ON Semiconductor®

# Test Procedure for LC709204F Evaluation board

## 1 Evaluation Kit

### 1.1 How to select Evaluation board

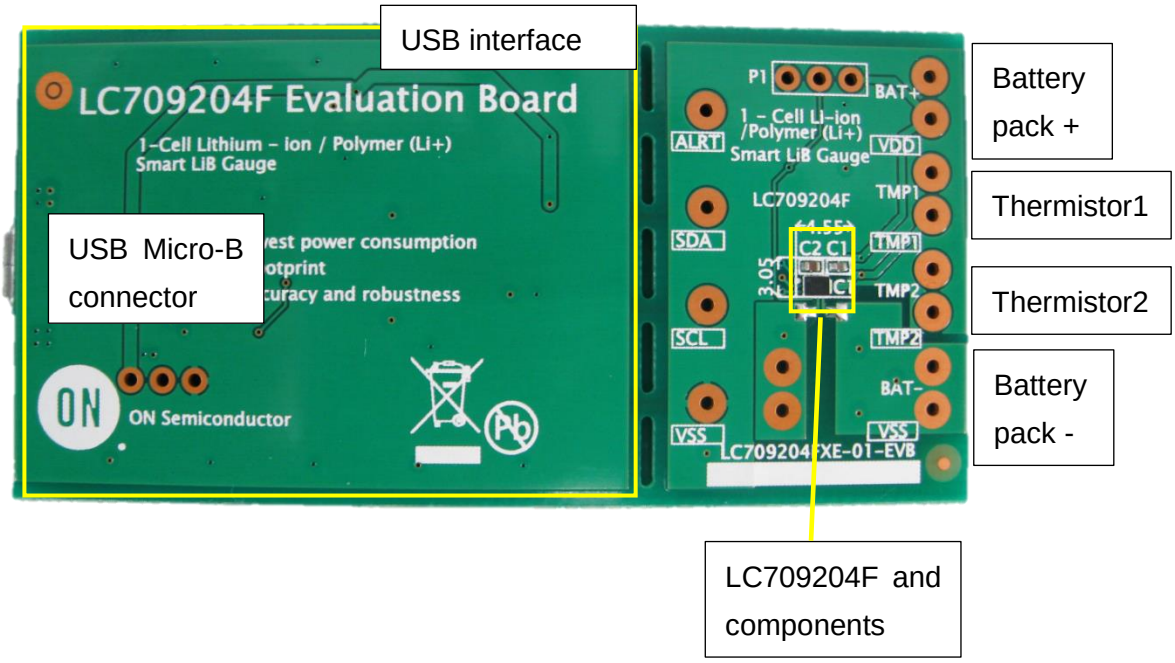
・Select a suitable Evaluation board according to target device and your battery.

| Evaluation board | Target device | Battery type | Related documents |
|---|---|---|---|
| LC709204FXE-01-GEVB | LC709204FXE-01TBG | 01, 04, 05, 06, 07 | *LC709204FXE-01-GEVB_SCHEMATIC.pdf*<br>*LC709204FXE-01-GEVB_GERBER.zip*<br>*LC709204FXE-01-GEVB_BOM.pdf* |

Battery profile vs registers

| IC Type | Battery Type | Nominal / Rated Voltage | Charging Voltage | Number of The Parameter (0x1A) | Change of The Parameter (0x12) |
|---|---|---|---|---|---|
| LC709204FXE-01TBG | 01 | 3.7 V | 4.2 V | 0x1001 | 0x00 |
| | 04 | UR18650ZY (Panasonic) | | | 0x01 |
| | 05 | ICR18650-26H (SAMSUNG) | | | 0x02 |
| | 06 | 3.8 V | 4.35 V | | 0x03 |
| | 07 | 3.85V | 4.4V | | 0x04 |

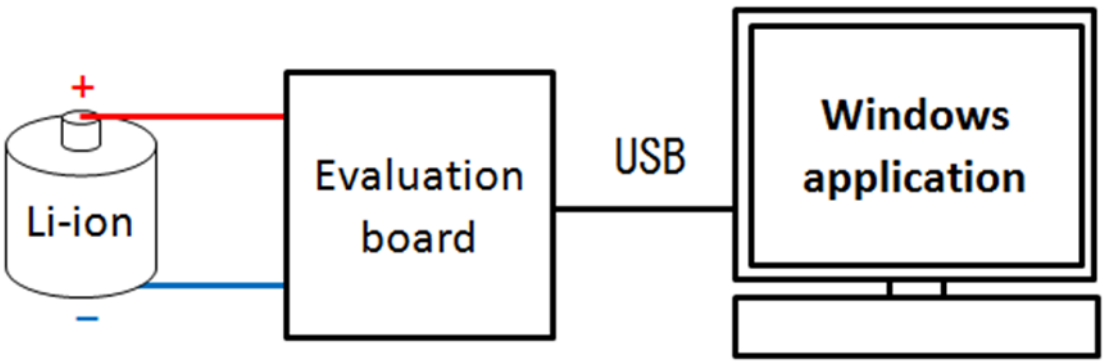
## 1.2 Evaluation board




## 1.3 Windows application

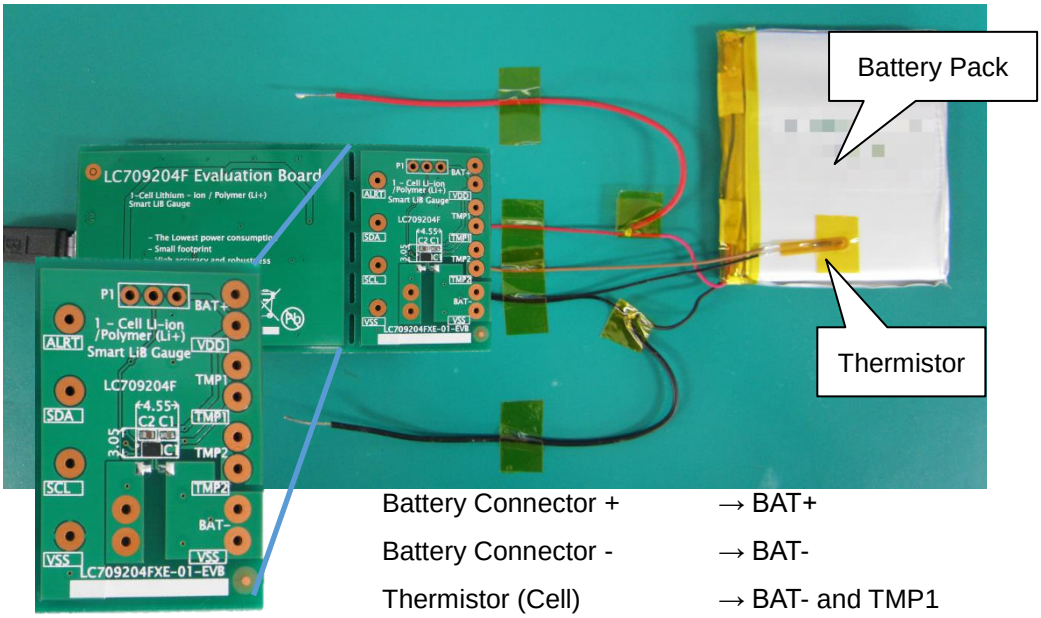
- FGICTool_Verxxx.exe. The software can be downloaded at ON Semiconductor Web site. (Software)

