

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.

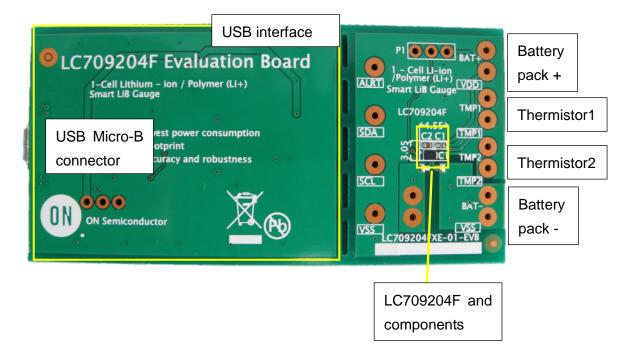
Evaluation board	Target device	Battery	Related documents
		type	
LC709204FXE-	LC709204FXE-	01, 04,	LC709204FXE-01-GEVB_SCHEMATIC.pdf
01-GEVB	01TBG	05, 06,	LC709204FXE-01-GEVB_GERBER.zip
		07	LC709204FXE-01-GEVB_BOM.pdf

Battery profile vs registers

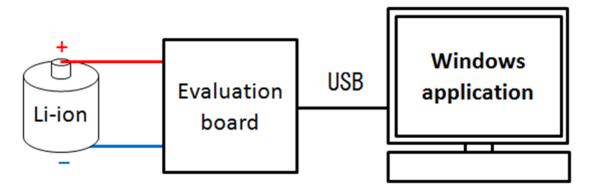
ІС Туре	Battery Type	Nominal / Rated Voltage	Charging Voltage	Number of The Parameter (0x1A)	Change of The Parameter (0x12)
	01	3.7 V	4.2 V		0x00
	04	UR18650ZY (F	Panasonic)		0x01
LC709204FXE -01TBG	05	ICR18650-26H (SAMSUNG)	0x1001	0x02
-UTBG	06	3.8 V	4.35 V		0x03
	07	3.85V	4.4V		0x04



1.2 Evaluation board



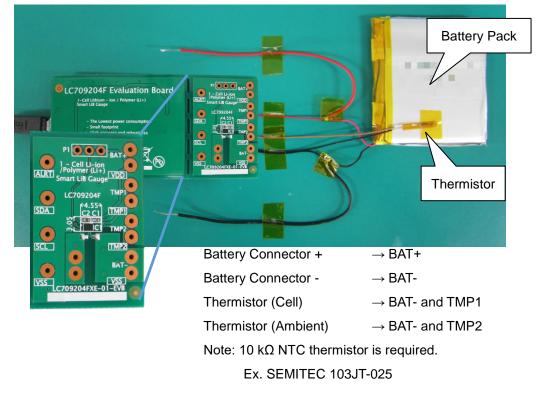
- 1.3 Windows application
 - FGICTool_Verxx.exe. The software can be downloaded at ON Semiconductor Web site. (<u>Software</u>)
- 1.4 Evaluation board Block diagram



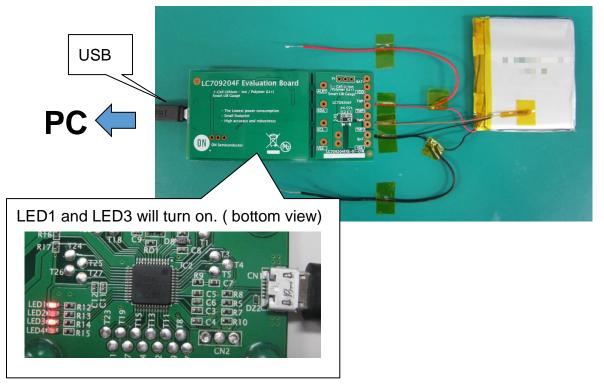


2 How to connect Evaluation board

2.1 Connection of Evaluation board and Battery



2.2 Connection of PC and EVA board





3 How to start application

3.1 Start application

Click "FGICTool_verxxx.exe"

