



Battery Management Solutions

The Final Steps to Production

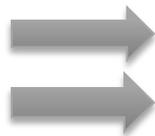
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October 23, 2014

The New Tools

bqEvaluation

bqMTester



bqStudio

bqProduction

- **Consistent looks across device families.**
- **No longer required to run the full setup program for each device. Transfer a 50 kbyte file versus a 50 Mbyte setup program!!**
- **The tools use a standardized evaluation platform and it are customized for each device with a .bqz file.**
- **The chemistry files take much less disk space and are much faster to update.**



bqStudio

Battery Management Studio (bqStudio)

File View AutoCycle Window Help

Registers Data Memory Calibration Chemistry Firmware Advanced Comm SMB Watch Data Graph Errors

Battery Mana...

Dashboard

EV2300 Version:3.1m

SMB

bq40z50 4500_0_12 Addr: 0x17 23.0 degC

11686 mV 64%

Registers

Registers

Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan
<input checked="" type="checkbox"/> Manufacturer Access	0x6100	hex	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 4 Current	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> PackGrid	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Remaining Cap. Alarm	300	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 1 Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 1 Grid	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Remaining Time Alarm	10	min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 2 Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 2 Grid	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> At Rate	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 3 Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 3 Grid	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> At Rate Time To Full	65535	min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 4 Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 4 Grid	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> At Rate Time To Empty	65535	min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> StateTime	21	s	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> At Rate OK	1	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Average Power	0	cW	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 1 DOD0	6848	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Temperature	23.0	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Int Temperature	20.3	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 2 DOD0	6768	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Voltage	11681	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TS1 Temperature	23.0	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 3 DOD0	6496	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Current	3	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TS2 Temperature	22.8	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 4 DOD0	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Average Current	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TS3 Temperature	23.0	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> DOD0 Passed Q	0	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Max Error	100	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TS4 Temperature	23.0	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> DOD0 Passed E	0	cWh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Relative State of Charge	64	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell Temperature	23.0	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> DOD0 Time	0	h/16	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Absolute State of Charge	57	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> FET Temperature	22.8	degC	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 1 DODEOC	1216	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Remaining Capacity	2475	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fit Rem Q	2475	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 2 DODEOC	1216	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Full charge Capacity	3893	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fit Rem E	2663	cWh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 3 DODEOC	1216	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Run time To Empty	65535	min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fit Full Chg Q	3893	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 4 DODEOC	0	-	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Average Time to Empty	65535	min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Fit Full Chg E	4317	cWh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Cell 1 QMax	4400	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Bit Registers

