



Introduction to BQStudio and TI tool chain for gauge evaluation

Battery Management Deep Dive Training

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Battery Management Studio (BQStudio)

- Introduction
- Views
- Dashboard
- Chemistry
- Advanced features
- Troubleshooting
- Useful links

Introduction

- Battery Management Studio (BQStudio) offers a full suite of robust tools to assist with the process of evaluating, designing with, configuring, testing, or otherwise utilizing TI Battery management products.
- Includes features that provide
 - full access to registers and data memory
 - support for real-time watching, graphing, and logging
 - an easy interface to send commands, direct low-level communication and I/O
 - automated and guided support for configuration, calibration, performing a learning cycle, and generating useful files for taking the device to production

Installing BQStudio

- Download BQStudio software from <https://www.ti.com/tool/BQSTUDIO>
- Complete Export Control Form to download
- Requires admin privileges for installation
- EV2400 does not require drivers

- **BQSTUDIO-STABLE**
 - Choose this if your product is on the list of supported devices
- **BQSTUDIO-TEST**
 - Is the latest untested release
 - Choose this only if your product is not supported by BQSTUDIO-STABLE or to work around any known issues in BQSTUDIO-STABLE

Introduction to BQStudio

- **TI's proprietary Battery management GUI software**
- **Authenticate, monitor and control: gauges, chargers and monitors, protectors**
- **Helps users design BMS Fuel Gauges**
 - Real-time Gauge Dashboard for monitoring basic registers
 - Full register access and logging
 - Full data memory access and logging
 - Product configuration and monitoring tools
 - Import and export of product configurations
 - Calibration and test automation
 - Export of FS files for the target production environment
- **Is a collection of views to perform specific tasks**

Typical gauge evaluation flow

1. Program Chemistry
2. Program data flash parameters
3. Calibrate
4. Learning cycle and optimization using GPC tools
5. Create golden image
6. Program fresh packs with golden image

Views in Battery Management Studio

- **Each view is a tab**
- **Customized for specific device**
- **Toolbar and menu items to open corresponding tabs**

Common views are:

- **Registers**
 - Shows Charger registers or Gauge RAM Data registers
- **Advance Communication**
 - Allows low level read/write on I2C and SMBus communication bus
- **Calibration**
 - Calculates and stores the actual corrections
- **Data Flash**
 - Read/Write from/to non-volatile storage registers in the fuel gauge

Typical gauge view (Registers)

Battery Management Studio (bqStudio) 1.3.44

File View Window Help

Project Registers Data Memory Commands Calibration Authentication Chemistry Advanced Comm Programming Golden Image Watch Data Graph Errors Learning Cycle Parameter Q&A I2C To HDQ

Battery Mana...

DashBoard

Auto Refresh is ON - Click to Turn OFF
bqStudio Version: 1.3.44

EV2300
Version:3.1r

I2C

bq27514G1
0541_2_24
Addr: 0xAA
30.2 °C

4001 mV
81%

Registers

Start Log Scan Refresh

Commands

CONTROL_STATUS
DEVICE_TYPE
FW_VERSION
HW_VERSION
RESET_DATA
PREV_MACWRITE
CHEM_ID
BOARD_OFFSET
CC_OFFSET
CC_OFFSET_SAVE
DF_VERSION

Manual Control Panel

Enter Cmd Delay Ms
1000

Read Addr Length

Log Panel Clear Log

Transaction Log
Name Cmd Result

Registers

Name	Value	Units	Name	Value	Units	Name	Value	Units
<input checked="" type="checkbox"/> Control	0x0224	Hex	<input checked="" type="checkbox"/> Full Charge Capacity	945	mAh	<input checked="" type="checkbox"/> Filtered RM	760	mAh
<input checked="" type="checkbox"/> At Rate	0	mA	<input checked="" type="checkbox"/> Average Current	0	mA	<input checked="" type="checkbox"/> Average Power	0	mw/cw
<input checked="" type="checkbox"/> Unfiltered SOC	81	%	<input checked="" type="checkbox"/> Time to Empty	65535	Min	<input checked="" type="checkbox"/> Internal Temperature	25.3	°C
<input checked="" type="checkbox"/> Temperature	30.2	°C	<input checked="" type="checkbox"/> Filtered FCC	945	mAh	<input checked="" type="checkbox"/> Cycle Count	0	Num
<input checked="" type="checkbox"/> Voltage	4001	mV	<input checked="" type="checkbox"/> Standby Current	-10	mA	<input checked="" type="checkbox"/> State Of Charge	81	%
<input checked="" type="checkbox"/> Nom Available Capacity	778	mAh	<input checked="" type="checkbox"/> Unfiltered FCC	945	mAh	<input checked="" type="checkbox"/> State Of Health	95	Num
<input checked="" type="checkbox"/> Full Available Capacity	963	mAh	<input checked="" type="checkbox"/> Max Load Current	-500	mA	<input checked="" type="checkbox"/> Passed Charge	0	mAh
<input checked="" type="checkbox"/> Remaining Capacity	760	mAh	<input checked="" type="checkbox"/> Unfiltered RM	760	mAh	<input checked="" type="checkbox"/> DOD0	3504	Num
						<input checked="" type="checkbox"/> Self Discharge Current	0	mA
						<input checked="" type="checkbox"/> Design Capacity	1000	mAh

