

FAILURE ANALYSIS REPORT 2020

FBP-1164: S2 Battery

Permanent Fault Issue

System S/N: 1809230069

Board S/N: 1808P4113650474

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GCT-MY

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FBP-1164: S2 Battery Permanent Fault

Failure/ Problem:

- 1-unit FBP-1164 S2 battery board reported from the field is having permanent fault issue.

Symptoms:

- Battery cannot be charged and discharged, connect to battery management studio, PF was triggered (TS1 and DFW)

Testing Instrument:

- Adjustable Power Supply
- Electronic Load
- EV2300 BQ tools
- Multimeter
- Battery Management Studio

Root Cause:

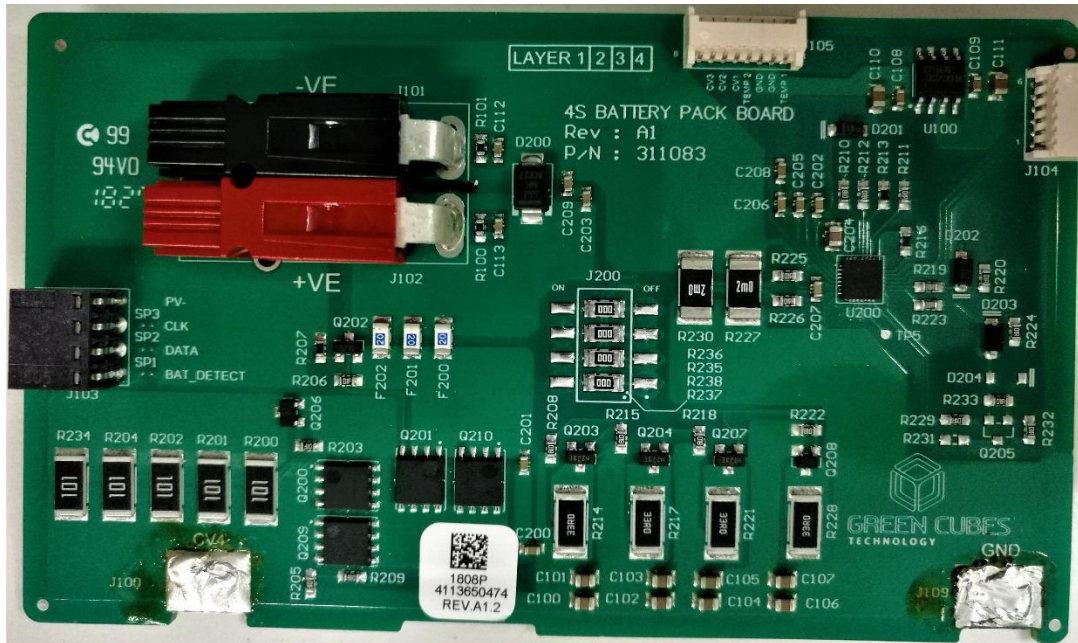
- Suspected BQ data memory corrupted during writing data to BQ

Summary:

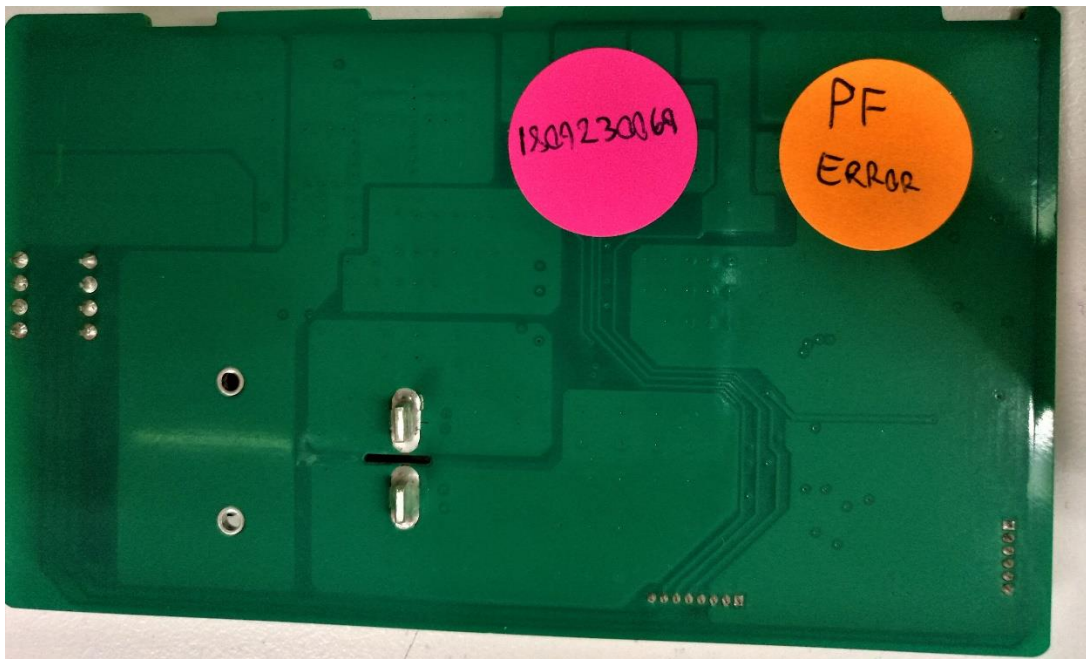
Board	Battery Charging	Battery Discharging	Remark
Faulty BQ	Unable to perform charging	Unable to perform discharging	- PFET, CFET, & DFET are switched OFF due to permanent fault is triggered. - Permanent Fault cannot be cleared.
Good BQ	Charging OK	Discharging OK	

