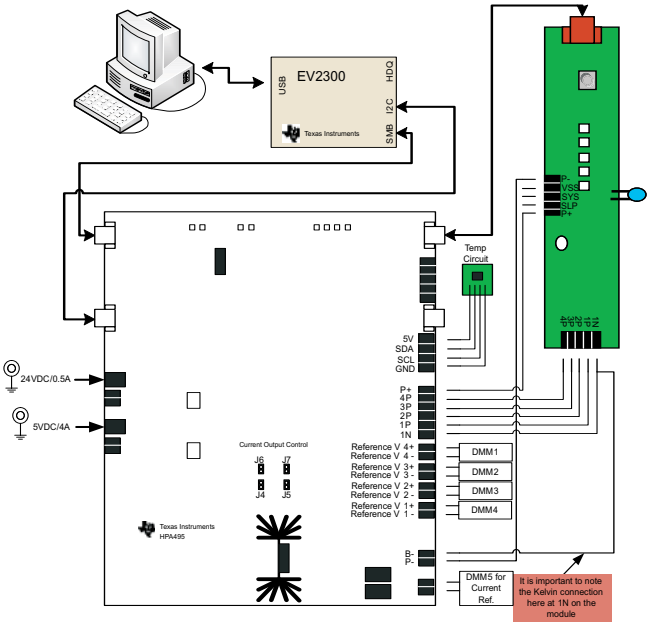
Advanced bqMTester

- **FEATURES**
  - Programs and Calibrates Smart Battery Modules Based on the Following Devices: bq306x and bq28xxx, and the Impedance Track™ devices bq20z4x, bq20z6x, bq20z7x, bq20z80, and bq20z9x
  - Calibrates Coulomb Counter Offset, Voltage, Temperature, and Current
  - Programs
    - Serial Number
    - Date
    - Pack Lot Code
    - Other Defaults Obtained from a *Golden* Image File
  - Provides Test Software Compatible with Microsoft® Windows® XP and 32-bit Windows 7
  - Preserves Calibration Records with its Data Logging Feature



Contents

Copyright © 2011–2020, Texas Instruments Incorporated

List of Figures

List of Tables

Trademarks

Impedance Track is a trademark of Texas Instruments.
Microsoft, Windows are registered trademarks of Microsoft Corporation.
All other trademarks are the property of their respective owners.

Copyright © 2011–2020, Texas Instruments Incorporated

1 Description

1.1 Introduction

The Texas Instruments Advanced bqMTester Multi-Station Test and Program Board is designed to calibrate and program electronic smart battery modules based on the latest Texas Instruments advanced battery gas gauges (bq306x, and bq28xxx, and the Impedance Track™ devices bq20z4x, bq20z6x, bq20z7x, bq20z80, bq20z9x). The bqMTester environment can support—on a single computer—up to a maximum of 12 calibration boards with each connected to an EV2300 communication board.

NOTE: For more information on the Advanced bqMTester program board and the Advanced bqMTester Software, go to the following Texas Instruments links:

Advanced bqMTester:
http://focus.ti.com/docs/toolsw/folders/print/advanced-bqmtester.html

NOTE: Do not use Texas Instruments' EVMs for production.

http://www.ti.com/legal/terms-of-sale/standard-evaluation-terms.html

1.2 Overview

- Programs and calibrates most smart battery modules based on the bq20zxx, bq306x, and bq28xxx. The newer software is compatible with the first generation HPA169 board; however, some devices are not. The table below shows the devices that the HPA169 and HPA495 supports, respectively:

	HPA169	HPA495
Devices Supported	bq20z4x, bq20z6x, bq20z7x, bq20z80, and bq20z9x	All devices supported by the HPA169, bq306x, and bq28xxx

- Calibrates coulomb counter offset, voltage, temperature, and current
- Programs serial number, date, pack lot code or manufacturer info block, and other defaults obtained from a Golden Image File
- Test software that is compatible with Windows XP and 32-bit Windows 7 operating systems
- Data logging feature preserves statistical records

2 Advanced bqMTester Requirements

2.1 Minimum System Requirements

2.1.1 Advanced bqMTester Multi-Station Tester

- Computer: PC or compatible
- Operating System: Windows XP or 32-bit Windows 7
- Minimum video resolution is 640 x 480. The recommended video resolution is 800 x 600 or above.
- One available USB port
- One EV2300 USB-based PC Interface Board for Battery Fuel Gauge Evaluation from Texas Instruments that includes the *USB Tester Ready* label. (This must be ordered separately.) The bqMTester software verifies the EV2300 (firmware version 3.1L or greater). For more information, see Section 4.2.2.
- One Texas Instruments HPA495 Advanced MTester Calibration Board
- Two SMBus connectors
- For Multi-Station support: 5 V/4 A and 24 V/0.5 A power supplies with isolated grounds (not included)
- 10 Mbytes of available hard drive space

Copyright © 2011–2020, Texas Instruments Incorporated

- Test software (to be downloaded from http://focus.ti.com/docs/toolsw/folders/print/advanced-bqmtester.html)
- Traceable Digital Multi-Meter (DMM) capable of measuring 2.5 A and 20 V accurate to less than 1 mv and 1 mA
- Traceable Temperature probe accurate to 0.1°C

3 Advanced bqMTester Environment

This is a brief explanation of the Advanced bqMTester software/hardware environment.

3.1 bqMTester: Hardware

The Advanced bqMTester requires the following:

- An HPA495 Advanced MTester Calibration Board
- Two wall DC power supplies (5 V/2.5 A and 24 V/0.5 A—each with isolated grounds, not included)
- Two SMBus connectors
- A user-supplied Test Head for every test station
- An EV2300 board (sold separately) for each station to be tested

NOTE: EV2300 boards prior to version 3.1L are not compatible with bqMTester. **StationSetup.exe** warns you if your EV2300 board is not compatible. All EV2300-HPA002 and all boards with USB Tester Ready (as shown in TBD, below right) are compatible.

3.1.1 bqMTester: Software Environment

The bqMTester software is a suite of programs that calibrates and tests modules in the devices listed in Section 1.2. There are four executable files, but only three are user-executable files. Of those three files, only two are needed for most applications: **StationSetup.exe** and **MultiStationTester.exe**.

- **MultiStationTester.exe:** The main test program for multi-station testing. This program can only be run after **StationSetup.exe** has been run. It requires the calibration board (HPA169/HPA495). This program's purpose is to coordinate background **bqTester.exe** functions and data. It initiates tests, handles priority conflicts, and processes and stores test statistical data received from **bqTester.exe**.
- **StationSetup.exe:** This is the setup program for **MultiStationTester.exe**. This program must be run prior to running **MultiStationTester.exe**. The EV2300/Temperature/Test Limits are configured using this program.

  TesterDFReader.exe: This program can read the data flash and write a ROM file (data flash image file) to be used by bqMTester software. In most cases, this program will not be used. bqEASY in the bqEVSW will generate the ROM file. If bqEASY is not compatible with the fuel gauge to be tested, refer to Appendix G. (For more information on bqEASY, see http://focus.ti.com/lit/ug/sluu278/sluu278.pdf.)
- **bqTester.exe:** This program is the backbone of the Multi-Station Tester. It performs all of the testing. **bqTester.exe** is a background object that is not visible when called by **MultiStationTester.exe**. There is an instance of **bqTester.exe** running for each EV2300 test station connected to the PC. The bqMTester (**MultistationTester.exe**) software calls on **bqTester.exe** to perform all the calibration and testing. All data from this testing is reported back to the Advanced bqMTester where it is displayed and logged.

  NOTE: Do not run the **bqTester.exe** as a standalone program. This is not supported and can cause unpredictable results. **bqTester.exe** executes in the background, supporting MultiStation Tester.

Copyright © 2011–2020, Texas Instruments Incorporated

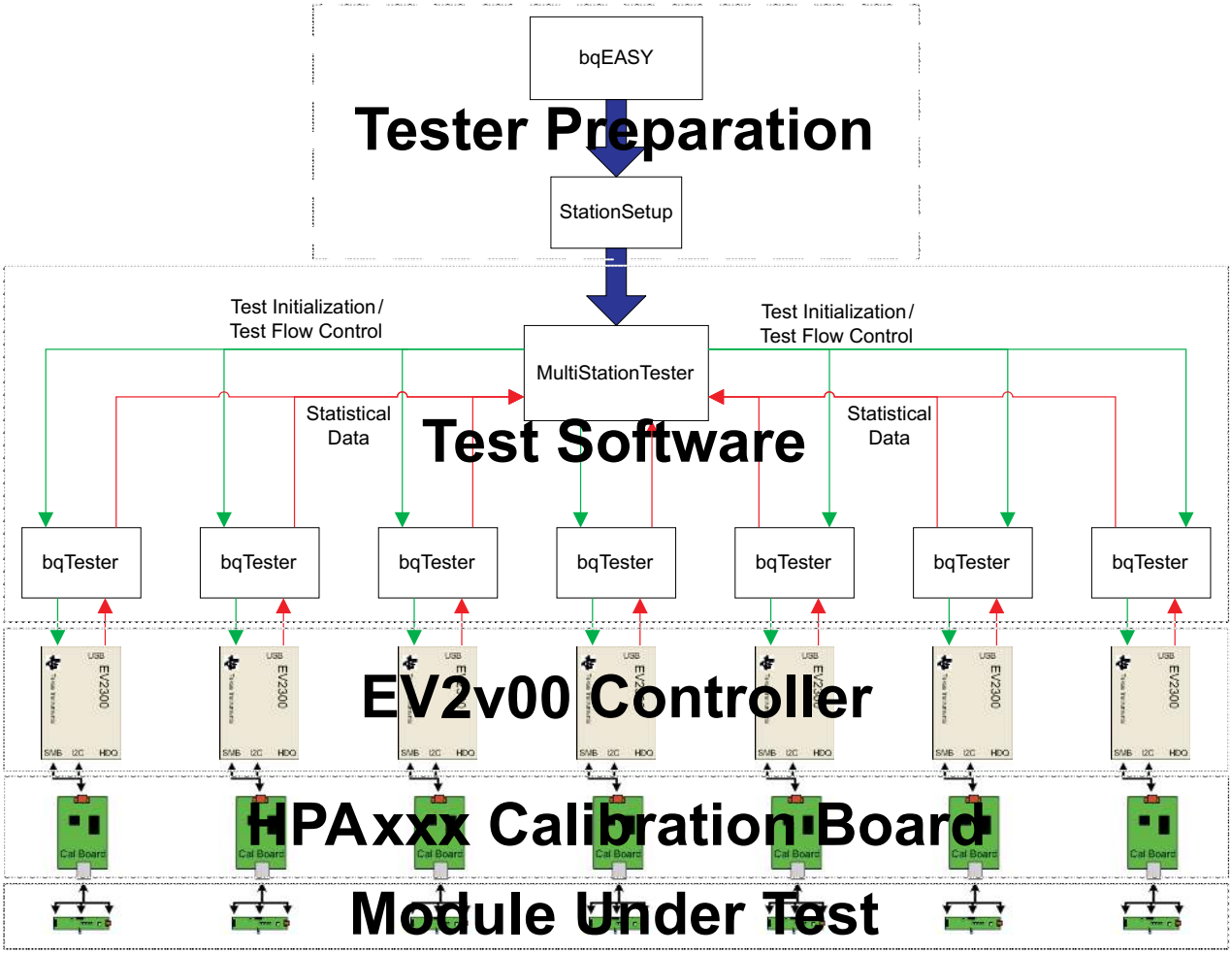


Figure 1. bqMTester Multi-Station Flow

4 Advanced bqMTester Instructions

4.1 Advanced bqMTester Functional Procedure

The Advanced bqMTester functional procedure is as follows:

1. **ROM File Generation:** Create ROM file using bqEASY in EVSW. If bqEASY is not available for your particular device, follow the procedure detailed in Appendix F to create the ROM file.
2. **Software Installation:** Install the software and drivers.
   - **NOTE:** Do not connect any EV2300s until the software is installed.
3. **EV2300 Driver to USB port Association:** Associate the EV2300 drivers to each USB port that will be used for the Advanced bqMTester.
4. **Station Hardware Connections:** Connect all stations (EV2300 and HPA495/HPA169) to the PC.
5. **Station Setup (StationSetup.exe):** Run the **StationSetup.exe** file.
   i. This program first detects all stations and request names for those stations.
   ii. Next, you will see the **Temperature Probe Setup** screen to assign individual temperature probes to each station.
   iii. The program then requests calibration-specific data and the location of the Golden Image File so that data can be installed in all gas gauge modules to be tested.
6. **Multi-Station (MultiStationTester.exe):** Finally, run the **MultiStationTester.exe** program. Here you

Copyright © 2011–2020, Texas Instruments Incorporated

will do the following:

i. Select the **Update VTI** screen to calibrate the HPA495 voltage, current, and temperature sources used to calibrate the modules.

ii. Start testing. Log data is displayed on the log screens and stored to a file (as setup in Step 3 of this section).

4.2 Detailed Instructions

This section describes the entire process of setting up the bqMTester software and hardware for a single station and a Texas Instruments bq20zxx EVM. It is recommended to start with *one* station and the Texas Instruments EVM to prevent setup complications. Once the setup for one station and the Texas Instruments EVM is complete, the process can be repeated with your fuel gauge and multiple stations.

4.2.1 Generate ROM File

NOTE: The ROM file is programmed into every device that uses the Advanced bqMTester, so it is very important that it is done correctly.

Create the ROM file using bqEASY in bqEVSW. If bqEASY is not available for your device, use the flow detailed in Appendix F to create the ROM file. It is recommended to use bqEASY whenever possible to generate the ROM file because it reduces the chances of mistakes in this very critical process.

The ROM file is a data flash image file. It has two parts.

1. Header information that includes the fuel gauge type and firmware version. This is used by bqMTester to protect against programming an incompatible data flash image into a fuel gauge, which could permanently damage the fuel gauge.
2. A binary image of the entire data flash. It does not include the firmware image, only the data flash. This cannot be used to reprogram firmware into a fuel gauge.

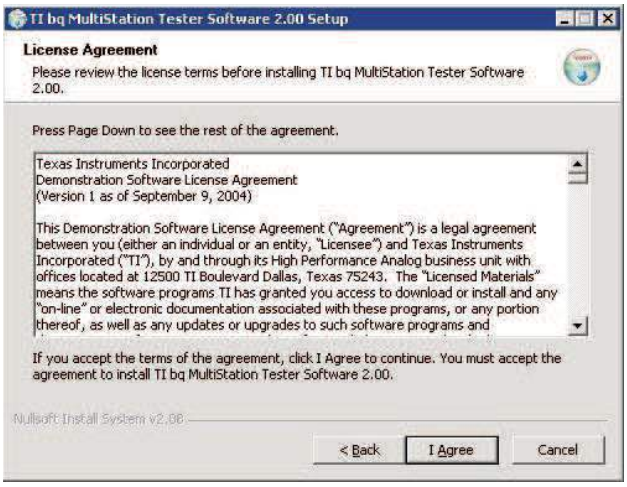
4.2.2 Software Installation

The **TIbqMultiStationNB2.00Setup.exe** file installs all required software, drivers, and DLL files for proper software operation. To install the software:

1. *Do not* connect any EV2300s to the PC before installing software. If any are connected, disconnect them now.
2. Download software from the bqMTester page on the www.ti.com web site.
3. Unzip the file downloaded in Step 2. Double-click **TIbqMultiStationNMx.xxSetup.exe"** ("x.xx" depends on the software version).

