# RRC EV2400 SMBus Intelligent Reader

- MANUAL -



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## Introduction

This manual describes how to use the EV2400 interface unit from Texas Instrument. After installing the battery management Studio on Windows based PC it is easy to communicate with RRC POWERPAQ over the SMBus, and shows results on screen.

Setup requirements:

- EV2400 evaluation kit, Texim p/n: EV2400-RRC
- POWERPAQ RRC battery (2020 / 2024 / 2037 / 2040(-2) / 2054(-2) / 2057 series)
  - The RRC3570 battery has another connector and, is not compatible with the SMBus cable as it is
     The RRC21xx batteries could be compatible with even another connector, too.
- SMBus cable, Texim p/n: EV2400-SMBUS-CABLE-RRC
- Windows 7 or higher based x86 computer

Download Battery Management Studio software from <a href="https://www.ti.com/tool/BQSTUDIO">https://www.ti.com/tool/BQSTUDIO</a>

**IMPORTANT:** By default the battery is delivered in "shipping mode". To exit this shipping mode and start communication a mating RRC charger is required (e.g. RRC-SMB-UBC).

## Initial Setup

1. First Install Battery Management Studio software from <u>https://www.ti.com/tool/BQSTUDIO</u>.

2. Connect EV2400 (PORT1 - SMB) to the RRC battery with SMBus cable:



3. Then connect EV2400 (USB Type B) to PC with USB-cable (part of EV2400 evaluation kit):



## Using Texas Instruments Battery Management Studio

#### The Overview Screen

When starting the Battery Management Studio Software below image will appear:



Figure 1 Main overview

On top of the screen is the "Registers" section, it shows main battery parameters:

