Protrol
PART OF ENSTO GROUP

Installation and Commissioning IPC402x

This installation and commissioning instruction describes the deployment of a typical control cabinet for IPC4020, IPC4022 and IPC4020exp with cable current transformers.

INSTALLATION INSTRUCTION

Contents

1 Overview

There are many types of control cabinets with Protrols fault detectors since the IPC402x products can be integrated by manufacturers of secondary substations. This instruction describes the following standard cabinet for the examples and terminal designations.

- Standard cabinet ST-2019-01 LO – fault detector IPC4020 for one line (Figure 1)

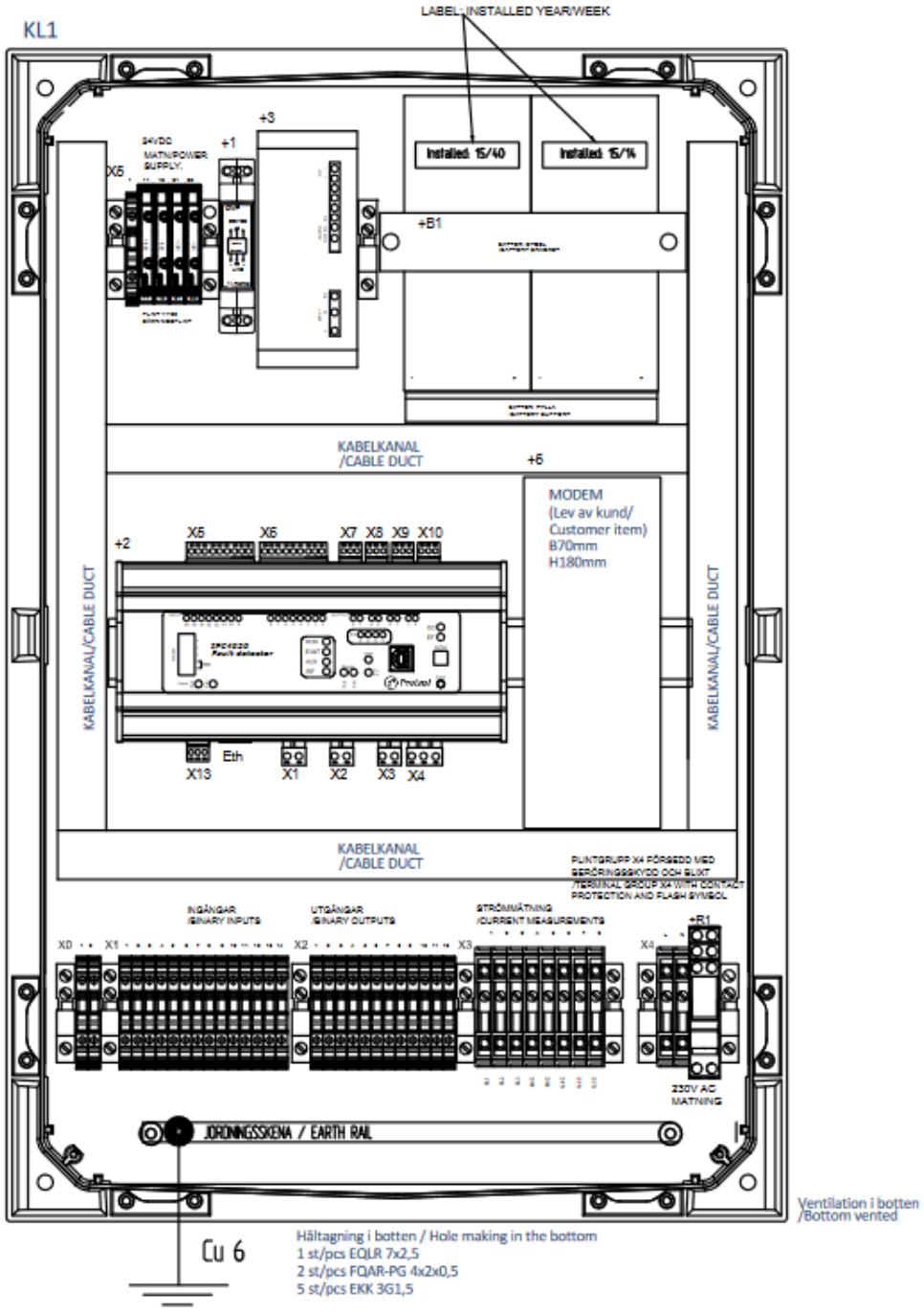

Figure 1: Control Cabinet ST-2019-01 LO with IPC4020 fault detector.