Name	Value	Log	Scan	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
<input checked="" type="checkbox"/> Battery Mode	0x6081	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CapM	ChgM	AM	RSVD	RSVD	RSVD	PB	CC	CF	RSVD	RSVD	RSVD	RSVD	RSVD	PBS	ICC
<input checked="" type="checkbox"/> Battery Status	0x48C0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	OCA	TCA	RSVD	OTA	TDA	RSVD	RCA	RTA	INIT	DSG	FC	FD	EC3	EC2	EC1	EC0
<input checked="" type="checkbox"/> Operation Status A	0x6100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SLEEP	XCHG	XDSG	PF	SS	SDV	SEC1	SECO	BTP_INT	RSVD	FUSE	RSVD	PCHG	CHG	DSG	PRES
<input checked="" type="checkbox"/> Operation Status B	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	EMSHUT	CB	SLPCC	SLPAD	SMBCAL	INIT	SLEEPM	XL	CAL_O...	CAL	AUTO...	AUTH	LED	SDM
<input checked="" type="checkbox"/> Temp Range	0x08	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	OT	HT	STH	RT	STL	LT	UT
<input checked="" type="checkbox"/> Charging Status	0x0004	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	RSVD	RSVD	CCC	CVR	CCR	VCT	MCHG	SU	IN	HV	MV	LV	PV
<input checked="" type="checkbox"/> Gauging Status	0x00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>									CF	DSG	EDV	BAL_EN	TC	TD	FC	FD
<input checked="" type="checkbox"/> IT Status	0x0004	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	OCVFR	LDMD	RX	QMAX	VDQ	NSFM	RSVD	SLPQMAX	QEN	VOK	RDIS	RSVD	REST
<input checked="" type="checkbox"/> Manufacturing Status	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CAL_EN	LT_TEST	RSVD	RSVD	RSVD	LED_EN	FUSE_EN	BBR_EN	PF_EN	LF_EN	FET_EN	GAUGE...	DSG_T...	CHG_T...	PCHG...	
<input checked="" type="checkbox"/> Safety Alert A+B	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	CUVC	OTD	OTC	ASCDL	RSVD	ASCLL	RSVD	AOLDL	RSVD	OC2D	OC1D	OCC2	OCC1	COV	CUV
<input checked="" type="checkbox"/> Safety Status A+B	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	CUVC	OTD	OTC	ASCDL	ASCD	ASCLL	ASCC	AOLDL	AOLD	OC2D	OC1D	OCC2	OCC1	COV	CUV
<input checked="" type="checkbox"/> Safety Alert C+D	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	RSVD	UTD	UTC	PCHGC	CHGV	CHGC	OC	CTOS	RSVD	PTOS	RSVD	RSVD	OTF
<input checked="" type="checkbox"/> Safety Status C+D	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	RSVD	UTD	UTC	PCHGC	CHGV	CHGC	OC	RSVD	CTO	RSVD	PTO	HWDF	OTF
<input checked="" type="checkbox"/> PF Alert A+B	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	VIMA	VIMR	CD	IMP	CB	QIM	SOTF	RSVD	SOT	SOC2	SOCC	SOV	SUV
<input checked="" type="checkbox"/> PF Status A+B	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RSVD	RSVD	RSVD	VIMA	VIMR	CD	IMP	CB	QIM	SOTF	RSVD	SOT	SOC2	SOCC	SOV	SUV
<input checked="" type="checkbox"/> PF Alert C+D	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	TS4	TS3	TS2	TS1	RSVD	RSVD	OPNCELL	RSVD	RSVD	ZLVL	AFEC	AFER	FUSE	RSVD	DFETF	CFETF
<input checked="" type="checkbox"/> PF Status C+D	0x0000	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	TS4	TS3	TS2	TS1	RSVD	DFW	OPNCELL	IFC	PTC	ZLVL	AFEC	AFER	FUSE	RSVD	DFETF	CFETF
<input checked="" type="checkbox"/> LStatus	0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>													FIELD...	ITEN	OP1	CF0



bqProduction

The screenshot displays the bqProduction SBB software interface, divided into two main windows: Configuration and MultiStation Tester.

Configuration Window:

- Calibration Types:** Includes checkboxes for Cell Voltage (checked), Batt Voltage, Pack Voltage, Temperature, Int Sensor, Ext1 Sensor, Ext2 Sensor, Ext3 Sensor, Ext4 Sensor, Pack Current, and Board Offset.
- Voltage:** Reference Gain is 12101 mV, % Error is 20.
- Current:** Sense Resistor is 1.0 mOhm, % Error is 50.
- Dynamic Pack Data:** Starting Serial No. is 1, Date is 2014-08-29. Includes checkboxes for Skip on error and Use current Date.
- Temperature:** Max Offset is 25.0 degC.
- Target Selection:** Target is 4500_0_12-bq40z50.bqz. Includes checkboxes for Program Srec and Program DF Image. File path: C:\Users\ao176037\Desktop\40z50.srec.
- Buttons:** Configure VTI, Save Configuration, VTI Update, Allow VTI Update when Locked, Set VTI Password.
- Test Status:** Log Test Status to File is checked, path: C:\Users\ao176037\Desktop\40z50.log.

MultiStation Tester Window:

- Test Status:** A large "Start Test" button is visible. Summary statistics: Tested 0, Passed 0, Failed 0, Passed/Hour 0.
- Test Log:** A table with columns: Test No., Station ID, TimeStamp, Serial No., Error Code.



