Built-In diagnostics

The MFT B-series has an extensive set of internal and external sensor/wiring checks it performs and reports. The following diagnostic tools are provided to support service technicians and minimize the amount of down-time on the meter. Intermittent events will also be captured for further evaluation allowing for faster corrective action. Some of the tools are designed for use with the LCD/keypad, some via Tera Term (open source Terminal Emulator for the PC) or KzComm (Kurz upload/download program) and some via Modbus. The available tools are:

- Bit-mapped event code with text description displayed on the local LCD (or echoed to the serial USB port)
- Internal event logs, 200 FIFO records of the bit-mapped event code and meter run-time.
- Min/Max event memory captures the daily extremes for velocity, flow rate, temperature, electronics temperature and the run time this occurred at. This memory has 20 records for each of the above variables.
- Trend data record of 20,416 records captured every 10 seconds. This permits 56+ hours of volatile memory of the flow rate, temperature and run-time, provided the meter does not loose power.
- The current event code or meter status can be read via the Modbus registers. (see Modbus section for details)
- NE-43 alarm, below 3.6 mA or above 21 mA which maps many of the bit mapped errors to NE-43 alarms. (see Figure E-1 for mapping of errors to alarms)
- Diagnostic data accessible through the *Display Mode* Menus. This is provided to aid troubleshooting with numeric data to supplement the bit-mapped event code. There are 5 menu categories, some of which have multiple menu items contained in the category. The 5 menu categories are listed below:
    - Input voltages
    - Sensor leakage
    - Electronics Temperature
    - Sensor Control
    - Sensor Output

Event Code

The MFT B-series status information is contained in a 4-byte long word (32-bit) Event Code. This Event Code provides a bit-wise mapping of the status of the flow meter with each bit corresponding to a specific meter status event as shown in Figure E-1 and E-2 below.

The following is an example of an event code displayed on the meter's local LCD screen:

```
EVENT CODE
IN HEX 200
```

The Event Code is displayed in hexadecimal and is 0x0200 (the leading zero and '0x' hexadecimal notation is not shown). In this Event Code a single bit is set; counting from right to left (LSB to MSB) it is the 9th bit. From Figure E-1, the 9th bit maps to "Meter Kick-out low". This means the flow reading was too low or below the lower limit of the Kick-out which is a user defined flow or velocity point set in *Program Mode*. From Figure E-1, the 9th bit also corresponds to Modbus Register #25.

When multiple errors are detected at the same time, the Event Code gets more complicated. For example if you disconnect the sensor wires after the meter has booted up the following fault will be displayed:

```
EVENT CODE
IN HEX 4025
```

This can be decoded using (Figure E-1) as follows:

	Event Code Bit Map	**Modbus Reg**	**Event Description**
4	Bit #14	30	Abnormal sensor node voltages
0	NA	NA	No errors in registers 24 to 27
2	Bit #5	21	Rps sensor lead open circuit
5	Bit #0 Bit #2	16 18	Rp resistance above high limit Rtc resistance above high limit

As shown by the above example, multiple events/errors can be reported by the single Event Code. In this example the meter is reporting (1) that there is no sensor connected since the voltages are abnormal, (2) the velocity sensor wire resistance sense lead (Rps) is open circuit, (3) Rp and (4) Rtc are reading high impedance.

The error register numbers referenced in Figure E-1 and E-2 are for the 1xxxx Modbus registers.

Figure E-1 Lower Word Event Code bit mapping.

