RTN/001/500/630/1527 – Nortroll CableTroll 2350NPg Fault Passage Indicator (FPI) Installation and Commissioning Procedure

1. Purpose

This document details the installation, testing and commissioning procedures for the Nortroll 2350NPg fault passage indicator (FPI). These tests shall be completed before the FPI can be accepted as fit for service. This Procedure shall be carried out in accordance with the Northern Powergrid OPM and DSR's by a competent and suitably authorised person and the results recorded on the associated test documentation.

This document supersedes the following documents, all copies of which should be destroyed.

Ref.	Version	Date	Title
RTN/001/500/630/1527	1.0	June 2016	Nortroll CableTroll 2350NPg Fault Passage Indicator

2. Scope

This document applies to all Northern Powergrid staff and approved contractors working on the Northern Powergrid distribution network.

The document provides guidance on the expected procedure for installing, commissioning and asset recording of the Cabletroll 2350NPg Ground mounted FPI.

2.1. Contents

General

The CableTroll 2350NPg (Figure 3.1) is a battery or external DC supply powered fault passage indicator (FPI) capable of detecting both overcurrent and earth faults on underground cable networks operating at voltages up to 36kV. It can be used with three FPI phase CTs which are usually fitted as standard on modern RMU's; or where not available, a 60/1 core-balance CT can be used. This will only provide an earth fault indication. The CableTroll 2350NPg can be used to replace any fault passage indicators and earth fault indicators.

Due to some early development work, an initial quantity of 200 units was manufactured that have fewer configuration options than subsequent units. These are identified by a different internal label as shown in Figure 3.4.2 and 3.4.3.

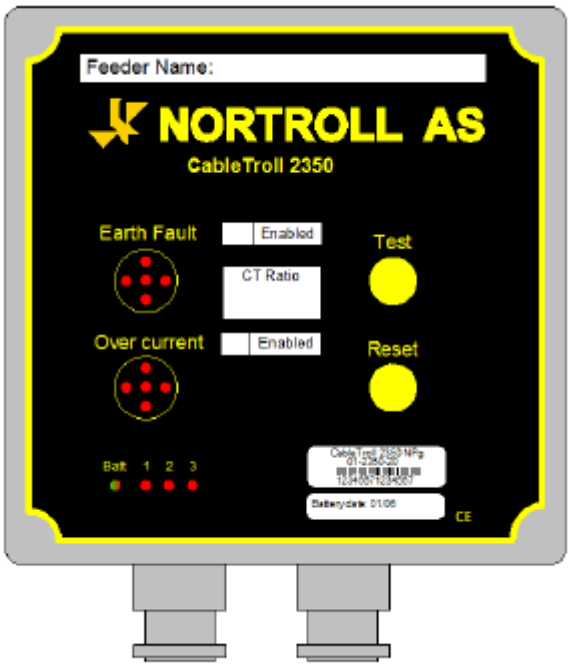


Figure 3.1- Nortroll 2350NPg Fault Passage Indicator

2.2. CableTroll 2350NPg functionality:

- Two LEDs Indicating detection of overcurrent and/or earth fault
- Remote indication to SCADA via local RTU
- Four reset modes: Self-reset, AC reset (55-250V range), local manual reset and remote reset via SACDA (9-36V range).
- Local test function
- DC powered; from external supply (9-36V range) and/or by an internal 10 year battery life
- Can be used with three 500:1 CTs or with one 60:1 CT

2.3. Sources for AC Reset (55V – 240V input range)

2.3.1. The two sources of acceptable FPI reset supply that shall always be, used where available are:

- Local LV board- if the LV board is normally powered by the associated circuit that the FPI is monitoring.
- Metering VT- if the VT is normally powered by the associated circuit that the FPI is monitoring.

2.3.2. Unacceptable sources which shall **NOT** be used, because any they could provide false readings to SCADA/APRS and persons carrying out restoration activities for resetting of any FPIs, are:

- Supplies from a customer's network. These shall **NOT** be used because:
  (a) The customer may have an auto-starting generator which might reset the FPI before the local HV supply was restored.
  (b) The customer may have an Uninterruptable Power Supply (UPS) which might maintain the reset supply throughout.
  (c) The customer's network might disconnect itself (low volt release relays, etc.) if the incoming supply is lost and might require switching by the customer before the FPI reset was restored.
- Substation supplies from service cables fed from the local LV mains cables. These shall **NOT** be used because the LV network might be reconfigured so it is not powered by the associated HV circuit at the time of the fault.

