

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 Nominal / Rated		Charging	Number of	Change of	
	Turne	Voltago	Voltogo	The Parameter	The Parameter	
	туре	voltage	vollage	(0x1A)	(0x12)	
	01	3.7 V	4.2 V		0x00	
	04	UR18650ZY (F	Panasonic)		0x01	
LC709204FXE	05	ICR18650-26H (SAMSUNG)	0x1001	0x02	
-UIIBG	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	0.0	an (
Current value	Data measured - % FSOC 100						Te	τρ °C 70.0
ON Semiconductor* RSOC Setting % Call temporature	50							
Communicate	0							-20.0
Sub communication Command Data	Graph Setting	z Zoom	•					
(Hex 00-FF) (Hex 0000-FFFF) Read word Write word	Date 2019/04/11	Time 19:29:16	RSOC[%]	Temp[°C]	Volt[mV]	ΠΕ[(×10)%]	Temp2[°C]	Acurrer
Flash Write								
Open file ID (32Bit HEX)								
Flash write Process result	•							•
	Start measur	e	Stop measure	Inte	rval : 2 sec	Clear lo	s Sti USB Connect	ed

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	٦
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 $\lceil 0000 \text{ to FFFF}$ (a value suitable for your battery) \rfloor 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	Type-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]				
Design Capacity	Туре-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 $\lceil 12 \rfloor$ in the Command field.
 - -Input 「0000 or 0001」 in the Data field.

	_Sub c	communication									
	Command Data (Hex 00-FF) (Hex 0000-FFFF)										
		Read word									
		Write word	12 00	01							
0x12 Cha	inge Of The Pa	aram- R/W 0x0	000 to 0x0004	Selects a battery profile.	0×0	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	0x00								
Image: Command (Hex 00-FF) Data (Hex 0000-FFFF) Write word 12 0x12 Change Of The Parameter (0x12) 0x12 Battery Type Number of Type Number of The Parameter (0x12) 10 3.7 V 4 UR186502Y (Panasonic) 04 UR186502Y (Panasonic) 05 ICR18650-26H (SAMSUNG) 0x1001 0x02											
Sub communication Command Data (Hex 00-FF) (Hex 0000-FFFF) Read word 012 Ox12 Change Of The Parameter (0x1A) Ox12 Change Of The Parameter (0x1A) Vite Write eter V 0x0000 to 0x0004 Selects a battery profile. Vertice Write word Click "Write word". Write word IC Type Battery Type Nominal / Rated Voltage Charging Voltage Number of The Parameter (0x1A) Charging Parameter (0x1A) 01 3.7 V 4.2 V 0x0 04 UR186502Y (Panasonic) 0x1001 0x0 05 ICR18650-26H (SAMSUNG) 0x1001 0x0			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	RSOC with current voltage when is set	1	¢
• (Lick "Write word	". ".		Write word		N'I ANT I		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			
		Command Data (Hex 00-FF) (Hex 0000-F	FFF)		
	Read word				
	Write word	06 0D34			
0x06.,	TSENSE1 Thermistor B.,	R/W., 0x0000 to 0xFFFF.,	K.,	Sets B-constant of the TSENSE1 thermistor	0x0D34
0x0E.,	TSENSE2 Thermistor B.,	R/W., 0x0000 to 0xFFFF.,	K.,	Sets B-constant of the TSENSE2 thermistor	0x0D34.₁₽ (3380K).₁
• Clic	ck "Write word".	Write word			

Click "Write word".

Starting evaluation 5

Measurements and Logging 5.1

· Click "Start measure".

Current value	Data measured	Fuel Gauge IC T	ool For LC7092xxF		Sec.	1.000		A	0.4		• X
ON Senticonductor RSOC Settine % Communicate % Cell temperature °C Ambient Temp. °C Sub communication °C	* F800 100 50 0 Craph Setting	Settine	Current value RSOC 90 % Cell temperature 25.4 °C Ambient Temp. 0.0 °C	Data measured % PSOC 100 50 0						Terre	-200
(Hex UU-FF) (Hex UUU-FFF) word Witte	Date Ti 2019/04/11 19	Sub communication	Command Data Hex 00-FF) (Hex 0000-FFFF)	Graph Setting Date 2019/04/11	Zoom Time 19:35:38	0 + RSOC[%] 90	"↓ Temp[°C] 25.4	Volt[mV] 4249	ПЕ[(×10)%] 0	Temp2[°C] /	Acur 1
Flash Write				2019/04/11	19:35:40	90	25.4	4248	0	0.0	
File type		Write		2019/04/11	19:35:42	90	25.3	4248	0	0.0	
No Data		mord		2019/04/11	19:35:44	90	25.4	4246	0	0.0	
Open file		Flash Write		2019/04/11	19:35:46	90	25.4	4247	Ő	0.0	
ID (32Bit HEX)			File type	2019/04/11	19:35:48	90	25.4	4245	0	0.0	E
Change			No Data	2019/04/11	19:35:50	90	25.5	4245	Ő	0.0	
Elach write Process result	1	Open file		2019/04/11	19:35:52	90	25.4	4245	Ő	0.0	
r Idan Willo			ID (32Bit HEX)	2019/04/11	19:35:54	90	25.4	4244	ů	0.0	
	Start measure		Change	2010/04/11	10.00.04	00	20.4	42.14	Ū	0.0	-
		Flash write	Process result	•							Þ
				Start measur	e :	Stop measure	1		Clear log	Stor	e log
					[[Demo Mode2]	Inte	rval : 2 sec	U	JSB Connecte	d

· Application starts measurements and logging.



