UR Family

CT/VT Modules with Enhanced Diagnostics

Technical Note

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This document explains advantageous functions of GE Universal Relay (UR) current transformer (CT) and voltage transformer (VT) modules 8L, 8M, 8N, 8R, 8S, and 8V.

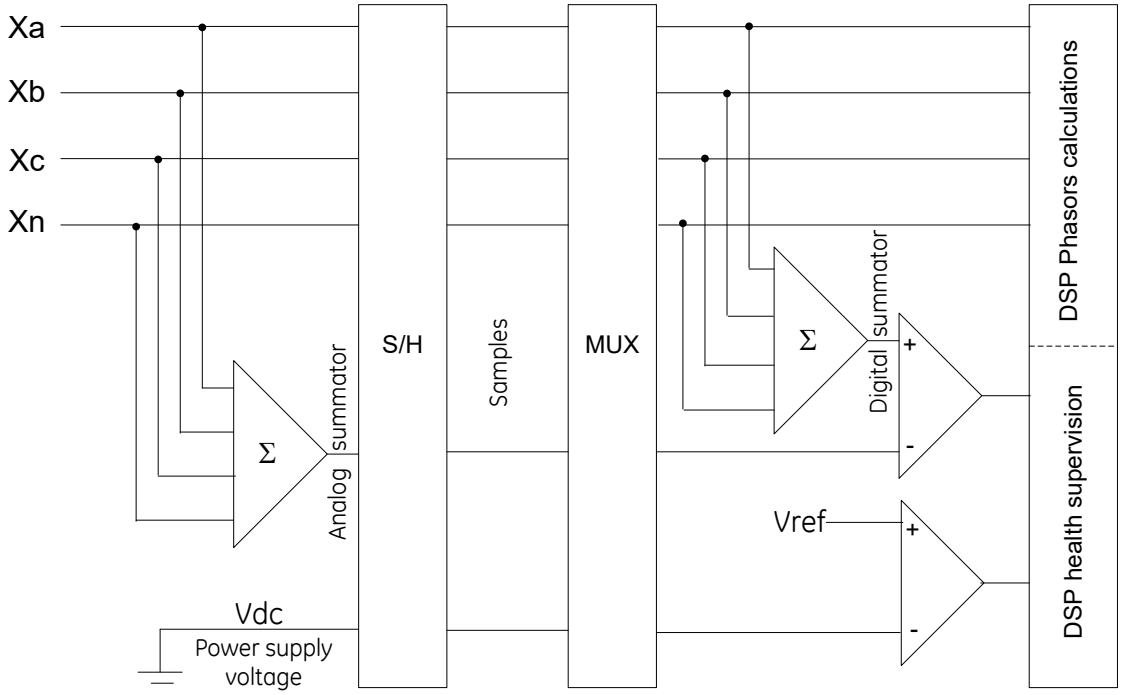
Introduction

The performance of a microprocessor-based relay is highly dependent on the performance of the analog channels measurement of the relay, as protection functions operate on these values. The failure of an analog measurement channel, either due to a failure in the external measurement circuit, or due to an internal failure inside a UR CT/VT module, can cause incorrect operation of protection functions. The UR CT/VT modules with Enhanced Diagnostics (module types 8L, 8M, 8N, 8R, 8S, 8V) can detect the failure of an analog channel measurement due to internal failures of the CT/VT module, alarm for failure of the module, and block tripping from any protection function associated with this module. This feature is available when using firmware 5.20 or later within the UR family and therefore field-proven since 2006.

Analog data integrity validation

The CT/VT input modules (8L, 8M, 8N, 8R, 8S, 8V) use an analog data integrity check to verify the performance of the analog measurement channels. This feature uses an additional analog hardware channel that has as its input, an analog sum of Sa = Xa – Xb + Xc + Xn, where X stands for either Voltage or Current phases A, B, C, and N analog inputs, to monitor the integrity of analog data.

Figure 1: CT/VT module with enhanced diagnostics



After the multiplexer samples analog channels via the sample and hold (S/H) mechanism, samples from all four channels are summed up digitally, using the same equation to get a digital value Sd. The “Mean Square” of the difference between the channels is summed up in the hardware and an equivalent, computed digitally over one protection pass is supplied to the comparator.

