User's Guide
SLUU234A –February 2006–Revised October 2013

bq20z90EVM-001 SBS 1.1 Impedance Track™ Technology Enabled Battery Management Solution Evaluation Module

This evaluation module (EVM) is a complete evaluation system for the bq20z90/bq29330/ bq29412 battery management system. The EVM includes one bq20z90/bq29330/bq29412 circuit module, a current sense resistor, two thermistors, and Windows®-based PC software. An EV2300 board for gas gauge interface is required to interface this EVM with the PC and can be purchased separately. The circuit module includes one bq20z90 integrated circuit (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, over discharge, 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 bq20z90 data registers, program the chipset for different pack configurations, log cycling data for further evaluation, and evaluate the overall functionality of the bq20z90/ bq29330/bq29412 solution under different charge and discharge conditions.

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1 Features

- Complete evaluation system for the bq20z90 SBS 1.1-compliant advanced gas gauge with Impedance Track™ Technology, bq29330 analog front end (AFE) and protection IC, and bq29412 independent overvoltage protection IC
- Populated circuit module for quick setup
- PC software and interface board for easy evaluation
- Software that allows data logging for system analysis

1.1 Kit Contents

- bq20z90/bq29330/bq29412 circuit module
- Software CD with the evaluation software
- Set of support documentation

1.2 Ordering Information

Table 1. Ordering Information

EVM PART NUMBER	CHEMISTRY	CONFIGURATION	CAPACITY
bq20z90EVM-001	Li-ion	2, 3, or 4 cell	Any

2 bq20z90/bq29330-Based Circuit Module

The bq20z90/bq29330/bq29412-based circuit module is a complete and compact example solution of a bq20z90 and bq29330 circuit for battery management and protection of Li-ion or Li-polymer packs. The circuit module incorporates a bq20z90 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)
- 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
SYS PRES	System present pin (if low, system is present)
PACK-	Pack negative terminal
VSS	Pack negative terminal
PACK+	Pack positive terminal

3 bq20z90/bq29330 Circuit Module Schematic

This section contains information for modifying and choosing a precharge mode for bq20z90/bq29330/bq29412 implementation.

3.1 Schematic

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

3.2 Modifications for Choosing Particular Precharge Mode

In order to charge, the charge FET (CHG-FET) must be turned on to create a current path. When the $V_{(BAT)}$ is 0 V and CHG-FET = ON, the $V_{(PACK)}$ is as low as the battery voltage. In this case, the supply voltage for the device is too low to operate. This function has three possible configurations, and the bq29330 can be easily configured according to the application needs. The three modes are 0-V Charge FET mode, Common FET mode, and Precharge FET mode.

1. 0-V Charge FET mode - Dedicates a precharge current path using an additional FET (ZVCHG-FET) to sustain the PACK+ voltage level.
2. Common FET mode - Does not use a dedicated precharge FET. The charge FET (CHG-FET) is set to ON state as default.
3. Precharge FET mode - Dedicates a precharge current path using an additional open-drain (OD) pin drive FET (PCHG-FET) to sustain the PACK+ voltage level.

To use a particular mode of charging with the EVM, add or remove some elements shown in Table 2, and use the given settings of DF.Configuration, ZVCHG1, 0.

Table 2. Components and Flash-Memory Settings for Different Precharge Modes

MODE	RESISTORS	PRECHG FET	ZVCHG1	ZVCHG0
1 0-V Chg (default)	R18, R23	Q3	0	0
2 Common FET	R20	Q2	0	1
3 Precharge	R19, R23	Q3	1	0

For more details about precharge operation and mode choices, see the bq29330 data sheet at (SLUS673).

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 TP4 low if a fuse-blow condition occurs; so, monitoring TP4 can be used to test this condition. Fuse placement on the application board is shown in the bq20z90 data sheet reference-board schematic.

4 Circuit Module Physical Layouts and Bill of Materials

This section contains the board layout, bill of materials, and assembly drawings for the bq20z90/ bq29330/ bq29412 circuit module.

4.1 Board Layout

This section shows the dimensions, PCB layers (Figure 1 through Figure 5), and assembly drawing for the bq20z90/bq29330 module.

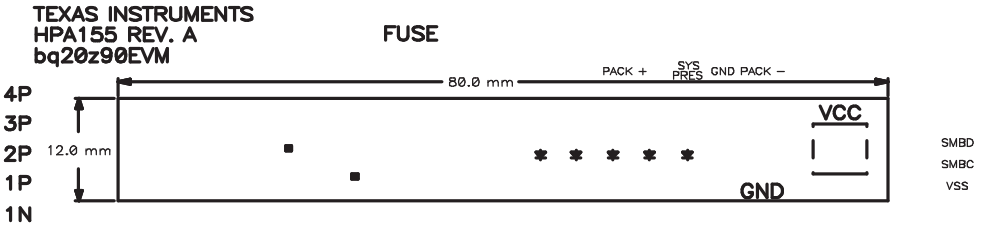


Figure 1. bq20z90EVM-001 Layout (Silk Screen)

