

# bq20z40EVM-001 SBS 1.1 Impedance Track<sup>™</sup>Technology Enabled Battery Management Solution EVM

This EVM is a complete evaluation system for the bq20z40/bq29330/bq29412 battery management system. The EVM includes one bq20z40/bq29330/bq29412 circuit module, a current sense resistor, two thermistors, and a link to Windows<sup>™</sup>-based PC software. The circuit module includes one bq20z40 IC, one bq29330 IC, one bq29412 IC, and all other onboard components necessary to monitor and predict capacity, perform cell balancing, monitor critical parameters, protect the cells from overcharge, overdischarge, short circuit, and overcurrent in 2-, 3- or 4-series cell Li-ion or Li-polymer battery packs. The circuit module connects directly across the cells in a battery. With the EV2300 interface board and software, the user can read the bq20z40 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the bq20z40/bq29330/bq29412 solution under different charge and discharge conditions.

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## 1 Features

- Complete evaluation system for the bq20z40 SBS 1.1-compliant advanced gas gauge with Impedance Track<sup>™</sup> technology, bq29330 analog front end (AFE) and protection IC, and bq29412 independent overvoltage protection integrated circuit (IC)
- Populated circuit module for quick setup
- Link to software that allows data logging for system analysis

# 1.1 Kit Contents

- bq20z40/bq29330/bq29412 circuit module
- Set of support documentation

# 1.2 Ordering Information

EVM PART NUMBER	CHEMISTRY	CONFIGURATION	CAPACITY
bq20z40EVM-001	Li-ion	2, 3, or 4 cell	Any

#### **Table 1. Ordering Information**

# 2 bq20z40/bq29330-Based Circuit Module

The bq20z40/bq29330/bq29412-based circuit module is a complete and compact example solution of a bq20z40 and bq29330 circuit for battery management and protection of Li-ion or Li-polymer packs. The circuit module incorporates a bq20z40 battery monitor IC, bq29330 AFE and protection IC, bq29412 independent overvoltage protection IC, and all other components necessary to accurately predict the capacity of 2-, 3-, or 4-series cells.

# 2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the cells: 1N (BAT-), 1P, 2P, 3P, 4P (BAT+)
- To the serial communications port (SMBC, SMBD, VSS)
- The system load and charger connect across PACK+ and PACK-
- To the system present pin (SYS PRES)



2.2 Pin Descriptions

PIN NAME	DESCRIPTION
1N	-ve connection of first (bottom) cell
1P	+ve connection of first (bottom) cell
2P	+ve connection of second cell
3P	+ve connection of third cell
4P	+ve connection of fourth (top) cell
SMBC	Serial communication port clock
SMBD	Serial communication data port
VSS	Pack negative terminal
PACK-	Pack negative terminal
SYS PRES	System present pin (if low, system is present)
PACK+	Pack positive terminal

# 3 bq20z40/bq29330 Circuit Module Schematic

This section contains information on the schematic for the bq20z40/bq29330/bq29412 implementation.

#### 3.1 Schematic

The schematic follows the bill of materials in this user's guide.

## 3.2 Choosing Particular Precharge Mode

The chipset supports both a charger that has a precharge mode and one that does not. The EVM supports a charger that does not have a precharge mode by grounding the PMS pin with resistor R16. R12 and Q2 are used as the precharge current path in order to sustain sufficient Pack+ voltage when the battery voltage is too low to power up the bq29330 IC.

If the charger has a precharge function, R12 and FET Q2 are not used. The EVM does not have a provision to pull high the PMS pin to disable ZVCHG output. The charge FET Q1 is used as the precharge FET, and the charger must control the precharge current and voltage.

Note: The configuration at PMS pin is a hardware level control. Once the bq20z40 is up and running, the firmware may change the precharge settings. See the bq20z40 data sheet (<u>SLUS801</u>). for further information.

# 3.3 Testing Fuse-Blowing Circuit

To prevent the loss of board functionality during the fuse-blowing test, the actual chemical fuse is not provided in the circuit. FET Q4 drives TP3 low if a fuse-blow condition occurs; so, monitoring TP3 can be used to test this condition.

# 4 Circuit Module Physical Layouts and Bill of Materials

This section contains the board layout, bill of materials, and assembly drawings for the bq20z40/ bq29330/ bq29412 circuit module.

**Note:** For the battery pack designer: D3 may have side effects. See the application report *bq*29330 *External Short-Circuit Protection* (<u>SLUA436</u>)

# 4.1 Board Layout

This section shows the dimensions, PCB layers, and assembly drawing for the bq20z40/bq29330 module.

