Application Report
SLUA640A–August 2012–Revised September 2012

Host System Calibration Method

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ABSTRACT

In order to add improvements to the Impedance Track™ algorithm, changes have been made to free up firmware code space. In the process of freeing up code space, the calibration calculations are no longer automatically performed by the gauge but must be performed by the host and the results written back to the gauge. This application note provides a flow on how to implement the calibration algorithm on a host device.

Gauges That Use the Host System Calibration Method

The host system calibration method is utilized by gauges that implement the Impedance Track (IT) algorithm as well as the Impedance Track with Dynamic Voltage Correlation (IT-DVC) algorithm. Note that gauges implementing the IT-DVC algorithm only need to do voltage and temperature calibration.

Impedance Track Gauges (as of time of writing)

- bq27520-G3
- bq27541-G1
- bq27545-G1
- bq28z560

Impedance Track with Dynamic Voltage Correlation (as of time of writing)

- bq27620-G1

General I²C Command Information

In the following flow charts, all I²C™ functions take 3 arguments.

Write command arguments:

1. Address
2. Data
3. Wait time in ms

Read command arguments:

1. Address
2. Number of bytes read
3. Wait time in ms

Calibration Method

The calibration method is broken up into the following sections:

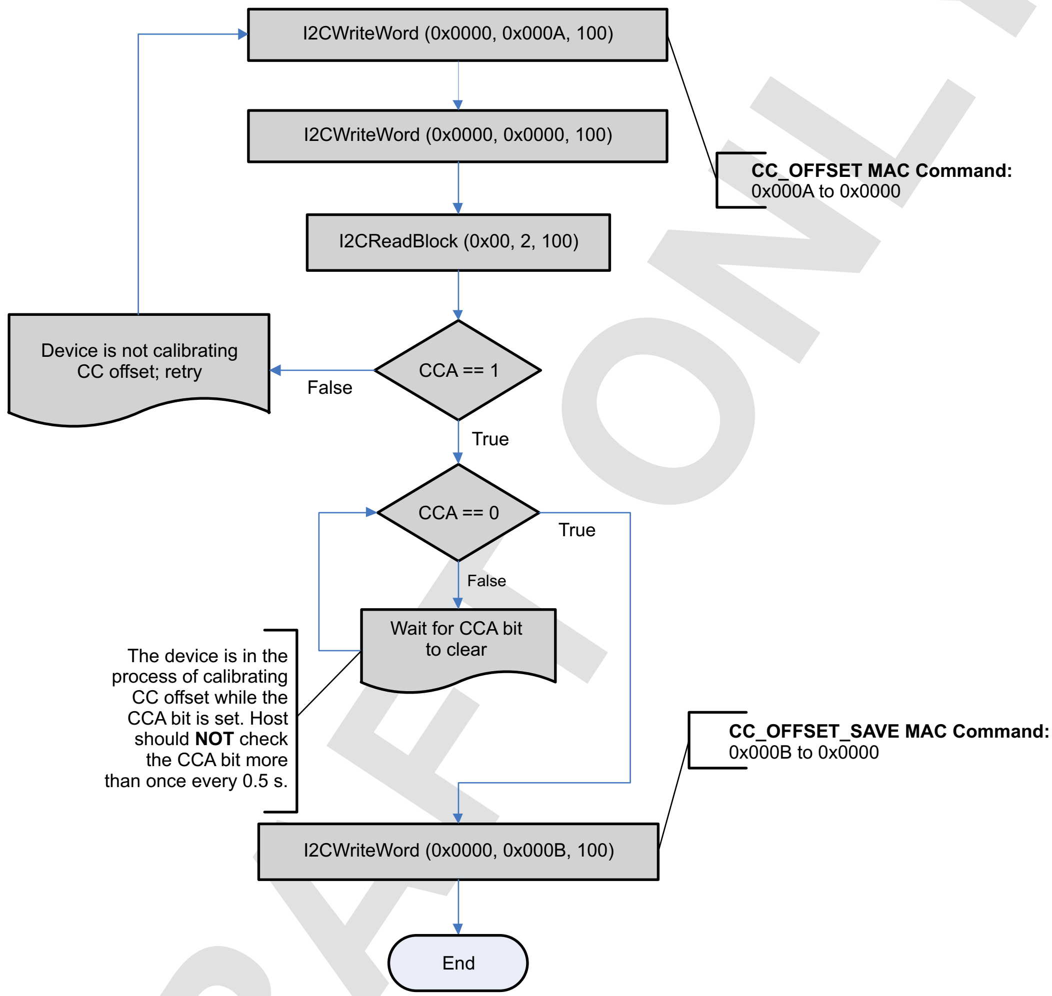
1. CC Offset
2. Board Offset
3. Obtain Raw Calibration Data
4. Current
5. Voltage
6. Temperature
7. DF Write – F4

Impedance Track is a trademark of Texas Instruments.
I²C is a trademark of Philips Semiconductor Corp..