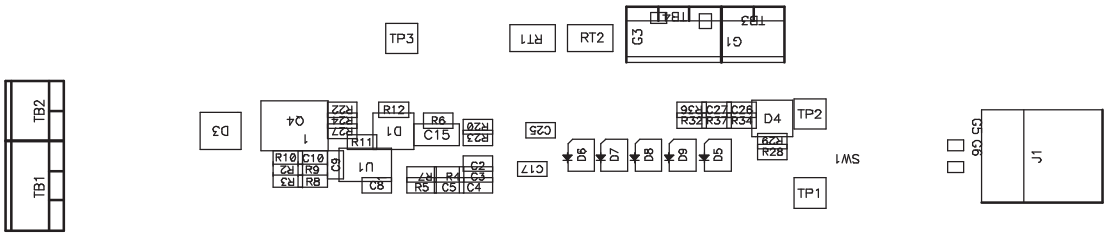


Figure 2. Top Assembly

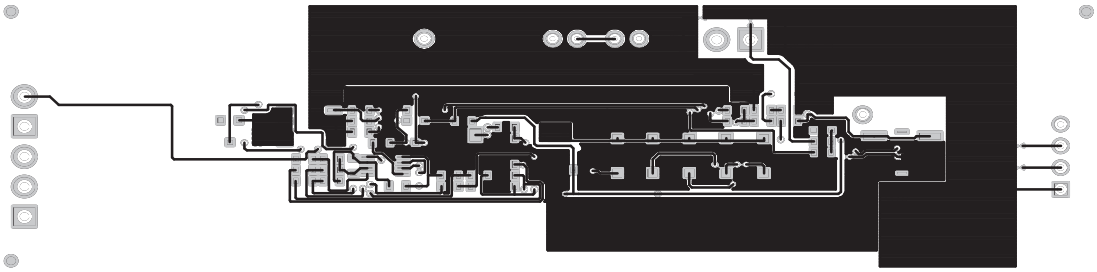


Figure 3. Top Layer

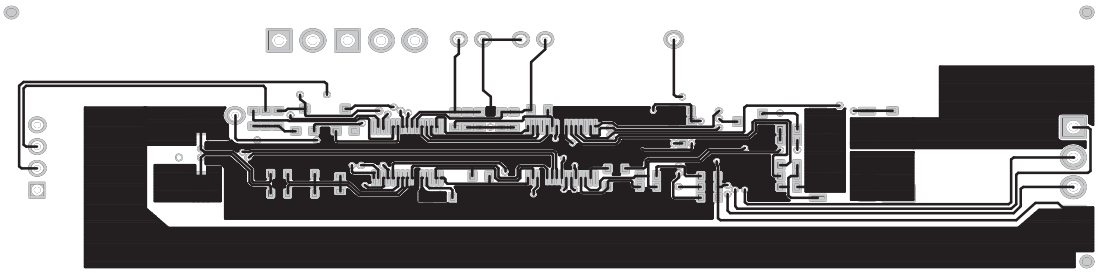


Figure 4. Bottom Layer

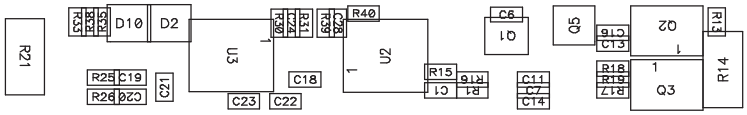


Figure 5. Bottom Assembly

4.2 Bill of Materials and Schematic

Table 3. Bill of Materials

Count	Ref Des	Description	Size	MFG	Part No.
20	C1, C2, C3, C4, C6, C7, C8, C9, C10, C11, C13, C16, C18, C19, C20, C21, C22, C23, C26, C27	Capacitor, ceramic, 0.1 µF 50 V, X7R, 20%	0603	Any	STD
1	C14	Capacitor, ceramic, 0.22 µF, 50 V, X7R, 20%	0603	Any	STD
1	C15	Capacitor, ceramic, 4.7 µF, 25 V, X7R, 10%	1206	Any	STD
2	C24, C28	Capacitor, ceramic, 0.47 µF, 16 V, X7R, 20%	0603	Any	STD
1	C25	Capacitor, ceramic, 4.7 µF, 10 V, X7R, 20%	0603	Any	STD
2	C5, C17	Capacitor, ceramic, 1.0 µF, 50 V, X7R, 20%	0805	Any	STD
3	D1, D2, D3	Diode, switching, 150-mA, 75-V, 350 mW	SOT23	Vishay-Liteon	BAS16
2	D4, D10	Diode, dual, Zener, 5.6 V, 300 mW	SOT23	Vishay-Telefunken	AZ23C5V6
5	D5, D6, D7, D8, D9	Diode, LED, green, Gullwing, GW type, 20 mA, 7.5 mcd Typ	0.120 × 0.087	Panasonic	LN1361C
1	J1	Header, friction lock assembly, 4-pin right angle	0.400 × 0.500	Molex	22-05-3041
1	Q1	MOSFET, P-ch, 20 V, 1.3 A, 0.16 Ω	SOT23	Fairchild	NDS331N
2	Q2, Q4	MOSFET, N-ch, 30 V, 10 A, Rds 16 mΩ	SO8	Fairchild	FDS6690S
1	Q3	MOSFET, P-ch, 30 V, 8.0-A, 20-mΩ	SO8	Siliconix	Si4435DY
1	Q5	MOSFET, Nch, 50 V, 0.22 A, 6 Ω	SOT23	Fairchild	BSS138
12	R1, R2, R3, R4, R5, R25, R26, R28, R32, R33, R37, R38	Resistor, chip, 100 Ω, 1/16 W, 5%	0603	STD	STD