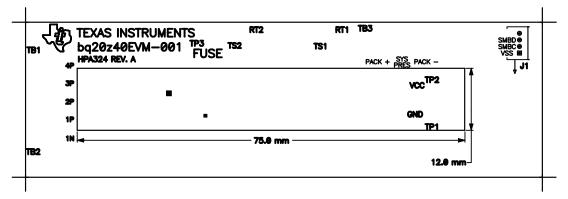


Figure 1. bq20z40EVM-001 Layout (Silk Screen)

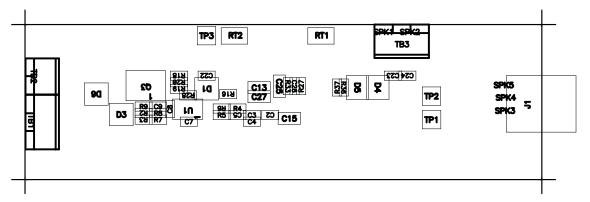
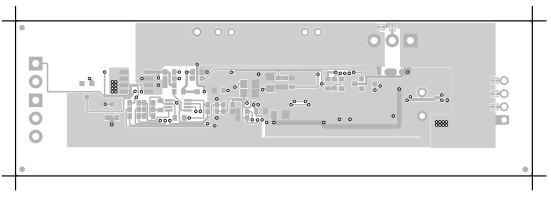


Figure 2. Top Assembly







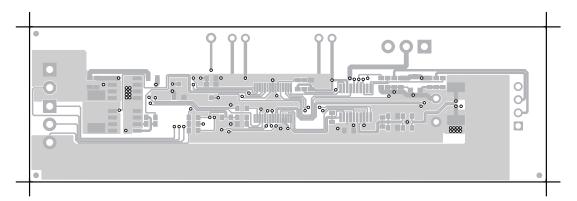


Figure 4. Bottom Layer

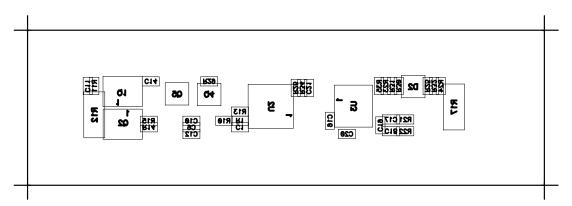


Figure 5. Bottom Assembly



# 4.2 Bill of Materials

# Table 2. Bill of Materials

Count	Ref Des	Value	Description	Size	Part No.	MFR
20	C1–C11, C14, C16–C20, C22–C24	0.1 μF	Capacitor, ceramic, 0.1 $\mu\text{F},$ 50 V, X7R, 20%	0603	STD	Any
1	C12	0.22 μF	Capacitor, ceramic, 0.22 $\mu\text{F},$ 25 V, X7R, 20%	0603	STD	Any
3	C13, C15, C27	1.0 μF	Capacitor, ceramic, 1.0 $\mu\text{F},$ 25 V, X7R, 20%	0805	STD	Any
2	C21, C26	0.47 μF	Capacitor, ceramic, 0.47 $\mu F,$ 16 V, X7R, 20%	0603	STD	Any
1	C25	2.2 μF	Capacitor, ceramic, 2.2 $\mu\text{F},$ 10 V, X7R, 20%	0805	STD	Any
4	D1, D3, D4, D6	BAS16	Diode, Switching, 150-mA, 75-V, 350 mW	SOT23	BAS16	Vishay-Liteon
2	D2, D5	AZ23C5V6	Diode, dual, Zener, 5.6V, 300mW	SOT23	AZ23C5V6	Vishay-Telefunken
1	J1	22-05-3041	Header, friction lock assembly, 4-pin right angle	0.400 x 0.500	22-05-3041	Molex
2	Q1, Q3	FDS8817NZ	MOSFET, N-ch, 30 V, 15 A, 7 mΩ	SO8	FDS8817NZ	Fairchild
1	Q2	FDS4435BZ	MOSFET, P-ch, -30 V, -8.8 A, 20 mΩ	SO8	FDS4435BZ	Fairchild
1	Q4	NDS331N	MOSFET, N-ch, 20 V, 1.3 A, 0.16 Ω	SOT23	NDS331N	Fairchild
1	Q5	BSS138	MOSFET, N-ch, 50 V, 0.22 A, 6 Ω	SOT23	BSS138	Fairchild
12	R1–R5, R21–R24, R31, R32, R36	100	Resistor, chip, 100 Ω, 1/16 W, 5%	0603	STD	STD
2	R11, R19	3M	Resistor, chip, 3 MΩ, 1/16 W, 5%	0603	STD	STD
1	R12	301	Resistor, chip, 301 $\Omega$ , 1 W, 1%	2512	WSL-2512-301 1% R86	Vishay
3	R13, R15, R18	5.1K	Resistor, chip, 5.1 k $\Omega$ , 1/16 W, 5%	0603	STD	STD
3	R14, R25, R30	1M	Resistor, chip, 1 M $\Omega$ , 1/16 W, 5%	0603	STD	STD
1	R16	100K	Resistor, chip, 100 k $\Omega$ , 1/16 W, 5%	0603	STD	STD
1	R17	0.010 75ppm	Resistor, chip, 0.010 $\Omega$ , 1 W, 1%	2512	WSL-2512-010 1% R86	Vishay
1	R20	10K	Resistor, chip, 10 kΩ, 1/16 W, 5%	0603	STD	STD
2	R26, R34	8.45K	Resistor, chip, 8.45 kΩ, 1/16 W, 1%	0603	STD	STD
2	R27, R33	61.9K	Resistor, chip, 61.9 kΩ, 1/16 W, 1%	0603	STD	STD
3	R28, R29, R35	220K	Resistor, chip, 220 kΩ, 1/16 W, 5%	0603	STD	STD
6	R6–R10, R37	1K	Resistor, Chip 1 kΩ, 1/16W, 5%	0603	STD	STD
2	RT1, RT2***	10K	Thermistor, 10 k $\Omega$	0.095 x 0.150	103AT-2	Sematec
2	TB1, TB3	ED1515	Terminal block, 3 pin, 6 A, 3,5 mm	0.41 x 0.25	ED555/3DS	OST
1	TB2	ED1514	Terminal block, 2 pin, 6 A, 3,5 mm	0.27 x 0.25	ED555/2DS	OST
1	TP1	GND	Test point, Black, Thru Hole Color Keyed	$0.100\times0.100$ in	5000	Keystone
1	TP2	VCC	Test point, Red, Thru Hole Color Keyed	$0.100\times0.100$ in	5001	Keystone
1	TP3	~FUSE	Test point, White, Thru Hole Color Keyed	$0.100\times0.100$ in	5002	Keystone
1	U1	bq29412DCT3R	IC, voltage protection for 2, 3, or 4 cell Li-Ion, 2nd protection, 4.45 OVP ±25 mV	MSOP-08 (DCT3)	bq29412DCT3R	TI
1	U2	bq29330DBT	IC, 2, 3, or 4 cell series protection control AFE	TSSOP-30	bq29330DBT	ТІ
1	U3	bq20z40PW	IC, Impedance Track Gas Gauge	TSSOP-20	bq20z40PW	TI