Apparatus list

1. Over voltage protection – for RS485 two-wire communication
2. Fault detector and remote terminal unit, RTU
3. Battery charger
4. Local/Remote switch (located on door)
5. Space for modem, if applicable

B1. 24 V Batteries

R1. Zero voltage relay, 230 VAC

The control cabinets are routine tested when supplied. There are lugs for wall mounting enclosed.

All references to markings of terminal blocks in this instruction are for control cabinet ST-2019-01 LO. If a different cabinet is installed, be aware that the markings may be different.

2 Safety Information

Only certified electricians are allowed to perform installation work.

National and local security guidelines must be followed.

Always short circuit the secondary conductors of the current transformers during maintenance or testing.

Always open terminal blocks for binary outputs during maintenance and testing, unless operating of primary equipment is desired.

If the secondary circuit of the CT's are opened or if their earthing point is missing or removed while the primary side is energized, high voltages can be generated. In worst case these voltages can be deadly and damage isolation material. Energization of the CT's primary side is not permitted as long as the secondary side is open or not earthed.

Dangerous voltages can be present on the terminals, also when power is removed from the device.

Violation against the security guidelines can lead to fatalities, personal injury or considerable damage to equipment.

Avoid removing the cover of the IPC402x devices. If it is removed, ensure that all electronic components are protected against electrostatic discharge, ESD, by proper earthing of both the device and the personnel performing maintenance.

All references to markings of terminal blocks in this instruction are for control cabinet ST-2019-01 LO. If a different cabinet is installed, be aware that the markings may be different.

3 Connecting External Wires

3.1 Supply Voltage – 230 VAC

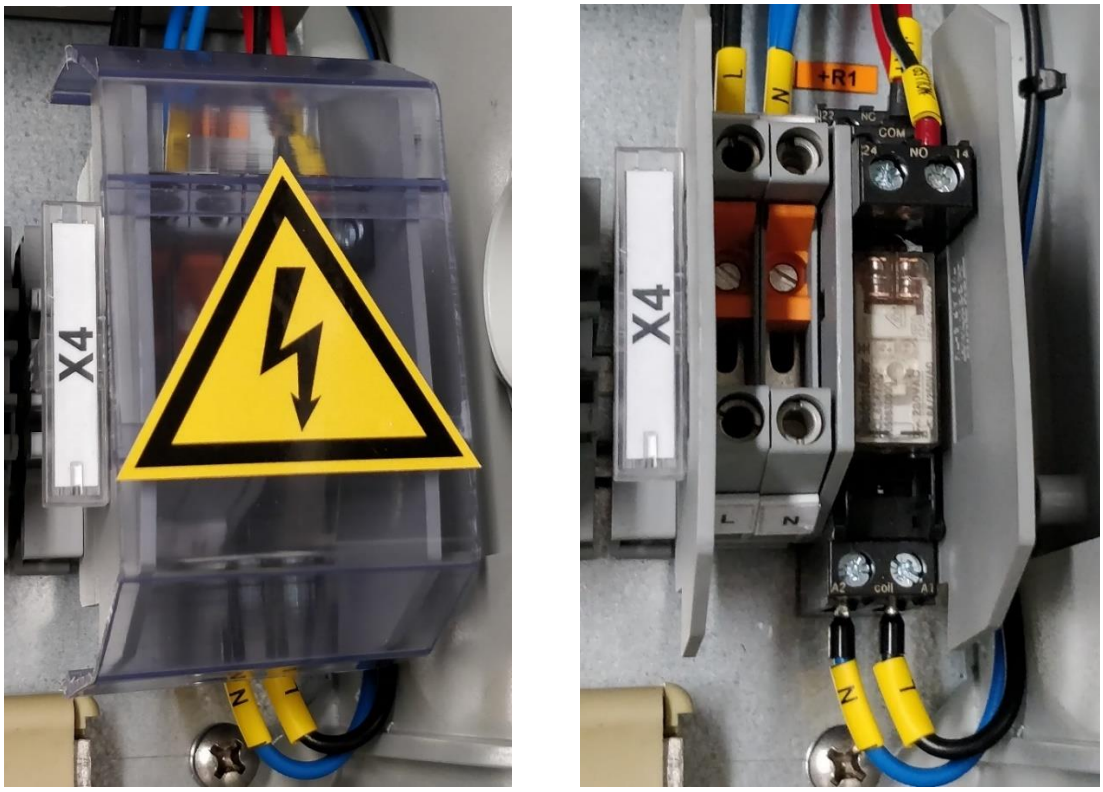

Figure 2: Terminal blocks for incoming supply voltage, 230 VAC, are found beneath the touch protection.

