SMD8332UM CQV User Manual

Purpose:

The following document describes the procedure to use the SMD8243 Capacitive Liquid Level Sensor Controller.

Required Equipment:

1) SMD8243 CQV Controller
2) SMD8244 or equivalent CQV Sensor
3) SWM12-12-NH-P5 or equivalent 5-24VDC Power Supply
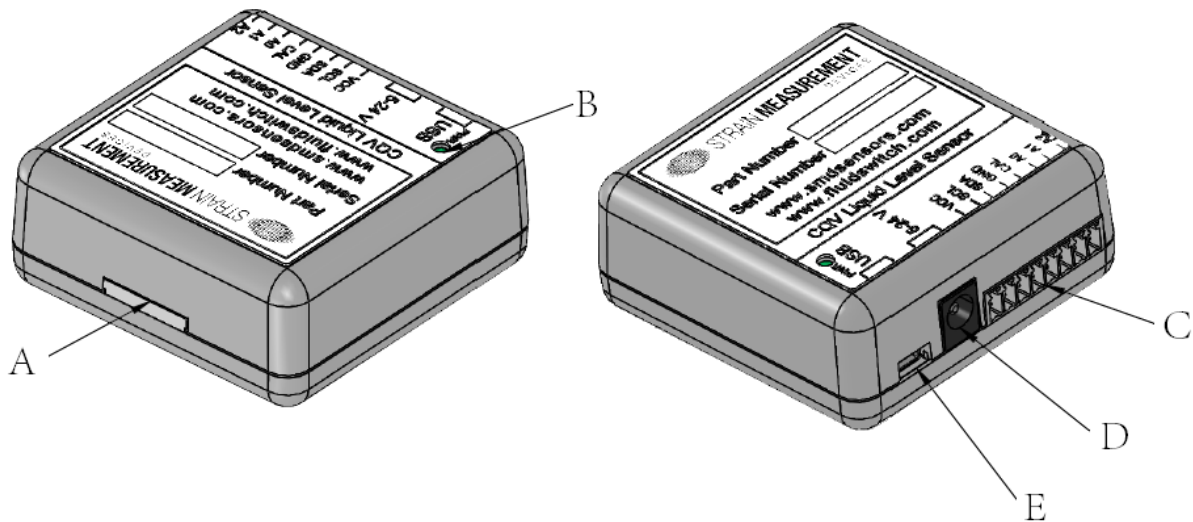4) Mini USB or I^{2}C interface

Equipment Overview:

Figure 1: Control Board Overview

A: Flat Flex Connector to interface with sensor SMD8244
B: Power Indication LED
C: Molex 0395021008 Terminal Block Connector (Connects to Molex 0395000008 header)
D: Barrel Jack Power Connector, Barrel Plug, 2.1mm I.D. x 5.5mm O.D. x 9.5mm
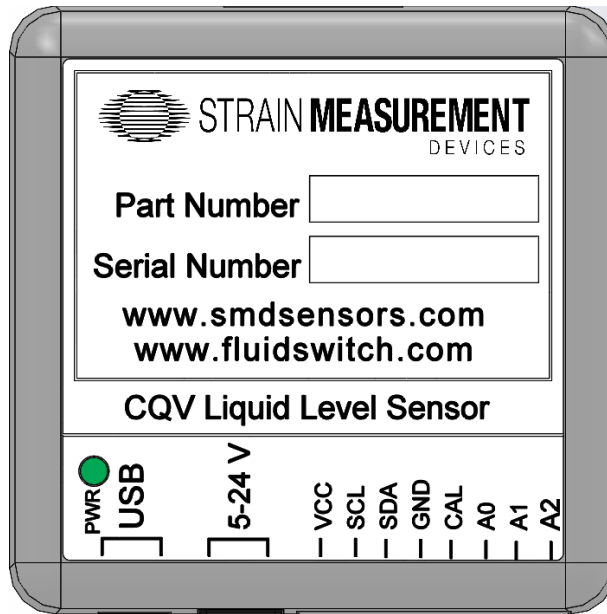E: Mini USB Connector

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Figure 2: Control Board Top-down View

Operating Modes:

The CQV Liquid Level Sensor Controller can be connected via USB or I2C to receive data packets with information about an attached sensor and its' output. The connection mode is auto-detected via successful connection to the USB host or I^{2}C master device. In the event both USB and I2C are connected, priority is given to USB.

