

RMU SCADA RTU Hardware Interface

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Nil.

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Document Control

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1. Documentation Scope

Three (3) Equipment Technical Specifications have been prepared for suppliers to deliver Endeavour Energy's functional and technical requirements for the SCADA connected Ring Main Units (RMU):

ETS 0114 - RMU SCADA RTU hardware interface outlines the requirements for the SCADA Remote Terminal Unit (RTU), the cubicle that houses the RTU, and cubicle plug interface.

ETS 0115 - RMU SCADA switchgear interface outlines the requirements for the switchgear interface and the cable between the switchgear and RTU.

ETS 0116 - Field device SCADA requirements outlines the RTU communications and general requirements necessary to integrate with the Endeavour Energy SCADA system.

The split of responsibilities between these documents is visualised below:

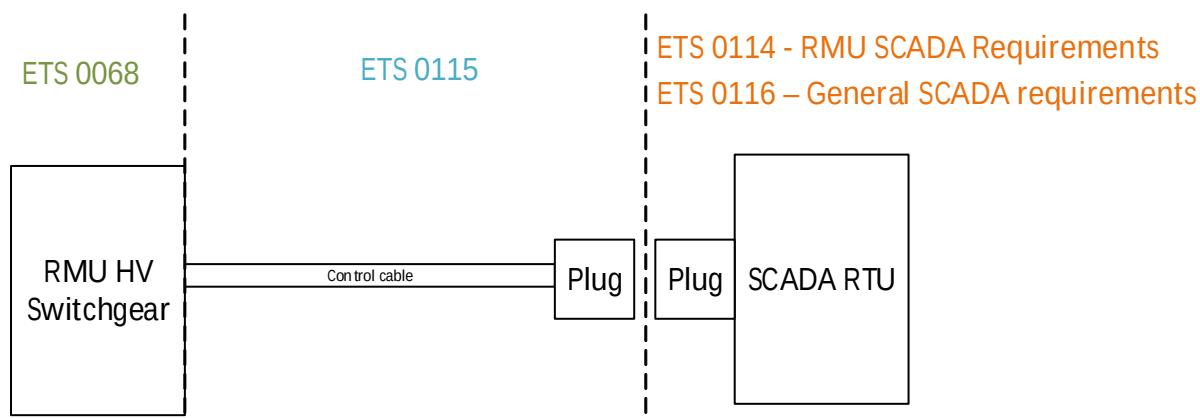


Figure 1: Split of responsibilities between RMU ETS documents.

Non-SCADA requirements for HV Switchgear can be found in *ETS 0068 - Distribution indoor and pad-mount substation 12-24kV switchgear*.

2. References

External Regulations	
Electricity Supply Act 1995 (NSW)	
Work Health and Safety Act 2011	
Work Health and Safety Regulation 2017 (NSW)	

External Standards		
Standard No.	Year	Title
AS/NZS 3000	2023	Electrical Installations
AS 60529	2004	Degrees of protection provided by enclosures (IP Code)
AS 62271.201	2019	High voltage switchgear and control gear Part 201: AC insulation-enclosed switchgear and control gear for rated

		voltages above 1kV and up to and including 52kV.
ENA Doc 01	2019	ENA National Electricity Network Safety Code

Company Policies and Procedures

Company Policy (Network) 9.2.1 – Network Planning
Company Policy (Network) 9.2.2 – Network Protection
Company Policy (Network) 9.2.5 – Network Asset Design
Company Policy (Network) 9.7.1 – Network Asset Construction
Company Policy (Network) 9.8.3 – Network Operations
Company Policy (Network) 9.9.1 – Network Asset Maintenance

Company Standards

ETS 0115 – RMU SCADA switchgear interface	ETS 0116 – Field device SCADA requirements
SDI 526 – Design of Substation Secondary Systems	

3. Definitions and Abbreviations

Term	Definition
CT	Current Transformer
DNP3	Distribution Network Protocol 3
I/O	Input/Output
M	Mandatory requirement
NTP	Network Time Protocol
P	Preferred requirement
RCBO	Residual Current Circuit Breaker
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SEF	Sensitive Earth Fault

4. Actions

4.1 General requirements

The requirements detailed in this document are in addition to those specified in Endeavour Energy Technical Specification ETS 0116 – Field Device SCADA requirements.

4.2 Cubicle Requirements

The cubicle must have space for the RTU, auxiliary supply and network equipment (4G modem or other ethernet devices).