Design Process

Identify Product Requirements

- No. of series cells
- No. of parallel cells
- Protection required
- Special requirements
- Chemistry

Select Gauging Solution

- Gauging Algorithm
- Protection
- Cell balancing
- Select ChemID

Breadboard Concept

- TI EVMs
- ChemID Verification
- Preliminary Optimization Cycle
- Run test cycles
- Tweak parameters

Develop System Platform

- Custom PCB
- Final Optimization Cycle
- Run test cycles
- Setup golden file

Develop Production Tools

- bqProduction
- bqMTester
- Custom tools

Production



SREC File

bqEvaluation Program

file types:

- .senc: Contains the full flash memory.
- .dfi: Contains the full data flash memory.
- .rom: Contains the full data flash memory and header information.
- .gg Contains the data flash parameters that the user can change.
- .chem Contains the chemistry data.

bqStudio Program

file types:

- .srec: Contains the full flash memory. Formatted in industry standard Motorola S-record format.
- .gg.csv: Contains the data flash parameters that the user can change. **Formatted in CSV, but edit with a text editor to import into the device.**
- chemdat2: Contains the chemistry data.
- chemdat4:
- chemdat6:
- chemdat8:



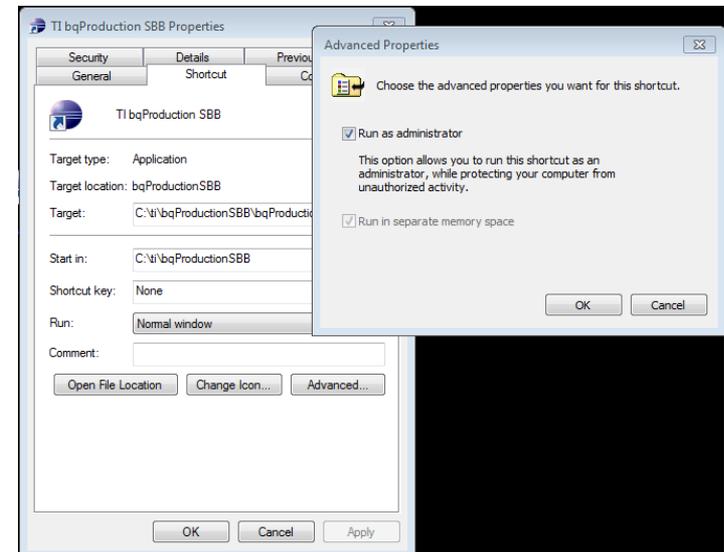
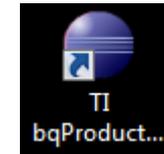
Golden File

- Run the Optimization Cycle to update Qmax and the Ra-table.
- Go to the **Data Flash** window and press the **Read All** button.
- Export the gg.csv file
- Edit the gg.csv file using a text editor. e.g. Notepad. Do not use Excel.
- Set the Update Status to 02 and set the Cycle Count to 0.
- Load the default .srec file into the device.
- Load the ChemID into the device.
- Load your modified gg.csv file into the device and press the Write All button.
- Save the golden .srec file.