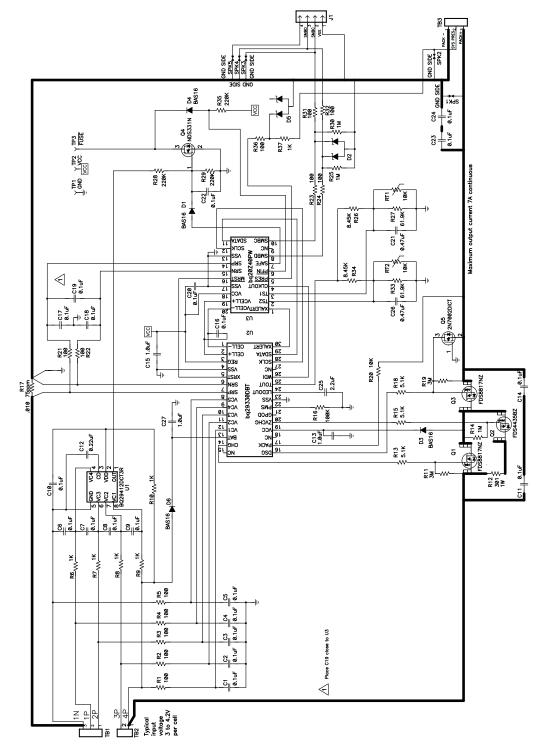


Figure 6. Schematic

# 4.3 bq20z40/bq29330/bq29412 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq20z40/ bq29330/bq29412 circuit module.

#### **Table 3. Performance Specification Summary**

Specification	Min	Тур	Max	Units
Input voltage Pack+ to Pack-	6	15	25	V
Charge and discharge current	0	2	7	A

# 5 EVM Hardware and Software Setup

This section describes how to install the bq20z40EVM-001 PC software, and how to connect the different components of the EVM.

# 5.1 System Requirements

The bq20z40EVSW requires Windows 2000 or Windows XP.

# 5.2 Software Installation

Obtain the latest software archive from the Support software section of the EVM product folder at **xxx**, or search for the latest software version from <u>power.ti.com</u>. Use the following steps to install the bq20z40EVSW software:

- 1. Save the archive to a temporary directory. Open the archive containing the installation package, and copy its contents in a temporary directory. The executable filename can consist of several component names and versions. Double-click on the executable filename, and follow the installer instructions to complete the bq20z40 EVSW installation.
- 2. If the EV2300 was not previously installed, after bq20z40 EVSW installation, a TI USB DRIVER INSTALLER pops up. Click "Yes" for the agreement message and follow its instructions.
- 3. Plug the EV2300 into a USB port.