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



5.3 Logging while Charging/Discharging

Fuel Gauge IC Tool For LC7092	xxF		10.00 m	1.000	• 9	A	Q 6		
ON Semiconductor [®] Setting Communicate	OC 4 % perature	Data measured						Temp	°C 700 •
Ambien 0: Sub communication	t Temp.	RSOC	Zoom	Q			Volt	age	-20.0
(nex of the control (nex	x 0000-1111/	Date	Time	**** (%]	Temp[°C]	Volt[mV]	ITE[(xlom]_rer	npel OJ P	(Cur ^
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	
Elash White		2019/04/11	19:38:31	85	25.4	4192	0	0.0	
File type		2019/04/11	19:38:33	84	25.4	4190	0	0.0	
No Data		2019/04/11	10.30.30	94	20.4	4190	0	0.0	
Open file		2013/04/11	10.00.07	84	20.4	4190	0	0.0	
		2019/02/11	L M 100 10M		Z . I . I	4100		0.0	
ID (32Bit HEX)		2019/04/11	19:36:39	84	25.4	4187	0	00	
ID (32Bit HEX)	Change	2019/04/11 2019/04/11	19:38:41	84	25.4	4187	0	0.0	+
ID (32Bit HEX) Flash write Process result	Change	2019/04/11	19:38:41	84	25.4	4187	0	0.0	



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		
	Current value	Data measured							
ON Semiconductor ^o		% RSOC						Te	mo *C 70.0
Setting	RSOC 84 %	50							25.0
Communicate	Cell temperature 25.4 °C								
	Ambient Temp.	0							-20.0
	0.0 °C								Þ
-Sub communication (Command Data	Graph Setting	z Zoom	+					
Read	IEX 00 117 (IIEX 0000 1111)	Date	Time	RSOC[%]	Temp[°C]	Volt[mV]	ΠE[(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	
First Was		2019/04/11	19:38:31	85	25.4	4192	0	0.0	
ridsh write	File type	2019/04/11	19:38:33	84	25.4	4190	0	0.0	
	No Data	2019/04/11	19.30.30	04 94	20.4	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	•	111						•
		Start measure	8	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			+	- 🗆				
(((((((((((((((((((nex 00-rr) (nex 0000-rrrr)	Date	Time	RSOC[%]	Temp[°C]	Volt[mV]	ΠE[(×10)%]	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	
Et al ULA		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	19:38:35	84	25.4	4190	0	0.0	_
Open file	no pala	2019/04/11	19:30:37	64 84	20.4	4190	0	0.0	
	ID (32Bit HEX)	2019/04/11	19:38:41	84	25.5	4187	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.

2111 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	11	2017/070-20.04	33	18.4	4091
2017/05/08 20:04:25, 39, 19.4, 4091	12	2017/5/8 20:04	99	19.4	4087
2017/05/08 20:04:27, 33, 13.4, 4087	13	2017/5/8 20:04	99	19.4	4087
2017/05/08 20:04:23, 33, 13.4, 4087	14	2017/5/8 20:04	99	19.4	4087
2017/05/08 20:04:31, 33, 13.4, 4087	15	2017/5/8 20:04	99	19.4	4087
2017/05/06 20:04:33, 33, 13.4, 4007	16	2017/5/8 20:04	99	19.4	4084
2017/05/06 20:04:35, 33, 13.4, 4064	17	2017/5/8 20:04	99	19.4	4084
2017/05/06 20:04:57, 33, 13:4, 4064	18	2017/5/8 20:04	99	19.4	4084
2017705700 20.04.39, 99, 19.4, 4004	19	2017/5/8 20:04	99	19.4	4080
2017705708 $20.04.41, 33, 13.4, 4000$	20	2017/5/8 20:04	99	19.4	4080
2017/05/08 20:04:43, 33, 13:4, 4000	21	2017/5/8 20:04	99	19.4	4080
2017/05/08 $20:04:43, 00, 10:4, 4000$	22	2017/5/8 20:04	99	19.4	4080
2017/05/08 20:04:41, 00, 10:4, 4000	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
		/- /			

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

		Cursor	· L								
Fuel Gauge IC Tool For LC7092xxF	L								- U	×	
OIN Semiconductor	Data measured								MinCellVolt mV 5000		
Settine 79 %	50					Graph Settir	ng				×
Display range		_		\square	Jump t	o Cursor		Min	Range	Max	
Sub communication Command Data (Hex 00-FF) (Hex 0000-FFFF)	Graph Setting 20		↓	2019/04/10 14:12:24	RSOC 90 %	\odot	RSOC [0]% [100	%
Read word	2019/04/10 14:13:49 2019/04/10 14:13:51 2019/04/10 14:13:51	81 81 81	26.7 26.7 26.7	3321 3322 331.9	819 817 816	\bigcirc \bigcirc	Temp [-20.0] ∘c [70.0	°C
Flash Write File type	2019/04/10 141355 2019/04/10 141355 2019/04/10 141355	81 81 80	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 14:14:0 2019/04/10 14:14:0 2019/04/10 14:14:0	80 80 80	26.7 26.7 26.7	3224 3219 3214	806 804 802	00	те [0	x10%	1000	x10%
Flash write Process result	2019/04/10 14:14:0 2019/04/10 14:14:0 2019/04/10 14:14:1	7 80 79 79	26.7 26.7 26.7	3220 3218 3223	800 798 795	00	emp2 [-20.0] ℃ [70.0	°C
	2019/04/10 14:14:13	1 79	26.7	3221	793	00	Acurrent [-32768	uV [32767	uV
	Start measure	Stop measure				00	/laxCellVolt [2500	mV [5000	mV
						00	MinCellVolt [2500] mV [5000	mV
						00	MinDcurrent [-32768] uV [32767	uV
						0	None				
6 FAQ'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