Bit Registers

Name	Value	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
<input checked="" type="checkbox"/> Control Status (hi...)	0x0094	SE	FAS	SS	CALMODE	CCA	BCA	RSVD	HDGHOSTIN
<input checked="" type="checkbox"/> Control Status (lo...)		SHUTDOWN	HIBERNATE	FULL SLEEP	SLEEP	LDMD	RUP_DIS	VOK	GEN
<input checked="" type="checkbox"/> Flags (high)	0x0108	OTC	OTD	BATHI	BATLOW	CHG_INH	RSVD	FC	CHG
<input checked="" type="checkbox"/> Flags (low)		OCVTAKEN	ISD	TDD	HW1	HW0	SOC1	SOCF	DSG
<input checked="" type="checkbox"/> Pack Configuratio...	0x5177	RESCAP	CALEN	INTPOL	INTSEL	RSVD	WAKE	RSMS1	RSNS0
<input checked="" type="checkbox"/> Pack Configuratio...		GNDSEL	RFACTSTEP	SLEEP	RMFCC	SE_PU	SE_POL	SE_EN	TEMPS

Bit Status 0 Bit Status 1

TEXAS INSTRUMENTS

Typical gauge view (Data Memory)

Battery Management Studio (bqStudio) 1.3.101

File View Window Help

Project Registers Data Memory Commands Calibration Advanced Comm Chemistry Authentication Programming Golden Image

Learning Cycle Parameter Q&A I2C to HDQ Watch Data Graph Errors

Dashboard Registers Data Memory Chemistry

Auto Refresh is ON - Click to Turn OFF

bqStudio Version: 1.3.101

Version:

Configuration System Data Gas Gauging OCV Table Ra Table Calibration Security

Data Memory

Filter/Search Auto Export Export Import Write All Read All

Read/Write Data Memory Contents

Configuration	Name	Value	Unit	Subclass ID	Data Length	Block Number	Block Offset	Native Units
	Safety							
	OT Chg		°C	0x2	2	0	0	0.1°C
	OT Chg Time		s	0x2	1	0	2	s
	OT Chg Recovery		°C	0x2	2	0	3	0.1°C
	OT Dsg		°C	0x2	2	0	5	0.1°C
	OT Dsg Time		s	0x2	1	0	7	s
	OT Dsg Recovery		°C	0x2	2	0	8	0.1°C
	Charge Inhibit Cfg							
	Chg Inhibit Temp Low		°C	0x20	2	0	0	°C
	Chg Inhibit Temp High		°C	0x20	2	0	2	°C
	Temp Hys		°C	0x20	2	0	4	°C
	Charge							
	Charging Voltage		mV	0x22	2	0	0	mV
	Charge Termination							
	Taper Current		mA	0x24	2	0	0	mA
	Min Taper Capacity		mAh	0x24	2	0	2	mAh
	Taper Voltage		mV	0x24	2	0	4	mV
	Current Taper Window		s	0x24	1	0	6	s
	TCA Set %		%	0x24	1	0	7	%
	TCA Clear %		%	0x24	1	0	8	%
	FC Set %		%	0x24	1	0	9	%
	FC Clear %		%	0x24	1	0	10	%
	DODatEOC Delta T		°C	0x24	2	0	11	0.1°C
	Data							
	Rem Cap Alarm		mAh	0x30	2	0	0	mAh
	Design Voltage		mV	0x30	2	0	6	mV
	Initial Standby		mA	0x30	1	0	8	mA
	Initial MaxLoad		mA	0x30	2	0	9	mA
	Cycle Count		Num	0x30	2	0	17	Num
	CC Threshold		mAh	0x30	2	0	19	mAh
	Design Capacity		mAh	0x30	2	0	23	mAh
	Design Energy		mWh	0x30	2	0	25	mWh
	SOH Load I		mA	0x30	2	0	27	mA
	TDD SOH Percent		%	0x30	1	0	29	%
	ISD Current		Hr rate	0x30	2	1	8	Hr rate
	ISD I Filter		Num	0x30	1	1	10	Num
	Min ISD Time		Hours	0x30	1	1	11	Hours

Commands

- CONTROL_STATUS
- DEVICE_TYPE
- FW_VERSION
- HW_VERSION
- RESET_DATA
- PREV_MACWRITE
- CHEM_ID
- BOARD_OFFSET
- CC_OFFSET
- CC_OFFSET_SAVE
- DF_VERSION
- SET_FULLSLEEP
- SET_HIBERNATE
- CLEAR_HIBERNATE
- SET_SHUTDOWN
- CLEAR_SHUTDOWN
- SET_HDQINTEN

Log Panel Clear Log

Transaction Log

Name	Cmd	Result	Read ...

Operation failed because initial read of all data flash failed.

Typical gauge view (Programming)

Battery Management Studio (bqStudio) 1.3.101

File View Window Help

Project Registers Data Memory Commands Calibration Advanced Comm Chemistry Authentication Programming Golden Image

Learning Cycle Parameter Q&A HDQ I2C To HDQ Watch Data Graph Errors

Dashboard Registers Data Memory Chemistry Programming

Auto Refresh is ON - Click to Turn OFF
bqStudio Version: 1.3.101

Version:

Perform Programming

This plug-in will allow you to program image files to a device.
Select Programmable File

C:\Users\{a0867361}\Downloads\Temp\AKA05_20200707.srec

Browse...
Program
Execute FW

Commands

- CONTROL_STATUS
- DEVICE_TYPE
- FW_VERSION
- HW_VERSION
- RESET_DATA
- PREV_MACWRITE
- CHEM_ID
- BOARD_OFFSET
- CC_OFFSET
- CC_OFFSET_SAVE
- DF_VERSION
- SET_FULLSLEEP
- SET_HIBERNATE
- CLEAR_HIBERNATE
- SET_SHUTDOWN
- CLEAR_SHUTDOWN
- SET_HDQINTEN

Log Panel Clear Log

Transaction Log

Name	Cmd	Result	Read ...