## 1.4 Evaluation board Block diagram



# 2 How to connect Evaluation board

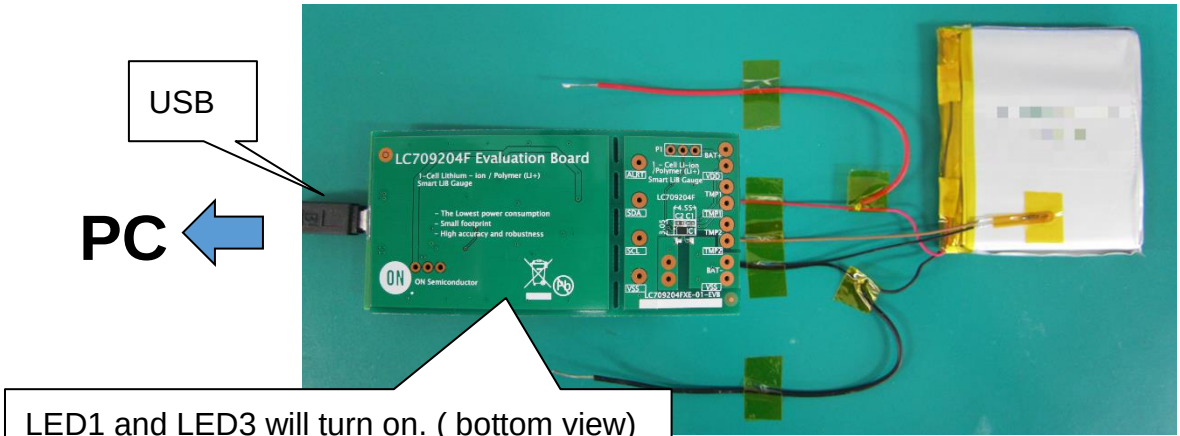
## 2.1 Connection of Evaluation board and Battery



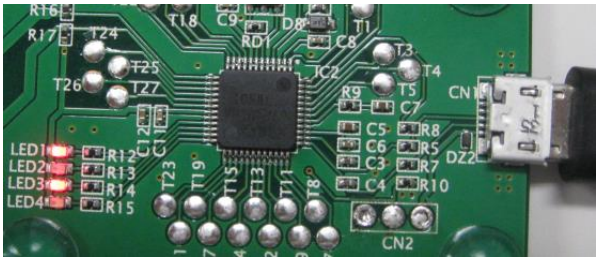

| | |
|---|---|
| Battery Connector + | → BAT+ |
| Battery Connector - | → BAT- |
| Thermistor (Cell) | → BAT- and TMP1 |
| Thermistor (Ambient) | → BAT- and TMP2 |

Note: 10 kΩ NTC thermistor is required.
Ex. SEMITEC 103JT-025

## 2.2 Connection of PC and EVA board



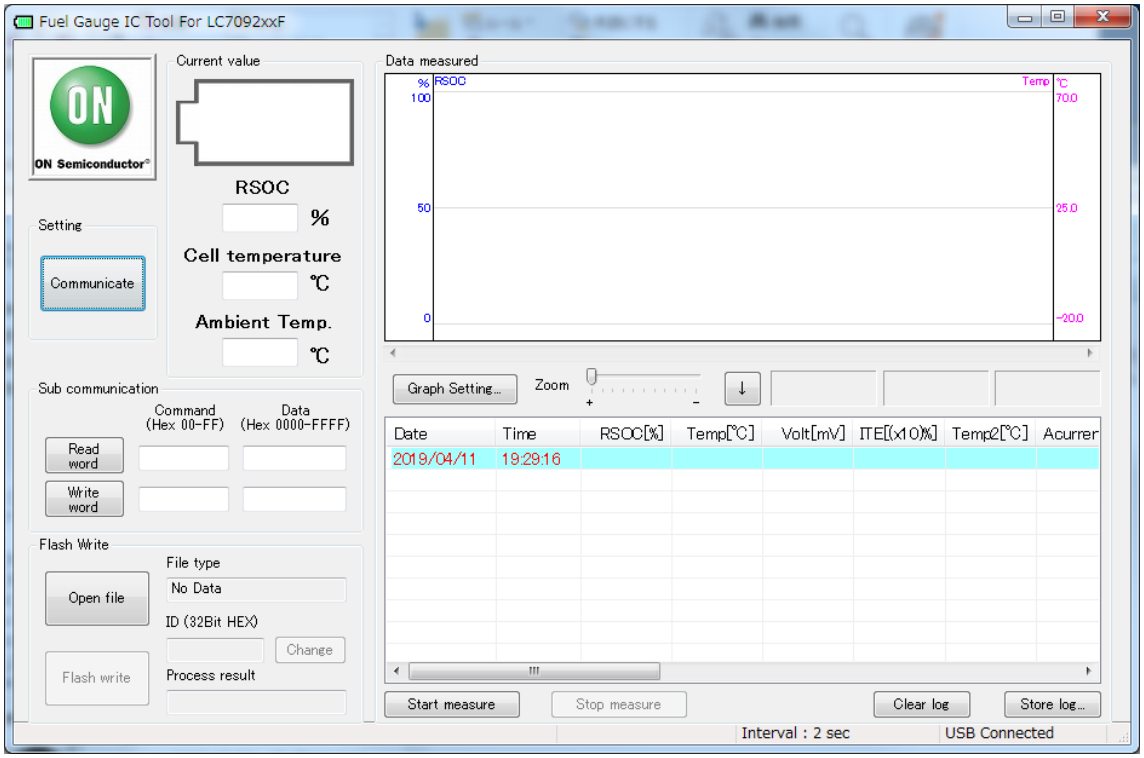

LED1 and LED3 will turn on. ( bottom view)