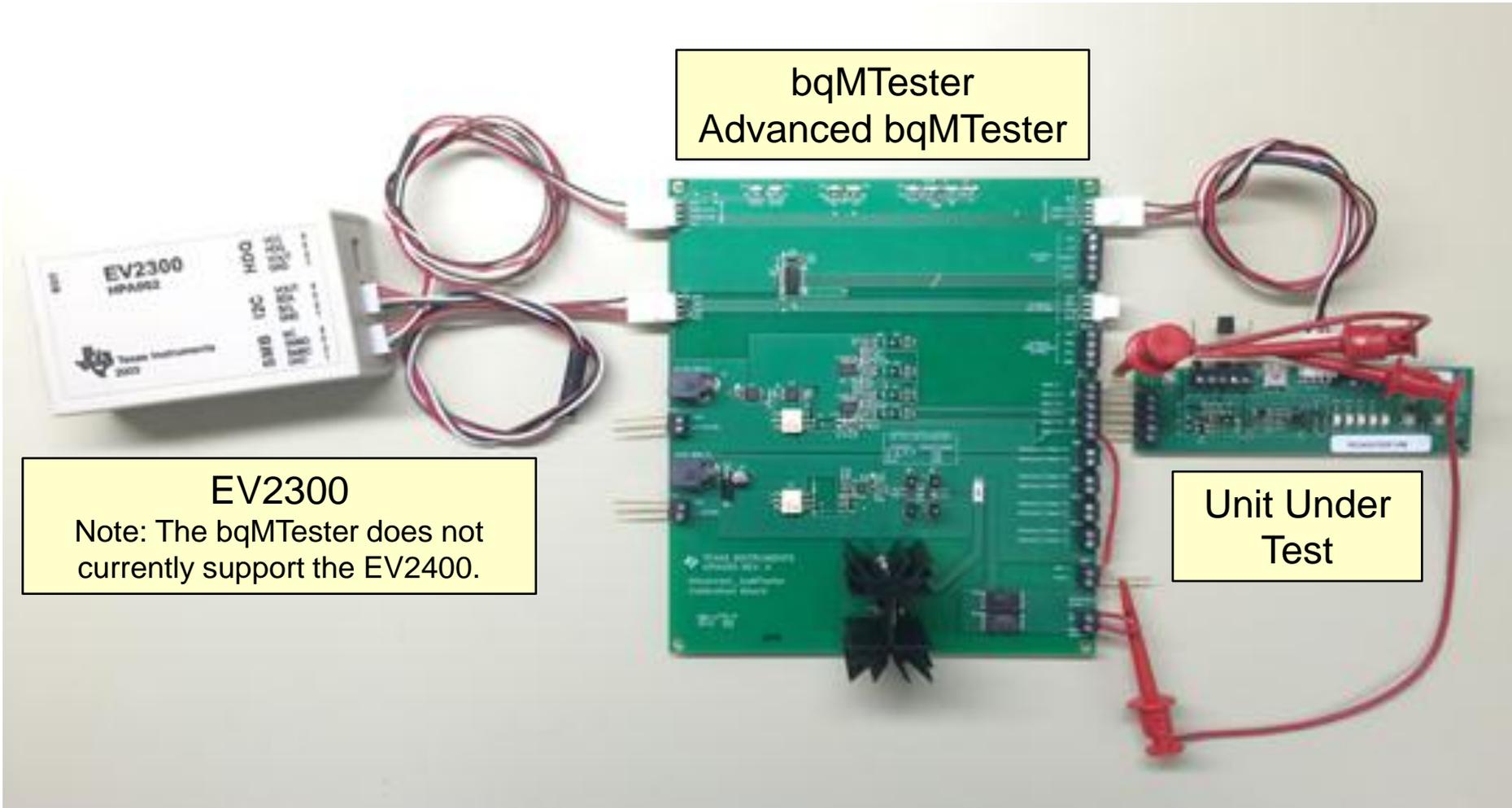


bqProduction

- The bqProduction setup program can be downloaded from the TI website. Search for bqProduction.
- Download and run the setup program.
- The files will be stored at C:\ti\bqProductionSBB.
- The shortcut should get placed on your desktop.
- Right click the icon and select Properties.
- Select Advanced and check the “Run as Administrator” box.
- Select OK to exit the configuration tool.



Items Needed



bqProduction

MultiStation Tester

Test Status

Message	Status

Start Test

Tested 0
Passed 0
Failed 0
Passed/Hour 0

Test Log

Test No.	Station ID	TimeStamp	Serial No.	Error Code



bqProduction

MultiStation Tester

Test Status

Message

Status

Start Test

Tested 0
Passed 0
Failed 0
Passed/Hour 0

Test Log

Test No.	Station ID	TimeStamp	Serial No.	Error Code
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The password is blank.
Just press **OK**.



bqProduction

The screenshot displays the bqProduction SBB software interface. The main window is titled "Station Setup" and contains a table for configuring individual stations. The table has the following columns: Adapter No., Station Id, Cal Board Found, Use for Test, and Flash LED's. The first row shows Adapter No. 1, Station Id bq40z50, Cal Board Found (unchecked), Use for Test (checked), and Flash LED's (unchecked). A yellow callout box is overlaid on the table with the following instructions:

- Select the **Scan Boards** button.
- You can rename the **Station list** names
- Check the **Flash LEDs** box to verify the setup.

