Application Report Start Guide for BQ Products

TEXAS INSTRUMENTS

ABSTRACT

Battery management devices at TI use the prefix BQ as the identifier. In particular, gas gauge products are divided into single cell, multi-cell, and specialized products. In nonmenclature, BQ27xxx are for CEDV and legacy single cell products, and BQ27Zxx are for current single cell products. BQ20Z, 30Z, and 40Z are multi-cell products using impedance track and BQ20xx, 30xx, 40xx are multicell products using CEDV. Multi-cell products are used in notebook, medical, applications and Industrial applications. Examples are computers, drones and appliances.

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1 How to Get Started with BQ Gas Gauge Products

1.1 Items Required to Get Started

- EVM of Gas Gauge
- EV2400 communications interface adapter
- · Cables to connect EVM to an EV2400 communication interface adapter
- USB cable to connect the communication interface adapter to the computer.
- Computer setup with Windows XP, or higher, operating system.
- Battery cells, or if using cell simulator, 1-kΩ resistors to match the number of cells of the chosen EVM
- A DC power supply that can supply the EVM's required voltage and current (constant current and constant voltage capability is desirable)

1.1.1 Selecting Gauge and Ordering EV2400

- 1. Select the right gauge for your application using https://www.ti.com/power-management/battery-management/ fuel-gauges/overview.html.
- 2. Order the desired EVM for your application. To order the EVM, go to the product page of the device and click "Design & Development".

Design & development

For additional terms or required resources, click any title below to view the detail page where available.

```
All Hardware development Software development CAD/CAE symbols
```

Hardware development		
	EVALUATION BOARDS	
	1 Series, 2 Series, 3 Series, and 4 Series Li-Ion Battery Pack Manager Evaluation Module	
```	BQ40Z50EVM-561	\$99.00
	User guide	Add to cart

 Order an EV2400. Please refer to the EVM user's guide on the product page to see if EV2400 is supported. If it is not supported, use what is recommended in the EVM user's guide. For a list of supported devices, please go to the EV2400 product page. The EV2400 is a HID device that converts data from BQSTUDIO to I2C /HDQ/SDQ/SMBus/SPI commands to the bq EVM (https://www.ti.com/tool/EV2400).

### Order Now

Part Number	Buy from Texas Instruments or Third Party	Buy from Authorized Distributor	Status
EV2400:	\$199.00(USD)	Pricing may vary.	ACTIVE
USB-Based PC Interface Board for Battery Fuel (Gas) Gauge Evaluation Module	Download	Buy from distributor	
Contact a Distributor - Select a location -			

🖸 TI's Standard Terms and Conditions for Evaluation Modules apply.

4. The EV2400 might need to have its firmware updated, the steps to update it can be found in the EV2400's user guide (https://www.ti.com/lit/ug/sluu446d/sluu446d.pdf).

### **1.2 Getting Started with BQSTUDIO**

1. Download the latest stable version of BQSTUDIO (https://www.ti.com/tool/download/BQSTUDIO-STABLE). There are two versions of BQSTUDIO, the stable version and the test version which is kept up to date with



the latest releases. For most development and released devices, TI recommends the stable version of BQSTUDIO. If the device is in PREVIEW phase or it is not supported by the stable version, try downloading the latest test version from https://www.ti.com/tool/download/BQSTUDIO-TEST to see if the gauge is supported.

Battery Management Studio (bqStudio) Software – stable version downloads for bq series of TI battery fuel gauges

BQSTUDIO-STABLE 1.3.86.6

Release Date: 13 Jan 2020

View release notes O Supported Platforms O What's New? O Release Information

This page contains specific information about Battery Management Studio (bqStudio) Software – stable version downloads for bq series of TI battery fuel gauges release package. Refer to the table below for download links and related content.

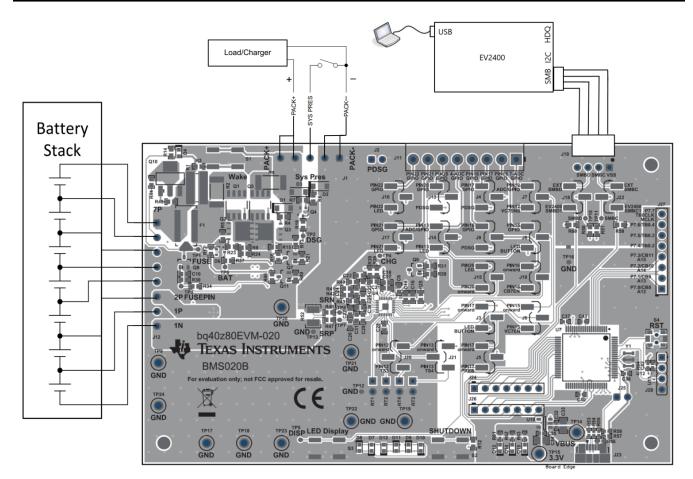
Produ	uct o	down	loads

Download requires export approval (1 minute)

	Title	Version	Description	Size
Batt	ery Management Studio (bqStudio) Installers			
2	Windows Installer for Battery Management Studio (bqStudio)	1.3.86.6	Windows Installer for Battery Management Studio (bqStudio)	190501 K
Batte	ery Management Studio (bqStudio) chemistry update zip fil	е		
	Chemistry update for Battery Management Studio (bqStudio)	791	Import this file with Battery Management Studio (bqStudio) Help menu for the latest chemistries.	
Batt	ery Management Studio (bqStudio) Documentation			
	Documentation Overview	1.0.0.0	Battery Management Studio (bqStudio) Documentation	

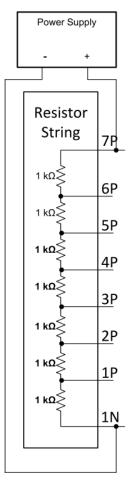
- 2. Make the necessary connections from battery to pack or battery terminals on the EVM based on the general setup guidelines on the selected EVM user's guide.
- 3. Generally, you will want to connect your battery cells starting from the lowest cell in the stack(cell 1) to ground, then attach the remaining cells in sequence, cell 2, cell 3, etc. This would be done up to the top of the stack or after you've reached the desired number of cells. If there are any empty battery cell slots in your gauge, short the empty cells from the bottom up to the positive terminal. For some EVMs, Sys Press might need to be shorted to PACK- in order for the device to start-up. You will also need to connect the thermistor if it is not connected already, the battery or power supply at the recommended voltage, the I2C or SMBus connections from the gauge to the EV2400, and USB from the EV2400 to PC as explained in your EVM User Guide. If discharge or charge current needs to be applied, connect a load or charger to the appropriate terminals.
- 4. A sample connection is shown below.