2.4. Powering the Cabletroll 2350NPg FPI (9V – 36V DC input range)

2.4.1. The FPI cannot be powered by an LV AC supply. Any LV AC connected to the FPI is for reset purposes only.

2.4.2. The FPI shall be wired to be powered by an external 24V DC supply from the battery in the RTU wherever a local RTU is installed in the substation. This provides a reliable, self-monitoring, large capacity power supply from the RTU main battery, although the FPI should still be fitted with an internal battery in case there is an issue with the DC supply from the RTU.

2.4.3. The FPI can be used where there isn't an external DC supply, in which circumstances it will run from a battery inside the FPI.

2.5. Installation of a CableTroll 2350NPg with Phase CTs

2.5.1. Remove the front cover of the CableTroll by removing the 4 screws in each corner of the panel.

2.5.2. Mount the back box of the unit on the supporting legs of the switchgear, preferably nearest to the CTs. Secure the unit in place using a minimum of two of the four fixing holes located in each corner.

2.5.3. Connect each of the phase CTs to its associated sensor block labelled L1, L2 and L3 respectively, ensuring consistent CT polarisation on terminations. See Figures 3.4.1 to 3.4.4.

2.5.4. It is acceptable to use only 4 cores for the CT wiring by looping L1/S2, L2/S2 and L3/S2 with a single return wire coming back from the loop. This is shown wired for a Lucy Electric RMU in Figure 3.4.5, and there is an example of an older model FPI in Figure 3.4.6.