- When the cabinet is supplied, 24 VDC is not connected to the batteries. Connect the minus cable to the minus terminal of the batteries.
- Remove the touch protection that covers terminal group X4.
- Verify that the supply cable is not energized.
- Open terminal blocks X4.1 and X4.2 if they are closed.
- Connect phase (L) to the lower side of X4.1 and neutral (N) to the lower side of X4.2.
- Yellow/green earthing wire is connected to the earthing bar.
- Energize the cable that is connected to the lower side of terminal group X4 and verify the voltage and polarity.
- Close the terminal block X4.2 (N) and continue with X4.1 (L).
- Verify that the battery charger starts and that the output is approximately 27.6 VDC.
- Verify that IPC402x starts up. The PWR LED should light up immediately (Figure 3). After a few seconds the RUN diode shall flash with 0.5 Hz frequency. If not, check that the fuses for 24 VDC at group X5 are mounted and not broken.
- The supervision relay R1 shall become activate.

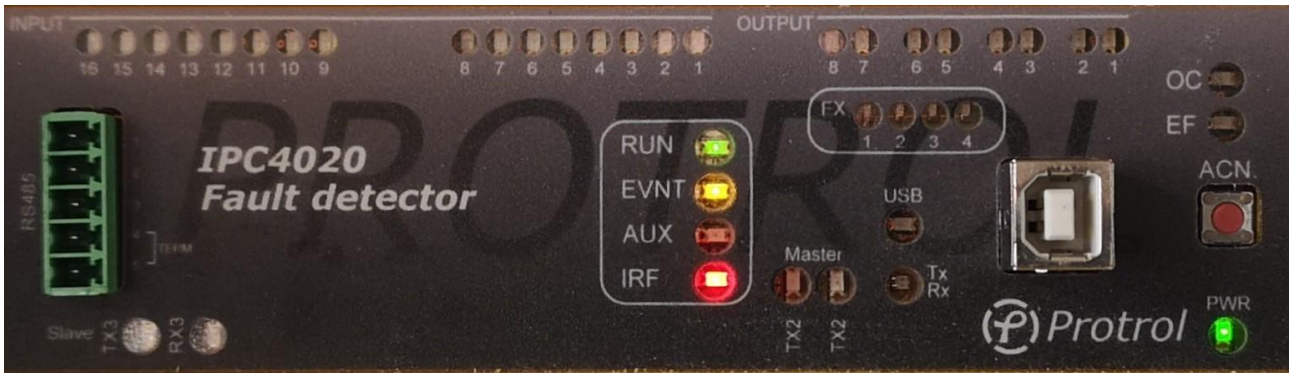

Figure 3: IPC4020 – front panel.

3.2 RS485 – Remote Control Interface

- Open terminal blocks X0.1 and X0.2.
- Connect a two-wire signal cable for RS485 to the lower side of X0.1 and X0.2.
- The last device must be terminated if there are several IPC402x, or other devices, on the same RS485 signal wire. Terminate RS485 at IPC402x by short-circuiting inputs 4 and 5 of the X11 contact located on the front panel of the IPC.
- Close terminal blocks X0.1 and X0.2.
- When communication is expected to be active, check that the Slave RX LED on the IPC402x front panel flashes. If the TX LED does not flash, the settings for the communication port and link address needs to be verified. If communication settings are correct, but it still is not possible to communicate with the IPC device, the cable parts connected to X0.1 and X0.2 might be swapped.

3.3 Connecting Split Core Current Transformers

Standard control cabinets are not supplied with current transformers, but there are several types that can be ordered separately.

The current transformer is labelled P1 and P2. The current transformer shall be mounted with P2 towards the object (the line) and P1 towards the busbar, see Figure 5. It is also possible to mount ALL the current transformers in the opposite direction, if such a configuration is desired.

