN 60947-1 and IEC/EN 60529	IP2• (connectors)
	Conforming to IEC 62262/EN 50102	IK05 (external mechanical impacts)
Flame resistance	Conforming to IEC/EN 60947-1 and IEC/EN 60695-2-11	• 650 °C (1,202 °F) 30 s/30 s on de-energized insulating parts • 960 °C (1,760 °F) 30 s/30 s on de-energized insulating parts
	Conforming to UL94	V0

Mechanical Characteristics

Characteristic		Value
Degree of protection of the installed module		• Part projecting beyond the escutcheon: IP4• • Other module parts: IP3• • Connectors: IP2•
Shock resistance	Conforming to NF EN 22248 (free fall, in packaging)	H = 90 cm (35.4 in)
	Conforming to IEC 60068-2-27	15 g (0.53 oz)/11 ms 1/2 sinusoidal
Resistance to sinusoidal vibration	Conforming to IEC/EN 60068-2-6	1 g (0.035 oz)/5-150 Hz

Electrical Characteristics

Characteristic		Value
Power supply		24 Vdc, -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	21 mA/24 Vdc at 20 °C (68 °F)
	Maximum	30 mA/19.2 Vdc at 60 °C (140 °F)
Resistance to electromagnetic discharges	Conforming to IEC/EN 61000-4-2	● 4 kV (direct) ● 8 kV (air)
Immunity to radiated electromagnetic interference	Conforming to IEC/EN 61000-4-3	10 V/m
Immunity to electrical fast transients/burst	Conforming to IEC/EN 61000-4-4	● 2 kV (power) ● 8 kV (signal)
Immunity to radiated fields	Conforming to IEC/EN 61000-4-6	10 V
Immunity to surges	Conforming to IEC/EN 61000-4-5	● Input and Output DC power ports: ❍ Differential mode: 0.5 kV ❍ Common mode: 0.5 kV ● Signal ports: Common mode: 1 kV

Physical Characteristics

Characteristic		Value
Dimensions (W x D x H)	Without power supply terminal block	96 x 96 x 33.1 mm (3.8 x 3.8 x 1.3 in)
	With power supply terminal block	96 x 96 x 43.2 mm (3.8 x 3.8 x 1.7 in)
Mounting		● Flush-mounted ● Surface-mounted, with surface-mounting accessory
Weight		200 g (7.06 oz)
Display	Screen	128 x 128 pixels
	Viewing angle	● Horizontal: ± 30° ● Vertical: ± 60°

Technical Characteristics of UTA Maintenance Module

Environmental Characteristics

Characteristic		Value
Conforming to standards		• IEC/EN 60947-1 • IACS E10
Certification		• CE and C-Tick marking
Ambient temperature	Storage	-40 °C to +85 °C (-40 °F to +185 °F)
	Operation	-10 °C to +55 °C (-14 °F to +131 °F)
Relative humidity	Conforming to IEC/EN 60068-2-78	4 days, 40 °C (104 °F), 93% RH, energized
Protective treatment	Conforming to IEC/EN 60068-2-30	6 cycles of 24 hours, 25/55 °C (77/131°F), 95% RH, energized
Pollution		3
Corrosive atmosphere	Conforming to IEC 60068-2-60	4 gases (H_2S, SO_2, NO_2, Cl_2)
Level of pollution	Access to hazardous parts and water penetration	Splashing outside the protective cover: IP4•
	Conforming to IEC/EN 60947-1 and IEC/EN 60529	Connectors: IP3•
	Conforming to IEC 62262/EN 50102	External mechanical impacts: IK05
Flame resistance	Conforming to IEC/EN 60947-1 and IEC/EN 60695-2-11	• 650 °C (1202 °F) 30 s/30 s on de-energized insulating parts • 960 °C (1760 °F) 30 s/30 s on de-energized insulating parts
	Conforming to UL94	V0

Mechanical Characteristics

Characteristic		Value
Shock resistance	Conforming to NF EN 22248 (free fall, in packaging)	H = 90 cm (35.4 in)
	Conforming to IEC 60068-2-27	15 g (0.53 oz)/11 ms 1/2 sinusoidal
Resistance to sinusoidal vibration	Conforming to IEC/EN 60068-2-6	1 g (0.035 oz)/5-150 Hz