- 5. A cell simulation can be used instead of battery cells. Connect a 1-kΩ resistor between each of the contacts of the input cell slots up to the desired number of cells is achieved. Short any empty cell slots. A power supply can provide power to the cell simulator. Set the power supply to the desired cell voltage × the number of cells and attach the ground wire to the bottom of the cell stack and the positive wire to the top of the stack. For example, for a 6 cell in series(6s) configuration with a 3.6-V cell voltage, set the power supply to 6 × 3.6 = 21.6-V.
- 6. A sample connection of a cell simulator is shown below.





- 7. After the necessary connections, wake your device according to your EVM User Guide and launch BQSTUDIO to make sure your device can be auto-detected with BQSTUDIO and the bqz container file.
- 8. If it does not automatically connect, you will see a selection dialog with many product lines, as shown below.

a Target Selection Wizard

 $\Box$   $\times$ 

# Battery Management Studio (bqStudio) Supported Targets

Please select a device type...

All Gauge Charger Wireless Charging Protector Monitor Reference Design				
Auto Detected Device : None If the type of device is not in the list above, you may dow (new versions add support for newer devices)	nload the latest ve	ersion of bqStudio a	at <u>http://www.ti.co</u>	om/tool/bqstudio.
	< Back	Next >	Finish	Cancel

9. After successful connection, you will see that the dashboard on left half of screen displays values for Voltage, Temp, and Current. It will also display the protocol used for communication. If no information is displayed, then there is an error in communication. Check connections and make sure to wake your device.



Board	~ -	C Registers 🛛														😂 Comma	nds 🖂		-
fresh is OFF - C	lick to Turn On	Registers													• ຂ	Comma	inds		
io Version: 1.3.86														Start Log	Scan Refresh				
		Registers															VICE_NUMBI	_	
																🖉 H	W_VERSION		
	EV2400	Name	Value	Units ^	Name		Value	Units	^ Name		Value	Units ^	Name	Value	Units ^	🤹 I	W_VERSION		
1	Version:0.28	Manufacturer Access	0x2D89	hex	🗄 Cel 3 C		0	mA	🗐 Cell 4 F		1000		Cell 2 QMax	4400	mAh		FW BUILD		
r		Remaining Cap. Alarm	300	mAh	Cel 4 C		0	mA	Cell 5 F		1000		Cell 3 QMax	4400	mAh		FWV_BOILD		
		Remaining Time Alarm	10	min	Cel 5 C		0	mA	Cell 6 F		1000	1.1	Cell 4 QMax	4400	mAh	2	CHEM_ID		
		At Rate	0	mA	Cel 6 C		0	mA	Cell 7 F		1000		Cell 5 QMax	4400	mAh		SHUTDOWN		
	SMB	At Rate Time To Full	65535	min	Cel 7 C		0	mA	Cell 1 C		0	mOhm	Cell 6 QMax	4400	mAh		ROIDOWN		
•		At Rate Time To Empty	65535	min	E Cell 1 P		0	cW	Cell 2 C		0	mOhm	Cell 7 QMax	4400	mAh	🛹 IAT	A_SHUTDOW	/N	
		At Rate OK	1		E Cel 2 P		0	cW	Cell 3 C		0	mOhm	Cell 1 QMax DOD0	0			CC OFFSET		
		Temperature	27.3 5253	degC mV	Cell 3 P		0	cW cW	Cell 4 C		0	mOhm mOhm	Cell 2 QMax DOD0	0		-	CC_OFFSET		
	bq40z80 4800_0_04	Current	5255	mA	Cel 5 P		0	cW	Cell 6 C		0	mOhm	Cell 4 QMax DOD0	0	-	PD:	G_FET_TOGO	5LE	
$\sim$ .	Addr: 0x17	Average Current	0	mA	Cell 6 P		0	cW	Cell 7 C		0	mOhm	Cell 5 QMax DOD0	0			IG FET TOGO		
$\sim$	27.3 degC	Max Error	100	%	Cel 7 P		0	cW	E PackGr		0	-	Cell 6 QMax DOD0	0		- PCF	10_FE1_10G0	JLE	
J*		Relative State of Charge	0	%	Power		0	cW	Cell 1 C		0		Cell 7 QMax DOD0	0		CH	G_FET_TOGG	LE	
•		Absolute State of Charge	0	%	Averag	e Power	0	cW	Cell 2 C		0		QMax Passed Q	0	mAH				
		Remaining Capacity	0	mAh	🗐 Int Temp		26.9	degC	Cell 3 C	3	0		GMax Time	0	h/16	* DS	G_FET_TOGG	LE	
		Full charge Capacity	3976	mAh	TS1 Ter	nperature	27.3	degC	Cell 4 C	1	0	1.0	Temp k	1.0		1	GAUGE_EN		
		Run time To Empty	65535	min	TS2 Ter	nperature	27.4	degC	Cell 5 C	t i	0		Temp a	1000	-				
53 mV		Average Time to Empty	65535	min	TS3 Ter	nperature	-273.2	degC	Cell 6 C	1	0		Cell 1 Raw DOD	16384	-	4	FET_EN		
0%		Average Time to Full	65535	min 🗡	TS4 Ter	noerature	-273.2	deoC	Y GCell 7 C	1	0	. *	Cell 2 Raw DOD	16384	. ×	1	IFETIME_EN		
		Bit Registers												Bit High E	t Low RSVD	1	LT_RESET		
ALL DOTTING		Name	Value	Bit7		Bit6	Bit5		Bit4	В	#3	Bit2	Bit1	Bit	• 0		LT FLUSH		
500		Battery Mode (high)	0x6081	CapM		ChoM	AM		RSVD	RS	VD	RSVD	PB	co				_	
1000		Battery Mode (low)		CF		RSVD	RSVI	>	RSVD	RS	VD	RSVD	PBS	ICC			LT_TEST		
1500		Battery Status (high)	0x02D0	0CA		TCA	RSVD	)	OTA	π	DA	RSVD	RCA	RTA	A		PF EN		
2000		Battery Status (low)		INIT		DSG	FC		FD	E	C3	EC2	EC1	EC	D		-	_	
		Operation Status A (hi	0x2D89	SLEEP		XCHG	XDSC	3	PF	S	iS	SDV	SEC1	SEC	:0	1	PF_CLEAR		
		Operation Status A (low)		BTP_NT		RSVD	FUSE		PDSG	PC	НG	CHG	DSG	PRE	S		BBR EN		
		Operation Status B (hi	0x0000	IATA_CTER		PSSHUT	EMSHU		CB		PCC	SLPAD		INF			and an		
		Operation Status B (lo		SLEEPM		XL	CAL_OFF		CAL		CALM	AUTH	LED	SDI		Log Panel			Clear
		Temp Range (high)	0x10	RSVD		RSVD	RSVE	)	RSVD		SVD	RSVD		RSV					Cicori
		Temp Range (low)		RSVD		OT	HT		STH		स	STL	LT	TU		Transacti			
		Charging Status (high)	0x0001	RSVD		RSVD	RSVE	)	RSVD	N		000	CVR	CC		Name	Cmd	Result	Read A
		Charging Status (low)		VCT		MCHG	SU		N		V	MV	LV	PV					
		Gauging Status	0xD5	CF		DSG	EDV		BAL_EN		rc D	TD	FC	FD					
		T Status (high)	0x0004	RSVD		RSVD	RSVE		OCVFR		MD	RX	QMAX	VD					
		IT Status (low)		NSFM		RSVD	SLPQM		QEN		ОК	RDIS	RSVD	RES					
		Manufacturing Status ( Manufacturing Status (	0x0090	CAL_EN BBR EN		LT_TEST PF_EN	PDSG_T		RSVD FET EN		SVD GE EN	RSVD DSG TE		FUSE					
		Safety Alert A+B (high)	0x0000	RSVD		CUVC	LF_EI OTD		PET_EN OTC	GAUG		DSG_TE RSVD		PCHG_ RSV					
		Safety Alert A+B (high)	0x0000	AOLDL		RSVD	010		OCD1		202	OCC1	COV	CU					
		Safety Status A+B (hig	0x4001	RSVD		CUVC	000		OCDI	AS		ASCD		ASC					

10.Default Register window in the middle reports data from the gauge.