TEXAS INSTRUMENTS

Typical single cell gauge view (Golden Image)

Battery Management Studio (bqStudio) 1.3.101

File View Window Help

Project Registers Data Memory Commands Calibration Advanced Comm Chemistry Authentication Programming Golden Image

Learning Cycle Parameter Q&A I2C To HDQ Watch Data Graph Errors

DashBoard Registers Data Memory Chemistry Programming Golden Image

Golden Image

Golden Image Export

This plug-in will allow you to export image files.
It will read the data memory contents of the connected gauge and save it to your hard drive in various formats.

Output Location

Output Directory: C:\ti\BatteryManagementStudio\OutputFiles

Base File Name: 0545_2_24-bq27545G1

Output Formats

<input checked="" type="checkbox"/>	SREC File (.srec)	0545_2_24-bq27545G1.srec	<input type="button" value="Options"/>
<input checked="" type="checkbox"/>	BQFS File (.fs)	0545_2_24-bq27545G1.bq.fs	<input type="button" value="Options"/>
<input checked="" type="checkbox"/>	DFFS File (.fs)	0545_2_24-bq27545G1.df.fs	<input type="button" value="Options"/>

Commands

- CONTROL_STATUS
- DEVICE_TYPE
- FW_VERSION
- HW_VERSION
- RESET_DATA
- PREV_MACWRITE
- CHEM_ID
- BOARD_OFFSET
- CC_OFFSET
- CC_OFFSET_SAVE
- DF_VERSION
- SET_FULLSLEEP
- SET_HIBERNATE
- CLEAR_HIBERNATE
- SET_SHUTDOWN
- CLEAR_SHUTDOWN
- SET_HDQINTEN

Log Panel

Transaction Log

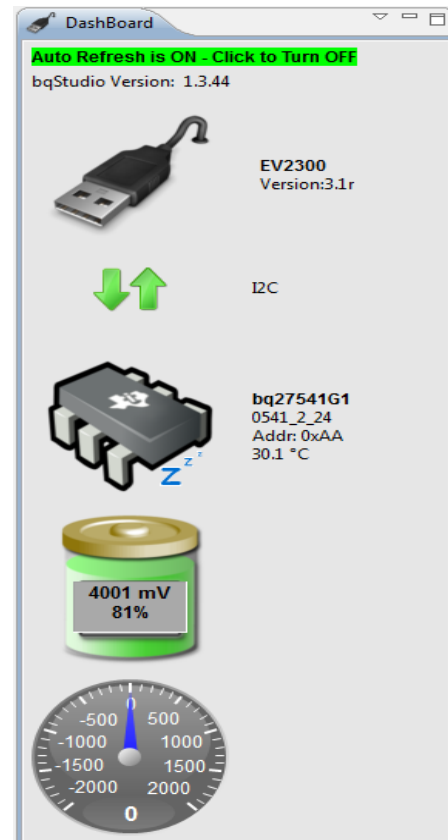
Name	Cmd	Result	Read ...

Not able to find a free communications adapter.

TEXAS INSTRUMENTS

Dashboard

- **Visual panel shows status of connected hardware:**
 - Adapter type / Version i.e. EV2300 or 2400
 - Communication Protocol i.e. SMB's or I2C
 - Device Name & Version e.g. BQ28Z610
 - Voltage, Temperature, Current, RSOC
- **May also shows sleep and sealed status for select devices**
- **Background polling every 4 seconds**



Tips: Sealed device

Lock is shown on the dashboard for sealed devices

The screenshot shows the Battery Management Studio (bqStudio) 1.3.44 interface. On the left, the Dashboard displays a USB icon for the EV2300 Version3.1m and a battery icon for the bq27541G1 (041_2_24) with a red padlock icon, indicating it is a sealed device. A red arrow points from this padlock icon to a larger padlock icon in the Registers window. The Registers window shows a table of battery parameters and their values.

Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan
Control	0x0224	Hex	<input type="checkbox"/>	<input type="checkbox"/>	Full Charge Capacity	937	mAh	<input type="checkbox"/>	<input type="checkbox"/>	Filtered RM	741	mAh	<input type="checkbox"/>	<input type="checkbox"/>
AI Rate	0	mA	<input type="checkbox"/>	<input type="checkbox"/>	Average Current	0	mA	<input type="checkbox"/>	<input type="checkbox"/>	Average Power	0	mW/mW	<input type="checkbox"/>	<input type="checkbox"/>
Unfiltered SOC	80	%	<input type="checkbox"/>	<input type="checkbox"/>	Time to Empty	60325	Min	<input type="checkbox"/>	<input type="checkbox"/>	Internal Temperature	19.6	°C	<input type="checkbox"/>	<input type="checkbox"/>
Temperature	24.9	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Filtered FCC	937	mAh	<input type="checkbox"/>	<input type="checkbox"/>	Cycle Count	0	Num	<input type="checkbox"/>	<input type="checkbox"/>
Voltage	3990	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Standby Current	-10	mA	<input type="checkbox"/>	<input type="checkbox"/>	State Of Charge	80	%	<input type="checkbox"/>	<input type="checkbox"/>
Non-Available Capacity	763	mAh	<input type="checkbox"/>	<input type="checkbox"/>	Unfiltered FCC	937	mAh	<input type="checkbox"/>	<input type="checkbox"/>	State Of Health	95	Num	<input type="checkbox"/>	<input type="checkbox"/>
Full Available Capacity	959	mAh	<input type="checkbox"/>	<input type="checkbox"/>	Max Load Current	-500	mA	<input type="checkbox"/>	<input type="checkbox"/>	Passed Charge	0	mAh	<input type="checkbox"/>	<input type="checkbox"/>
Remaining Capacity	741	mAh	<input type="checkbox"/>	<input type="checkbox"/>	Unfiltered RM	741	mAh	<input type="checkbox"/>	<input type="checkbox"/>	DOOD	3760	Num	<input type="checkbox"/>	<input type="checkbox"/>
										Self Discharge Current	0	mA	<input type="checkbox"/>	<input type="checkbox"/>
										Design Capacity	1000	mAh	<input type="checkbox"/>	<input type="checkbox"/>

Below the Registers window, there is a Bit Registers table with columns for bit names and their values.