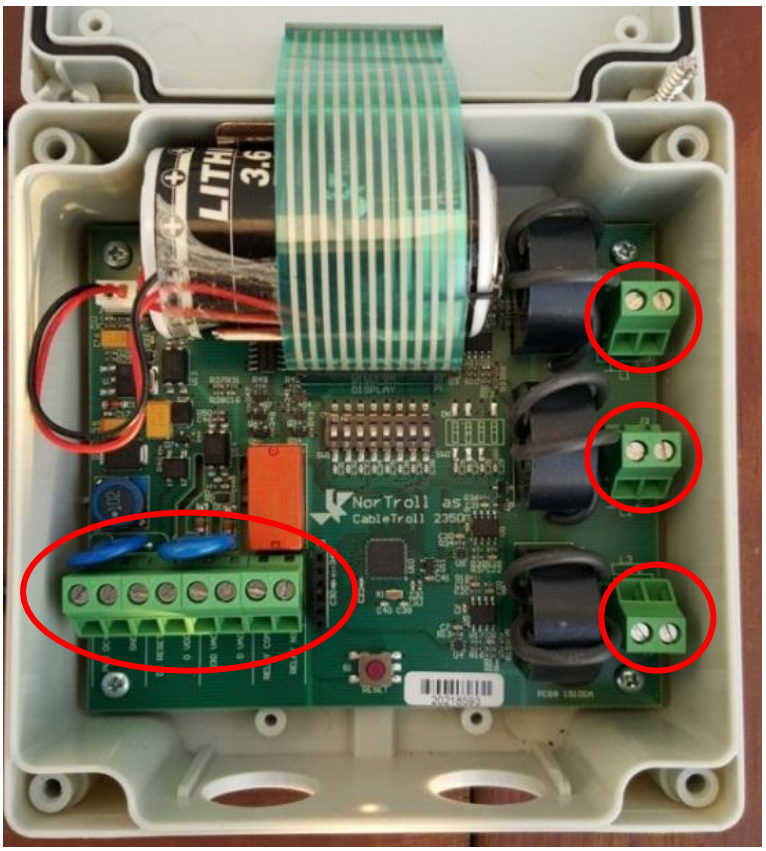


Figure 3.4.1-Internal Wiring FPI

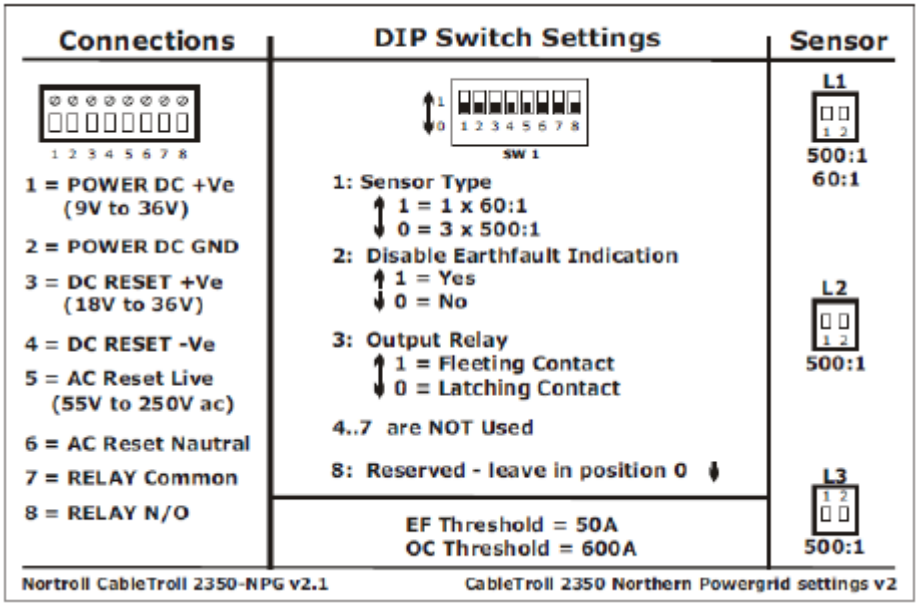


Figure 3.4.2-Internal Wiring and Settings Label on FPI on <u>first 200</u> produced units

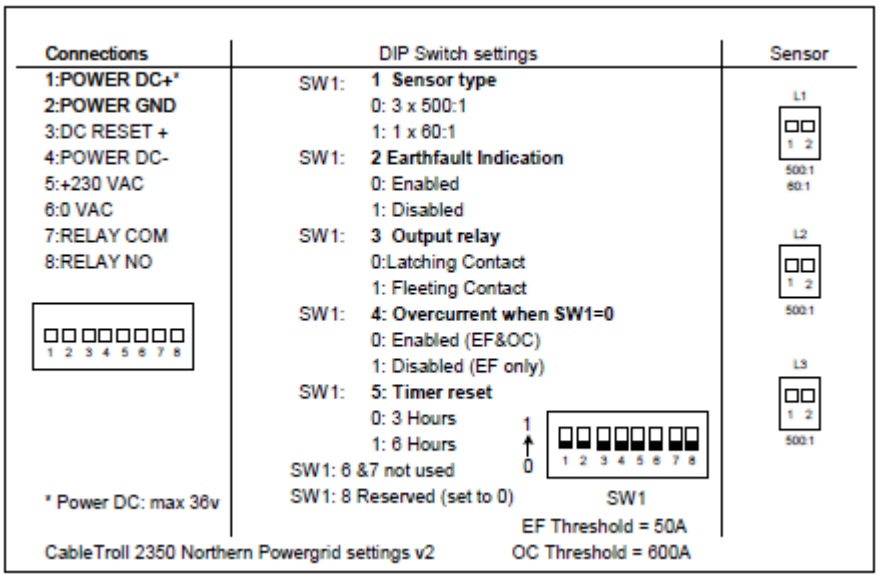


Figure 3.4.3-Internal Wiring and Settings Label on FPI after modification to add 6 hour timer reset and option to turn off overcurrent detection.