To the right, the "MultiStation Tester" window is visible, showing a "Test Status" section with a "Start Test" button and a summary of test results: Tested 0, Passed 0, Failed 0, and Passed/Hour 0. Below this is a "Test Log" section with a table header: Test No., Station ID, TimeStamp, Serial No., and Error Code.



bqProduction

The screenshot displays the bqProduction SBB software interface. The main window is titled "Configuration" and contains several sections for setting up calibration types and tolerances. A "VTI Configuration (1 of 1)" dialog box is open, showing the station name "bq40z50" and various calibration parameters for Voltage, Current, and Temperature. The "MultiStation Tester" window on the right shows a "Start Test" button and test statistics. The "Test Log" window at the bottom right shows a table with columns for Test No., Station ID, TimeStamp, Serial No., and Error Code.

Configuration

Configure the calibration types and tolerances here

Calibration Types

- Cell Voltage
- Batt Voltage
- Pack Voltage
- Temperature
- Int Sensor
- Ext1 Sensor
- Ext2 Sensor
- Ext3 Sensor
- Ext4 Sensor
- Pack Current
- Board Offset

Voltage

Reference Gain 12101

% Error 20

Current

Sense Resistor 1.0

% Error 50

Dynamic Pack Data

Starting Serial No. 2

Date 2014-08-29

VTI Configuration (1 of 1)

