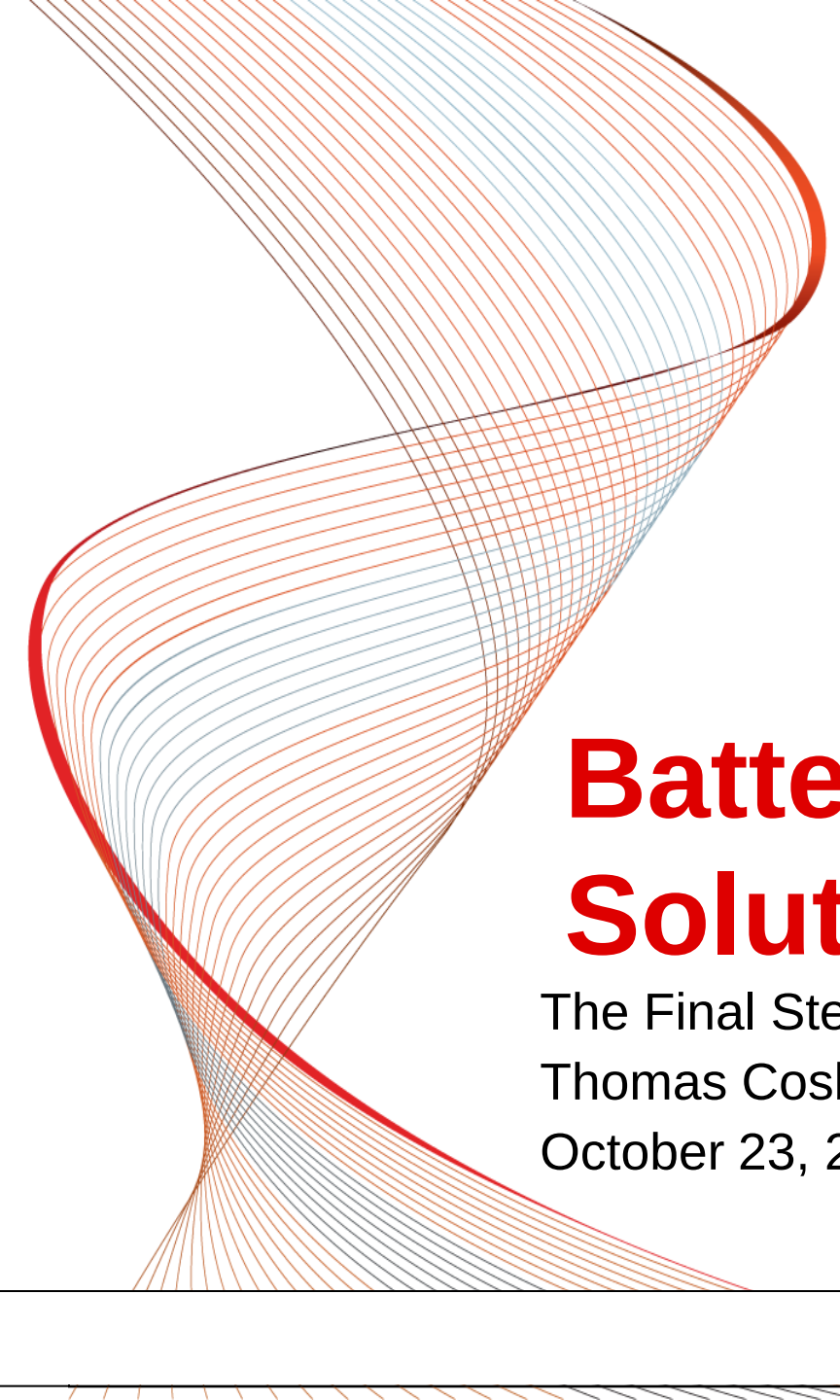




Battery Management Solutions

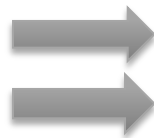
The Final Steps to Production

Thomas Cosby

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

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
Manufacturer Access	0x6100	hex	☒	☒
Remaining Cap. Alarm	300	mAh	☒	☒
Remaining Time Alarm	10	min	☒	☒
At Rate	0	mA	☒	☒
At Rate Time To Full	65535	min	☒	☒
At Rate Time To Empty	65535	min	☒	☒
At Rate OK	1	-	☒	☒
Temperature	23.0	degC	☒	☒
Voltage	11681	mV	☒	☒
Current	3	mA	☒	☒
Average Current	0	mA	☒	☒
Max Error	100	%	☒	☒
Relative State of Charge	64	%	☒	☒
Absolute State of Charge	57	%	☒	☒
Remaining Capacity	2475	mAh	☒	☒
Full charge Capacity	3893	mAh	☒	☒
Run time To Empty	65535	min	☒	☒
Average Time to Empty	65535	min	☒	☒