# 6 Troubleshooting Unexpected Dialog Boxes

Ensure that the files were extracted from the zip file using the Preserve Folder names option.

Ensure that all the files were extracted from the zip file.

The user that is downloading the files must be logged in as the administrator.

The driver is not signed, so the administrator must allow installation of unsigned drivers in the operating system policy.

# 7 Hardware Connection

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The bq20z40EVM-001 comprises two hardware components: the bq20z40/bq29330/bq29412 circuit module and the EV2300 PC interface board.





# 7.1 Connecting the bq20z40/bq29330/bq29412 Circuit Module to a Battery Pack

Figure 7 shows how to connect the bq20z40/bq29330/bq29412 circuit module to the cells and system load/charger.

The cells must be connected in the following order:

- 1. 4-Cell Pack: 1N (BAT-), 1P, 2P, 3P, then 4P (see Section 2.2 for definitions).
- 2. 3-Cell Pack: 1N (BAT-), 1P, 2P, and then connect 4P and 3P together.
- 3. 2-Cell Pack: 1N (BAT-), 1P, and then connect 4P, 3P, and 2P together

To start charge or discharge test, connect SYS PRES pin to PACK- pin to set SYS PRES state. To test sleep mode, disconnect the SYS PRES pin.

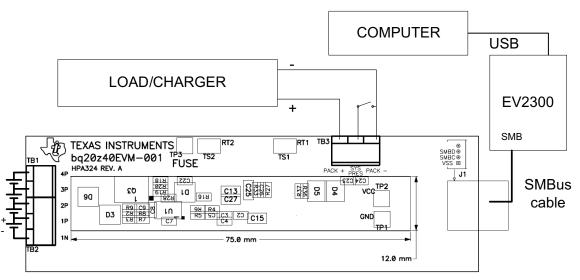


Figure 7. bq20z40/bq29330 Circuit Module Connection to Cells and System Load/Charger

# 7.2 PC Interface Connection

The following steps configure the hardware for interface to the PC:

1. Connect the bq20z40/bq29330-based smart battery to the EV2300 using the provided cable or the connections shown in Table 4.

bq20z40/bq29330-Based Battery	EV2300
SMBD	SMBD
SMBC	SMBC
VSS	GND

### Table 4. Circuit Module to EV2300 Connections

2. Connect the PC USB cable to the EV2300 and the PC USB port.

The bq20z40EVM-001 is now set up for operation.



### 8 Operation

This section details the operation of the bq20z40 EVSW software. Note: the EV2300 driver does not support Windows Sleep or Hibernate. If communicating with the EV2300 or the EVM is a problem, first unplug the USB cable, then plug it back in. If the problem persists, check to determine if the EVM is in Shutdown mode. The bq20z40 can be awakened by momentarily applying a voltage higher than 5.5 V (but less than 25 V) at Pack+ pin of the EVM.

## 8.1 Starting the Program

With the EV2300 and the bq20z40EVM connected to the computer, run bq20z40 EVSW from the Start | All Programs | Texas Instruments | bq Evaluation Software menu sequence. The SBS Data screen appears. Data begins to appear once the <Refresh> (single time scan) button is clicked, or when the <Keep Scanning> check box is checked. To disable the scan feature, deselect <Keep Scanning>.

The continuous scanning period can be set via the |Options| and |Set Scan Interval| menu selections. The range for this interval is 0 ms to 65535 ms. Only items that are selected for scanning are scanned within this period.

The bq20z40 EVSW provides a logging function which logs the values that were last scanned by EVSW. To enable this function, select the *Start Logging* button; this causes the *Keep Scanning* button to be selected. When logging is *Stopped*, the keep scanning button is still selected and has to be manually unchecked.

The logging interval are specified under the |Options| menu with the maximum value of 65535 ms. The *Log* interval cannot be smaller than the scan interval because this results in the same value being logged at least twice.