Registers 🧐	🗫 Data Memory 🛛 💈	Commands [ Calibration	R SHA Authent	ication 🚳	🖁 Advanced Comm SMB 🔓	ECC Authentic	ation 🗼	Chemistry	iware 🚺 GPCPackag	ger 📴 Wa	tch 🔚 Data Graph 🔤	Errors		_	
Board	~ -	Registers											- 0	🗳 Commands 🛙	
	Click to Turn On	Registers										Start Log	Scan Refresh	Commands	
Version: 1.3.8	16	Registers											search merican	DEVICE_NUMBER	
Л														HW_VERSION	
	EV2400	Name	Value	Units ^	Name	Value	Units ^	Name	Value	Units ^	Name	Value	Units ^	FW_VERSION	
	Version:0.28	Manufacturer Access	0x2D89	hex	Cell 3 Current	0	mA	Cell 4 RaScale	1000		Cell 2 QMax	4400	mAh	🔮 FW BUILD	
/		Remaining Cap. Alarm	300	mAh	Cell 4 Current	0	mA	Cell 5 RaScale	1000		Cell 3 QMax	4400	mAh	V FW_BUILD	
		Remaining Time Alarm	10	min	Cell 5 Current	0	mA	Cell 6 RaScale	1000		Cell 4 QMax	4400	mAh	CHEM_ID	
		At Rate	0	mA	Cell 6 Current	0	mA	Cell 7 RaScale	1000		Cell 5 QMax	4400	mAh	SHUTDOWN	_
	SMB	At Rate Time To Full	65535	min	Cell 7 Current	0	mA	Cell 1 CompRes	0	mOhm	Cell 6 QMax	4400	mAh	* SHOTDOWN	
•		At Rate Time To Empty	65535	min	Cell 1 Power	0	cW	Cell 2 CompRes	0	mOhm	Cell 7 QMax	4400	mAh	IATA_SHUTDOWN	
•		At Rate OK	1		Cell 2 Power	0	cW	Cell 3 CompRes	0	mOhm	Cell 1 QMax DOD0	0			
2		Temperature	27.3	degC	Cell 3 Power	0	cW	Cell 4 CompRes	0	mOhm	Cell 2 QMax DOD0	0		CC_OFFSET	
22	bq40z80	Current	5253	mV mA	Cell 4 Power	0	cW	Cell 5 CompRes	0	mOhm mOhm	Cell 3 QMax DOD0	0		PDSG_FET_TOGGLE	
$\sim$	4800_0_04 Addr: 0x17	Average Current	0	mA	Cell 6 Power	0	cW	Cell 6 CompRes	0	mOhm	Cell 5 QMax DOD0	0	-		
	27.3 degC	Max Error	100	%	Cel 7 Power	0	cW	PackGrid	0	-	Cell 6 QMax DOD0	0		PCHG_FET_TOGGLE	
ur~	-	Relative State of Charge	0	%	Power	0	cW	Cell 1 Grid	0		Cell 7 QMax DOD0	0		CHG FET TOGGLE	
•		Absolute State of Charge	0	%	Average Power	0	cW	Cell 2 Grid	0		QMax Passed Q	0	mAH		_
		Remaining Capacity	0	mAh	Int Temperature	26.9	degC	Cell 3 Grid	0		GMax Time	0	h/16	DSG_FET_TOGGLE	
		Full charge Capacity	3976	mAh	TS1 Temperature	27.3	deoC	Cell 4 Grid	0		Temp k	1.0		GAUGE_EN	
		Run time To Empty	65535	min	TS2 Temperature	27.4	degC	Cell 5 Grid	0		Temp a	1000	-		_
253 mV		Average Time to Empty	65535	min	TS3 Temperature	-273.2	degC	Cell 6 Grid	0		Cell 1 Raw DOD	16384	-	FET_EN	
0%		Average Time to Full	65535	min 🗡	TS4 Temperature	-273.2	deoC Y	Cell 7 Grid	0	. v	Cell 2 Raw DOD	16384	. ×	LIFETIME_EN	
		Bit Registers										Bit High B	t Low RSVD	LT_RESET	
111111		Name	Value	Bit7	Bit6	Bit5		Bit4	Bit3	Bit2	Bit1	Bit	0 ^	LT_FLUSH	
n 500		Battery Mode (high)	0x6081	CapM	ChgM	AM		RSVD	RSVD	RSVD	PB	CC			
1000		Battery Mode (low)		CF	RSVD	RSVI	D	RSVD	RSVD	RSVD	PBS	ICC	2	LT_TEST	
1500	1	Battery Status (high)	0x02D0	0CA	TCA	RSVI	D	OTA	TDA	RSVD	RCA	RTA	λ	🛷 PF EN	
0 2000	1	Battery Status (low)		INIT	DSG	FC		FD	EC3	EC2	EC1	ECI	D	-	
0		Operation Status A (hi	0x2D89	SLEEP	XCHG	XDS	3	PF	SS	SDV	SEC1	SEC	:0	PF_CLEAR	
<u> </u>		Operation Status A (low)		BTP_INT	RSVD	FUSE		PDSG	PCHG	CHG	DSG	PRE	S	BBR EN	
		Operation Status B (hi	0x0000	IATA_CTER		EMSH		CB	SLPCC	SLPAD	SMBLCAL	INT			
		Operation Status B (lo		SLEEPM		CAL_OF		CAL	AUTOCALM	AUTH	LED	SDI		Log Panel	Cle
		Temp Range (high)	0x10	RSVD	RSVD	RSVI	2	RSVD	RSVD	RSVD		RSV			cie
		Temp Range (low)		RSVD	OT	HT		STH	RT	STL	LT	UT		Transaction Log	
		Charging Status (high)	0x0001	RSVD	RSVD	RSVI		RSVD	NCT	000	CVR	CCI		Name Cmd I	Result Read
		Charging Status (low)		VCT	MCHG	SU		N	HV	MV	LV	PV			
		Gauging Status	0xD5	CF	DSG	EDV		BAL_EN	TC	TD	FC	FD			
		T Status (high)	0x0004	RSVD	RSVD	RSVI		OCVFR	LDMD	RX	QMAX	VDI			
		IT Status (low)	0x0090	NSFM CAL EN	RSVD LT_TEST	SLPQM PDSG T		QEN RSVD	VOK RSVD	RDIS	RSVD LED EN	RES			
		Manufacturing Status ( Manufacturing Status (	0x0090	BBR EN		PDSG_T LF_E		RSVD FET_EN	GAUGE_EN	DSG TE		FUSE_			
		Safety Alert A+B (high)	0x0000	RSVD	PF_EN CUVC			OTC	GAUGE_EN ASCDL	DSG_TE RSVD		PCHG_ RSV			
		Safety Alert A+B (low)	0,0000	AOLDL	RSVD	OTD OCD:		OCD1	OCC2	OCC1	COV	CUV			
		Safety Status A+B (hig	0x4001	RSVD		OCD.		OCDI	ASCDL	ASCD	ASCCL	ASC			
		Safety Status A+B (ng	00000	RSVD	COVC	010		010	MOUDL	ASUD	ASUUL	ASU	~		

11. Commands window on the right side of the screen can be used to send commands to the gauge. You can use these commands to obtain gauge information such as the programmed Chemistry ID, and the hardware or firmware version. Many of the gauge's functions such as protection FETs can also be controlled using these commands. You can also unseal or seal your device with these commands. Refer to your gauge's Technical Reference Manual for descriptions of each Command function.