Name	Value	Log	Scan	B015	B014	B013	B012	B011	B010	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
Control Status	0x0204	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RES	PAE	SE	CALIBROW	CEA	BCA	RSV0	NOOP05	SOFTDOWN	PREWRITE	PAUSESEP	SLEEP	LAND	RESUM	LOCK	DEF
Flags	0x0108	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	ONC	OT0	BATH	BANLOW	CHG_MN	RDVD	FC	CHG	SOFTANKEN	SD	YSD	WV1	WV0	SOCL	SOOF	CG0
Pack Configuration	0x5177	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RESCAP	CALN	MTPCL	BTTSEL	RSVD	WVARE	RMG0	RMG05	LODSEL	PACTY0	SLEEP	RMFCC	SE_C0	SE_C0L	SE_C0R	TEMP

Disabling dashboard timer

- Polling is active by default when BQStudio is started
- Click on “Auto Refresh is ON – Click to Turn OFF” to stop polling

The screenshot shows the BQStudio software interface with the following components:

- Dashboard:** Displays battery status for EV3300 (Version: 3.1r) and bq27541G1 (S41_2_24, Addr: 0xAA, 30.2 °C). A green double-headed arrow indicates bidirectional communication. A battery icon shows 4001 mV and 81% charge. A red box at the top left of the dashboard says "Auto Refresh is ON - Click to Turn OFF" and a red box at the bottom left says "Auto Refresh is ON - Click to Turn OFF bqStudio Version: 1.3.44".
- Registers:** A table showing various battery parameters and their values.
- Bit Registers:** A table showing bit-level control and status registers.
- Commands:** A list of commands such as CONTROL_STATUS, DEVICE_TYPE, FW_VERSION, HW_VERSION, RESET_DATA, PREV_MACWRITE, CHEM_ID, BOARD_OFFSET, CC_OFFSET, CC_OFFSET_SAVE, and DF_VERSION.
- Manual Control Panel:** Includes fields for "Enter Cmd" and "Delay Ms" (set to 1000), and buttons for "Read Addr" and "Length".
- Log Panel:** Includes a "Clear Log" button and a "Transaction Log" table with columns for Name, Cmd, and Result.

Name	Value	Units	Name	Value	Units	Name	Value	Units
Control	0x0224	Hex	Full Charge Capacity	945	mAh	Filtered RM	760	mAh
At Rate	0	mA	Average Current	0	mA	Average Power	0	mW/mA
Unfiltered SOC	81	%	Time to Empty	65535	Min	Internal Temperature	25.3	°C
Temperature	30.2	°C	Filtered FCC	945	mAh	Cycle Count	0	Num
Voltage	4001	mV	Standby Current	-10	mA	State Of Charge	81	%
Nom Available Capacity	778	mAh	Unfiltered FCC	945	mAh	State Of Health	95	Num
Full Available Capacity	963	mAh	Max Load Current	-500	mA	Passed Charge	0	mAh
Remaining Capacity	760	mAh	Unfiltered RM	760	mAh	DODD	3504	Num
						Self Discharge Current	0	mA
						Design Capacity	1000	mAh

Name	Value	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Control Status (hi...)	0x0094	SE	FAS	SS	CALMODE	CCA	BCA	RSVD	HDQHDSTN
Control Status (lo...)		SHUTDOWN	HIBERNATE	FULL SLEEP	SLEEP	LDMD	RUP_DIS	VOK	GEN
Flags (high)	0x0108	OTC	OTD	BATHI	BATLOW	CHG_RH	RSVD	FC	CHG
Flags (low)		OCVTAKEN	ISD	TDD	HW1	HW0	SOC1	SOCF	DSG
Pack Configuration...	0x5177	RESCAP	CALEN	INTPOL	INTSEL	RSVD	WAKE	RSNS1	RSNS0
		GNOSSEL	RFACSTEP	SLEEP	RMFCC	SE_PU	SE_POL	SE_EN	TEMPS

Note: Restarting BQStudio will automatically re-enable/start the dashboard update timer

Chemistry database

- **Chemistry database stores the chemical characteristics of the battery**
- **Each chemistry identified by unique chemID**
 - TI maintains database of chemID
 - Associated with cell Manufacturer and Model
- **BQStudio programs chemistry tables for given chemID**

Updating chemistry database

- Download BQStudio chemistry updater from <https://www.ti.com/tool/bqStudio> or <https://www.ti.com/tool/GASGAUGECHM-SW>

The screenshot shows the Battery Management Studio (BQStudio) 1.3.44 interface. The 'Update Chemistry' menu item is circled in red. The main window displays a table of battery chemistries with columns for Manufacturer, Model, Chemistry ID, and Description. At the bottom, two buttons are circled in red: 'Update Chemistry from Database' and 'Update Chemistry from External File...'.