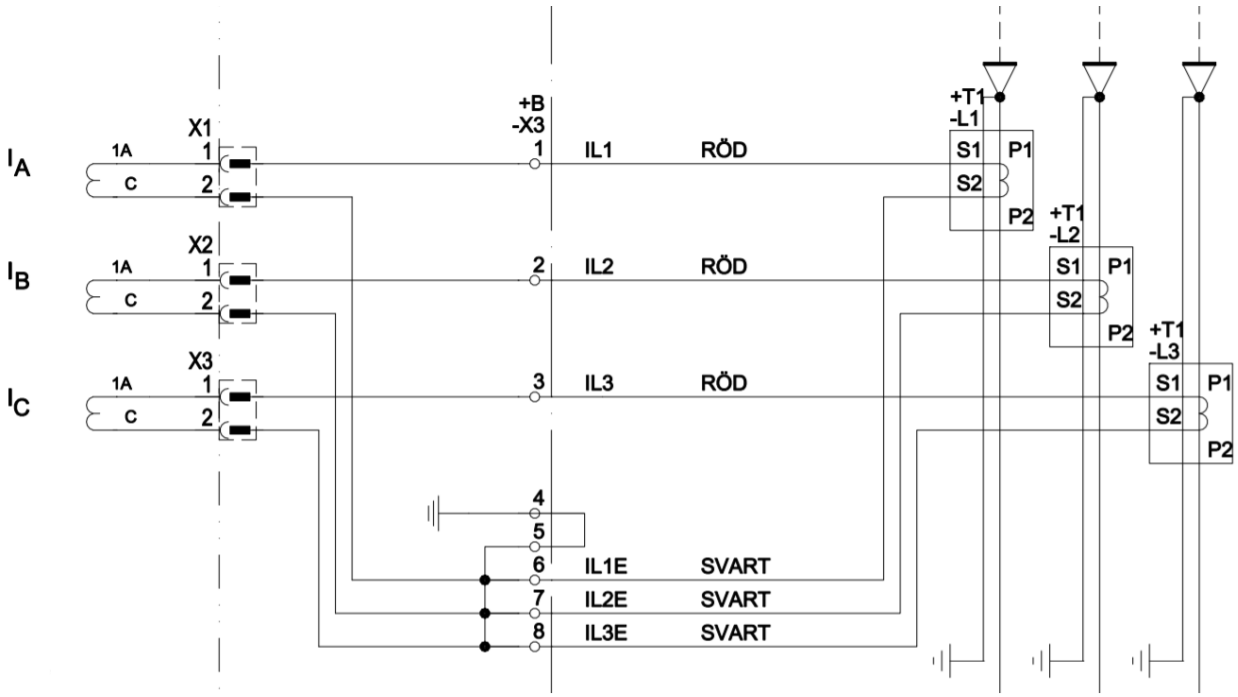

Figure 4: Connecting current transformers to the terminal blocks (RÖD = RED, SVART = BLACK).

We recommend applying a thin layer of the rust-preventive solvent-free product Noxudol 700 on the visible iron core ends before they are mounted together. The treatment will not affect the magnetic or electric properties of the current transformers. If Noxudol is not available, an alternative is CRC 5-56.

The secondary current leads from each current transformer should be kept tightly together to minimize the risk of being affected by mutual inductance that can cause measurement errors. It is of great importance that the secondary leads from each bay are positioned on a distance from those of the other bays.

Split Core Current Transformer with Quick Lock

The current transformer is of split core type in a durable plastic casing. The detachable part can be removed without tools so that the main unit can be fixed around the cable. When the main part is in position, the detachable yoke can be snapped into position again.

Figure 5: Split core current transformer with quick lock for measuring current in a cable part.

Casted with Shielded Secondary Cable

The current transformer is of split ring core type and can be assembled on medium voltage cable without any tools.

The secondary cables from each current transformer are shielded. Still, it is recommended that the secondary cables from each bay are placed on a distance from those of other bays.

The rating sticker specifies which of the parts that represent S1 and S2. Red part represents S1, black S2. Performance is not affected if the polarity is reversed for all current transformers in the bay.

Figure 6: Split core current transformer with shielded cable measuring current in a cable part.