There are four variants of RTU options which need to be catered for:

1. Single motor-controlled switch
2. Two motor-controlled switches
3. Three motor-controlled switches
4. Four motor-controlled switches

There are two (2) enclosure category types specified in this document:

- **ABB Safelink installation** – Preferred installation at the HV side of a pad-mount substation cubicle.
- **Other installations** – Preferred installation at the LV side of a pad-mount substation cubicle.

Table 1 - Cubicle Requirements

Component	Requirement
Material	304 Stainless steel or equivalent with 1.5mm thickness. The enclosure shall be powder coated for an additional degree of protection.
Size Restrictions	The RTU and associated components shall be suitable for both ABB Safelink and other installations. ABB Safelink installation: H: 380mm, W: 600mm, D: 210mm (depth inclusive of 30mm door) <i>This is the <u>maximum</u> size allowed due to space limitations in existing pad-mount substations.</i> Other installations: H: 800mm, W: 350mm, D: 280mm (depth inclusive of 30mm door) <i>This size is to be used as a guide only, and different arrangements will be considered.</i>
Door	ABB Safelink installation: The door hinges shall be located on the bottom side of the enclosure, as the door opens from top to bottom. The door does not need to be removable. Other installations: The door hinges shall be located on the right-hand side of the enclosure (Door opens from left to right). The door shall be removable, that is it can be lifted off from the enclosure for increased accessibility to the enclosure internals.
Earthing	An M12 stud, complete with nut, locking nut and washer, must be provided on the cubicle for the termination of an earth.

Component	Requirement
	ABB Safelink installation: The door of the cubicle must have an earth strap installed to bond the door to the main control cubicle. Other installations: The door of the cubicle must have an earth strap installed to bond the door to the main control cubicle. The earth strap must be coiled and at least 1m in length to allow for the removal of the door.
	IP 55 or better.
Degree of protection	Consideration must be given if battery is rated for use in a sealed cubicle. The enclosure must provide adequate thermal conditions for the RTU. Ventilation and cooling systems will be considered if required, but consideration must be given to ants, pests, and vermin.
Internal Degree of protection	The required degree of protection within the cubicle is IP2X or IP1XB to prevent contact with live Exposed conductive parts greater than 50Vac or 120Vdc with a standard finger as specified in AS/NZS 3000. Exposed conductive parts as defined in AS/NZS 3000:2018 - clause 1.4.62 Exposed Conductive part.
Cabling Requirements	All cubicle AC, DC and control wiring must be coloured and labelled in accordance with Endeavour Energy standard SDI 526. All AC electrical wiring must be completed in accordance with AS/NZS 3000 Electrical Wiring rules. The cubicle shall provide cable ducts and covers for internal wiring.
Radio/Modem Provision	The cubicle must have sufficient room to allow mounting of an Endeavour Energy nominated Modem: - Minimum space required: 180 x 150 x 70 mm. The cubicles must be fitted with a dedicated radio mounting tray or DIN rail. If a tray is utilised, it is desirable for the tray to be easily removable to allow installation of the radio outside the cubicle. Adequate room must be left surrounding the radio mounting location as to allow for the connection of power, ethernet and antennas. Provide at least 100mm from the front communication terminals of the radio to allow for removal of connections.
AC Supply	The cubicle must include an RCBO for all AC supply inputs as per the following requirements: • <i>Double Pole</i> • <i>Rated Voltage – 240 V</i> • <i>Rated Input Current – 25 A</i> • <i>Earth-Leakage – 30 mA</i> • <i>Curve Code – C</i>
DC Auxiliary and Battery supply	The cubicle shall provide power for communication equipment as described in ETS 0116. The cubicle shall provide 24Vdc auxiliary supply to the RMU primary equipment. The cubicle shall provide for easy replacement of the battery.

Component	Requirement
	The battery shall provide for standalone supply to the RTU, radio and switchgear for at least 16 hours. The battery shall be securely mounted to ensure that during handling and transport to site no movement occurs.
Mounting Options	ABB Safelink installation: Cubicle is not mounted and is instead placed on a secure plinth within the RMU pad mount installation. Other installations: No strict requirements, all mounting options will be considered.
Cable Penetrations	Cable routes inside the cubicle shall be carefully considered to accommodate and maintain suitable cable bending radiuses. Cable glands shall ensure multiple 7.9mm SMA connectors can be routed through while maintaining the stated IP rating. Any unused holes must be suitably blanked off (if applicable), ensuring the IP requirements are maintained.
Locking	The door of the cubicle must be fitted with a robust fastening arrangement that is capable of being secured by a padlock with a shackle of 8mm diameter.

