

EUROPROT +

**Voltage input
function block setting guide**



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User's manual version information

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1 Application of the voltage input function

The application of the voltage inputs depends on the correct connection of the hardware terminals and also on the correct parameter setting for the VT4 function block. This guide describes examples, based on which any other combinations can be realized.

In the applications of the voltage transformer hardware module, the first three voltage inputs receive the three phase voltages (UL1, UL2, UL3), the fourth input is reserved for zero sequence voltage, for the busbar voltage if synchronized switching is applied or for any additional voltages. Accordingly, the first three inputs have common parameters while the fourth voltage input needs individual setting.

The VT4 function block is an independent module in the sense that:

- It has independent parameters to be set, associated to the voltage inputs,
- It delivers the sampled voltage values for protection, measurement function blocks and for disturbance recording,
- It provides parameters for the subsequent functions blocks for scaling the measured voltages.
- It performs the basic calculations
 - Fourier basic harmonic magnitude and angle,
 - True RMS value.

1.1. Parameter setting

1.1.1. Summary of the parameters

The parameters of the voltage input function are explained in the following tables.

Enumerated parameters

| Parameter name | Title | Selection range | Default |
|--|-----------------|----------------------------|----------|
| Rated secondary voltage of the input channels. 100 V or 200V is selected by parameter setting, no hardware modification is needed. | | | |
| VT4_Type_EPar_ | Range | Type 100,Type 200 | Type 100 |
| Connection of the first three voltage inputs (main VT secondary) | | | |
| VT4_Ch13Nom_EPar_ | Connection U1-3 | Ph-N, Ph-Ph, Ph-N-Isolated | Ph-N |
| Selection of the fourth channel input: phase-to-neutral or phase-to-phase voltage | | | |
| VT4_Ch4Nom_EPar_ | Connection U4 | Ph-N,Ph-Ph | Ph-Ph |
| Definition of the positive direction of the first three input channels, given as normal or inverted | | | |
| VT4_Ch13Dir_EPar_ | Direction U1-3 | Normal,Inverted | Normal |
| Definition of the positive direction of the fourth voltage, given as normal or inverted | | | |
| VT4_Ch4Dir_EPar_ | Direction U4 | Normal,Inverted | Normal |

Table 1-1 The enumerated parameters of the voltage input function

Integer parameter

| Parameter name | Title | Unit | Min | Max | Step | Default |
|--------------------|---------------|------|-----|-----|------|---------|
| Voltage correction | | | | | | |
| VT4_CorrFact_IPar_ | VT correction | % | 100 | 115 | 1 | 100 |

Table 1-2 The integer parameter of the voltage input function

Floating point parameters

| Parameter name | Title | Dim. | Min | Max | Default |
|--|--------------------|------|-----|------|---------|
| Rated primary voltage of channel 1, 2, 3 | | | | | |
| VT4_PriU13_FPar | Rated Primary U1-3 | kV | 1 | 1000 | 100 |
| Rated primary voltage of channel 4 | | | | | |
| VT4_PriU4_FPar | Rated Primary U4 | kV | 1 | 1000 | 100 |

Table 1-3 The floating point parameters of the voltage input function

NOTE: The rated primary voltage of the channels is not needed for the voltage input function block itself. These values are passed on to the subsequent function blocks.

1.1.2. Setting the rated secondary voltage

The scaling of the voltage depends on parameter setting.

Range

There are basically two standard voltage transformer types: one with secondary rated voltage 100 V, the other with 200 V. Select the parameter value respectively: Type 100, Type 200. No hardware modification is needed. This parameter influences the internal number format and, naturally, accuracy. (A small voltage is processed with finer resolution if 100V is selected.)

VT correction

In some cases the rated secondary of the voltage transformers is not 100V but e.g. 110 V. This parameter is to correct this difference, if the rated secondary voltage of the main voltage transformer does not match the rated input of the device. As an example: if the rated secondary voltage of the main voltage transformer is 110V, then select Type 100 for the parameter "Range" and the required value to set here is 110%.

1.1.3. Setting the connection and the positive direction of the voltages

The connection and direction parameters of the first three VT secondary windings must be set to reflect actual physical connection of the main VTs.

Connection U1-3.

The selection can be: "Ph-N", "Ph-Ph" or "Ph-N-Isolated".