CC Offset

Use MAC commands for CC Offset calibration. The host system does not need to write information to the Data Flash (DF). Please refer to the fuel gauge data sheet for the location of the CCA bit. The host system needs to make sure the fuel gauge is unsealed.

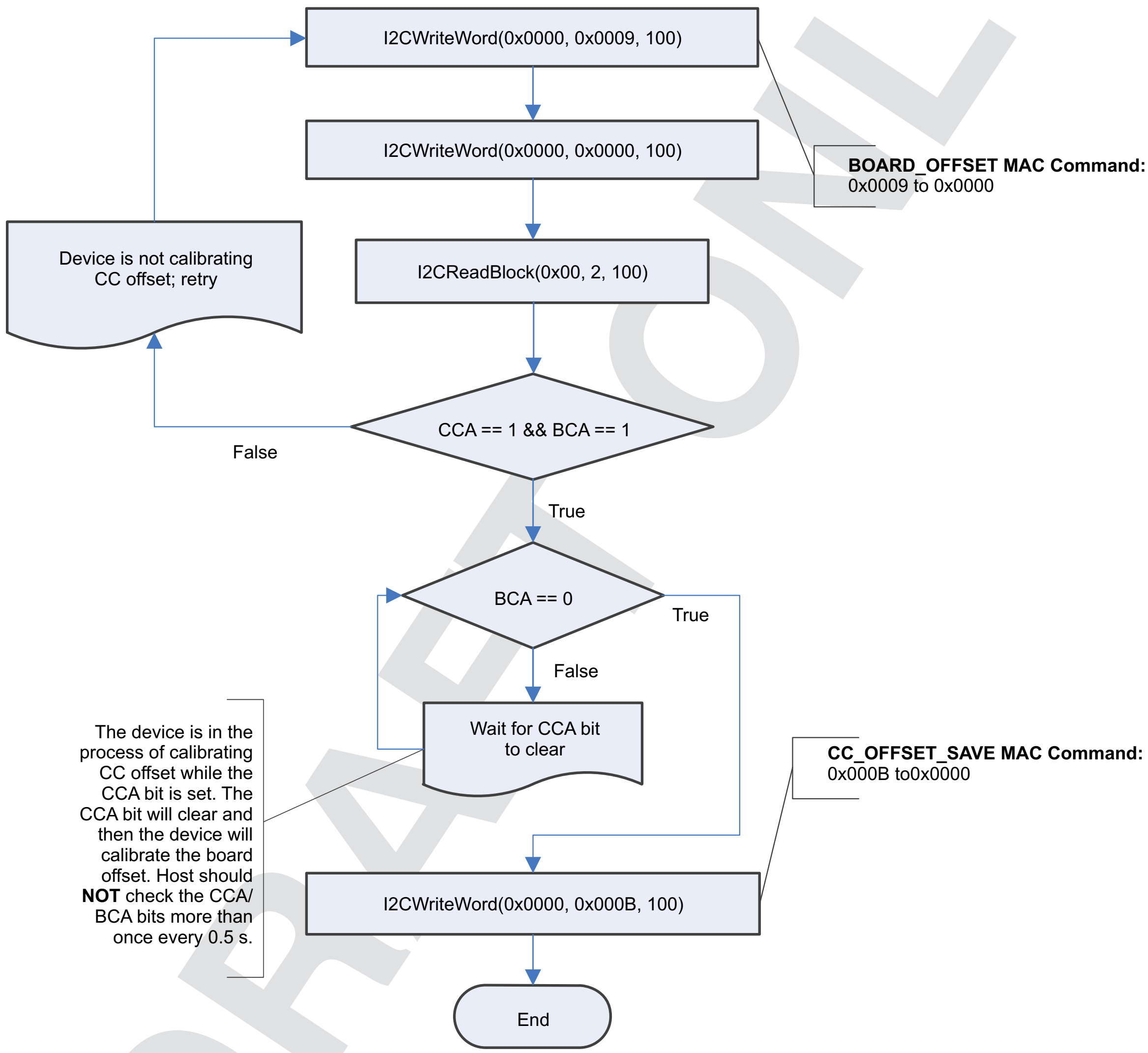
NOTE: While the device is calibrating the CC Offset, the host system must not read the Control Status Register at a rate greater than once every 0.5 seconds.



