

## Motor differential protection schemes

This application note applies to Vamp 40, Vamp 265, Vamp 300 and WIMO

### 1 Differential Protection using 6 CT's

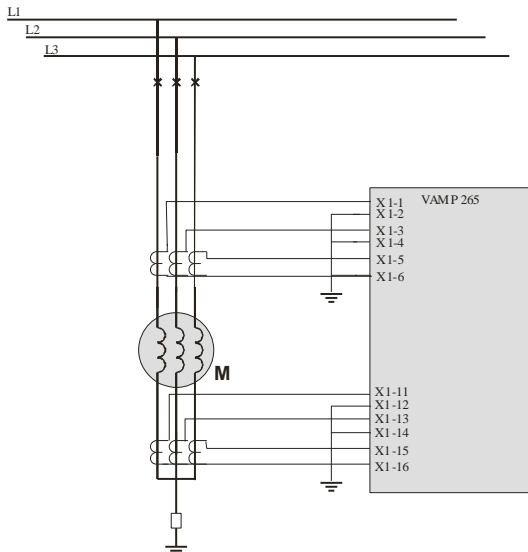


Figure 1 VAMP 265 connected as a motor differential protection using 6 CT's.

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

#### 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**

$\Delta I > 87$  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 %

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

$\Delta I > 2^{nd}$  harmonic block enable can be set OFF (disabled).

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

**2 Motor differential protection using flux balancing principle**

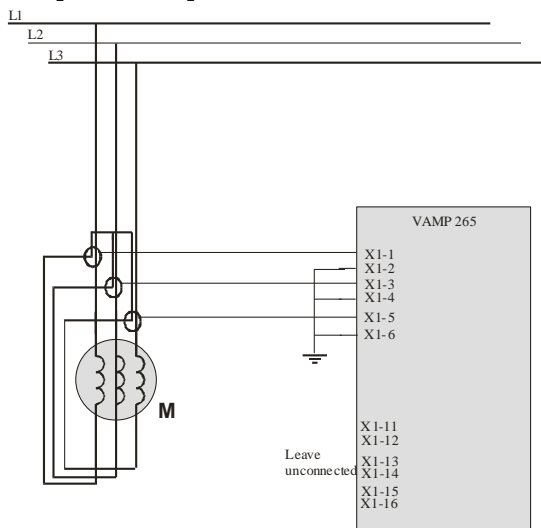


Figure 2 VAMP 265 connected as a motor differential protection using 3 core balance CT's connected using flux balancing principle.

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 %

$\Delta I > 2^{nd}$  harmonic block enable can be set OFF (disabled).

$\Delta I > 2^{nd}$  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

$S_{MOT} = 352 \times 380 \times \sqrt{3} = 232$  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

$$S_{MOT} = 305 \times 6600 \times \sqrt{3} = 3487 \text{ kVA}$$

$$\text{Target } \Delta I > \text{pick-up level } 20 \text{ A} \rightarrow (20/305) \times 100 = 7 \%$$

 $I_L$  Side Nominal Voltage = 6600 V $I'_L$  Side Nominal Voltage = 6600 V

Transformer nom Power = 3487 kVA

pick-up 7 %

### 3 VAMP 40 applied as motor differential protection

Alternatively VAMP 40 unit may be applied as a differential protection in a flux balancing connection (see figure 2) instead of VAMP 265.

The three core balance CT inputs shall be connected to VAMP 40 terminals' X6:1, X6:3, X6:5 and the common shall be connected to X6:2, X6:4, X2:6 respectively.

Three programmable stages with coupling to IL1, IL2 and IL3 can be used for differential protection in order to achieve the sensitivity of 5 %.

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