Technical Analysis:

1. Board Received Condition:



○ Battery Board Top View



○ Battery Board Bottom View

Check List	1808P4113650474
Component Removed	NO
Bad Soldering	NO
Component Burned/ Burned Mark	NO
Scratches on board	NO
Pad lifted on PCB footprint	NO
Board Damaged	NO

2. Board Level Checking:

Board Test Level Testing		
Serial Number	1808P4113650474	
Component To be removed	NO	
MOSFET Shorted Check		
Q203	NO Shorted	
Q204	NO Shorted	
Q207	NO Shorted	
Q208	NO Shorted	
D-FET Check		
Q201	NO Shorted	
Q210	NO Shorted	
C-FET Check		
Q200	NO Shorted	
Q209	NO Shorted	
Capacitor Check		
C100	10.66uF	Up to 5MOhm
C101	10.76uF	Up to 5MOhm
C102	10.78uF	Up to 5MOhm
C103	10.90uF	Up to 5MOhm
C104	10.98uF	Up to 5MOhm
C105	10.75uF	Up to 5MOhm
C106	10.49uF	Up to 5MOhm
C107	10.97uF	Up to 5MOhm

- Did not find any component damaged and pin shorted on board level checking.

3. Connect to Battery Management Studio

○ Step of testing:

- Solder the FBP-1164 battery board to the battery pack.
- Make sure all the soldering point is well welded and all the wiring connectors are fully inserted and plugged.
- Connecting to EV2300 BQ tools and launch Battery management studio software.
- Check any unexpected parameter and fault reported by BQ.

○ Result:

- TS1 and DFW were found then 1st connect to the battery management studio.
- DFW fault cannot be cleared by PF_CLEAR.
- Fail to reload GG file to the BQ.

Registers

Start Log Scan Refresh

Registers

Name	Value	Units	Name	Value	Units	Name	Value	Units	Name	Value	Units
Bit Registers											
Name	Value		Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Battery Mode (low)			CF	RSVD	RSVD	RSVD	RSVD	RSVD	PBS	ICC	
Battery Status (hi...)	0x48C0		OCA	TCA	RSVD	OTA	TDA	RSVD	RCA	RTA	
Battery Status (low)			INIT	DSG	FC	FD	EC3	EC2	EC1	EC0	
Operation Status ...	0x7181		SLEEP	XCHG	XDSG	PF	SS	SDV	SEC1	SEC0	
Operation Status ...			BTP_INT	RSVD	FUSE	RSVD	POH3	CHG	DSG	PRES	
Operation Status ...	0x0000		RSVD	PSSHUT	EMSHUT	CB	SLPAD	SLPAD	SMCAL	INIT	
Operation Status ...			SLEEPM	XL	CAL_OFFSET	CAL	AUTOCALM	AUTH	LED	SDM	
Temp Range (high)	0x08		RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	RSVD	
Temp Range (low)			RSVD	OT	HT	STH	RT	STL	LT	UT	
Charging Status (...)	0x0004		RSVD	RSVD	RSVD	RSVD	NCT	CCC	CVR	CCR	
Charging Status (l...)			VCT	MCHG	SU	IN	HV	MV	LV	PV	
Gauging Status	0x50		CF	DSG	EDV	BAL_EN	TC	TD	FC	FD	
IT Status (high)	0x0011		RSVD	RSVD	RSVD	OCVFR	LDMD	RX	QMAX	VDQ	
IT Status (low)			NSFM	RSVD	SLPQMAX	QEN	VOK	RDIS	RSVD	REST	
Manufacturing Sta...	0x03F8		CAL_EN	LT_TEST	RSVD	RSVD	RSVD	RSVD	LED_EN	FUSE_EN	
Manufacturing Sta...			BBR_EN	PF_EN	LF_EN	FET_EN	GAUGE_EN	DSG_TEST	CHG_TEST	PCHG_TEST	
Safety Alert A+B (...)	0x0000		RSVD	CUVC	OTD	OTC	ASCDL	RSVD	ASCDL	RSVD	
Safety Alert A+B (...)			AOLDL	RSVD	OCOD2	OCOD1	OCOD2	OCOD1	COV	CUV	
Safety Status A+...	0x0000		RSVD	CUVC	OTD	OTC	ASCDL	ASCDL	ASCDL	ASCDL	
Safety Status A+...			AOLDL	AOLD	OCOD2	OCOD1	OCOD2	OCOD1	COV	CUV	
Safety Alert C+D (...)	0x0000		RSVD	RSVD	OCODL	COVL	UTD	UTC	PCHGC	CHGV	
Safety Alert C+D (...)			CHGC	OC	CTOS	RSVD	PTOS	RSVD	RSVD	OTF	
Safety Status C+...	0x0000		RSVD	RSVD	OCODL	COVL	UTD	UTC	PCHGC	CHGV	
Safety Status C+...			CHGC	OC	RSVD	CTO	RSV	PTO	HWOF	QTF	
PF Alert A+B (high)	0x0000		ASCDL	ASCDL	AOLDL	VMA	VMA	CD	IMP	CB	
PF Alert A+B (low)			QIM	SOTF	COVL	SOT	SOCOD	SOCOD	SOV	SUV	
PF Status A+B (hi...	0x0000		ASCDL	ASCDL	AOLDL	VMA	VMA	CD	IMP	CB	
PF Status A+B (lo...			QIM	SOTF	COVL	SOT	SOCOD	SOCOD	SOV	SUV	
PF Alert C+D (high)	0x0000		TS4	TS3	TS2	TS1	RSVD	RSVD	RSVD	RSVD	
PF Alert C+D (low)			RSVD	2VL	AFEC	AFER	FUSE	OCODL	DFETF	CFETF	
PF Status C+D (h...	0x1400		TS4	TS3	TS2	TS1	RSVD	DFW	RSVD	IFC	
PF Status C+D (l...			PTC	2VL	AFEC	AFER	FUSE	OCODL	DFETF	CFETF	
LS Status	14						FIELD_QMAX	ITEN	CF1	CF0	