### How to Get Started with BQ Gas Gauge Products

Registers #	· · · · · · · · · · · · · · · · · · ·	Commands 🔯 Calibration	SHA Authent	ication 🍯	Advanced Comm	SMB 时	ECC Authentic	ation 💧	Chemistry Firm	nware 🔛 GPCPacka	iger 📑 Wa	atch 🔛 Data Graph	Errors				
shBoard	~ - [	□ 🔕 Registers 🛛												- 0	🕏 Commands 🛛		-
	Click to Turn On	Registers											Start Log	Scan Refresh	Commands		
io Version: 1.3.	86														DEVICE NU	MRER	
Ω		Registers													HW_VERSI		
- ·	EV2400	Name	Value	Units ^	Name		Value	Units 1	Name	Value	Units ^	Name	Value	Units ^			
	Version:0.28	Manufacturer Access	0x2D89	hex	Cell 3 Current		0 Value	mA	Cell 4 RaScale	1000	Units ···	Cell 2 QMax	4400	mAh	FW_VERSI		
~/		Remaining Cap. Alarm	300	mAh	Cell 4 Current		0	mA	Cell 5 RaScale	1000		Cell 3 QMax	4400	mAh	🔮 FW_BUIL	D	
S		Remaining Cap. Alarm	10	min	Cell 5 Current		0	mA	Cell 6 RaScale	1000		Cell 4 QMax	4400	mAh	8 cumu	•	
		At Rate	0	mA	Cel 6 Current		0	mA	Cell 7 RaScale	1000		Cell 5 QMax	4400	mAh	CHEM_I	0	
		At Rate Time To Full	65535	min	Cel 7 Current		ő	mA	Cell 1 CompRes	0	mOhm	Cell 6 QMax	4400	mAh	SHUTDOV	VN	
	SMB	At Rate Time To Empty	65535	min	Cell 1 Power		0	cW	Cell 2 CompRes	0	mOhm	Cell 7 QMax	4400	mAh			
		At Rate OK	1		Cell 2 Power		0	cW	Cell 3 CompRes	0	mOhm	Cell 1 QMax DOD0	0		IATA_SHUTD	OWN	
~		Temperature	27.3	degC	Cell 3 Power		0	cW	Cell 4 CompRes	0	mOhm	Cell 2 QMax DOD0	0		CC_OFFS	FT	
<b>N</b> .	bq40z80	Voltage	5253	mV	Cel 4 Power		0	cW	Cell 5 CompRes	0	mOhm	Cell 3 QMax DOD0	0				
<u> </u>	4800_0_04	Current	0	mA	Cel 5 Power		0	cW	Cell 6 CompRes	0	mOhm	Cell 4 QMax DOD0	0		PDSG_FET_TC	OGGLE	
$\sim$ .	Addr: 0x17	Average Current	0	mA	Cell 6 Power		0	cW	Cell 7 CompRes	0	mOhm	Cell 5 QMax DOD0	0		PCHG FET T		
	27.3 degC	Max Error	100	%	Cel 7 Power		0	cW	PackGrid	0	-	Cell 6 QMax DOD0	0	-	• Periodicia	JOULL	
U T		Relative State of Charge	0	%	Power		0	cW	Cell 1 Grid	0	-	Cell 7 QMax DOD0	0		CHG_FET_TC	IGGLE	
		Absolute State of Charge	0	%	Average Powe	ar	0	cW	Cell 2 Grid	0	-	QMax Passed Q	0	mAH	DSG_FET_TC	COLE	
677		Remaining Capacity	0	mAh	Int Temperature		26.9	degC	Cell 3 Grid	0	-	CMax Time	0	h/16	✓ DS0_FE1_10	GOLE	
		Full charge Capacity	3976	mAh	TS1 Temperatu	ire	27.3	degC	Cell 4 Grid	0		Temp k	1.0		GAUGE_	IN	
100		Run time To Empty	65535	min	TS2 Temperatu	ire	27.4	degC	Cell 5 Grid	0	-	Temp a	1000	-			
253 mV		Average Time to Empty	65535	min	TS3 Temperatu	ire	-273.2	degC	Cell 6 Grid	0	-	Cell 1 Raw DOD	16384	-	FET_EN		
0%		Average Time to Full	65535	min 🗡	TS4 Temperatu	ire	-273.2	deoC `	Cell 7 Grid	0	. Y	Cell 2 Raw DOD	16384	. Y	🖉 LIFETIME	EN	
		Bit Registers											Bit High	Bit Low RSVD	LT_RESE	т	
TTTTTTT		Name	Value	Bit7		Bit6	BitS		Bit4	Bit3	Bit2	Bit1	Bi	0 ^	LT_FLUS	н	
nn <b>500</b>		Battery Mode (high)	0x6081	CapM	(	ChgM	AM		RSVD	RSVD	RSVE	PB	00				
1000	3	Battery Mode (low)		CF	F I	RSVD	RSVI	)	RSVD	RSVD	RSVD	PBS	ICO	2	LT_TEST		
1500		Battery Status (high)	0x02D0	0CA		TCA	RSVI	)	OTA	TDA	RSVD	RCA	RT	Δ	🛷 PF EN		
0 2000	7	Battery Status (low)		INIT		DSG	FC		FD	EC3	EC2	EC1	EC	0	-		
0		Dperation Status A (hi	0x2D69	SLEEP		KCHG	XDS	3	PF	SS	SDV		SEC	0	PF_CLEA	R	
		Operation Status A (low)		BTP_NT	6	RSVD	FUSE		PDSG	PCHG	CHG	DSG	PRE	IS	✓ BBR_EN	1	
		Operation Status B (hi	0x0000	IATA_CTER		SSHUT	EMSH		CB	SLPCC	SLPAD		. IN		+ bbit_ci	•	
		Operation Status B (lo		SLEEPM		XL	CAL_OF	SET	CAL	AUTOCALM	AUTH		SD	м	Log Panel		Cl
		Temp Range (high)	0x10	RSVD		RSVD	RSVI		RSVD	RSVD	RSVE		RSV	/D			CI
		Temp Range (low)		RSVD		OT	HT		STH	RT	STL	LT	U		Transaction Log		
		Charging Status (high)	0x0001	RSVD		RSVD	RSVI	)	RSVD	NCT	000		CC		Name Cmd	Result	Rea
		Charging Status (low)		VCT		/CHG	SU		N	HV	MV	LV	P\				
		Gauging Status	0xD5	CF		DSG	EDV		BAL_EN	TC	TD	FC	FC				
		T Status (high)	0x0004	RSVD		RSVD	RSVI		OCVFR	LDMD	RX	QMAX	VD				
		IT Status (low)		NSFM		RSVD	SLPQM		QEN	VOK	RDIS		RES				
		Manufacturing Status (	0x0090	CAL_EN		TEST	PDSG_T		RSVD	RSVD	RSVD		FUSE				
		Manufacturing Status (		BBR_EN		F_EN	LF_E		FET_EN	GAUGE_EN	DSG_TE						
		Safety Alert A+B (high)	0x0000	RSVD		CUVC	OTD		OTC	ASCOL	RSVD		RSV				
		Safety Alert A+B (low)		AOLDL		RSVD	OCD:		OCD1	0002	0001		CU				
		Safety Status A+B (hig	0x4001	RSVD	0	CUVC	OTD		OTC	ASCOL	ASCE	ASCOL	ASI	C			