	🦑 Texas Instrume	NTS			R E	AL WORLD S	1 6 N	A L		8.0.	CESSING				
	Refresh Start Logging		Keep canning			2 word mand								2	
	Name	Value	Unit	Log	Scan	Name	Value	Unit	Log	Scan	Name	Value	Unit	Log	Sca
	Manufacturer Access	0000	hex	V	1	Absolute State of Charge	0	%	1	V	Cell Voltage 1	3533	mV	V	7
	Remaining Cap. Alarm	300	mAh	•		Remaining Capacity	0	mAh	V	~	FET Status	0006	hex	V	V
5	Remaining Time Alarm	10	min	•		Full charge Capacity	4126	mAh	~	~	Safety Alert	0000	hex	-	V
	Battery Mode	6081	hex			Run time To Empty	0	min	1	1	Safety Status	0000	hex		V
	At Rate	0.	mA		2	Average Time to Empty	0	min	1	1	PF Alert	0000	hex		1
	At Rate Time To Full	65535	min			Average Time to Full	65535	min	•	~	PF Status	0000	hex		V
ta	At Rate Time To Empty	65535	min			Charging Current	3900	mA	~	~	Operation Status	8043	hex	V	V
sh	At Rate OK	0	-	-	1	Charging Voltage	16760	mV	1	1	Charging Status	0400	hex	1	1
sn	Temperature	22.65	°C			Battery Status	OBDO	hex	1	V	Temperature Range	0004	hex		V
	Voltage	14206	mV	•		Cycle Count	0	-	1	1	Safety Alert2	0000	hex	V	V
	Current	-44	mA	-		Cell Voltage 4	3608	mV	-	-	Safety Status2	0000	hex	-	V
·0	Average Current	-29	mA		1	Cell Voltage 3	3535	mV	1	V	Permanent Alert2	0000	hex	1	V
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			%	-										-	-
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	Flags / Status Bits Battery Status - SCANNI OCA TCA RSVD INIT DSG FC Operation Status - SCAN PRES FAS SS WAKE DSG XDSG PF status - SCANNIING FBF RSVD RSVD DFF DFETF OFETF Safety Alert - SCANNIIN OTD OTC OCD CUV COV PF	ING OTA FD INING CSV XDSGI CIM G OCC HWDG S RSVD	TDA EC3 RSVD DSGIN SOCD SOCD SOTD OCD2	RSI EC LD/ R_L SO SO SO CC AO	VD RC 22 EC MD RSU 115 VO CC AFE TC SO CC PU CC SC VD RSU	XA     RTA       12     ECO       VD     RSVD       WD     RSVD       XK     QEN       XK     QEN       Battery Mc       CopM     C       CopM     C       VD     PFIN       VD     PFIN       VP     PFIN       VP     PFIN       VP     PFIN       VD     FEF       VD     PFIN       VD     FEF       VD     RSVD	ort o cov P tatus - SC ssusP Pc cB PcA de - SCAI hgM A ssvb Rs SCANNI SSVb Rs SCANNI SSVb Rs FETF CFB re Range -	CD F H ANNI HG M ATO F NNING WD F VD F VD S ETF SCAN	OCC WDG NG ACHG CMTO CMTO SSVD SSVD SSVD	WDF LTCHG OCHGV RSVD RSVD SOCD SOTD	AOCD SCC SCD STCHG HTCHG RSVD OCHGI OC XCHGLV RSVD PB CC RSVD PBS ICC SOCC AFE_P AFE_C				
	Flags / Status Bits Battery Status - SCANND OCA TCA RSVD INIT DSG FC Operation Status - SCAN FRES FAS SS WAKE DSG XDSG PF status - SCANNING FBF RSVD RSVD DFF DFEFF GFEF Safety Alert - SCANNING FET Status - SCANNING FST Status - SCANNING RSVD RSVD RSVD RSVD	ING OTA FD INING CSV XDSGI SOPT CIM AG OCC HWDG S RSVD OD	TDA EC3 RSVD DSGIN SOCD SOTD OCD2 WDF RSVD	RSI EC LD/ R_L SO SO SO CC AO	VD RC 22 EC MD RSU 115 VO CC AFE TC SO CC PU CC SC VD RSU	XA     RTA       12     ECO       VD     RSVD       WD     RSVD       XK     QEN       XK     QEN       Battery Mc       CopM     C       CopM     C       VD     PFIN       VD     PFIN       VP     PFIN       VP     PFIN       VP     PFIN       VD     FEF       VD     PFIN       VD     FEF       VD     RSVD	DTC 0 DTC 0 DV P itatus - SQ SSUSP PCI CB PCA de - SCAI hgM A SVD RS SCANNIH SVD RS SCANNIH SVD RS FETF CFI re Range - SVD RS SSVD RS	CD F H CANNI HG M ATO F NNING WD F NG VD F NG SCAN WD S SCAN WD S	OCC WDG NG ACHG CMTO CMTO SVD SVD SOPT CIM INING SVD INING	WDF LTCHG OCHGV RSVD RSVD SOCD SOTD SOTD RSVD	AOCD         SCC         SCD           STCH0         HTCH0         RSVD           OCH01         OC         XCH0LV           RSVD         PB         CC           RSVD         PBS         ICC           SOCC         AFE_P         AFE_C           SOTC         SOV         PFIN           RSVD         RSVD         RSVD				