Board Offset

Use MAC commands for Board Offset calibration. The host system does not need to write information to the DF. The host system needs to make sure the fuel gauge is unsealed. Refer to the fuel gauge data sheet for the location of the CCA and BCA bits. Note that calculating the board offset will also calculate the CC Offset, therefore, it is not necessary to go through the CC Offset calibration process if the Board Offset calibration process is implemented.

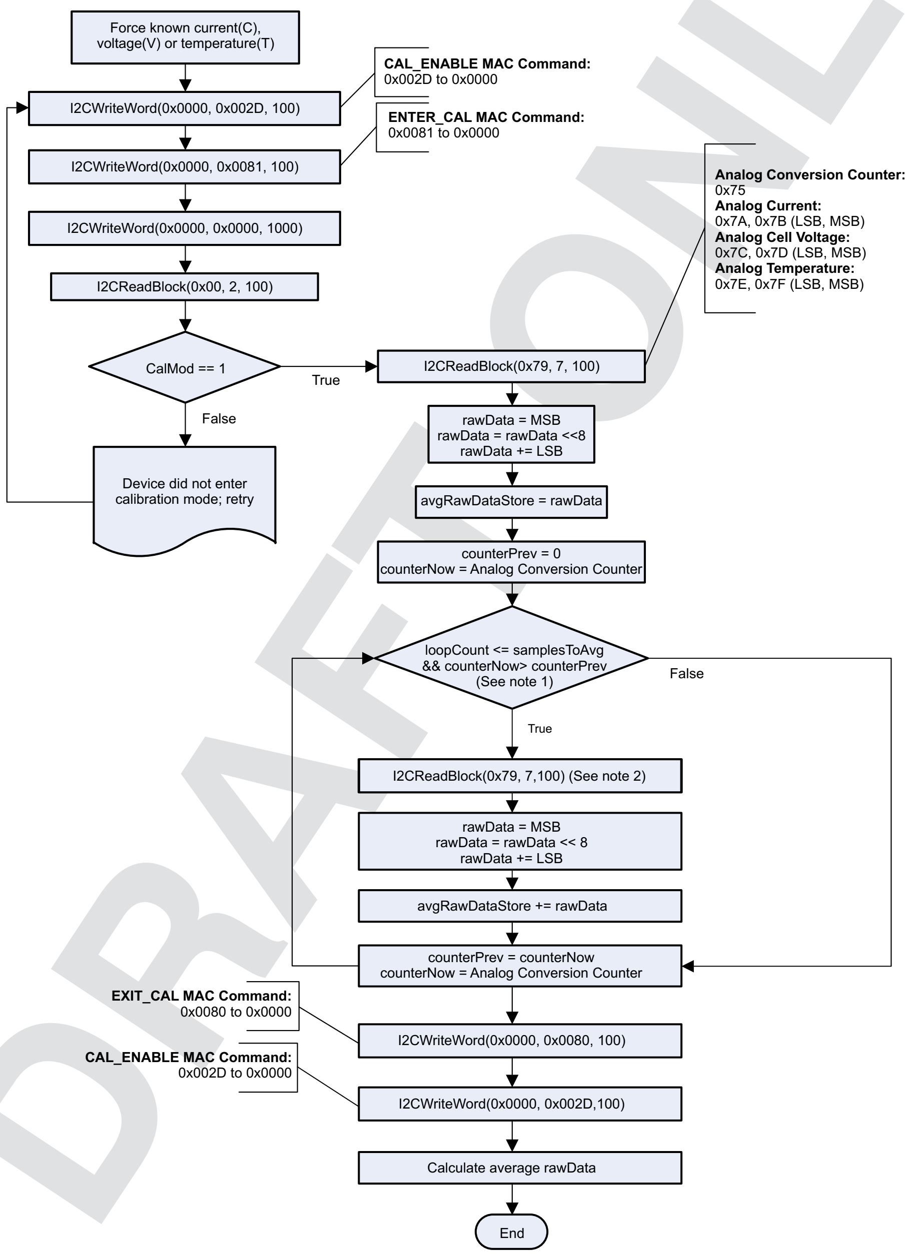
NOTE: While the device is calibrating the CC Offset, the host system should not read the ControlStatus() Register at a rate greater than once every 0.5 seconds.