4. Click **Next** at the welcome screen.

Copyright © 2011–2020, Texas Instruments Incorporated



5. If you agree with the terms, click **I Agree**; otherwise, click **Cancel** and exit the installation software.

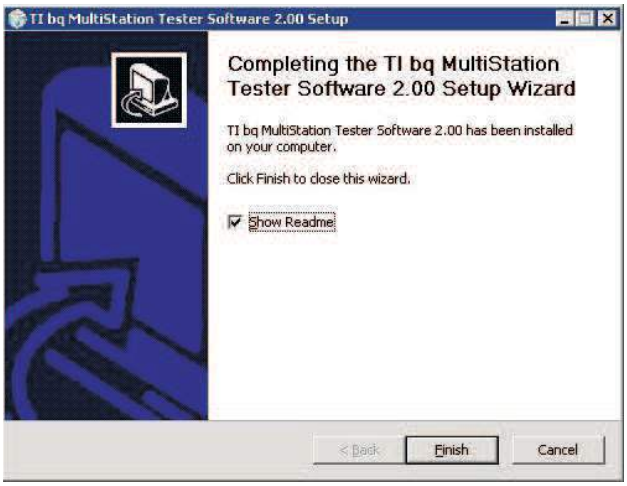
6. Click **Next** at the **Choose Components** screen (there is only one option for the bqMTester installation).

7. Choose the **Start Menu Folder** where you would like to install the bqMTester associated shortcuts. *Texas Instruments* shows as the default destination. Click **Install**.

Copyright © 2011–2020, Texas Instruments Incorporated

NOTE: If at any time you are asked to reboot, click **No** and continue.

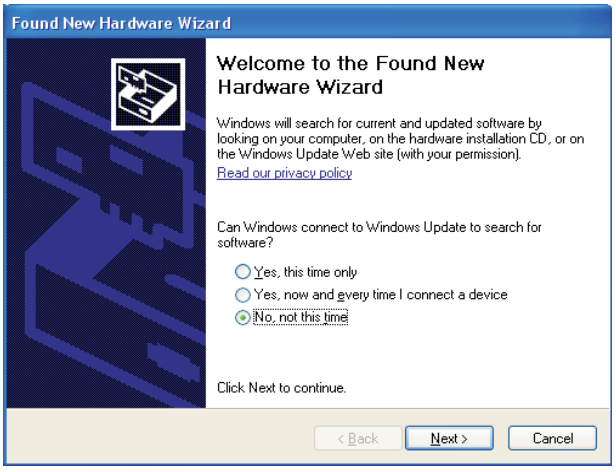
8. When the software installs, click **Finish** to exit the software installation process.



All bqMTester software is now installed on the PC. Now, the EV2300 drivers need to be associated with the USB ports that will be used with bqMTester software, as described in the following section.

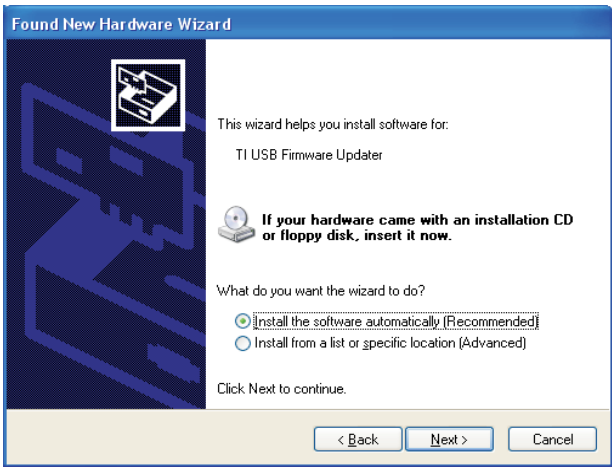
4.2.3 EV2300 Driver to USB Port Association

There are two drivers associated with the EV2300. An instance of the two drivers must be associated with each EV2300 connected to the bqMTester PC through any USB port. In other words, each USB port that has an EV2300 connected to it must have an additional instance of the two EV2300 drivers. That means for 12 Advanced bqMTester stations, there will be a total of 24 drivers running at the same time. If an EV2300 is connected to the bqMTester PC and the PC detects that it has not had an EV2300 connected to that particular USB port, then the computer requires the following procedure to associate a copy of the drivers for that USB port. To associate an instance of the EV2300 drivers to any given USB port, do the following:

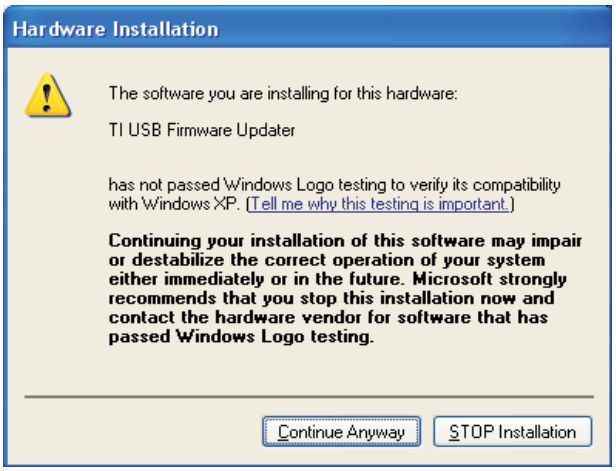


1. Connect an EV2300 to the bqMTester PC. After a few seconds, the **Found New Hardware** screen appears. Select **No, not this time** and click **Next**. If the first screen that appears does not look like this screen, then proceed to the next step. All of the following driver screens will only appear if the EV2300 driver has not been previously installed on the system. Connect an EV2300 to bqMTester PC. The system acknowledges the EV2300 if drivers were previously installed. The Microsoft USB host plug manager announces installation with a tone.

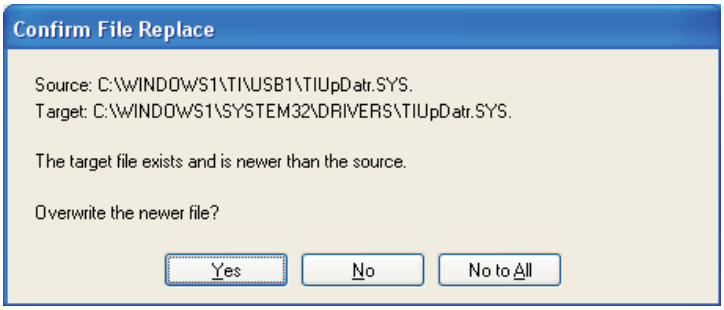
Copyright © 2011–2020, Texas Instruments Incorporated



2. On the next **Found New Hardware** screen, select **Install the software automatically (Recommended)** and click **Next** for the first of the two drivers (TI USB Firmware Updater) required for this instance of the EV2300.

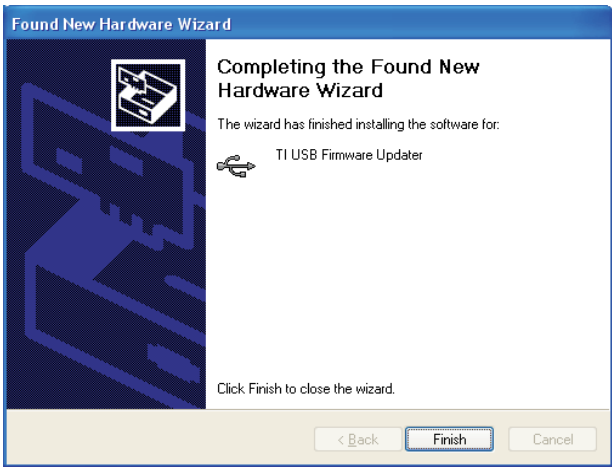


3. Click **Continue Anyway** on the Windows Logo Testing notification on the **Hardware Installation** screen.



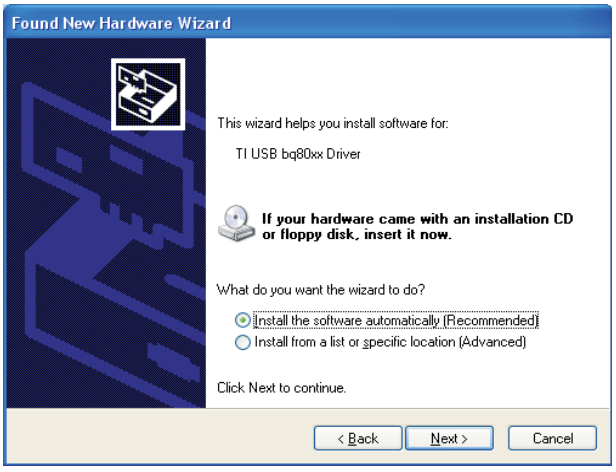
4. It is common for the next screen to be the **Confirm File Replace** screen. Click **No** to continue. If this screen does not appear, then go to the next step. (This screen only appears if the computer has previously installed the USB driver.)

Copyright © 2011–2020, Texas Instruments Incorporated



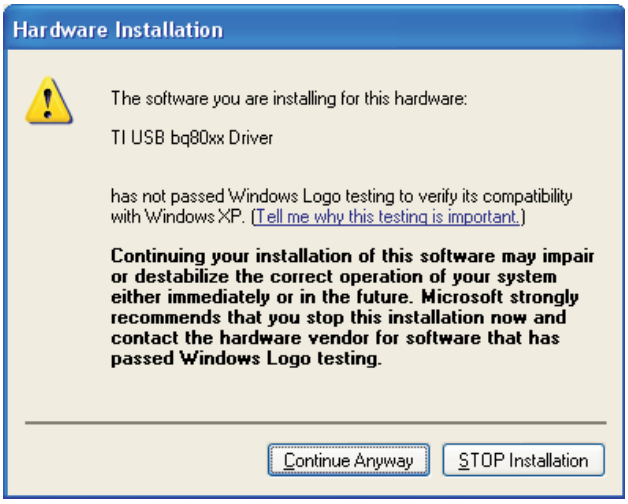
5. The TI USB Firmware Update driver is now installed for this instance of the EV2300. Click **Finish** to exit this **Found New Hardware Wizard**.

6. After a few seconds, another **Found New Hardware Wizard** screen appears to start the installation of the final driver for this instance of the EV2300. Select **No, not this time** and click **Next**. If the screen that appears does not look like this screen, then proceed to the next step.

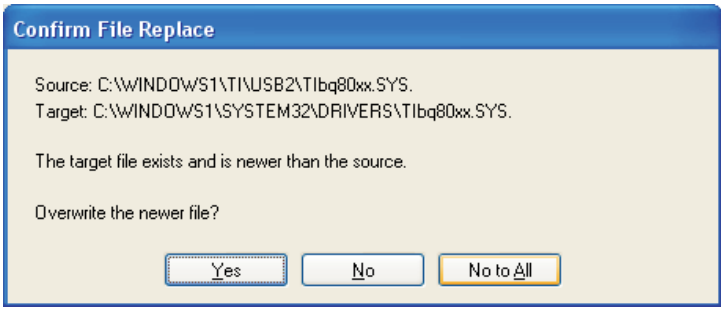


7. Select **Install the software automatically (Recommended)** and click **Next** on the next **Found New Hardware Wizard** screen for the second of the two drivers (TI USB bq80xx Driver) required for this instance of the EV2300.

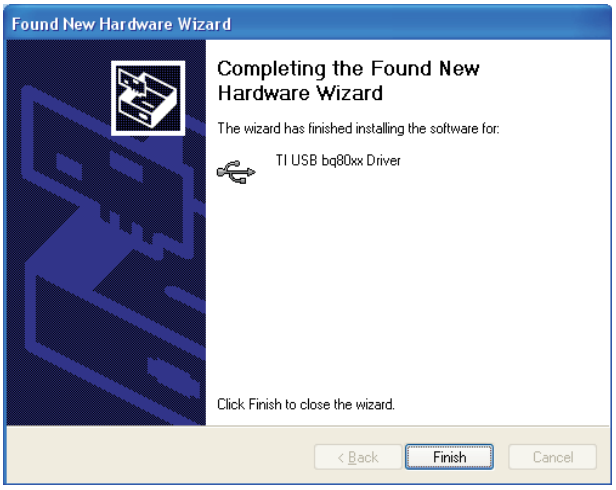
Copyright © 2011–2020, Texas Instruments Incorporated



8. Click **Continue Anyway** on the *Windows Logo Testing* notification on the **Hardware Installation** screen.



9. It is common for the next screen to be the **Confirm File Replace** screen. Click **No** to continue. If this screen does not appear, then go to the next step.



10. The TI bq80xx Driver is now installed for this instance of the EV2300. Click **Finish** to exit this **Found New Hardware Wizard**.

At this point, the installation of one instance of the EV2300 on one USB port is complete. To install more EV2300 boards to the bqMTester PC, repeat the installation process detailed in Step 1 in this section for every instance of each EV2300 board required.

Copyright © 2011–2020, Texas Instruments Incorporated

The driver installation process of each instance of the EV2300 boards should only be done one time. After the initial installation, the only reason it would be required to repeat the process is if the orientation between the USB ports and EV2300 boards changes. This could happen if a USB hub position is changed, a USB hub is installed, or if an additional EV2300 is installed. USB hubs can be used to accommodate stations for the bqMTester.

NOTE: It is recommended not to exceed seven EV2300/Test Stations per USB hub, and USB hubs cannot be nested. Stations will not install with nested USB hubs. It is also recommended that the USB hub be USB 2.0-compliant and capable of 1.0 A of output current. Operating power for each EV2300 is supplied by the hub.

4.3 Station Hardware Connections

The bqMTester requires that the latest version of the EV2300 interface from Texas Instruments be installed and running properly. These instructions explain connecting an HPA495 bqMTester board.

Both SMB and I^2C connections are required between the EV2300 and HPA495 for all devices that use SMB protocol (shown in Figure 2). All four pins—VOUT, SDA, SCL, and GND—on the I^2C connector of the EV2300 should be connected to the calibration board I^2C connector.

CAUTION

It is very important that the two ground connections connected to 1N of the module under test be connected as close to the BAT– Kelvin connection as possible. This connection is critical to ensure accurate voltage calibration.

Connect an isolated 5 V/2.5 A wall DC power supply to the bottom power connector, and an isolated 24 V/0.5 A wall DC power supply to the top power connector.

CAUTION

It is very important that these power supplies be ground isolated. There should be no ground plug on the wall connection. An example of good supplies are:

24-V supply: CUI Inc model no. EUA-101W-24
5-V supply: CUI Inc model no. EPA-201DA-05

The jumpers on the HPA495 bqMTester board are only for setting up the desired current for the current source. There are three options available:

Current (Approximate)	Jumpers
0.5 Amps	J4, J5, J6, J7
1.0 Amps	J4, J6
2.0 Amps	None

Copyright © 2011–2020, Texas Instruments Incorporated

While the HPA495 Calibration Board includes an on-board temperature sensor, it is recommended that you use external temperature sensors for the most accurate temperature calibration. For an external temperature sensor, use the TI TMP100 (not supplied) and connect as shown in Figure 3. The software distinguishes between the on-board temperature sensor and any external temperature sensor.