Manufacturer	Model	Chemistry ID	Description
A&TB	LGR18650CU	0100	LiCoO2/graphitized carbon (default)
A01	ALPBA002 (1430mAh)	0207	NiCoMn/carbon 2
A123	APR18650RM (1100 mAh)	0404	LiFePO4/carbon
A123	26650MLB (2500mAh)	0434	LiFePO4/carbon
A123	ANR26650ML-B (2500mAh)	0440	LiFePO4/carbon
A123	ANR26650ML-B Consult TI before u...	0453	LiFePO4/carbon
A123 Systems	26650A	0400	LiFePO4/carbon
AA Portable Power	LFP-18650-1500 (1500 mAh)	0439	LiFePO4/carbon
AAPortable	26650 (3300mAh)	0451	LiFePO4/carbon
AAPortable	8790160 (10000mAh)	0456	LiFePO4/carbon
AEnergy	AE1004765 (3500mAh)	0131	LiCoO2/carbon 4
AET	AE583696PPIHR (2150 mAh)	0222	PSS, LiNiO2 with Co, Mn doping
AGM	TP2000-15P (2000mAh)	0100	LiCoO2/carbon 11
ALE	JNR34600K2 (7500mAh)	0210	NiCoMn/carbon
Alees	045062 (2300 mAh)	1254	LiNiCoMnO2/5GenNo1_4.2V
Alees	26700FE (3300mAh)	0411	LiFePO4/carbon
Amitec	A2770102 (13000mAh)	0412	LiFePO4/carbon
Amista	LPC 776285M	0204	NiCoMn/carbon
Amista	LPC50991301 (5120 mAh)	0304	NiCoMn/carbon, 4.2V
Amista	LPC77625H (2700 mAh)	0304	NiCoMn/carbon, 4.2V
ATL	604396	0100	LiCoO2/graphitized carbon (default)
ATL	laminate 354480	0103	LiCoO2/carbon 2
ATL	604396 (ML-V4 / Obsolete)	0105	LiCoO2/carbon 3

- In case chemistry id or battery is not listed after updating the chemistry database Go to <http://www.ti.com/tool/GPCCHEM>

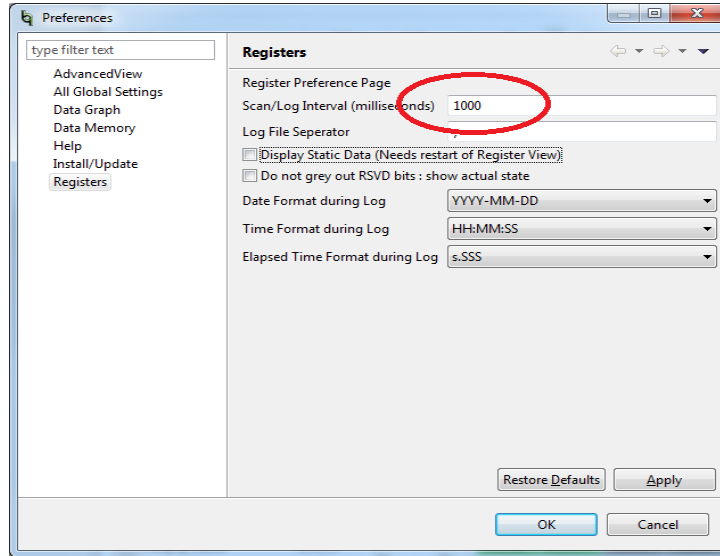
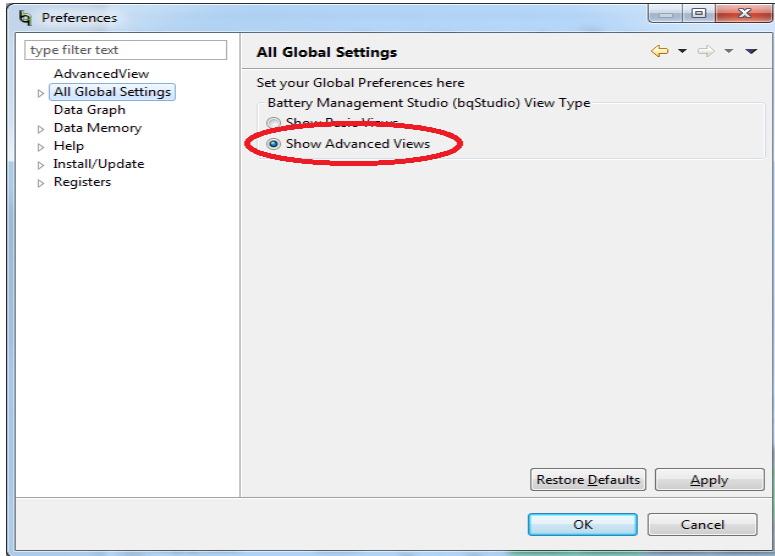
Registers – Basic vs Advanced view

- Register Advanced view provides user with more capabilities

Basic View	Advanced View
Groups of 8 bits	Groups of 16 bits
All registers are logged and scanned	Customize registers to log and scan. (Default is identical to basic view)
	Additional label field for parallel EVM evaluation

Logging at faster rate

- 1 register logged in ~35ms, approx. 28 registers logged in 1 second (Dashboard disabled)
- Logging less registers improves performance
- Select the registers to log from Registers Advanced view



Registers - Advanced view

The screenshot shows the Battery Management Studio (bqStudio) 1.3.44 interface. The main window displays a list of registers with columns for Name, Value, Units, Log, and Scan. Below this, a detailed view of the Bit Registers is shown, highlighting the bit fields for various registers.