# 3 How to start application

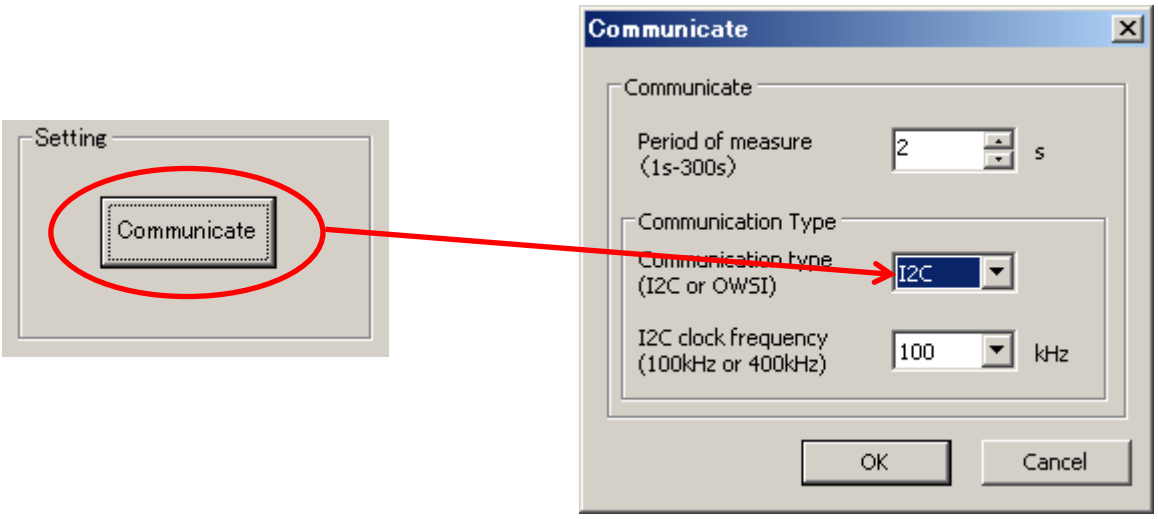
## 3.1 Start application

・Click “FGICTool_verxxx.exe”

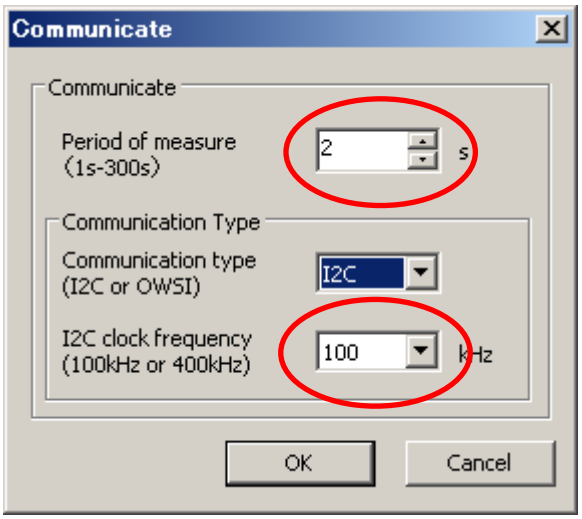



## 3.2 Select communication type

・Click “Communicate” and select I2C.



・Select time interval of log and I2C clock frequency.



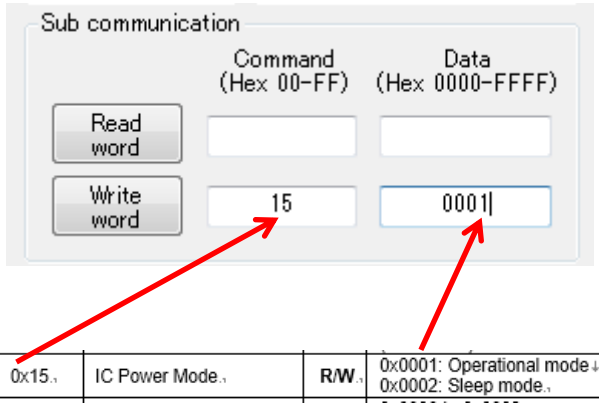

# 4 Register setting

## 4.1 Set Operational mode

・Setting registers

-Input 「15」 in the Command field.

-Input 「0001」 in the Data field.




| | | | | | |
|---|---|---|---|---|---|
| 0x15 | IC Power Mode | R/W | 0x0001: Operational mode<br>0x0002: Sleep mode | Selects Power mode. | 0x0002 |

・Click “Write word”.

## 4.2 Set APA

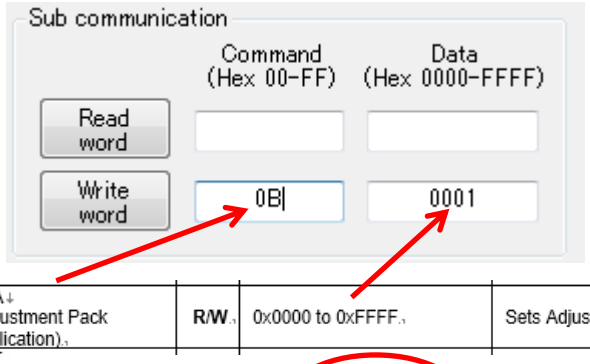
Set APA parameter that is suitable for your battery. Refer datasheet about typical APA. The applied APA value is selected by the design capacity of your battery and Battery type. Select Maximum APA when your design capacity exceeds the listed capacity.

・Setting registers

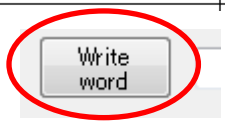
-Input 「0B」 in the Command field.

-Input 「0000 to FFFF (a value suitable for your battery)」in the Data field.

Note: For example the set value in APA register is 0x0D0D for 0x0D APA value.




・Click “Write word”.