Obtain Raw Calibration Data

The following flow chart demonstrates how the host system obtains the raw data to calibrate current, voltage and temperature. The host system uses this flow in conjunction with the Obtain Raw Calibration Data, Current, Voltage, and Temperature flows described in this document. It is recommended that the host system samples the raw data multiple times, at a rate of once per second, in order to obtain an average of the raw current, voltage and temperature. The host system needs to make sure the fuel gauge is unsealed.

NOTE: The CAL_ENABLE MAC command is used to enable or disable calibration mode but is not responsible for entering or exiting calibration mode.



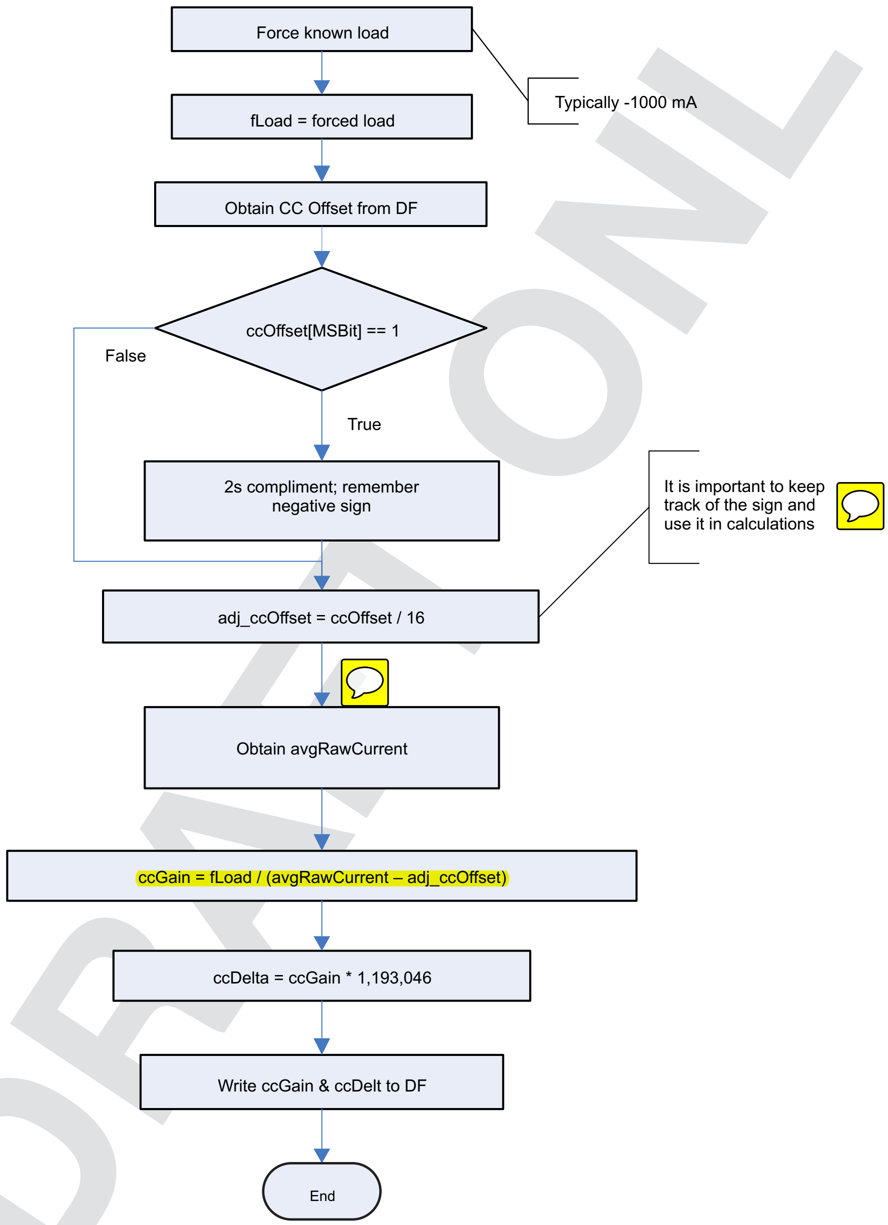
1) If the Analog Conversion Counter has not increased by at least 1 count in between reads, then the host should wait ~200 ms, until the counter is checked again. The counter can be larger than just a single count. The loop should exit when the number of averaged samples has been obtained, but the host should not read from the fuel gauge until the Analog Conversion Counter has increased by at least one count.