The *Ph-N* option is applied in solidly grounded networks, where the measured phase voltage is never above $1.5 \cdot U_n$. In this case the primary rated voltage of the VT must be the value of the rated PHASE-TO-NEUTRAL voltage.

The *Ph-N-Isolated* option is applied in compensated or isolated networks, where the measured phase voltage can be above $1.5 \cdot U_n$ even in normal operation. In this case the primary rated voltage of the VT must be the value of the rated PHASE-TO-PHASE voltage.

The *Ph-Ph* option is to be selected if phase-to-phase voltage is connected to the VT input of the device. Here, the primary rated voltage of the VT must be the value of the rated PHASE-TO-PHASE voltage. This option must not be selected if the distance protection function or directional overcurrent protection function is supplied from the VT input.

Connection U4

The fourth input is reserved for zero sequence voltage or for a voltage from the other side of the circuit breaker for synchronized switching. Accordingly, the connected voltage must be identified with parameter setting Connection U4. Here, phase-to-neutral or phase-to-phase voltage can be selected: "Ph-N", "Ph-Ph"

Direction U1-3

If needed, the phase voltages can be inverted by setting the parameter Direction U1-3. This selection applies to each of the channels UL1, UL2 and UL3. The primary/secondary connection of the VT windings is generally star/star connected and the phase voltages signed with • are connected to the VT4 terminals 1-3-5. In this case the parameter setting is „Normal". Select "Inverted" to the parameter Direction U1-3 in case of inverted connection of phase voltages." (See also Figure 1-1 in setting example.)

Direction U4

This parameter applies to the channel UL4. If the voltage signed with • is connected to the VT4 terminal 7 the parameter setting is „Normal". Select "Inverted" to the parameter Direction U4 in case of inverted connection of the voltage. This inversion may be needed in protection functions such as distance protection or for any functions with directional decision, or for checking the voltage vector positions.

Figure 1-1 shows an example with harmonized connection and parameter setting.

If the voltages are connected not this way then change the parameter values accordingly.

1.1.4. Setting the rated primary voltage

These parameters are needed only to display the voltages (and powers) in primary scale. The protection functions apply secondary values, these parameters are not needed for protection functions.

Rated Primary U1-3 and Rated Primary U-4

Select the rated primary voltages according to the nominal data of the main voltage transformers. The two parameters are: common for the first three channels and one for the fourth channel respectively.

1.2. Application of the on-line measurements in commissioning

The performed basic calculation results the Fourier basic harmonic magnitude and angle value of the voltages. These results are processed by subsequent protection function blocks and they are available for on-line displaying as well.

1.2.1. Summary of the on-line measurements

The **measured values** of the voltage input function block.

| Measured value | Dim. | Explanation |
|-----------------|--------------|---|
| Voltage Ch - U1 | V(secondary) | Fourier basic component of the voltage in channel UL1 |
| Angle Ch - U1 | degree | Vector position of the voltage in channel UL1 |
| Voltage Ch – U2 | V(secondary) | Fourier basic component of the voltage in channel UL2 |
| Angle Ch – U2 | degree | Vector position of the voltage in channel UL2 |
| Voltage Ch – U3 | V(secondary) | Fourier basic component of the voltage in channel UL3 |
| Angle Ch – U3 | degree | Vector position of the voltage in channel UL3 |
| Voltage Ch – U4 | V(secondary) | Fourier basic component of the voltage in channel U4 |
| Angle Ch – U4 | degree | Vector position of the voltage in channel U4 |

Table 1-4 The measured analogue values of the voltage input function

NOTE1: The scaling of the Fourier basic component is such that if pure sinusoid 57V RMS of the rated frequency is injected, the displayed value is 57V.

NOTE2: The reference vector (vector with angle 0 degree) is the vector calculated for the first voltage input channel of the first applied voltage input module. (The first voltage input module is the one, configured closer to the CPU module.)

1.3. Examples

When the vector position of the voltages are relevant (e.g. distance protection, directional overcurrent protection, power measurement, synchrocheck, etc.) then mind the correct connection of the instrument transformers and the related parameter setting. If the wires of the secondary cables are interchanged then change also the related parameter values.