2	R13, R24	Resistor, chip, 3.01 mΩ, 1/16 W, 5%	0603	STD	STD
1	R14	Resistor, chip, 300-Ω, 1-W, 10%	2512		WSL=2512-xx
3	R15, R18, R22	Resistor, chip, 5.1 kΩ, 1/16 W, 5%	0603	STD	STD
0	R19	Resistor, chip, 5.1 kΩ, 1/16 W, 5%	0603	STD	STD
3	R17, R35, R36	Resistor, chip, 1 mΩ, 1/16 W, 5%	0603	STD	STD
1	R23	Resistor, chip, 100 kΩ, 1/16 W, 5%	0603	STD	STD
0	R20	Resistor, chip, 100 kΩ, 1/16 W, 5%	0603	STD	STD
1	R21	Resistor, chip, 0.010Ω, 1-W, xx%	2512	Vishay	WSL-2512-020
1	R29	Resistor, chip, 1 kΩ, 1/16 W, 5%	0603	STD	STD
2	R30, R40	Resistor, chip, 8.45 kΩ, 1/16 W, 1%	0603	STD	STD
2	R31, R39	Resistor, chip, 61.9 kΩ, 1/16 W, 1%	0603	STD	STD
4	R6, R11, R12, R34	Resistor, chip, 220 kΩ, 1.16 W, 5%	0603	STD	STD
6	R7, R8, R9, R10, R16, R27	Resistor, chip, 1 kΩ, 1.16 W, 5%	0603	STD	STD
2	RT1, RT2	Thermistor, 10 kΩ	0.095 × 0.150	Sematec	NTC103AT
1	SW1	Switch, push button, momentary, N.O. low profile	5 mm × 5 mm	Panasonic	EVQPLCxxxx
2	TB1, TB4	Terminal block, 3 pin, 6 A, 3,5 mm	0.41 × 0.25	OST	ED1515
2	TB2, TB3	Terminal block, 2 pin, 6 A, 3,5 mm	0.27 × 0.25	OST	ED1514
1	TP1	Test point, black, thru hole color keyed	0.100 × 0.100	Keystone	5001
1	TP2	Test point, red, thru hole color keyed	0.100 × 0.100	Keystone	5000
1	TP2	Test point, white, thru hole color keyed	0.100 × 0.100	Keystone	5002
1	U1	IC, voltage protection for 2, 3, or 4 cell Li-Ion, 2nd protection, 4.45 V, OVP	SSOP-08	TI	bq29412DCT
1	U2	IC, 2-3, or 4 cell series protection control AFE	TSSOP30	TI	bq29330DBT
1	U3	IC, impedance track advanced gas gauge	TSSOP30	TI	bq20z90DBT