Name	Value	Units	Log	Scan
Cell 4 Current	0	mA	☒	☒
Cell 1 Power	0	cW	☒	☒
Cell 2 Power	0	cW	☒	☒
Cell 3 Power	0	cW	☒	☒
Cell 4 Power	0	cW	☒	☒
Power	0	cW	☒	☒
Average Power	0	cW	☒	☒
Int Temperature	20.3	degC	☒	☒
TS1 Temperature	23.0	degC	☒	☒
TS2 Temperature	22.8	degC	☒	☒
TS3 Temperature	23.0	degC	☒	☒
TS4 Temperature	23.0	degC	☒	☒
Cell Temperature	23.0	degC	☒	☒
FET Temperature	22.8	degC	☒	☒
Fit Rem Q	2475	mAH	☒	☒
Fit Rem E	2663	cWH	☒	☒
Fit Full Chg Q	3893	mAH	☒	☒
Fit Full Chg E	4317	cWH	☒	☒

Name	Value	Units	Log	Scan
PackGrid	0	-	☒	☒
Cell 1 Grid	0	-	☒	☒
Cell 2 Grid	0	-	☒	☒
Cell 3 Grid	0	-	☒	☒
Cell 4 Grid	0	-	☒	☒
StateTime	21	s	☒	☒
Cell 1 DOD0	6848	-	☒	☒
Cell 2 DOD0	6768	-	☒	☒
Cell 3 DOD0	6496	-	☒	☒
Cell 4 DOD0	0	-	☒	☒
DOD0 Passed Q	0	mAh	☒	☒
DOD0 Passed E	0	cWh	☒	☒
DOD0 Time	0	h/16	☒	☒
Cell 1 DODEOC	1216	-	☒	☒
Cell 2 DODEOC	1216	-	☒	☒
Cell 3 DODEOC	1216	-	☒	☒
Cell 4 DODEOC	0	-	☒	☒
Cell 1 QMax	4400	mAh	☒	☒

Bit Registers

Name	Value	Log	Scan	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Battery Mode	0x6081	☒	☒	CapM	ChgM	AM	RSVD	RSVD	RSVD	PB	CC	CF	RSVD	RSVD	RSVD	RSVD	RSVD	PBS	ICC
Battery Status	0x48C0	☒	☒	OCA	TCA	RSVD	OTA	TDA	RSVD	RCA	RTA	INIT	DSG	FC	FD	EC3	EC2	EC1	EC0
Operation Status A	0x6100	☒	☒	SLEEP	XCHG	XDSG	PF	SS	SDV	SEC1	SEC0	BTP_INT	RSVD	FUSE	RSVD	PCHG	CHG	DSG	PRES
Operation Status B	0x0000	☒	☒	RSVD	RSVD	EMSHUT	CB	SLPCC	SLPAD	SMBCAL	INIT	SLEEPM	XL	CAL_O...	CAL	AUTO...	AUTH	LED	SDM
Temp Range	0x08	☒	☒	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	OT	HT	STH	RT	STL	LT	UT
Charging Status	0x0004	☒	☒	RSVD	RSVD	RSVD	RSVD	RSVD	CCC	CVR	CCR	VCT	MCHG	SU	IN	HV	MV	LV	PV
Gauging Status	0x00	☒	☒	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	CF	DSG	EDV	BAL_EN	TC	TD	FC	FD
IT Status	0x0004	☒	☒	RSVD	RSVD	RSVD	OCVFR	LDMD	RX	QMAX	VDQ	NSFM	RSVD	SLPQMAX	QEN	VOK	RDIS	RSVD	REST
Manufacturing Status	0x0000	☒	☒	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...	
Safety Alert A+B	0x0000	☒	☒	RSVD	CUVC	OTD	OTC	ASCDL	RSVD	ASCCL	RSVD	AOLDL	RSVD	OC2	OC1	OCC2	OCC1	COV	CUV
Safety Status A+B	0x0000	☒	☒	RSVD	CUVC	OTD	OTC	ASCDL	ASCD	ASCCL	ASCC	AOLDL	AOLD	OC2	OC1	OCC2	OCC1	COV	CUV
Safety Alert C+D	0x0000	☒	☒	RSVD	RSVD	RSVD	RSVD	UTD	UTC	PCHGC	CHGV	CHGC	OC	CTOS	RSVD	PTOS	RSVD	OTF	
Safety Status C+D	0x0000	☒	☒	RSVD	RSVD	RSVD	RSVD	UTD	UTC	PCHGC	CHGV	CHGC	OC	RSVD	CTO	RSVD	PTO	HWDF	OTF
PF Alert A+B	0x0000	☒	☒	RSVD	RSVD	RSVD	VIMA	VIMR	CD	IMP	CB	QIM	SOTF	RSVD	SOT	SOC2	SOCC	SOV	SUV
PF Status A+B	0x0000	☒	☒	RSVD	RSVD	RSVD	VIMA	VIMR	CD	IMP	CB	QIM	SOTF	RSVD	SOT	SOC2	SOCC	SOV	SUV
PF Alert C+D	0x0000	☒	☒	TS4	TS3	TS2	TS1	RSVD	RSVD	OPNCELL	RSVD	RSVD	2LVL	AFEC	AFER	FUSE	RSVD	DFETP	CFETP
PF Status C+D	0x0000	☒	☒	TS4	TS3	TS2	TS1	RSVD	DFW	OPNCELL	IFC	PTC	2LVL	AFEC	AFER	FUSE	RSVD	DFETP	CFETP
LSStatus	0	☒	☒													FIELD...	ITEN	CF1	CF0