Name	Value	Units	Log	Scan
Control	0x0224	Hex	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
AI Rate	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Unfiltered SOC	79	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Temperature	28.0	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage	3988	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Nom Available Capacity	783	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Full Available Capacity	961	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Remaining Capacity	742	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Filtered RRI	940	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Average Current	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Time to Empty	65535	Min	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Filtered FCC	940	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Standby Current	-19	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Unfiltered FCC	940	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Max Load Current	-500	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Unfiltered RRI	742	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Filtered RRI	742	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Average Power	0	mW/mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Internal Temperature	21.8	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cycle Count	0	Num	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
State Of Charge	79	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
State Of Health	95	Num	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Passed Charge	0	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
OCOD	3780	Num	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Self Discharge Current	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Design Capacity	1000	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Name	Value	Log	Scan	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Control Status	0x0094	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SE	FAS	SS	CALMODE	CCA	BCA	RSVD	HQHOSTIN	SHUTDWN	HIBERNATE	FULLSLEEP	SLEEP	LDMD	RUP_DIS	VOK	QEN
Flags	0x0105	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	OTC	OTD	BATHI	BATLOW	CHG_INH	RSVD	FC	CHG	OCVTAKEN	ISD	TDD	HW1	HW0	SOC1	SOCF	DSG
Pack Configuration	0x3177	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RESCAP	CALEN	INTPOL	INTSEL	RSVD	WAKE	RSNS1	RSNS0	GNDSEL	RFACTSTEP	SLEEP	RMFCC	SE_PU	SE_POL	SE_EN	TEMPS



Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
SE	FAS	SS	CALMODE	CCA	BCA	RSVD	HQHOSTIN	SHUTDWN	HIBERNATE	FULLSLEEP	SLEEP	LDMD	RUP_DIS	VOK	QEN
OTC	OTD	BATHI	BATLOW	CHG_INH	RSVD	FC	CHG	OCVTAKEN	ISD	TDD	HW1	HW0	SOC1	SOCF	DSG
RESCAP	CALEN	INTPOL	INTSEL	RSVD	WAKE	RSNS1	RSNS0	GNDSEL	RFACTSTEP	SLEEP	RMFCC	SE_PU	SE_POL	SE_EN	TEMPS

Configuring Advanced view

- Enable from BQStudio -> Window -> Preferences

The screenshot displays the Battery Management Studio (bqStudio) 1.3.44 interface. The 'Window' menu is open, and 'Preferences' is selected. The Preferences dialog box is open, showing the 'All Global Settings' section. Under 'Battery Management Studio (bqStudio) View Type', the 'Show Advanced Views' radio button is selected and circled in red. The main interface shows a sidebar with hardware components (EV2300, I2C, bq27541G1, 4001 mV battery) and a central area with 'Registers' and 'Bit Registers' tables. The 'Registers' table lists various battery parameters like Control, At Rate, Unfiltered SOC, Temperature, Voltage, Nom Available Capacity, Full Available Capacity, and Remaining Capacity. The 'Bit Registers' table shows bit-level details for Control Status, Flags, and Pack Configuration.

Name	Value	Units	Log	Scan
Control	0x0094	Hex	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
At Rate	0	mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Unfiltered SOC	81	%	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Temperature	29.4	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Voltage	4001	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Nom Available Capacity	779	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Full Available Capacity	963	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Remaining Capacity	760	mAh	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Name	Value	Log	Scan	Bit15	Bit0
Control Status	0x0094	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SE	FA
Flags	0x0108	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	OTC	OT
Pack Configuration	0x5177	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	RESCAP	CAL

Recommended Registers to log

Registers

Name	Value	Units	Log	Scan
<input checked="" type="checkbox"/> Control	0x0224	Hex	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Air Rate	0	mA	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Unfiltered FCC	0	mA	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Temperature	24.2	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Voltage	3989	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Unfiltered FCC	0	mA	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Full Available Capacity	96	mAh	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Remaining Capacity	74	mAh	<input type="checkbox"/>	<input type="checkbox"/>

- Voltage
- Current
- Temperature

Name	Value	Units	Log	Scan
<input checked="" type="checkbox"/> Temperature	24.2	°C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Voltage	3989	mV	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Bit Registers

Name	Value	Log	Scan	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
<input checked="" type="checkbox"/> Control Status	0x0094	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	SE	TAS	SS	CALMODE	CCA	CCA	RSVD	INDMOD	SHUTDOWN	INERRATE	FULLSLEEP	SLEEP	LOWD	WUP_DSE	YOK	OKR
<input checked="" type="checkbox"/> Flags	0x0108	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	OTC	OTD	BATH	BATLOW	SHL_ARM	RSVD	YC	CHD	OCVWARN	BO	TDD	HW1	HW0	SOC1	SOC0	DS0
<input checked="" type="checkbox"/> Pack Configuration	0x0177	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	BESCAP	CALEN	INTPOL	INTSEL	RSVD	WAKR	BAN1	SEN00	DRGSEL	INFACTST	SLEEP	IMPEC	SE_P0	SE_P0L	SE_EN	TEMP

Voltage, Current and Temperature logs – 1second.log

Sample,DateTime,ElapsedTime,Temperature,Voltage,LogRowTime(ms),LogStatus

1,2015-09-22 15:52:03,1.007,34.3,3993,32,SUCCESS
2,2015-09-22 15:52:04,2.001,34.3,3993,38,SUCCESS
3,2015-09-22 15:52:06,4.146,34.3,3993,30,SUCCESS
4,2015-09-22 15:52:07,5.001,34.3,3993,33,SUCCESS
5,2015-09-22 15:52:08,6.002,34.3,3993,31,SUCCESS
6,2015-09-22 15:52:10,8.150,34.3,3993,37,SUCCESS
7,2015-09-22 15:52:11,9.002,34.3,3993,27,SUCCESS
8,2015-09-22 15:52:12,10.002,34.3,3993,25,SUCCESS
9,2015-09-22 15:52:14,12.171,33.3,3993,25,SUCCESS
10,2015-09-22 15:52:15,13.002,33.3,3993,36,SUCCESS
11,2015-09-22 15:52:16,14.002,33.3,3993,34,SUCCESS
12,2015-09-22 15:52:18,16.187,33.3,3993,34,SUCCESS
13,2015-09-22 15:52:19,17.003,33.3,3993,29,SUCCESS
14,2015-09-22 15:52:20,18.003,33.3,3993,27,SUCCESS
15,2015-09-22 15:52:22,20.167,33.3,3993,31,SUCCESS
16,2015-09-22 15:52:23,21.003,33.3,3993,37,SUCCESS