4.3 Communications Provisions

The Endeavour Energy Telecommunications team will approve an appropriate radio and antenna for RMU installations. The RTU solution needs to accommodate the following:

- Power for communication equipment as described in ETS 0116.
- 2 din-rail mounted 24Vdc terminals which are connected to the telecom power supply for Endeavour Energy to terminate the radio supply to. DC Terminals must be adequately labelled.
- Communications equipment shall be earthed as per manufacturer specifications. Devices shall have access to a chassis earth stud or earth bar.
- CAT 5E (or better) ethernet lead from the RTU to the radio mount shall be provided ready for connection. The cable shall be of adequate length to allow for ease of installation.

4.4 RTU to RMU Interface

4.4.1 Plug Pinout Requirements

The RTU-RMU interface shall be via a cable loom which is terminated to a 24-pin Phoenix Contact Heavycon Plug per switch. The plugs shall be located on the side of the RTU enclosure that is deemed suitable for the targeted switchgear installation.

Switch 1 requires the following items to be terminated between the female Heavycon plug insert and RTU I/O:

- “General Status + Motor Supply”
- Switch 1 “Indications”
- Switch 1 “Controls”

- Switch 1 “CT”

All subsequent switches require the following items to be terminated between the female Heavycon plug insert and RTU I/O:

- Switch n “Indications”
- Switch n “Controls”
- Switch n “CT”

Refer to Table 2 for a detailed pinout configuration for each switch Heavycon plug. The table does not account for additional wiring requirements internal to the enclosure required for the supplied RTU to function, for example, the RTU module connectivity or power supply.

For reference Endeavour Energy's current solution pinout can be found in Annexure 1.

The Supplier shall provide a complete wiring diagram for approval. The supplier shall provide a prototype test unit prior to commencing bulk construction to ensure compatibility with existing switchgear configurations.

Table 2 – Plug Pin Out

Category	Pin	Pin Size	Plug 1	Plug 'n'
Control	1	0.75mm ²	Remote control common +24Vdc	Remote control common +24Vdc
	2	0.75mm ²	Remote open	Remote open
	3	0.75mm ²	Remote close	Remote close
Indication	4	0.75mm ²	Switch open	Switch open
	5	0.75mm ²	Switch closed	Switch closed
	6	0.75mm ²	Indication common	Indication common
	7	0.75mm ²	Earth Switch (open indication)	Earth Switch (open indication)
	8	0.75mm ²	Earth Switch (close indication)	Earth Switch (close indication)
	9	0.75mm ²	Cable box cover removed	Cable box cover removed
Spare	10		<i>spare</i>	<i>spare</i>
General Status + Motor Supply	11	1.5mm ²	Motor supply +24Vdc	<i>Not used</i>
	12	0.75mm ²	Low gas	<i>Not used</i>
	13	0.75mm ²	Local/Remote	<i>Not used</i>
	14	1.5mm ²	Motor supply 0V	<i>Not used</i>
	15	0.75mm ²	Low gas lockout	<i>Not used</i>
Spare	16		<i>spare</i>	<i>spare</i>
	17		<i>spare</i>	<i>spare</i>
	18		<i>spare</i>	<i>spare</i>
	19		<i>spare</i>	<i>spare</i>
	20		<i>spare</i>	<i>spare</i>

CT	21	1.5mm ²	L1	L1
	22	1.5mm ²	L2	L2
	23	1.5mm ²	L3	L3
	24	1.5mm ²	Star point	Star point

4.4.2 RTU to RMU Interface Part Numbers

Refer to Table 3 for the required compatible Phoenix Contact HeavyCon part numbers for the RTU to RMU interface. The listed parts are to be acquired by the supplier.

Table 3 - Phoenix Contact HeavyCon Part Numbers

Description	Manufacturers Part Number
Female insert 24 way	1584046
Mounting base	1411319
Coding pin	1676857
Coding socket	1676860
Female pin 0.75mm ²	1672440
Female pin 1.5mm ²	1674930

4.4.3 Plug Coding

Each plug will be coded to ensure that each motorised switch cable cannot be plug into the incorrect socket. Phoenix Contact coding conventions are below in Figure 3.