Fuel Gauge IC Tool For LC7092xxF	1 1 1		1.000.000	0. *	an			• ×
Current value	Data measured - % RSOC 100						Te	TP 1C 70.0
ON Semiconductor® RSOC	50							
Communicate Cell temperature °C Ambient Temp.	0							-20.0
C	<	7	0					4
Sub communication Command Data	Graph Setting	z	+					
(Hex 00-FF) (Hex 0000-FFFF) Read word Write word	Date 2019/04/11	Time 19:29:16	RSOC[%]	Temp[°C]	Volt[mV]	ΠE[(⋊ 0)%]	Temp2[°C]	Acurrer
Flash Write								
Open file Dopen file D(32Bit HEX)								
Flash write Process result	•							•
	Start measur	e	Stop measure			Clear log	g Sti	ore log
				Inte	rval : 2 sec		USB Connect	ed j

3.2 Select communication type

• Click "Communicate" and select I2C.

	Communicate X
Communicate	Communicate Period of measure (1s-300s) Communication Type Communication Type (I2C or OWSI) I2C clock frequency (100kHz or 400kHz) I00 kHz OK Cancel



Select time interval of log and I2C clock frequency.

Communicate	×
Communicate	
Period of measure (1s-300s)	
Communication Type	
Communication type (I2C or OWSI)	
I2C clock frequency (100kHz or 400kHz)	
OK Cancel	

4 Register setting

ON Semiconductor®

- 4.1 Set Operational mode
 - Setting registers
 - -Input [15] in the Command field.
 - -Input 「0001」 in the Data field.

-Sub communication				
Comm (Hex 00	and -FF)	Data (Hex 0000-FFFF)		
Read word				
Write word		0001		
0x15., IC Power Mode.,	R/W.	0x0001: Operational mode↓ 0x0002: Sleep mode.,	Selects Power mode	0x0002.,*
1 1				

• Click "Write word".



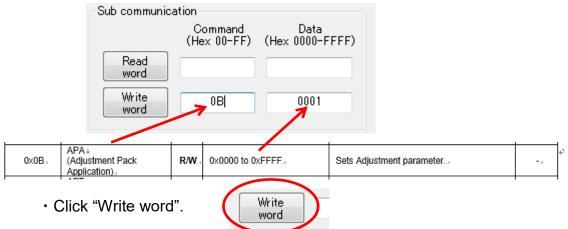


4.2 Set APA

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.



Typical APA

	APA[15:8] / APA[7:0]	
Design Capacity	Туре-01	Туре-06	Туре-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	-

	APA[15:8] / APA[7:0]	1
Design Capacity	Туре-04	Туре-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 $\lceil 12 \rfloor$ in the Command field.
 - -Input 「0000 or 0001」 in the Data field.

mpa			in the Bata here			
	_ Sub c	communication -				
			ommand Da x 00-FF) (Hex 000	ata)0-FFFF)		
		Read word				
		Write word	12 00	01		
	Change Of The Pa ter	aram- R/W 0)	0000 to 0x0004	Selects a battery profile.	0×00	000
• Click	"Write wo	rd".	Write word			
ІС Туре	Battery Type	Nominal / Rated Voltage	Charging Voltage	Number of The Parameter (0x1A)	Change of The Parameter (0x12)	
	01	3.7 V	4.2 V		0x00	
	04	UR18650	ŻY (Panasonic)		0x01	
LC709204FXE- 01TBG	05	ICR18650-2	26H (SAMSUNG)	0x1001	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 $\lceil 07 \rfloor$ in the Command field.
 - -Input 「AA55」 in the Data field.

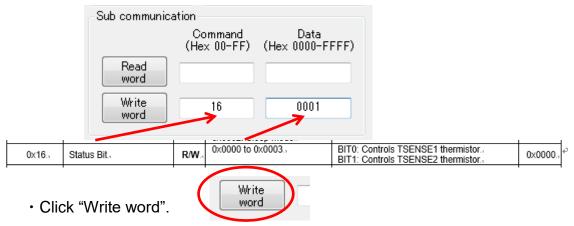
	-Sub communic	ation -					
		Co (He	ommand × 00-FF)	Data (Hex 0000-F	FFF)		
	Read word						
	Write word	5	07	AA55			
0x07.1	Initial RSOC.,	W .,	0xAA55: Init	ialize RSOC.	Initialize 0xAA55	1	ę
• (Llick "Write word	".		Write word			I

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.