Electrical Characteristics

Characteristics		Value
Power supply		24 Vdc -20%/+10% (19.2–26.4 Vdc)
Consumption	Typical	60 mA/24 Vdc at 20 °C (68 °F)
	Maximum with Bluetooth	100 mA/19.2 Vdc at 60 °C (140 °F)
Resistance to electromagnetic discharges	Conforming to IEC/EN 61000-4-2	• 4 kV (direct) • 8 kV (air)
Immunity to radiated electromagnetic interference	Conforming to IEC/EN 61000-4-3	10 V/m
Immunity to electrical fast transients/burst	Conforming to IEC/EN 61000-4-4	• 2 kV (power) • 8 kV (signal)
Immunity to radiated fields	Conforming to IEC/EN 61000-4-6	10 V
Immunity to surges	Conforming to IEC/EN 61000-4-5	• Input and Output DC power ports: ❍ Differential mode: 0.5 kV ❍ Common mode: 0.5 kV • Signal ports: Common mode: 1 kV

Physical Characteristics

Characteristic	Value
Dimensions (W x D x H)	Without power supply terminal block: 112 x 164 x 42 mm (4.4 x 6.5 x 1.6 in)
Mounting	• DIN rail • Magnetic
Weight	408 g (14.4 oz)

RJ45 Male/Male ULP Cord Characteristics

Characteristics

The common characteristics of ULP cords are as follows:

- Shielded cable with four twisted-pairs, 0.15 mm^2 (26 AWG) cross-section, with typical impedance of 100 Ω
- Shielded male RJ45 connector at each end, cable shielding connected to the connector cover (connector conforming to standard IEC 60603-7-1)
- Color and order of internal wires conforming to standard EIA/TIA568B.2 (see the composition of the Modbus cable *(see page 49)*)
- Insulation voltage of the outer sheath: 300 V(1)
- Bending radius: 50 mm (1.97 in)(1)

(1) Cable must be compliant with installation requirements for voltage and temperature ratings. It is the responsibility of the user to select the correct cable for the specific installation.

Modbus Cable Characteristics

Introduction

When a Modbus cable other than Schneider Electric part number 50965 is used, it must have the following characteristics:

- Shielded cable with two twisted-pairs:
  - One communication pair for the RS 485 signal, with typical impedance of 120 Ω and minimum cross-section 0.25 mm^2 (24 AWG). The recommended colors for the wires are white and blue.
  - One 24 Vdc power supply pair. The cross-section depends on the current to be carried and the length of the Modbus cable required, with the following restrictions: 0.32 mm^2 (22 AWG) minimum for a 1 A 24 Vdc power supply, and 0.5 mm^2 (20 AWG) minimum for a 3 A 24 Vdc power supply.
    The recommended colors for the wires are black and red.
- Shielding braid, with shielding drain wire (for connecting the shield to the ground terminal on the 5-pin connector of the IFM Modbus-SL interface for one circuit breaker).
- Nominal insulation voltage of the outer sheath: 300 V minimum.
  Cable must be compliant with installation requirements for voltage and temperature ratings. It is the responsibility of the user to select for correct cable for the specific installation.

Connection Rules

The Modbus cable recommended below must follow the rules and recommendations for connection defined in this guide.

Part Numbers

The following table lists two recommended Modbus cable part numbers:

Type of installation	24 Vdc rating	Cross-section of power supply pair	Part number	Comment
Installation limited to a few IMUs	1 A	0.34 mm^2 (22 AWG)	Belden part number 3084A1	External diameter limited to 7 mm (0.28 in) for ease of wiring
Large installation: all topologies	3 A	0.75 mm^2 (18 AWG)	Belden part number 7895A1	Recommended cable with shielding drain wire and 9.6 mm (0.38 in) diameter
Cable must be compliant with installation requirements for voltage and temperature ratings. It is the responsibility of the user to select the correct cable for the specific installation.				

Modbus Cable Lengths

The maximum permitted length for the Modbus network (for the trunk cable, excluding derivations) is 500 m (1,640 ft) at 38,400 Baud and 1,000 m (3,281 ft) at 19,200 Baud.

The Modbus cable connecting the IFM interfaces in the ULP system incorporates both the Modbus communication network and the 24 Vdc power supply. Because of the stresses caused by a drop in the supply voltage, more restrictive limitations are imposed:

- The voltage drop between the power supply and the furthest point, both on the +24 V wire and on the 0 V wire, must be limited to 4 V (2 V on the +24 V wire and 2 V on 0 V wire).
  A minimum supply of 24 V -20% (19.2 V) is thus obtained on the last IFM interface, with a 24 Vdc power supply regulated at:
  - +/-3% (23.3–24.7 V) for 3 A power supplies
  - +/-5% (22.8–25.2 V) for 1 A power supplies
- For optimum quality of the Modbus communication, the voltage on the 0 V terminal on each IFM interface (Modbus common) must not vary by more than +/-4 V compared to the 0 V voltage of any other Modbus product in the installation. This restriction further limits length when the Modbus equipment is divided between a number of power supply segments.