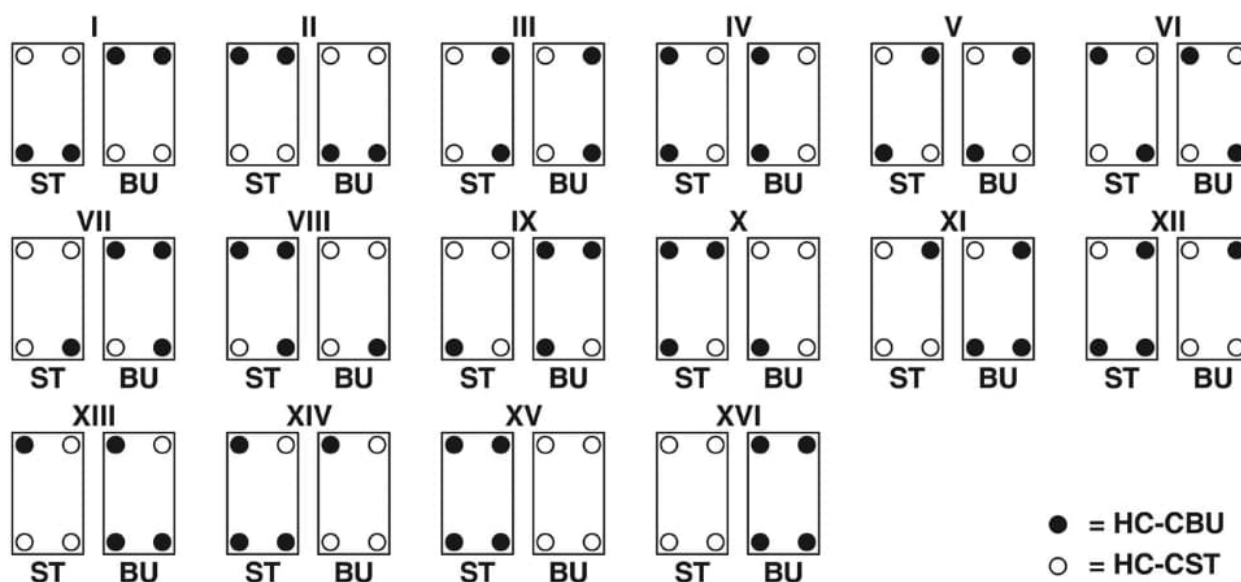


Figure 2: Phoenix Contact Heavycon Plug coding.

The coding for each plug shall for the RMU to receive switch cables 1 to 4 is given in Table 4.

Table 4 - Switch Plug Coding

Plug Number	Coding (Phoenix Contact Convention)	Diagram
Switch 1 ¹ (Including general inputs)	I – BU	
Switch 2 ¹	II – BU	
Switch 3 ¹	III – BU	
Switch 4 ¹	IV – BU	

¹Switch numbering only includes motorised SCADA operable switches. Plugs are not allocated to non-motorised switches. Switch number is from left to right.

4.5 Additional Requirements

The supplier will confirm all internal wiring prior to first construction, however additional requirements are specified below:

Control Common

All 0 V indication common connections on the RTU and associated modules will be wired to a common terminal block.

The Control Common for all associated inputs and outputs will be wired to the +24 V connection.

Module Communications Devices

Internal modular equipment (for example, switch controllers, battery chargers, power supplies etc) that require a communications interface to the main RTU shall be preconfigured by the manufacturer. Communications addressing and device configuration must be consistent between all RTUs. This is required as to ensure compatibility between all RMUs and maintain consistent base configuration files.

Residual Current Measurements

To achieve residual current measurements, a Holmgreen connection of the three (3) single phase CT connections shall be utilised. The implementation of this on the RTU shall be incorporated and tested by the supplier.

4.6 Cubicle Labelling Requirements

The following items list in Table 5 shall be labelled and affixed by the supplier. All labels shall be of Traffolyte style material and engraved. Alternative label materials designed for long life and high temperature environments may be used after approval from Endeavor Energy.

Direct Thermal labels / tape shall not be used.

