



LiCM-03S Module – User Manual V1.0

Mutex Embedded Solutions

September 2026

This manual highlights all the necessary information to run the LiCM-03S module including specifications, hardware design, registers map and serial interface.

Version Control

LiCM-03S User Manual update version control:

Table 1: Version Control

Version	Date	Modified by	Description
1.0	18/09/2026	M.Yaqoob	Create the initial LiCM User Manual

Table of Contents

1.	Specifications	3
1.1.	Features.....	3
1.2.	Electrical Ratings.....	3
1.3.	Applications.....	3
2.	Hardware	4
2.1.	Pinout.....	4
2.2.	Dimensions	5
3.	Serial Interface	6
3.1.	Registers Map	6
3.2.	UART – Modbus	9
3.3.	RS485 – Modbus	10
3.4.	I2C Interface.....	10
4.	Extension Board.....	13
4.1.	Pinout.....	13
5.	PC Application	14

1. Specifications

The LiCM-03S module is an embedded Lithium-ion, single cell, battery charger and fuel gauge. It utilizes the TI Impedance Track technology which is known for its superior accuracy. The module also includes battery protection circuit. It is designed to be mounted onto the user PCB with simple I2C or UART-Modbus interface.

1.1. Features

The LiCM-03S module has the following features:

- Compatible with Single Cell 3.7V battery
- Battery protection circuit: Overvoltage, Undervoltage, Overcurrent and Short Circuit.
- Capacity: up to 8000mAh
- Maximum Current: 3A
- Smart Charger
- Impedance Track fuel gauge: very precise, account for aging, temperature and report battery health.
- Serial Interfaces: UART-Modbus and I2C
- Power ON/OFF pin + software power OFF
- Power down mode: MCU can be put into power down mode. Host MCU can wake up the module periodically for data sampling.

1.2. Electrical Ratings

The LiCM-03S module electrical specifications are summarized in the following table:

Table 2: Electrical Specifications

Parameter	Minimum	Nominal	Maximum
Charger Input Voltage	3.9	-	13.5
Battery Output Voltage	2.8V	3.7V	4.2V
3.3V Supply current	-	-	700mA
Current consumption	-	20mA	-
I2C signal level	-	3.3V	-
UART signal level	-	3.3V	-
RS485 EN signal level	-	3.3V	-

1.3. Applications

The LiCM-03S module is a great way to add lithium battery to your device without getting into the complicated process of hardware design and software development.

Typical applications include:

- IoT devices
- Handheld electronics
- Asset Tracking
- Sensors

2. Hardware

2.1. Pinout

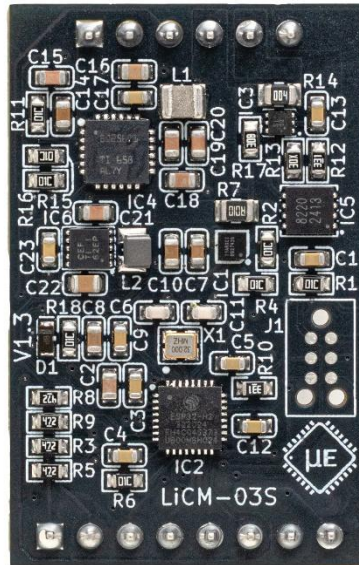


Figure 1: LiCM-03S Module

Table 3: Digital interface connector pinout

No.	Pin Name	Functionality	Comments
1	SCL	I2C_SCL	
2	SDA	I2C_SDA	
3	RST	nRESET MCU	To reboot MCU or Wakeup from Deep sleep
4	TX	UART_TX (Out)	
5	RX	UART_RX (In)	
6	RE	RS485_RE (Out)	Used for RS485 input control
7	GND		
8	+3.3V	3.3V supply	3.3V Out, 0.8A max

Table 4: Power connector pinout

No.	Pin Name	Functionality	Comments
1	VIN	Charger Voltage Input	Charger input power supply
2	GND	GND	
3	PWR	Power button	Power ON/OFF and Wakeup from Deep Sleep
4	VOUT	Battery Power Output	Module battery power output.
5	BAT-	Battery -	Battery negative terminal
6	BAT+	Battery +	Battery positive terminal

The dimensions of the FFT module and the Extension board are as shown below:

FFT Module

- Length = **36 mm**
- Width = **23 mm**
- Distance between pin headers centers = **32 mm**

