



VEBKO ONLINE HELP

PMU Test

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Section	PMU Test
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1 Imported Content

The function of the PMUR device is to record phasor, frequency and rate of frequency changes (ROCOF). The measurement error of each of these values is defined by TVE, FE and RFE respectively as follows:

In the above, X and $\hat{X}$ represent the real value of the phase and the value estimated by the PMU, the i and r indices represent the imaginary and real parts of the phase X respectively.

$$TVE = \sqrt{\frac{(\hat{X}_r - X_r)^2 + (\hat{X}_i - X_i)^2}{(X_r)^2 + (X_i)^2}}$$

Figure 1

The test device is required to record the theoretical value of the injected signal for all time tags along with its signal-to-noise ratio (SNR). The PMU sends the measured data to the test machine using C37.118 protocol.

The test device compares the theoretical and measured values of phase, frequency and ROCOF for specific time tags determined by the rate of data transmission, and computes TVE, FE and RFE values.

$$FE = f_{\text{measured}} - f_{\text{ref}}$$

$$RFE = (df/dt)_{\text{measured}} - (df/dt)_{\text{ref}}$$

Figure 2

A phase measurement unit (PMU) is a device used to estimate the amount and phase angle of an electric phase value (such as voltage or current) in an electrical grid using a common time source for

synchronization. Time synchronization is usually provided by GPS or IEEE 1588 Precision Time protocol, which allows simultaneous measurement of multiple remote points on the network. They are capable of taking samples from the waveform sequentially and reconstructing the phase quantity, which consists of an angle measurement and a large measurement. These synchronous measurements are important because if the supply and demand of the network are not fully matched, frequency imbalances can cause stress on the grid, which is a potential cause of power outages.

PMUs can also be used to measure frequencies on the power grid. A typical commercial one can report measurements with very high temporal resolution, up to 120 measurements per second. This helps engineers analyze the dynamic events in the network that are not feasible with traditional SCADA measurements that create a measurement every 2 or 4 seconds. Consequently, PMUs equip installations with advanced monitoring and control capabilities and are considered to be one of the most important measurement devices in the future of power systems. The PMU can be a dedicated device, or the PMU function can be incorporated into a protective relay or other device.

To perform PMU test on the start screen of the software, click on the Phasor measurement unit (PMU) room, and in the opened page, 4 tests are designed in 4 tabs called Steady State, Modulation, Frequency ramp, Step.

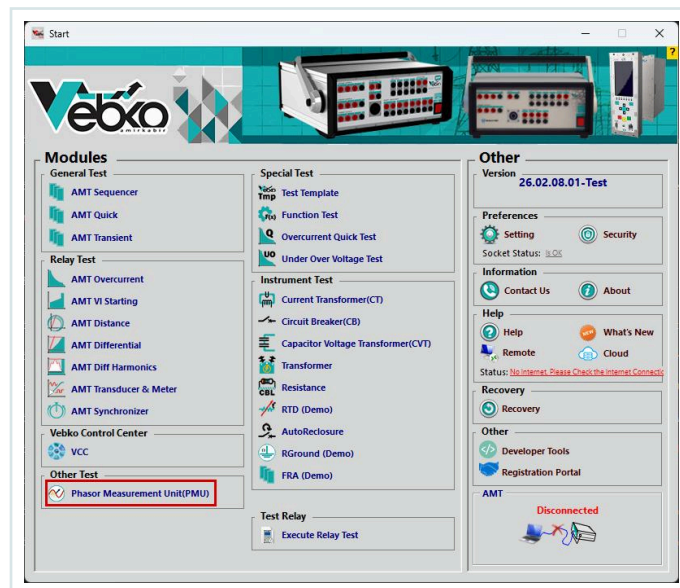


Figure 3

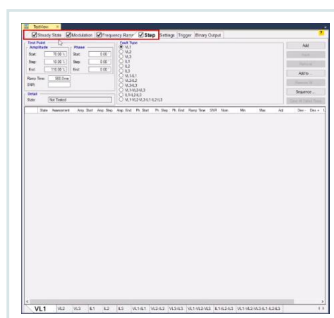


Figure 4

In the Steady State tab, you can see different modes. For example, in Fault Type VI1, Mode adds two points with harmonic characteristics of 2, 40% and 70% and 0.2 seconds and after testing and comparing the nominal and measured values, the test will pass or fail.