Table 5 - Required Cubicle Labels

Text	Location	Label Background / Text Colour	Description
SCADA Cubicle	Cubicle door (Centre Top)	White / Black	
Switch 1	Above Switch 1 HeavyCon Plug	White / Black	
Switch 2	Above Switch 2 HeavyCon Plug	White / Black	
Switch 3	Above Switch 3 HeavyCon Plug	White / Black	
Switch 4	Above Switch 4 HeavyCon Plug	White / Black	
Switch 5	Above Switch 5 HeavyCon Plug	White / Black	
Switch 6	Above Switch 6 HeavyCon Plug	White / Black	
Cubicle Weight 'X' – Two Man Lift Required	Top of cubicle	White / Black	Where 'X' is the measured cubicle weight
Warning – Short CT links via switchgear prior to disconnecting switch cables	Cubicle Door (Bottom Right / Near switch plugs)	Red / White	

4.7 Manual Handling Requirements (ABB Safelink installations only)

The RTU enclosure will be required to be moved throughout the life of the RTU for various operating and maintenance purposes. Due to the weight of the RTU enclosure, 2 lifting handles will be required on the top of the enclosure to mitigate any manual handling risks by allowing for a 2-person lift. The handles must be rated to lift at least 30kg (evenly distributed) and should not introduce more than 100mm to the height of the RTU enclosure.

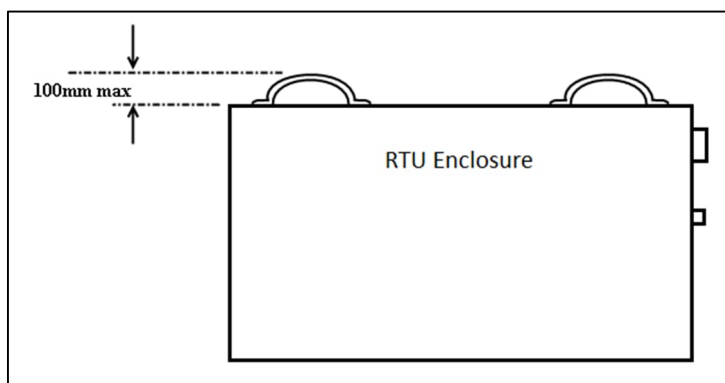


Figure 3: RTU enclosure for ABB Safelink installations

5. SCADA Requirements

5.1 RTU Local and Remote Status and Control

The RTU must include a two-position local/remote switch on the front of the control panel. The local / remote switch shall restrict the ability to perform operations on the RTU based on its respective state.

Remote Mode

Controls originating from the SCADA control cubicle are passed through to the motorised switches. Local operation of each switch shall still be available for manual switching purposes.

Local Mode

In this mode, a local operator can initiate a control on the device and change configuration parameters. Only monitoring functions are available to remote operators, all SCADA controls are blocked. Remote operations via available external management interfaces are permitted in this mod, for example, by Web HMI or configuration software.

Combined Local / Remote Indication

The RTU shall also be capable of providing a combined Local / Remote status point that represents the local / remote state of both the RTU and switchgear as per Table 6.

Table 6 - Remote local reporting

Device State		Telemetered Status
Switchgear local	RTU local	Local
Switchgear remote	RTU local	Local
Switchgear local	RTU remote	Local
Switchgear remote	RTU remote	Remote

5.2 Indicators and Alarms

All indicators, status signals and alarms shall be of self-resetting type, for example, on a successful close operation of the switch the protection flags and fault currents reset.

Indicators must clear or reset once the triggering condition has cleared.

Descriptions for all status points, analogue measurements and controls shall be provided by the supplier in the device documentation.

5.3 Device Health and General Alarms

The supplier will provide further details on all available general alarms and health status points, including trigger conditions.

The RTU shall not raise a device health indication or general alarm under normal operation of the equipment. Device health and general alarm indicators must clear once the triggering condition has cleared.

5.4 Fault Detection and Protection Indication Parameters

All fault detection and protection related parameters must be stored locally and persist after device resets or power cycles. Configured parameters must be made programmable via the same software application that is used to configure general RTU related settings.

The following parameters are required per protection element:

- Enable / Disable
- Operating Curve Type
- Threshold Value (A)
- Operate Delay Time
- Reset Delay Time
- Inrush Filter Enable / Disable

Inrush Filtering

The RTU shall provide adequate functionality to mitigate false protection operations and indications due to switching or network energisation. This is a mandatory requirement to ensure false indications are not transmitted to the Endeavour Energy control room, which could inadvertently trigger centralised automation schemes.