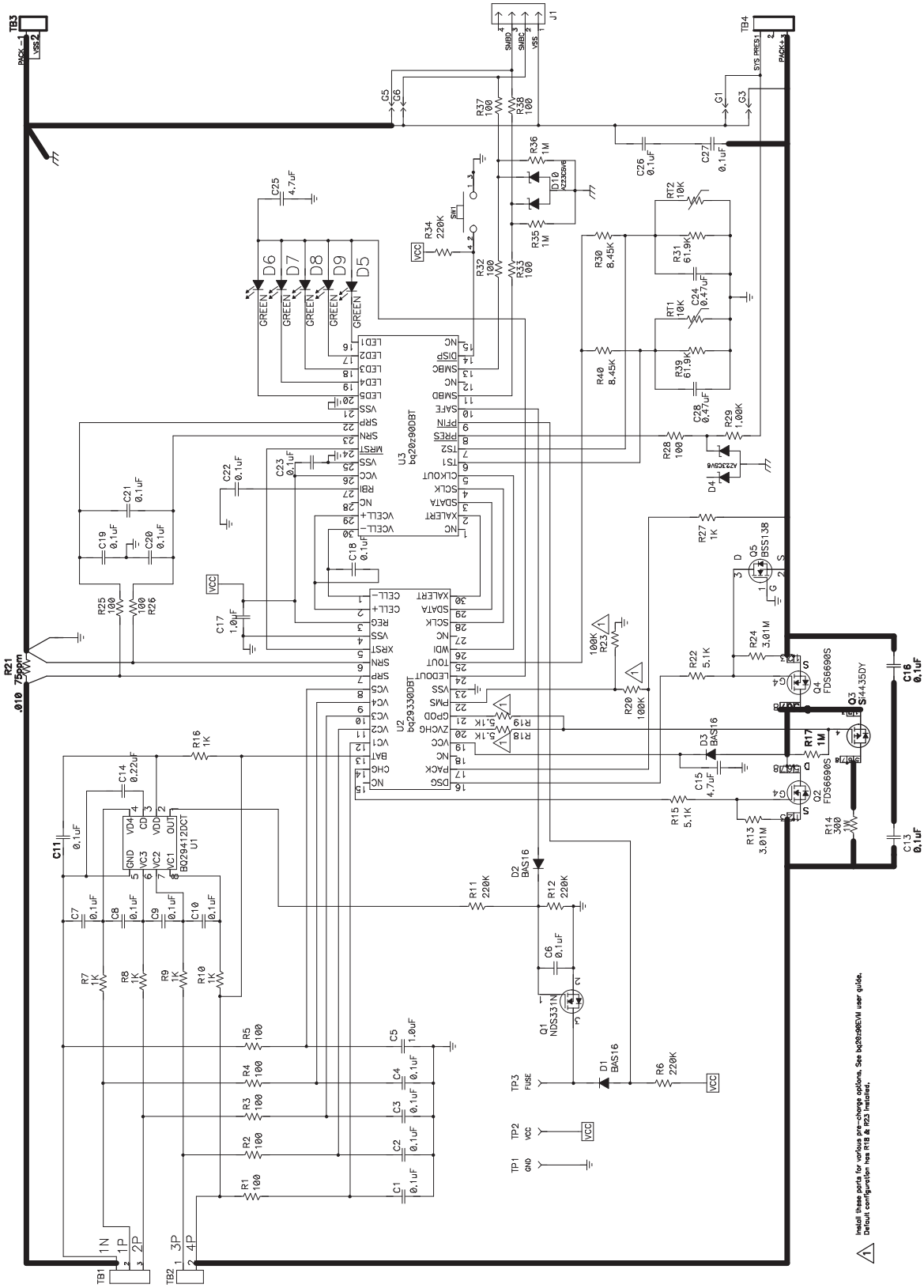


Figure 6. Schematic

4.3 bq20z90/bq29330/bq29412 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq20z90/ bq29330/bq29412 circuit module.

Table 4. Performance Specification Summary

Specification	Min	Typ	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 bq20z90EVM-001 PC software, and how to connect the different components of the EVM.

5.1 System Requirements

The bq20z90EVSW software requires Windows 2000 or Windows XP. Drivers for Windows 98SE are provided, but Microsoft no longer supports Windows 98; and there may be issues in Windows 98 with USB driver support. The EV2300 USB drivers have been tested for Windows 98SE, but no assurance is made for problem-free operation with specific system configurations.

5.2 Software Installation

Find the latest software version in the bq20z90 tool folder on power.ti.com. Use the following steps to install the bq20z90EVSW software:

1. Copy the files from the CD into the temporary directory you selected, open the archive TI USB DRVRS.zip, and extract its contents in a subdirectory/drivers. Choose preserve *directory structure* option when extracting. Alternatively, run SETUP.EXE from the same directory.
2. Plug the EV2300 into a USB port.
3. Wait until system prompt *new hardware found* appears. Choose *select location manually*, and use the *browse* button to point to subdirectory TIUSBWin2K-XP-1.
4. Answer *continue* to the warning that drivers are not certified with Microsoft.
5. After installation finishes, another system prompt *new hardware found* appears. Repeat procedure above, but point to subdirectory TIUSBWin2K-XP-2
6. Answer *continue* to the warning that drivers are not certified with Microsoft. Installation of drivers is now finished.
7. For Windows 98, point to directory TIUSBWin98.
8. Return to the temporary directory where you extracted files; double-click on the *Setup.exe* icon to install EV Software.

If files were downloaded from the Web:

1. Open the archive containing the installation package, and copy its contents in a temporary directory.
2. Follow the preceding steps 1 - 8.

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

The bq20z90EVM-001 comprises three hardware components: the bq20z90/bq29330/bq29412 circuit module, the EV2300 PC interface board (purchased separately), and the PC.

7.1 Connecting the bq20z90/bq29330/bq29412 Circuit Module to a Battery Pack

Figure 7 shows how to connect the bq20z90/bq29330/bq29412 circuit module to the cells and system load/charger.

The cells should be connected in the following order:

1. 4-Cell Pack: 1N (BAT-), 1P, and 2P (see Section 2.1 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 PRES pin to PACK- pin to set SYS PRES state. To test sleep mode, disconnect the PRES pin.

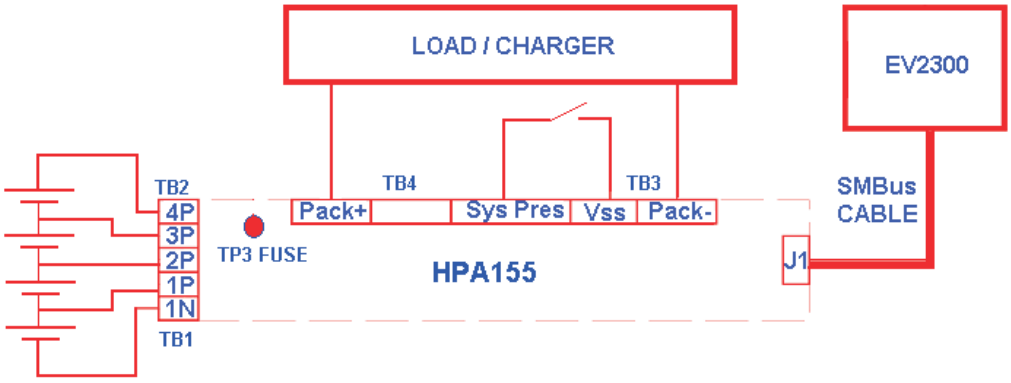


Figure 7. bq20z90bq29330 Circuit Module Connection to Cells and System Load/Charger