Auto cycle (SMBus gauges)

Registers

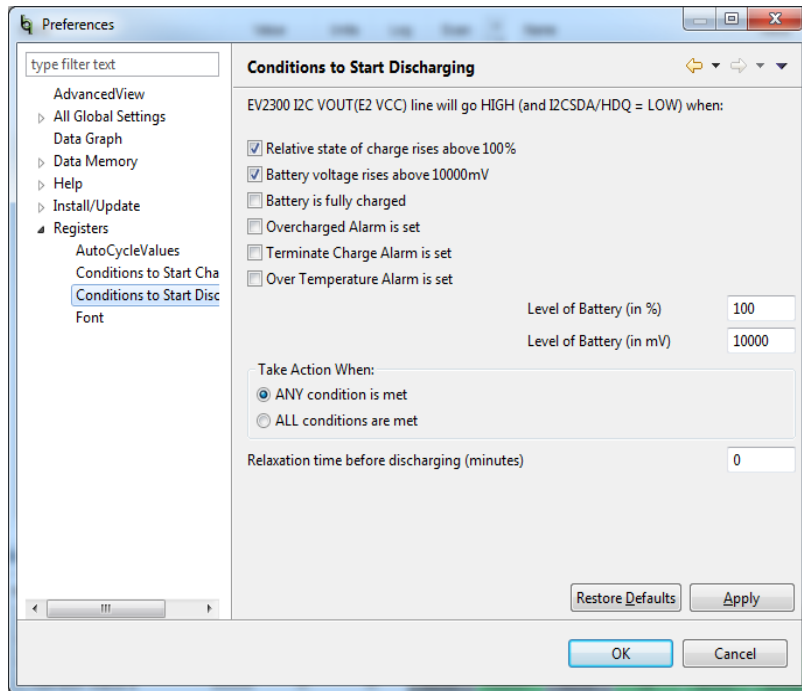
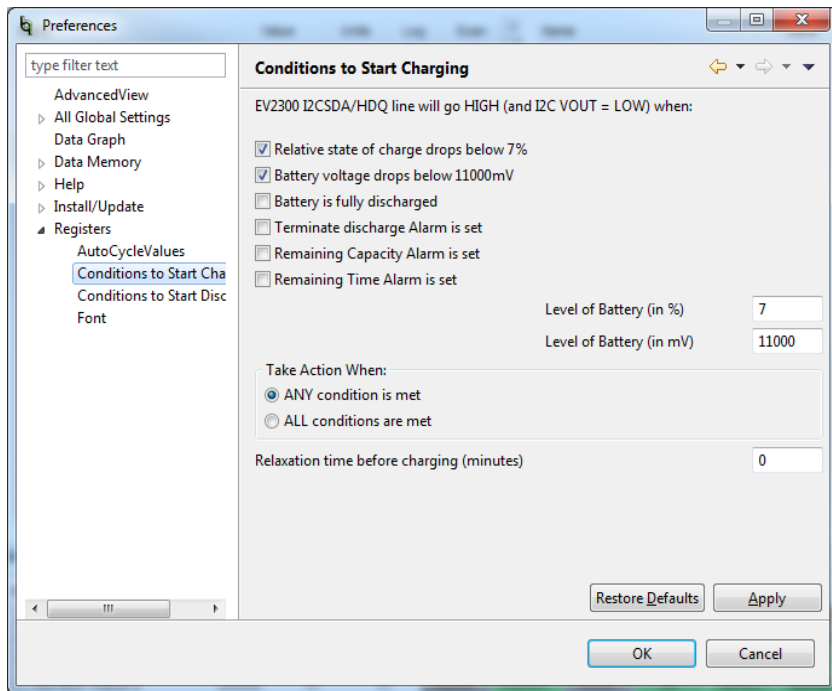
Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan	Name	Value	Units	Log	Scan
Manufacturer Access	0d4f181	hex	✓	✓	BAT pin voltage	10933	mV	✓	✓	Cell 3 CompRes	0	mOhm	✓	✓
Remaining Cap	300	mAh	✓	✓	PAC pin voltage	4	mV	✓	✓	Cell 4 CompRes	0	mOhm	✓	✓
Remaining Time Alarm	10	min	✓	✓	Cell 1 Current	0	mA	✓	✓	PackGnd	0	-	✓	✓
Air Rate	5	mA	✓	✓	Cell 2 Current	0	mA	✓	✓	Cell 1 Gnd	0	-	✓	✓
Air Rate Time To Full	65535	min	✓	✓	Cell 3 Current	0	mA	✓	✓	Cell 2 Gnd	0	-	✓	✓
Air Rate Time To Empty	65535	min	✓	✓	Cell 4 Current	0	mA	✓	✓	Cell 3 Gnd	0	-	✓	✓
Air Rate OK	1	-	✓	✓	Cell 1 Power	0	uW	✓	✓	Cell 4 Gnd	0	-	✓	✓
Temperature	26.1	degC	✓	✓	Cell 2 Power	0	uW	✓	✓	StandTime	717	s	✓	✓
Voltage	1967	mV	✓	✓	Cell 3 Power	0	uW	✓	✓	Cell 1 D00D	15176	-	✓	✓
Current	0	mA	✓	✓	Cell 4 Power	0	uW	✓	✓	Cell 2 D00D	15224	-	✓	✓
Average Current	0	mA	✓	✓	Power	0	uW	✓	✓	Cell 3 D00D	15208	-	✓	✓
Max Error	100	%	✓	✓	Average Power	0	uW	✓	✓	Cell 4 D00D	0	-	✓	✓
Relative State of Charge	6	%	✓	✓	Int Temperature	25.5	degC	✓	✓	D00D Passed Q	0	mAh	✓	✓
Absolute State of Charge	5	%	✓	✓	TS1 Temperature	26.1	degC	✓	✓	D00D Passed E	0	uWh	✓	✓
Remaining Capacity	201	mAh	✓	✓	TS2 Temperature	26.6	degC	✓	✓	D00D Time	3	h16	✓	✓
Full charge Capacity	3669	mAh	✓	✓	TS3 Temperature	26.4	degC	✓	✓	Cell 1 D0DOEC	1184	-	✓	✓
Run Time To Empty	65535	min	✓	✓	TS4 Temperature	26.7	degC	✓	✓	Cell 2 D0DOEC	1184	-	✓	✓
Average Time to Empty	65535	min	✓	✓	Cell Temperature	26.1	degC	✓	✓	Cell 3 D0DOEC	1184	-	✓	✓
Average Time to Full	65535	min	✓	✓	FET Temperature	26.6	degC	✓	✓	Cell 4 D0DOEC	0	-	✓	✓
Charging Current	0	mA	✓	✓	FIR Rem Q	201	mAh	✓	✓	Cell 1 QMax	4400	mAh	✓	✓
Charging Voltage	0	mV	✓	✓	FIR Rem E	201	uWh	✓	✓	Cell 2 QMax	4400	mAh	✓	✓