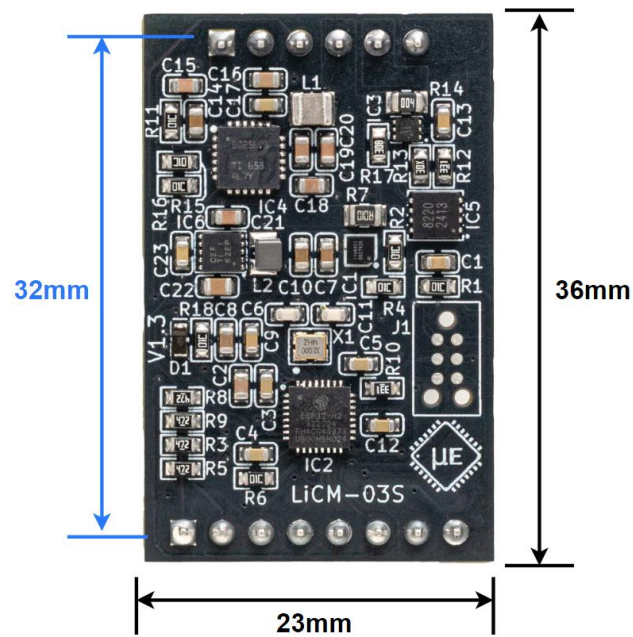


Figure 2: Module Dimensions

3. Serial Interface

To communicate with the module and access the internal registers, users need to use one of these interfaces: UART-Modbus, I2C or RS-485 (Requires an external circuitry).

3.1. Registers Map

Note: Registers are 16-bit each, based on Modbus standard.

Holding Registers (Write / Read)

Table 5: FFT Module Holding Registers

Address	Size / U16	Function	Range	Default	Type	Description
0	1	Slave Address	1 - 127	5	uint16	Modbus/I2C Slave address. (Restart required)
1	2	Baud Rate	0 - 4	4	enum	0: 9600 1: 19200 2: 38400 3: 57600 4: 115200 (default) (Restart required)
3	2	Parity	0 - 3	0	enum	0: None (default) 1: -/- 2: Even 3: Odd (Restart required)
5	1	Battery Capacity	1 - 8000	1200	uint16	mAh
6	1	Terminate Voltage	2500 - 3700	3000	uint16	milli Volt. Corresponds to 0% SOC or a fully discharged battery.
7	1	Shutdown	0 - 1	0	bool	Shut down device. Hold PWR button low for 2s to wake it up.
8	1	Shutdown delay	0 - 1	0	bool	0: No shutdown delay. 1: shutdown delay of 10s after sending shutdown command.
9	1	Input Current limit	1 - 32	5	uint16	x100mA. Charger input current limit. Value of 5 = 500mA
10	1	Charger Enable	0 - 1	1	bool	0: Charger Disable, 1: Charger Enable.
11	1	Charger Supply Enable	0 - 1	0	bool	Used to isolate charge supply in case of fault for safety. 0: Switch OFF charger supply. 1: Switch ON charger supply
12	1	Charger Precharge Current	1 - 13	2	uint16	x60mA. Precharge current for batteries with critically low voltage. Value of 2 = 2x60 = 120mA. This helps recover old batteries.
13	1	Charger Normal Current	1 - 40	8	uint16	x60mA. Battery normal charging current. Value of 8 = 8x60 = 480mA

14	1	Charger Terminate Current	1 - 10	2	uint16	x60mA. Charge termination current. Charger will stop charging after 15 minutes of reaching this threshold. Value of 2 = 2x60 = 120mA
15	2	Charger OVP	0 - 3	0	enum	0: 5.5V 1: 6.5V (default) 2: 10.5V 3: 14V
17	1	Charger Minimum Voltage	3900 - 5400	4500	uint16	mV. Limit the charging current when voltage drop to this minimum.
18	1	New Battery - Ra0	0 - 32767	0	uint16	
19	1	New Battery - Ra1	0 - 32767	0	uint16	
20	1	New Battery - Ra2	0 - 32767	0	uint16	
21	1	New Battery - Ra3	0 - 32767	0	uint16	
22	1	New Battery - Ra4	0 - 32767	0	uint16	
23	1	New Battery - Ra5	0 - 32767	0	uint16	
24	1	New Battery - Ra6	0 - 32767	0	uint16	
25	1	New Battery - Ra7	0 - 32767	0	uint16	
26	1	New Battery - Ra8	0 - 32767	0	uint16	
27	1	New Battery - Ra9	0 - 32767	0	uint16	
28	1	New Battery - Ra10	0 - 32767	0	uint16	
29	1	New Battery - Ra11	0 - 32767	0	uint16	
30	1	New Battery - Ra12	0 - 32767	0	uint16	
31	1	New Battery - Ra13	0 - 32767	0	uint16	
32	1	New Battery - Ra14	0 - 32767	0	uint16	
33	1	New Battery - Qmax Cell	0 - 32767	1	uint16	Qmax Cell number for the new cell, can be read from Qmax Cell input register after the first learning cycle
34	1	New Battery - Set	0 - 1	0	bool	Set this to 1 to use New Battery parameters, requires a battery reinsertion. It resets to 0 upon successful reinsertion.
35	1	New Battery - Learn	0 - 1	0	bool	Set to 1 to update New Battery parameters using the next successful learning cycle automatically. It resets to 0 upon successful learning.
36	1	Terminate Voltage Shutdown	0 - 1	0	bool	Enable automatic shutdown when terminate voltage is reached. This is a must in Battery Learning Cycle.
37	1	Deep Sleep	0 - 1	0	bool	1: Put the module into Deep Sleep. Wakeup through PWR pin or Reset.
39	1	Firmware Update Enable	0 - 1	0	bool	1: Put device into bootloader mode, for FW update.