	Flags / Status Bits Battery Status - SCANND OCA TCA RSVD INIT DSG FC Operation Status - SCAN FRES FAS SS WAKE DSG XDSG PF status - SCANNING FBF RSVD RSVD DFF DFETF GFETF Safety Alert - SCANNING FBF OTC OCD CUV COV FF FET Status - SCANNING FSVD RSVD RSVD CNTL RSVD RSVD RSVD CNTL RSVD MSCAG	ING OTA FD INING CSV XDSGI CSV XDSGI CSV XDSGI HWDG OCC HWDG RSVD NG RSVD	TDA EC3 RSVD DSGIN SOCD SOTD OCD2 WDF RSVD	RSI EC LD/ R_L SO SO SO CC AO	VD RC 22 EC MD RSU DIS VO CC AFE TC SO CC PU CD SC VD RSU VD RSU	IX     PTA       IX     PTA       IX     PTA       IX     RSVD       IX     RSVD       IX     QEN       IX     PARE_C       IX     POV       IX	DTC         Or           COV         P           COV         P           Status - SCOSSUSP         PCO           SSUSP         PCO           CB         PCO           de - SCAI         PCO           Mde - SCAININ         RS           SSVD         RS           SCANNIN         RS           FETF         CFF           SVD         RS           SVD         RS           SVD         RS           SVD         RS	CD F H ANNI HG M MTO F NNING VD F VD F VD S CAN VD F VD S CAN VD F ANNI ANNI	OCC WDG NG ACHG CMTO CMTO SVD SVD SOPT CIM INING SVD INING	WDF LTCHG OCHGV RSVD RSVD SOCD SOTD SOTD RSVD	AOCD         SCC         SCD           STCH0         HTCH0         RSVD           OCH01         OC         XCH0LV           RSVD         PB         CC           RSVD         PBS         ICC           SOCC         AFE_P         AFE_C           SOTC         SOV         PFIN           RSVD         RSVD         RSVD				
	Flags / Status Bits Battery Status - SCANNZ OCA TOA RSVD INIT DSG PC Operation Status - SCAN PRES FAS SS WARE DSG XDSG PF status - SCANNING FBF RSVD RSVD DFF DFETE OFETE Safety Alert - SCANNIN OTD OTC OCD CUV COV PF FET Status - SCANNIN RSVD RSVD RSVD RSVD RSVD RSVD CMTL RSVD RSVD RSVD Saftey Alert - SCANNI RSVD RSVD RSVD RSVD	ING OTA FD INIING CSV XDSGI CCM G CCM HWDG CC HWDG CC RSVD RSVD RSVD RSVD INIING RSVD	TDA EC3 RSVD DSGIN SOCD SOTD OCD2 WDF RSVD ZVCHG RSVD	RSS EC SO SO OCC AO RSS CH RSS RSS	VD RC 22 EC MD RSV DIS VO CC AFE TC SO CC PU CD SC VD RSV VD RSV VD RSV VD OT2	IX         RTA         OTD           IX         ECA         CUV           IX         ECO         CUV           IX         RSVD         CArriging S           IX         QEN         PLSOFF           IX         QEN         PLSOFF           IX         QEN         PLSOFF           IX         QEN         PLSOFF           IX         QEN         COMM           IX         PAFE_C         COMM           IX         PAFE_C         CP           IX         POV         CF           IX         CS         CF           IX         CS         DFF           IX         CS         SOF           IX         RSVD         RSVD           IX         RSVD         RSVD           IX         RSVD         RSVD           IX         RSVD         RSVD           IX         RSVD         RSVD	optic or pov P status - SC SSUSP Pci c8 Pci	CD C	OCC WDB NG CMTO CMTO CMTO CMTO CMTO CMTO CMTO CMTTS CSVD CSVD CSVD	WDF LTCHG OCHGV RSVD RSVD SOTD SOTD SOTD SOTD SOTD SOTD RSVD JTR4 RSVD RSVD	AOCD         SCC         SCD           STCHG         HTCHG         RSVD           OCHGI         OC         XCHGLV           RSVD         PB         CC           RSVD         PBS         ICC           SOCC         AFE_P         AFE_C           SOTC         SOV         PFIN           RSVD         RSVD         RSVD           JTR3         JTR2         JTR1           RSVD         RSVD         RSVD           RSVD         RSVD         CC				