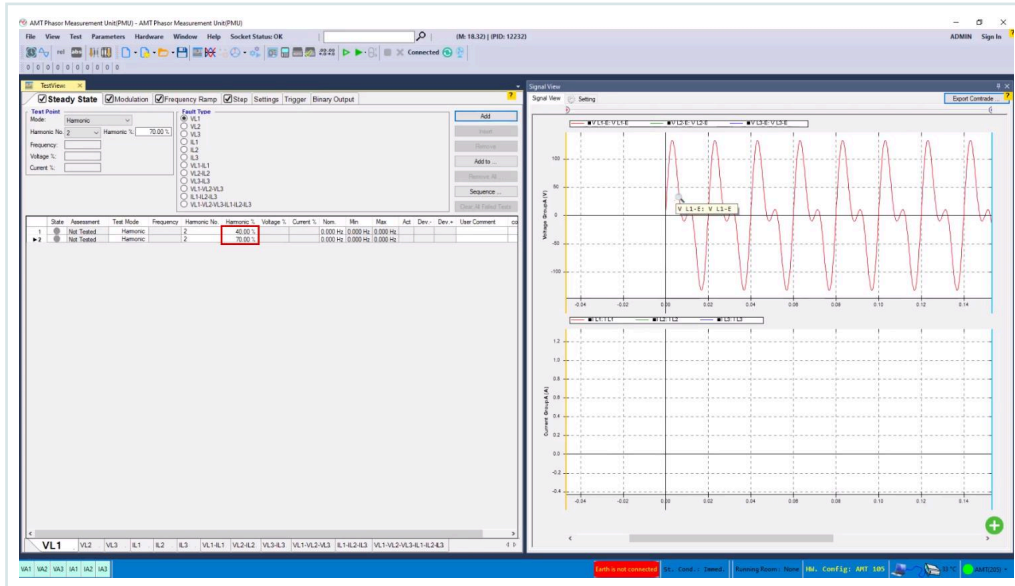


Figure 5

The Modulation tab consists of two tests of amplitude modulation and phase. According to the standard, either amplitude modulation or phase modulation is applied. The signal model in modulation is considered as follows:

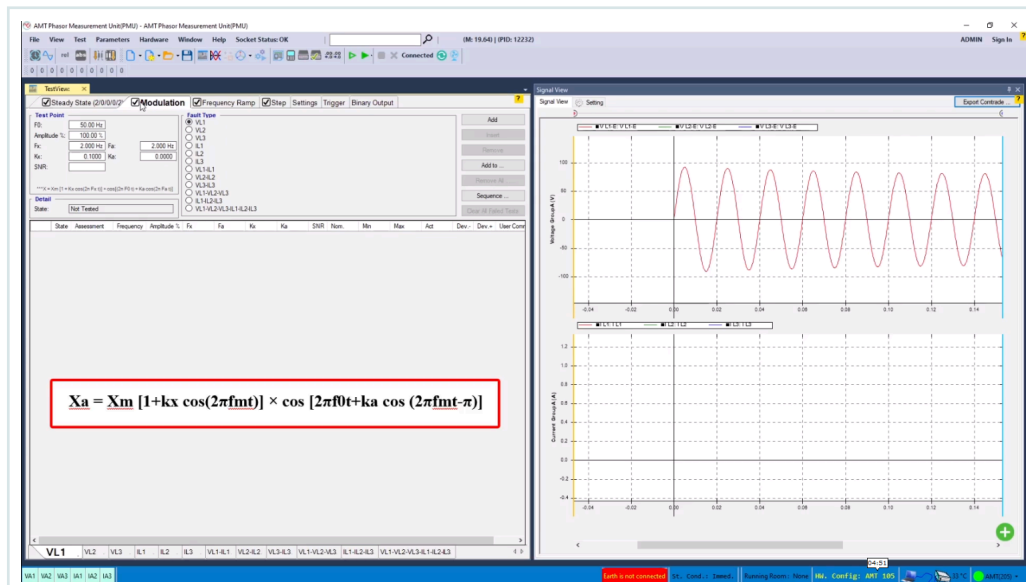


Figure 6

$$X_a = X_m [1 + k_x \cos(2\pi f_m t)] \times \cos [2\pi f_0 t + k_a \cos (2\pi f_m t - \pi)]$$

For this test, the first points of interest are added, for example, a point with the specifications of $F_0=500\text{Hz}$, amplitude 100%, $K_x=0.1$, $F_a=100\text{Hz}$, $K_a=0.9$ and $\text{SNR}=40\text{dB}$, and after performing the test and getting feedback from PMU and comparing the nominal and measured values, the test will pass or fail.