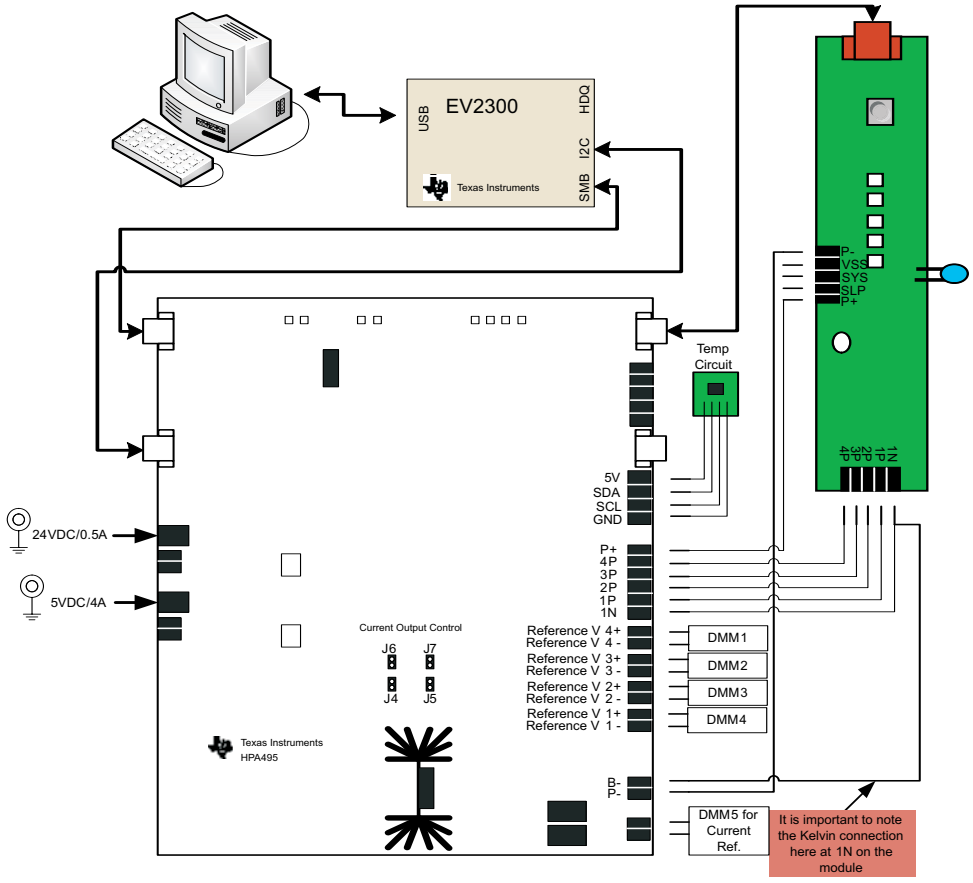


Figure 2. One Testing Station: EV2300/HPA495 Cal Board/Smart Battery Module Connections

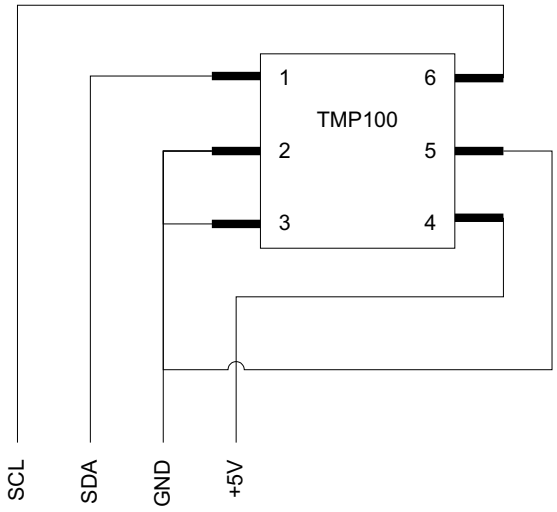


Figure 3. External Temperature Sensor Connection

Copyright © 2011–2020, Texas Instruments Incorporated

4.4 Station Setup (StationSetup.exe)

NOTE: For the first run through the installation procedures, use only one station. You can install up to 12 stations, but ensure the first station is running properly and then repeat the procedures for each subsequent station.

When setting up for the first time or adding testing stations to the PC, run the **StationSetup.exe** program to identify and setup the configurations for all the test stations connected to the PC. Follow these steps to prepare all stations:

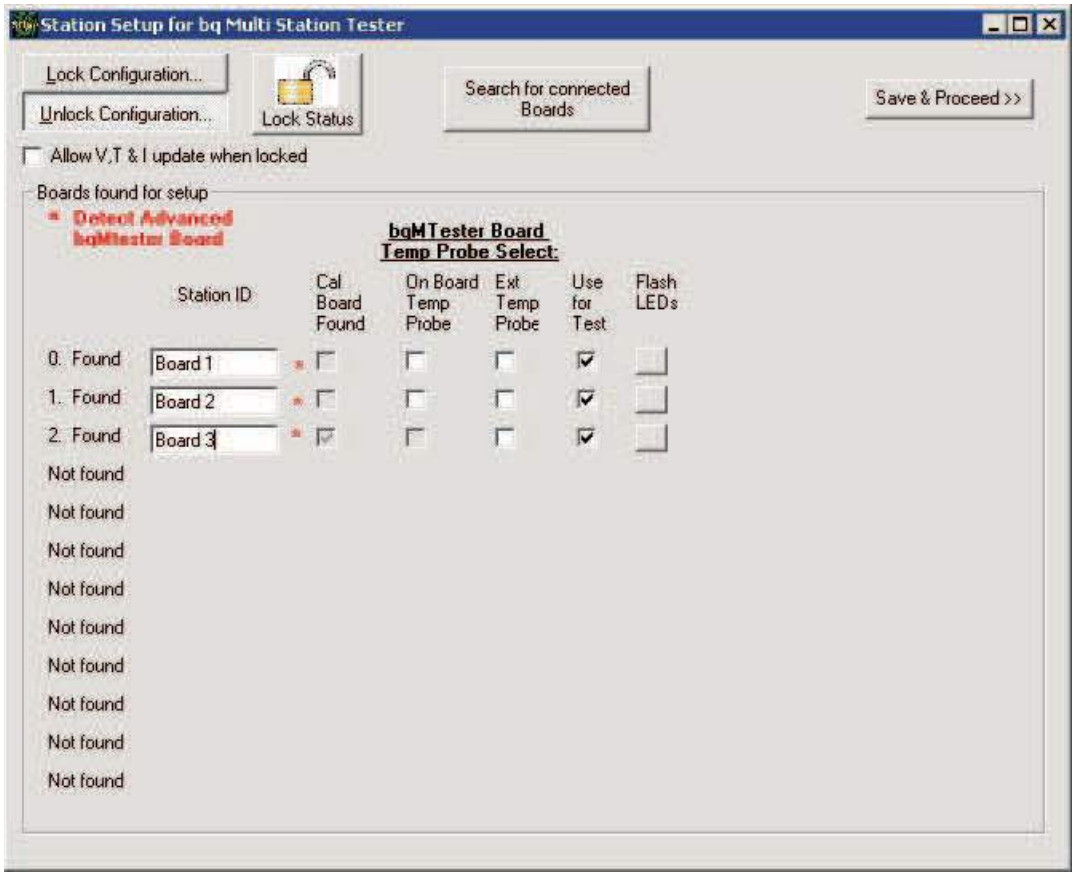


Figure 4. Station Setup Program

NOTE: Do not use two generations of boards at the same time: Use either a new board, HPA495, or an old board, HPA169, in a setup. Do *not* use the two together.

1. Once you have connected the first station as described in the previous section, run the **StationSetup.exe** program.
2. To unlock the **StationSetup.exe** program, click **Unlock Configuration**. You will be prompted to input a password. The default password is *bq20z80*. Click **OK** next to the password input field after typing the password. When relocking the software, you will be prompted to change the password.
3. Click **Search for Connected Boards** so the software can detect all the stations you have connected to the PC. The software will detect and display all stations connected to the PC. If a textbox appears with a message saying *Detected EV2300* with an old firmware version, update the EV2300 to a version 3.1L or later. If required, contact TI for assistance.
4. Note the asterisk (*) next to the board fields. An asterisk indicates that the board is an HPA495/Advanced board as opposed to the older generation HPA169 board.
5. Type a unique text name in the **Station ID** field to help identify each station. Use a simple name.

Copyright © 2011–2020, Texas Instruments Incorporated

6. Select which stations will have their internal or external temperature probes available for use for calibration by clicking the **On Board Temp Probe** or **Ext Temp Probe** checkbox. If neither internal nor external temperatures are selected, then that station will be required to either use a temperature probe from another station or manual input of the temperature.

NOTE: These selections are not to be confused with the temperature sensors that are part of the fuel gauge module being tested. These are part of the HPA495 test/calibration equipment.

7. Select the **Use for Test** checkbox to enable a station for use during testing. If the **Use for Test** is de-selected, then that station will be disabled and will not perform testing. A disabled station's temperature probe will be available to other stations; however, if it is selected from Step 5 in this section.
8. Clicking **Flash LED** for each station causes the corresponding calibration board to flash its LEDs and enable the current and voltage power supplies. This is useful for testing the power supplies and for identifying the corresponding hardware for each station.
9. Click **Save and Proceed**.

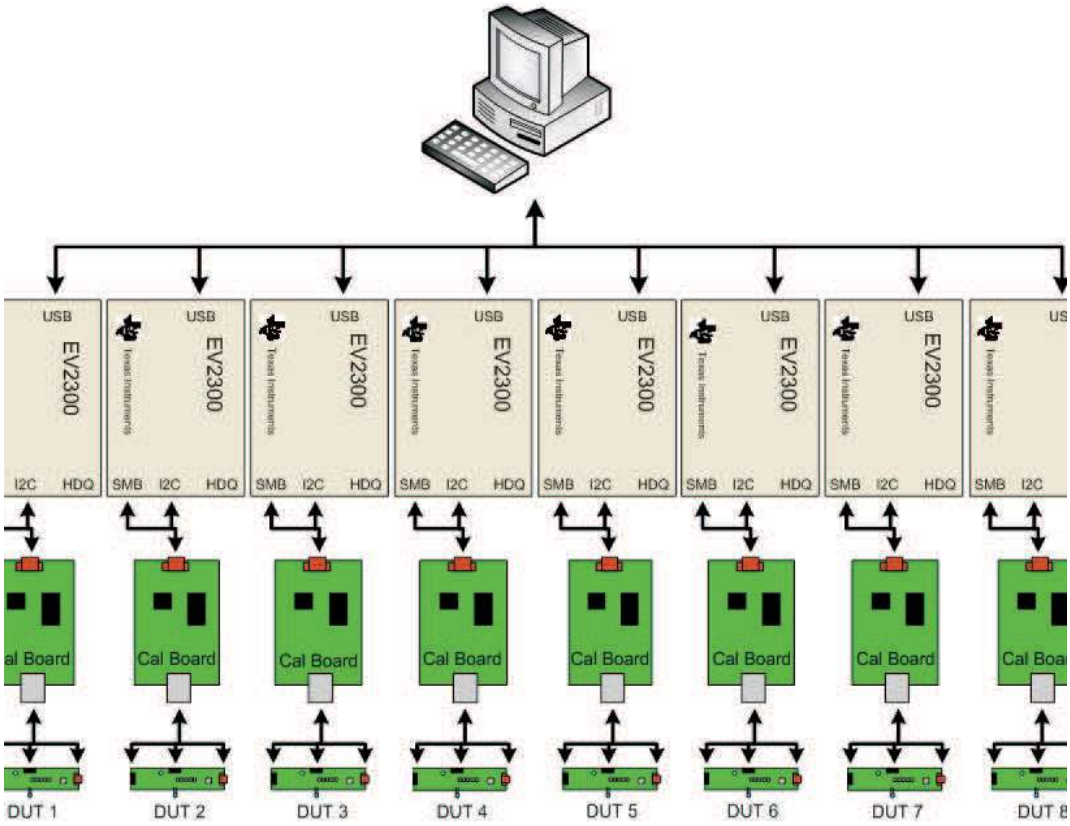


Figure 5. Multi-Station Setup

4.5 Temperature Probe Selection

Clicking **Save and Proceed** brings up the **Temperature Probe Selection** window. This window is used to configure the temperature probes. For each station, you can select either of the following options:

1. "No Tracking – Use entered value."
2. Any on-board or external temperature probe that is selected at station setup stage (the **Use for Test** checkbox must be checked for that station, see Figure 4) will be available in the drop-down box menu list.

For example:
If only one temperature probe is required for all channels, and it is to be an external temperature sensor and not the one installed on the calibration board for a station named *Station1*, you would do the following:

Copyright © 2011–2020, Texas Instruments Incorporated

1. Start the **StationSetup.exe** program.
2. Unlock and click **Search for boards**.
3. Name all of the stations using a unique Station ID but name one station *Station1* so that it can be referenced in the next couple of steps.
4. Select the *Ext. Temp Probe* checkbox for *Station1*. All other stations select *On Board Temp Probe*.
5. Select the *Use for Test* checkbox for *Station1* and all other stations.
6. Click **Save and Proceed**.
7. On the **Temperature Probe Selection** screen, select *External Probe: Station1* for all the stations available in the list.
8. Click Next.
9. Configure the global screen as described in Section 4.6.

Now all stations will use the probe connected to the *External Temperature Probe Terminal Block* for the station named *Station1*.

4.6 Global Configuration Window

Clicking the **Next** button from the **Temperature Probe Selection** window brings up the **Global Configuration** window, as shown in Figure 6. Here, all data that is *Global* to all stations connected to the PC can be configured. All numeric values are specified in signed decimal except for the serial number field, which is unsigned with a max value of 65535.

NOTE: If you do not select items such as **CC Offset Calibration**, **Temperature Calibration**, **Voltage Calibration**, or **Pack Current Calibration**, the respective frames in this window are grayed out for ease of use.

Copyright © 2011–2020, Texas Instruments Incorporated

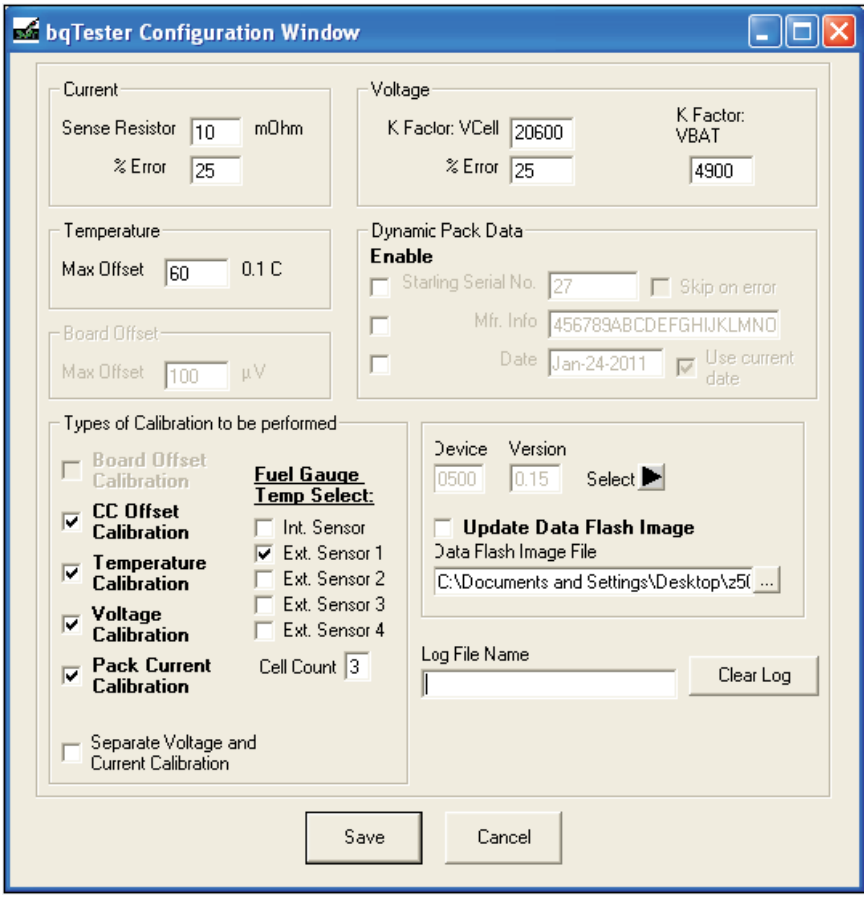


Figure 6. Global Configuration Screen

4.6.1 Board Offset Calibration

Board Offset Calibration is activated depending on which device is selected. Some devices do not support Board Offset Calibration for each module tested. If activated, this option is used to check for board offset values within user configurable limits. The software automatically computes the board offset in microvolts for the cases where it is activated and enabled. You can change these values, if needed.