2) The host system needs to delay at least 1 second in between reads.

Current

The CC Gain and CC Delta are two calibration parameters of concern for current calibration. A known load, typically –1000 mA, is applied to the device during this process. Details on writing the CC Gain and CC Delta to DF are in the DF Write – F4 section of this document. The host system needs to make sure the fuel gauge is unsealed.

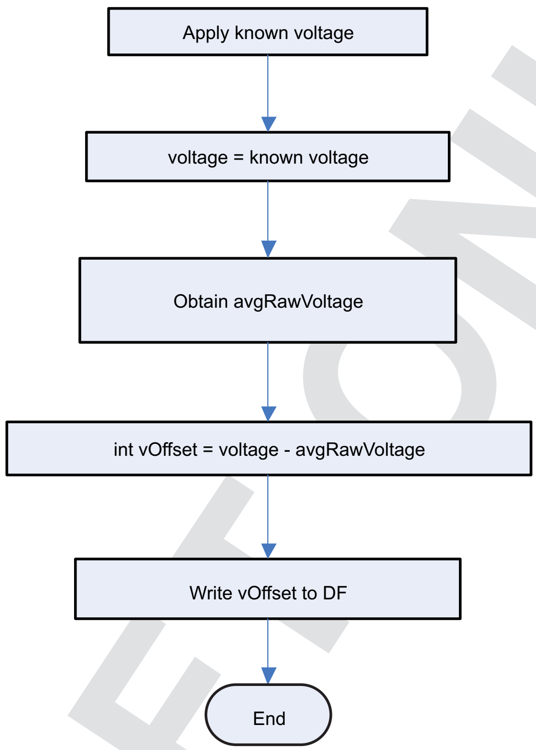
NOTE: The step labeled **Obtain avgRawCurrent** refers to the Obtain Raw Calibration Data section of this document.



Voltage

A known voltage must be applied to the device for voltage calibration. The calculated voltage offset must be written to the corresponding location in DF. The voltage offset is represented by an integer that is a single byte in size and can be written to the appropriate location in DF without any intermediate steps. The host system needs to make sure the fuel gauge is unsealed.

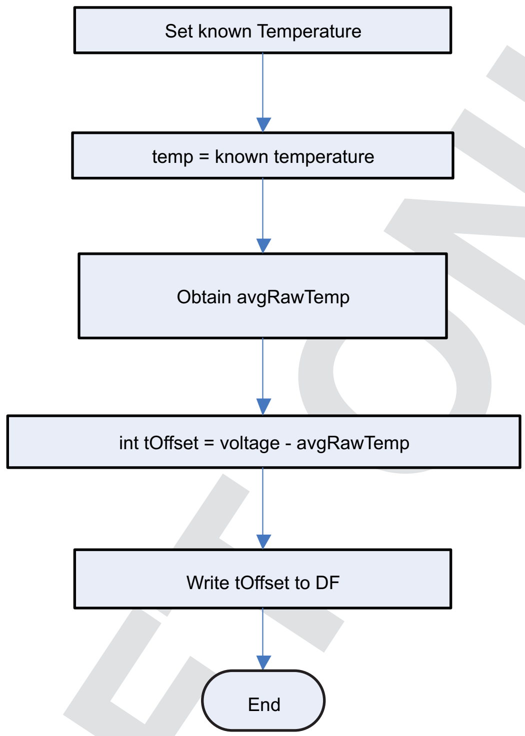
NOTE: The step labeled **Obtain avgRawVoltage** refers to the Obtain Raw Calibration Data section of this document.