7.2 PC Interface Connection

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

1. Connect the bq20z90/bq29330-based smart battery to the EV2300 using wire leads as shown in Table 5.

Table 5. Circuit Module to EV2300 Connections

bq20z90/bq29330-Based Battery	EV2300
SMBD	SMBD
SMBC	SMBC
VSS	GND

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

The bq20z90EVM-001 is now set up for operation.

8 Operation

This section details the operation of the bq20z90 EVSW software.

8.1 Starting the Program

Run bq20z90 EVSW from the Start | Programs | Texas Instruments | bq20z90 EVSW menu sequence. The SBS Data screen (Figure 8) 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 bq20z90 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 intervals are specified under the | Options | menu with the maximum value of 65535 ms. The *Log* interval cannot be smaller than scan interval because this results in the same value being logged at least twice.

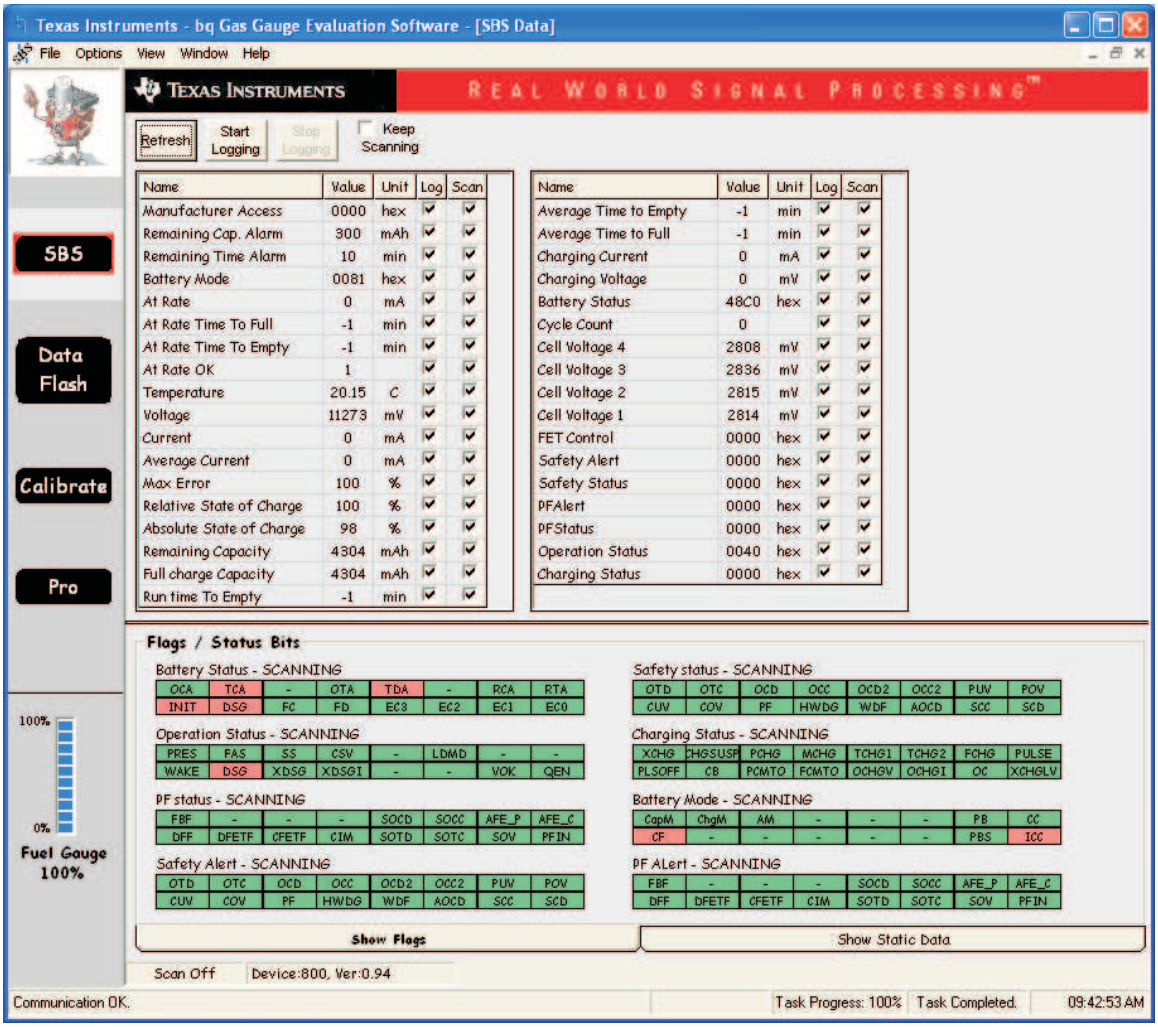


Figure 8. SBS Data Screen

This screen (Figure 8) 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.