4.6.2 CC Offset Calibration

CC Offset Calibration is the coulomb counter offset. There are no user-definable values in this box. This calibration can be selected by checking the box or deselected by unchecking the box. The default is that the box is checked.

NOTE: If this test is disabled, the values from the Golden Image File will be used and not the values currently in the part.

4.6.3 Voltage Calibration

Voltage Calibration can be selected by placing a check in its selection box, or deselected by removing the check. The default is checked. The voltage calibration area also has a box to enter the number of series cells being simulated. The default number of cells is four. If this checkbox is not selected, the corresponding voltage frame is grayed out.

Copyright © 2011–2020, Texas Instruments Incorporated

NOTE: If this test is disabled, the values from the Golden Image File will be used and not the values currently in the part.

4.6.4 Temperature Calibration

Temperature Calibration can be selected by placing a check in its selection box, or deselected by removing the check. The default is checked. The temperature calibration area also offers three different temperature probe selections or five different temperature probe selections for some devices. The proper selections should be made depending on the application.

NOTE: If this test is disabled, the values from the Golden Image File will be used and not the values currently in the part.

4.6.5 Pack Current Calibration

Pack Current Calibration can be selected by placing a check in its selection box or deselected by removing the check. The default is for it to be checked. *On (External Load)* should always be selected (this configuration is the default). **Off (Bypassed)** should never be selected and is only included for possible future use.

NOTE: If this test is disabled, the values from the Golden Image File will be used and not the values currently in the part.

4.6.6 Board Offset Frame

This frame will be grayed out if not selected in the **Type of calibration to perform** frame. Due to simplified single ground circuit design, a separate board offset is required for each device. The board offset calibrates all the errors that the CC Offset does not calibrate out. This includes the board layout, sense resistor, and other offsets that are external to the board. The max offset value is auto-populated by the software and can be changed. The board offset frame value is in µV and defaults to 100 µV for most parts. In the unlikely event that there is a great number of calibration failures due to board offset calibration, you can loosen the constraints for board offset calibration. Contact TI for questions on how to do this, if required.

4.6.7 Current Frame

This frame is grayed out if it is not selected in the **Type of calibration to perform** frame. This frame contains two values:

1. **Sense Resistor:** Enter the value of the sense resistor used in the gas-gauge–based smart battery pack in the **Sense Resistor** field. This value is entered in units of mΩ. The sense resistor value can be found from the EVM schematic.
2. **% Error:** Enter the desired acceptable percent error that the sense resistor can differ from the value listed in the **Sense Resistor** field in the **% Error** field. This **% Error** field is used as a rough test to make sure the sense resistor is mounted correctly and not shorted. After the bqMTester calibrates the Sense Resister gain value, then it compares the new calibration value to what is in the **Sense Resistor** field. If the percent difference between the two values is more than 25% then it fails the calibration because it assumes something must be grossly wrong to get a value more than 25% from the nominal **Sense Resistor Value**. This value must be specified as a positive integer value.

NOTE: The default value for this field is 25%. The value of 25% may seem like a large number, but this value is not related to the calibration accuracy to which the bqMTester calibrates. That calibration is highly accurate.

Copyright © 2011–2020, Texas Instruments Incorporated

4.6.8 Voltage Frame

This frame will be grayed out if not selected in the **Type of calibration to perform** frame. This frame contains two values:

1. **Reference/FSV:** The tester calibrates the voltage gain by manipulating the Full Scale Voltage Reference. Do not change the values in this field. The **Voltage** frame looks the same for most of the parts, except for the bq306x. For bq306x device-based parts, extra K-factor fields appear. The frame for K-factor–based parts are shown in Figure 7.

Figure 7. Reference/FSV and K-Factor Fields

2. **% Error:** The **%Error** field is used as a rough test to check the Voltage Measurement Circuitry. After the bqMTester calibrates the voltage gain, then it compares the new calibration value to what is in the **Reference/FSV** field.

4.6.8.1 Limit to Force the Voltage Calibration

If the percent difference between the two values is more than 25%, then it fails the calibration because it assumes something must be grossly wrong to get a value more than 25% from the nominal. As shown in Figure 7, bq306x device-based parts show limits to voltage calibration in ±mV. In this case, if the voltage read by the device is within this limit, no calibration is done. Precious time is saved (~4s) during calibration if voltage calibration can be avoided. In the case where voltage calibration is always needed, a 0 can be entered in this field.

4.6.9 Temperature Frame

The **Temperature** frame will be grayed out if not selected in the **Type of calibration to perform** frame. This frame contains one value. Enter the maximum absolute value of offset that the bqMTester software will be allowed to put into any of the data flash temperature offset registers for the tested module. This is not an accuracy verification. This is a gross Error detection. The default value of this field is 40, meaning that the calibrated offset put in the data flash cannot exceed positive or negative 4°C. For internal Temperature Sensor calibration, it is recommended to increase this value because the internal temperature sensor offset accuracy commonly exceeds 4°C.

4.6.10 Starting Serial Number

Enter the value for the serial number of the first smart battery module to be tested. This number will be incremented by one as each new module is tested. If **Skip On Error** is checked, the number will not increment in the case of a module that fails the test. The default for this box is 1. This value must be specified as a positive integer value.

4.6.11 Date

Enter the value for the desired date to be programmed into the smart battery module. If **Use Current Date** is checked, the system date from the PC running the bqMTester software will be used.

4.6.12 Log File Name

Enter the complete path and file name to be used for the log file. This file contains all relevant test data for each smart battery module tested. If **Clear Log** button is clicked, the log file contents will be deleted.

4.6.13 Pack Lot Code or Manufacturer Info

Enter the value for the Lot Code of the group of smart battery modules currently being tested. This number will not change until it is changed manually and will be programmed into each smart battery module tested. This value must be specified as a positive integer value.

Copyright © 2011–2020, Texas Instruments Incorporated

4.6.14 Save

Clicking **Save Configuration and Proceed** will cause the current configuration settings to be saved.

4.6.15 Data Flash Image File

Input the location of the Golden Image File that will be stored in all parts to be tested when running the **bqMTester.exe** program. Clicking the browse () button gives the option to browse for the Golden Image File. If the **Update Data Flash Image** checkbox is not checked, then no data flash image will be installed in any parts. It is always recommended that an Image file be used.

4.6.16 Device and Version

Use the select () button to select the proper device and firmware version of the modules to test from the dialog box that appears. If the device or version are not available, check the Texas Instruments web site for an updated version of the bqMTester software on the bqMTester page on www.ti.com.

4.6.16.1 Adding New Parts

For special/custom parts, it is possible that the device can be added to the file that holds all allowed parts compatible with bqMTester. Using this option is sometimes tricky. It is recommended that TI be contacted before using this option to ensure that the bqMTester has been tested with the requested device. The file to be edited is called *Targets* and is located in the directory where bqMTester is installed. If this file is modified, it is advised to thoroughly test it before it is deployed to manufacturing.

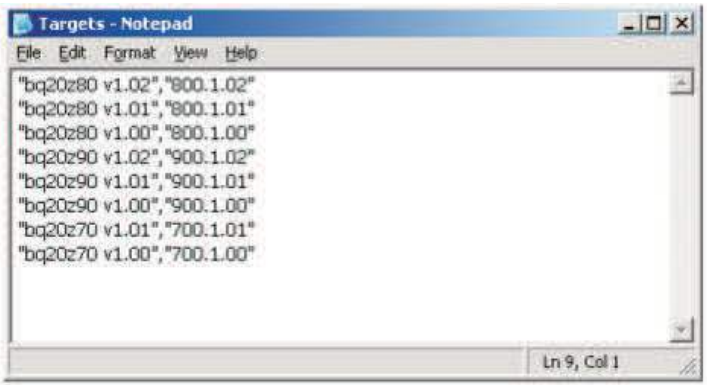


Figure 8. Example Targets File

NOTE: When using this option, carefully verify that some modules are tested and calibrated with bqMTester software for accuracy and DF compatibility. This software is not designed for production. It is the responsibility of the user to make sure that bqMTester is compatible with the custom device.

4.7 Multi-Station (bqMultiStationTester.exe)

To start testing modules, run the **MultiStationTester.exe** file. This brings up the main Multi-Station Tester window. This window keeps track of all tests at each station, then logs and displays the information from the stations that were initialized and setup in Section 3 of this document.

When the software opens, the **Start** button is disabled by default until the voltage, current, and temperature of all the references are verified by clicking on the **Configure VTI** button. The purpose of this is to secure the configuration via engineering approval prior to testing modules and as a reminder to ensure that the reference data is accurate before allowing testing.

Copyright © 2011–2020, Texas Instruments Incorporated

NOTE: Note that the **Configure VTI** button is disabled if no VTI items have been enabled in the Station Setup.

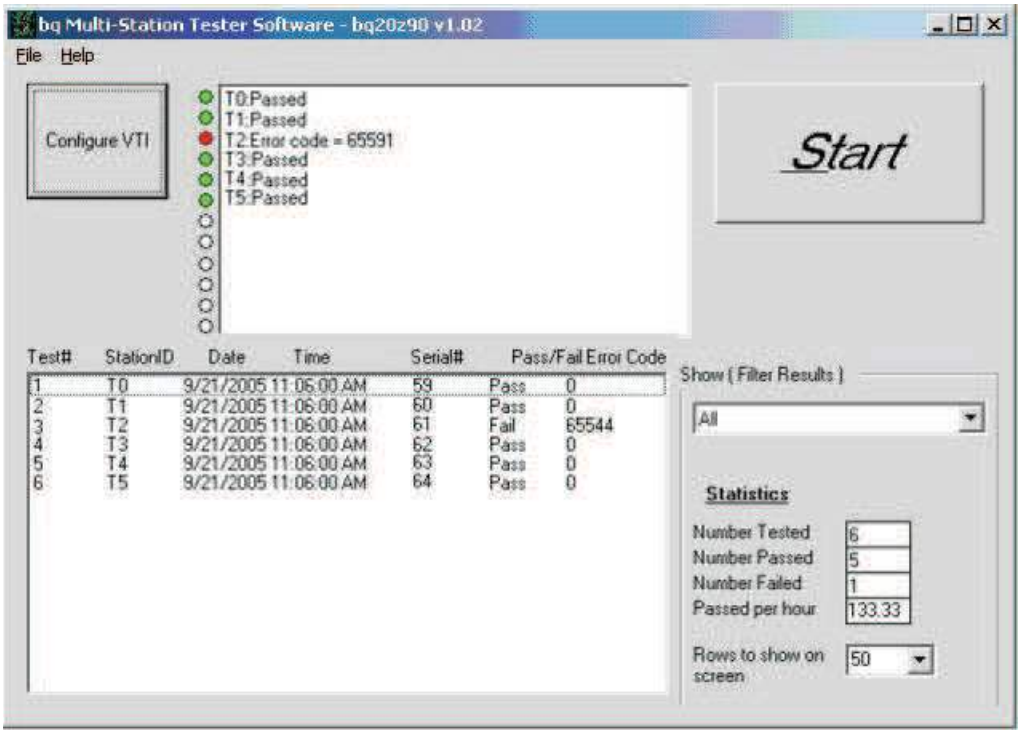


Figure 9. Multi-Station Tester Window

4.7.1 Verifying the V, T, I Configuration

First, click on **Configure VTI**. The **Update VTI** window will pop up as shown in Figure 10. If “Allow V, T, I while locked” is not selected then the *Unlock Configuration* button must be pressed to allow voltage, temperature, and current reference adjustment. If no calibration is selected in the **StationSetup.exe** program, then this button will not be visible and the software is only a DFI writer.

Copyright © 2011–2020, Texas Instruments Incorporated

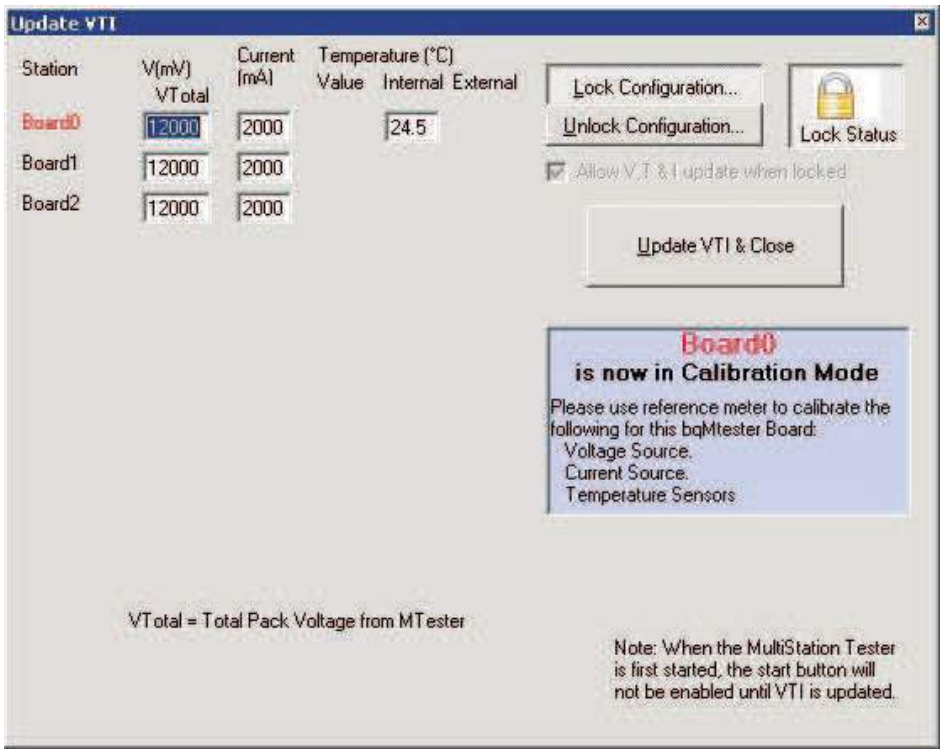


Figure 10. Update VTI Window

As you can see above, this is the calibration screen for a regular device. Selecting the appropriate control flashes the board in calibration. In this case, Board 0 is calibrating (and should be flashing).

The new board HPA495 supports multiple devices, some of them K-factor–based, as described in previous chapters. The calibration for the K-factor–based parts (bq30xx) is done differently and the **Update VTI** screen looks different, as shown in Figure 11.

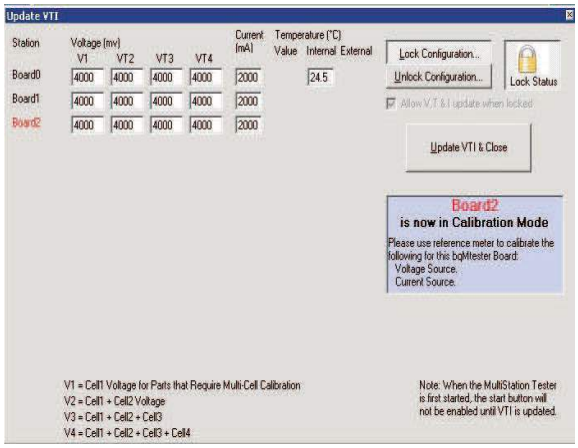


Figure 11. Update VTI

For the K-factor–based parts (bq30xx), the individual voltages must be calibrated. The new HPA495 board has individual voltage outputs based on the selected configuration. The **Update VTI** screen displays the corresponding controls. Individual control is possible depending on if the K-factor is selected.

