POWER AUTOMATION TECHNOLOGIES

CT Polarity on a SIPROTEC Relay – Quick Start Instructions

These instructions are provided for the purpose on providing a quick start to CT Polarity on a SIPROTEC 4 relay for commonly used 3 phase and restricted earth fault applications. Please refer to the relevant relay manuals for full details or specialised applications.

Model	Relevant manual sections
7SJ62/63/64	2.1.3.2 Power System Data 1: Polarity of Current Transformers 2.1.6.2 Power System Data 2: Inversion of Measured Power Values A.3.1 Connection Examples for Current Transformers
7SJ80	2.1.3.2 Power System Data 1: Polarity of Current Transformers 2.1.6.2 Power System Data 2: Inversion of Measured Power Values A.3 Connection Examples
7UT6	2.1.4.2 General Power System Data: Current Transformer Data for 3 Phase Measuring Locations & Current Transformer Data for Further 1 Phase Current Inputs 2.1.6.1 Power System Data 2: Sign of Power A.3.1 Current Transformer Connection Examples
7SD61	2.1.2.2 Setting Notes: Current Transformer Polarity 2.1.4.2 General Protection Data: Setting Notes: General Performance Data 2.3.1 Restricted Earth Fault Protection: Application Examples A.3.1 Current Transformer Connection Examples
7SD5	2.1.2.1 Power System Data 1: Setting Notes: Polarity of the Current Transformers 2.1.4.1 General Protection Data: Setting Notes: General Line Data of the Distance Protection 2.10.1 Restricted Earth Fault Protection: Application Examples A3.1 Current Transformer Connection Examples
7SA5	2.1.2.1 Power System Data1: Setting Notes: Current Transformer Polarity 2.1.4.1 Power System Data 2: Setting Notes: General Line Data A.3.1 Connection Examples: Current Transformer Examples
7UT85	Setting Notes: A.10 Connection Examples: Current Transformer Example 6.4. Restricted Ground Fault Protection
7SD8	Setting Notes: A.9 Connection Examples: Current Transformer Example 6.4 Restricted Ground Fault Protection

This quick start describes:

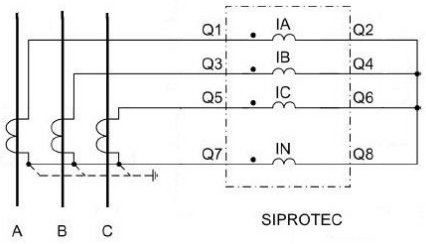
Section 1) Phase CT polarity
Section 2) Positive power direction
Section 3) NCT connection for REF with a 7UT6x
Section 4) NCT connection for REF with a 7UT8x
Section 5) NCT connection for REF with a 7SD61/53/53
Section 5) NCT connection for REF with a 7SD8x

1 Phase CT polarity

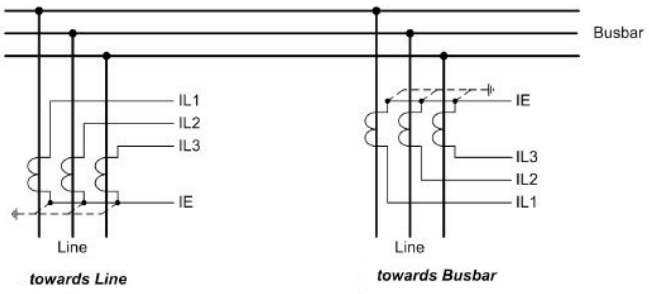
When using the CT connection examples in the SIPROTEC manuals and in this document, there are two basic assumptions:

1. The P1 & S1 terminals are always drawn on the same side of the CT.

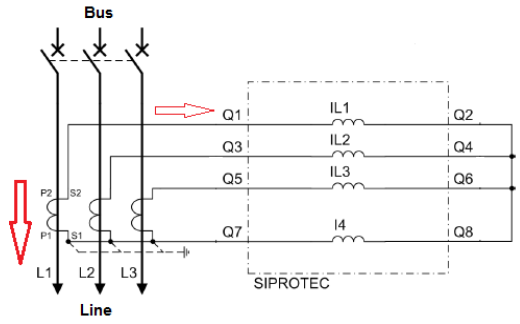
2. The non 'star-point' side of the CTs are always connected to Q1, Q3, Q5 terminals.