1.3.1. Phase voltage and residual voltage measurement

Figure 1-1 shows the phase voltage measurement and also the residual voltage measurement e.g. for residual directional overcurrent protection function. In this example the residual voltage is measured in open delta of the VT secondary coils. The network is supposed to be compensated. This figure also indicates the proposed parameter values.

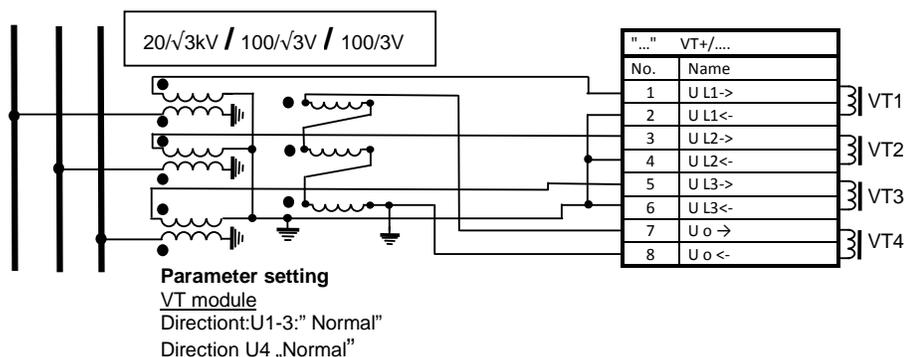


Figure 1-1 Example: Phase voltage and residual voltage measurement

| | | |
|--------------------|---------------|---|
| Range | Type 100 | The type indicates the rated secondary voltage of the VT. This can be 100 V (in this example) or 200V |
| Connection U1-3 | Ph-N-Isolated | This indicates that the VT primary is connected between the conductor and the ground (in this example in compensated network). This could be Ph-N or Ph-Ph in other application. (NOTE: If the neutral of the system is not grounded, select Ph-N-Isolated) |
| Connection U4 | Ph-Ph | In case of earth fault the open delta measures 100 V. This corresponds to the phase-to-phase value |
| Direction U1-3 | Normal | Figure 1-1 shows the normal VT connection, i.e. the signed • phase wires are connected to the terminals 1-3-5. (Select "Inverted" in case of inverted connection.) |
| Direction U4 | Normal | Figure 1-1 shows the normal VT connection, i.e. the signed • wire of the open delta of VT-s is connected to the terminal 7. (Select "Inverted" in case of inverted connection.) |
| VT correction | 100 | If the rated secondary value of the VT is e.g. 110 V then select this correction value to 110%. |
| Rated Primary U1-3 | 20 | Setting, according to the VT rated voltage, applied at the primary side. This parameter is used for scaling the displayed values only. |
| Rated Primary U4 | 11.55 | This parameter is used for scaling the displayed values only. In case of earth fault, the open delta measures 100 V. In primary value it is displayed as the phase voltage in the 20 kV network. |

Table 1-5 Example parameters for the voltage input function

1.3.2. Syncrocheck using phase-to neutral voltage

Figure 1-2 shows the application of the fourth voltage input of the VT module for syncrocheck function. Here UL2 of the busbar voltage is used for this purpose.

NOTE: Among syncrocheck parameters set "Voltage select" parameter to "L2-N."