Figure 8. SBS Data Screen

This screen shows the SBS data set along with additional ManufacturersAccess() command information such as individual cell measurements. Additional Flag and Static data can be viewed by selecting the appropriate tab at the bottom of the SBS screen.

Data such as SBS.ManufacturerName() is static and does not change. This data is viewed separately using the *Static Data* tab available at the bottom of the screen.

Dragging the splitter bar (line that separates the Flags/Static data from SBS values) changes the height of the Flags/Static Data display. Selecting |View| then |Auto Arrange| returns the splitter bar to its original location.

# 8.2 Setting Programmable bq20z40 and bq29330 Options

The bq20z40 data flash comes configured per the default settings detailed in the bq20z40 data sheet (<u>SLUS801</u>). Ensure that the settings are correctly changed to match the pack and application for the bq20z40/bq29330 solution being evaluated.

**IMPORTANT:** The correct setting of these options is essential to get the best performance.

The settings can be configured using the Data Flash screen.



	V TEXAS INSTRUMENTS		RE	AL WI	IRLD S	IENAI	р в и	CESSINO			
	Bead All Write All	Write	All, <u>P</u> reserve								
-	Calibration						-				
	Configuration		Pow	er	Gas G	auging	Ĭ	Ra Table	Ĭ	PF Statu	IS
	1st Level Safety	Y	2nd Level S	iafety	Charge C	ontrol	) si	BS Configuration	Ϋ́	System Data	
1	Name	Value	Unit	Name		Value	Unit	Name		Value	Un
	Voltage	+	-	OC Dsg Re	covery		mA	OT Dsg Time		-	Se
	LT COV Threshold		mV	OC (2nd T	ier) Chg		mA	OT Dsg Recover	ry		°C
	LT COV Recovery		mV	OC (2nd T	ier) Chg Time		Sec	Start Over Tem	p Dsg		°C
	ST COV Threshold		mV	OC (2nd T	ier) Dsg		mA	Start OT Dsg Ti	me		Se
	ST COV Recovery		mV	OC (2nd T	ier) Dsg Time		Sec	Start OT Dsg Re	covery		°C
	HT COV Threshold		mV	Current Re	covery Time		Sec	Temperature 2		140	4
1	HT COV Recovery		mV	AFE OC De	9		hex	Over Temp Chg			°C
	COV Time		Sec	AFE OC D	g Time		hex	OT Chg Time			Se
	CUV Threshold		mV	AFE OC DE	g Recovery		mA	OT Chg Recover	ry .		°C
	CUV Time		Sec	AFE SC Ch	ig Cfg		hex	Over Temp Dsg			°C
	CUV Recovery		mV	AFE SC Ds	g Cfg		hex	OT Dsg Time			Se
	Current		-	AFE SC Re	covery		mA	OT Dsg Recover	ry		°C
	OC (1st Tier) Chg		mA	Temperate		(H)		Start Over Tem			°C
	OC (1st Tier) Chg Time		Sec	Over Temp	Chg		°C	Start OT Dsg Ti	ime		Se
1	OC Chg Recovery		mA	OT Chg Ti			Sec	Start OT Dsg Re	scovery		°C
	OC (1st Tier) Dsg		mA	OT Chg Re	and the second second		°C	Host Comm		17	-
-	OC (1st Tier) Dsg Time		Sec	Over Temp	) Dsg		°C	Host Watchdog	Timeout		Sec

Figure 9. Data Flash Screen, 1st Level Safety Class

To read all the data from the bq20z40 data flash, click on menu option | Data Flash | Read All |.

To write to a data flash location, click on the desired location, enter the data, and press <Enter>, which writes the entire tab of flash data, or select menu option |Data Flash|Write All|. The data flash must be read before any writes are performed to avoid any incorrect data being written to the device.

The | File | Special Export | menu options allows the data flash to be exported, but it configures the exported data flash to a learned state ready for mass production use.

The data flash configuration can be saved to a file by selecting | File | Export |, and entering a file name. A data flash file also can be retrieved in this way, imported, and written to the bq20z40 using the | Write All | button.

The configuration information of the bq29330 and module calibration data is held in the bq20z40 data flash.

The bq20z40 allows for an automatic data flash export function, similar to the SBS Data logging function. This feature, when selected via | Options | Auto Export |, exports Data Flash to a sequential series of files named as *FilenameNNNNN.gg* where N = a decimal number from 0 to 9.

The AutoExport interval is set under the | Options menu | with a minimum value of 15 seconds. The AutoExport filename is set under the | Options menu |.

When a check is next to | AutoExport |, the AutoExport is in progress. The same menu selection is used to turn on/off AutoExport.

If the data flash screen is blank, then the bq20z40 that is being used may not be supported by the bqEVSW version that is being used. An upgrade may be required.



# 9 Calibration Screen

# 9.1 How to Calibrate

The bq20z40 must be calibrated using power supplies or a power supply and cell simulation resistors (200  $\Omega$  to 1000  $\Omega$  each) before cells are attached. Before the bq20z40 is calibrated:

- Connect and measure a 2-A current source from 1N (-) and Pack- (+) to calibrate without using the FETs (calibration using the FETs is not recommended).
- Measure the pack voltage from Batt+ to Batt- (total of cell voltages).
- Measure the temperature of the pack.
- Whether the foregoing steps are necessary depends on the type of calibration being performed.