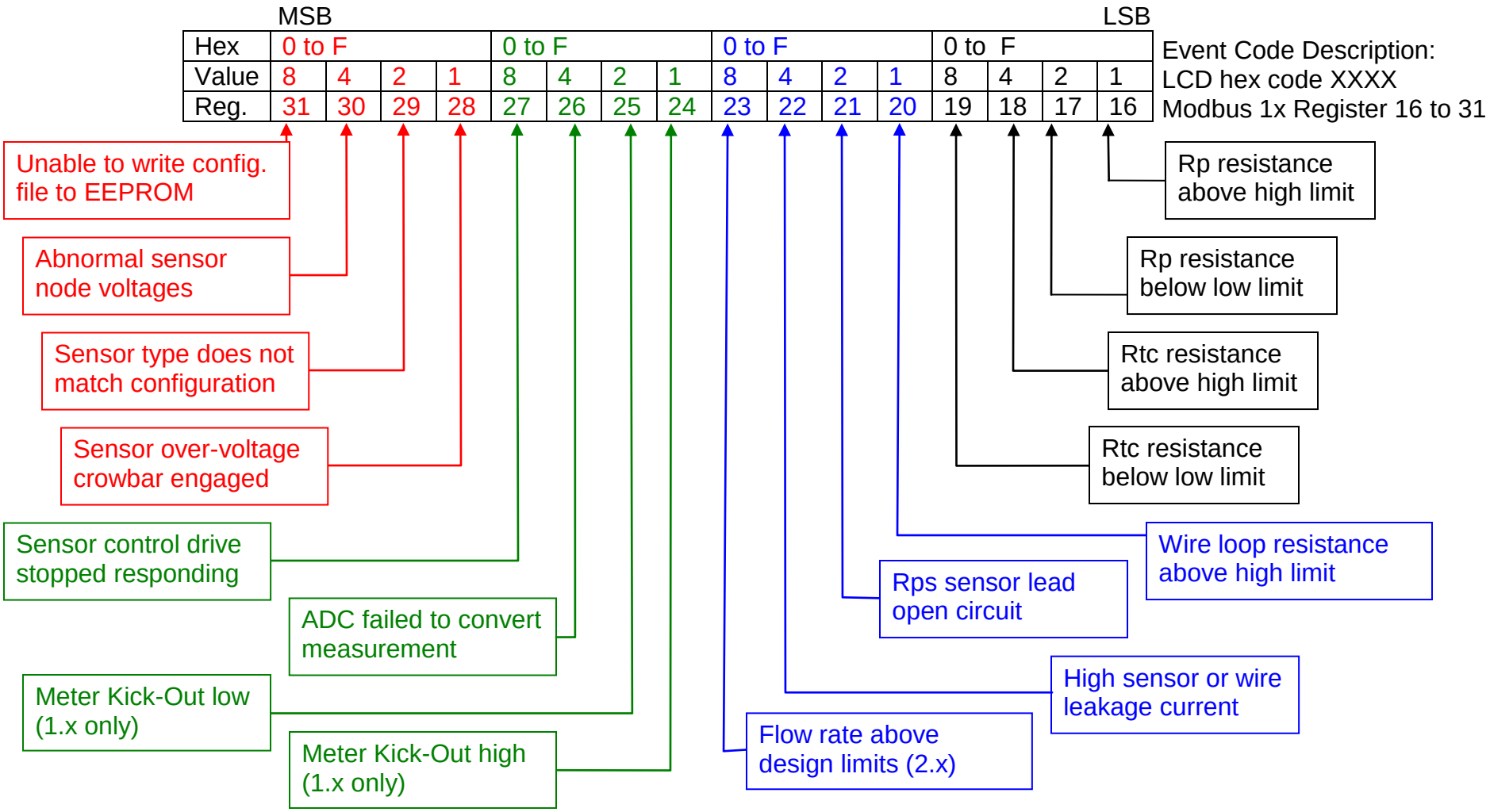


Figure E-2 Upper Word Event Code bit mapping.

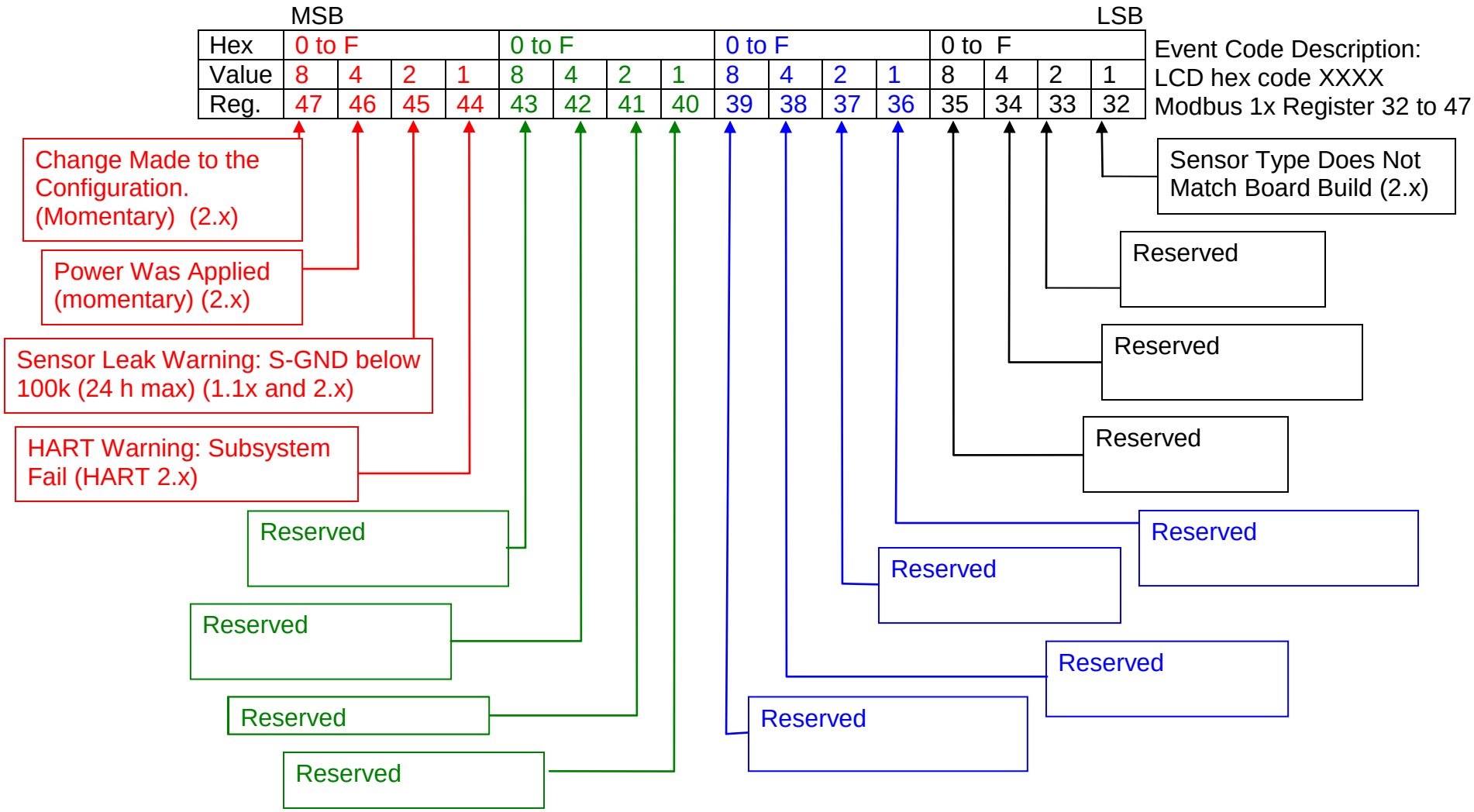


Table E-1. MFT B-Series Diagnostic Error limits

Parameter	Low Limit	High Limit	Comments
Vps	0.150 V	17.6 V	Sensor drive voltage. (used for code 4xxx)
Vll	0.009 V	2.30 V	Sensor wire voltage (used for code 4xxx)
Viph	0.004 V	0.765 V	Sensor current sense voltage (used for code 4xxx)
Vrtch	0.4136 V	2.55 V	Rtc high side voltage (used for code 4xxx)
Vrtcl	0.310	2.55 V	Rtc low side voltage (used for code 4xxx)
Rp, velocity sensor 9/27 FD2 9/300 FD 9/100 MD 20/20 CD	Ohms 5.0 5.0 5.0 10.0	Ohms 30.0 30.0 (32.0) 30.0 60.0	Rp sensor resistance, sensor and temperature dependent. 600 °C mode, 1.1x or higher firmware.
Rtc, process temperature sensor 9/27 FD2 9/300 FD 9/100 MD 20/20 CD	Ohms 14.0 150 50 9	Ohms 100.0 1000.0 350.0 50.0	Rtc sensor resistance, Sensor and temperature dependent
Rwire	0.020 Ohms	5.00 Ohms	Sensor wire loop resistance (total)
Rleak	100 kOhms 20 kOhms		Sensor/wire leakage to ground for first 24 h in 600 °C mode
Rtc/Rp ratio	-10%	+10 %	Sensor Rtc/Rp ratio. Used to know the sensor type “Sensor Type Does Not Match”