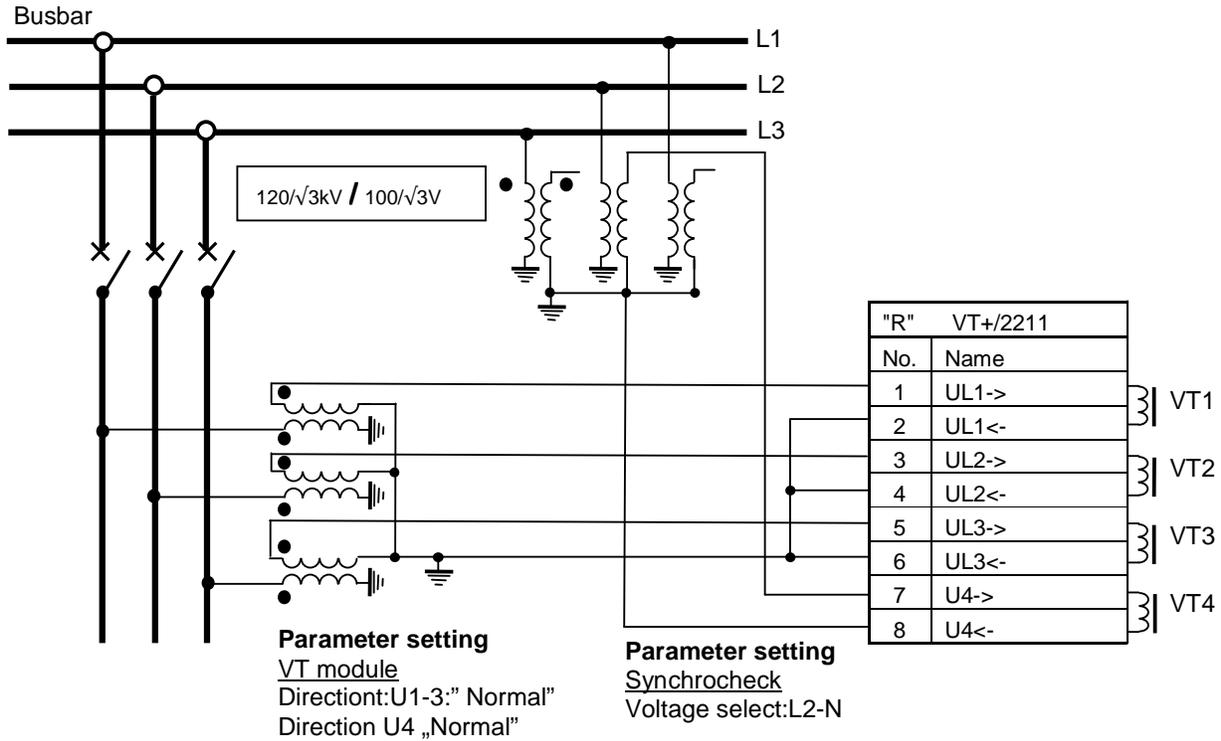


Figure 1-2 Example: Syncrocheck, using phase-to-neutral voltage

Figure 1-3 shows the screenshot indicating the proposed parameter values.



Figure 1-3 Example:Parameters for syncrocheck, using phase-to-neutral voltage

The "On-line window" of the VT4 input module shows the checking the correct voltage vector position. When the line is connected to the busbar, i.e. the CB is closed, in this example the U4 voltage is expected to have the same value and position as U2. See Figure 1-4.



Figure 1-4 Example: On-line measurement for syncrocheck, using phase-to-neutral voltage

1.3.3. Syncrocheck using phase-to-phase voltage

Figure 1-5 shows the application of the fourth voltage input of the VT module for syncrocheck function. Here UL1-UL3 line-to-line signal of the busbar voltage is used for this purpose.

NOTE: Among syncrocheck parameters set "Voltage select" parameter to "L3-L1". This selection is opposite to that, of the connected voltage. This can be corrected selecting the "Direction U4" parameter value to "Inverse".