For USB communication, connect the device to a PC using a USB A to Mini B cable and use a serial terminal to read the data. The parameters for UART Serial via USB are as follows -

      Baud Rate: 115,200
      Data Bits: 8
      Parity: None
      Stop Bits: 1 bit

Upon establishing connection, commands which can be sent are as follows:

"Info" – Outputs all device info, version, commands, and calibration.
"Version" – Outputs the controller ID and software revision.
"Help" – Output a list of all available commands.
"Begin" – Enables output sensor data stream formatted as specified in the data packet table.
"Clear" – Clear any latched error codes. If successful, the console will respond with "Complete".
"Pause" – Pauses data output stream.
"Speed #" – Change the data packet transmission rate between 33 – 5000ms. Default is 500ms. If successful, the console will respond with "Complete".

Note: Each command is case insensitive and the first letter can be sent in place of the entire word.
      Ex: "P" instead of "Pause"

Calibration is performed with the following commands. The entire word must be typed, and is case sensitive.

"ecal" – Perform calibration when vessel is 'empty'. If successful, the console will respond with "Saved to Memory". (see calibration procedure)

"fcal" – Perform calibration when vessel is 'full'. If successful, the console will respond with "Saved to Memory". (see calibration procedure)

"rcal" – Reset calibration to factory default values. If successful, the console will respond with "Complete".

"get_cal" – Returns the current calibration information.

Advanced users may enter into Admin Mode by typing "`enable.admin.mode`" to access the following commands:

"thrcon ##" – Change the continuous output threshold. This is used to increase noise resilience. Threshold must be a value between 10% – 90%. Default is 25%

"thrstp ##" - – Change the stepwise output threshold. This is used to increase noise resilience. Threshold must be a value between 10% – 90%. Default is 50%

"ecorr" – Enables an advanced correction mode. This increases precision but may decrease accuracy.

"dcorr" – Disables correction mode

Command mode can be disabled by reentering "`enable.admin.mode`". Entering an incorrect command, or an admin command while admin mode is not enabled, will result in a response "Command Error. Please refer to the User Manual for a list of available commands."

Serial data output is delimited by a comma in the following format
Sensor ID, Continuous Liquid Level, Stepwise Level, Internal Die Temperature (C), Status

Example: **SMD1234,94.441,94,23,1** (terminated with line feed LF)

Connection via I2C is done though the terminal header (C) and connecting to SCL and SDA. The parameters for I2C are as follows -

> **Bus Speed: 100kHz**
> **Slave Address: 0x08**

Data packets for I2C are formatted as follows.

Table 1: Data Packet Structure

Sensor ID	Liquid Level	Stepwise Level	Temperature	Status
Byte 0:3	Byte 4:7	Byte 8	Byte 9	Byte 10

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Sensor ID: Gives the ID of the sensor as written on the label. The first two bytes are the date code, and the second two bytes are the ID number.

Continuous Liquid Level: Outputs a value between 0.000-100.000%, indicating how much of the sensor has been covered in IEEE754 format

Stepwise Liquid Level: Outputs a stepwise representation of percentage full for higher accuracy / redundancy

Temperature: Outputs the internal die temperature in Celsius, +/- 127 C

Status: Gives user information regarding the sensor with the following bit field:

Table 2: Status Bit Field

BIT	7	6	5	4	3	2	1	0
STATUS	RS	TE	CE	UE	UE	IE	PS	OK

Bit 0 – Sensor is operating normally and is outputting data

Bit 1 – Sensor is operating normally and output is paused

Bit 2 – Internal system error

Bit 3 – Sensor was unplugged

BIT 4 – USB lost connection to terminal

Bit 5 – Calibration is zero

Bit 6 – Drastic temperature change detected

Bit 7 – Hardware is in reset

Example:

ID	LL %	LL Step	Temp	Status
NA001023	25.606	25	25	0b0001 0010
4E 41 30 30 31 30 32 33 0A	0x1A D2 CC 41	0x19	0x19	0x12

Valid I2C commands, when writing the appropriate hex value, are as follows:

Get Sensor ID (0x01) – Returns the sensor ID
Read All (0x10) – Returns the entire data packet outlined above
Read Temp (0x11) – Returns the internal die temp
Read Step (0x12) – Returns the stepwise measurement
Empty Calibration (0x30) – Perform calibration when vessel is 'empty'.
Full Calibration (0x31) – Perform calibration when vessel is 'full'.