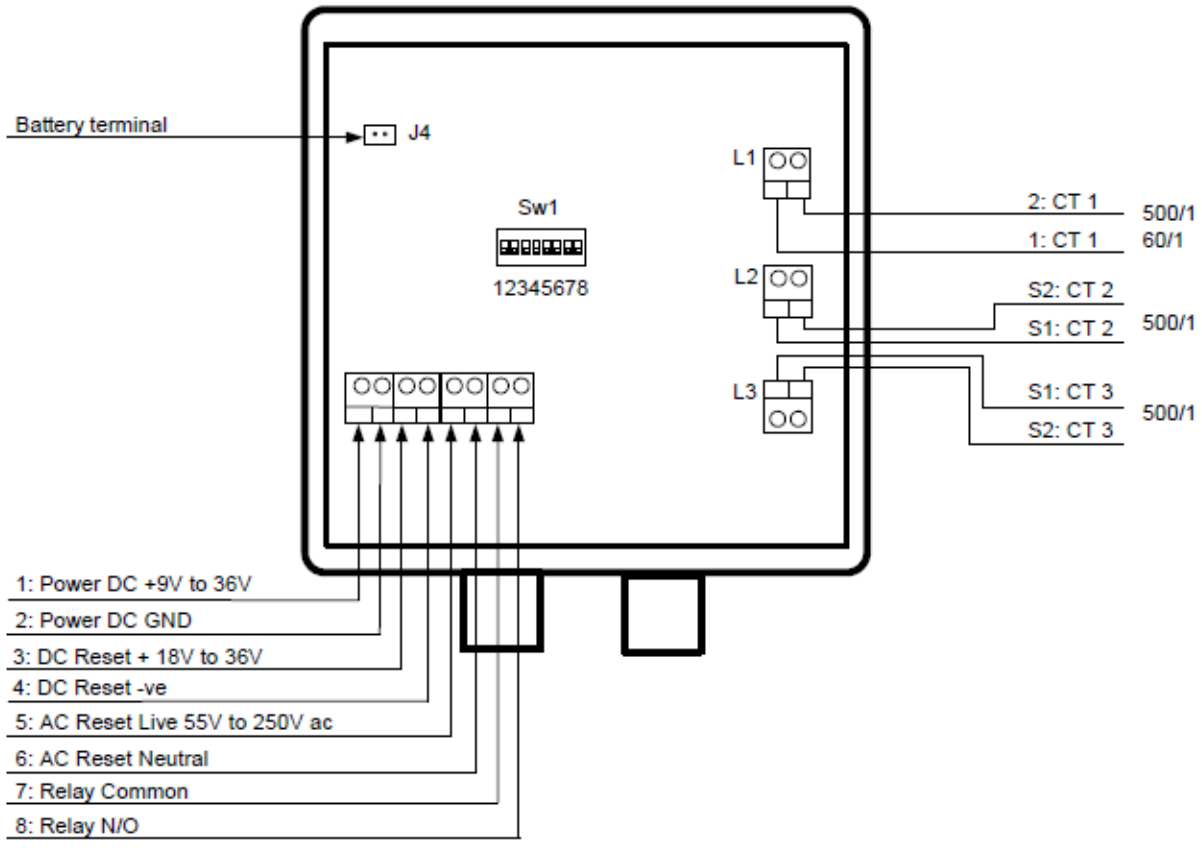


Figure 3.4.4- Connections and location of dipswitches for configuration

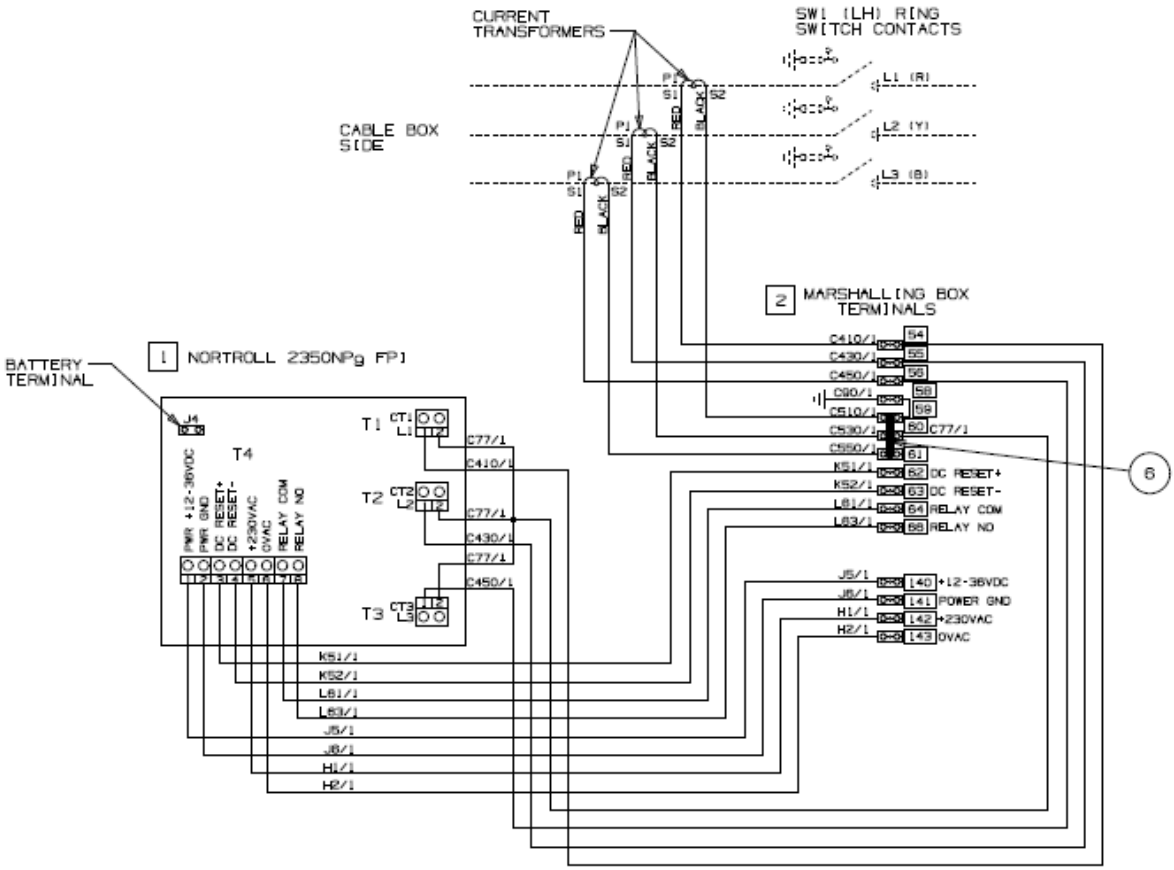


Figure 3.4.5- Typical RMU suppliers wiring diagram

Figure 3.4.6- Example of CT wiring "looped".

2.5.5. AC electrical reset can be taken from a metering VT or from a direct 230V supply from the substation. This is connected to junction 5(live) and junction 6(neutral) of the connection block highlighted in figure 2a. The AC supply shall be taken from the same associated LV circuit, or VT as the HV circuit that the FPI is monitoring.

2.5.6. Where remote output and remote reset are required from an RTU, these shall be connected to junction 7(COM) and 8 (NO) for the remote output, and to junction 3(positive) and junction 4(negative) for remote reset. These incoming cables shall be fed through the cable glands supplied with the FPI. The entry/exit holes are shown in figure 3.3.1