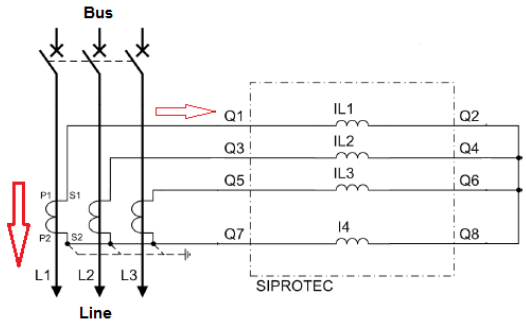


In a line protection relay the possible options are that the CT star-point is towards the line or towards the busbar. In a 7UT relay the options are that the star-point is towards the protected object (e.g. transformer) or not towards the protected object. This can easily be seen from the drawings and applied as a relay setting.



If the CT secondary star-point connection is to the correct relay terminals then the CT primary orientation can be either way without effect on the relay. This is shown in the following two examples - a fault towards the line results in the same secondary currents into the relay, even though the CT primary orientation has been swapped.





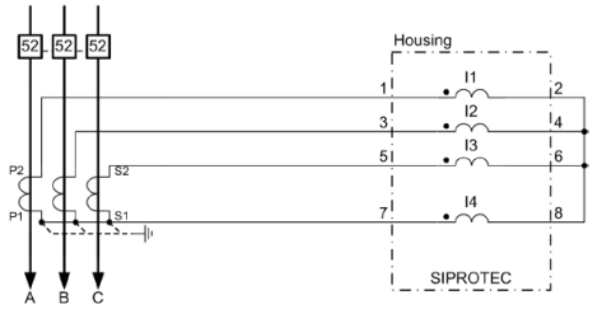
The default setting is for the CT star point towards the line or protected object. The currents used in the relay elements and oscillographic records follow the convention that current into the line/protected object will be in-phase with the voltage (if a power factor of one is assumed). *If the star-point is connected opposite to this then the setting needs to be changed to 'towards busbar' in a line protection relay or 'NO' in a 7UT relay.* The relay will then invert the phase CT signals before they are used in the protection elements or oscillographic records. ***This setting also swaps the polarity of the I4 input in 7SJ6/7SD61/7SD5/7SA5 relays and the IN input in 7SJ80 relays.***

In DIGSI 5, the parameter **CT connection** shows the connection type of the current transformer for the 3-phase current measuring point. The parameter can be found in the DIGSI 5 project tree under **Name of the device (e.g. 7UT8x device or 7SD8x) → Settings → Power-system → Measuring point I 3-phase**. You cannot change the connection type of the current transformer in the power-system data.

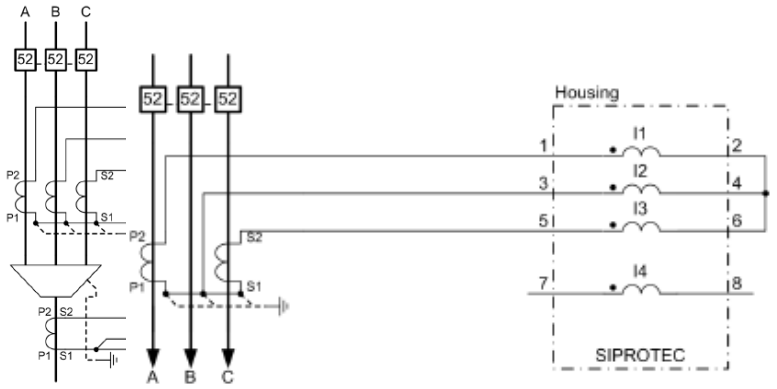
The current transformer connection can only be changed under **measuring point routing**. The following types of connections are available:

- ***3-phase + IN-separate***
- ***3-phase + IN***
- ***3-phase***
- ***3-phase, 2 primary CT***
- ***3ph, 2prim.CT + IN-separate***