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Connecting and Mounting Procedure:

Mount the sensor to a vessel using the included 3M #9731 double sided adhesive, or similar. Vessels made from conductive materials interfere with the electric field pattern and cannot be used with this technology. Vessel materials with a relative permittivity between 2.0 and 8.0 can be used, as seen in Table 3. Note that varying relative permittivity and material thickness will influence accuracy. In general, material thickness should be no greater than (Relative Permittivity / 2.5mm), though other factors may affect this and a thorough analysis of each application must be completed. For example, the maximum thickness for a glass vessel would be approximately 8.0/2.5 = 3.2mm. Contact SMD for more details.

Table 3: Table of Material Permittivity's

Relative Permittivity of Overlay Materials

Material	e_r
Air	1.0
Formica	4.6 – 4.9
Glass (Standard)	7.6 – 8.0
Glass (Ceramic)	6.0
PET Film (Mylar®)	3.2
Polycarbonate (Lexan®)	2.9 – 3.0
Acrylic (Plexiglas®)	2.8
ABS	2.4 – 4.1
Wood Table and Desktop	1.2 – 2.5
Gypsum (Drywall)	2.5 – 6.0

Note that variations in wall thickness and material dielectric properties can affect accuracy. Contact SMD for more details.

To connect the sensor to the device, plug the sensor (SMD8244) into the controller (SMD8243)
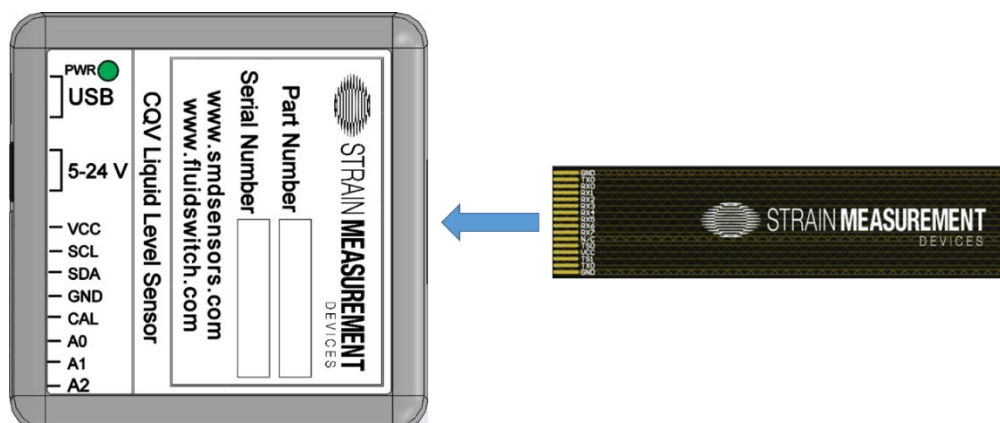

Figure 3: Connecting controller (left) to flex sensor (right)

To power the device, supply power from USB, a 5-24VDC barrel jack input, or from the VCC and GND connections on the terminal block.

Calibration Procedure:

For sensors which require recalibration due to liquid or environmental changes, the following procedure can be followed.
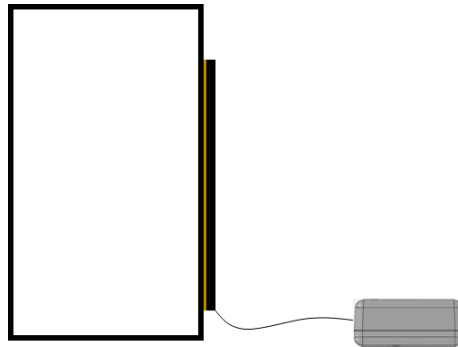

Figure 4: Empty Vessel

With the sensor connected to the vessel, start with a dry and empty vessel as seen in Figure 4 and send the command for empty calibration. The controller will respond with the results of the empty calibration.
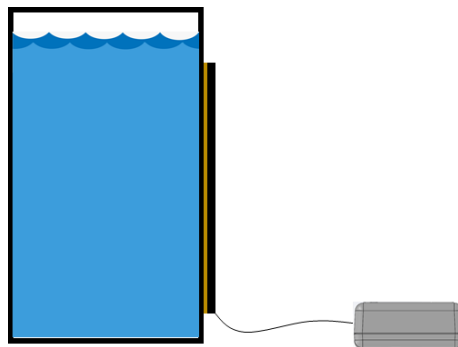

Figure 5: Full Vessel

Fill the vessel with liquid until the sensor is completely covered as seen in Figure 5 and send the command for full calibration. The device will respond with the results of full calibration, as well as the span of each sensor.

The sensor is now calibrated and the calibration data will be stored on the device until reset or recalibrated.