12.BQSTUDIO provides a logging function which logs the values that are selected by the Log check boxes located beside each parameter in the Register section. To enable this function, select the Log button; this causes the Scan button to be selected. When logging is stopped, the Scan button is still selected and has to be manually deselected.



egisters														Start Log	Scan	€ Refre
egisters																
Name	Value	Units	^ Na	me	Value	Units	^	Name	Valu	Je	Units	^	Name	Value	Units	s
Manufacturer Access	0x6D81	hex		Cell 3 Current	0	mA		Cell 4 RaScale	100	0	-		Cell 2 QMax	4400	mAh	1
Remaining Cap, Alarm	300	mAh		Cell 4 Current	0	mA		Cell 5 RaScale	100	0	-		Cell 3 QMax	4400	mAh	
Remaining Time Alarm	10	min		Cell 5 Current	0	mA		Cell 6 RaScale	100	0	-		Cell 4 QMax	4400	mAh	1
At Rate	0	mA	8	Cell 6 Current	0	mA		Cell 7 RaScale	100	0	-		Cell 5 QMax	4400	mAh	1
At Rate Time To Full	65535	min	8	Cell 7 Current	0	mA		Cell 1 CompRes	0		mOhm		Cell 6 QMax	4400	mAh	1
At Rate Time To Empty	65535	min		Cell 1 Power	0	cW		Cell 2 CompRes	0		mOhm		Cell 7 QMax	4400	mAh	n
At Rate OK	1	-	8	Cell 2 Power	0	cW		Cell 3 CompRes	0		mOhm		Cell 1 QMax DOD0	0	-	
Temperature	28.4	degC	8	Cell 3 Power	0	cW		Cell 4 CompRes	0		mOhm		Cell 2 QMax DOD0	0	-	
☐ Voltage	5154	mV		Cell 4 Power	0	cW		Cell 5 CompRes	0		mOhm		Cell 3 QMax DOD0	0	-	
Current	0	mA	8	Cell 5 Power	0	cW		Cell 6 CompRes	0		mOhm		Cell 4 QMax DOD0	0	-	
Average Current	0	mA	8	Cell 6 Power	0	cW		Cell 7 CompRes	0		mOhm		Cell 5 QMax DOD0	0	-	
Max Error	100	%		Cell 7 Power	0	cW		PackGrid	0		-		Cell 6 QMax DOD0	0	-	
Relative State of Charge	0	%	8	Power	0	cW		Cell 1 Grid	0		-		Cell 7 QMax DOD0	0	-	
Absolute State of Charge	0	%	8	Average Power	0	cW		Cell 2 Grid	0		-		QMax Passed Q	0	mAH	4
Remaining Capacity	0	mAh		Int Temperature	27.7	degC		Cell 3 Grid	0				QMax Time	16	h/16	3
Full charge Capacity	1414	mAh	8	TS1 Temperature	28.4	degC		Cell 4 Grid	0		-		Temp k	1.0	-	
Run time To Empty	65535	min		TS2 Temperature	28.5	degC		Cell 5 Grid	0		-		Temp a	1000	-	
Average Time to Empty	65535	min		TS3 Temperature	-273.2	degC		Cell 6 Grid	0				Cell 1 Raw DOD	16384	-	
Average Time to Full	65535	min	•	TS4 Temperature	-273.2		¥	Cell 7 Grid	0		-	<b>~</b>	Cell 2 Raw DOD	16384		
Registers														Bit High	Bit Low	R
lame	Value	Bit7		Bit6	Bit5			Bit4	Bit3		Bi	t2	Bit1		3it0	
Battery Mode (high)	0x6081	Cap	4	ChaM	AM			RSVD	RSVD		RS	VD	PB		cc	
Battery Mode (low)		CF		RSVD	RSVD	)		RSVD	RSVD		RS	VD	PBS		сс	
Battery Status (high)	0x02D0	004	ι	TCA	RSVE	)		OTA	TDA		RS	VD	RCA	F	RTA	
Battery Status (low)		INIT		DSG	FC			FD	EC3		EC	2	EC1		C0	
Operation Status A (hi	0x6D81	SLEE	P	XCHG	XDSG	1		PF	SS		SD	v	SEC1	S	EC0	
Operation Status A (low)		BTP I	νT	RSVD	FUSE			PDSG	PCHG		СН	IG	DSG	P	RES	
Operation Status B (hi	0x0000	IATA_CT		PSSHUT	EMSHU	т		CB	SLPCC		SLP	AD	SMBLCAL		NIT	
Operation Status B (Io		SLEEP		XL	CAL_OFF	SET		CAL	AUTOCALM		AU	тн	LED	5	DM	
Temp Range (high)	0x10	RSV	D	RSVD	RSVE	)		RSVD	RSVD		RS	VD	RSVD	R	SVD	
Temp Range (low)		RSV	D	OT	HT			STH	RT		ST		LT		UT	
Charging Status (high)	0x0001	RSV	D	RSVD	RSVE	)		RSVD	NCT		CC		CVR	(	CR	
Charging Status (low)		VCT		MCHG	SU			IN	HV		M	v	LV		PV	
Gauging Status	0xC5	CF		DSG	EDV			BAL_EN	TC		т	D .	FC		FD	
IT Status (high)	0x0014	RSV	D	RSVD	RSVE	)		OCVFR	LDMD		RJ	х	QMAX	1	/DQ	
IT Status (low)		NSFI	4	RSVD	SLPQM	AX		QEN	VOK		RD	IS	RSVD	R	EST	
Manufacturing Status (	0x0288	CAL	EN	LT_TEST	PDSG_T	ST		RSVD	RSVD		RS	VD	LED_EN	FU:	SE_EN	
Manufacturing Status (		BBR	EN	PF_EN	LF_EI			FET_EN	GAUGE_EN		DSG_	TES	T CHG_TES		G_TEST	
Safety Alert A+B (high)	0x0000	RSV		CUVC	ОТD			OTC	ASCDL		RS	VD	ASCCL		SVD	
Safety Alert A+B (low)		AOLE	)L	RSVD	OCD2			OCD1	OCC2		00	C1	COV	0	:UV	

13. The Log Interval can be adjusted by opening the Windows tab, then Preferences>Registers. Anything below 1000-milliseconds will not provide any useful information, because most of this data gets updated only once a second. Do not set this to more than 10-seconds, because then useful information can be lost. Ideally, you'd keep this between 2000-milliseconds and 8000-milliseconds, between 2 and 8 seconds. We recommend to leave the log interval at the default value of 4000-ms.

### 1.2.1 Gauge Configurations Using BQSTUDIO

1. Navigate to "Data Memory".

File View Winde	ow Help	_										
Registers	s 🛲 Data Memory	ᡷ Comm	ands 🔟 Calibrat	ion 👔 SHA Authentication	Wanced Comm SMB	ECC Authentication	👗 Chemistry	Firmware	GPCPackager	Watch	Data Graph	Errors
