Technical description of memory behaviour in VAMP protection relays

The information described below is applicable for the VAMP 200 series relays.

MEMORIES

There are four different kinds of memories in VAMP protection relays.

FLASH ROM

The software of the relay is stored in this Read Only Memory (ROM). The chip is programmed in the production and the data is stable; retention time is at least 20 years at chip temperature +125°C, which gives a much longer time at ambient temperature +55°C or less.

E2PROM

User parameters and calibration values are stored in an Electrically Erasable Programmable Read Only Memory (E2PROM). The data retention time is 100 years or more. The software is continuously supervising the consistency of data stored in this memory.

Non-volatile RAM with super capacitor back-up

The first three events with time stamps of the last event burst are stored in this capacitor back-upped Random Access Memory (RAM) memory. The data retention time in power off situation is more than five days.

RAM

The latest 50 events with time stamps and disturbance recordings are stored in this Random Access Memory (RAM) memory. All data is lost during a power off situation.

FUTURE PLANS

Vamp is working with a new CPU-card with non-volatile RAM for disturbance recordings and one hundred latest events. The data retention time in power off situation should be more than 50 h.

WATCHDOG FUNCTIONS

There are three watchdogs in VAMP relays.

Watchdog #1

This is an external watchdog chip which the software is feeding every 100 m/s. If the time between two feed actions is longer than 1 s, the watchdog will reset the CPU.

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Watchdog #2

This watchdog is integrated on the CPU chip. It is enabled by the software before the operating system is started. This watchdog is fed every 5 m/s unless some software supervising function finds any malfunction. If the time between two feed actions is longer than 60 m/s the watchdog will reset the CPU.

Watchdog #3

This is an external watchdog circuitry which the software is feeding once a second. If the time between two feed actions is longer than 4 s the watchdog will release the internal fault indicating relay. (In normal situation this relay has its coil activated all the time.) Also the red error LED on the front panel will be activated.

SELF DIAGNOSIS FUNCTIONS

The clock of the watchdog #3 is supervised by the software. This way the software and watchdog #3 are continuously cross checking each other. If software runs out of control or the watchdog #3 breaks down the internal fault relay will be released.

Twice every 5 millisecond the stack-pointer value is checked to detect stack overflow or underflow. Also the top of the stack content i.e. the latest return address is checked to be within certain limits.

Internal parameters, values and status are partly supervised during the normal execution.

The internal supply voltages are measured and supervised.

The consistency of setting and calibration data is continuously supervised.

Anytime a self-supervising software function finds a problem the output relay control is disabled by hardware.

Input multiplexer is partially supervised. **(X)**

A/D-converter is supervised. **(X)**

D/A-converter is partially supervised. **(X)**

Output relays are partially supervised. **(X)**

Internal temperature is measured and its maximum is registered into non-volatile memory (E2PROM).

The coverage of self-supervision of software and hardware has not been estimated. It is not a simple task.

NOTICE

Items marked with **(x)** are supported by the hardware and partially supervised with the software.