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.

	-Sub communica	tion			
	Read word	Command Data (Hex 00-FF) (Hex 0000-	FFF)		
	Write word	06 0D34			
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.1	Sets B-constant of the TSENSE2 thermistor	0x0D34 (3380K).
• Clic	ck "Write word".	Write word			

Starting evaluation 5

Measurements and Logging 5.1

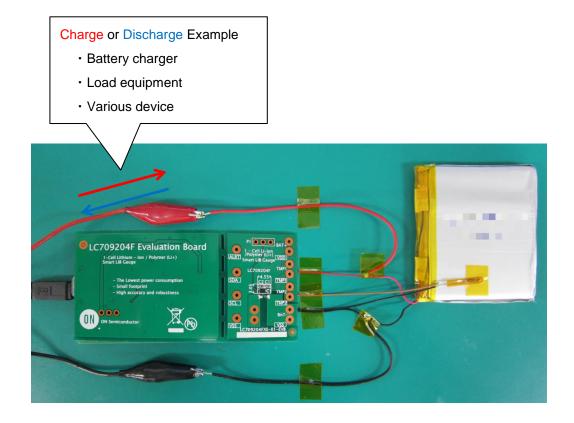
· Click "Start measure".

	Current value	Data measured % RSOC 100	Tuel Gauge IC	Tool For LC7092xxF		5. a a	2.000			9.1		
etting Communicate	RSOC % Cell temperature	50	ON Semiconductor	Current value RSOC 90 %	Data measured % PSOC 100 50						Te	emo 1C 70.0 25.0
	Ambient Temp. °C	<pre></pre>	Communicate	Cell temperature 25.4 ℃								
ub communication		Graph Setting		Ambient Temp.	0							-20.0
(H Read word Write word	Command Data Hex 00-FF) (Hex 0000-FFFF)	Date Til 2019/04/11 19	Read	0.0 °C n Command Data (Hex 0000-FFF)	4 Graph Settin Date	Time	+ RSOC[%]	- Temp[°C]			Temp2[°C]	
Read word Write word			Read	n			+	-	Volt[mV] 4249 4248	ΠΕ[(×10)%] 0 0	0.0	
Read word Write word	File type		Read	n	Date 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42	+ RSOC[%] 90 90 90	- Temp[°C] 25.4 25.4 25.3	4249 4248 4248	0 0 0	0.0 0.0 0.0	
Read word Write word			Read word Write word	n	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:44	+ RSOC[%] 90 90 90	 Temp[°C] 25.4 25.4 25.3 25.4	4249 4248 4248 4248 4246	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0	
Read word Write word ash Write	File type		Read word	n Command Data Hex 00-FF) (Hex 0000-FFFF)	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:44 19:35:46	+ RSOC[%] 90 90 90 90 90	 Temp[°C] 25.4 25.3 25.4 25.4 25.4 25.4	4249 4248 4248 4246 4246 4247	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0	
Read word Write word ash Write	File type No Data		Read word Write word Flash Write	n Command Data Hex 00-FFP (Hex 0000-FFFF)	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:44 19:35:46 19:35:48	+ RSOC[%] 90 90 90 90 90 90	 Temp[°C] 25.4 25.4 25.3 25.4 25.4 25.4 25.4 25.4	4249 4248 4248 4246 4247 4247 4245	0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0	E
Read word Write word lash Write	File type No Data ID (32Bit HEX)		Read word Write word	n Command Data Hex 00-FFF (Hex 0000-FFFF)	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:44 19:35:46	+ RSOC[%] 90 90 90 90 90	- Temp[°C] 25.4 25.4 25.3 25.4 25.4 25.4 25.4 25.4 25.5	4249 4248 4248 4246 4246 4247	000000000000000000000000000000000000000	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	
Read word Write word lash Write Open file	File type No Data ID (32Bit HEX) Change	2019/04/11 19	Read word Write word Flash Write	ri Command Hex 00-FFF) (Hex 0000-FFFF)	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:44 19:35:46 19:35:48 19:35:50	+ RSOC[%] 90 90 90 90 90 90 90	 Temp[°C] 25.4 25.4 25.3 25.4 25.4 25.4 25.4 25.4	4249 4248 4248 4246 4247 4247 4245 4245	0 0 0 0 0 0 0 0	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Ш
Read word Write word ash Write Open file	File type No Data ID (32Bit HEX) Change	2019/04/11 19	Read word Write word Flash Write	n Command Data Hex 00-FFF (Hex 0000-FFFF)	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:42 19:35:42 19:35:42 19:35:42 19:35:48 19:35:50 19:35:50	+ RSOC[%] 90 90 90 90 90 90 90 9	- Temp["C] 25.4 25.4 25.4 25.4 25.4 25.4 25.5 25.4	4249 4248 4248 4246 4247 4245 4245 4245 4245		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Ш
Read word Write word lash Write Open file	File type No Data ID (32Bit HEX) Change	2019/04/11 19	Read word Write Write Flash Write Open file	n Command (Hex 00-FFF) (Hex 0000-FFFF) File type No Data D (32Bit HEX) Change	Date 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11 2019/04/11	Time 19:35:38 19:35:40 19:35:44 19:35:44 19:35:46 19:35:48 19:35:50 19:35:52 19:35:54	+ RSOC[%] 90 90 90 90 90 90 90 9	- Temp["C] 25.4 25.4 25.4 25.4 25.4 25.4 25.5 25.4	4249 4248 4248 4246 4247 4245 4245 4245 4245		0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Ш