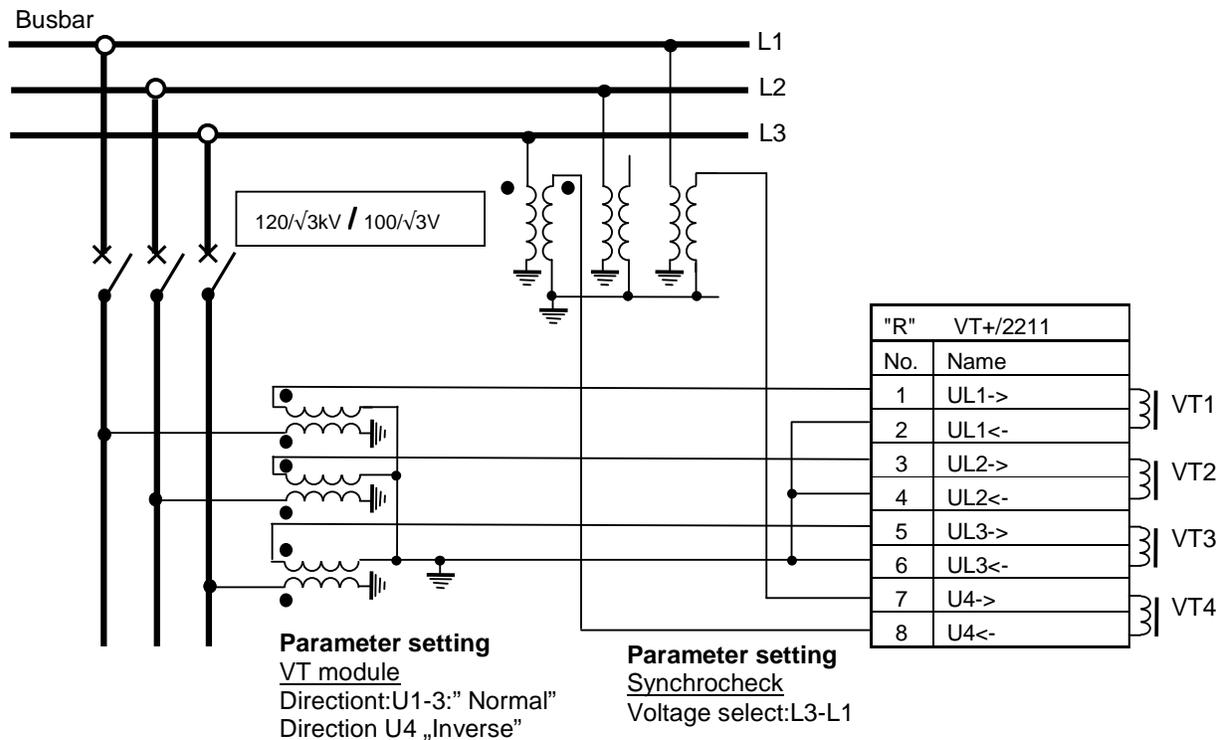


Figure 1-5 Example: Syncrocheck, using phase-to-phase voltage

Figure 1-6 shows the proposed parameter values for the connection shown above.

| | Device value (Default_set_1) | New value | | |
|--------------------|---------------------------------|-----------|----|-------------------------|
| Range | Type 100 | Type 100 | | |
| Connection U1-3 | Ph-N | Ph-N | | |
| Connection U4 | Ph-Ph | Ph-Ph | | |
| Direction U1-3 | Normal | Normal | | |
| Direction U4 | Inverted | Inverted | | |
| VT correction | 100 | 100 | % | (100 - 115 / 1) |
| Rated Primary U1-3 | 69.28 | 69.28 | kV | (1.00 - 1000.00 / 0.01) |
| Rated Primary U4 | 120.00 | 120.00 | kV | (1.00 - 1000.00 / 0.01) |

Figure 1-6 Example: Parameters for syncrocheck, using phase-to-phase voltage

The “On-line window” of the VT4 input module shows the checking the correct voltage vector position. When the line is connected to the busbar, i.e. the CB is closed, in this example the U4 voltage is expected to have a vector identical with the voltage difference U3-U1. See Figure 1-7.

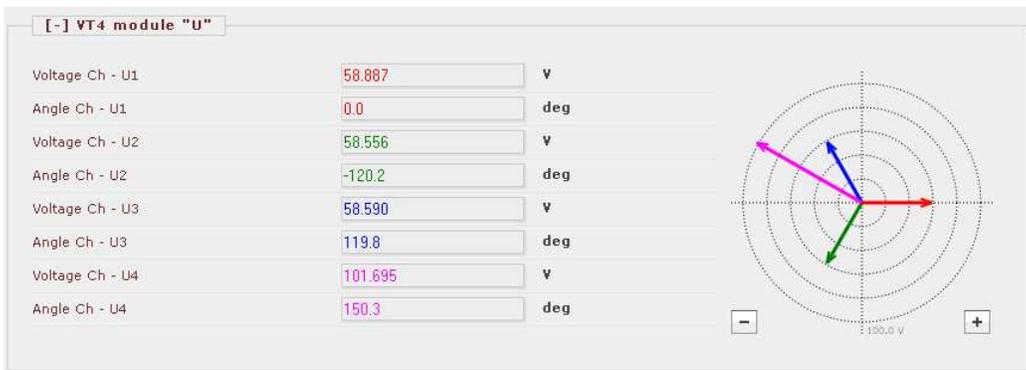


Figure 1-7 Example: On-line measurement for syncrocheck, using phase-to-phase voltage

NOTE that due to the reverse connection of the voltage difference and the parameter setting also reverted by “Inverse” setting, the indicated U4 vector corresponds to the parameter “Voltage select=L3-L1” among syncrocheck parameters.