bqProduction

bqProduction SBB

File Admin Window Help

Station Setup Configuration

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 mV
% Error

Current

Sense Resistor mOhm
% Error

Temperature

Max Offset degC

Target Selection

Target
☐ Program Srec ☐ Program DF Image

Dynamic Pack Data

☒ Starting Serial No. ☐ Skip on error
☐ Date ☐ Use current Date

VTI Update

☐ Allow VTI Update when Locked

Test Status

☒ Log Test Status to File

MultiStation Tester

VTI Update

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
----------	------------	-----------	------------	------------



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:



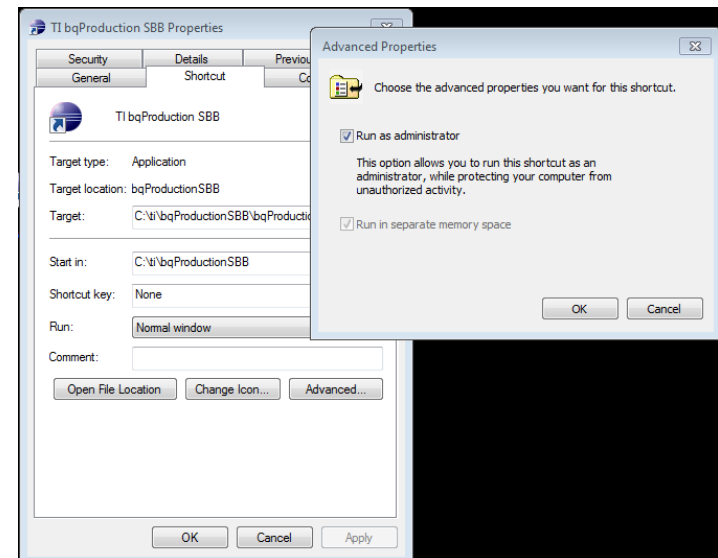
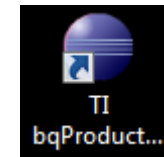
Golden File

- 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.