The supplier shall provide information on their devices inrush filtering capabilities and implemented filtering mechanism. Possible filtering methods (but not limited to) are listed below:

- Current Multiplier (preferred)
- 2nd Harmonic

5.5 Minimum Control Requirements

The supplier will provide a list of all supported controls. A list of mandatory controls is given below in Table 7.

Table 7 – Minimum control requirements for pad-mount switchgear

Control origin	Features	Remarks
Local	Set local/remote	
	Open switch	
	Close switch	
	Enable/Disable automation	If automation available
Remote	Open switch	
	Close switch	
	Enable/Disable automation	If automation available

5.6 Minimum indication requirements

The supplier will provide a list of all supported remote/local indication as per Table 8.

Table 8 – Minimum Indication requirements for pad-mount switchgear

Requirements	Remarks	Requirement
Switch status	Open/Closed	M
Earth switch status	Open/Closed	M
Current	RMS phase currents	M
General alarms	- RTU status - Battery status - Charger status - Supply status	M ¹
Low gas	Low gas and / or low gas lockout (if applicable)	M
Fault detection	Minimum requirements include: - Overcurrent (individual phase) - Overcurrent (grouped) - Earth/Ground overcurrent - SEF overcurrent - SEF start / pickup	M ²
Operations Counter	Operations count per switch	P
Time Sync Status	State of NTP or DNP3 time sync	P
General I/O	Status or value or all available analogue and digital inputs.	M
Custom Logic Points	User configured custom logic variables	P

¹Supplier to provide further details on all available general alarms.

²Supplier to provide further details on protection indicator/pick up settings.

6. Responsibilities

Head of System Operations has the authority and responsibility for:

- Approving this standard.

Secondary Systems Manager has the authority and responsibility for:

- Keeping the contents of this specification up to date.
- Making recommendations concerning compliance in respect to this specification.
- Evaluate and approve submissions from suppliers.

Telecommunications Manager has the authority and responsibility for:

- Approve an appropriate radio and antenna suitable for RMU installations.

Annexure 1: Example pin-out for RTU

Table 1A: 11kV Transformers

Category	Pinout	Pin Size	Plug 1	Plug 'n'	T300 Pinout 1	T300 Pinout n
Control	1	0.75mm ²	Remote control common (24V)	Remote control common (24V)	PS50 (24V)	PS50 (24V)
	2	0.75mm ²	Remote open	Remote open	SC150:1-Port4:3	SC150:n-Port4:3
	3	0.75mm ²	Remote close	Remote close	SC150:1-Port4:2	SC150:n-Port4:2
Indication	4	0.75mm ²	Switch open	Switch open	SC150:1-Port2:1	SC150:n-Port2:1
	5	0.75mm ²	Switch closed	Switch closed	SC150:1-Port2:2	SC150:n-Port2:2
	6	0.75mm ²	Indication common (0V)	Indication common (0V)	Common terminal	Common Terminal
	7	0.75mm ²	Switch earthed (open indication)	Switch earthed (open indication)	SC150:1-Port2:3	SC150:n-Port2:3
	8	0.75mm ²	Switch earthed (close indication)	Switch earthed (close indication)	SC150:1-Port2:4	SC150:n-Port2:4
	9	0.75mm ²	Cable box cover removed	Cable box cover removed	SC150:1-Port2:8	SC150:n-Port2:8
	10		spare	spare		
General Status + Motor Supply	11	1.5mm ²	Motor supply +24Vdc	Not used	PS50 24V +ve	
	12	0.75mm ²	Low gas	Not used	HU250-Port10:DI1:2	
	13	0.75mm ²	Local/Remote	Not used	HU250-Port10:DI2:6	
	14	1.5mm ²	Motor supply 0V	Not used	PS50 0v	
	15	0.75mm ²	Low gas lockout	Not used	HU250-Port10:D1:3	
	16		spare	spare		
	17		spare	spare		
	18		spare	spare		
	19		spare	spare		
	20		spare	spare		
CT	21	1.5mm ²	L1	L1	SC150:1-Port3:1 (Red)	SC150:n-Port3:1 (Red)
	22	1.5mm ²	L2	L2	SC150:1-Port3:2 (White)	SC150:n-Port3:2 (White)
	23	1.5mm ²	L3	L3	SC150:1-Port3:3 (Blue)	SC150:n-Port3:3 (Blue)
	24	1.5mm ²	Star point (Holmgren)	Star point (Holmgren)	SC150:1-Port3:6 (Black)	SC150:n-Port3:6 (Black)