Table E-2. Event Code Meaning. (leading zeros are not shown in event codes)

Message/code	Meaning
Rp resistance above high limit Code: xxxxxxx1	Velocity sensor resistance is above the normal range for the sensor type configured. This accounts for sensor core temperature up to ~650 °C before setting the error. ~720 °C in 600 °C mode. Open circuit on the sensor wiring Defective sensor or SC electronics board

Rp resistance below low limit Code: xxxxxxx2	Velocity sensor resistance is below the normal range for the sensor type configured. This accounts for sensor down to -112 °C before setting the error. Short in the sensor wiring Defective sensor or SC electronics board
Rtc resistance above high limit Code: xxxxxxx4	The process temperature sensor resistance is above the normal range for the sensor type configured. This accounts for sensors up to 650 °C for the metal sensors, FD, FD2 and MD and 460 °C on the CD sensor Open circuit on the sensor wiring. Defective sensor or SC electronics board When this limit is reached, the meter will turn the drive off until it cools. This can cause the sensor to regulate at this temperature and set multiple errors in the log as it goes below and above the limit.
Rtc resistance below low limit Code: xxxxxxx8	The process temperature sensor resistance is below the normal range for the sensor type configured. This accounts for sensor down to -120 °C in normal operation before setting an error Short circuit on the sensor wiring. Defective sensor or SC electronics board.
Wire loop resistance above high limit Code: xxxxxx1x	The sensor wire resistance from the sensor it its electronics board is too high, > 5.0 ohms. Loop resistance is from the electronics out to a sensor and back. Wire is too long for the gage being used Loose wire joint connection (but not too loose, see code 20) Defective sensor or SC electronics board
Sensor Rps lead open circuit Code: xxxxxx2x	The sensor wire Rps is open circuit or not connected. Open circuit on the Rps wire, pin 1 of TB1. Open on the Rp lead will also set this, Pin 3, TB1 Defective Sensor or SC electronics board
High Sensor or wire leakage Code: xxxxxx4x	The sensor or wiring is showing too much leakage current to ground. The trip point of this error is the equivalent of 100 kOhms leakage resistance[1]. Wet or contaminated wiring or a junction box Water in the backend of a sensor Corroded front sided to a sensor

[1] Firmware version newer than 1.09 have a factory configuration option to allow operation up to 600 °C for the FD2 Sensor and the event code may be preceded by the warning code 2xxxxxxx.

	Sensor above temperature limit Defected SC electronics board At normal temperatures, three 10 minute leakage updates are required before the error is set.
Flow Rate Above Design Limits (2.x firmware) Code xxxxxx8x	Under high heat flow conditions (very high flow rates), the demand to heat the sensor may exceed the drive limits of the SC electronics board. The reported flow readings at this point will be compressed and lower than the true flow readings.
Meter Kick-Out High (1.x firmware only) Code: xxxxx1xx	If the flow rate or temperature is above the high kick-out limit in the meter, it will set this error code. This is a normal alarm if the flow rate or temperature is above the kick-out set point which is user programmable. Condensate on the velocity sensor can cause high heat flow and will set this also. A change in gas composition to high heat flow gases like H2 can cause this alarm.
Meter Kick-Out Low (1.x firmware only) Code: xxxxx2xx	If the flow rate or temperature is below the low kick-out limit in the meter, it will set this error code. This is a normal alarm if the flow rate or temperature is below the kick-out set point which is user programmable. Drop in process pressure at very low flow rates can cause a loss in heat flow and will set this alarm. A change in gas composition to low heat flow gases like Ar can cause this alarm, or from CH4 to Air.
ADC failed to convert measurement Code: xxxxx4xx	The circuits on the SC board which measures the input signals are not working properly. The SC board is defected and needs to be replaced.
Sensor Control Drive stopped responding Code: xxxxx8xx	The sensor drive voltage to heat the velocity sensor is not matching the set point. Short or miss-wring of the sensor. The SC board is defective and needs replacement.
Sensor Over voltage crowbar engaged Code: xxxx1xxx	The sensor drive voltage was not matching the set point and would not fall to low drive on command. The crowbar SCR was engaged to clamp the sensor drive voltage to zero. Sensor field wiring short to a DC power supply

	(4-20 mA) or 24 V supply Defective SC board which needs replacement.
Sensor type does not match configuration Code: xxxx2xxx	The sensor resistance ratio, Rtc/Rp exceeds 10% of the normal value for the sensor the meter was configured for. Wrong sensor is connected to the electronics. Double check the SN matching Upset to the process temperature causing the two sensors (Rp and Rtc) to not match in temperatures Defective sensor or SC board.
Abnormal Sensor node voltages Code: xxxx4xxx	This fault is often a redundant error to the above entries on sensor and wiring faults. It is looking at the sensor wire voltages only, not just the resistance values. Miss-wired sensor. Short or Open circuit. Defective sensor or SC board.
Unable to write config. File to EEPROM Code: xxxx8xxx	The sensor and meter configuration data can not be verified after a memory write. Defective sensor control (SC) board Any EEPROM read/write fault may set this.
Sensor Type Does Not Match Board Build. (2.x firmware) Code: xxx1xxxx	The version of the SC board hardware is not compatible with the connected sensor type. Board mix-up in production or field service Sensor failure, Board Failure
Code: xxx2xxxx	Reserved
Code: xxx4xxxx	Reserved
Code xxx8xxxx	Reserved
Code xx1xxxxx	Reserved
Code xx2xxxxx	Reserved
Code xx4xxxxx	Reserved
Code xx8xxxxx	Reserved
Code x1xxxxxx	Reserved
Code x2xxxxxx	Reserved
Code x4xxxxxx	Reserved
Code x8xxxxxx	Reserved
Code 1xxxxxxx (HART 2.x firmware)	The subsystem responsible for communicating via the HART protocol is not responding. The unit will not communicate via HART.
Code 2xxxxxxx (1.1x and 2.x firmware)	The sensor is in a process above 100 °C and is leaking current. It has 24 hours to recover to a leakage resistance above 100 k ohms before the warning is converted to an error. Note that if the