7UT85 Relay Current Transformer connection: 3- phase

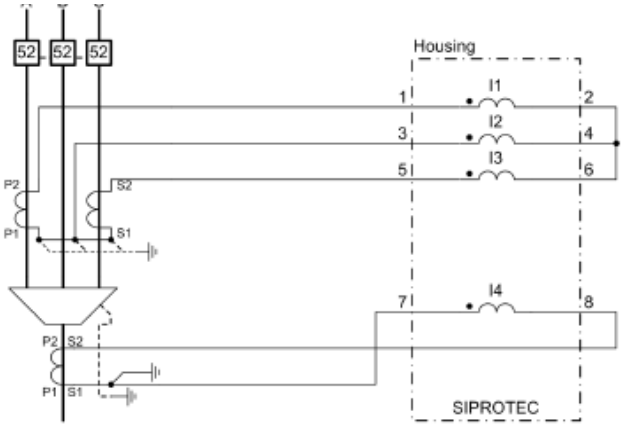


7UT85 Relay Current Transformer connection: 3- phase + IN



7UT85 Relay Current Transformer connection: 3- phase + IN Separate

7UT85 Relay Current Transformer connection: 3- phase, 2 primary CT



7UT85 Relay Current Transformer connection: 3- phase, 2 prim. CT + IN -Separate

Note: The current transformer connections for the 7SD8x devices are the same as the 7UT8x devices

7SJ6/7SD61/7SD5/7SA5/7SJ80

Power System Data 1:

0201	CT Starpoint	towards Line

7UT5/7UT6

Power System Data 1:

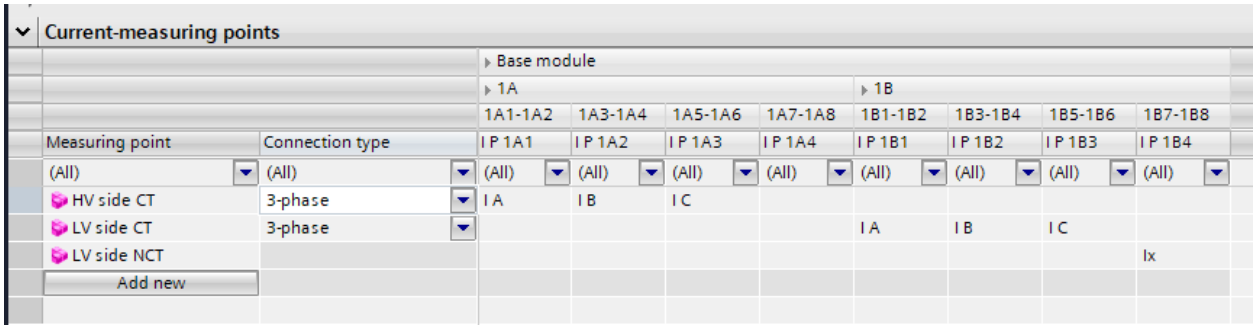
0511	CT-Strpnt. Meas. Loc.1 in Dir. of Object	YES