· Application starts measurements and logging.



- 5.2 Start charging/discharging
 - Connect charger/load to your battery.



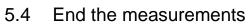
5.3 Logging while Charging/Discharging

	100							U
RSOC								70.0
Setting 84 %	50							25.0
Cell temperature								
Ambient Temp.	0							-20.0
O° 0.0								+
Sub communication	RSOC	Zoom	0	· · ·				
Command Data		-^_	+	_		🕖 Volt	age	
(Hex 00-FF) (Hex 0000-FFFF)	Date	Time	\$\$QC[%]	Temp[°C]	Volt[mV]		npeloj A	cur ^
Read word	2019/04/11	19:38:25	85	25.4	4194	0	0.0	
Write	2019/04/11	19:38:27	85	25.3	4193	0	0.0	
word	2019/04/11	19:38:29	85	25.4	4192	0	0.0	
	2019/04/11	19:38:31	85	25.4	4192	0	0.0	
Flash Write File type	2019/04/11	19:38:33	84	25.4	4190	0	0.0	
	2019/04/11	19:38:35	84	25.4	4190	0	0.0	
Open file No Data	2019/04/11	19:38:37	84	25.4	4190	0	0.0	
ID (32Bit HEX)	2019/04/11	19:38:39	84	25.5	4190	0	0.0	
Change	2019/04/11	19:38:41	84	25.4	4187	0	0.0	-
Flash write Process result	•	III			\sim			•
	Start measur		Stop measure Derno Mode2]		Cell ten	nneratu	re tec	e log



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





• To end, click "Stop measure".