Split Core Taped Current Transformer

This current transformer is a split ring core unit that is screwed together using a hose clamp. When delivered, the detachable part has tape across the split. It must be removed before splitting the two parts. The hose clamp must be fully unscrewed to allow the main part of the current transformer to be mounted on the cable part.

Figure 7: Split core current transformer of ring type with hose clamp for measuring current in a cable part.

The substation can be either non-energized or energized when installing the current transformers:

- Non-energized – The power cables are disconnected and earthed, and no current can pass in the high voltage cables.
- Energized – The power cables are energized and current may flow through them.

Alternative 1 – install current transformers in a non-energised substation

1. The current transformer must be located on a fully insulated cable part. If the current transformer by special reasons must be installed on the semiconducting layer, then the earth shield **shall** be inserted through the current transformer and then led back again to the earthing bar to ensure that the transformer is at ground potential.
2. The shield current shall not be measured by the fault detector. This is the reason why they earth shield is led back through the transformer; any shield current will be cancelled (Figure 8).
3. Make sure that the current transformers are fixed. They should not be loosely attached to the power cable. If needed, use electric tape on the cable to make it thicker.
4. Connect the secondary leads of the current transformers to the lower side of terminal group X3 according to the circuit diagram, see Figure 4 for an example.
5. Check the earthing of the secondary circuit of the current transformers to make sure that each current transformer is correctly connected to station ground and only at one electric point.

6. Verify the resistance in the secondary circuit by opening a terminal block in the current circuit and measure across the CT. The resistance should be < 1.5 Ohm at ratio 150/1, < 2.5 Ohm at ratio 300/1.
7. Make a primary current injection to verify the ratio, the wiring from current transformer to the IPC402x, and the phase sequence. The IPC402x has an integrated transient fault recording function that can be used to visualize the amplitude and sequence of the phases.
8. Perform a polarity check to verify the direction of the secondary current with respect to the primary current. As a minimum, verify the phase sequence and identical polarity for all phases. This is important for a correct detection of earth faults.
9. Close the current terminal blocks if not done before.

Figure 8: Left – wrong – the earth shield returns OUTSIDE the current transformers.
Right – correct – the earth shield returns INSIDE the current transformers.

Alternative 2 – install current transformers in an energised substation

It is of great importance that the actions are performed in the listed order.

1. Prepare the medium voltage bay for work in the presence of high voltage according to national regulations and guidelines.
2. Connect the secondary leads of the current transformers to the lower side of terminal group X3 according to the circuit diagram, see Figure 4 for an example.
3. Verify the resistance in the secondary circuit by opening a terminal block in the current circuit and measure across the CT. The resistance should be < 1.5 Ohm at ratio 150/1, < 2.5 Ohm at ratio 300/1.
4. Short-circuit the secondary current leads using short-circuit plugs or similar on the lower side of the current terminal group X3 and open the current terminal blocks so that no current reaches the IPC4020.
5. Install the split core current transformers as described in the first three steps described in Alternative 1 above. Verify the earthing according to step 5.
6. Close the current terminal blocks so that the secondary current can pass the current inputs of the IPC402x.
7. Remove the short-circuit plugs.
8. Check that there is no sound from the current transformers.
9. Remove any protective shields for high voltage.
10. Use the integrated transient fault recording function to verify the polarity for all phase currents. This is important for a correct detection of earth faults.

3.4 Connecting Binary Signals

- Open all terminal blocks at the X1 and X2 groups.
- Verify all binary inputs and outputs at the lower side of the terminal blocks.
- Verify all signals to the terminal blocks, both with respect to signal level and polarity.
- Close all terminal blocks at the X1 and X2 groups. The LED at each input is switched on for all active inputs. Do NOT use AC voltage. Only DC voltage is used for binary inputs.

4 Commissioning

A current transformer with wrong polarity or a missing phase signal results in a large zero-sequence current. To help identify if this is the case, it is strongly recommended to use the IPC4020 web interface. On the tab Station Manager, it is possible to verify the phase and zero-sequence currents. Also, the fault detectors are supplied with the non-directional earth fault function activated. If there is a problem with one or two phase currents, the EF and EX4 LEDs will signal that there is an earth fault. It is recommended that the non-directional earth fault stage is disabled or temporarily enabled only when the circuit breaker is closed.

A detailed commissioning instruction is found in the manual for the fault detector products [1], together with detailed information about function and configuration.

5 References

[1] *IPC402x_manual_xxyy_en.pdf*

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