Input Registers (Read Only)

Table 6: FFT Module Input Registers - Realtime

Address	Size	Function	Range	Default	Type	Description
Gauge						
100	1	SOC	0 - 100	0	uint16	State Of Charge
101	1	SOH	0 - 100	0	uint16	State Of Health
102	1	Voltage	0 - 4400	0	uint16	milli Volt (mV)
103	1	Current	-4000 to 4000	0	uint16	milli Amps (mA). Negative: discharging. Postive: Charging
104	1	Power	-16800 to 16800	0	uint16	milli Watts (mW)
105	1	Internal Temperature	-400 to 850	250	int16	deci degrees C (250 = 25.0C)
106	1	Capacity Remaining	1 - 10000	1	uint16	mAh
107	1	Capacity Full	1 - 10000	1	uint16	mAh, Reduces with battery aging.
108	1	Capacity Design	1 - 10000	500	uint16	mAh. Design capacity, written by user in Battery capacity register.
109	1	ChemId	U16	0	uint16	ChemId, 4610 confirms 4.2V profile
110	1	SOH Accurate	0 - 1	0	bool	Check if SOH is valid. 1: SOH is valid
111	1	Cell Resistance Updated	0 - 1	0	bool	1: Gauge calculated cell resistance, thus it is more accurate
112	1	Cell Qmax Updated	0 - 1	0	bool	1: Gauge calculated real Qmax, thus it is more accurate
113	1	Full Charge	0 - 1	0	bool	Is battery full charge detected by gauge
114	1	OCV Taken	0 - 1	0	bool	Relaxed and OCV is captured
115	1	Resistance Update Disabled	0 - 1	0	bool	
116	1	Gauge IC Status	0 - 1	0	bool	1: Gauge IC is detected. 0: Not detected, maybe battery volt is very low.
Charger						
120	2	Charger status	0 - 3	0	enum	0: Not charging 1: Pre-charge (low battery) 2: Normal charging 3: Full battery
122	1	Vsupply Power good	0 - 1	0	bool	Is charger power supply connected and functional.

123	2	Charger fault	0 - 3	0	enum	0: Normal 1: Vsupply fault 2: Thermal shutdown 3: Charger safety timer expired
125	1	Battery fault	0 - 1	0	uint16	0: Normal, 1: Battery overvoltage
126	1	Input current limit	0 - 1	0	uint16	0: Normal, 1: Input current limited
127	1	Charger IC Status	0 - 1	0	bool	1: Charger IC is detected. 0: Not detected
Gauge Learning						
140	1	Ra0	0 - 32767	0	uint16	
141	1	Ra1	0 - 32767	0	uint16	
142	1	Ra2	0 - 32767	0	uint16	
143	1	Ra3	0 - 32767	0	uint16	
144	1	Ra4	0 - 32767	0	uint16	
145	1	Ra5	0 - 32767	0	uint16	
146	1	Ra6	0 - 32767	0	uint16	
147	1	Ra7	0 - 32767	0	uint16	
148	1	Ra8	0 - 32767	0	uint16	
149	1	Ra9	0 - 32767	0	uint16	
150	1	Ra10	0 - 32767	0	uint16	
151	1	Ra11	0 - 32767	0	uint16	
152	1	Ra12	0 - 32767	0	uint16	
153	1	Ra13	0 - 32767	0	uint16	
154	1	Ra14	0 - 32767	0	uint16	
155	1	Qmax Cell	0 - 32767	0	uint16	