	leakage resistance is below 20 k or the process temperature is below 100 °C, it will automatically convert to an error without delay.[2] During the warning the meter will continue to output readings, but upon converting to an error the NE-43 alarms will be set and the meter will no longer output readings. This is designed to allow the sensor to operate while drying out its MI cable. Wet or contaminated wiring or a junction box Water in the backend of a sensor Corroded front sided to a sensor Sensor above temperature limit Defected SC electronics board
Power On or power Cycle (2.x firmware) Code: 4xxxxxxx	This is a momentary code which occurs every time the unit boots up or there is a power cycle. It is logged in the event logs for diagnostics purposes.
Configuration Change (2.x firmware) Code: 8xxxxxxx	This is a momentary code which is logged in the event log any time the meter programming or configuration has been changed. This is for diagnostics purposes. If other errors or meter trouble started after a configuration change, this will support identifying this issue. The type of change is not recorded, only that a change was made and the meter's run time for the change.

[2] Firmware version newer than 1.09 have a factory configuration option to allow operation up to 600 °C for the FD2 Sensor and the warning code may be followed by the error xxxxxx4x.

Table E-4. Some single wire fault error codes and results. AC powered version of 454FTB.

Event Code	Description
0000	No Events/Faults
20	Rps open circuit
4000	Rp short to GND
4000	Rtcl short to GND
4004	Rtcl open circuit
4004	Rtch open circuit
4008	Rtch short to GND
401a	Rpl open circuit
4021	Rp open circuit
Shuts down, reboot attempt every 1 second.	24 V short to Rps. AC supply goes into current limit.
Shuts down, reboot attempt every 1 second	24 V short to Rpl. AC supply goes into current limit.
Shuts down, reboot attempt every 1 second	24 V short to Rp. AC supply goes into current limit.
Shuts down, reboot attempt every 1 second	24 V short to Rtcl permanent fault. Abnormal sensor node voltages. SC board must be serviced.
Shuts down, reboot attempt every 1 second	24 V short to Rtch, permanent fault. Abnormal sensor node voltages. SC board must be serviced.

Event Code and 24 hour Min/Max log.

To facilitate intermittent errors and troubleshooting, the flow meter records its most recent 200 non-zero event codes and corresponding elapsed run-time. Associated with this is a 24 hour min/max log for the top or bottom 20 extremes of velocity, flow rate, process temperature, electronics temperature and the run time that these occurred.

The internal logs are accessed in two ways.

- In *Log Mode* the Event Log (Option #1), Min/Max Log (Option #2), or Trend Log (Option #3) can be sent to the USB interface and captured to a file using a terminal emulator program like HyperTerminal or TeraTerm.
- Using KzComm the data can be extracted via Modbus on the RS-485 multipoint network interface or via the USB interface.

Accessing the logs using Tera Term

Start Tera Term and setup the Tera Term communication parameters to 9600 baud, 8 data bits, 1 stop bit, No Parity, No Flow Control. If Tera Term is communicating with the Kurz meter, the information displayed on the meter's local LCD screen will be echoed on the TeraTerm terminal display.

The diagnostic logs can be accessed from the *Log Mode* menu. The Table below lists the Option #s and the corresponding Log Reports available through *Log Mode*.

Option #	Menu
1	Event Log **(EVENT)**
2	Min/Max Data **(MIN/MAX)**
3	Trend Log **(TREND)**
4	System Configuration **(CONFIG)**
5	System Monitored Data **(RUN DATA)**

Note: the following sequence of key presses assumes the user is interfacing with the flow meter through the terminal emulator program on a PC/Laptop and is using the PC Keyboard; terminal echo must be turned ON (press <SHIFT>+ on the keyboard to toggle terminal echo ON if it is not already turned ON).

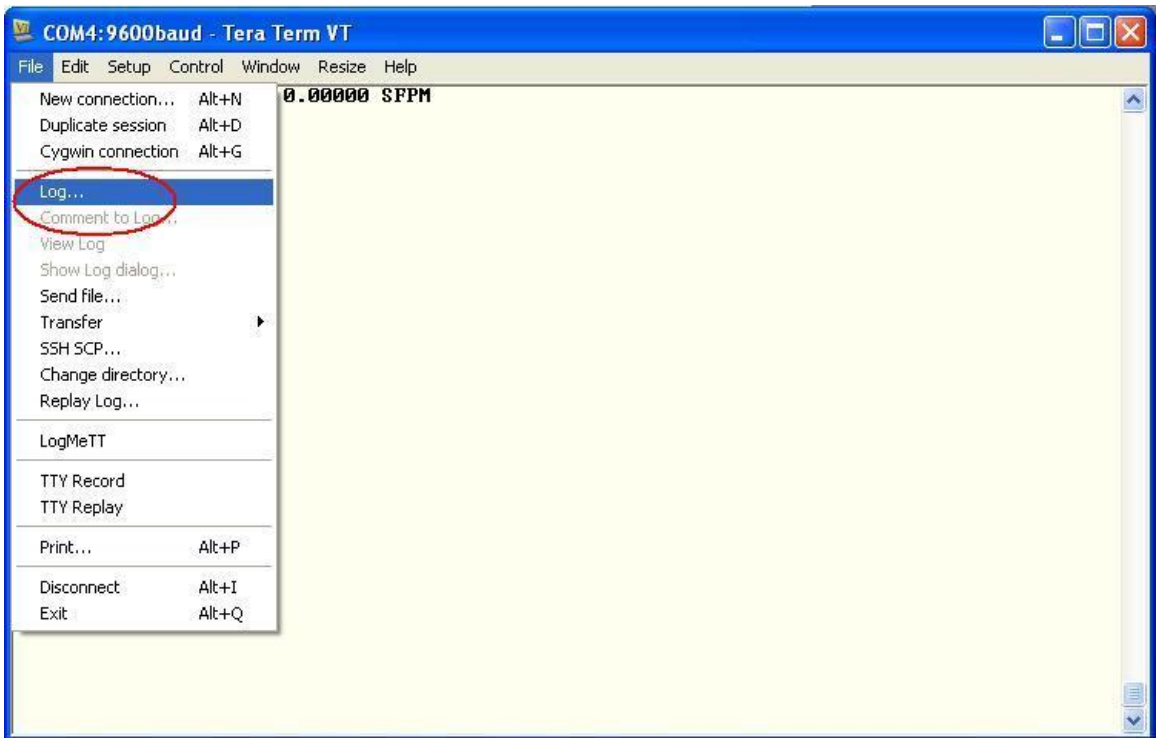
Invoke Log Mode by pressing (lowercase or unshifted) L. Press **2** to invoke the *Quick Jump* option entry method. The meter will prompt for the Log Mode option (the following screens are from the TeraTerm terminal; similar output is also shown on the meter's local LCD display)

```
Enter LOG Option  1-5>1
```