0521	CT-Strpnt. Meas. Loc.2 in Dir. of Object	YES

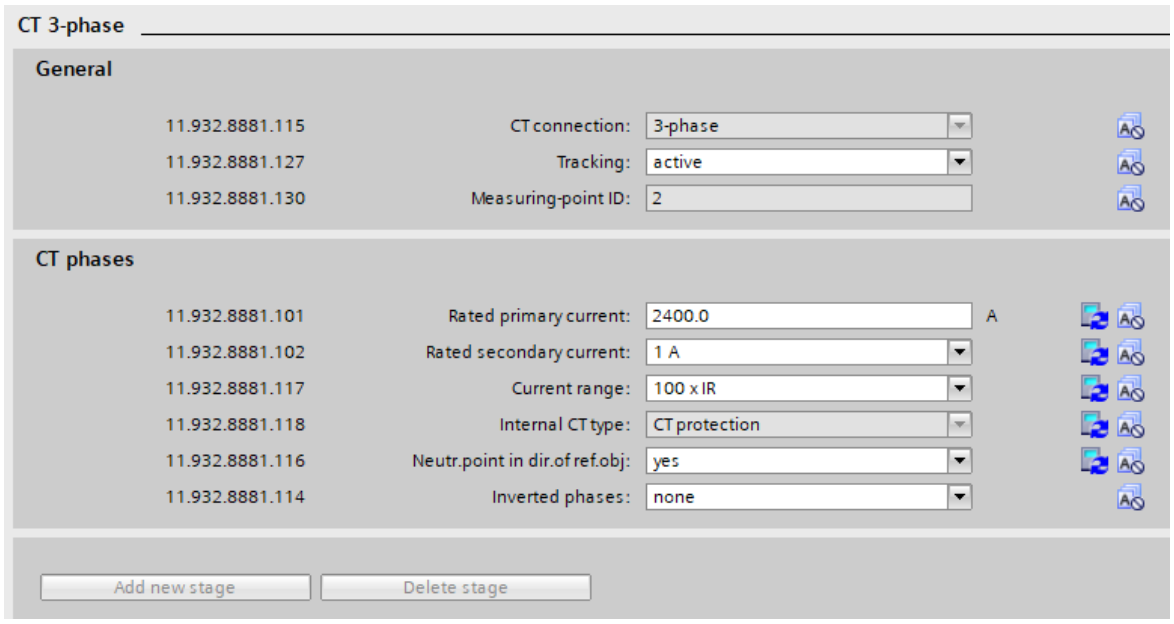
0531	CT-Strpnt. Meas. Loc.3 in Dir. of Object	YES

7UT82/7UT85/7UT86/7UT87

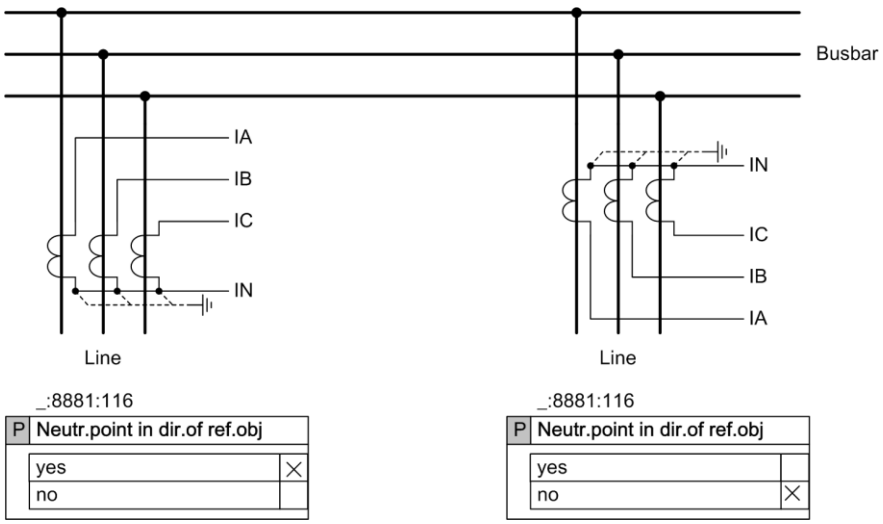
DIGSI 5- Measuring points routings:



DIGSI 5- Power system – Meas.point I-3ph:



The **Neutr.point in dir.of ref.obj** parameter is used to set the direction of the neutral point of the Current transformer (see the following figure next page - the polarity of current transformer). The neutral point of the current transformer is determined by the direction of the protected object (for example, in the direction of the line, cable, transformer).
The default setting of the parameter was defined as ***yes*.** When switching the parameter, the direction of the phase currents and the ground current IN or IN-separate will change as well



7UT85- The polarity of Current Transformers

2 Positive power direction

Measured power is usually considered positive if it is in the direction of the protected line/object. If required, this can be swapped by changing setting 'P,Q operational measured values sign' to 'reversed'. *This affects all relay functions using these measured/metered values including any reverse power elements.*

SETTINGS

7SJ6/7SJ80

Power System Data 2:

1108	P,Q operational measured values sign	not reversed

7SD61/7SD5/7UT6 (with voltage option)

Power System Data 2:

1107	sign of P,Q	not reversed

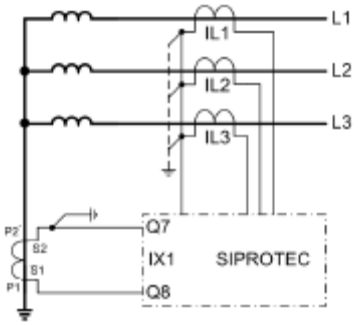
7SD61/7SD5/7SA5

Power System Data 2:

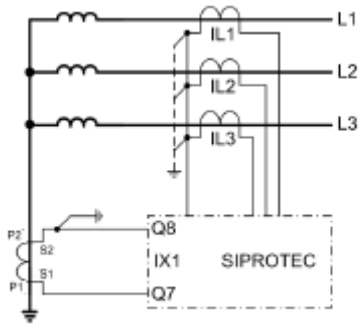
1107	P,Q operational measured values sign	not reversed

3 NCT connection for REF in a 7UT6x

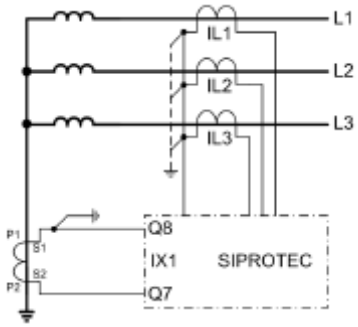
The value required for setting 0711 ‘EARTH iX1 AT’ (or 0721 if the iX2 input is used) depends on which relay terminal is connected to the CT secondary circuit that corresponds to the CT primary closest to the transformer earth.



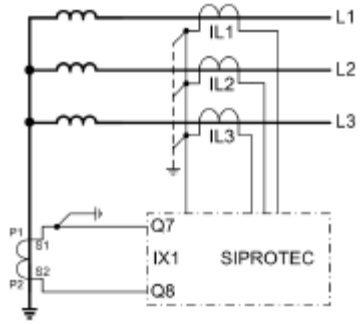
P1 towards earth, S1 connected to Q8.
Set 0711 ‘EARTH iX1 AT’ = Q8



P1 towards earth, S1 connected to Q7.
Set 0711 ‘EARTH iX1 AT’ = Q7



P2 towards earth, S2 connected to Q7.
Set ‘EARTH iX1 AT’ = Q7



P2 towards earth, S2 connected to Q8.
Set ‘EARTH iX1 AT’ = Q8

The secondary earthing of the CT is required but its location is not relevant to the setting. The connection or setting of the phase CTs is also not relevant. Setting 711 inverts the current input if necessary so that the signal in the protection elements and the oscillographic fault records follow the convention that positive current flow is into the protected object.

SETTINGS

Power System Data 1:

if IX1 input is used:

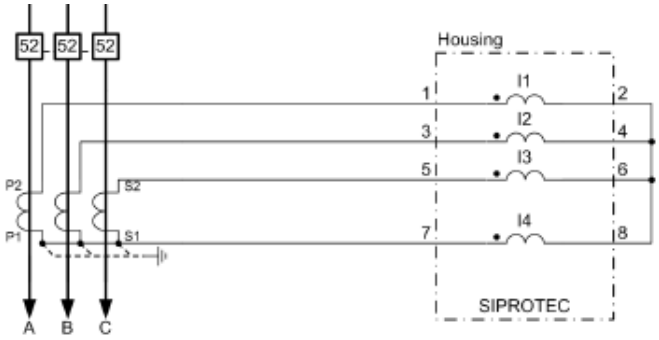
0711	Earthing electrod IX1 connected to	Terminal Q7

if IX2 input is used:

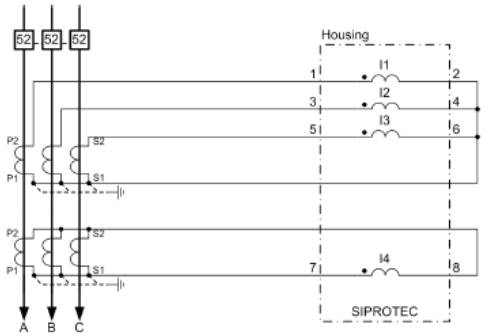
0721	Earthing electrod IX2 connected to	Terminal N7

