Motor differential protection schemes

This application note applies to Vamp 265, Vamp 300 and WIMO

1 Differential protection using 6 CT’s

CT settings
Here the motor high and low side primary and secondary CT ratings are set according to the actual CT ratios.

Transformer Settings
Here the motor name plate settings must be calculated using below formula:

\[ S_{MOT} = I_{MOT} \times U_N \times \sqrt{3} \]

where:

- \( I_{MOT} \) = motor nominal current
- \( U_N \) = motor nominal voltage
- \( S_{MOT} \) = motor nominal power

Given settings in VAMP 265 relay:

- \( I_L \) Side Nominal Voltage = \( U_N \)
- \( I'_L \) Side Nominal Voltage = \( U_N \)
- Transformer nom Power = \( P_{MOT} \)

Transformer connection group has to be set as \( Yy0 \).
I_0 compensations have to be set OFF.
**Settings of the differential protection**

ΔI> 87 function shall be enabled for differential protection.

ΔI> pick-up setting range is user selectable from 5 % to 50 %.

Slope 1 can be set to 5 %

I_{BIAS} for start of slope 2 can be set to 3 x I_{N}

Slope 2 can be set to 50 %

If CTs are saturating at through faults, the Slope 2 settings must be changed accordingly.

ΔI> 2^{nd} harmonic block enable can be set OFF (disabled).

ΔI> 2^{nd} harmonic block limit can be disregarded and the factory default setting can be left intact.

## 2 Motor differential protection using flux balancing principle

![Diagram of VAMP 265 connected as a motor differential protection using 3 core balance CT's connected using flux balancing principle.](image)

In this application mode the settings in VAMP 265 relay’s menu SCALING should be set as described in the following section.

**CT settings**

CT Primary and CT Secondary settings shall be set according to the actual core balance CT ratios.

CT’ Primary and CT’ Secondary settings can be disregarded and the factory default settings can be left intact.
Transformer settings
Here the motor name plate settings must be calculated using below formula:

\[ S_{MOT} = I_{MOT} \times U_N \times \sqrt{3} \]

where:
- \( I_{MOT} \) = motor nominal current
- \( U_N \) = motor nominal voltage
- \( S_{MOT} \) = motor nominal power

Given settings in VAMP 265 relay:
- \( I_L \) Side Nominal Voltage = \( U_N \)
- \( I'_L \) Side Nominal Voltage = \( U_N \)
- Transformer nom Power = \( P_{MOT} \)

Transformer connection group has to be set as \( Yy0 \).
\( I_0 \) compensations have to be set OFF.

Settings of the differential protection
\( \Delta I > 87 \) function shall be enabled for differential protection.
\( \Delta I > \) pick-up setting range is user selectable from 5 % to 50 %.

Slope 1 can be set to 5 %
\( I_{BIAS} \) for start of slope 2 can be set to 3 \( \times \) \( I_N \)
Slope 2 can be set to 50 %

\( \Delta I > \) 2\textsuperscript{nd} harmonic block enable can be set OFF (disabled).
\( \Delta I > \) 2\textsuperscript{nd} harmonic block limit can be disregarded and the factory default setting can be left intact.

Setting Example 1:
Motor name plate ratings:
- \( P_{MOT} = 200 \) kW
- \( I_{MOT} = 352 \) A
- \( U_N = 380 \) V
- CT ratio 100/5 A

\[ S_{MOT} = 352 \times 380 \times \sqrt{3} = 232 \text{ kVA} \]
Target \( \Delta I > \) pick-up level 18 A \( \rightarrow (18/352) \times 100 = 5 \% \)

- \( I_L \) Side Nominal Voltage = 380 V
- \( I'_L \) Side Nominal Voltage = 380 V
- Transformer nom Power = 232 kVA
pick-up 5 %
Setting Example 2:
Motor name plate ratings:
\[ P_{MOT} = 3 \text{ MW} \]
\[ I_{MOT} = 305 \text{ A} \]
\[ U_N = 6.6 \text{ kV} \]
CT ratio 100/5 A

\[ S_{MOT} = 305 \times 6600 \times \sqrt{3} = 3487 \text{ kVA} \]
Target \( \Delta I > \) pick-up level 20 A → \( (20/305) \times 100 = 7 \% \)

\[ I_L \text{ Side Nominal Voltage} = 6600 \text{ V} \]
\[ I_L' \text{ Side Nominal Voltage} = 6600 \text{ V} \]
Transformer nom Power = 3487 kVA
pick-up 7 %