3.2. UART – Modbus

The module uses a standard Modbus RTU format with the following default specifications:

Parameter	Value
Baud Rate	115200
Data bits	8 bits
Parity	None
Stop bit	1 bit
Flow Control	RS485 - DTR
Mode	RTU
Default Slave Address	12
Functions	03: Holding read 04: Input read 06: Holding write single

	16: Holding write multiple
CRC	CRC-16 Modbus

Data Format

Accessing Modbus Registers require interpreting the data correctly. An I2C C library is provided that also handles data formats.

The following table highlights the data formats:

Data Type	Registers Count	Value	Data Format
Bool	1	True = 0x0001, False = 0x0000	0x0001
U16	1	0x1234	0x1234
I16	1	-123 = 0xFF85	0xFF85
U32	2	0x12345678	[0] = 0x5678 [1] = 0x1234
I32	2	-123456 = 0xFFFE1DC0	[0] = 0x1DC0 [1] = 0xFFFE
Enum	2	4 = 0x00000004	[0] = 0x0000 [1] = 0x0004
Float	2	12.567 = 0x4149126f (IEEE-754)	[0] = 0x126F [1] = 0x4149
String	ceil(Strlen / 2) e.g. 10 chars = 5 registers	"World" = 0x48 0x65 0x6C 0x6C 0x6F	[0] = 0x6548 "oW" [1] = 0x6C6C "lr" [2] = 0x006F "d"

3.3. RS485 – Modbus

To use RS485 Bus, the module provides the RS485 Enable output pin to connect to an external RS485 transceiver as follows:

RS485

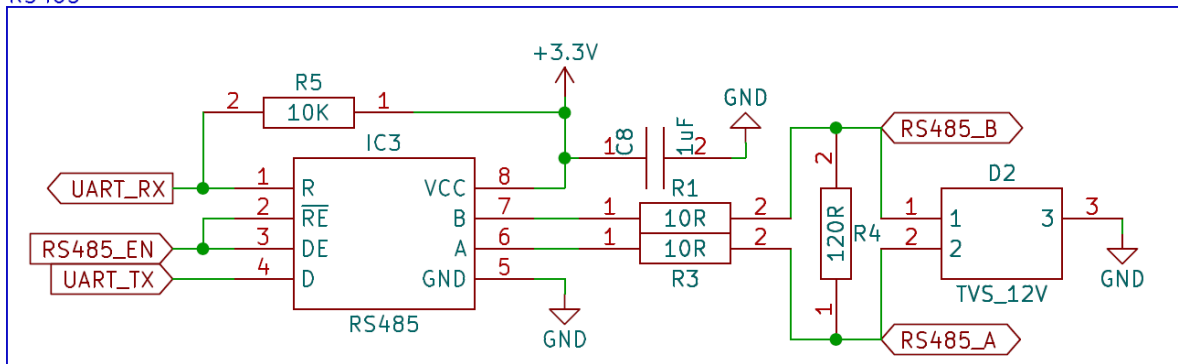


Figure 3: RS485 External Circuit

3.4. I2C Interface

This section describes how to communicate with the module via I2C. We provide a universal C library for I2C communication with all our modules.

I2C interface hardware requirements:

- Signal Level is 3.3V
- Pull-up resistors are already included in the module PCB. **No need** to add external pull-up resistors.

Write Holding registers

To write holding registers using I2C, the following request shall be sent:

- [0]: 1 (Mode = Write holding)
- [1]: Start Register Address LSB
- [2]: Start Register Address MSB
- [3]: Length (Registers count to write)
- [4]: CRC-8 SMBus

Then, followed by registers data:

- Data0-LSB
- Data0-MSB
- ...
- CRC-8 SMBus

The Data will be written to the Register(s) successfully if I2C Write operation succeeded and CRC is correct.

Read Holding registers - request

To read holding registers using I2C, the following request shall be sent:

- [0]: 2 (Mode = Read holding)
- [1]: Start Register Address LSB
- [2]: Start Register Address MSB
- [3]: Length (Registers count to read)
- [4]: CRC-8 SMBus

After that, you need to wait briefly for processing, at least 5ms.

Then, perform an I2C read for data + CRC byte. CRC shall be verified.