If the summed squared difference $\Sigma(Sa - Sd)^2$ is greater than the adaptable per signal level error boundary, then “invalid data” is declared and protection functions using the measured data are momentarily blocked. In addition, if the error keeps repeating, a major self-test diagnostics error message is displayed on the UR. As a result of such failure, the relay’s self-test alarm contact operates and the relay is taken out of service. The relay can be rebooted and if no more failures are detected, it continues to be functional unless a new failure is detected and the relay is again taken out of service. The above analog data integrity check is performed on both analog banks (that is, four currents or four voltages) within each CT/VT input module.

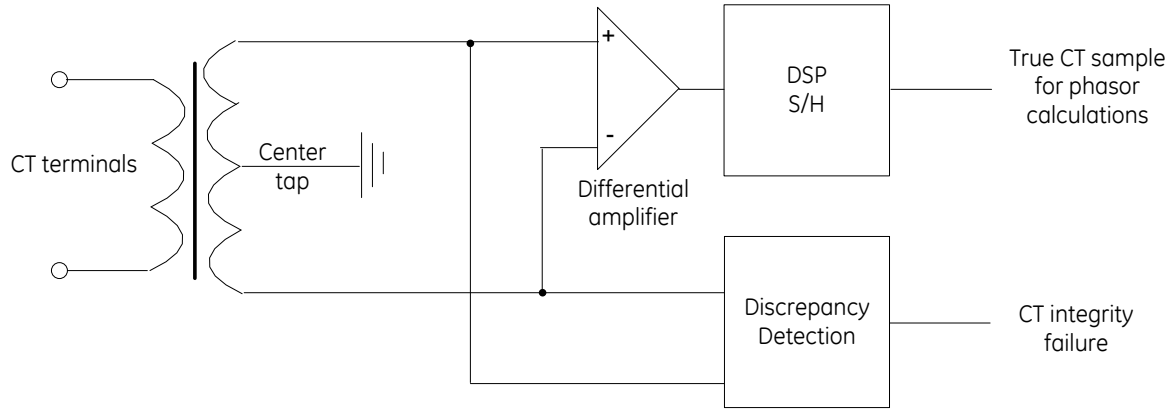
In addition, these modules with enhanced diagnostics include power supply voltage rail monitoring to further monitor hardware health. This is achieved by continuous check of the power supply voltage Vdc against safe operate reference voltage Vref, which ensures that all electronic components of the CT/VT module operate in the safe operating conditions.

Internal CT secondary monitoring

The CT/VT input modules with enhanced diagnostics are monitoring internal CT circuitry integrity. This is done to eliminate relay erroneous operation in case of CT secondary winding failure. The secondary

winding of CT is divided into two equal parts with a central tap in the middle. CT current values from both halves of the CT secondary windings are run through a differential amplifier to get a true current sample for the phasor calculations. It also compares between each other by simply summing two samples together. (Note that due to CT central tap, samples have different polarity.) In case that values from different halves of the same CT accumulated over one protection pass per adaptable per signal level do exceed the fixed error boundary, failure is declared and protection is blocked. CT secondary monitoring is performed at all four CT channels (A, B, C, and N) individually at each CT bank.

Figure 2: CT secondary integrity monitoring



Conclusion

CT/VT modules with enhanced diagnostics, released on 23 October 2006 with firmware 5.2, offer much higher security for internal CT/VT module error detection and prevent undesired operations of URs. Every UR firmware released since version 5.2 supports CT/VT modules with enhanced diagnostics, which greatly improves the security and reliability of the protection system.

To take advantage of this feature, a relay hardware and possibly firmware upgrade is required. If the existing relay has a firmware version below 4.0, GE recommends purchasing a UR Upgrade Kit that allows modernization of the obsolete relay hardware while taking advantage of the relay modularity. The UR Upgrade Kit contains a new CPU and CT/VT modules that can be inserted in an existing relay case (case is fully backwards compatible).

If the relay currently has firmware version 4.0 to 5.0, the latest firmware can be downloaded from the GE Multilin website, and Enhanced Diagnostic CT/VT modules (8L, 8M, 8N, 8R, 8S, 8V) can be purchased from the GE Online Store.

Consult with your local GE representative if you have any questions on the upgrade process.

GE VERNOVA

For further assistance

For product support, contact the information and call center as follows:

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