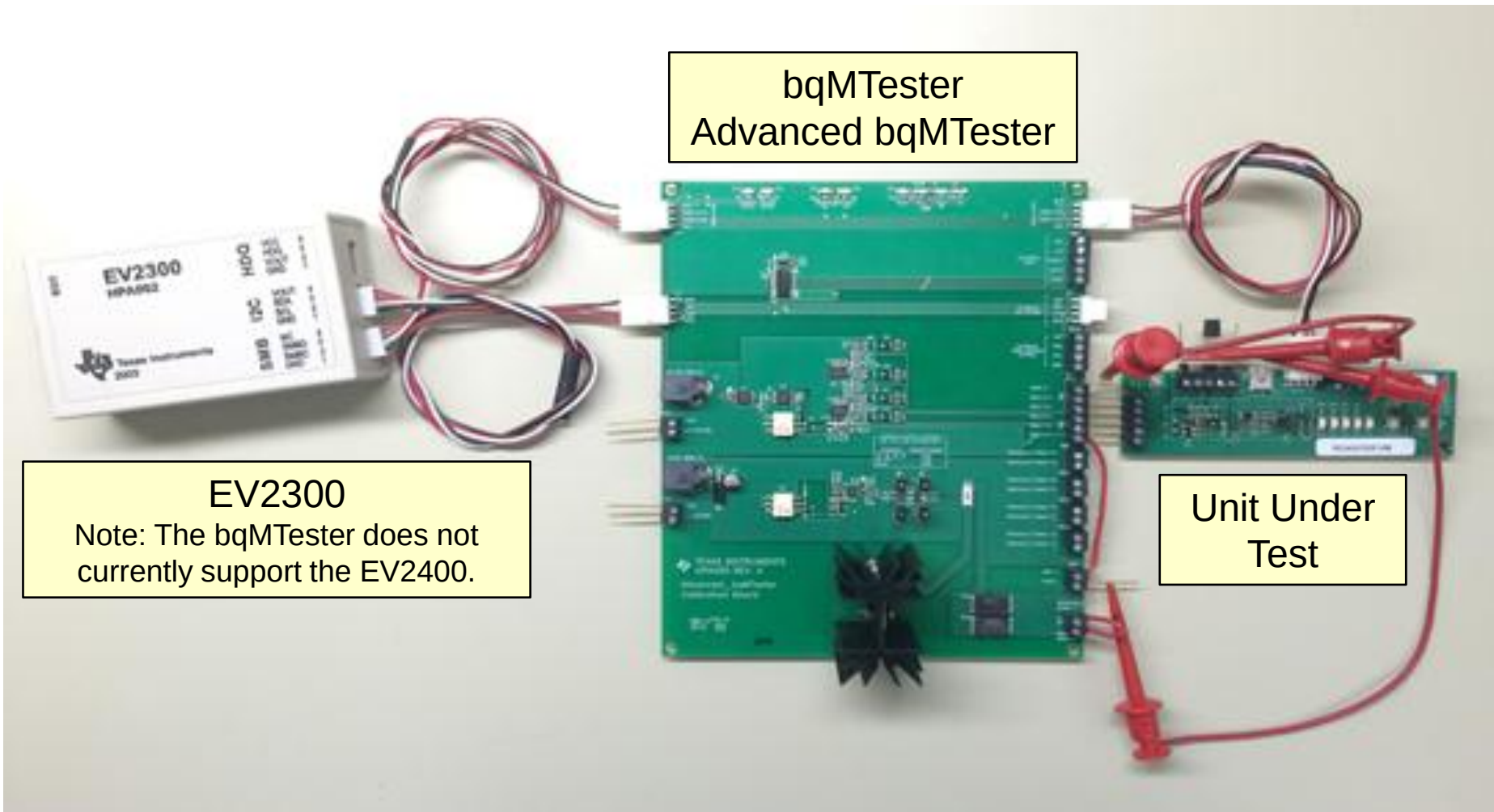


bqProduction

- 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.