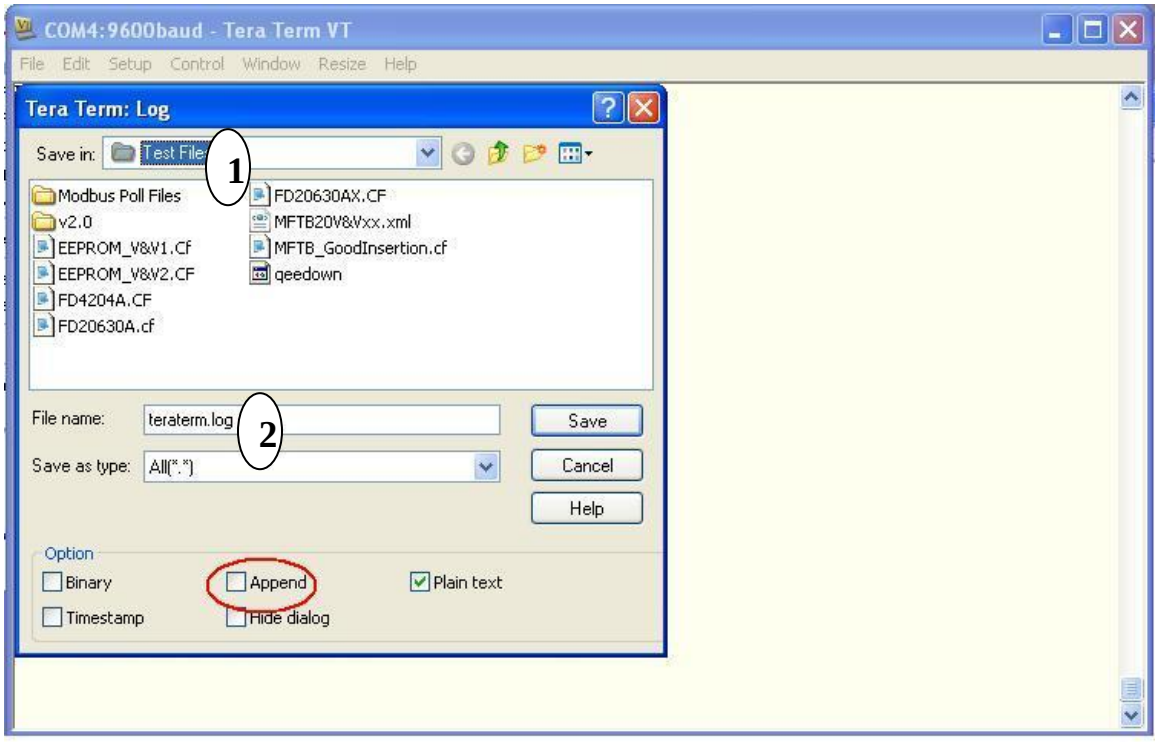
Use the numeric keys on the computer keyboard to enter the Option # and press **<ENTER>** to accept the entry. Use **C** to clear the entry if a wrong option # was entered. After the user selects the option # and presses **<ENTER>**, the meter will prompt to start the requested log

```
EVENT LOG  START LOG> YES
```

Prepare the log capture on TeraTerm. At the FILE menu, select 'Log…'