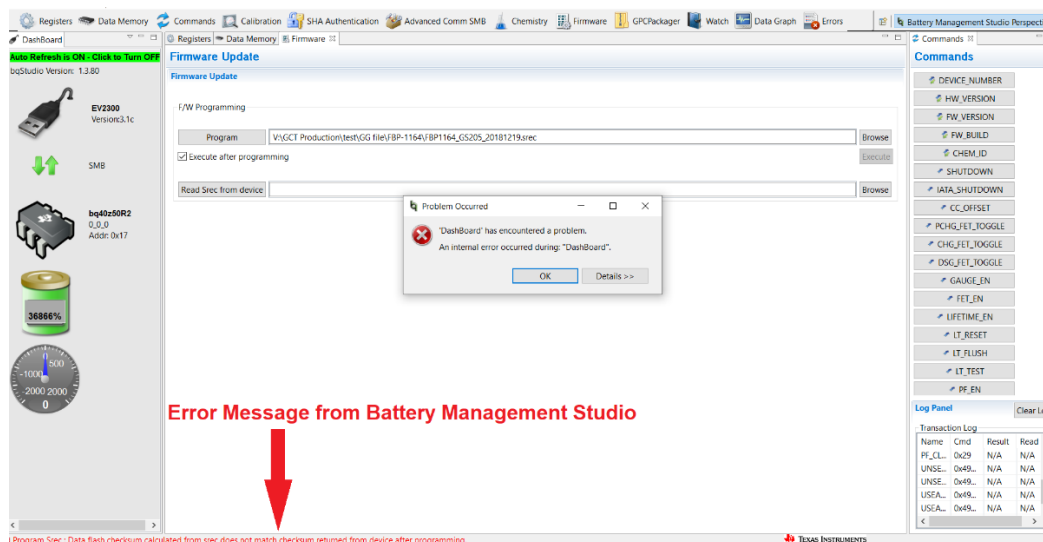
- When 1st connect to the Battery Management Studio, TS1 and DFW were triggered. TS1 is temperature cell 1 and DFW is Data Flash Wearout Failure.
- DFW fault cannot be cleared by battery management Studio.

Lifetimes	Temperature	Max Temp Cell	45 Â°C
Lifetimes	Temperature	Min Temp Cell	13 Â°C

- However, checked into the GG file, Lifetimes temperature cell maximum and minimum range are about 13°C ~ 45°C. This temperature range still have not reach fault trigger threshold.