**Typical APA**

| Design Capacity | APA[15:8] / APA[7:0] | | |
|---|---|---|---|
| | Type−01 | Type−06 | Type−07 |
| 50 mAh | 0x13 | 0x0C | 0x03 |
| 100 mAh | 0x15 | 0x0E | 0x05 |
| 200 mAh | 0x18 | 0x11 | 0x07 |
| 500 mAh | 0x21 | 0x17 | 0x0D |
| 1000 mAh | 0x2D | 0x1E | 0x13 |
| 2000 mAh | 0x3A | 0x28 | 0x19 |
| 3000 mAh | 0x3F | 0x30 | 0x1C |
| 4000 mAh | 0x42 | 0x34 | - |
| 5000 mAh | 0x44 | 0x36 | - |
| 6000 mAh | 0x45 | 0x37 | - |

| Design Capacity | APA[15:8] / APA[7:0] | |
|---|---|---|
| | Type−04 | Type−05 |
| 2600 mAh | 0x10 | 0x06 |

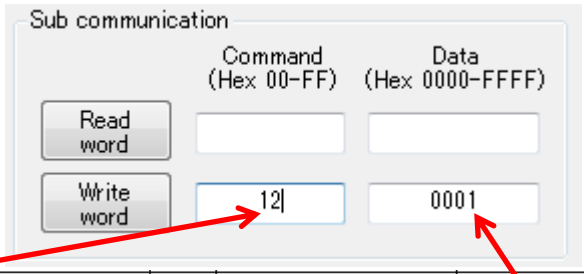
## 4.3 Select battery profile

Select and set a profile that is suitable for your battery from the datasheet.

・Setting registers

-Input 「12」 in the Command field.

-Input 「0000 or 0001」 in the Data field.




| | | | | | |
|---|---|---|---|---|---|
| 0x12 | Change Of The Param-eter | R/W | 0x0000 to 0x0004 | Selects a battery profile. | 0x0000 |

・Click “Write word”.


| IC Type | Battery Type | Nominal / Rated Voltage | Charging Voltage | Number of The Parameter (0x1A) | Change of The Parameter (0x12) |
|---|---|---|---|---|---|
| LC709204FXE-01TBG | 01 | 3.7 V | 4.2 V | 0x1001 | 0x00 |
| | 04 | UR18650ZY (Panasonic) | | | 0x01 |
| | 05 | ICR18650-26H (SAMSUNG) | | | 0x02 |
| | 06 | 3.8 V | 4.35 V | | 0x03 |
| | 07 | 3.85V | 4.4V | | 0x04 |

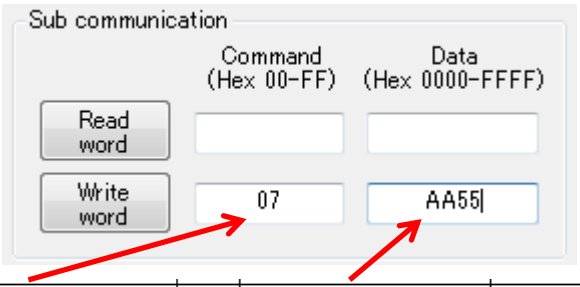
## 4.4 Initialize RSOC

Execute RSOC initialization.

・Setting registers

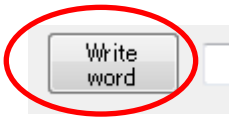
-Input 「07」 in the Command field.

-Input 「AA55」 in the Data field.




| | | | | | |
|---|---|---|---|---|---|
| 0x07 | Initial RSOC | W | 0xAA55: Initialize RSOC | Initialize RSOC with current voltage when 0xAA55 is set | - |

・Click “Write word”.




Note: The accuracy of the Initialization requires the OCV reading to be taken with minimal load or charge, under 0.025C, on the battery. (i.e. less than 75mA for 3000mAh design capacity battery.)

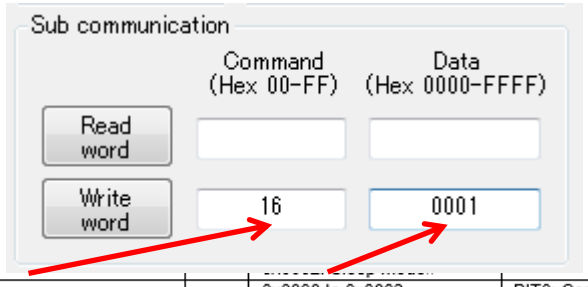
## 4.5 Set Thermistor mode

Select Thermistor mode.

・Setting registers

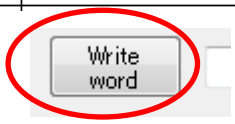
-Input 「16」 in the Command field.

-Input 「0001」 in the Data field.




| | | | | |
|---|---|---|---|---|
| 0x16 | Status Bit | R/W | 0x0000 to 0x0003 | BIT0: Controls TSENSE1 thermistor<br>BIT1: Controls TSENSE2 thermistor | 0x0000 |

・Click “Write word”.




Note: This setting is not required if this LSI receives Cell temperature from Master device via I2C.

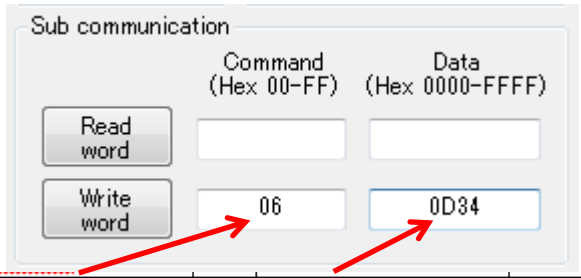
## 4.6 Set Thermistor B

Set a value that is suitable for your thermistor for TSENSE1,TSENSE2.
Refer to the datasheet of the thermistor for the B constant.

・Setting registers

-Input 「06」 in the Command field.(「0E」 TSENSE2 )

-Input 「B constant」 in the Data field.