🖋 DashBoard	D	ata Flash View	Command &									

2. This is where you configure the gauge parameters.



ta Memory		Filter/Search	😱 🔒 _ + 3
la monory		Auto Exp	ort Export Import Write_All Rea
d/Write Data Memory Content	is		
Calibration	Name	Value	Unit
	✓ Voltage		
Settings	Cell Gain	12135	-
Protections	Pack Gain	44470	-
Protections	Vc6-Vss Gain	32868	-
Permanent Fail	✓ Current		
	CC Gain	2.076	mOhm
dvanced Charge Algorithm	Capacity Gain	2.076	mOhm
C C :	✓ Current Offset		
Gas Gauging	CC Offset	0	-
Power	Coulomb Counter Offset Samples	64	-
	Board Offset	0	-
PF Status	CC Auto Config	07	hex
	CC Auto Offset	9	-
System Data	✓ Temperature		
SBS Configuration	Internal Temp Offset	3.1	°C
555 conngaration	External1 Temp Offset	0.1	°C
LED Support	External2 Temp Offset	0.3	*C
	External3 Temp Offset	0	*C
Black Box	External4 Temp Offset	0	*C
Lifetimes	✓ Ext Cell Voltage		
Lifetimes	VC7 Sense Gain	41660	
Ra Table	✓ Internal Temp Model		
	Int Gain	-12143	
	Int base offset	6232	
	Int Minimum AD	0	
	Int Maximum Temp	6232	0.1°K
	✓ Cell Temperature Model	VL94	
	Coeff a1	-11130	-
	Coeff a2	19142	-
	Coeff a3	-19262	-
	Coeff a4	28203	-
	Coeff a5	892	-
	Coeff b1	328	-
	Coeff b2	-605	_
	Coeff b3	-2443	_
	Coeff b4	4696	_
	Rc0	11703	_
	Adc0	11703	-
	Rpad	0	
	Rint	0	
	✓ Fet Temperature Model	U	-
	Coeff a1	-11130	-
	Coeff a2	19142	

- 3. To read all the data from the gauge non-volatile flash memory, click on the **Read All** button on the Data Memory window. The device must not be sealed and must be in full access in order to read or write to the data memory.
- 4. Calibrate your gauge as shown in your EVM's user guide and configure all values for your application. Remember to change the *DA Configuration* to set up the number of series cells to match the physical pack configuration. This is done in | *Data Memory* | *Settings* | *DA Configuration* register. This provides basic functionality to the setup.
- 5. For Learning Cycle purposes in TI's Impedance Tracking gauges, you will want to adjust Design Capacity, Design Voltage, Charge Term Taper Current, Discharge Current Threshold, Charge Current threshold, Quit Current and Term Voltage. For other parameters, please refer to your gauge's Technical Reference Manual and EVM User Guide for detailed descriptions.
- 6. To save or review the configuration settings, you can export a .GG.CSV file by using the export button on the top-right corner of Data Memory.
- 7. You can also import any existing .GG.CSV file by using the import button on the top-right corner of Data Memory; you must then write it to memory by using the Write All button on the top-right corner of Data Memory. This will write all imported configurations into the data flash memory of the gauge.



a Memory		Filter/Search	port Export Import Write_All Re
I/Write Data Memory Content	s		
Calibration	Name	Value	Unit
Calibration	✓ Voltage		
Settings	Cell Gain	12135	-
	Pack Gain	44470	-
Protections	Vc6-Vss Gain	32868	-
Permanent Fail	✓ Current		
	CC Gain	2.076	mOhm
dvanced Charge Algorithm	Capacity Gain	2.076	mOhm
Gas Gauging	✓ Current Offset		
Gas Gauging	CC Offset	0	-
Power	Coulomb Counter Offset Samples	64	-
	Board Offset	0	-
PF Status	CC Auto Config	07	hex
C + D +	CC Auto Offset	9	-
System Data	✓ Temperature		
SBS Configuration	Internal Temp Offset	3.1	°C
LED Support Black Box	External1 Temp Offset	0.1	°C
	External2 Temp Offset	0.3	°C
	External3 Temp Offset	0	°C
	External4 Temp Offset	0	°C
Lifetimes	✓ Ext Cell Voltage		
	VC7 Sense Gain	41660	-
Ra Table	✓ Internal Temp Model		
	Int Gain	-12143	-
	Int base offset	6232	-
	Int Minimum AD	0	-
	Int Maximum Temp	6232	0.1°K
	✓ Cell Temperature Model		
	Coeff a1	-11130	-
	Coeff a2	19142	-
	Coeff a3	-19262	-
	Coeff a4	28203	-
	Coeff a5	892	-
	Coeff b1	328	-
	Coeff b2	-605	-
	Coeff b3	-2443	-
	Coeff b4	4696	-
	Rc0	11703	-
	Adc0	11703	-
	Rpad	0	-
	Rint	0	-
	✓ Fet Temperature Model		
	Coeff a1	-11130	-
	Coeff a2	19142	-

### 1.3 Chemistry ID

When using Impedance Track[™] gauges, choosing the proper Chemistry ID is critical to achieving good performance. Chemistry ID refers to a set of tables containing information about the cell's characteristics and behaviors. BQSTUDIO offers a large portfolio of Chemistry IDs that have been created by Texas Instruments for a vast variety of cells.