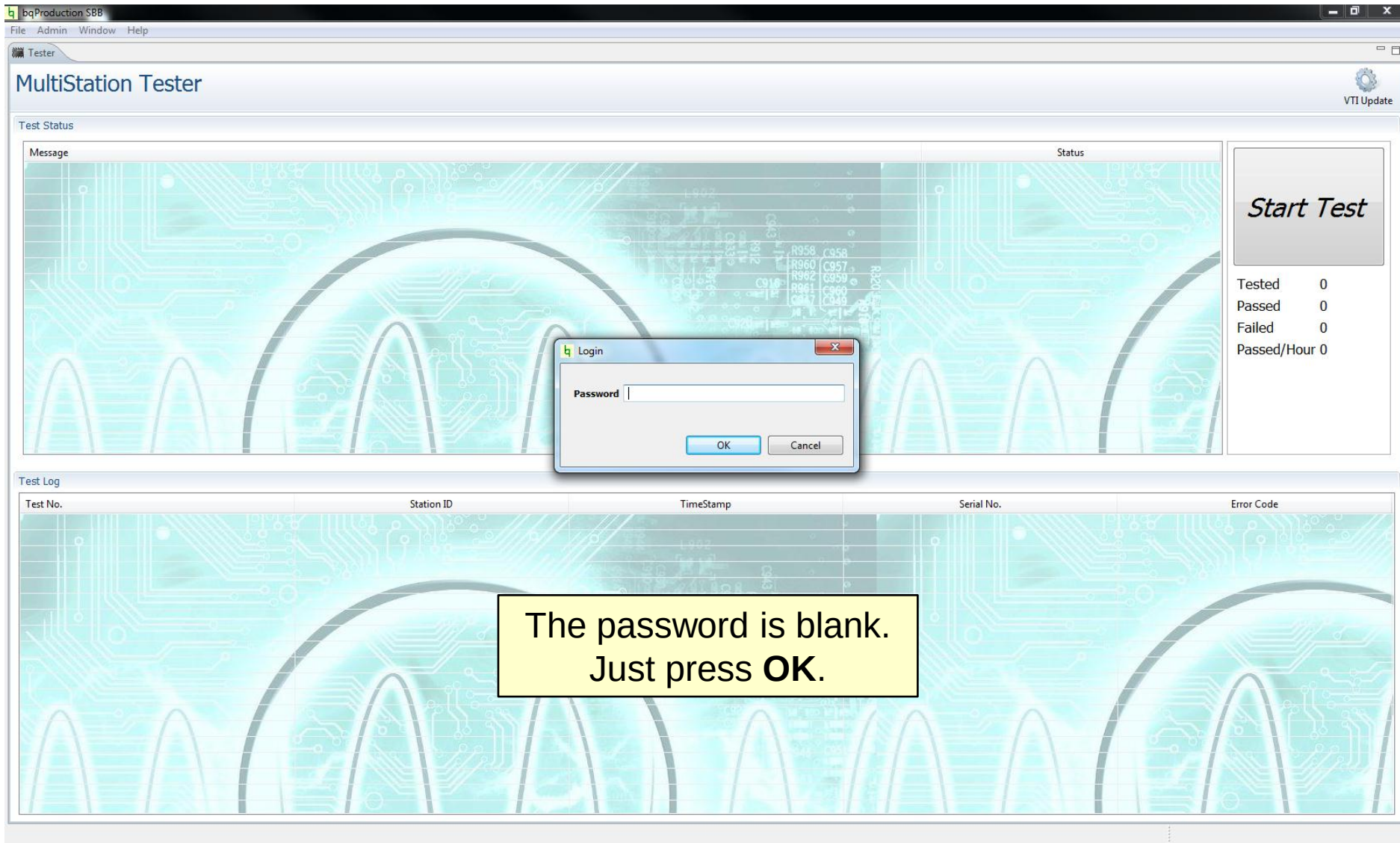
Items Needed



The image shows a screenshot of the 'MultiStation Tester' software interface. At the top, the window title is 'bqProduction SB8'. Below it is a menu bar with 'File', 'Admin', 'Window', and 'Help'. The main header area contains the text 'MultiStation Tester' on the left and a 'VTI Update' button on the right. The interface is divided into two main sections. The top section, titled 'Test Status', contains a large area with a circuit board background and a central component labeled 'L902'. To the right of this area is a 'Start Test' button and a statistics panel showing 'Tested 0', 'Passed 0', 'Failed 0', and 'Passed/Hour 0'. The bottom section, titled 'Test Log', is currently empty and has headers for 'Test No.', 'Station ID', 'TimeStamp', 'Serial No.', and 'Error Code'. The entire interface has a light blue and white color scheme with a circuit board pattern in the background.



bqProduction



bqProduction

Station Setup

Setup the individual stations here

Adapter No.	Station Id	Cal Board Found	Use for Test	Flash LED's
1	bq40z50	☐	☒	☐

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

The screenshot displays the bqProduction SBB software interface. The main window is titled "Configuration" and contains sections for "Calibration Types", "Voltage", "Current", "Dynamic Pack Data", "VTI Update", and "Test Status". A "VTI Configuration (1 of 1)" dialog box is open, showing fields for "Station Name", "Voltage", "Current", and "Temperature". The "VTI Configuration" dialog box has the following fields:

- Station Name: bq40z50
- Voltage: Cell 8722 mV, Batt 14735 mV, Pack 14731 mV
- Current: -2000 mA
- Temperature: Int 24.0 degC, Ext1 25.0 degC, Ext2 25.0 degC, Ext3 25.0 degC, Ext4 25.0 degC

The "VTI Configuration" dialog box has "Previous", "Finish", and "Cancel" buttons. The "VTI Update" section has a checkbox for "Allow VTI Update when Locked" and a "Set VTI Password" button. The "Test Status" section has a checkbox for "Log Test Status to File" and a file path "C:\Users\ao176037\Desktop\40z50.log".