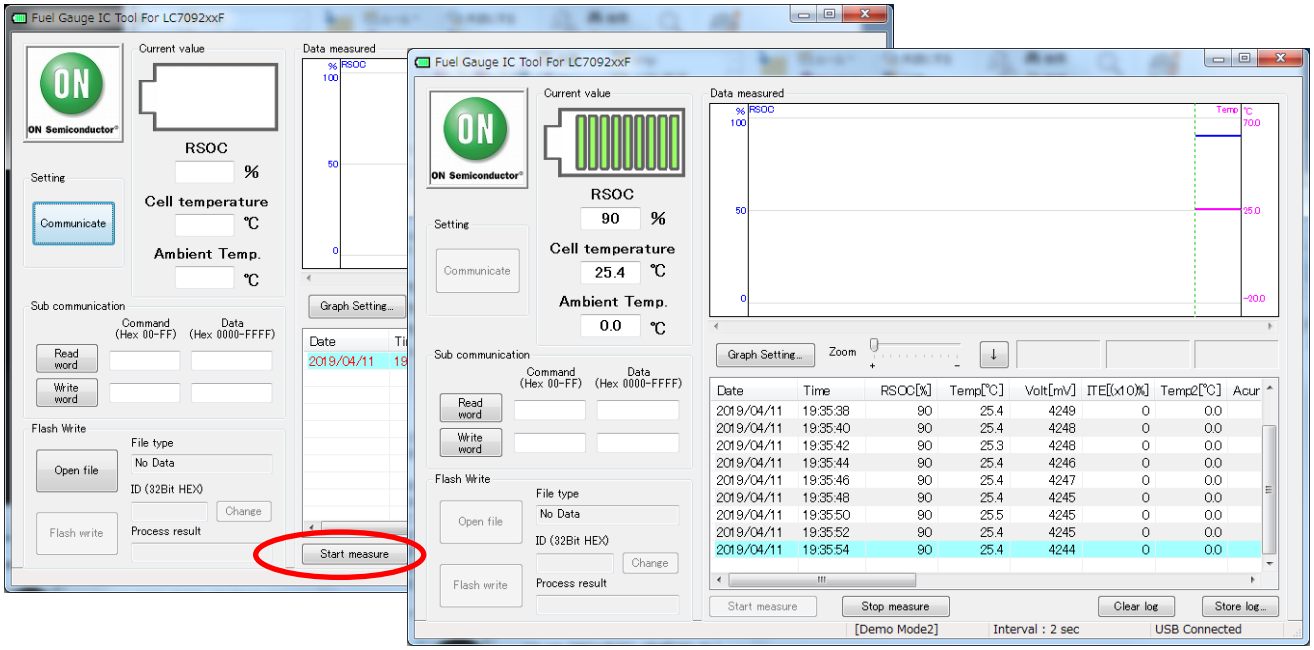

| | | | | | | |
|---|---|---|---|---|---|---|
| 0x06 | TSENSE1 Thermistor B | R/W | 0x0000 to 0xFFFF | K | Sets B-constant of the TSENSE1 thermistor | 0x0D34 (3380K) |
| 0x0E | TSENSE2 Thermistor B | R/W | 0x0000 to 0xFFFF | K | Sets B-constant of the TSENSE2 thermistor | 0x0D34 (3380K) |

・Click “Write word”.


# 5 Starting evaluation

## 5.1 Measurements and Logging

・Click “Start measure”.



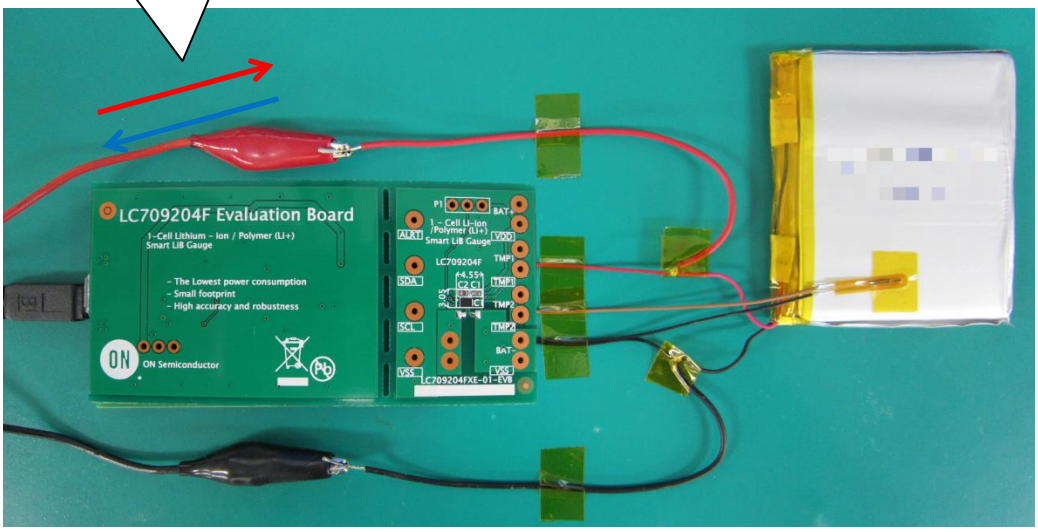

・Application starts measurements and logging.

## 5.2 Start charging/discharging

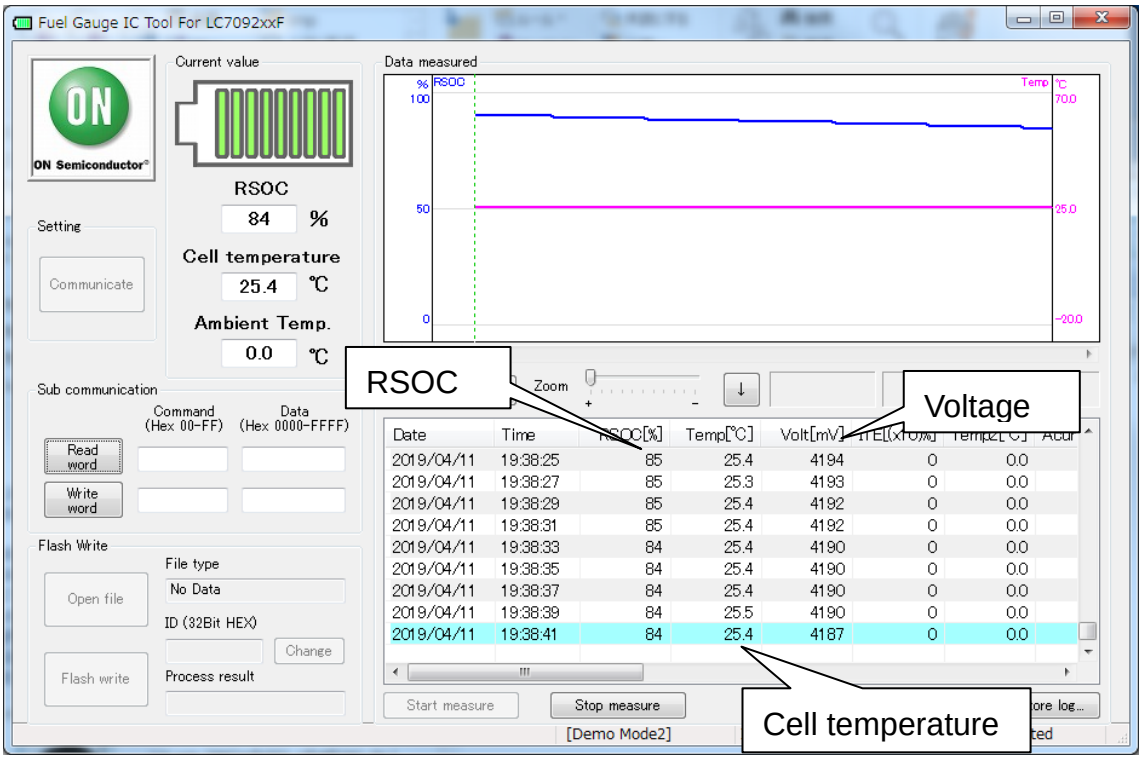
・Connect charger/load to your battery.