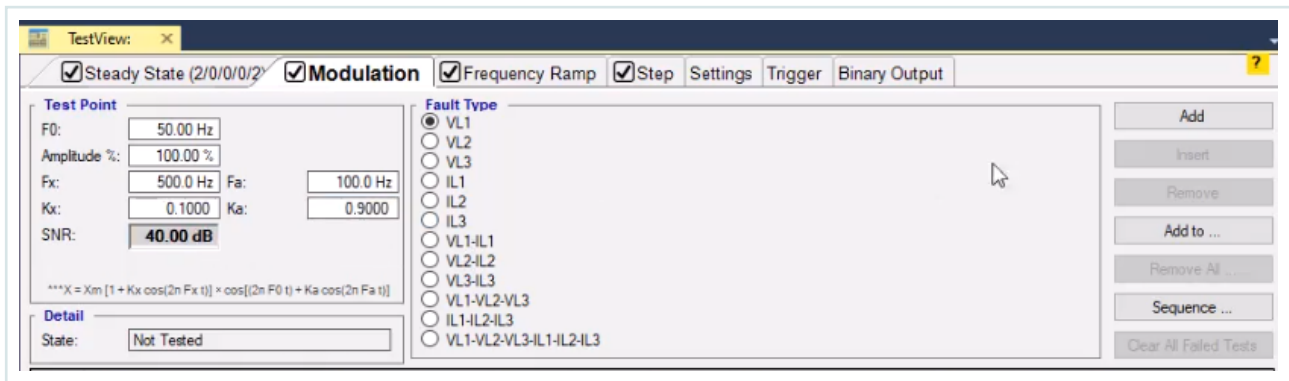


Figure 7

The other two tests will be passed or fail after adding the points and running the test and getting feedback from the PMU and comparing the measured and rated values.

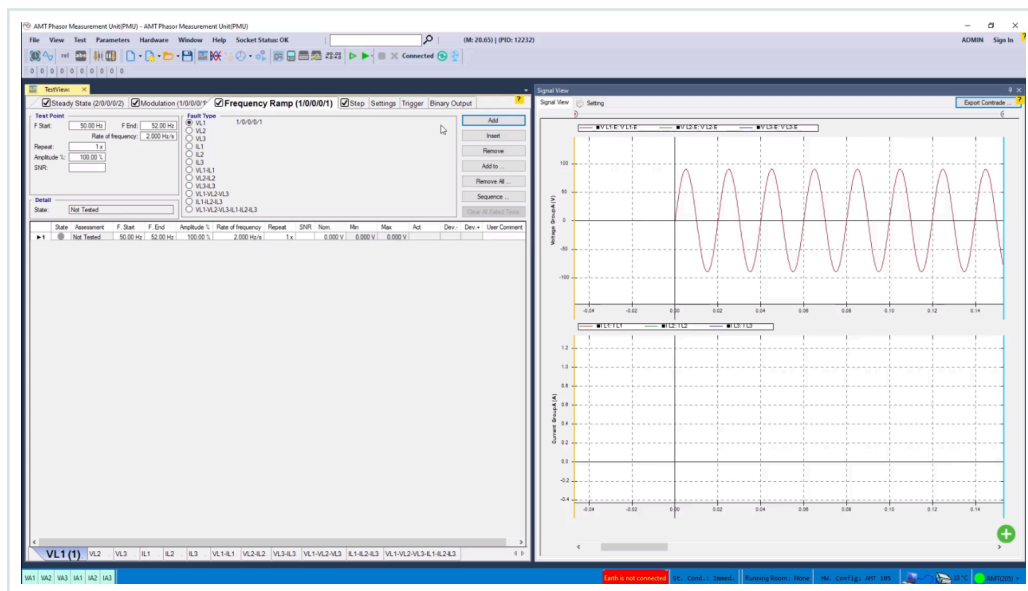


Figure 8

[jg1]Rogowski_Coil_Test