Station Name: bq40z50

Voltage

Cell 8722 mV

Batt 14735 mV

Pack 14731 mV

Temperature

Int 24.0 degC

Ext1 25.0 degC

Ext2 25.0 degC

Ext3 25.0 degC

Ext4 25.0 degC

Current

-2000 mA

Buttons: Previous, Finish, Cancel

VTI Update

Allow VTI Update when Locked

Set VTI Password

Test Status

Log Test Status to File CAUsers\va0176037\Desktop\40z50.log

MultiStation Tester

Test Status

Message	Status
Start Test	
Tested	0
Passed	0
Failed	0
Passed/Hour	0

Test Log

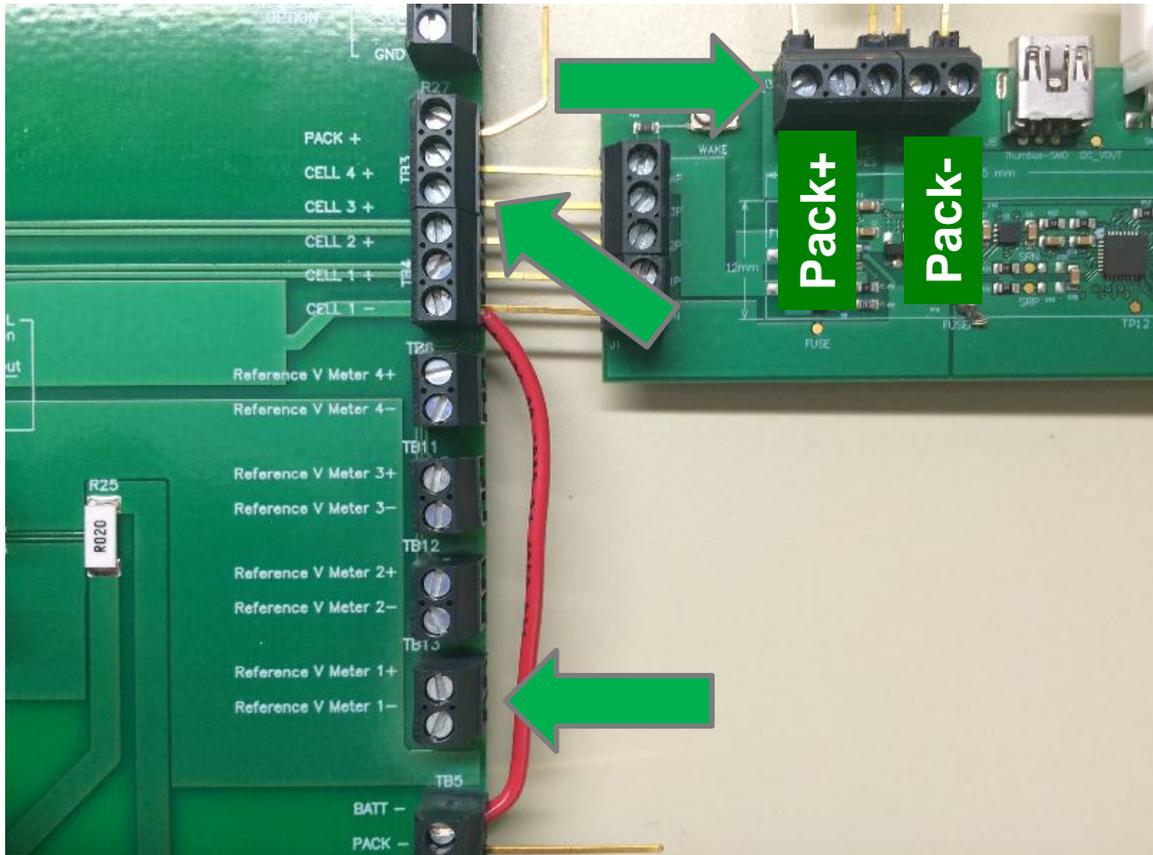
Test No.	Station ID	TimeStamp	Serial No.	Error Code
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Configure VTI

- Select the parameters to be calibrated.
- Press the **Save Configuration** button.
- Press the **Configure VTI** button and update the parameters.



bqProduction



Voltage Calibration:

Measure the Cell Voltage from CELL1+ to CELL1- or the Cell1 Reference V meter port.

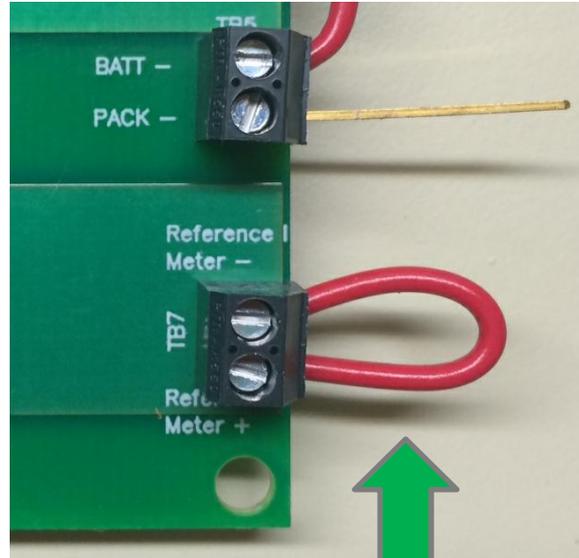
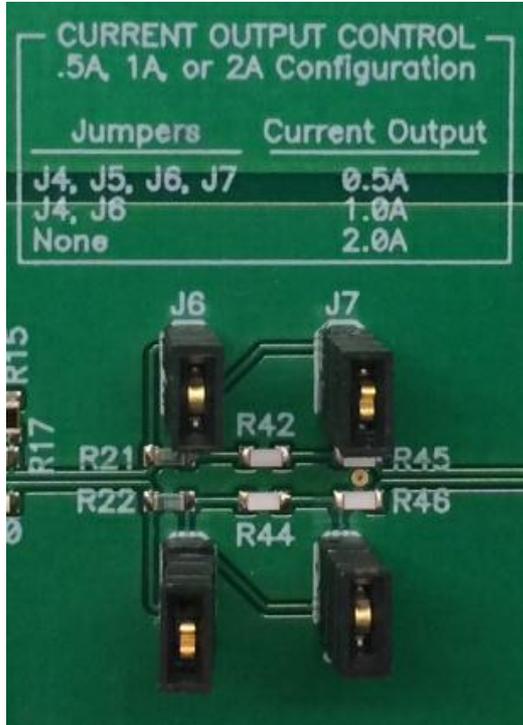
Measure the Battery Voltage from CELL1- to PACK+.