Temperature

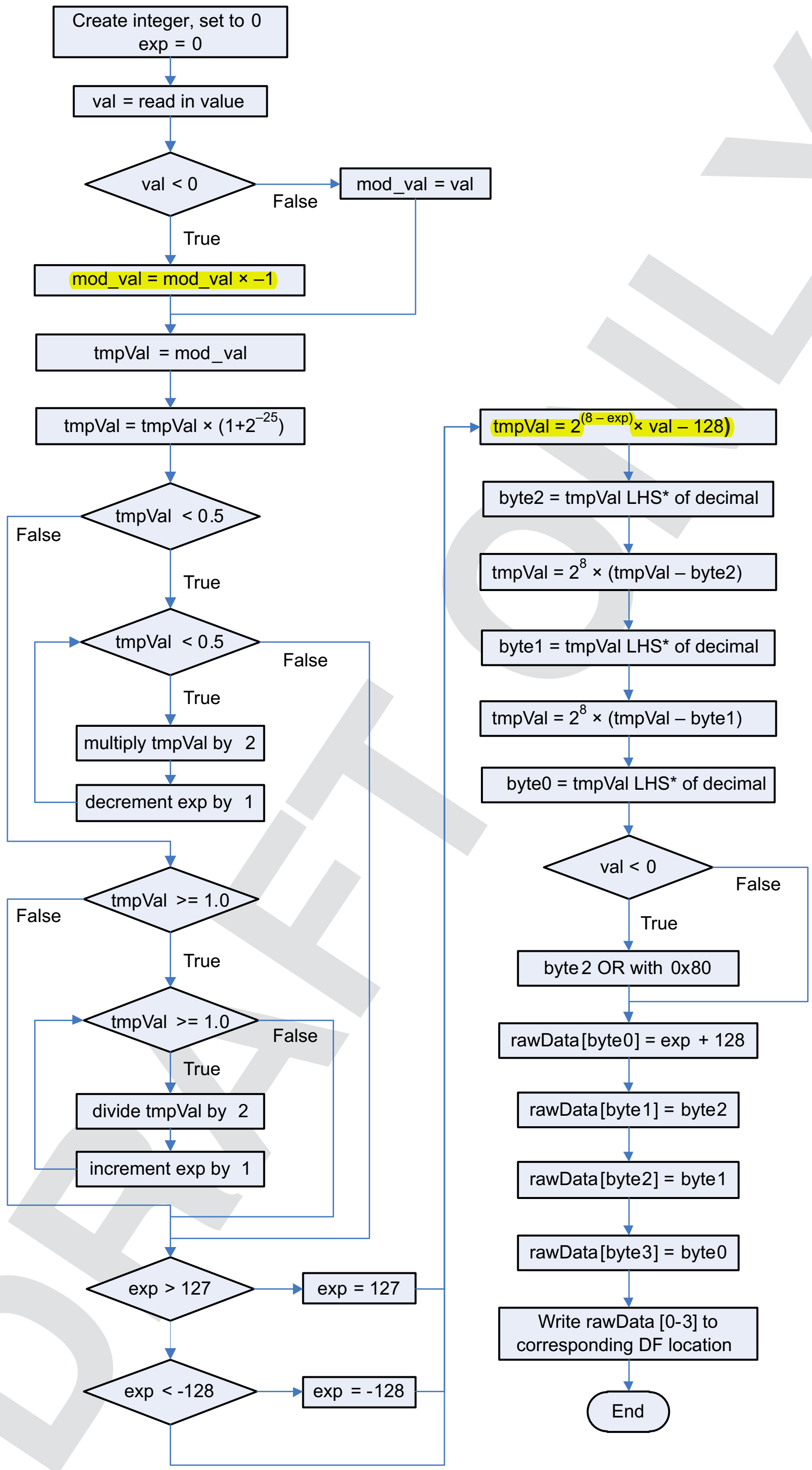
A known temperature must be applied to the device for temperature calibration. The calculated temperature offset is written to the corresponding location in DF. The temperature offset is represented by an integer that is a single byte in size and can be written to the appropriate location in DF without any intermediate steps. The host system needs to make sure the fuel gauge is unsealed.

NOTE: The step labeled **Obtain avgRawTemp** refers to the Obtain Raw Calibration Data section of this document.



DF Write – F4

This section details how to write the floating point CC Gain and CC Delta to the Data



* LHS is an abbreviation for Left Hand Side. This refers to truncating the floating point value by removing anything to the right of the decimal point.