Copyright © 2011–2020, Texas Instruments Incorporated

Also, depending on items selected in the StationSetup Program, the **Update VTI** screen is populated accordingly. As seen in Figure 12, there is only one difference between the previous and following setups. The following setup does not have **Voltage** selected in the StationSetup Program; thus, the voltage controls are not populated during calibration.

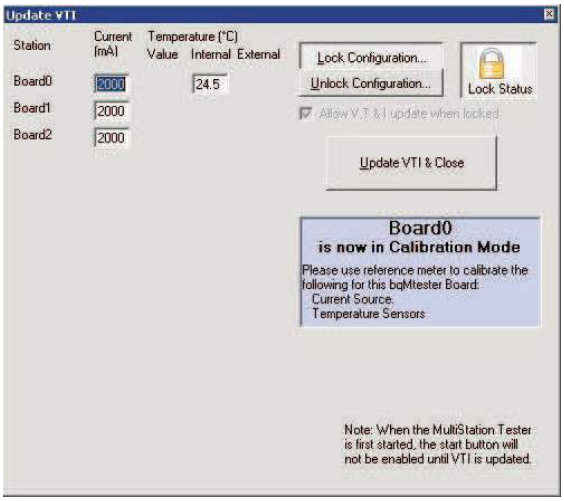


Figure 12. Update VTI: No Voltage Selected

4.7.2 Reference Adjustments

Once unlocked, the references can be adjusted as required. When any field is selected in a particular station row, the LEDs for that station flash and the voltage and current power sources power up.

To calibrate the references, use the following process:

1. Measure the voltage for the first station by connecting a traceable DMM to the *Reference V Meter +* and *Reference V Meter –* connections (as shown as DMM1 in Figure 2) to measure the actual voltage of the cell simulation voltage supplied by the calibration board for the first station. Input this voltage in the **Voltage** column for the first station. Repeat this step for each remaining station.
2. Setup the DMM for current measuring, and connect the DMM to *Reference I Meter +* and *Reference I Meter –* (as shown as DMM2 in Figure 2) for the first station being setup. Be sure to disconnect the wire that shorted these two connections so that current flows through the meter. Input the current measured in the **Current** column for this station. Repeat this step for each remaining station. Re-install the short from the *Reference I Meter +* to the *Reference I Meter –*.
3. Place the traceable temperature probe next to the temperature probe being used on the calibration board at the first station with a temperature probe being used for testing. Click **Read the Currently Calibrated Temperatures**. Compare the temperature from the traceable temperature probe to the calibration board temperature displayed. If the temperatures are different, then type in the temperature from the traceable temperature probe into the corresponding temperature field. Type over the value displayed when **Update VTI** is selected. Repeat this step for each station that has a temperature probe.
4. In the case of the bq30xx parts, additional voltage controls are populated depending on the number of cells selected. The same procedure of calibration used in Step 1 can be used for the individual voltage controls.

4.7.3 Allow V, T, I While Locked Selection

If the software is unlocked, then the **Allow V, T, I while locked** checkbox is enabled. Otherwise, it is disabled and dimmed. If the checkbox is selected, you can adjust the actual values for voltage, temperature, and current references even though the configuration has been locked. If the checkbox is not selected, you cannot alter these values without unlocking the configuration.

Copyright © 2011–2020, Texas Instruments Incorporated

4.7.4 Locking and Unlocking the Configuration

Once all information is updated as required then click **Update V, T, and I and Close**. This locks the software and enables the **Start** button.

To unlock the software at any time, click **Configure VTI** on the main screen and then click **Unlock Configuration**. A password dialog window displays. Supply the required password and click **OK**. The default password is *bq20z80*. This password should be changed after the first use.

To change the password, click **Lock Configuration**. This causes a password dialog window to appear. Enter a password and be sure to record it in a safe location for future reference. Re-enter the password to ensure it was not misspelled. Click **OK**.

The software always locks when **Update VTI and Close** is clicked. When either **Update VTI and Close** or **Lock Configuration** are selected, notice that the **Lock Status** icon changes from an open lock to a closed lock.

4.8 Testing Modules

Once setup is completed, testing can begin. There are multiple indicators on the main screen of the multi-station tester program and the **Start** button.

4.8.1 Progress Textbox

The software displays a description of the progress of the test for each station in the textbox in the upper center of the main window (see Figure 9). Only enabled stations show in this window. Next to the **Progress** textbox is a column of simulated LEDs adjacent to each station progress entry. After a test finishes, this simulated LED turns red or green, depending on a pass or fail.

The progress steps are:

1. **Verifying Device Version:** Powers up the device, waits for parameters to settle, and verifies the version of firmware to be tested.
2. **Writing Data Image:** Writes the Golden Image File to the data flash of the device under test
3. **Calibrating:** Calibrates voltage, temperature, and current
4. **Verifying Calibration Limits:** Verifies the calibrated gain and offset values did not go out of the ranges selected in the Tester Setup program
5. **Writing Manufacturer Data:** Writes Pack Lot Code and Date, etc., as required
6. **Writing Serial Number:** Writes serial number
7. **Pass or Error Code = XXXXX:** If the test failed, then an error code is reported. The error code displayed with a failed device in the **Progress** textbox will be a more detailed code than the error code reported in the Statistics Log textbox.

4.8.2 Statistics Log Textbox

The **Statistics Log** textbox is located under the **Progress** textbox. It shows the entire past statistical test data from all stations installed and selected. This data is also logged in a log file with the name entered in the **Log File Name** field on the **Global Configuration** screen of the Station Setup program. When more tests are performed than can fit in the **Statistics Log** textbox, a scroll bar appears on the right side of the box and only the most recent tests will be displayed. Past data can be seen by adjusting the scroll bar. Error codes reported here are of a more generic nature than the ones reported in the **Progress** testbox, as described above. Both error codes will be logged if a log file is open.

4.8.3 Test#

Test# is the number of tests since the software was opened.

4.8.4 StationID

StationID is the name given to the station when the Station Setup software was run.

Copyright © 2011–2020, Texas Instruments Incorporated

4.8.5 Date/Time

Date and Time shows the date and time the tests were performed.

4.8.6 Serial#

Serial Number is the serial number given to the device. The serial number increments depending on the progress of the tests for each station. No two stations can have the same serial number even if they start at the same time because the software assigns serial numbers in such a way to prevent this. If *Skip on Error* is selected in the Station Setup software, a failed device will not be assigned a new serial number to help preserve serial numbers for parts that pass.

4.8.7 Pass/Fail Error Code

This is a more generic error code than the one in the **Progress** textbox. The error code given here tells what test failed. The two error codes can be used together to give a better understanding of what caused the error. If the test passed, then this will be 0.

4.8.8 Filter Results Pull-Down Menu

This menu gives the option to filter the data shown in the **Statistics Log** textbox to only show data for a specific station or for all stations at one time. It will list the stations by their Station ID.

4.8.9 Next Calibration Due

The *Next Calibration Due* Indicator indicates when the Multi-Station software requires a calibration of the Voltage, Current, and Temperature references due to timeout of an adjustable software timer in the **global.ini** file as shown in Figure 13. There are three adjustable values of interest in this file under the [CalRemind] Header:

1. REM_Timed_CalInterval: This is the period in minutes between forced calibrations.
2. REM_SnoozeInterval: This is the approximate time between reminders.
3. REM_SnoozeCount: This is the number of reminders that will occur prior to forced calibration.

Default settings are shown in Figure 13. With these settings the interval time is 70 minutes. There will be two reminders prior to the 70-minute expiration. Each of these reminders will be 5 minutes apart so one will be at 60 minutes and the next would be at 65. Then at 70 minutes, the **Start** button will be disabled until *VTI* Calibration Verification is performed. Adjustments can be made to this file to modify these settings. Caution should be taken when modifying the **global.ini** file. This only changes the numbers next to the values. Any other changes could cause unpredictable results.

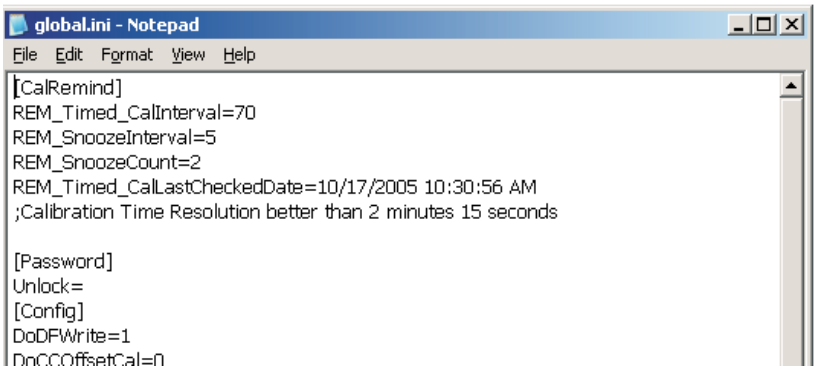


Figure 13. Global.ini file

4.8.10 Allow Testing Button

Click on **Allow Testing** to continue testing if a forced calibration reminder expires (as described in *Next Calibration Due* above).

Copyright © 2011–2020, Texas Instruments Incorporated

4.8.11 Real Time Statistics

The **Statistics** data displayed on the lower right corner of the main window displays real time test statistics for all stations combined.

4.8.12 Number Tested

This textbox displays the total number of devices that have been tested on all test stations.

4.8.13 Number Passed

This textbox displays the total number of devices that have passed the test on all test stations.

4.8.14 Number Failed

This textbox displays the total number of devices that have failed the test on all test stations.

4.8.15 Passed per Hour

This textbox displays the number of devices that have passed the test on average per hour.

4.8.16 Rows to Show on Screen

The system only remembers the statistical data from the number of tests that are selected in the **Rows to show on screen** pull-down menu.

4.8.17 Start Button

The **Start** button is disabled every time the Multi-Station software is executed. VTI configuration must be verified to enable the **Start** button. Once this button is enabled, clicking it initiates testing at each of the installed stations that were setup and initialized with the Station Setup software. Each station performs its test independently of the others. The software tracks the test progress from each station.

Copyright © 2011–2020, Texas Instruments Incorporated

Theory of Operation for HPA495 Calibration Board

The HPA495 multi-station tester board consists of three sections: a communication, control, and temperature section, a voltage supply section, and a current supply section. The board is designed to be temperature-independent. The board can be controlled through an SMBus via an EV2300 interface, or through a user-designed custom interface supporting I^2C. For the schematic, see Appendix B. For cell voltage references, see TBD.

The communication, control, and temperature section consists of two ICs, a TMP100NA Digital Temperature Sensor with I^2C interface, and a TPIC2810D 8-bit LED Driver with I^2C interface. The TMP100NA is used to report the board temperature through SMBus or I^2C. The TPIC2810D is used not only to control board status LEDs, but also to enable and disable the voltage and current sections by controlling two optoisolators. Power for these two devices (5 VDC) is supplied from the EV2300 or custom user interface from the computers USB port. Headers have been provided on the board for the addition of an external I^2C temperature sensor, an additional I^2C communication port, and external status LEDs.

The voltage supply section consists of a TL317 100 mA Adjustable Positive Voltage Regulator set to supply 20 VDC, a REF5050 +5V Precision Voltage Reference, a H11A1SM optoisolator, a 2N7002 N-channel FET, two OPA4244 quad op amps, four FMMT491A general purpose NPN transistors, and various capacitors, and resistors. Power is supplied to the voltage supply section with a 24V, 500mA wall mounted power supply. When power is supplied to the voltage supply section, the Voltage Supply LED will light, the TL317 will supply 20 V, and the REF5050 will supply a 5 V reference. The REF5050 is a high precision reference with very low temperature drift. The voltage divider formed by R11, R10, and R18 will cause 3.7 V to appear on the positive input of the OPA4244 error amps. R11 is a high precision 0.5% 10 PPM resistor. R10 and R18 are high precision 0.1% 25 PPM resistors. These values are critical to ensure 3.7 V is supplied to the positive input of the error amps. Four of the eight error amps in the two OPA4244 ICs are utilized to create four different voltages representing the four voltages in a 4s battery stack. For example, R33 and R34 are used in a non-inverting configuration with the error amp to produce a 7.4 V output. The four networks produce 3.7 V, 7.4 V, 11.1 V, and 14.8 V. The FMMT491A transistors provide current boost. The H11A1SM optoisolator and 2N7002 FET are used to enable or disable the voltage supply. An enable or disable command is sent via SMBus from the EV2300 or user-supplied I^2C controller to the TPIC2810D LED driver which then enables or disables the appropriate output pin which is connected to the H11A1SM optoisolator. This causes the optoisolator to turn on or turn off the 2N7002 FET which in turn will ground or unground the positive input of the OPA4244 error amp. Grounding the input will cause the output of the error amp to go to 0 V, which will disable the voltage supply. The transition of the TPIC2810D output pin will also cause the Voltage On LED to turn on or off.

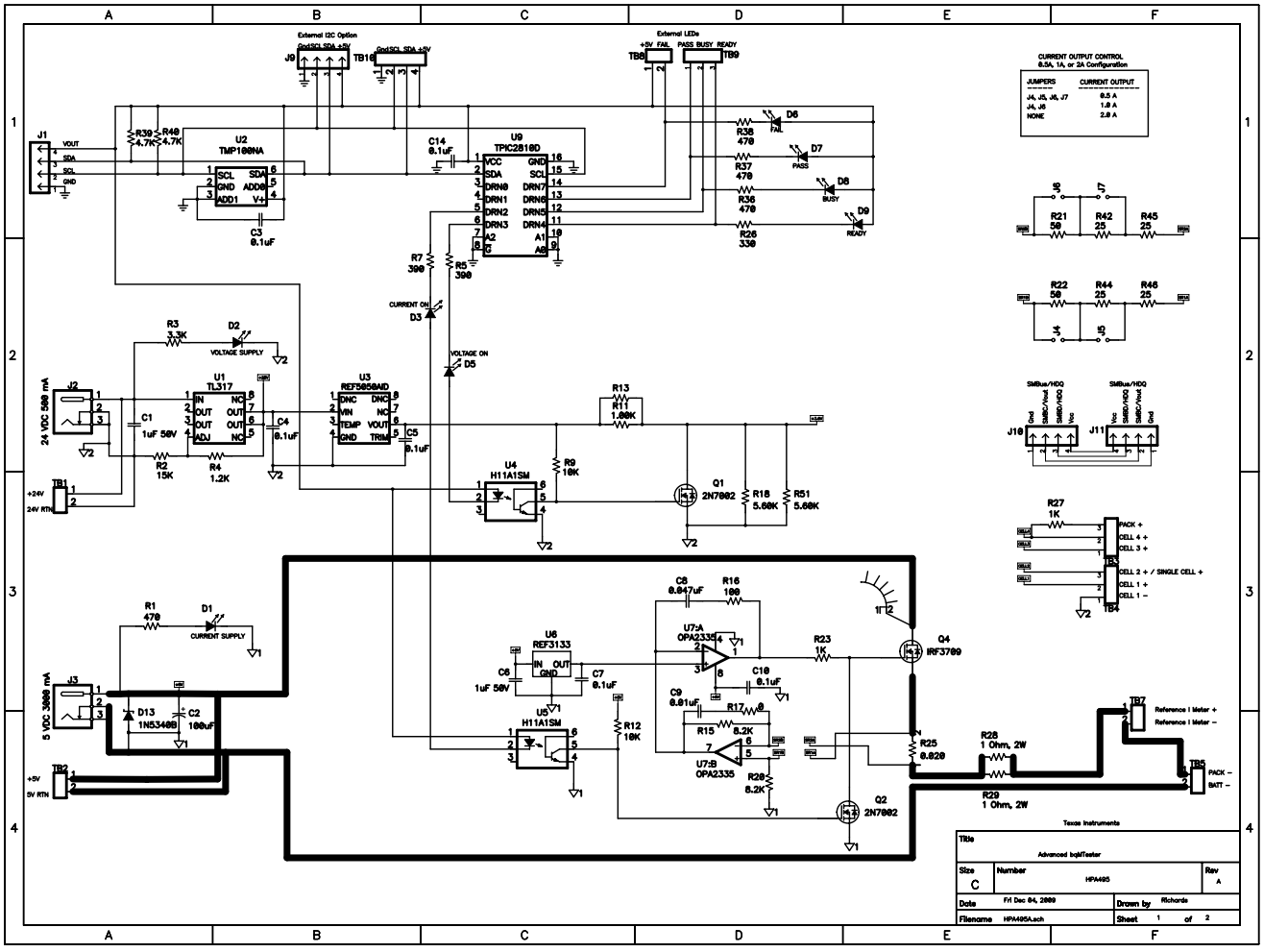
The current supply section consists of a REF3133 +3.3 V Precision Voltage Reference, a H11A1SM optoisolator, a 2N7002 N-channel FET, a OPA2335 dual op amp, a IRF3709 FET, a 20-mΩ sense resistor, two 1-Ω 2-W resistors, and various capacitors and resistors. Power is supplied to the current supply section with a 5-V, 3-A wall mounted power supply. When power is supplied to the current supply section, the Current Supply LED will light. Current flows from the power supply, through the IRF3709 FET, through the 20-mΩ sense resistor, through the two parallel 1-Ω, 2-W heat dissipating resistors, through a user-supplied reference meter, through the sense resistor in the unit under test, and back to the wall mounted power supply. This current induces a voltage across the 20-mΩ sense resistor, which is then amplified by the differential amplifier (U7:B). The voltage from the differential amplifier is then fed back into the error amp (U7:A). The error amp gets its reference voltage from the REF3133 +3.3-V voltage reference. The REF 3133 is a high precision reference with very low temperature drift. The output of the error amp drives the gate of the IRF3709 FET. This feedback arrangement ensures that the current in the current loop remains exactly the configured value, regardless of the temperature. The current setting can be configured for three different settings of 0.5 A, 1 A, or 2 A, depending on the setting of jumpers J4, J5, J6, and J7. These jumpers control the input resistance to U7:B; thus, adjusting the feedback gain of the