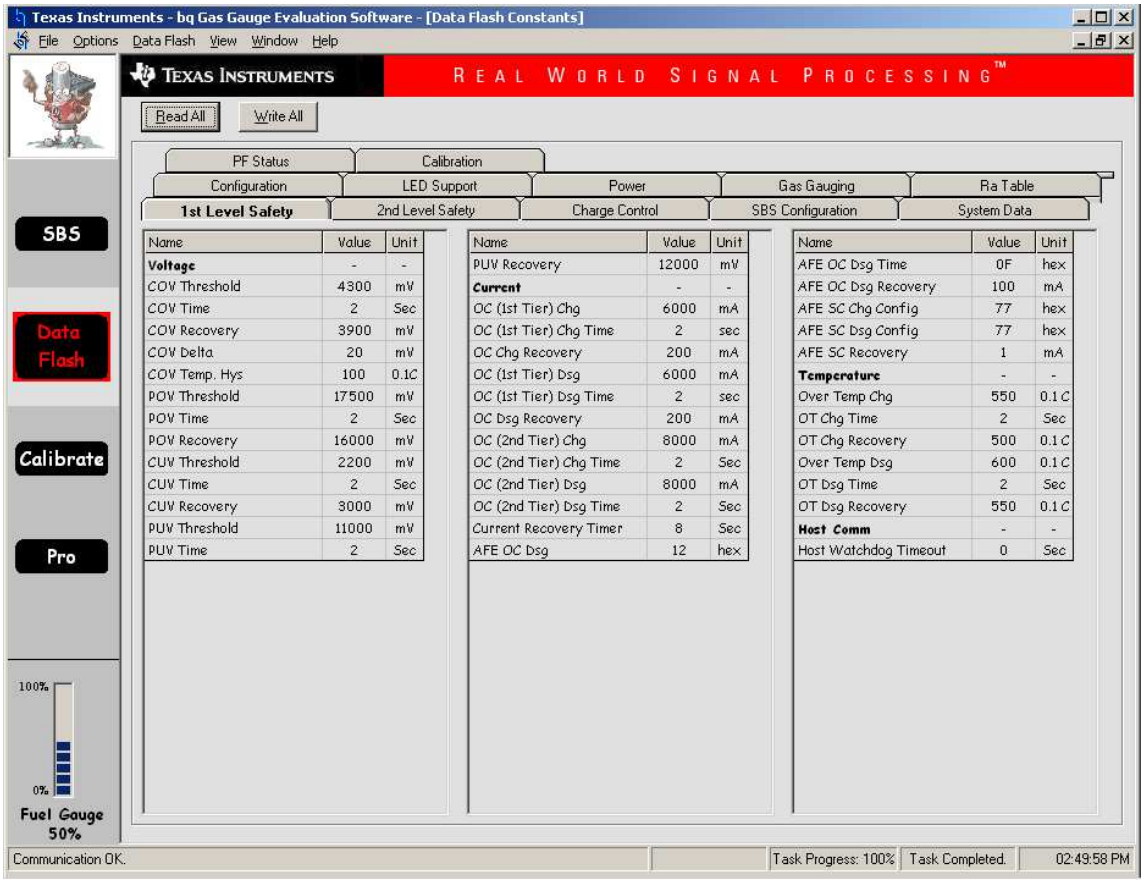
Dragging the splitter bar (line that separates the Flags/Static data from SBS values) changes the height of the Flags/Static Data display. Selecting | View |, then | Auto Arrange | returns the splitter bar to its original location.

8.2 Setting Programmable bq20z90 and bq29330 Options

The bq20z90 data flash comes configured per the default settings detailed in the bq20z90 data sheet. Ensure that the settings are correctly changed to match the pack and application for the bq20z90/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 (Figure 9).



Name	Value	Unit
Voltage	-	-
COV Threshold	4300	mV
COV Time	2	Sec
COV Recovery	3900	mV
COV Delta	20	mV
COV Temp. Hys	100	0.1C
POV Threshold	17500	mV
POV Time	2	Sec
POV Recovery	16000	mV
CUV Threshold	2200	mV
CUV Time	2	Sec
CUV Recovery	3000	mV
PUV Threshold	11000	mV
PUV Time	2	Sec

Name	Value	Unit
PUV Recovery	12000	mV
Current	-	-
OC (1st Tier) Chg	6000	mA
OC (1st Tier) Chg Time	2	sec
OC Chg Recovery	200	mA
OC (1st Tier) Dsg	6000	mA
OC (1st Tier) Dsg Time	2	sec
OC Dsg Recovery	200	mA
OC (2nd Tier) Chg	8000	mA
OC (2nd Tier) Chg Time	2	Sec
OC (2nd Tier) Dsg	8000	mA
OC (2nd Tier) Dsg Time	2	Sec
Current Recovery Timer	8	Sec
AFE OC Dsg	12	hex

Name	Value	Unit
AFE OC Dsg Time	0F	hex
AFE OC Dsg Recovery	100	mA
AFE SC Chg Config	77	hex
AFE SC Dsg Config	77	hex
AFE SC Recovery	1	mA
Temperature	-	-
Over Temp Chg	550	0.1 C
OT Chg Time	2	Sec
OT Chg Recovery	500	0.1 C
Over Temp Dsg	600	0.1 C
OT Dsg Time	2	Sec
OT Dsg Recovery	550	0.1 C
Host Comm	-	-
Host Watchdog Timeout	0	Sec

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

To read all the data from the bq20z90 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 can also be retrieved in this way, imported, and written to the bq20z90 using the | Write All | button.