# 9.2 To Calibrate the bq20z40

Select the types of calibration to be performed.

Enter the measured values for the types selected (Except for CC Offset Calibration).

If Voltage Calibration is selected, enter the number of cells on the pack.

If Temperature Calibration is selected, select the sensor that is to be calibrated.

If the current source is connected between 1N and Pack-, then select the Off (Bypassed) check box in the FET Control section.

Press the Calibrate Part button.

# 9.3 Board Offset Calibration

This performs the offset calibration for the current offset of the board.

Remove any current source, load, or external voltage from the PACK terminals.

Press the Software Board Offset Calibration button.

# 9.4 Pack Voltage Calibration

This calibrates the voltage at the AFE Pack pin.

Ensure that *Voltage Calibration* has been performed for the pack. If *Voltage Calibration* is not performed, then *Pack Voltage Calibration* calibrates incorrectly.

Remove load/external voltage applied between Pack+ and Pack-.

Press the Pack Voltage button to calibrate.



#### Calibration Screen

100	🜵 TEXAS INSTR	RUMENTS	REA	L W B	RLD SI	ENAL PROCESS	ING
1	This screen supports bq	20z80 version 0.13 ar	nd newer. Please ens	ure that scanr	ning/communication	is off on all other open windows.	
•	Pack Voltage and Pack Voltage Calibration	I CC Board Offset	Calibration		for 2 sec ware Board t Calibration		
85	Calibrate Part as indicated below						
ash	CC Offset Calibration						
ro	Calibration	Measured voltage 14204 mV	Enter actual voltage 0 mV	Cell Count	FET Control C On G Off	Ensure voltage reference is stable. Calibration with cells connected is not recommended unless cells are in a state of rest.	
brate	☐ Temperature Calibration	Measured temperature 23.6 °C	Enter actual temperature	☐ Int. Se ☑ Ext. Se ☐ Ext. Se	insor 1		
-	Pack Current Calibration	Measured current -44 mA	Enter actual current -2000 mA	FET Co C On (E C Off (E	xternal Load)	Apply a 2 Ampere discharge load. Discharge current is a negative value.	
Gauge							

Figure 10. Calibration Screen



# 10 Pro (Advanced) Screen

### 10.1 SMB Communication

The set of read/write operations over SMBus are not specific to any gas gauge. These are provided as general-purpose communication tools.

## 10.2 Hex/Decimal Converter

These two boxes convert between hexadecimal (hex) and decimal as soon as values are typed into the boxes. Invalid values can cause erroneous results.

When scaling converted hex values to a higher number of bytes, follow these rules:

- When unsigned is selected, the left pad contains zeroes.
- When signed is selected, the left pad contains zeroes for a positive number, or the left pad contains *F* for negative numbers.

# 10.3 Programming

Allows for device reprogramming from unencrypted and encrypted files.

	uments by Gas Gauge Evaluation Software - by20z40 v0.01 - [Pro (Adv	vanced) Screen]	
Eile Options	Flas <u>h</u> Memory <u>W</u> indow <u>H</u> elp		- @ ×
400	TEXAS INSTRUMENTS REAL WORLD	I SIENAL PROCESSING	
<u> </u>	This screen is only for advanced users. Some commands may cause permanent damage t All Values are in Hexadecimal without the 0x prefix. Target Address 17 Send SMB Command	to the hardware. Please use caution.	
	SMB Command 08		
	Read SMB Word		
585	SMB Command OD Bead Result (hex) None.		
	Write SMB Word		
Data Flash	SMB Command 00 Word (hex) 0F00		
ridsh	Read SMB Block		
Pro	SMB Command 78 Result (hex) None.		
	Write SMB Block		
Calibrate	SMB Command 78 Block Data		
	Hexadecimal to Decimal converter and vice versa		
	Hexadecimal value 00 = Signed		
100%			
1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 - 1999 -	Stee programming		
	C:\20z40\example.senc		
0% Fuel Gauge 0%			
Communication DK		SBS Task Progress: 100% Task Completed. 02	2:32:07 PM

Figure 11. Pro (Advanced) Screen



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# Related Documentation from Texas Instruments

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, identify this document by its title and literature number. Updated documents can also be obtained through the TI Web site at www.ti.com

Documents:	Literature Number:
bq20z40, SBS 1.1-Compliant Gas Gauge With Impedance Track data sheet	<u>SLUS801</u>
bq20z40 and bq20z45 Technical Reference Manual	<u>SLUU313</u>
bq29330, 2-, 3-, and 4-Cell Li-Ion or Li-Polymer Battery Protective AFE data sheet	<u>SLUS673</u>

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