On the right side of the interface, there is a "MultiStation Tester" window. It has a "Test Status" section with a "Start Test" button and a table showing test results:

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

Below the "Test Status" section is a "Test Log" section with a table showing test results:

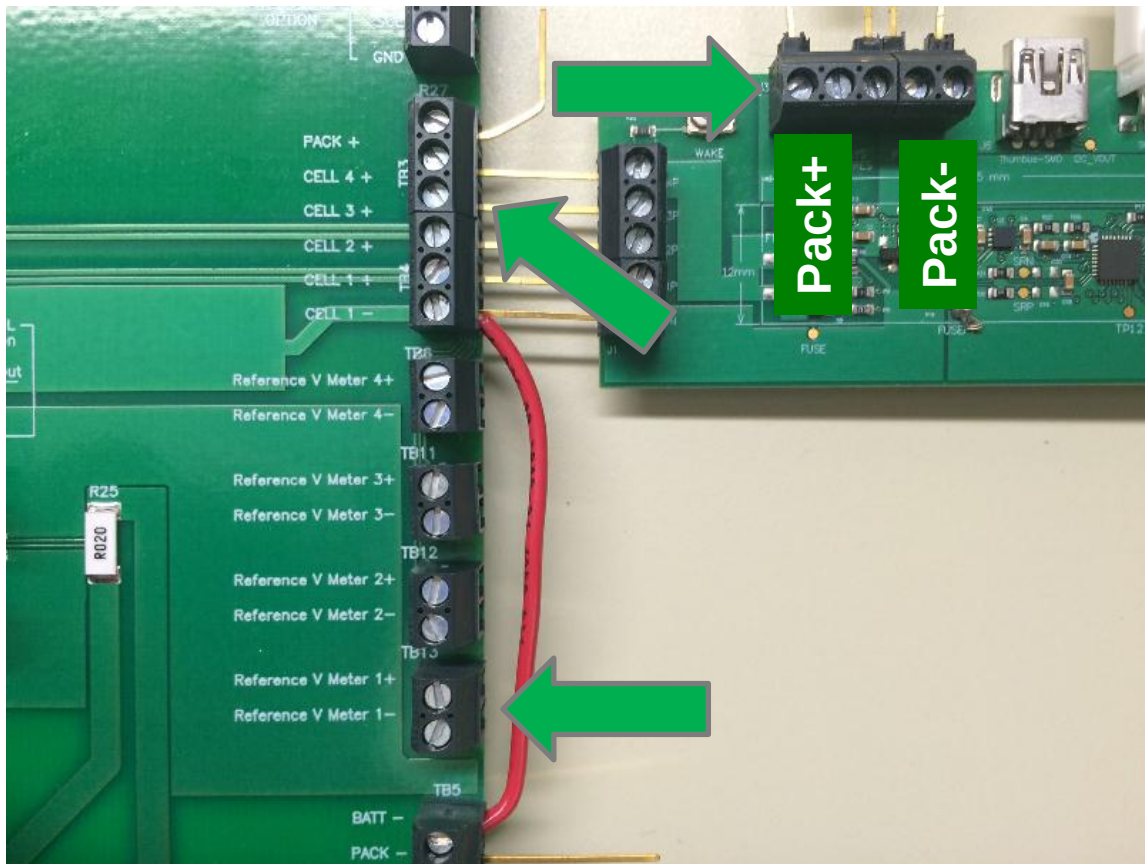
Test No.	Station ID	TimeStamp	Serial No.	Error Code
----------	------------	-----------	------------	------------

A yellow box at the bottom of the screenshot contains the following instructions:

- 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.