Copyright © 2011–2020, Texas Instruments Incorporated

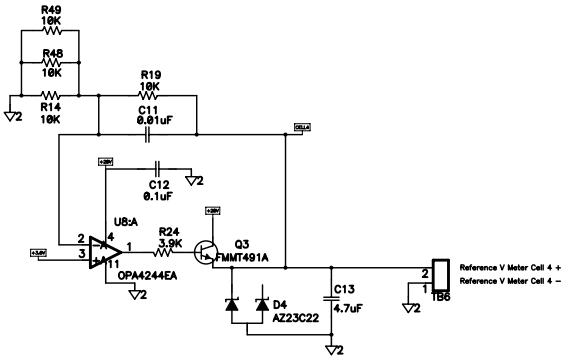
amplifier. The H11A1SM optoisolator and 2N7002 FET are used to enable or disable the current supply. An enable or disable command is sent via the SMBus from the EV2300 or user-supplied I^2C controller to the TPIC2810D LED driver which then enables or disables the appropriate output pin which is connected to the H11A1SM optoisolator. This causes the optoisolator to turn on or turn off the 2N7002 FET which in turn will ground or unground the gate of the IRF3709 FET. Grounding the gate will turn off the FET and disable the current supply. The transition of the TPIC2810D output pin will also cause the Current On LED to turn on or off.

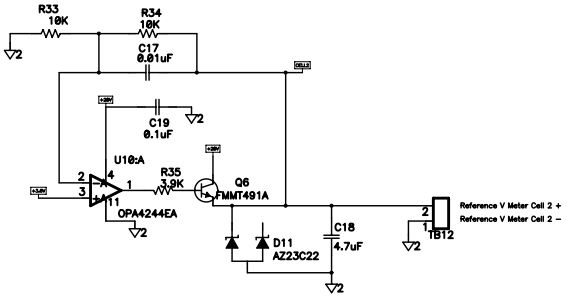
Copyright © 2011–2020, Texas Instruments Incorporated

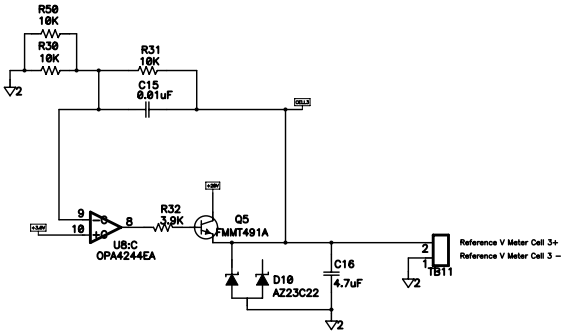
HPA495 Schematic

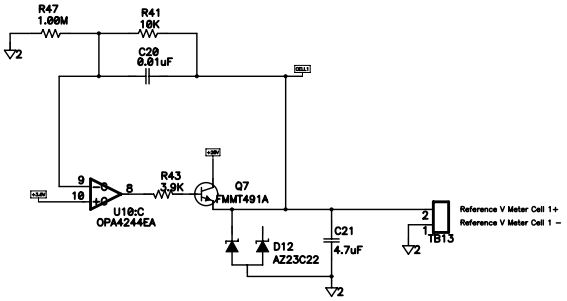


Copyright © 2011–2020, Texas Instruments Incorporated









Copyright © 2011–2020, Texas Instruments Incorporated

HPA495 Calibration Board Bill of Materials

Table 1. HPA495 Calibration Board Bill of Materials

Count	RefDes	Value	Description	Size	Device Number	MFR
2	C1, C6	1 µF 50V	Capacitor, Ceramic, 50 V, X7R, 10%	1206	STD	Any
4	C13, C16, C18, C21	4.7 µF	Capacitor, Ceramic, 25 V, X7R, 10%	1206	STD	Any
1	C2	100 µF	Capacitor, Aluminum, 10 V, 20%	0.177 x 0.177	EEE-1AA101WR	Panasonic
8	C3, C4, C5, C7, C10, C12, C14, C19	0.1 µF	Capacitor, Ceramic, 50 V, X7R, 10%	0603	STD	Any
1	C8	0.047 µF	Capacitor, Ceramic, 50 V, X7R, 10%	0603	STD	Any
5	C9, C11, C15, C17, C20	0.01 µF	Capacitor, Ceramic, 25 V, X7R, 10%	0603	STD	Any
3	D1, D2, D7	LTST-S320KGKT	Diode, LED Green Side Lumination, 75 mW, 30 mA	0.126 x 0.087 inch	LTST-S320KGKT	LiteOn
1	D13	1N5340BG	Diode, Zener Voltage Regulator, 5 Watts, 6 V, 0.79 A	DO-41	1N5340BG	On Semi
3	D3, D5, D6	LTST-S320KRKT	Diode, LED Red Side Lumination, 75 mW, 30 mA	0.126 x 0.087 inch	LTST-S320KRKT	LiteOn
4	D4, D10, D11, D12	AZ23C22-V-G	Diode, Dual, Zener, 22 V, 300 mW	SOT23	AZ23C22-V-G	Diodes
1	D8	LTST-S320KSKT	Diode, LED Yellow Side Lumination, 120 mW, 20 mA	0.126 x 0.087 inch	LTST-S320KSKT	LiteOn
1	D9	LTST-S320TBKT	Diode, LED Blue Side Lumination, 120 mW, 20 mA	0.126 x 0.087 inch	LTST-S320TBKT	LiteOn
1	HS1	6298B	Heatsink, TO-220, Vertical-mount, 3.9°C/W	1.67 x 1.00	6298B	Thermalloy
4	J1, J8, J9, J10	22-05-3041	Header, Friction Lock Ass'y, 4-pin Right Angle,	0.400 x 0.500	22-05-3041	Molex
1	J2	24 VDC 500 mA	Connector, 2.1 mm, DC Jack w/Switch, TH	0.57 x 0.35	RAPC 722X	Switchcraft
1	J3	5 VDC 3000 mA	Connector, 2.1 mm, DC Jack w/Switch, TH	0.57 x 0.35	RAPC 722X	Switchcraft
4	J4, J5, J6, J7		Header, 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
2	Q1, Q2	2N7002	MOSFET, N-ch, 60 V, 115mA, 1.2-Ω	SOT23	2N7002DICT	Vishay-Liteon
4	Q3, Q5, Q6, Q7	FMMT491A	Transistor, NPN, High-Performance, 500 mA	SOT23	FMMT491A	Zetex
1	Q4	IRF3709	MOSFET, N-ch, 30 V, 90 A, 9 mΩ	TO-220AB	IRF3709	IR
4	R1, R36, R37, R38	470	Resistor, Chip, 1/16W, 5%	0603	STD	Any
1	R11	1.00K	Resistor, Chip, 1/10W, 0.5%, 10 ppm	0805	RG2012N-102-D-T5	Susumu Co Ltd
0	R13		Resistor, Chip, 1/10W, 0.5%, 10 ppm	0805	STD	Any
2	R15, R20	16.5K	Resistor, Chip, 1/10W, 0.1%, 25 ppm	0603	RG1608P-1652-B-T5	Susumu Co Ltd
1	R16	100	Resistor, Chip, 1/16W, 5%	0603	STD	Any
1	R17	0	Resistor, Chip, 1/16W, 5%	0603	STD	Any
1	R2	15K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
2	R21, R22	100	Resistor, Chip, 1/10W, 0.1%, 25 ppm	0603	ERA-3AEB101V	Panasonic-ECG
2	R23, R27	1K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
4	R24, R32, R35, R43	3.9K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
1	R25	0.02	Resistor, Chip, 1W, 1%, 75ppm	2512	WSL2512R0200FEA	Vishay Dale

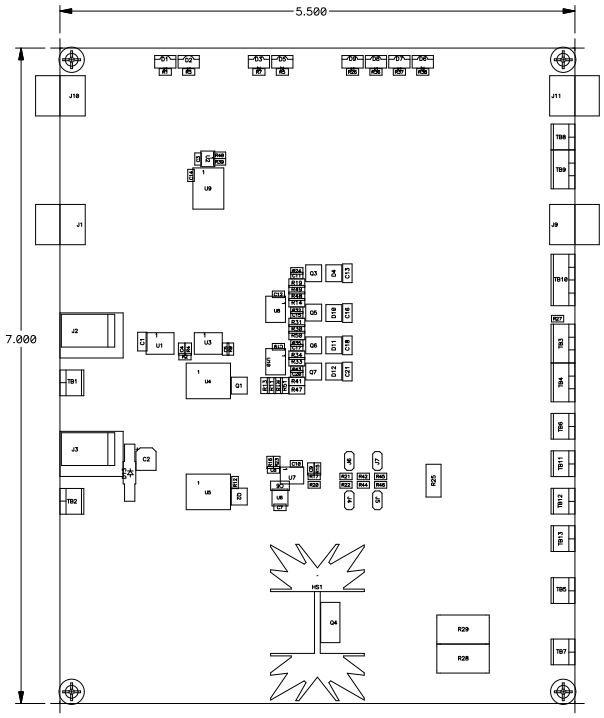
Copyright © 2011–2020, Texas Instruments Incorporated

Table 1. HPA495 Calibration Board Bill of Materials (continued)

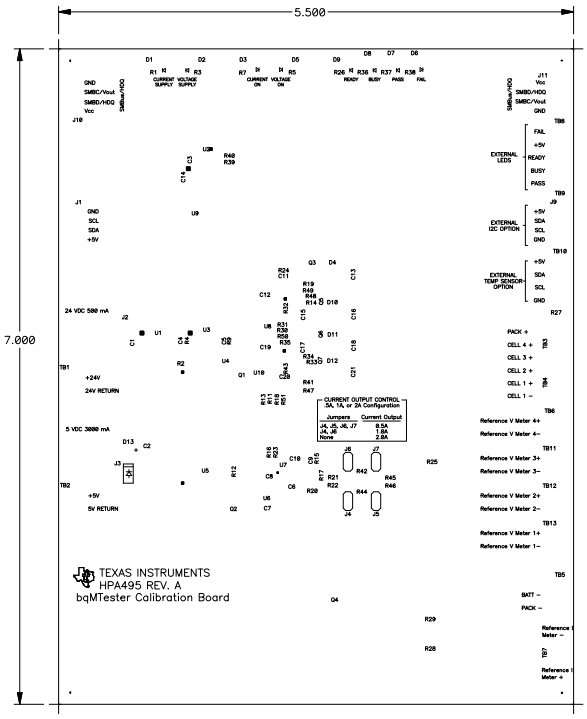
Count	RefDes	Value	Description	Size	Device Number	MFR
1	R26	330	Resistor, Chip, 1/16W, 5%	0603	STD	Any
2	R28, R29	1 Ω, 2W	Resistor, Metal Strip, 2W, 1%	0.49 x 0.10 inch	WSR21R000FEA	Vishay Dale
1	R3	3.3K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
2	R39, R40	4.7K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
1	R4	1.2K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
4	R42, R44, R45, R46	50	Resistor, Chip, 1/8W, 0.1%, 25 ppm	0603	FC0603E50R0BTBST1	Vishay/Thin Film
1	R47	1.00M	Resistor, Chip, 1/8W, 0.1%, 25 ppm	0805	ERA-6AEB105V	Panasonic - ECG
2	R5, R6	390	Resistor, Chip, 1/16W, 5%	0603	STD	Any
2	R7, R12	10K	Resistor, Chip, 1/16W, 5%	0603	STD	Any
10	R8, R10, R14, R19, R30, R31, R33, R34, R41, R48	10K	Resistor, Chip, 1/8W, 0.05%, 10 ppm	0805	RG2012N-103-W-T1	Susumu Co Ltd
2	R9, R18	5.60K	Resistor, Chip, 1/8W, 0.1%, 25 ppm	0805	ERA-6YEB562V	Panasonic-ECG
9	TB1, TB2, TB5–TB8, TB11– TB13		Terminal Block, 2-pin, 6A, 3.5 mm	0.27 x 0.25 inch	ED555/2DS	OST
1	TB10		Terminal Block, 4-pin, 6A, 3.5 mm	0.55 x 0.25 inch	ED555/4DS	OST
3	TB3, TB4, TB9		Terminal Block, 3-pin, 6A, 3.5 mm	0.41 x 0.25 inch	ED555/3DS	OST
1	U1	TL317	IC, 3-Terminal Adjustable Regulator	S08	TL317CD	TI
1	U2	TMP100NA	IC, Digital Temperature Sensor With I^2C Interface	SOT23-6	TMP100NA	TI
1	U3	REF5050AID	IC, Precision Voltage Reference, 5 V, 8 ppm	SO-8	REF5050AID	TI
2	U4, U5	H11A1SM	IC, Optoisolator, NPN Transistor w/base	SOP-6	H11A1SM	Fairchild
1	U6	REF3133	IC, Voltage Reference, 15 ppm/°C Max, 100 µA	SOT23	REF3133AIDBZ	TI
1	U7	OPA2335	IC, Single Supply CMOS Op Amp, Dual, 0.05 V/°C max,	MSOP-8	OPA2335AIDGK	TI
2	U8, U10	OPA4244EA	IC, Micro Power, Single Supply Op-Amp	TSSOP-14	OPA4244EA	TI
1	U9	TPIC2810D	IC, 8-Bit Led Drive With I²C Interface	SO16	TPIC2810D	TI
4			Shunt, 100-mil, Black	0.100	929950-00	3M
6			Bumpers, Clear, Polyurethane	SDM	2566	SPC Technology
1	—		PCB		HPA495	Any