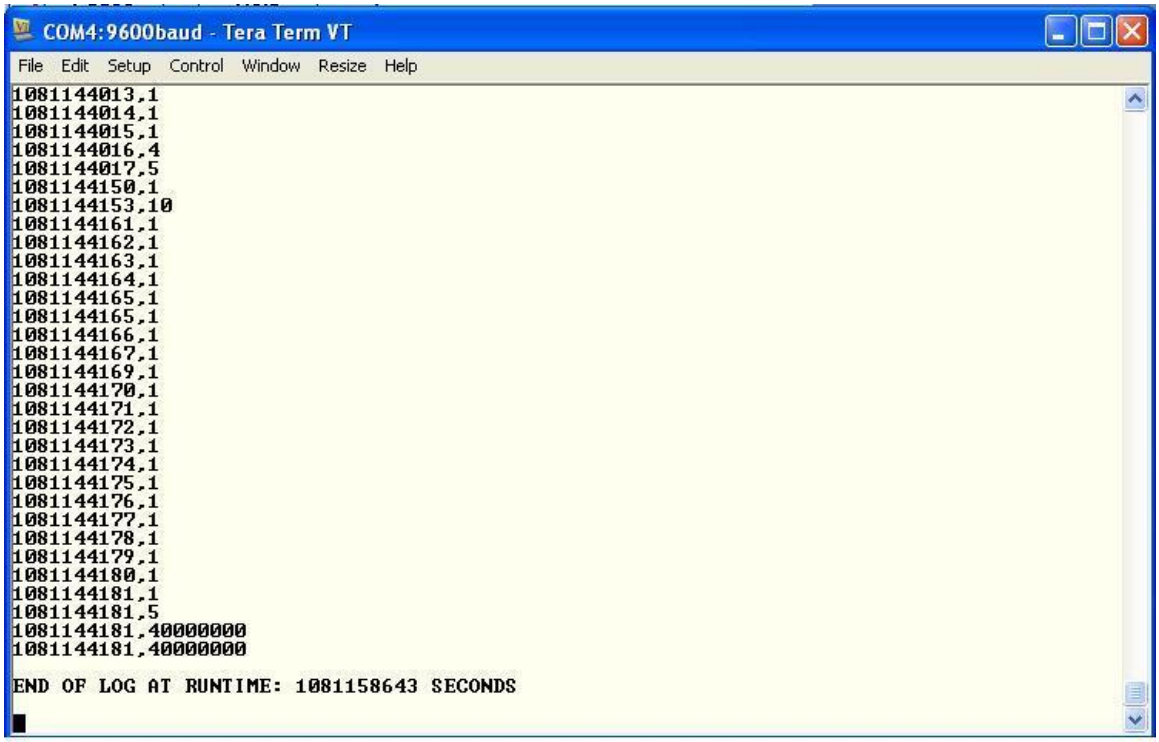
The following popup menu will display



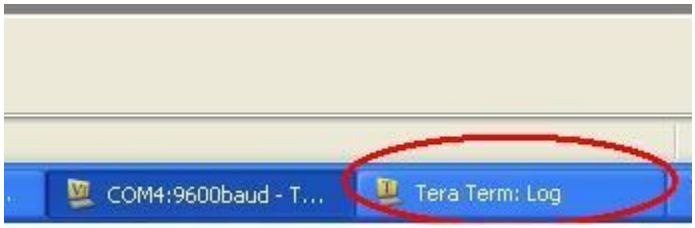
Select the Folder on the laptop/PC (item 1 marked on the screen shot) where the log file will be stored and enter the file name (item 2 marked on the screen shot).

Uncheck the ‘Append’ box so a previously saved log file does not get appended to.

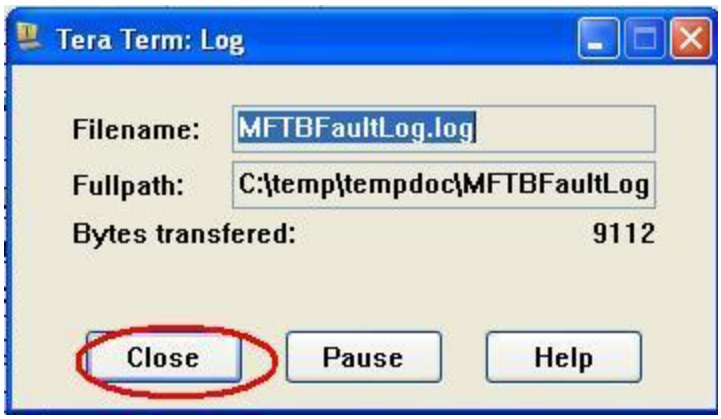
Press **<ENTER>** at the terminal keyboard to start the log. The log data being captured to the file will also display on the terminal display. When the download is complete the terminal display will be similar to the following. The meter is waiting for input from the user. This allows the user to end the data capture before terminal echo is restored.



Stop the data capture by clicking the TeraTerm:Log on the Windows Task Bar.



The Log Status Window will be activated. Press Close to stop the log capture and properly close and save the file containing the Event Log data.



Press **<SHIFT>D** at the terminal keyboard to return to the Log Mode Option Entry screen and restore terminal echo.

Example data captured using a Tera Term session as outlined above will look similar to the following (this is an excerpt using Windows Notepad to view the file).

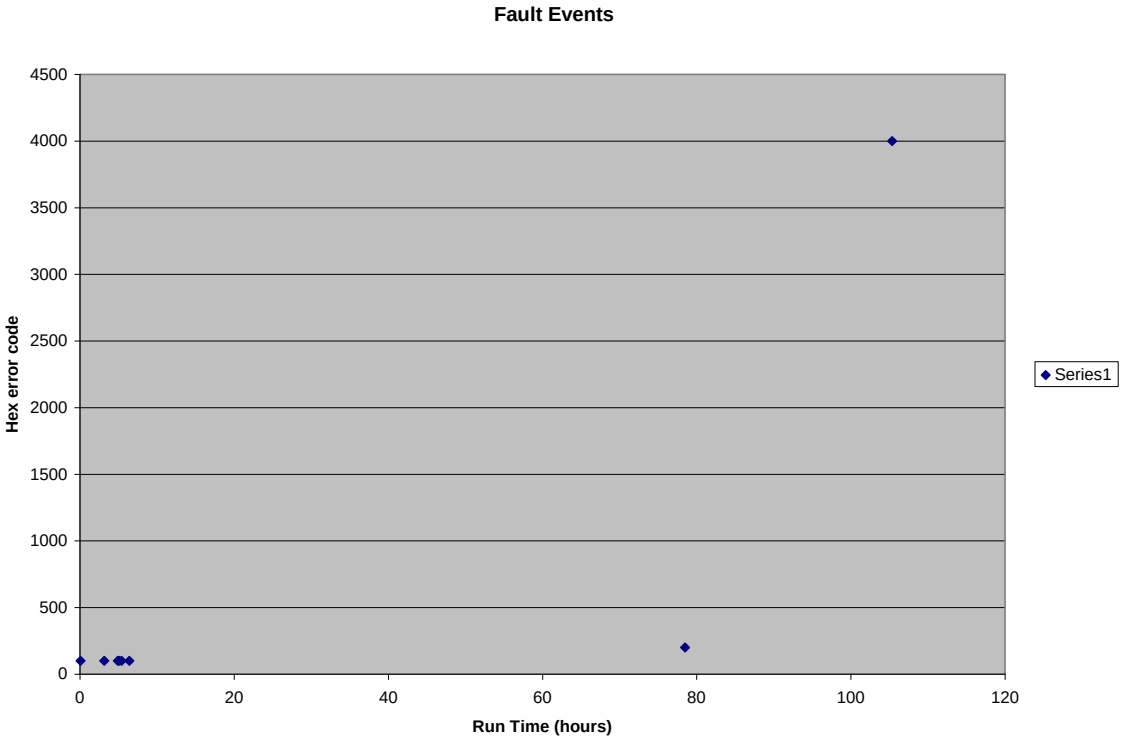
```
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES
EVENT LOG  START LOG> YES

Sensor Serial Number: FD20630A
Board Serial Number: A00000
Current Runtime: 1081158207 Seconds

EVENT CODES
Runtime (sec),Event Code
1081143006,1
1081143012,1
1081143013,1
1081143014,20
1081143015,21
1081143016,24
1081143144,1
1081143145,1
1081144177,1
1081144178,1
1081144179,1
1081144180,1
1081144181,1
1081144181,5
1081144181,40000000
1081144181,40000000

END OF LOG AT RUNTIME: 1081158218 SECONDS
```