The configuration information of the bq29330 and module calibration data is also held in the bq20z90 data flash.

The bq20z90 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 s. The AutoExport filename is also set under the | Options menu |.

When there is a check 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 bq20z90 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

Before the bq20z90 is calibrated:

- Connect a load to Pack- and Pack+ that draws approximately 2 A and measures discharge current to use the FETs.
- Connect a current source to Batt- and Pack- to calibrate without using the FETs.
- Measure the pack voltage from Batt+ to Batt- (Total of Cell voltages).
- Measure the temperature of the pack.
- These steps may or may not be required, depending on the type of calibration being performed.

Note that voltage calibration with cells attached requires special consideration. Cells must be in a resting state. For additional information, go to the TI Web site (www.ti.com) and access the TI Knowledge Base and search for *bq20zxx Calibration Using EV Software*.

9.2 To Calibrate the bq20z90

Select the types of calibration to be performed (see Figure 10).

Enter the measured values for the types selected.

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

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

If the load is connected between Pack+ and Pack-, then select the *Use FETs* check box.

Press the *Calibrate Part* button.

9.3 Board Offset Calibration

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

Remove load/external voltage and short Pack- to Batt-.

Press the *CC Board Offset Calibration* button.

9.4 Pack Voltage Calibration

This calibrates the voltage at the AFE Pack pin.

Make sure *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.