Maximum Modbus cable lengths for a centralized Modbus architecture *(see page 62)*:

24 Vdc rating	Cross-section of power supply pair	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	Sum of the L1s (for all power supply segments)	Sum of the L1s and L3s (total length)
1 A	0.34 mm^2 (22 AWG)	5 m (16.4 ft)	30 m (98 ft)	75 m (246 ft)	500 m (1,640 ft)
	0.5 mm^2 (20 AWG)	5 m (16.4 ft)	45 m (148 ft)	105 m (344 ft)	500 m (1,640 ft)
3 A	0.34 mm^2 (22 AWG)	Cross-section not compatible with currents > 1 A			
	0.5 mm^2 (20 AWG)	3 m (9.8 ft)	15 m (49 ft)	35 m (115 ft)	500 m (1,640 ft)
	0.75 mm^2 (18 AWG)	3 m (9.8 ft)	25 m (82 ft)	60 m (197 ft)	500 m (1,640 ft)
	1 mm^2 (17 AWG)	3 m (9.8 ft)	30 m (98 ft)	70 m (230 ft)	500 m (1,640 ft)
	1.5 mm^2 (16 AWG)	3 m (9.8 ft)	50 m (164 ft)	120 m (394 ft)	500 m (1,640 ft)

Maximum Modbus cable lengths for a daisy-chained distributed Modbus architecture *(see page 72)*:

24 Vdc rating	Cross-section of power supply pair	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	Sum of the L1s (for all power supply segments)	Sum of the L1s and L3s (total length)
1 A	0.34 mm^2 (22 AWG)	5 m (16.4 ft)	30 m (98 ft)	75 m (246 ft)	500 m (1,640 ft)
	0.5 mm^2 (20 AWG)	5 m (16.4 ft)	45 m (148 ft)	105 m (344 ft)	500 m (1,640 ft)
3 A	0.34 mm^2 (22 AWG)	Cross-section not compatible with currents > 1 A			
	0.5 mm^2 (20 AWG)	3 m (9.8 ft)	15 m (49 ft)	35 m (115 ft)	500 m (1,640 ft)
	0.75 mm^2 (18 AWG)	3 m (9.8 ft)	25 m (82 ft)	60 m (197 ft)	500 m (1,640 ft)
	1 mm^2 (17 AWG)	3 m (9.8 ft)	30 m (98 ft)	70 m (230 ft)	500 m (1,640 ft)
	1.5 mm^2 (16 AWG)	3 m (9.8 ft)	50 m (164 ft)	120 m (394 ft)	500 m (1,640 ft)

Maximum Modbus cable lengths for a derivated distributed Modbus architecture *(see page 80)*:

24 Vdc rating	Cross-section of power supply pair	L0 (in 0.75 mm^2 (18 AWG) wires)	L1	L2	Sum of the L2s (for all power supply segments)	Sum of the L1s, L2s, and L3s (total length)
1 A	0.34 mm^2 (22 AWG)	5 m (16.4 ft)	20 m (66 ft)	10 m (33 ft)	40 m (131 ft)	500 m (1,640 ft)
	0.5 mm^2 (20 AWG)	5 m (16.4 ft)	35 m (115 ft)	10 m (33 ft)	40 m (131 ft)	500 m (1,640 ft)
3 A	0.34 mm^2 (22 AWG)	Cross-section not compatible with currents > 1 A				
	0.5 mm^2 (20 AWG)	3 m (9.8 ft)	10 m (33 ft)	5 m (16.4 ft)	40 m (131 ft)	500 m (1,640 ft)
	0.75 mm^2 (18 AWG)	3 m (9.8 ft)	15 m (49 ft)	10 m (33 ft)	40 m (131 ft)	500 m (1,640 ft)
	1 mm^2 (17 AWG)	3 m (9.8 ft)	20 m (66 ft)	10 m (33 ft)	40 m (131 ft)	500 m (1,640 ft)
	1.5 mm^2 (16 AWG)	3 m (9.8 ft)	40 m (131 ft)	10 m (33 ft)	40 m (131 ft)	500 m (1,640 ft)

ULP System Part Numbers

ULP System for PowerPact H-, J-, and L-Frame Circuit Breakers - Part Numbers

The following table lists the part numbers for the components of the ULP system for PowerPact H-, J-, and L-frame circuit breakers:

Product	Description	Part number
PowerPact H-, J-, and L-frame circuit breaker	–	Refer to *PowerPact H-, J-, or L-Frame Circuit Breaker Catalog*
NSX cord	L = 1.3 m (4.27 ft)	S434201
	L = 3 m (9.84 ft)	S434202
	L = 4.5 m (14.7 ft)	S434304
NSX cord for system voltage greater than 480 Vac	L = 1.3 m (4.27 ft), U > 480 Vac (cord with female socket)	S434204
	L = 3 m (9.84 ft). U > 480 Vac	S434303
	L = 4.5 m (14.7 ft), U > 480 Vac	S434305
Circuit breaker BCM ULP cord	L = 0.35 m (1.15 ft)	LV434195
	L = 1.3 m (4.26 ft)	LV434196
	L = 3 m (9.84 ft)	LV434197
BSCM circuit breaker status control module	–	S434205
NSX cord plus BSCM module	L = 1.3 m (4.27 ft)	S434201BS
	L = 3 m (9.84 ft)	S434202BS
	L = 4.5 m (14.7 ft)	S434304BS
NSX cord for system voltage greater than 480 Vac plus BSCM module	L = 1.3 m (4.27 ft), V > 480 Vac	S434204BS
	L = 3 m (9.84 ft), V > 480 Vac	S434303BS
	L = 4.5 m (14.7 ft), V > 480 Vac	S434305BS
Micrologic trip unit	–	Refer to *PowerPact H-, J-, and L-Frame Circuit Breakers Catalog*, *PowerPact P- and R-Frame Circuit Breakers Catalog*, *Masterpact NT/NW Circuit Breakers Catalog*
FDM121 ULP display for one circuit breaker	–	STRV00121
Surface-mounting accessory	–	TRV00128
IFM Modbus-SL interface for one circuit breaker	–	STRV00210
IFE Ethernet interface for one circuit breaker	–	LV434010
IFE Ethernet switchboard server	–	LV434011
IO input/output application module for one circuit breaker	–	LV434063
Stacking accessory	10 stacking accessories	TRV00217
Maintenance kit	UTA maintenance module, 24 Vdc external power supply unit, and associated cables	STRV00910
UTA maintenance module		STRV00911
UTA maintenance module power supply unit	–	TRV00915
Micrologic test cable	–	TRV00917
Bluetooth option	–	SVW3A8114

Product	Description	Part number
RSU software	–	LV4ST100
LTU software	–	LV4ST121
RJ45 male/male ULP cord	L = 0.3 m (0.98 ft) (10 cords)	TRV00803
	L = 0.6 m (1.97 ft) (10 cords)	TRV00806
	L = 1 m (3.28 ft) (5 cords)	TRV00810
	L = 2 m (6.56 ft) (5 cords)	TRV00820
	L = 3 m (9.8 ft) (5 cords)	TRV00830
	L = 5 m (16.4 ft) (1 cord)	TRV00850
RJ45 female/female connector	10 RJ45 female/female connectors	TRV00870
ULP line termination	10 ULP terminations	TRV00880
Modbus line termination	2 Modbus cable line terminations with impedance of 120 Ω + 1 nF	VW3A8306DRC
24 Vdc power supply	24/30 Vdc - 24 Vdc - 1 A - overvoltage category IV	685823
	48/60 Vdc - 24 Vdc - 1 A - overvoltage category IV	685824
	100/125 Vdc - 24 Vdc - 1 A - overvoltage category IV	685825
	110/130 Vac - 24 Vdc - 1 A - overvoltage category IV	685826
	200/240 Vac - 24 Vdc-1 A - overvoltage category IV	685827
	380/415 Vac - 24 Vdc - 1 A - overvoltage category IV	685829
	100/500 Vac - 24 Vdc - 3 A - overvoltage category II	ABL8RPS24030
Modbus cable	Belden: 7 mm (0.28 in) diameter shielded cable with two twisted-pairs	3084A
	Belden: 9.6 mm (0.38 in) diameter (recommended) shielded cable with two twisted-pairs	7895A
Shunt terminal block	4-channel spring terminal block (gray)	NSYTRR24D+NSYTRALV24
	4-channel protective ground terminal block (green/yellow)	AB1 RRNETP235U4
	Protective ground screw terminal block	NSYTRV22PE
	End plate	AB1 RRNACE244
	Clip-on plastic end stop	AB1 AB8R35
	Phoenix Contact: Pluggable connector MSTB 2.5/5-STF-5.08	1778014
	Phoenix Contact: Base unit on DIN rail UMSTBVK 2.5/5-GF-5.08	1787953
	Phoenix Contact: Optional cable cover for pluggable connector KGG-MSTB 2.5/5	1803895
ZSI Wire Harness H/J	ZSI OUT only	S434300
ZSI Wire Harness L	ZSI IN and ZSI OUT	S434301
ENVT Wire Harness	–	S434302

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