Name	Value	Unit
▼ Data		
Remaining AH Cap. Alarm	300	mAh
Remaining WH Cap. Alarm	432	cWh
Remaining Time Alarm	10	min
Initial Battery Mode	0081	hex
Specification Information	0024	hex
Manufacture Date	2043-12-31	date
Serial Number	fff	hex
Manufacturer Name	-	-
Device Name	bq40z50-R2	-
Device Chemistry	LION	-

- Besides that, Serial Number, manufacture name, and manufacture date are seemingly to be erase.
- The Battery serial number and manufacture date will be written into the BQ and verified during Pact Test. - [Pack Test Result](#)
- During final pack test, test system will read GG file version, manufacture date and serial number to verify these data are correctly to be written. - [Final Pack Test Result](#)



- In addition, re-program GG file into the BQ IC is fail and return error “Data flash checksum from srec does not match checksum returned from device after programming”
- Highly suspected BQ flash memory is corrupted or damaged.

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Data Flash (DF) Permanent Fail

3.23 Data Flash (DF) Permanent Fail

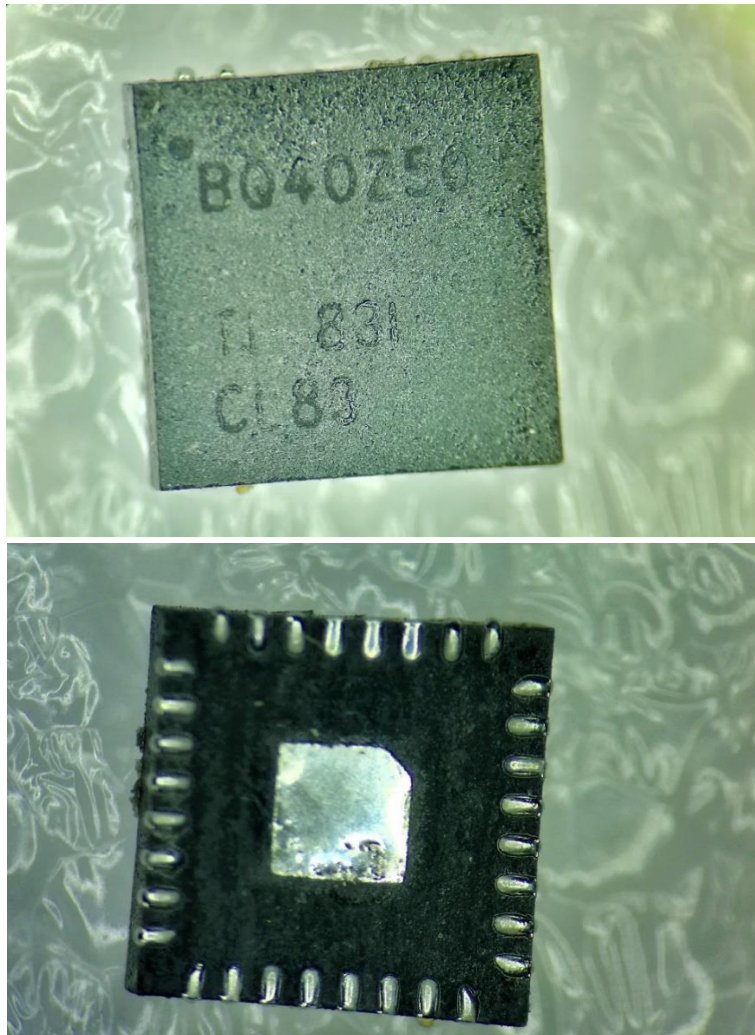
The device can permanently disable the battery in case a data flash write fails.

NOTE: A DF write failure causes the gauge to disable further DF writes.

Status	Condition	Action
Normal	Data flash write OK	—
Trip	Data flash write not successful	<i>PFStatus()[DFW] = 1</i>

- According to data sheet, DFW will be triggered when data flash write fails.

4. Visual Check under microscope



- No physical damaged or burnt mark found on the BQ IC body on top as well as bottom.
- Besides that, no pin is found shorted or damaged.

5. Replaced New BQ IC and Testing

- **Step of Testing:**

- Replaced new BQ IC to the FBP-1164 battery board and make sure all pins are well connected and soldered.
- Solder the FBP-1164 battery board to the battery pack.
- Perform Charging and discharging, observed any abnormalities.
- Connect to Battery Management studio to check any cell different and warning flag.

- **Result:**

- Battery Pack can be discharge 10A without triggered any fault.
- Battery pack charging behavior is expected SOC rising and pack voltage rising while charging.
- Cell voltage balancing does not find any abnormalities after changing BQ.

- **After replaced the BQ, battery board functioning still in good condition. The permanent fault was reported from the field is caused by faulty BQ flash memory corrupted.**

Conclusion:

- The FBP-1164 battery board malfunctioning is caused by faulty BQ IC which reported permanent fault DFW and cannot be cleared.
- Data flash memory wear out/ data flash permanent fault causes the gauge disable and reported permanent fault.