2.5.7. Ensure all connections and glands are adequately tightened.

2.5.8. Dip Switch settings need to be configured for correct operation depending on the CT type and therefore connections utilised. Figure 3.3.3 shows how the Dip switches should be set for each scenario of use.

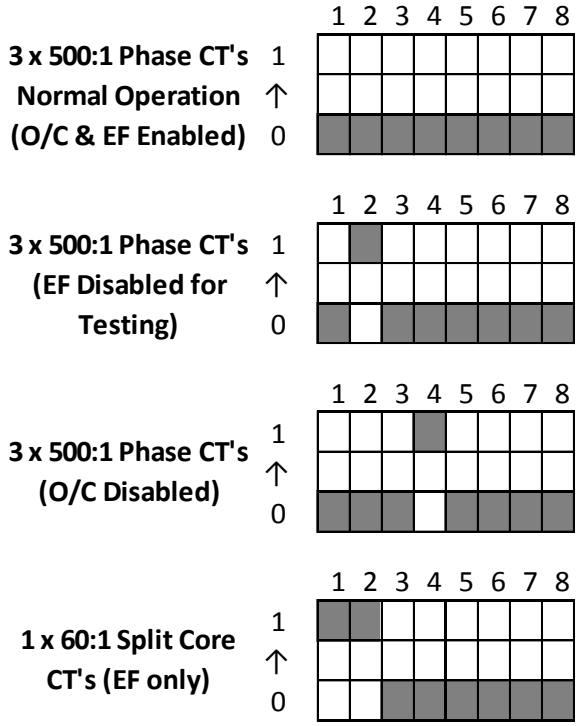


Figure 3.3.3-FPI Dipswitch settings

2.5.9. Test and commission the CableTroll 2350NPg according to Northern Powergrid procedures.

2.6. Installation of a CableTroll 2350NPg using a core-balance split CT

2.6.1. Connect a 1.5mm^2 2-core cable to the CT

2.6.2. Separate the CT and position it correctly around the cable with reference to figures 3.5.1 – 3.5.4 below. **Note if the cable earth/screen wires pass through the CT as part of the cable collective before they are terminated, then the earth/screen wires must pass back through the CT once more on their own. This is to cancel the current in the screens so the CT measures the earth fault current in the cable cores only.**