### 1. Navigate to "Chemistry"

File View AutoCycle Window Help		
🚳 Registers 🐲 Data Memory 💈 C	rmmands 🔟 Calibration 🔐 SHA Authentication 🐲 Advanced Comm SMB 🄐 ECC Authentication	🔔 Chemistry 🖳 Firmware 👖 GPCPackager 📦 Watch 📰 Data Graph 🔤 Errors
🥒 DashBoard 🗢 🗖	🚳 Registers 🛛 🗢 Data Memory	Chemistry

2. Match the model of the desired cell to one in the table if available and select the matching Chemistry ID.



- -

Chemistry Programming

#### Program Battery Chemistry

Most Li-ion cells use LiCoO2 cathode and graphitized carbon anode, which is supported by the default firmware in the Impedance track fuel gauges. This tool allows the fuel gauge to be set up for various alternate battery chemistries. Use this tool to load settings for any alternate chemistry if your cell manufacturer indicates that their cells use a different chemistry than LiCoO2 cathode and graphite anode.

Manufacturer	Model	Chemistry ID	Description	Supports Turbo Mode
360FLY	PR-693231 (815mAh)	1318	LiCoO2/carbon 11	Yes
S A&TB	LGR18650OU	0100	LiCoO2/graphitized carbon (default)	No
8 A01	ALPBA002 (3430mAh)	0207	NiCoMn/carbon 2	No
💦 A123	APR18650M1 (1100 mAh)	0404	LiFePO4/carbon	No
💀 A123	26650M1B (2500mAh)	0434	LiFePO4/carbon	Yes
🚴 A123	ANR26650M1-B (2500mAh)	0440	LiFePO4/carbon	No
🚴 A123	ANR26650M1-B Consult TI before use (2500mAh)	0453	LiFePO4/carbon	Yes
🙃 A123 Systems	26650A	0400	LiFePO4/carbon	No
🕄 A123Systems	ANR26650M1-B (2500mAh)	0465	LiFePO4/carbon	Yes
🙃 A123Systens	A123_Pack (20000mAh)	6105	NiMH	No
🚴 A123Systens	A123 (2000mAh)	6111	NiMH	No
🚴 AA Portable Power	LFP-18650-1500 (1500 mAh)	0439	LiFePO4/carbon	Yes
🕄 AAPortable	26650 (3300mAh)	0451	LiFePO4/carbon	No
💀 AAPortable	8790160 (10000mAh)	0456	LiFePO4/carbon	No
🚴 ABS	62D12000_InVista (12000mAh)	6116	NiMH	No
🚴 ABS	BPI-50C5500_InVista (5500mAh)	6117	NiMH	No
跪 Acebel	ECFV1260 (60Ah)	0807	Lead Acid	Yes
💦 Advanced Electronics Energy	AE18650C-26 (2600mAh)	2151	NiCoMn/carbon	Yes
💀 AEenergy	AE1004765 (3500mAh)	0131	LiCoO2/carbon 4	No
💀 AEenergy	AE583696PM1HR (2150 mAh)	0222	PSS, LiNiO2 with Co, Mn doping	No
3 AESC	295B9-3NK0B (16500mAh)	1554	LiCoO2/carbon 11	Yes
💦 AESC	295B9-4NN0A (10425mAh)	1561	LiCoO2/carbon 11	Yes
3 AESC	ModuleHC3 (120Ah)	1785	LiMn2O4 (Co,Ni)/carbon, 4.4V	No
🕄 AET	TP2000-1SPL (2000mAh)	0190	LiCoO2/carbon 11	No
🕄 AGM	INR34600K2 (7500mAh)	0210	NiCoMn/carbon	No
🕄 AISIPU	3872C8 (5100mAh)	1335	LiCoO2/carbon 11	Yes
🕄 AISIPU	723292 (3080mA)	1363	LiCoO2/carbon 11	Yes
🕄 AISIPU	856360 (4750mAh)	3636	LiMn2O4 (Co,Ni)/carbon, 4.35V	Yes
3 ALE	045062 (2300 mAh)	1254	LiNiCoMnO2/SGenNo1, 4.2V	Yes
S ALE	ALE073470 (1700mAh)	2047	NiCoMn/carbon	Yes
Alees	26700FE (3300mAh)	0411	LiFePO4/carbon	No

Program selected chemistry Program from GPCRB file...

Chemistry Version : 791 Check for a newer chemistry update on ti.com

- 3. If no model in the table matches the cell, create a log based on the GPCCHEM tool (http://www.ti.com/tool/ GPCCHEM) and obtain a GPCCHEM report. Select the Chemistry ID with the lowest error based on the GPCCHEM report. This will ensure that the learning cycle does not fail. Running the GPCCHEM test is the best method to determine a good chemistry ID for the gas gauge.
- 4. If no appropriate ID exists, contact your local TI representative or post the GPCCHEM log and your gauge setup to e2e.ti.com.
- 5. After the proper Chemistry ID is obtained, program the selected Chemistry ID



🚳 Registers 🗢 Data Memory 🚡 Chemistry 🔀

#### **Chemistry Programming**

Program Battery Che

Most Li-ion cells use LiCoO2 cathode and graphitized carbon anode, which is supported by the default firmware in the Impedance track fuel gauges. This tool allows the fuel gauge to be set up for various alternate battery chemistries. Use this tool to load settings for any alternate chemistry if your cell manufacturer indicates that their cells use a different chemistry than LiCoO2 cathode and graphite anode.