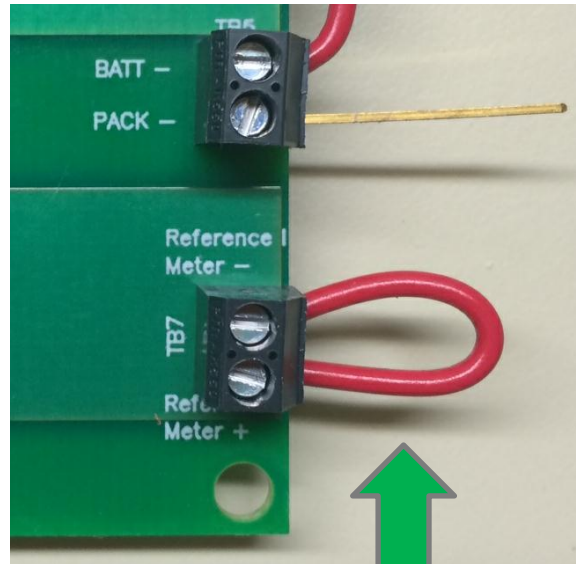
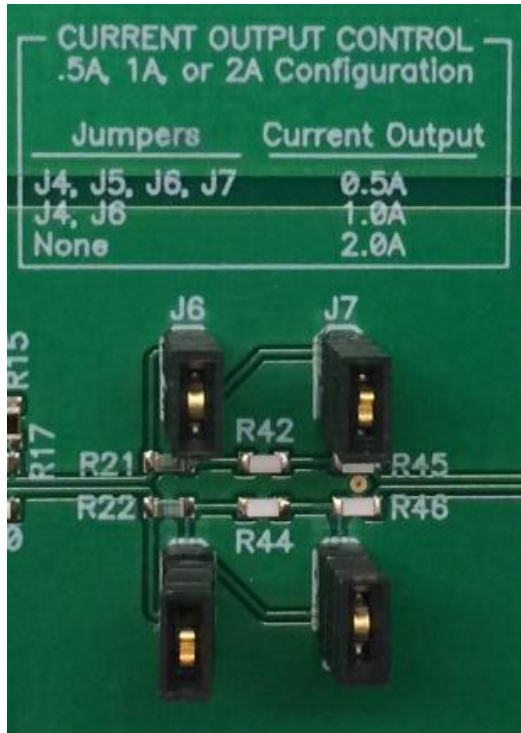
Measure the Battery Voltage from CELL1- to PACK+.

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

bqProduction SBB

File Admin Window Help

Station Setup Configuration

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

Configure VTI

Temperature

degC

VTI Configuration (1 of 1)

Station Name: bq40z50

Voltage

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

Current

-2000 mA

Previous Finish Cancel

VTI Update

☒ Allow VTI Update when Locked

Set VTI Password

Test Status

☒ Log Test Status to File CA\Users\ao176037\Desktop\40z50.log

MultiStation Tester

VTI Update

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
----------	------------	-----------	------------	------------

Select the Finish button.



bqProduction

bqProduction SBB

File Admin Window Help

Tester

MultiStation Tester

VTI Update

Test Status

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

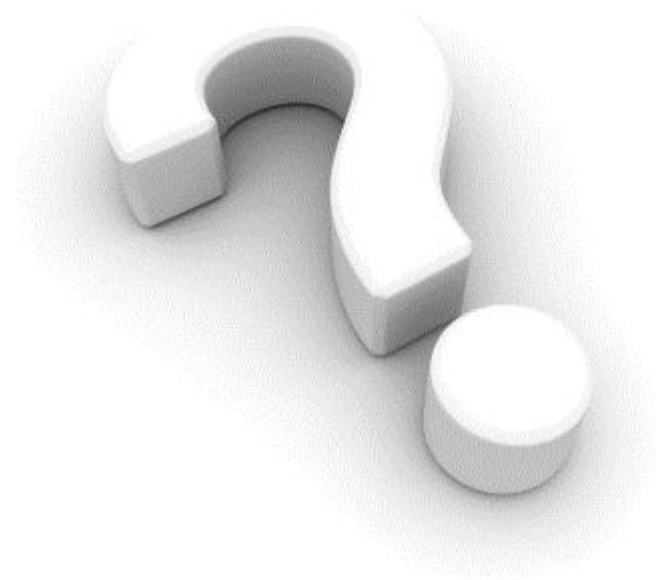
Select the Start Test button to execute the test.



Demonstration

bqProduction





Questions

