

The Telemetric TVM Voltage Monitor

The TVM product line is intended to be a low cost voltage monitor that can be used to report outages and provide a first indication of voltage problems. The TVM is available in single phase (TVM1) and three phase (TVM3) models that fully integrate wireless communication with the voltage and outage measurement instrumentation. This white paper explains how the TVM carries out voltage and outage measurements.

TVM VOLTAGE MEASUREMENTS

The TVM includes two types of AC voltage monitoring: sag/surge monitoring and true RMS steady state voltage monitoring.

Sags and Surges

Sags and surges can be detected and measured within two cycles (~0.032 seconds). The three voltages (phases A, B, & C) are each measured **once per cycle** at the peak of the AC waveform. (The zero crossing point is detected, and then the voltage is measured 0.004167 seconds later.) The voltage reading is then compared to five different user programmable acceptable voltage limits (set points). If the voltage goes out of range, an event timer is started. If the event lasts longer than the user programmable trigger time, a reportable event has occurred.

After a reportable Under/Over Voltage event has occurred, the TVM will continue to monitor the voltages for an additional 16 seconds. After that time, a report will be sent which includes:

- the set point that was exceeded
- the phase(s) that triggered the call
- the minimum or maximum voltage that was measured for each phase, and
- the duration of time that the trigger time was exceeded (up to 16 seconds).

If the under or over voltage condition is ongoing at the time of the call, the call will report a

“continuing” voltage condition. A second call will then be made when the voltage condition clears.

True RMS

Steady state voltages are measured every 3 seconds using true RMS measurement techniques. The TVM3 time-scheduled report includes the minimum and maximum steady state RMS voltages (measured since the last report) for all three phases. If the product is configured as a TVM1, the default report includes the present voltage, plus the minimum and maximum voltage as measured for one phase only.

Transient voltage readings can be further filtered out of the steady state report by enabling the 96-second averaging routine, in which 16 six-second readings are averaged over a 96 second period. This averages and reports the present, minimum and maximum values.

Power Outage Reporting

A power outage is reported when a monitored phase drops below 30 VAC for longer than the user specified trigger time. An outage event will replace any pending under voltage event, and an under voltage will not be reported. If outage reporting is disabled and under voltage set points are exceeded during an outage, an under voltage will be reported.

Outage Duration Reporting

When the voltage drops below 30 VAC for more than the trigger time, a reportable event has occurred. For the next one minute, the TVM will count and time any further state changes (power on or off). After one minute, the TVM will report the number and duration of up to 7-state changes. Durations will be reported in seconds (if duration reporting is enabled).

TIMING FOR EVENT REPORTS

Here are some more details on the way the TVM recognizes and reports events.

Under and Over Voltage events:

1. The TVM monitors voltage until it falls below or rises above user specified set points (3 under voltage values, 2 over voltage vales are available). It then starts timing the event.
2. If the event ends before the applicable trigger time has been exceeded, a report is not sent and the TVM goes back to monitoring the voltage.
3. If the event exceeds the trigger time, the TVM prepares to call in and report the event. It waits approximately **16 seconds** before placing the call. If the event ends (i.e. the voltage returns to normal) during that 16 seconds, the TVM reports a **momentary** event (and reports duration). This is indicated by an “M” next to the voltage reading on the TVM Status page in the web site. If the event is still ongoing when the TVM makes the call, it reports a **continuing** event. If it reports a **continuing** event, the TVM will then place a second call to report when the event has ended.

Note: The OV or UV call includes the highest or lowest reported voltage that it saw during the trigger time, not the voltage that it sees at the time of the call.

Outage events:

1. The TVM monitors the voltage, and if it falls below 30 VAC it considers this the beginning of an outage event and starts timing the event.
2. If the event ends before the outage trigger time has been exceeded, nothing happens.
3. If the event exceeds the outage trigger time, the TVM then waits an additional **one minute and 16 seconds** before placing the call. If the outage ends during that time, the TVM reports a **momentary** outage. If there are a number of outages during that time that exceed the trigger time, the TVM will report each state change and the duration of each one, up to seven state changes (if Outage Duration Reporting is turned on). If an outage still exists when the TVM makes its outage call, it will report a **permanent** outage.
4. If the TVM reports a permanent outage, it will wait one minute after making its outage call. If the power comes back on before that minute is over, the TVM will make a **Power Restoration** call. If the power is still out at the end of that minute, the TVM will then shut itself down to preserve battery power. When it is shut down it will not hear or respond to any requests from the web site. When it sees the return of AC power after being shut down, it will wake up and make a **Registration** call including the current voltage