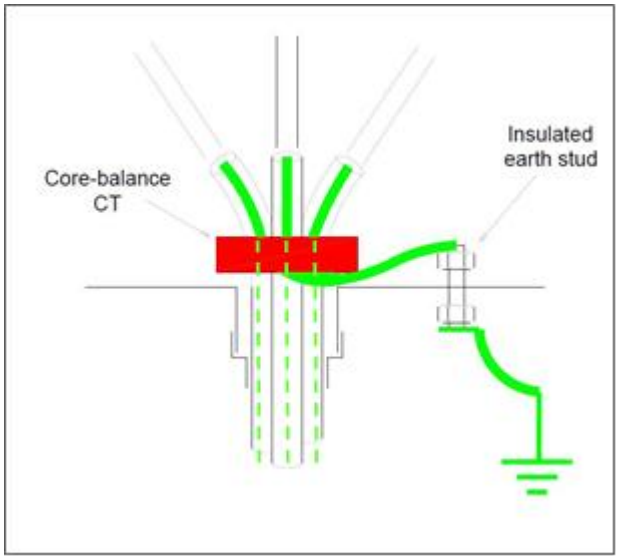


Figure 3.5.1-Triplex Cable, Cable screen and Earth through Internally mounted CT

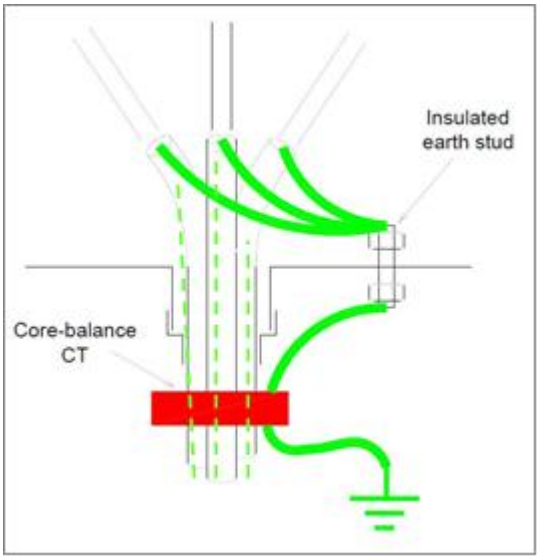


Figure 3.5.2-Triplex Cable, Cable screen and Earth through Externally mounted CT

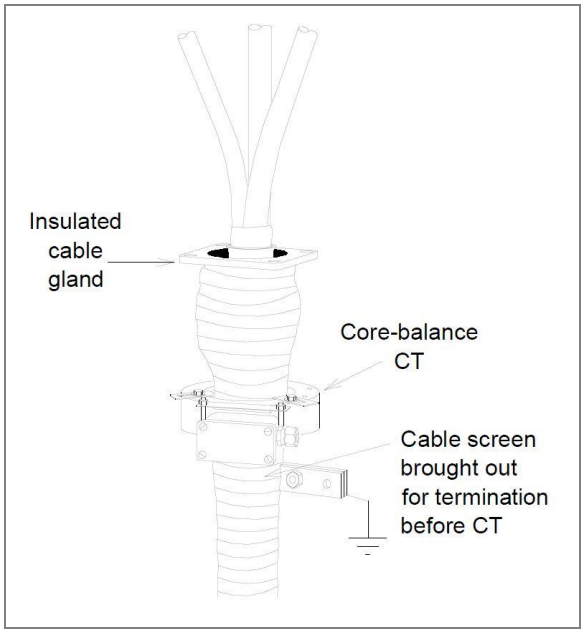


Figure 3.5.3-Three-core Cable, Cable Screen and Earth through Externally mounted CT

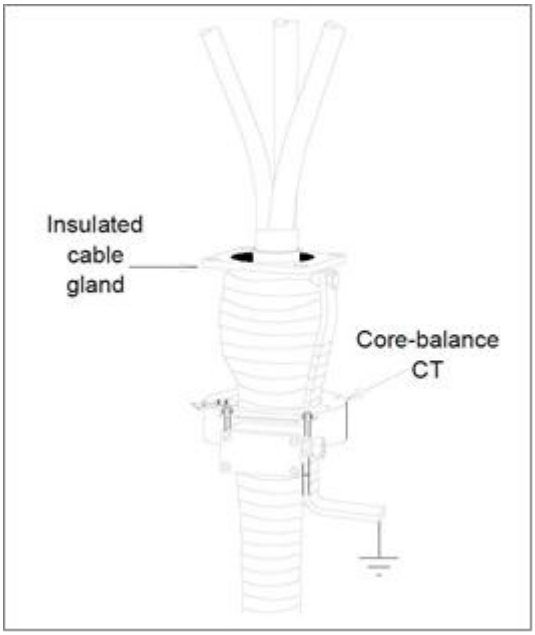


Figure 3.5.4-Three-core Cable, Cable Screen terminated before CT and no Earth through CT