Bit Registers

Name	Value	Log	Scan	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Battery Mode	0d0591	✓	✓	CCM	CHM	AM	RSVD	RSVD	RSVD	RS	CC	CF	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	CC
Battery Status	0d02C0	✓	✓	TCA	TCA	RSVD	DTA	TDA	RSVD	PCA	PFA	MBT	DSG	FC	FD	EC1	EC2	FC1	EC4
Operation Status A	0d0181	✓	✓	LSM	LSM	RSVD	DF	RT	RSVD	MSR	MSR	RSVD	FSR	RSVD	RSVD	RSVD	DC1	RSVD	PRM
Operation Status B	0d0000	✓	✓	EMSHFT	CS	SLPCC	SNLCL	WT	SLEEP	XL	CAL_D	CAL	AUTOC	AUTH	LED	SOW			
Temp	0x10	✓	✓	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	GT	HT	KTM	RT	STL	LT	LT	
Charging Status	0d0004	✓	✓	RSVD	RSVD	RSVD	RSVD	CCC	CVR	CCR	VCT	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD
Charging Status	0x04	✓	✓	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD
IT Status	0d0004	✓	✓	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD
Manufacturing Status	0d0000	✓	✓	CAL_EN	LT_TEST	RSVD	RSVD	RSVD	RSVD	LED_EN	FIRK_EN	PP_EN	LP_EN	FET_EN	GAUG	DSG_T	CHG_T	PCRH	
Safety Alert A+B	0d0000	✓	✓	RSVD	CAVC	OTD	OTC	ASDCL	RSVD	ASDCL	RSVD	ASDCL	RSVD	DSG2	DD01	DSG2	DC01	DSV	DSV
Safety Status A+B	0d0000	✓	✓	RSVD	CAVC	OTD	OTC	ASDCL	RSVD	ASDCL	RSVD	ASDCL	RSVD	DSG2	DD01	DSG2	DC01	DSV	DSV
Safety Alert C+D	0d0000	✓	✓	RSVD	RSVD	RSVD	UTD	UTC	RSVD	CHGV	CHGV	CHGV	OC	CTD0	RSVD	PTD0	RSVD	RSVD	OTD
Safety Status C+D	0d0000	✓	✓	RSVD	RSVD	RSVD	UTD	UTC	RSVD	CHGV	CHGV	CHGV	OC	CTD0	RSVD	PTD0	RSVD	RSVD	OTD
PF Alert A+B	0d0000	✓	✓	RSVD	RSVD	RSVD	VMA	VMA	CD	IMP	DR	DR	RSVD	SOTF	RSVD	SOTF	RSVD	SOCV	RSV
PF Status A+B	0d0000	✓	✓	RSVD	RSVD	RSVD	VMA	VMA	CD	IMP	DR	DR	RSVD	SOTF	RSVD	SOTF	RSVD	SOCV	RSV
PF Alert C+D	0d0000	✓	✓	TS4	TS3	TS2	TS1	RSVD	OPRNC	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	OPRNC	OPRNC
PF Status C+D	0d0000	✓	✓	TS4	TS3	TS2	TS1	RSVD	OPRNC	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	OPRNC	OPRNC
LiStatus	0	✓	✓	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD

Configuring auto cycle

- Auto charging/discharging can be configured from Window → Preferences → Registers



Troubleshooting

- **BQStudio does not autodetect target**
 - Wake up the gauge
 - Check connections and follow steps in user guide
 - Missing BQZ file
- **Dashboard related**
 - Time sensitive tasks could be impacted, communication debug
 - Insert and removal of adapter / EVM quicker than 4 seconds not detected
 - Repeated detection of device in noisy communication conditions
 - Logging can stop when new device detected

Useful Links

- **BQStudio**
 - <https://www.ti.com/tool/BQSTUDIO>
- **Chemistry updater**
 - <https://www.ti.com/tool/GASGAUGECEM-SW>
- **Product pages have been updated to reflect the list of supported parts**
 - Know before you download if the part you are using is supported.
- **GPC tools landing page** : <https://www.ti.com/tool/GAUGEPARCAL>

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