Charge or Discharge Example

- Battery charger
- Load equipment
- Various device



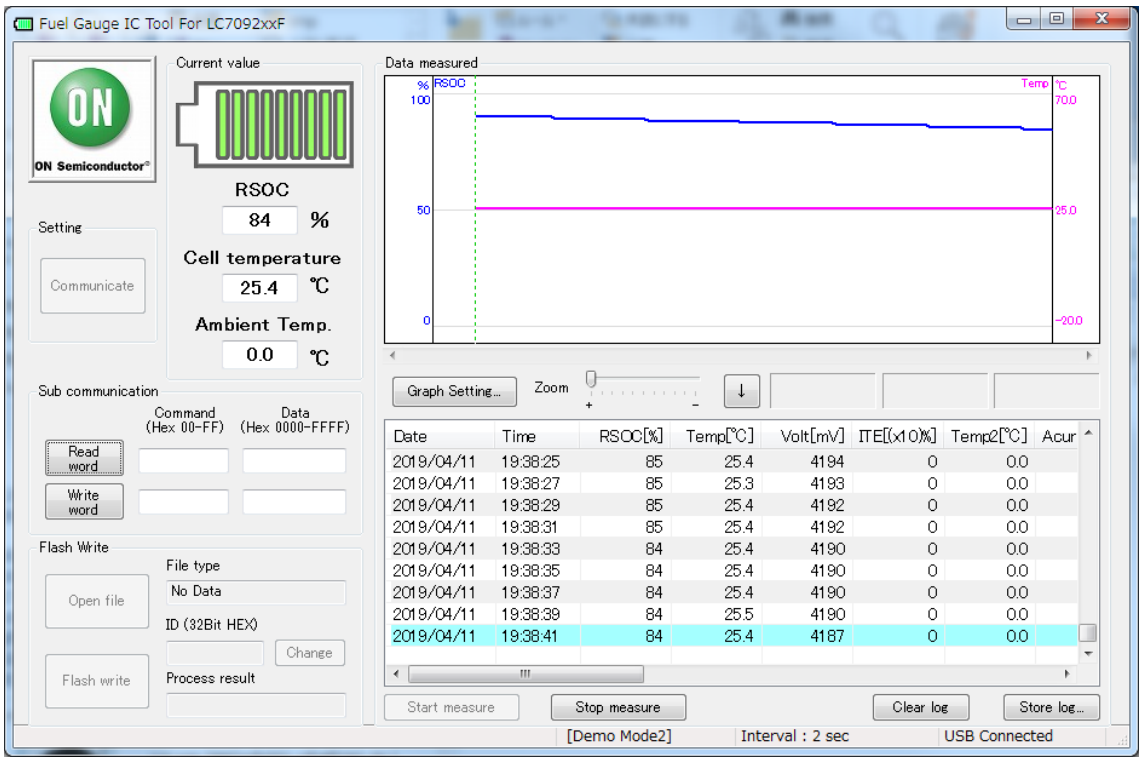

## 5.3 Logging while Charging/Discharging



| Display in GUI | Command Code | Register Name | Comment |
|---|---|---|---|
| RSOC | 0x0D | RSOC | |
| Temp | 0x08 | Cell Temperature | |
| Volt | 0x09 | Cell Voltage | |
| ITE | 0x0F | ITE | |
| Temp2 | 0x30 | Ambient Temperature | |
| Acurrent | 0x34 | Average Cell Current | Acurrent=0 for LC709204FXE<br>Cell Current<br>= Acurrent * Sense resistance |
| MaxCellVolt | 0x2A | Maximum Cell Voltage | |
| MinCellVolt | 0x2B | Minimum Cell Voltage | |
| MinDcurrent | 0x2F | Minimum Cell Current | MinDcurrent=0 for LC709204FXE<br>Cell Current<br>= MinDcurrent * Sense resistance |