Include chemistry IDs that do not support Turbo Mode 2

Manufacturer	Model	Chemistry ID	Description	Supports Turbo Mode
360FLY	PR-693231 (815mAh)	1318	LiCoO2/carbon 11	Yes
🖧 A&TB	LGR18650OU	0100	LiCoO2/graphitized carbon (default)	No
🖧 A01	ALPBA002 (3430mAh)	0207	NiCoMn/carbon 2	No
🚜 A123	APR18650M1 (1100 mAh)	0404	LiFePO4/carbon	No
🚜 A123	26650M1B (2500mAh)	0434	LiFePO4/carbon	Yes
💦 A123	ANR26650M1-B (2500mAh)	0440	LiFePO4/carbon	No
💦 A123	ANR26650M1-B Consult TI before use (2500mAh)	0453	LiFePO4/carbon	Yes
🚜 A123 Systems	26650A	0400	LiFePO4/carbon	No
🔝 A123Systems	ANR26650M1-B (2500mAh)	0465	LiFePO4/carbon	Yes
🚜 A123Systens	A123_Pack (20000mAh)	6105	NiMH	No
🔝 A123Systens	A123 (20000mAh)	6111	NiMH	No
🔝 AA Portable Power	LFP-18650-1500 (1500 mAh)	0439	LiFePO4/carbon	Yes
🚜 AAPortable	26650 (3300mAh)	0451	LiFePO4/carbon	No
🖧 AAPortable	8790160 (10000mAh)	0456	LiFePO4/carbon	No
🖧 ABS	62D12000_InVista (12000mAh)	6116	NiMH	No
🖧 ABS	BPI-50C5500_InVista (5500mAh)	6117	NiMH	No
🕄 Acebel	ECFV1260 (60Ah)	0807	Lead Acid	Yes
🔝 Advanced Electronics Energy	AE18650C-26 (2600mAh)	2151	NiCoMn/carbon	Yes
🚜 AEenergy	AE1004765 (3500mAh)	0131	LiCoO2/carbon 4	No
🚜 AEenergy	AE583696PM1HR (2150 mAh)	0222	PSS, LiNiO2 with Co, Mn doping	No
🖧 AESC	295B9-3NK0B (16500mAh)	1554	LiCoO2/carbon 11	Yes
🚜 AESC	295B9-4NN0A (10425mAh)	1561	LiCoO2/carbon 11	Yes
🖧 AESC	ModuleHC3 (120Ah)	1785	LiMn2O4 (Co,Ni)/carbon, 4.4V	No
🖧 AET	TP2000-1SPL (2000mAh)	0190	LiCoO2/carbon 11	No
3 AGM	INR34600K2 (7500mAh)	0210	NiCoMn/carbon	No
🖧 AISIPU	3872C8 (5100mAh)	1335	LiCoO2/carbon 11	Yes
🕄 AISIPU	723292 (3080mA)	1363	LiCoO2/carbon 11	Yes
🕄 AISIPU	856360 (4750mAh)	3636	LiMn2O4 (Co,Ni)/carbon, 4.35V	Yes
🖧 ALE	045062 (2300 mAh)	1254	LiNiCoMnO2/SGenNo1, 4.2V	Yes
🖧 ALE	ALE073470 (1700mAh)	2047	NiCoMn/carbon	Yes
🕄 Alees	26700FE (3300mAh)	0411	LiFePO4/carbon	No
A 1	A 3770102 (12000 AL)	0.412	115 8047 1	K1



Chemistry Version : 791 Check for a newer chemistry update on ti.com

## 1.4 Learning Cycle

During the golden file creation process, Impedance Tracking gauges must undergo a learning cycle process. The learning cycle requires the user to carry out a few cycles on the pack to make sure that possible variation in cell manufacturer processes is accounted for in the learned resistance, as well to account for board contact and trace resistances which could impact the gauges state of charge reporting and accuracy.

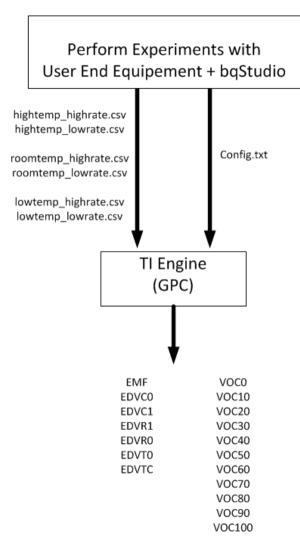
- 1. Prior to starting the learning cycle, a matching Chemistry ID must be selected.
- 2. Perform the learning cycle on the device. There are multiple learning cycle guidelines, please refer to the learning cycle application notes(Achieving A Successful Learning Cycle) below for single cell and multi-cell gauges. (https://www.ti.com/lit/slua903).
- 3. Run accuracy cycle and determine if learning cycle/chemistry is successful (https://e2e.ti.com/blogs / archives/b/fullycharged/archive/2016/11/04/how-accurate-is-your-battery-fuel-gauge-part-2-2).

## 1.5 Compensated End of Discharge Voltage (CEDV) Gauges

When using TI's CEDV algorithm-based gauges, you must obtain CEDV coefficients for your specific battery profile. These coefficients allow the user to increase the accuracy of the fuel gauge IC over temperature. You can obtain CEDV parameters from our online gauging parameter calculator(GPC) for CEDV gauges tool (http:// www.ti.com/tool/GPCCEDV). After programming the design parameters to the gauge, the EVM can be used to obtain the experimental data needed to calculate the CEDV coefficients.

How to Get Started with BQ Gas Gauge Products

TEXAS INSTRUMENTS www.ti.com



Refer to *Simple Guide to CEDV Data Collection for Gauging Parameter Calculator (GPC)* (http://www.ti.com/lit/pdf/SLUUB45) for a detail explanation of the CEDV coefficients data collection process and GPC tool configuration.



## 2 Example BQ40Z50-R3 Evaluation

- 1. Please use samples.ti.com to place an order for the BQ40Z50-R3 EVM. In the EVM user's guide discusses the options for connecting the board (http://www.ti.com/lit/ug/sluuav7b/sluuav7b.pdf).
- 2. Use samples.ti.com to place an order for the EV2400 board
- 3. Install BQSTUDIO: http://www.ti.com/tool/BQSTUDIO, there are two options, stable and test version can be used. TI recommends using the stable version for first time users.
- 4. Once you have installed BQSTUDIO, make sure you can log the SBS registers by clicking start log. Make sure you know how to export a gg.csv file using the data memory tab.
- 5. Follow instructions for GPCCHEM tool. Once you have submitted the input log files to GPCCHEM, use the chemistry plug-in and program the chemID in the BQ40Z50-R3.
- 6. Perform learning cycle.



# **3 Linux and Windows Drivers**

TI gas gauges that support the SMBus communication protocol adhere to the Smart Battery Specification(SBS) standard. Windows and Linux have built in drivers to read data from SBS compliant battery gas gauges.

Most TI gas gauges that use the I2C communication protocol have drivers integrated into the Linux kernel. TI regularly pushes updates to add support for new I2C gas gauges in the Linux Kernel.

An operating system + gas gauge combination that is not described above may require custom driver development.

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