Read Holding - response

- [0]: 2 (Mode = Read holding)
- [1]: Start Register Address LSB
- [2]: Start Register Address MSB
- [3]: Length (Registers count to read)
- [4]: Data0_L
- [5]: Data0_M
- ...
- []: CRC-8 SMBus

Read Input registers - request

To read Input registers via I2C, the following request shall be sent:

- [0]: 3 (Mode = Read input)

- [1]: Start Register Address LSB
- [2]: Start Register Address MSB
- [3]: Length (Registers count to read)
- [4]: CRC-8 SMBus

After that, you need to wait briefly for processing, at least 5ms.

Then, perform an I2C read for data + CRC byte. CRC shall be verified.

Read Input - response

- [0]: 3 (Mode = Read input)
- [1]: Start Register Address LSB
- [2]: Start Register Address MSB
- [3]: Length (Registers count to read)
- [4]: Data0_L
- [5]: Data0_M
- ...
- []: CRC-8 SMBus

NOTE: Mutex provides a C library called `modbus_i2c` for handling the I2C packets processing and data formats. It can be used on any Microcontroller, so why not use it!

4. Extension Board

An extension board is available to evaluate the module functionality and connect it to the PC App via USB. The Extension board is a great way to test the module.

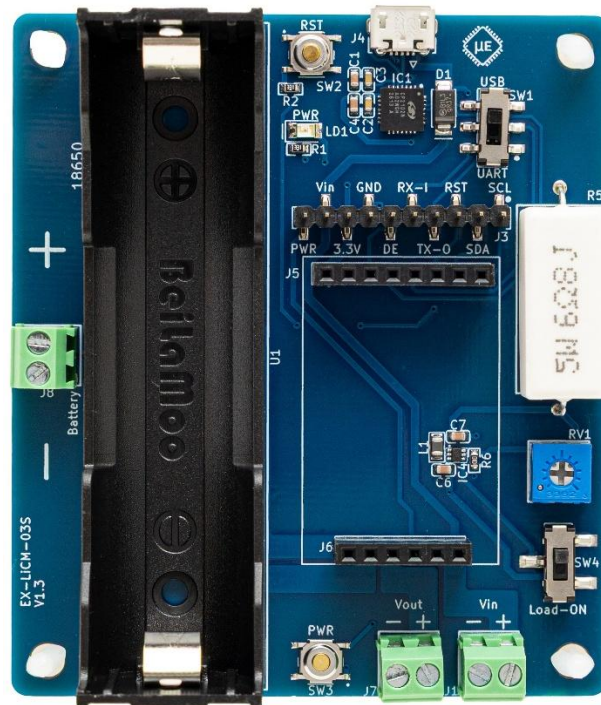


Figure 4: Extension Board

- Extension Board dimensions: **70 x 80 mm**

4.1. Pinout

Table 7: Extension pinout connector

No.	Pin Name	Functionality	Comments
1	SCL	I2C_SCL	
2	SDA	I2C_SDA	
3	RST	nRESET MCU	Set to LOW to disable/reboot MCU
4	TX-O	TX Output	UART TX – Output
5	RX-I	RX Input	UART RX – Input
6	DE	DE	Used for RS485 input control. Data Send Enable
7	GND	GND	Common GND
8	+3.3V	+3.3V power supply	3.3V output, 0.8A max
9	Vin	Voltage Input	Charging Voltage input
10	PWR	Power button	Power ON/OFF and Wakeup from Deep Sleep

5. PC Application

The Mutex Connect App is provided to allow users to fully configure and evaluate the LiCM-03S Module.

The App provides the following features:

- Holding Registers Read/Write
- Input Registers Read
- Module firmware update

The screenshot displays the Mutex Embedded PC Application interface. On the left is a blue sidebar with navigation options: Connection, Holding Registers, Input Registers (highlighted), Dashboard, Firmware Update, and About. The main area shows the 'Input Registers' configuration. At the top right, it indicates 'Communication Status: Connected', 'Success Count: 12', and 'Failed Count: 0', with a 'Clear Count' button. Below this, there's a 'Sector' dropdown menu set to 'Gauge' and a 'Periodic Read (s)' input field set to '1'. A 'Read' button is positioned next to the input field. The central part of the interface features a table with the following data:

Name	Address	Type	Value
SOC	100	U16	5
SOH	101	U16	100
Voltage	102	U16	3639
Current	103	I16	20
Power	104	I16	73
Internal Temperature	105	I16	266
Capacity Remaining	106	U16	121
Capacity Full	107	U16	2798
Capacity Design	108	U16	2000
ChemId	109	U16	4610

Figure 5: PC App