4 NCT connection for REF in a 7UT8x

The current definition states that the sum of the currents flowing into the protected object is equal to 0 (IA + IB + IC + IN = 0 or IA + IB + IC = -IN). The protected object is located to the right or left of the transformer set. The following basic connections result from this



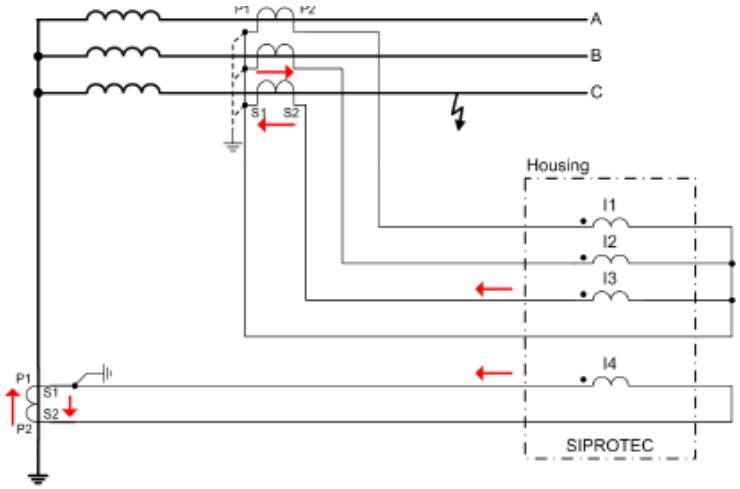
7UT85 Current Transformer connection: 3- phase + IN



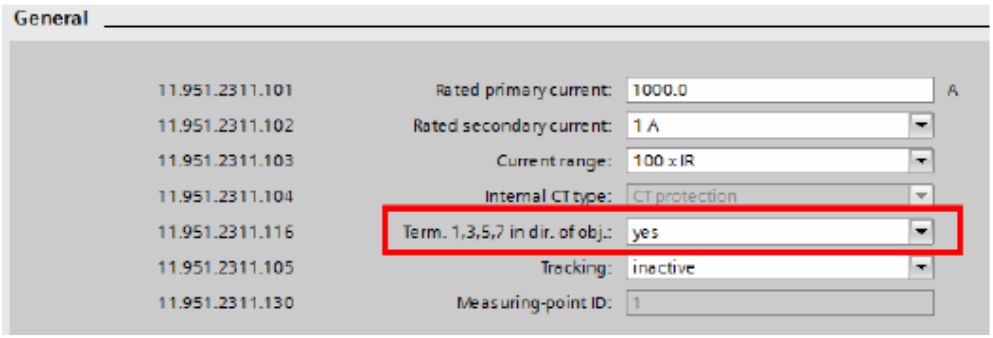
7UT85 Current Transformer connection: 3- phase + IN -Separate

The following figure below describes the polarity of the current transformer. The current terminal numbers are designed so that this side is fed out on an odd number terminal point. In SIPROTEC 5 device, each current transformer can be assigned to a 1-phase measuring point, the odd number terminal points are named in the setting parameters. According to the figure below, the setting must be ***yes***.

• Default setting **(_:115) terminal 1,3,5,7 in dir.obj.** = ***yes***



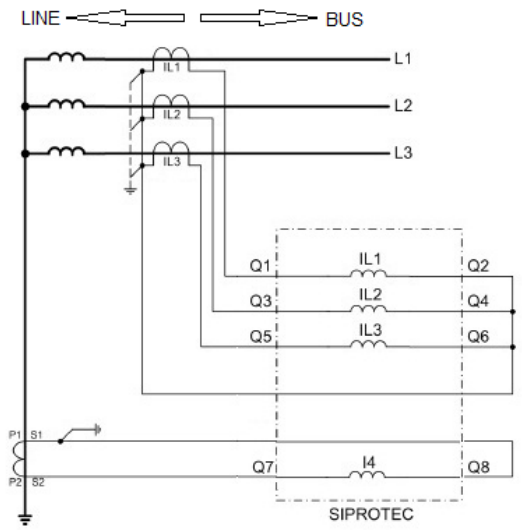
Current Transformer 3 –phase connection: 3- phase
Current Transformer 1 –phase connection: IN