Fuel Gauge IC To	ool For LC7092xxF		-	2.000	• 9	A	9.1		• X
	Current value	Data measured							
ON Semiconductor ^o	C 00000000	% RSOC						Te	mo î⊂ 70.0
Setting	RSOC 84 %	50							25.0
Communicate	Cell temperature 25.4 °C								
	Ambient Temp.	0							-20.0
	O ° 0.0	•							Þ
	Command Data lex 00-FF) (Hex 0000-FFFF)	Graph Setting		+					
Read	IEX 00 117 (TIEX 0000 1111)	Date	Time	RSOC[%]	Temp[°C]		ΠE[(×10)%]		Acur 1
word		2019/04/11	19:38:25	85	25.4	4194	0	0.0	
Write		2019/04/11	19:38:27	85	25.3	4193	0	0.0	
word		2019/04/11	19:38:29	85	25.4	4192	0	0.0	
Flash Write		2019/04/11	19:38:31	85	25.4	4192	0	0.0	
ridsri write	File type	2019/04/11 2019/04/11	19:38:33 19:38:35	84 84	25.4 25.4	4190 4190	0	0.0 0.0	
	No Data	2019/04/11	19:38:35	84	25.4	4190	0	0.0	
Open file		2019/04/11	19:38:39	84	25.5	4190	0	0.0	
	ID (32Bit HEX)	2019/04/11	19:38:41	84	25.4	4187	0	0.0	
	Change			2.				5.0	-
Flash write	Process result	•							•
		Start measure	e 🗌	Stop measure			Clear log	s Sti	ore log
			[]	Demo Mode2]	Inte	erval : 2 sec		USB Connect	ed

5.5 Store log

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

• To save a log, click "Store log".

Fuel Gauge IC T	ool For LC7092xxF		Contraction of the second			-			
ON Semiconductor®	Current value RSOC 84 % Cell temperature 25.4 °C Ambient Temp. 0.0 °C	Data measured						Te	re ¹ C 700 25.0 -200
-Sub communicatio	1	Graph Setting	Zoom		· · · ·				
	Command Data Hex 00-FF) (Hex 0000-FFFF)			+	-				
Read	nex 00-rr) (nex 0000-rrrr)	Date	Time	RSOC[%]	Temp[°C]	Volt[mV]	TTE[(x10)%]	Temp2[°C]	Acur 1
word		2019/04/11	19:38:25	85	25.4	4194	0	0.0	
Write		2019/04/11	19:38:27	85	25.3	4193	0	0.0	
word		2019/04/11	19:38:29	85	25.4	4192	0	0.0	
FL-LUID-		2019/04/11	19:38:31	85	25.4	4192	0	0.0	
Flash Write	File type	2019/04/11	19:38:33	84	25.4	4190	0	0.0	
	No Data	2019/04/11 2019/04/11	19:38:35 19:38:37	84 84	25.4 25.4	4190 4190	0	0.0 0.0	_
Open file		2019/04/11	19:38:37	84 84	25.4 25.5	4190	0	0.0	
	ID (32Bit HEX)	2019/04/11	19:38:41	84	25.5	4190	0	0.0	
	Change	2010/04/11	10.00.41		20.4	-107	0	0.0	+
Flash write	Process result	•							•
		Start measure		Stop measure			Clear log	Sto	ore log
			[Demo Mode2]	Inte	erval : 2 sec	l	JSB Connect	ed



5.6 Convert log file format

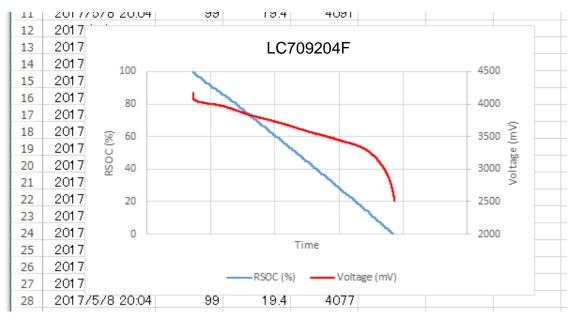
The output text file can be converted to Excel format csv. The conversion to csv facilitates the analysis of data.

• Change the file format from .txt to .csv. Example) test.txt \rightarrow test.csv.