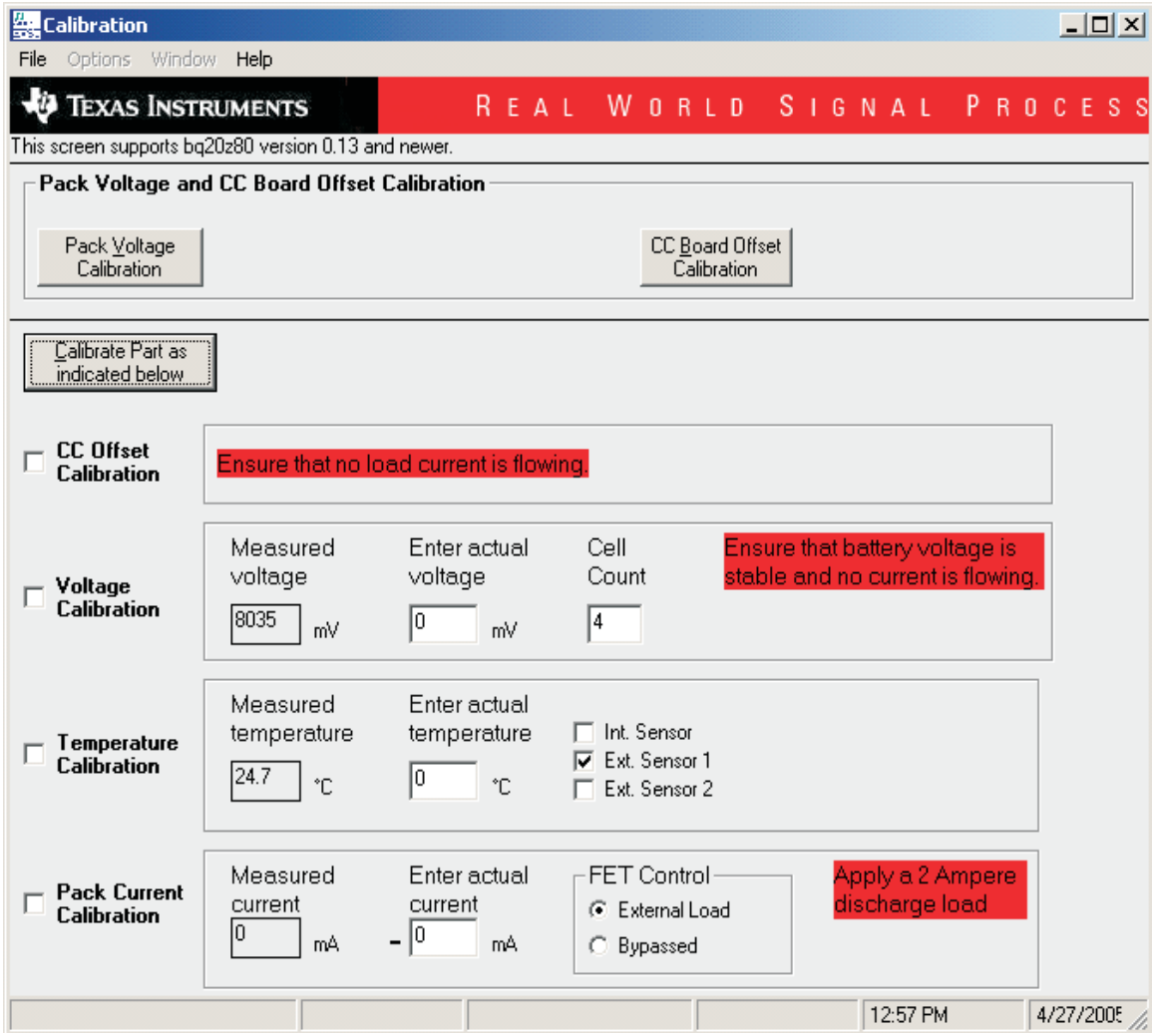


Figure 10. Calibration Screen

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 (Figure 11).

10.2 Hexadecimal/Decimal Converter

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

When scaling converted hexadecimal 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

This screen allows device reprogramming from unencrypted and encrypted files.

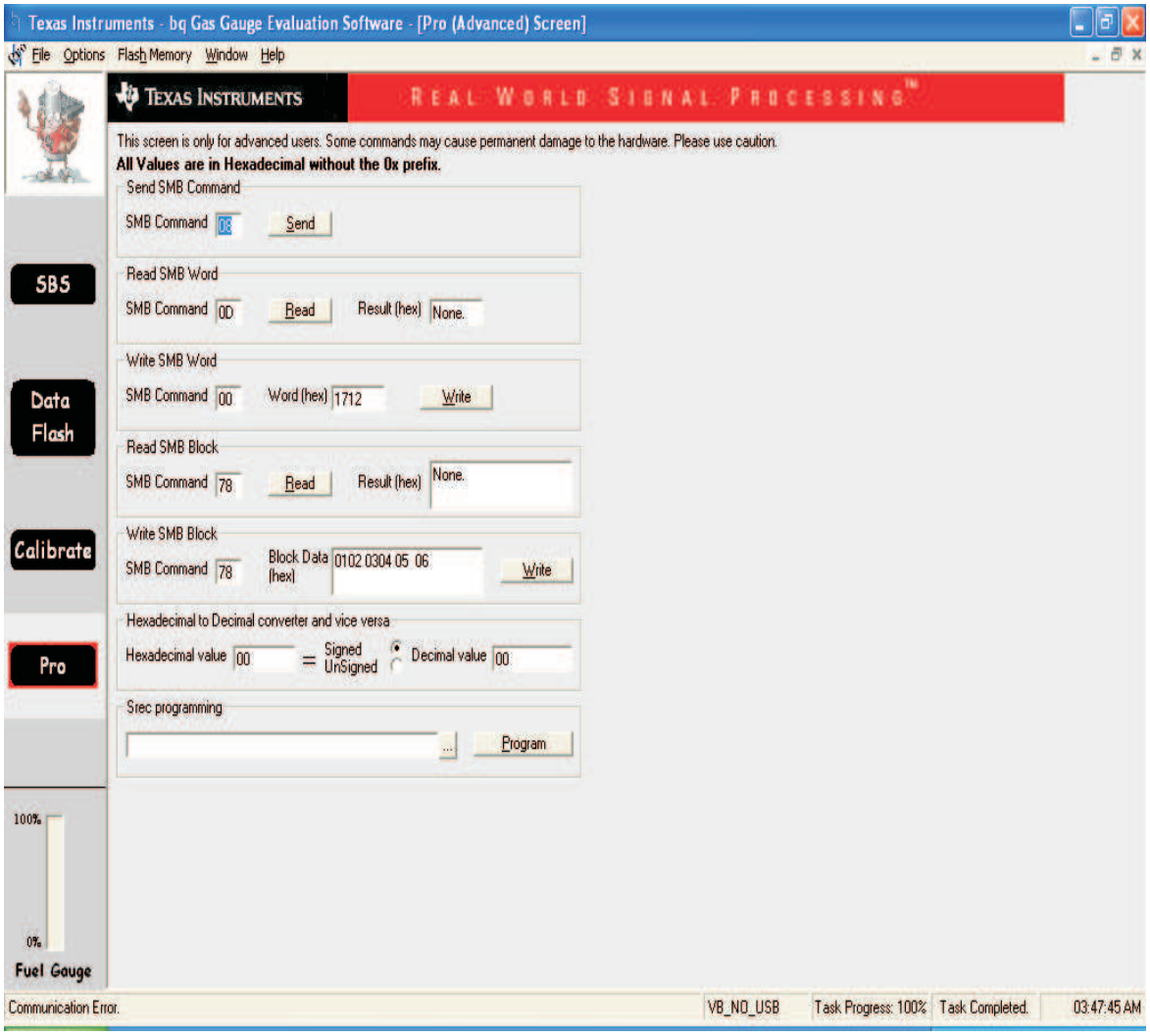


Figure 11. Pro (Advanced) Screen

Related Documentation from Texas Instruments

To obtain a copy of any of the following TI document, 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.

Data Sheets:	Literature Number:
bq20z90	SLUS662
bq29330	SLUS673

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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