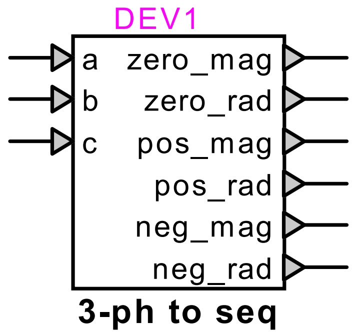
Meter : 3-phase to sequence polar



1 Description

This device converts the first harmonic of the instantaneous value of 3 phase signals to the polar coordinates of the corresponding zero-, positive-, and negative-sequence phasors in a reference frame rotating at the fundamental frequency.

1.1 Pins

This meter has nine pins:

pin	*type*	*description*	*units*
a	input pin	phase-a input signal	any
b	input pin	phase-b input signal	same as a
c	input pin	phase-c input signal	same as a
zero_mag	output pin	magnitude of zero-sequence phasor	same as a
zero_rad	output pin	angle of zero-sequence phasor	rad
pos_mag	output pin	magnitude of pos-sequence phasor	same as a
pos_rad	output pin	angle of pos-sequence phasor	rad
neg_mag	output pin	magnitude of neg-sequence phasor	same as a
neg_rad	output pin	angle of neg-sequence phasor	rad

1.2 Parameters

The following parameter must be defined:

parameter	*description*	*units*

freq	fundamental frequency of the input signal	Hz

1.3 Input

The input pins may be connected to any control signals.
The 3 signals are the instantaneous values of a 3-phase quantity.

1.4 Output

The outputs are the polar phasor representation of the zero-, positive-, and negative-sequence transformations of the instantaneous values of the 3-phase input signals. The polar coordinates are the magnitude and angle of the phasors in a reference frame rotating at the fundamental frequency.

The coordinates of the phasors in that reference frame are calculated over a sliding time window of period equal to *1/freq*, as follows.

The (x,y) coordinates of the first harmonic of each input signal *k* are calculated as

$$\begin{aligned} x_k &= \frac{2}{\text{period}} \cdot \int_{t-\text{period}}^{t} in_k(t) \cdot \cos(2\pi \cdot freq \cdot t) \cdot dt \\ y_k &= \frac{2}{\text{period}} \cdot \int_{t-\text{period}}^{t} -in_k(t) \cdot \sin(2\pi \cdot freq \cdot t) \cdot dt \end{aligned} \quad (1)$$

where the negative sign for *y* follows the engineering convention for an inductive (lagging) current to have a negative angle when phasor rotation is counterclockwise.

The (x,y) coordinates of the zero-sequence transformation are calculated as

$$\begin{aligned} seq0\_x &= \frac{1}{3} \cdot (x_a + x_b + x_c) \\ seq0\_y &= \frac{1}{3} \cdot (y_a + y_b + y_c) \end{aligned} \quad (2)$$

The (x,y) coordinates of the positive-sequence transformation are calculated as

$$\begin{aligned} seq1\_x &= \frac{1}{3} \cdot \left(x_a + r x_b + r^2 x_c\right) \\ seq1\_y &= \frac{1}{3} \cdot \left(y_a + r y_b + r^2 y_c\right) \end{aligned} \quad (3)$$

The (x,y) coordinates of the negative-sequence transformation are calculated as

$$\begin{aligned} seq2\_x &= \frac{1}{3} \cdot \left(x_a + r^2 x_b + r x_c\right) \\ seq2\_y &= \frac{1}{3} \cdot \left(y_a + r^2 y_b + r y_c\right) \end{aligned} \quad (4)$$

where r represents a phasor rotation of $2\pi/3$, and r^2 a rotation of $4\pi/3$.

The conversion to polar coordinates is calculated individually for each sequence phasor as

$$\begin{aligned} \text{magnitude} &= \sqrt{seqn\_x^2 + seqn\_y^2} \\ \text{angle} &= \tan^{-1}\left(\frac{seqn\_y}{seqn\_x}\right) \end{aligned} \quad (5)$$

The phasor magnitude is the peak amplitude, not the RMS value. The phasor angle is expressed in radians.