## 5.4 End the measurements

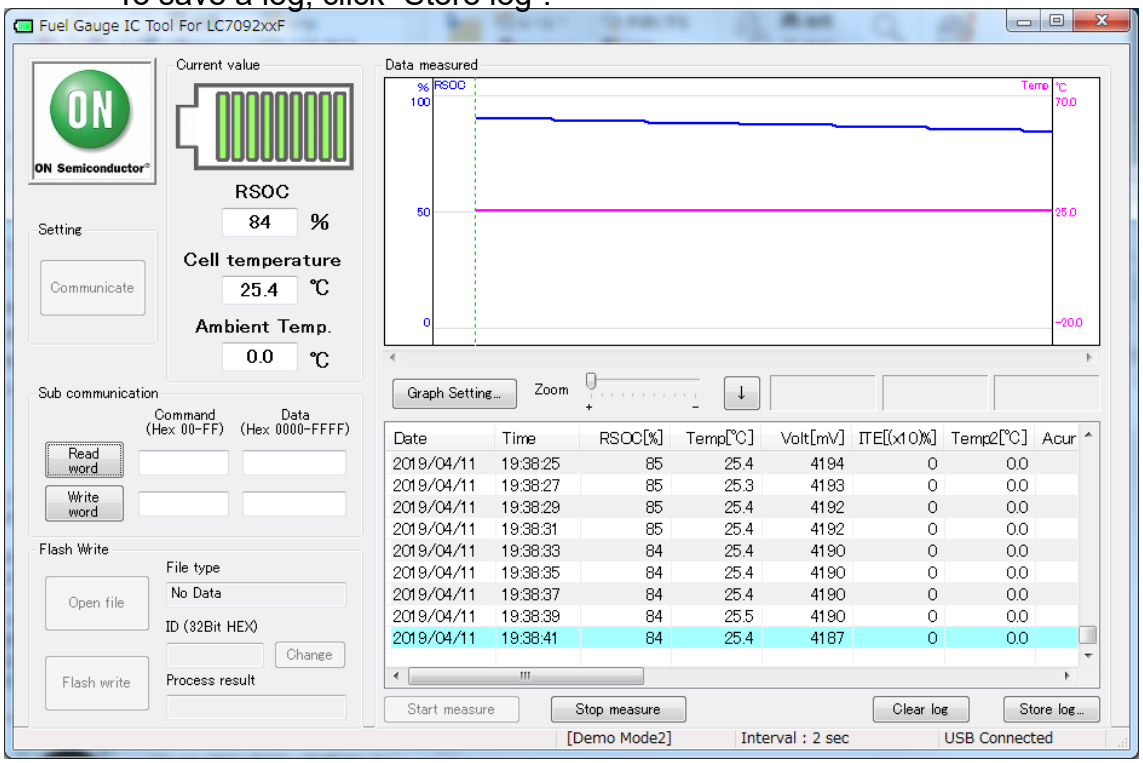
・To end, click “Stop measure”.




## 5.5 Store log

This application can save all measurement log as a text file.

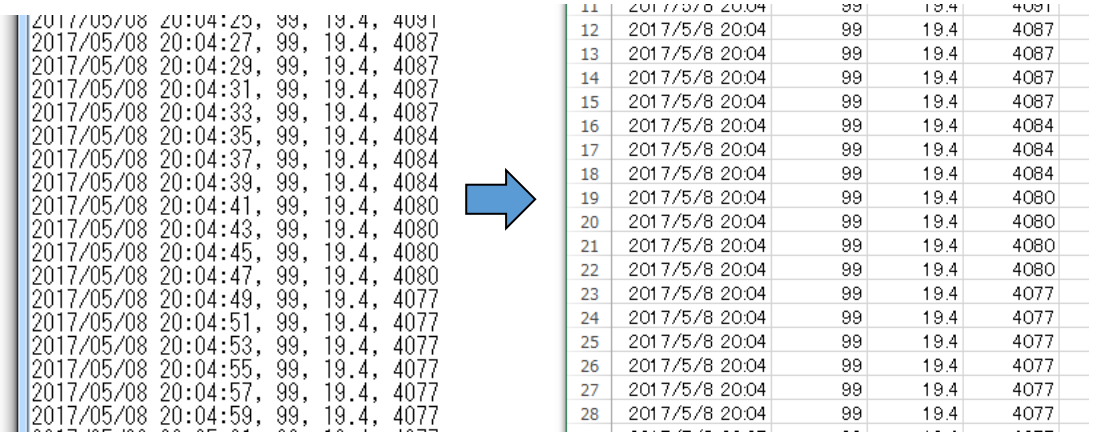
・To save a log, click “Store log”.



## 5.6 Convert log file format

The output text file can be converted to Excel format csv. The conversion to csv facilitates the analysis of data.

・Change the file format from .txt to .csv. Example) test.txt → test.csv.

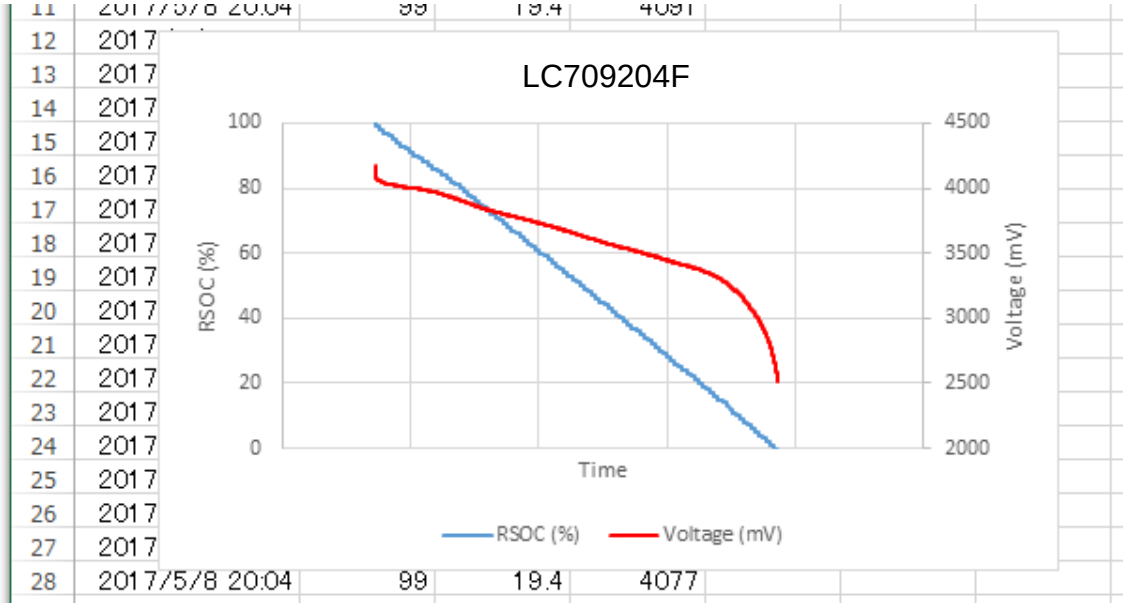


| | | | | |
|---|---|---|---|---|
| 12 | 2017/5/8 20:04 | 99 | 19.4 | 4087 |
| 13 | 2017/5/8 20:04 | 99 | 19.4 | 4087 |
| 14 | 2017/5/8 20:04 | 99 | 19.4 | 4087 |
| 15 | 2017/5/8 20:04 | 99 | 19.4 | 4087 |
| 16 | 2017/5/8 20:04 | 99 | 19.4 | 4084 |
| 17 | 2017/5/8 20:04 | 99 | 19.4 | 4084 |
| 18 | 2017/5/8 20:04 | 99 | 19.4 | 4084 |
| 19 | 2017/5/8 20:04 | 99 | 19.4 | 4080 |
| 20 | 2017/5/8 20:04 | 99 | 19.4 | 4080 |
| 21 | 2017/5/8 20:04 | 99 | 19.4 | 4080 |
| 22 | 2017/5/8 20:04 | 99 | 19.4 | 4080 |
| 23 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |
| 24 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |
| 25 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |
| 26 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |
| 27 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |
| 28 | 2017/5/8 20:04 | 99 | 19.4 | 4077 |