The run time is logged in seconds. The event codes vs the runtime (converted to hours) can be plotted as an XY scatter plot in MS Excel.



The plot shows the time distribution of the events (only the first two significant bytes of the event code show up in this plot). This can be correlated with known events for the process or maintenance which was performed etc. This type of plot is easy to do and makes it easy to understand the significance of the event codes.

The Min/Max log can be retrieved in a similar manner using Option #2 at the Log Mode Option entry. An example of the Min/Max log is shown below

MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES
MIN/MAX DATA START LOG> YES

MINIMUM FLOWRATE
Runtime,Flowrate,Process Temp.,Elec. Temp.
1080777103,3265.1411,6.58,66.59
1080861536,0.0000,0.00,18.25
1080946593,0.0000,0.00,61.54
1081035078,0.0000,77.64,71.01
1081036801,0.0000,78.87,72.84

MAXIMUM FLOWRATE
Runtime,Flowrate,Process Temp.,Elec. Temp.
86016,39436.1130,6.99,27.84
1080689277,14.4533,27.03,77.74
1080777103,1416.7278,29.40,66.59

1080861536,0.0000,0.00,18.25
1080946593,0.0000,0.00,61.54
1081033899,18593.9785,26.04,59.49
1081059651,15298.6044,85.48,80.80

MINIMUM PROCESS TEMPERATURE
Runtime,Flowrate,Process Temp.,Elec. Temp.
86016,39436.1130,11.96,27.84
1080689277,7.2981,44.46,77.74
1080777104,975.8851,44.19,66.56
1080861536,0.0000,0.00,18.25
1080946593,0.0000,0.00,61.54
1081033900,18593.9785,26.04,59.44
1081113141,0.0000,77.62,70.71

MAXIMUM PROCESS TEMPERATURE
Runtime,Flowrate,Process Temp.,Elec. Temp.
86016,39436.1130,15.06,27.84
1080690456,0.0000,80.77,79.39
1080777104,304.2090,54.92,66.56
1080863832,0.0000,77.48,71.75
1080949575,0.0000,83.51,77.31
1081036280,0.0000,78.83,72.47
1081056046,0.0000,88.65,83.76

MINIMUM ELECTRONICS TEMPERATURE
Runtime,Flowrate,Process Temp.,Elec. Temp.
86017,39436.1130,17.37,27.83
1080689278,6.1471,60.88,77.72
1080777104,193.1424,60.70,66.56
1080861537,0.0000,0.00,18.22
1080946594,0.0000,0.00,61.50
1081033901,18593.9785,26.04,59.41
1081113141,0.0000,77.62,70.71

MAXIMUM ELECTRONICS TEMPERATURE
Runtime,Flowrate,Process Temp.,Elec. Temp.
86017,39327.9570,19.36,27.83
1080690456,0.0000,80.77,79.39
1080777105,111.5559,65.61,66.54
1080863832,0.0000,77.48,71.75
1080950175,0.0000,83.37,77.78
1081036280,0.0000,78.83,72.47
1081056046,0.0000,88.65,83.76

END OF LOG AT RUNTIME: 1081164711 SECONDS

For the Min/Max events, each record entry has 4 items, Flowrate, Process Temp, Electronics Temp and Runtime. These entries are generated on a 24 hour interval. There are 6 logged categories, Min/Max Flowrate, Min/Max Process Temp and Min/Max Electronics Temp. Each category has 20 records. During the first 20 days of operation, the flow meter will discard the default values (those whose runtime is 0 seconds) and replace it with actual min/max data. The order of the records 1 to 20 is not sorted. The lowest low flow or the highest high flow can be located in any of the record locations of that category. Plotting the min/max data using the X-Y scatter plot can be helpful when trying to correlate process events with meter faults.

Note the data from both log files are comma separated, this is a common format when importing the data to a spreadsheet.

Using KzComm to extract the event and min-max logs.

The event log and min-max log are saved as separate .csv files. As KzComm supports USB, Modbus serial and Modbus TCP/IP via a gateway, it is an integrated program to capture this diagnostic data. The format of these files is similar to what was shown above using the MFT B onboard menu system. The diagnostic logs extracted using KzComm will also include the time in hours since the data transfer to a PC, which is a relative time. See the KzComm manual for more on how this looks and works.

Volatile Trend Data memory.

Volatile memory (SRAM) in the flow meter will record 56+ hours of history provided there is no interruption in the power to the meter. This is another tool to isolate and understand intermittent process and flow meter issues. This data is accessed using the USB interface and Tera Term to request the log in Log Mode, similar to the Event Log. Or it can be accessed using KzComm and the USB or Modbus interface.