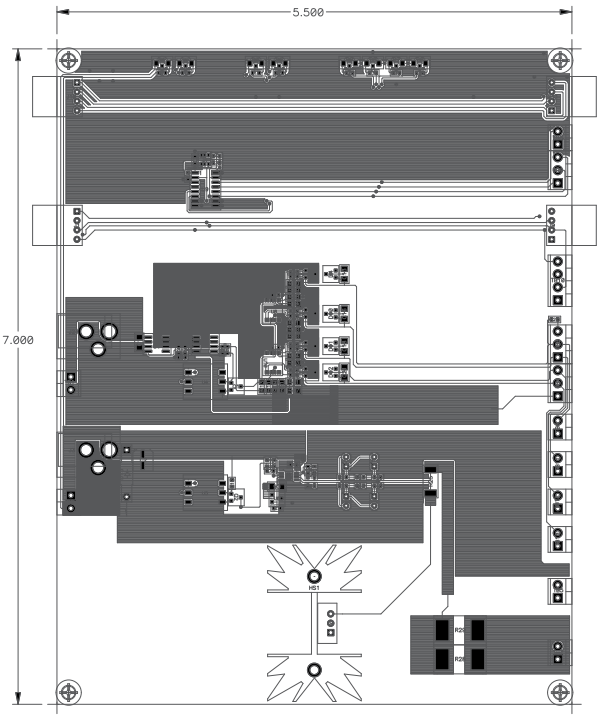
Copyright © 2011–2020, Texas Instruments Incorporated

HPA495 Board Layout

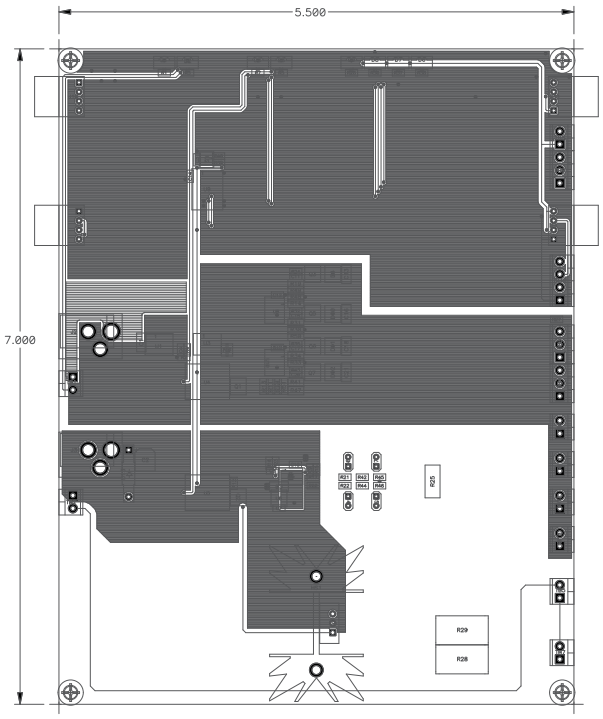


Copyright © 2011–2020, Texas Instruments Incorporated





Copyright © 2011–2020, Texas Instruments Incorporated



Copyright © 2011–2020, Texas Instruments Incorporated

Error Code Definitions

Table 2. Error Code Definitions

Error Code	Error #	Description	Most Probable Cause	Possible Action
NO_ERROR	0	Successful (No errors)		
LOST_SYNC	1	EV2300 lost synchronization	EV2300 has outdated firmware or drivers are outdated.	Contact TI to get EV2300 with latest firmware. Ensure latest drivers for EV2300 installed.
NO_USB	2	USB Connection Missing.	No EV2300 is connected.	Close program, reboot, and connect EV2300 first.
BAD_PEC	3	Bad PEC on SMBus	Possible Bad hardware.	Replace EV2300 / target board
WRONG_NUM_BYTES	5	Unexpected number of bytes sent/received	Unexpected hardware behavior.	May need assistance from TI
T2H_UNKNOWN	6	SMBus communication terminated unexpectedly / timed out or the bus was busy.	Wrong kind of target connected or target timing is off Trim oscillator	make sure that the target mode accepts the SMB command being sent
INCORRECT_PARAM	7	Invalid parameter type passed to function - especially Variant argument.	Incorrect parameter in call to function. Software Bug or overflow	Contact TI
TIMEOUT_ERROR	8	USB Timeout	No response on USB	EV2300 or driver problems or software is not supposed to wait for a response.
INVALID_DATA	9	AssemblePacket could not build a valid packet	Bad data / bad packet. Software found problem with data	Possible version incompatibility between BqTester and Module under test.
ERR_UNSOLICITED_PKT	10	Found an unsolicited non-error packet when looking for error packets	Unexpected packet received. The packet may be a response from a previous transaction that failed or that did not check the response.	Make corrections to software
COMPARE_DIFFERENT	11	Comparison failed and data read is different from srec	Flash comparison results in mismatch. Possible Flash failure or SMBus failure.	Module under test Flash failure
BQ80XRW_OCX_INTERNAL_ERROR	12	Problems with pointers being NULL etc.	Possible software bug or overflow.	Contact TI
USER_CANCELLED_OPERATION	34	User clicked on cancel button on progress bar dialog		
DF_CHECKSUM_MISMATCH	51	Data Flash checksum mismatch	Flash comparison results in mismatch. Possible Flash failure or SMBus failure.	Module under test Flash failure
IF_CHECKSUM_MISMATCH	52	Instruction Flash checksum mismatch	Flash comparison results in mismatch. Possible Flash failure or SMBus failure.	Module under test Flash failure
OPERATION_UNSUPPORTED	53	Unsupported type	Software problem	Check that Module under test and bqTester versions are compatible. Then contact TI
ERR_TOO_MANY_QUERIES	81	Not used		
ERR_BAD_QUERY_ID	82	Not used		
BAD_CRC	83	Packet was corrupted during USB communication	Too much noise or bad connection	
ERR_TOO_MANY_RESPONSES	84	Not used		

Copyright © 2011–2020, Texas Instruments Incorporated

Table 2. Error Code Definitions (continued)

Error Code	Error #	Description	Most Probable Cause	Possible Action
ERR_NO_QUERIES_TO_DELETE	85	Not used		
ERR_QUERY_UNAVAILABLE	86	Not used		
ERR_NO_RESPONSES_TO_DELETE	87	Not used		
ERR_RESPONSE_UNAVAILABLE	88	Not used		
ERR_TMMT_NO_RESPONSE	90	Not used		
T2H_ERR_TIMEOUT	92	SMBus communication terminated unexpectedly / timed out or the bus was busy.	Wrong kind of target connected or target timing is off Trim oscillator	make sure that the target mode accepts the SMB command being sent
BUS_BUSY	94	SMBus communication terminated unexpectedly / timed out or the bus was busy.	Wrong kind of target connected or target timing is off Trim oscillator	make sure that the target mode accepts the SMB command being sent
T2H_ERR_BAD_SIZE	95	SMBus communication terminated unexpectedly / timed out or the bus was busy.	Wrong kind of target connected or target timing is off Trim oscillator	make sure that the target mode accepts the SMB command being sent
ERR_BAD_PAYLOAD_LEN	97	Packet was corrupted during USB communication or software sent in a bad packet	Bad USB connection	Check Version Compatibility and USB cable
ERR_TMMT_LIST_FULL	98	Not used		
ERR_TMMT_BAD_SELECTION	99	Not used		
UNKNOWN	100	Unexpected/unknown error		Outdated software Contact TI
UNEXPECTED_ERROR	110	Should not happen	Unexpected error	Hardware not expected to respond to this error
OUT_OF_MEMORY	111	Not enough memory on PC		Install more memory
SREC_OPEN_FAIL	221	Srec specified does not exist or cannot be opened	SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester software and Module under Test.
SREC_BAD_START_RECORD	222	Srec not in expected format	SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester softare and Module under Test.
SREC_UNKNOWN_TYPE	223	Srec not in expected format	SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester softare and Module under Test.
SREC_BAD_CHECKSUM	224	Srec not in expected format	SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester softare and Module under Test.
SREC_BAD_RECORD_COUNT	225	Srec not in expected format	SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester softare and Module under Test.
SREC_DEV_MISMATCH	226		SREC targets a different device than the one detected on the SMBus '	Ensure version compatibility between bqMTester softare and Module under Test.
CONFIG_OPEN_FAIL	227	Config file not found / cannot be opened		Redo StationSetup.exe configuration
CONFIG_UNEXPECTED_EOF	228	Config file not found / cannot be opened		Redo StationSetup.exe configuration
CONFIG_BAD_FORMAT	229	Config file format incorrect		Redo StationSetup.exe configuration
PCFG_DEVVER_MISMATCH	231	Config file device version not compatible		Ensure version compatibility between bqMTester softare and Module under Test.
PCFG_DEV_MISMATCH	232	Config file device not compatible		Ensure version compatibility between bqMTester softare and Module under Test.
PCFG_SRECDEVVER_MISMATCH	233	Srec not compatible with current hardware device		Ensure version compatibility between bqMTester softare and Module under Test.
PCFG_SRECDEV_MISMATCH	234	Srec not compatible with current hardware device		Ensure version compatibility between bqMTester softare and Module under Test.

Copyright © 2011–2020, Texas Instruments Incorporated

Table 2. Error Code Definitions (continued)

Error Code	Error #	Description	Most Probable Cause	Possible Action
BCFG_DEVVER_MISMATCH	235	Srec not compatible with current hardware device		Ensure version compatibility between bqMTester softare and Module under Test.
BCFG_DEV_MISMATCH	236	Srec not compatible with current hardware device		Ensure version compatibility between bqMTester softare and Module under Test.
SMBC_LOCKED	260	Unused but reserved for backward compatibility		
	516	Unused but reserved for backward compatibility		
T2H_NACK	772	No response from target	Target not connected/not powered	Connect target and check is correct power is applied
SMBD_LOW	1028	Unused but reserved for backward compatibility		
SMB_LOCKED	1284	Unused but reserved for backward compatibility		
ERR_NOTHINGTODO	5001	Calling the function with specified values resulted in nothing being done		
ERR_VOLTAGE_LESSTHANZERO	5002	Specified Voltage must be greater than 0		
ERR_TEMPERATURE_LESSTHANZERO	5003	Specified temperature must be greater than 0		
ERR_CURRENT_EQUALSZERO	5004	Specified current cannot be 0		
ERR_NOT_IN_CAL_MODE	5010	Gas gauge was not in Calibration mode/ could not be put in calibration mode		
ERR_CALIBRATION_IN_FIRMWARE_FLASHWRITE	5020	Error writing flash in calibration mode		
ERR_CALIBRATION_IN_FIRMWARE_AFE	5021	Error in AFE calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_PACKV	5022	Error in Pack voltage calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_PACKG	5023	Error in Pack gain calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_VGAIN	5024	Error in Voltage gain calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_CCIGAIN	5025	Error in Current gain calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_TMPOFFEXT1	5026	Error in external temperature 1 offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_TMPOFFEXT2	5027	Error in external temperature 2 offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_TMPOFFINT	5028	Error in internal temperature offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_ADCOFF	5029	Error in ADC offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_BRDOFF	5030	Error in Board offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_CCIOFF	5031	Error in CC offset calibration	Value too large (Overflow) in firmware	
ERR_CALIBRATION_IN_FIRMWARE_RDRAWCALDATA	5032	Error in reading raw calibration data		
ERR_CALIBRATION_IN_FIRMWARE_RSVD1	5033	Reserved for future use		
ERR_CALIBRATION_IN_FIRMWARE_RSVD2	5034	Reserved for future use		
ERR_CALIBRATION_IN_FIRMWARE_RSVD3	5035	Reserved for future use		
ERR_CALIBRATION_IN_FIRMWARE_RSVD4	5036	Reserved for future use		
ERR_CALIBRATION_IN_FIRMWARE_RSVD5	5037	Reserved for future use		

Copyright © 2011–2020, Texas Instruments Incorporated

Table 2. Error Code Definitions (continued)

Error Code	Error #	Description	Most Probable Cause	Possible Action
ERR_CALIBRATION_IN_FIRMWARE_RSVD6	5038	Reserved for future use		
ERR_CALIBRATION_IN_FIRMWARE_UNDEFINED	5039	Unknown error code returned by hardware	Software is obsolete	
ERR_DF_RD_REQ_B4_WR	5041	Data flash cannot be written before reading the remaining values in a given class		
ERR_INVALID_DATA_ENTERED	5042	Invalid data entered on screen		
ERR_USB_ACQUIRE	5043	EV2300 is locked by another thread	Attempting to do multiple transactions possibly from different windows in background at the same time. Could also be a software problem. Stop scanning in SBS.	
NVALID_FILENAME	65537			Check File Name for Rom File and Log File
DEVICE_VERSION_MISMATCH	65538	Incompatible device/version		Check Connections. Verify version compatibility between bqMTester software and Module under Test.
RETURN_TO_ROM_FAILED	65539	Gas gauge could not be put in Rom mode	Hardware incompatibility	Check Connections. Verify version compatibility between bqMTester software and Module under Test.
RUNGG_FAILED	65541	Gas gauge could not exit ROM mode	Hardware incompatibility	Check Connections. Verify version compatibility between bqMTester software and Module under Test.
WRITEFLASH_GG_FAILED	65542	Writing to flash failed	Data Flash Failure	Module Repair
CALIBRATE_FAILED	65543	Calibration failed	Module hardware failure or Configuration failure	Module Repair or Check Testing Configuration Settings
POST_CAL_CHECKS_FAILED	65544	Post calibration checks failed	Module hardware failure or Configuration failure	Module Repair or Check Testing Configuration Settings
WRITESERIAL_FAILED	65545	Write serial number failed	Data Flash Failure	Module Repair/Retry Test
WRITECAL2DF_FAILED	65547	Fail to write the calibration result to data flash	Data Flash Failure Possible	Module Repair/Retry Test
ERR_UNEXPECTED	65552	Unexpected value/response	Software does not know how to handle this	
ERR_FILE	65553	Error opening/processing File	Wrong File location settings.	Check all File location settings in bqMTester Software
ERR_NOT_IN_ROM	65554	GG not in ROM mode when expected - communication failure?	Gas gauge could not be put in ROM	Check Connections. Verify version compatibility between bqMTester softare and Module under Test.
ERR_ENTER_CALMODE	65555	Cannot put GG in Cal mode	Gas gauge could not be put in Calibration mode	Check Connections. Verify version compatibility between bqMTester softare and Module under Test.
ERR_CUSTOM_FUNC	65556	User defined function returned error		
BAD_FILE_FORMAT	65557	Header bad or format bad	Bad image file format	
ERR_WRITE_MFG_DATA	65558	Failed to write manufacturer data	Data Flash Failure	Module Repair/Retry Test
ERR_READ_DEV_VER	65559	Communication error reading device version	Hardware incompatibility	Check Connections. Verify version compatibility between bqMTester softare and Module under Test.
CAL_VOLT_LESSTHANZERO	65600	Calibration voltage must be greater than 0	On screen values incorrect	Verify VTI and Configuration Settings
CAL_TEMP_LESSTHANZERO	65601	Calibration current must be greater than 0	On screen values incorrect	Verify VTI and Configuration Settings
CAL_CURR_LESSTHANZERO	65602	Calibration current must be greater than 0	On screen values incorrect	Verify VTI and Configuration Settings

Copyright © 2011–2020, Texas Instruments Incorporated

Table 2. Error Code Definitions (continued)