2.6.3. Secure the removable half of the CT in position using the cable clamps and jubilee clips provided.

2.6.4. Remove the front cover of the CableTroll by removing the 4 screws in each corner of the panel.

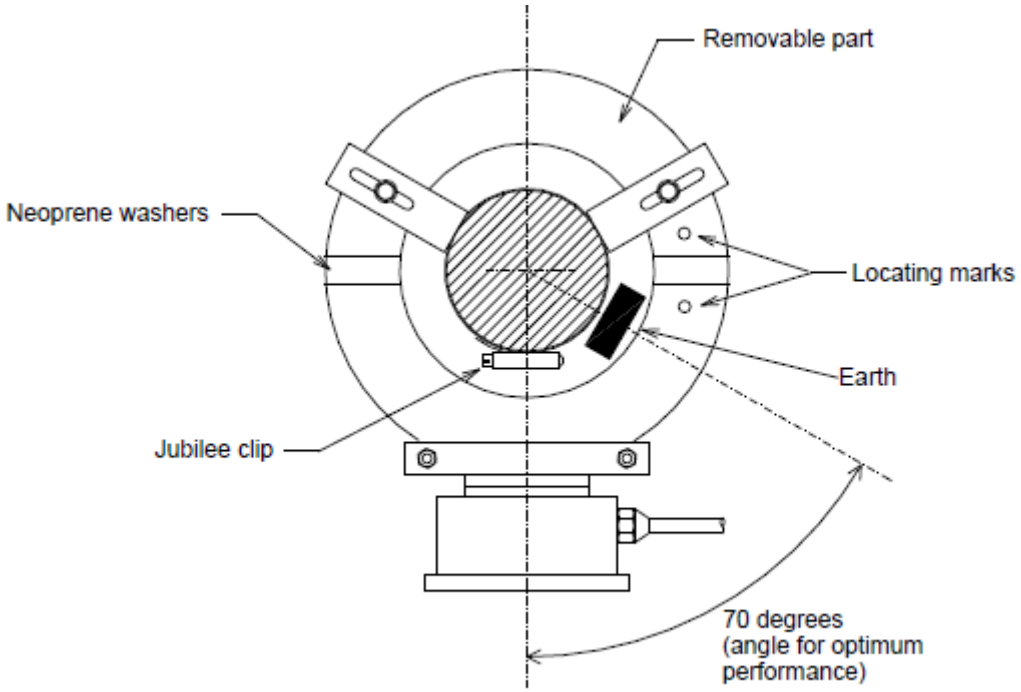
2.6.5. Mount the back box of the unit on the supporting legs of the switchgear, preferably nearest to the CTs. Secure the unit in place using a minimum of two of the four fixing holes located in each corner.

2.6.6. Connect the output from the CT to sensor block L1 only. Note only the earth fault function of the FPI will operate using a core-balance CT.

2.6.7. Install the other half of the CT ensuring the contact faces are clean and apply a thin coating of contact grease to both faces. Bring both halves of the CT together ensuring the locating marks line up.

2.6.8. Where the earth passes through the CT, rotate the CT so the edge of the removable part of CT lines up with the edge of the earth, this should make an angle of approximately 70 degrees between the earth and the terminal box giving optimum performance.

2.6.9. Tighten the stainless steel band to secure both halves of the CT together.



2.6.10. AC electrical reset can be taken from a metering VT or from a direct 230V supply from the substation. It shall be connected to junction 5(live) and junction 6(neutral) of the connection block highlighted in figure 3.4.4. The AC supply must be taken from the same associated circuit as the FPI. **Note the 230v AC source is for an AC reset signal only; the FPI cannot be powered by an AC supply.**

2.6.11. Where remote output and remote reset are required from an RTU, these shall be connected to junction 7(COM) and 8 (NO) for the remote output, and to junction 3(positive) and junction 4(negative) for remote reset. These incoming cables shall be fed through the cable glands supplied with the FPI. The entry/exit holes are shown in figure 3.3.1

2.6.12. Ensure all connections and glands are adequately tightened

2.6.13. Test and commission the CableTroll 2350NPg according to company procedure.

2.7. Operation Testing

2.7.1. Carry out a visual inspection of the CableTroll 2350NPg and ensure it is mounted correctly and not damaged.

2.7.2. Remove the front cover

2.7.3. Connect the battery and press the reset button on the PCB or the front cover.

2.7.4. Short press (0.5-3 sec) the test button on the front cover of the FPI, the earth fault and overcurrent LED's should flash followed by a green LED illuminated in the battery indication. If the battery indication flashes red the battery will need to be replaced. This test WILL NOT operate the Remote indication relay. Reset the CableTroll 2350NPg.

2.7.5. Long press (>3 sec) the test button on the front cover of the FPI, the earth fault and overcurrent LED's should flash in turn. The Remote indication relay will operate in accordance with Dipswitch 3 setting (Latched if OFF, closed for 1 sec if ON).