Measure the Pack Voltage from Pack+ to Pack-.

Enter the data into the **Configure VTI** screen.



bqProduction



Replace shunt with current meter.

Current Calibration:

Set the CURRENT OUTPUT CONTROL jumpers to select the calibration current.

Replace the TB7 shunt with a current meter.

Measure the discharge current.

Enter the data into the **Configure VTI** screen.



bqProduction

The screenshot displays the bqProduction SBB software interface. The main window is titled "Configuration" and contains several sections for setting up calibration types and tolerances. A "VTI Configuration (1 of 1)" dialog box is open in the foreground, showing settings for Station Name, Voltage, and Current. The dialog box has a "Finish" button highlighted. A yellow box with the text "Select the Finish button." is overlaid on the dialog box. The background window also shows a "MultiStation Tester" window with a "Start Test" button and a "Test Log" table.

Configuration

Configure the calibration types and tolerances here

Calibration Types

- Cell Voltage
- Batt Voltage
- Pack Voltage
- Temperature
- Int Sensor
- Ext1 Sensor
- Ext2 Sensor
- Ext3 Sensor
- Ext4 Sensor
- Pack Current
- Board Offset

Voltage

Reference Gain: 12101
% Error: 20

Temperature

degC

Current

Sense Resistor: 1.0
% Error: 50

Dynamic Pack Data

- Starting Serial No. 2
- Date: 2014-08-29

VTI Configuration (1 of 1)

Station Name: bq40z50

Voltage		Current	
Cell	8722 mV	Int	24.0 degC
Batt	14735 mV	Ext1	25.0 degC
Pack	14731 mV	Ext2	25.0 degC
		Ext3	25.0 degC
		Ext4	25.0 degC

Buttons: Previous, **Finish**, Cancel

MultiStation Tester

Test Status

Message	Status
Start Test	
Tested	0
Passed	0
Failed	0
Passed/Hour	0

Test Log

Test No.	Station ID	TimeStamp	Serial No.	Error Code
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Select the Finish button.



bqProduction

Message
Operation executed successfully.

Status
Passed

Start Test

Tested 2
Passed 2
Failed 0
Passed/Hour 94

Test Log

Test No.	Station ID	TimeStamp	Serial No.	Error Code
1	Station 1	2014-10-08 09:03:44.267	2	0
2	Station 1	2014-10-08 09:04:09.837	3	0

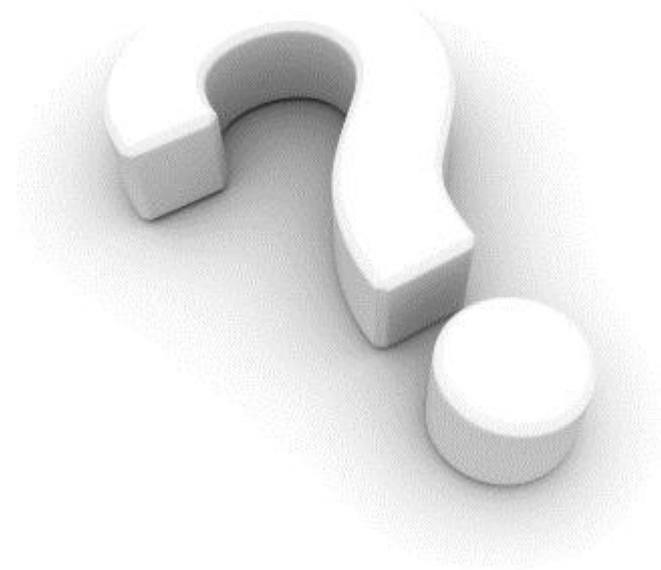
Select the Start Test button to execute the test.



Demonstration

bqProduction





Questions