Error Code	Error #	Description	Most Probable Cause	Possible Action
WRITEFLASH_ROM_FAILED	65560	Failed to write flash while in ROM mode		
SENSE_RES_CAL_HIGH	65570	Sense resistor value too high in post cal checks	Sensor Resistor Hardware Failure, Connection Problem, Setting Problem, or HPA169 Power Supply Problem	Verify Sense Resistor Value, check current supply connections, and verify VTI and Configuration Settings. Try increasing tolerances if possible
SENSE_RES_CAL_LOW	65571	Sense resistor value too low in post cal checks	Sensor Resistor Hardware Failure, Connection Problem, Setting Problem, or HPA169 Power Supply Problem	Verify Sense Resistor Value, check current supply connections, and verify VTI and Configuration Settings. Try increasing tolerances if possible
VOLT_CAL_HIGH	65580	Voltage value too high in post cal checks	Module hardware failure, HPA169 Voltage power supply problem or Configuration failure	Verify Voltage circuit, voltage power supply, VTI, and Configuration Settings. Try increasing tolerances if possible
VOLT_CAL_LOW	65581	Voltage value too low in post cal checks	Module hardware failure, HPA169 Voltage power supply problem or Configuration failure	Verify Voltage circuit, voltage power supply, VTI, and Configuration Settings. Try increasing tolerances if possible
TEMP_CAL_HIGH	65590	Temperature value too high in post cal checks	Module hardware failure, HPA169 Temperature sensor Failure	Verify VTI settings, and Temperature sensor location
TEMP_CAL_LOW	65591	Temperature value too low in post cal checks	Module hardware failure, HPA169 Temperature sensor Failure	Verify VTI settings, and Temperature sensor location
SEAL_CMD_FAILED	65610	Seal command failed	Communication Failure	Check Connections. Verify version compatibility between bqMTester softare and Module under Test.
ERR_READ_CB_INT_TEMP_SENSOR	65611	Error reading internal temperature sensor on HPA169 calibration board	Temperature sensor failure	Verify HPA169 calibration board temperature sensor connections or replace sensor
ERR_READ_CB_EXT_TEMP_SENSOR	65612	Error reading external temperature sensor on HPA169 calibration board	Temperature sensor failure	Verify HPA169 calibration board temperature sensor connections or replace sensor
ERR_CALIBRATION_OUTOFSPEC	65613	Time to recalibrate HPA169 calibration board	VTI calibration Timer expired.	Calibrate VTI settings
ERR_TEST_ROUTINE	65614	Reserved		
ERR_WRITEDATE_FAILED	65546	Failed to write date	Data Flash Failure	Module Repair/Retry Test
ERR_WORKAROUND_ROUTINE	65614	GG mode work around failure	Board offset has too much variance.	Calibrate board offset
ERR_BOARD_OFFSET_LIMIT	65615	Board offset outside of limits	Board offset has too much variance.	Calibrate board offset
ERR_BOARD_OFFSET_TIMEOUT	65616			

Copyright © 2011–2020, Texas Instruments Incorporated

Using TesterDFReader to Create an Image of the Data Flash

1. To run the data flash that reads the software in the bqMTester suite, double-click the **TesterDFReader.exe** file in the directory where the software was installed.

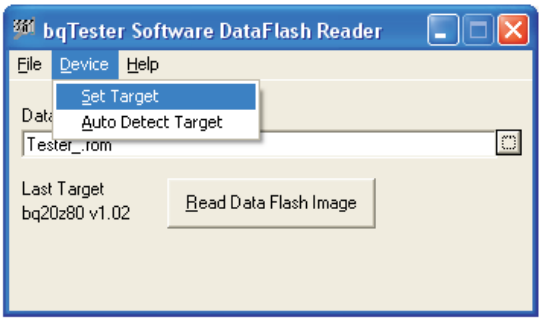


Figure 14. TesterDFReader.exe Software

2. Select the device type from the *Device* pulldown menu.
3. Type in a complete path and file name with a .rom extension in the dialog box or click **Browse** ( ).
4. Click the *Read Data Flash Image* button. This causes the software to read the data flash information from the smart battery module and store it in this file.

This .rom file is created to be the *Golden Image File* that is used to program all other smart battery modules.

Copyright © 2011–2020, Texas Instruments Incorporated

Creating the Golden Image File Without bqEASY

NOTE: bqEASY only supports catalog, not custom, parts.

After engineering development is completed, a Golden Image File must be made from an *Engineering Perfect* module. Flash constants in smart battery modules that use this Golden Image File are used as a default to program the Static Data Flash constants in all the smart battery modules that use the bqMTester. It is very important that this process is completed. If it is not, then the Impedance Track algorithm may not function correctly.

NOTE: The bq3060 and bq28400 devices use Compensated End-of-Discharge Voltage (CEDV) technology. The remainder of this section applies only to Impedance Track technology. To create a Golden Image File (Data Flash) for CEDV devices, refer to the bq3060 and bq28400 device documentation found on www.ti.com.

This chapter assumes familiarity with Texas Instruments evaluation software for the bq20zxx modules since it was most likely used during the engineering development phase of this project. If not familiar with the TI evaluation software, refer to the bq20z80-001 EVM tool folder that includes an EVM user guide, application notes, and the latest EV software:

http://focus.ti.com/docs/toolsw/folders/print/bq20z80evm-001.html

All the functions described below are supported by bqEASY. It is recommended that bqEASY be used for all of the procedures unless there are some parameters that bqEASY does not support. Alternatively, if a device being characterized is a custom spin device and *not* a catalog device, bqEASY may not work correctly with this device. bqEASY only supports catalog parts. In such cases, use **TesterDFReader.exe** software, which is accompanied with bqMTester. Information regarding how to use TesterDFReader is detailed in Appendix F.

G.1 *Creating the Engineering Perfect* Battery Pack

Static Data examples: Static data examples are Charging Voltage, Impedance Track resistance tables, and QMAX settings. Examples of non-static data include serial number, date, and calibration data.

It is also assumed that this Engineering Perfect battery pack was created using the correct chemistry support SENC file. Chemistry tables are programmed into a device with either bqEASY or bqCHEM (included with bqEVSW). For more information, refer to the Multi-Chemistry Support application note: *Support of Multiple Li-Ion Chemistries w/Impedance Track(TM) Gas Gauge* at: http://focus.ti.com/general/docs/litabsmultiplefilelist.tsp?literatureNumber=slua372r.

Now the Impedance Track data must be verified. This data must be updated and accurate so that all battery packs produced have accurate Impedance Track tables in the data flash right out of the box. To ensure that the Impedance Track tables are optimized, complete the following steps:

1. For Impedance Track devices only: Using an EV2300 and the EV software appropriate for the device being used in this application (for example: bnq20z70, bq20z80, or bq20z90), ensure that the data flash locations **Qmax Cell 0**–**Qmax Cell 3**, and **Qmax Pack** have good estimates in them for the battery pack capacity. This information can be derived from the battery cell manufacturer data sheet. Also note that if more than one cell is connected in parallel, then the capacity increments by one cell capacity for every cell in parallel. For example, if a single-cell data-sheet capacity is 2400 mAh, and 3 parallel cells are used, set each value to 2400 × 3 = 7200 mAh.

Copyright © 2011–2020, Texas Instruments Incorporated

2. Charge the pack to full. If it does not charge, then ensure that Impedance Track is enabled by sending data 0x0021 to SMBus command 0x00 (*Manufacturer Access*).
3. When the pack is full, remove the charger and let the pack relax for two hours.
4. Discharge the pack to minimal device acceptable voltage (also set as *Term Voltage* flash constant) at a typical rate for the target application. The exact rate is not critical.
5. Let the pack relax for at least five hours.
6. Repeat Steps 2 through 5 for maximum accuracy.
7. Connect the pack to the EV software, go to the data flash screen, and ensure that **Update Status** is 0x06.
8. The battery pack is now *Engineering Perfect*.

G.2 *Creating Golden GG File from the Engineering Perfect* Battery Pack

Create a GG file with all of the data from the *Engineering Perfect* battery pack to create the Golden Image File. The purpose of this GG file is to get all the non-reserved data saved to install it back into the module after the battery pack is put back into the original state with a new SENC file (see Section G.3). Also, change *usage* data to the original values so all programmed battery packs do not report that they have been used. Use bqEASY to configure the parameters. Alternatively, use the procedures below.

1. Ensure that the *Engineering Perfect* battery pack is still connected to the EV2300 and that the EV software for the applicable device is open.
2. Go to the **Data Flash** screen in the EV software and click **Read All**.
3. Select the **File** pulldown menu, click **Export**, and chose a (*.gg) file name for saving the pre-learned defaults (example: optimized.gg).
4. In a text editor such as Notepad, open the saved GG file. Change the value of *Update Status* from 06 to 02, which indicates that the parameters are learned but the Impedance Track feature is disabled (as should be the case for a new pack prior to calibration).

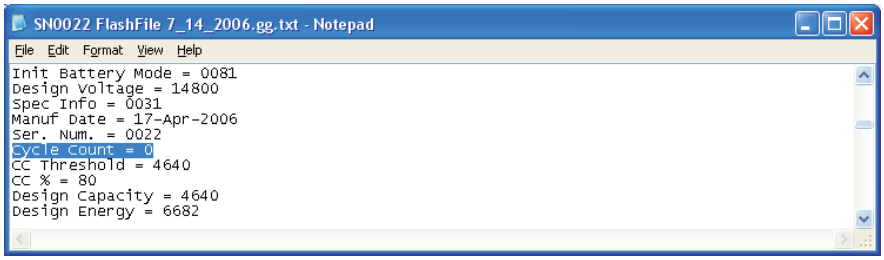


Figure 15. Cycle Count Modification in GG file using Notepad

5. Reset the *Cycle Count* field to "0," as shown in Figure 15.
6. Save the file. Use this file as detailed below.

G.3 *Installing the Original SENC File with Correct Chemistry Support*

It is assumed that the proper chemistry-supported SENC file has been determined for this application during the Engineering and Development Phase of this project. For most applications (LiCoO2/graphitized carbon chemistry), the default SENC file for the applicable device (ex: bq20z80, bq20z90, or bq20z70) is used. For more information on multi-chemistry support, refer to the Multi-Chemistry Support application note: *Support of Multiple Li-Ion Chemistries w/Impedance Track(TM) Gas Gauge* .

The following instructions explain how to install the original chemistry-supported SENC file into the *Engineering Perfect* battery pack. Do not worry about losing all the static data from this pack, because it was stored, as detailed in the previous chapter.

1. Go to the product folder for the device in use in this application.
   Some Examples:
   a. For the bq20z70: go to bq20z70 Tools and Software Section
   b. For the bq20z80, go to bq20z80 Tools and Software Section

Copyright © 2011–2020, Texas Instruments Incorporated

c. For the bq20z90, go to bq20z90 Tools and Software Section

2. Click on the Multi-Chemistry Support Software zip file pertaining to the device being used:
   Some Examples:
   a. For the bq20z70: go to bq20z70-V101 Multiple Li-Ion Chemistries Software
   b. For the bq20z80: go to bq20z80-V102 Multiple Li-Ion Chemistries Software
   c. For the bq20z90: go to bq20z90-V102 Multiple Li-Ion Chemistries Software
3. Download the applicable zip file and extract to a temporary directory. An example would be C:\Temp\sluc058.zip.
4. Ensure that the *Engineering Perfect* battery pack is still connected to the EV2300, and that the EV software for the applicable device is open.
5. Go to the **Pro** screen in the EV software.

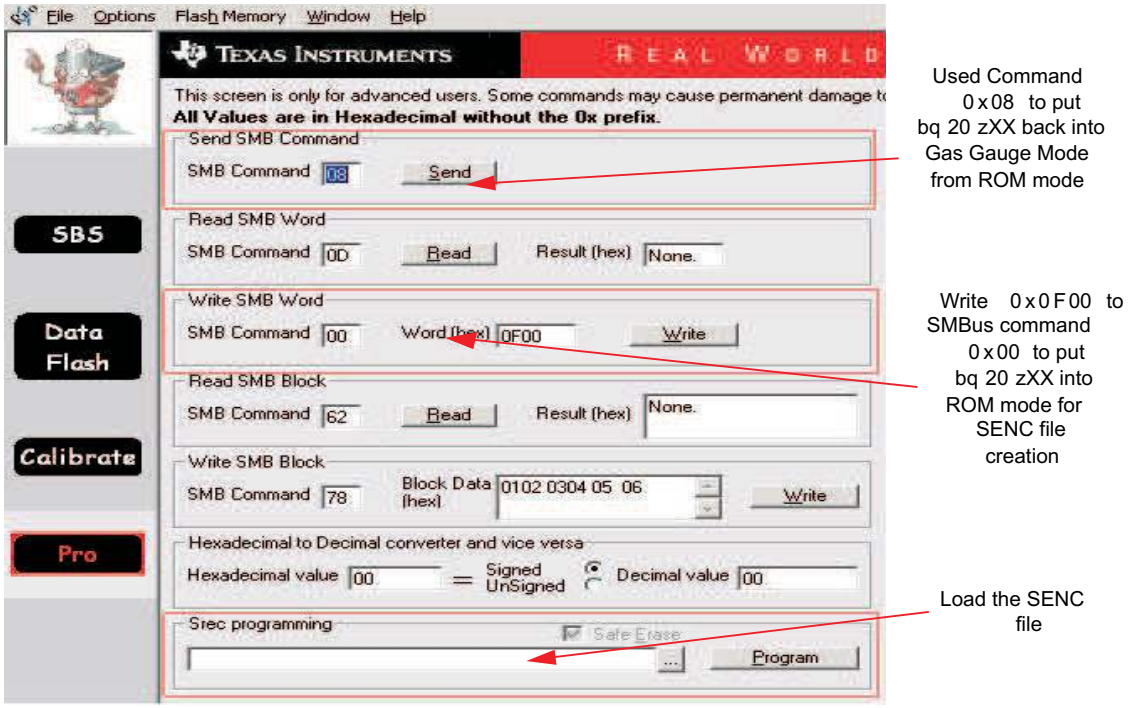


Figure 16. EV Software Pro Screen

6. Ensure that **Write SMB Word** frame has the SMBus Command set to 0x00, and the SMBus Word set to 0x0F00.If they are not, then change them.
7. Click **Write**. This puts the bq20zxx module into ROM mode to prepare for writing the SENC file created (as detailed in the section above).
8. Write the SENC file to the *Engineering Perfect* pack by clicking the browse (...) button in the **Srec programming** frame.
9. In the file manager that pops up, locate and select the previously saved SENC file created (detailed in the above section).
10. Click **Program**. The software indicates when it is finished.
11. After it finishes writing, ensure that the SMB Command is 0x08 in the **Send SMB Command** frame. If it is not, change it to 0x08.
12. Click **Send**. This puts the bq20zxx back into Gas Gauge mode. Your factory default SENC file is now loaded.

Copyright © 2011–2020, Texas Instruments Incorporated

G.4 Creating the Golden Image File:

The final step in this process is creating the Golden Image File. This file will include all the static data in the data flash that is constant from one smart battery module to the next. It also has all the reserved data and *usage* data set to default states to ensure that all programmed packs start out in a new state. This process is mandatory for new designs and is required for using Multi-Station Testing (**MultiStationTester.exe**). Without this process the Impedance Track Algorithm may not function properly. Follow these steps to create this file:

1. Ensure that the *Engineering Perfect* battery pack is still connected to the EV2300 and that the EV software for the applicable device is open. Go to the **Data Flash** screen and open the **File** pulldown menu. Select **Import**.
2. In the file manager that pops up, locate and select the Golden GG file created (as detailed in the above section). Click **Write All**.
3. The *Engineering Perfect* battery pack now has all *Golden* data in it. The next step is to retrieve that data into a Golden Image File.
4. Go to Appendix F to read the DFI file from a golden pack.

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (May 2011) to B Revision	Page
• Updated the user's guide to align with TI EVM terms of sale and removed obsolete items	3

Copyright © 2011–2020, Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2020, Texas Instruments Incorporated