2.8. Core-balance CT Tests

2.8.1. Carry out a primary injection test from the CT to test the earth fault threshold.

2.8.2. With the exception of "CAS" cabled switchgear; connect the injection test through the Core-balance CT, ensuring that the test current path is via the earth that goes through the CT. Increase the current through the CT until the earth fault LED on the FPI illuminates. This value should be between 50A-60A. Record the actual current value on the test form.

2.8.3. Where utilised and available the Remote Reset Function should be tested and proven. The circumstances under which testing is taking place will dictate how this can be achieved either from SCADA Network Control Tele-command or from a connected RTU.

2.8.4. Disconnect the test set and reset the CableTroll 2350NPg

2.9. Phase CT Tests - Primary Injection Earth Fault Test

2.9.1. Carry out a primary injection test from the associated cable box to test the earth fault threshold.

2.9.2. Close the associated earth switch

2.9.3. Connect the injection test between the L1 phase bushing, located in the cable box, and the switchgear earth, increase the current until the earth fault LED illuminates, this should be around the value of 50A-60A. Record the actual current value on the test form.

2.9.4. If remote indication is used, ensure the appropriate indication is shown on the RTU, and that the Remote Reset Function (where fitted) operates correctly either from SCADA Network Control Tele-command or from a connected RTU.

2.9.5. Reset the FPI and repeat for phases L2 and L3 by injecting through the associated phase bushing. The earth fault threshold should be similar for all 3 phases. Disconnect the test set.

2.10. Phase CT Tests - Secondary Injection Earth Fault Test

2.10.1. Carry out a secondary injection test from the CT Terminal Block on the switchgear to test the earth fault threshold.

2.10.2. Ensure that one side of each CT is connected together, for most switchgear this is supplied as standard however if this is not the case use a shorting-link where applicable.

2.10.3. Connect the test set across the L1-L2 Phase CT at the CT terminal block. Increase the injection current until the overcurrent LED on the FPI illuminates; this should operate at the 600A setting.

2.10.4. Record the actual current on the test form.

2.10.5. If remote indication is used, ensure the appropriate indication is shown on the RTU, and that the Remote Reset Function (where fitted) operates correctly either from SCADA Network Control Tele-command or from a connected RTU.

2.10.6. Reset the FPI and repeat for phases L2-L3 and L3-L1. The overcurrent threshold should be similar in all three tests.

2.10.7. If applicable remove all shorting links and test leads used in any of the above tests.

3. References

3.1. External Documentation

Reference	Title

3.2. Internal documentation

Reference	Title
OPM	Operation Practice Manual
DSR	Distribution Safety Rules

3.3. Amendments from Previous Version

Reference	Title
3.3 / 3.4 / 3.5 onwards	Corrected numbering errors
3	Expanded wording for installation clarity
Figures 3.4.5 & 3.4.6	Addition of Wiring schematic and wiring example for installation clarity
3.7.2	Added exception for “CAS” cables

4. Definitions

Term	Definition
The Company	Northern Powergrid
CT	Current Transformer
FPI	Fault Passage Indicator
RTU	Remote Terminal Unit
RMU	Ring Main Unit
OPM	Operation Practice Manual
DSR	Distribution Safety Rules
Externally mounted CT	The CT is mounted OUTSIDE the Cable termination box
Internally mounted CT	The CT is mounted INSIDE the Cable termination box

5. Authority for issue

5.1. CDS Assurance

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

		Sign	Date
Andrew Leggett	CDS Administrator	Andrew Leggett	10/04/18

5.2. Author

I sign to confirm that I have completed and checked this document and I am satisfied with its content and submit it for approval and authorisation.

Review Period - This document should be reviewed within the following time period.

Standard CDS review of 3 years?	Non Standard Review Period & Reason	
No	Period: 5	Reason: Update will be dictated by contract renewal date or any significant changes in the product or documents referenced.
Should this document be displayed on the Northern Powergrid external website?		Yes

		Sign	Date
Alan MacDonald	Policy & Standards Engineer	Alan MacDonald	10/04/2018

5.3. Technical Assurance

I sign to confirm that I am satisfied with all aspects of the content and preparation of this document and submit it for approval and authorisation.

		Sign	Date
David Blackledge	Senior Policy & Standards Engineer	David Blackledge	25/04/2018

5.4. Authorisation

Authorisation is granted for publication of this document.

		Sign	Date
David Gazda	Policy & Standards Manager	David Gazda	19/04/2018