0		• •				
	11	20177070-20.04	55	19.4	4091	
2017/05/08 20:04:25, 99, 19.4, 4091	12	2017/5/8 20:04	99	19.4	4087	
2017/05/08 20:04:27, 99, 19.4, 4087 2017/05/08 20:04:29, 99, 19.4, 4087	13	2017/5/8 20:04	99	19.4	4087	
2017/05/08 20:04:29, 99, 19.4, 4087 2017/05/08 20:04:31, 99, 19.4, 4087	14	2017/5/8 20:04	99	19.4	4087	
2017/05/08 20:04:31, 33, 15:4, 4087	15	2017/5/8 20:04	99	19.4	4087	
2017/05/08 20:04:35, 99, 19.4, 4084	16	2017/5/8 20:04	99	19.4	4084	
2017/05/08 20:04:37, 99, 19.4, 4084	17	2017/5/8 20:04	99	19.4	4084	
2017/05/08 20:04:39, 99, 19.4, 4084	18	2017/5/8 20:04	99	19.4	4084	
2017/05/08 20:04:41, 99, 19.4, 4080	19	2017/5/8 20:04	99	19.4	4080	
2017/05/08 20:04:43, 99, 19.4, 4080	20	2017/5/8 20:04	99	19.4	4080	
2017/05/08 20:04:45, 99, 19.4, 4080	21	2017/5/8 20:04	99	19.4	4080	
2017/05/08 20:04:47, 99, 19.4, 4080	22	2017/5/8 20:04	99	19.4	4080	
2017/05/08 20:04:49, 99, 19.4, 4077	23	2017/5/8 20:04	99	19.4	4077	
2017/05/08 20:04:51, 99, 19.4, 4077	24	2017/5/8 20:04	99	19.4	4077	
2017/05/08 20:04:53, 99, 19.4, 4077	25	2017/5/8 20:04	99	19.4	4077	
2017/05/08 20:04:55, 99, 19.4, 4077	26	2017/5/8 20:04	99	19.4	4077	
2017/05/08 20:04:57, 99, 19.4, 4077	27	2017/5/8 20:04	99	19.4	4077	
2017/05/08 20:04:59, 99, 19.4, 4077	28	2017/5/8 20:04	99	19.4	4077	
laade keelka oo beladi bai dalif dabb		/- /				

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

Г

-

(4) Apply

Fuel Gauge IC To			Curse	or L						- 0	×	
ON N Semiconductor*	Current value RSOC 79 %	Data measured sc RSCC 100 50				<u> </u>	Graph Settir			MinCell Volt mV 5000		>
Disp	play range					-	to Cursor]	Min	Range	Max	
Sub communicatio	n Command Data Hex 00-FF) (Hex 0000-FFFF)	Graph Setting 2	y		2019/04/10 14:12:24		00	RSOC	0	% [100	%
Read word Write		2019/04/10 14:13 2019/04/10 14:13 2019/04/10 14:13 2019/04/10 14:13	51 81	Temp[°C] 26.7 26.7 26.7	Volt[mV] 3321 3322 3319	ITE[(x10)%] Ter 819 817 816	ightarrow	Temp	-20.0] ∘ c [70.0] °C
word Lash Write	File type	2019/04/10 1413 2019/04/10 1413 2019/04/10 1413	55 81 57 81	26.7 26.7 26.7	3221 3219 3220	814 811 808	00	Volt	0] mV [5000] mV
Open file	No Data ID (32Bit HEX)	2019/04/10 14:14 2019/04/10 14:14 2019/04/10 14:14 2019/04/10 14:14	01 80 03 80	26.7 26.7	3224 3219 3214	806 804 802	00	TE	0	x10% [1000	x10%
Flash write	Process result	2019/04/10 14:14 2019/04/10 14:14 2019/04/10 14:14	07 80 09 79 11 79	26.7 26.7 26.7	3220 3218 3223	800 798 795	00	emp2	-20.0] ∘ c [70.0] °C
		2019/04/10 14:14	13 79	26.7	3221	793	00	Acurrent	-32768]uV [32767] uV
		Start measure	Stop measure				00	4axCellVolt	2500] mV [5000	mV
							00	MinCellVolt	2500] mV [5000	mV
							00	MinDcurrent	-32768	uV	32767	uV
							0	None				
F	AQ's						Can	cel	ОК		Apply	>

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 (<u>www.onsemi.com</u>). Search part number: LC709204F.

- 1) LC709204F, Smart LiB Gauge Battery Fuel Gauge LSI for 1-Cell Lithiumion/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