## 5.7 Graph

### 5.7.1 .csv file

・Graph the .csv file.




This graph shows association between time and cell voltage and RSOC in constant current discharging.

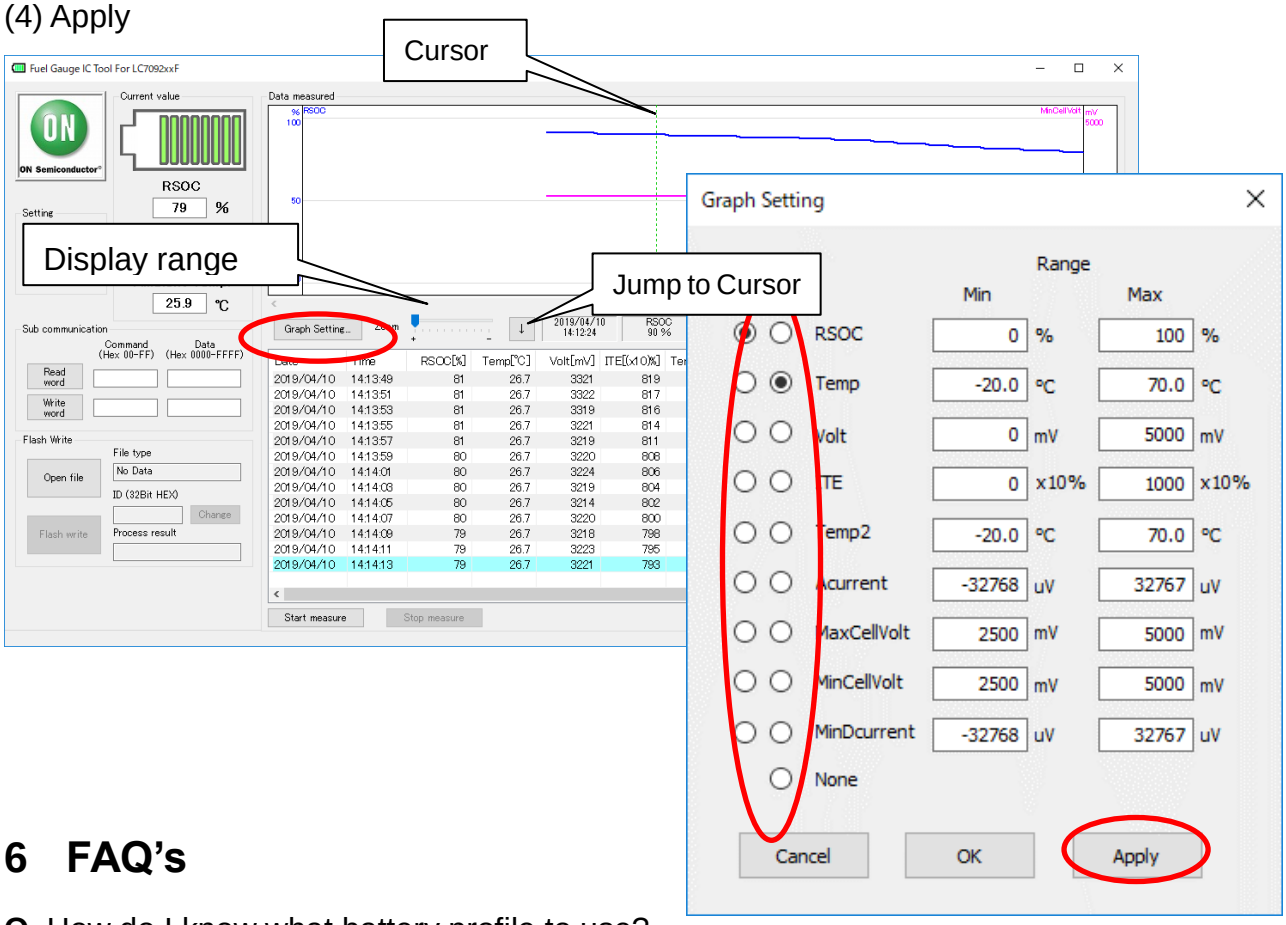
5.7.2 FGI Graph

(1) Click “Graph Setting”

(2) Select “Graph 1 and 2”

(3) Change the value of range for each graph

(4) Apply




# 6 FAQ’s

**Q.** How do I know what battery profile to use?

**A.** Battery characteristics are listed on Table 8 of datasheet. If your battery is not listed on the table, please contact ON Semiconductor.

**Q.** Why does the Fuel Gauge continue to display the same voltage or temperature or RSOC?

**A.** Please ensure that Fuel gauge is not in Sleep mode. Please set Operational mode if so.

**Q.** Can I load the other battery profile to the Fuel Gauge?

**A.** Yes. You can load a new battery profile to the Fuel Gauge using Evaluation board or Master device via I2C. Please contact ON Semiconductor for details.

# 7 Related Documents

Please obtain the latest documents about LC709204F at ON Semiconductor Web site (www.onsemi.com). Search part number: LC709204F.

1) LC709204F, *Smart LiB Gauge Battery Fuel Gauge LSI for 1-Cell Lithium-ion/Polymer (Li+) Data Sheet*
2) LC709204F, *Application Note*
3) LC709204F, *Evaluation Board Documents*
4) LC709204F, *Software FGICTool*

# 8 Revision history

| Version | Date | Details |
|---|---|---|
| **1.0** | **01/09/2019** | **Initial release** |