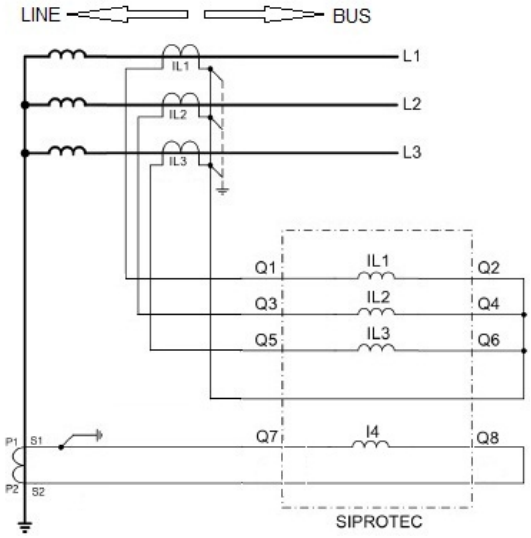
DIGSI 5 setting: 1 –phase measuring point

5 NCT connection for REF in a 7SD61/52/53

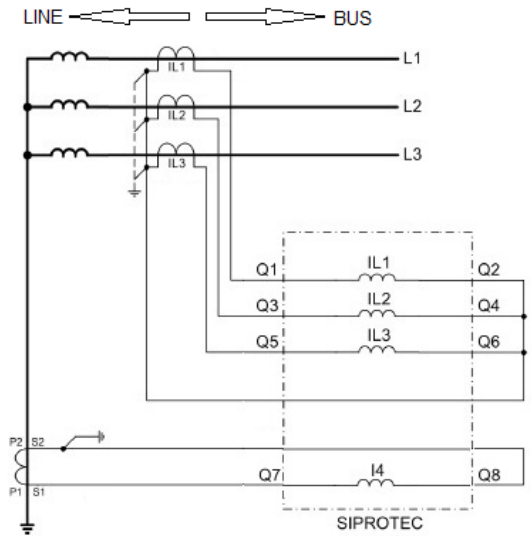
The polarity of the I4 neutral CT input is dependent on setting 0201 CT Starpoint. The value selected for this setting depends on the phase CT connection. If the I4 input is used for the connection of a transformer NCT for REF protection then the CT connection must match the 0201 setting that has been applied.



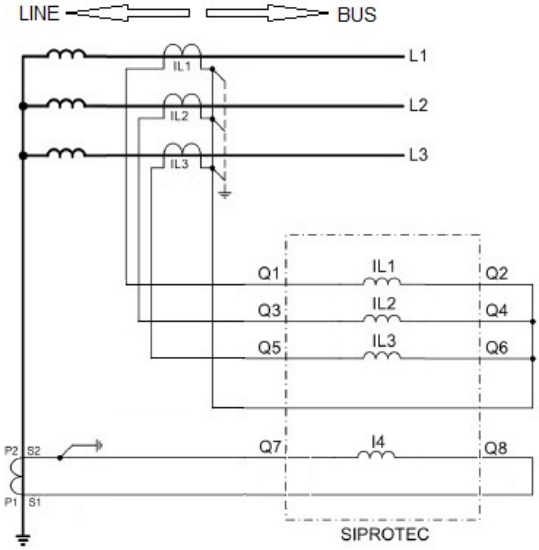
0201='towards line', P2 towards earth.
Connect S2 to Q7.



0201 = 'towards bus', P2 towards earth.
Connect S1 to Q7.



0201='towards line', P1 towards earth.
Connect S1 to Q7.



0201 = 'towards bus', P1 towards earth.
Connect S2 to Q7.

The secondary earthing of the CT is required but its location is not relevant to the setting.

6 NCT connection for REF in a 7SD8x

The structure of the REF function and the connection diagram of NCT in 7SD8x relays are same as the 7UT8x relays