There are a total of 20,416 records, 10 seconds apart and each record is three numbers: Flow Rate, Temperature and Run-time. The memory is written as a first-in, first-out buffer or FIFO. Both the run time in seconds and the time in hours counting back from the memory download are shown in the spreadsheet. This is an example of a header:

TREND LOG

DATE:	11\14\2007
TIME:	13:05
Sensor Serial Number:	FD00000A
Meter 1 ID:	FLOW RATE
Current Runtime:	216994
NUMBER OF RECORDS:	1661

Runtime	Time From Download (hrs)	Flowrate (SCFM)	Temperature (DEGF)
215535	-0.40528	301.2267	82.89966
215525	-0.40806	309.7246	82.75954
215515	-0.41083	303.265	82.96161
215505	-0.41361	307.9795	83.51061
215495	-0.41639	307.9881	83.42668
215485	-0.41917	308.203	83.39914
215475	-0.42194	302.4459	83.4002
215465	-0.42472	314.0277	84.27499

215455	-0.4275	315.4738	84.42581
215445	-0.43028	316.9582	83.68893
215434	-0.43333	305.9884	83.32154
215425	-0.43583	317.662	83.74442
215415	-0.43861	309.0524	83.121

On a power cycle, all the data records are set to zero and the accumulation starts over. As this memory represents 245 kbytes of memory, it is too large and updated too often to be stored in the EEPROM used for the meter configuration or event log.

The data transfer time using KzComm for a 56 hour trend log at 57,600 baud using Modbus serial can take about 4 minutes. Using the USB interface (lower baud rate) and the Xmodem protocol this is about 17 minutes.

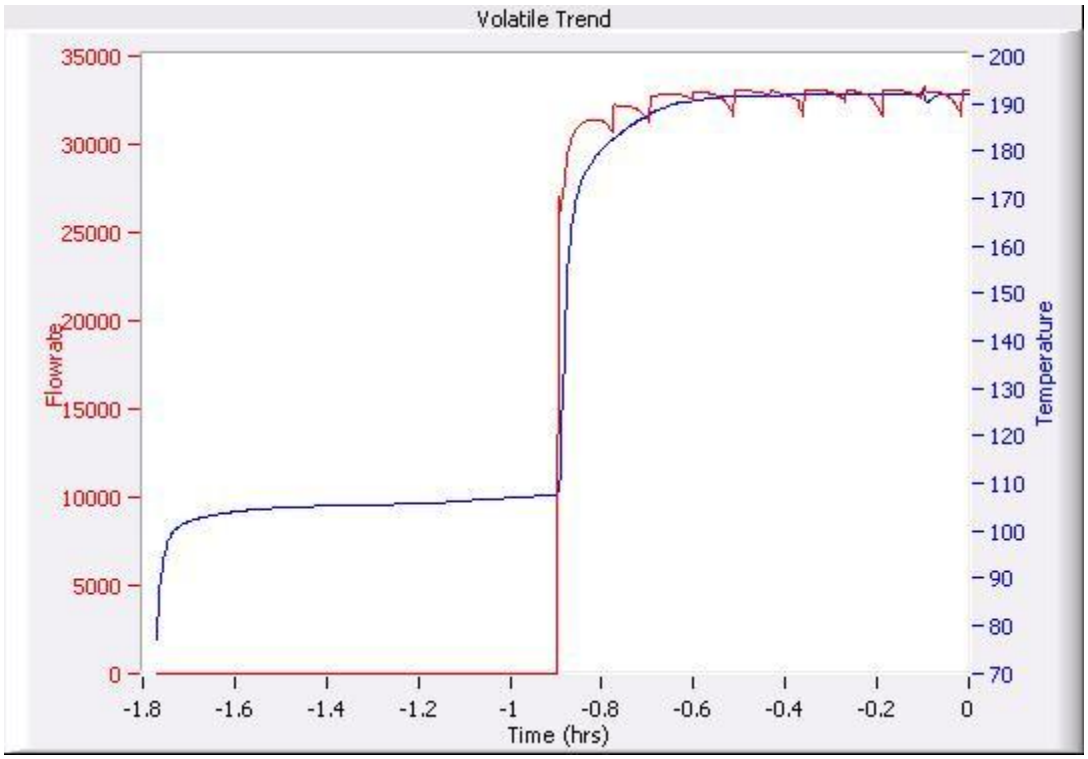


Figure E-2. Example trend data from volatile memory.

Internal Diagnostic Measurement Menus.

Advanced users and customers instructed by Kurz service personal can make use of the many analog parameters in the Diagnostic Data menus. Process or meter trouble may be more subtle than the bitwise errors from the event code so these “raw data” analog measurements are provided. These are broken down in the following categories.

- Input voltages
  - Voltages measured by the ADC from which all other parameters are computed.
- Sensor leakage
  - This is the common mode resistance from Rtch to Chassis ground. It is measured at boot up and every 10 minutes there after.
- Electronics Temperature
  - This is the sensor control (SC) board temperature sensor. This board will operate up to ~20 °C above the ambient of the meter environmental enclosure depending on the process flow rate. Higher flow rates will cause higher board temperatures.
- Sensor Control
  - These are the PID control values of the velocity sensor.
- Sensor Output
  - Velocity sensor current, power, resistance, temperature and the reference sensor resistance and temperature.

These diagnostic data items can be viewed from *Display Mode*. The Table below lists the option #s used to access the menu for each category of data listed above.

Option #	Menu	Menu Items
44	Input Voltage **(INPUT VOLT)**	VPs VIph VLl VLeakSense VRtch VRtcl VExt VTemp VCal
45	Sensor Output **(SENSOR OUT)**	IRp PRp Rp Rtc TRp TRtc RLl
46	Sensor Control **(SENSOR CTL)**	PErr IErr DErr RpSetpoint
47	Electronics Temperature **(ELEC TEMP)**	Electronics Temperature
48	Sensor Leakage **(SENS LEAKG)**	Sensor Leakage

Display Mode is invoked by pressing **D** in *Run Mode*. The Display menus can be selected either by scrolling through the Display Mode Option List (Menu Scroll) or directly entering the Option # (Quick Jump). Since there are over 50 Display menus, it is more convenient to access the Diagnostic Display Data using the Quick Jump navigation. After pressing **D** to invoke *Display Mode*, press **2** to invoke the *Quick Jump* option entry method. Use the numeric keys to input the Option number as shown in the Table above and press **E** to accept the entry. The meter will quickly jump to the menu associated with the option number entered.

If the Display Menu has multiple Menu Items, use **P** to scroll through the Menu Items in the Menu. Press **H** to return to the *Display Mode* Option Entry screen.