ashBoard	~ -	Registers 22											- 0	Commands 🕸		-
Refresh is ON -	Click to Turn OFF	Registers										Start Log	Scan Refresh	Commands		
dio Version: 1.3.	.101	Registerr										start cog		DEVICE_NUMBER	5	
Λ		inclution												HW_VERSION		
	EV2400	Name	Value	Units ^	Name	Value	Units	^ Name	Value	Units ^	Name	Value	Units ^	FW VERSION		
	Version:0.32	Manufacturer Access	0x0387	hex	Cell 4 Voltage	3888	mV	initial E	3530	cWh	Cel 3 DODEOC	0				
		Remaining Cap. Alarm	690	mAh	BAT pin voltage	15539	mV	True Full Chg Q	6552	mAh	Cell 4 DODEOC	0		FW_BUILD		
3		Remaining Time Alarm	10	min	PACK pin voltage	15541	mV	True Full Chg E	9491	cWh	Cell 1 QMax	7085	mAb	🐔 CHEM ID		
		At Rate	-19	mA	Cell 1 Current	0	mA	T_sin	21.1	degC	Cell 2 QMax	7085	mAh	g enange		
	SMR	At Rate Time To Full	65535	min	Cell 2 Current	0	mA	T_ambient	22.2	degC	Cell 3 QMax	7107	mAh	SHUTDOWN		
▼∎		At Rate Time To Empty	13633	min	Cell 3 Current	0	mA	Cell 1 RaScale	1000		Cell 4 QMax	7090	mAh	A CC OFFEET		
		At Rate OK	1		Cell 4 Current	0	mA	Cell 2 RaScale	1000		Cell 1 QMax DOD0	2603		- cc_orraci		
$\sim$		Temperature	22.2	degC	Cell 1 Power	0	cW	Cell 3 RaScale	1000		G Cell 2 QMax DOD0	2607		PCHG_FET_TOGGI	.E	
	bo40z50R1	■ Votage	15552	πV	Cell 2 Power	0	cW	Cell 4 RaScale	1000		Cell 3 QMax DOD0	2575				
	4500_1_06	Current	0	mA	Cell 3 Power	0	cW	Cell 1 CompRes	35	mOhm	Cell 4 QMax DOD0	2591		CHG_FET_TOGGL	E .	
ر `	Addr: 0x17	Average Current	0	mA	Cell 4 Power	0	cW	Cell 2 CompRes	38	mOhm	QMax Passed Q	37	mAH	DSG FET TOGGLI		
	22.2 degC	Max Error	9	%	E Power	0	cW	Cell 3 CompRes	37	mOhm	GMax Time	65535	h/16			
		Relative State of Charge	66	%	Average Power	0	cW	Cell 4 CompRes	35	mOhm	Temp k	3.43	-	GAUGE_EN		
		Absolute State of Charge	63	%	int Temperature	23.5	degC	PackGrid	2		Temp a	4675	-	🖉 FET EN		
677		Remaining Capacity	4317	mAh	TS1 Temperature	22.2	degC	Cell 1 Grid	0	1.1	Cell 1 Raw DOD	5216				
		Full charge Capacity	6552	mAh	TS2 Temperature	22.2	degC	E Cell 2 Grid	0	-	Cell 2 Raw DOD	5184	-	LIFETIME_EN		
		Run time To Empty	65535	min	TS3 Temperature	-53.0	degC	E Cell 3 Grid	0		Cell 3 Raw DOD	5152	-	A IT RECET		
5551 mV		Average Time to Empty	65535	min	TS4 Temperature	205.9	degC	Cell 4 Grid	0	-	Cell 4 Raw DOD	5184	-	EL[KESE]		
66%		Average Time to Full	65535	min *	Cell Temperature	22.2	deoC	StateTime	22175	8 V	Cell 1 Bal Time	0	8 <sup>V</sup>	LT_FLUSH		
		Bit Registers										Bt High	Bit Low RSVD	LT_TEST		
		Name	Value	B#7	846	8	t5	B84	B#3	8#2	Bit1	84	• •	PF_EN		
00 500	2	Battery Mode (high)	0x0081	CapM	ChgV	A	И	RSVD	RSVD	RSVD	PB	00		# DE CLEAR		
1000	A	Battery Mode (low)		CF	RSVD	RS RS	VD	RSVD	RSVD	RSVD	PBS	101	0	· Pr_ccon		
1500	E .	Battery Status (high)	0×00C0	0CA	TCA	RS	VD	OTA	TDA	RSVD	RCA	RT	A	BBR_EN		
0 2000	8	Battery Status (low)		INIT	DSG		c	FD	EC3	EC2	EC1	EC	0			
0 Y	7	Geration Status A (hi	0x0387	SLEEP	XCHC	i XI	SG	PF	SS	SDV	SEC1	SEC	20	BBR_CLEAR		
<u> </u>		Operation Status A (low)		BTP_N	RSVC	. R	SE	RSVD	PCHG	CHG	DSG	PRE	IS	FUSE_EN		
		Operation Status B (hi	0x0000	RSVD	PSSHL	T EMS	HUT	CB	SLPCC	SLPAD	SMBLCAL	N	r			
		Operation Status B (lo		SLEEPN	XL XL	CAL	FFSET	CAL	AUTOCALM	AUTH	LED	SO	м	Log Panel		Cle
		Temp Range (high)	0x08	RSVD	RSVD	RS	VD	RSVD	RSVD	RSVD	RSVD	RSI	/0			
		Temp Range (low)		RSVD	OT	E State Stat	т	STH	RT	STL	LT .	U		Transaction Log		
		Charging Status (high)	0x0004	RSVD	RSVE	R	VD	RSVD	RSVD	CCC	CVR	CC	8	Name Cmd	Result	Read
		Charging Status (low)		VCT	MCHG	i 5	U	N	HV	MV	LV	P	/			
		Gauging Status	0×D0	CF	DSG	E	IV I	BAL_EN	TC	TD	FC	FC				
		GIT Status (high)	0x0719	RSVD	RSVD	RS	VD	OCVFR	LDMD	RX	QMAX	VD	a			
		IT Status (low)		NSFM	RSVI	SLPC	MAX	OEN	VOK	RDIS	RSVD	RES	T			
		Manufacturing Status (	0x03F8	CAL_EN	LT_TES	T RS	VD	RSVD	RSVD	RSVD	LED_EN	FUSE	_EN			
		Manufacturing Status (		BBR_EN	PF_E	U,	EN	FET_EN	GAUGE_EN	DSG_TES	ST CHG_TEST	PCHG_	TEST			
		Safety Alert A+B (high)	0×0000	RSVD	CUVO	0	0	OTC	ASCOL	RSVD	ASCOL	RSI	/0			
		Safety Alert A+B (low)		AOLDL	RSVD	00	02	0001	0002	0001	cov	CU	V			
		Safety Status A+B (hig.)	0x0000	RSVD			0	OTC	ASCOL	ASCD	ASCCL	ASI	C			

Figure 2 Registers section

Registers 🖷	🐡 Data Memory 💈	Commands 🔝 Calibration	SHA Authent	tication 🍯	Advanced Comm SMB	Chemistry	E Firmware	Watch 🔛	Data Graph 🔤 Error	5						
hBoard	~ - [	1 🔕 Registers 🕸					-							Comma	nds 🕸	
fresh is ON - C	lick to Turn OFF	Registers										Start Log	Scan Refresh	Comma	inds	
o version: 1.3.10	01													🔮 DE	VICE_NUMBER	
Ω		Registers												6 F	W VERSION	
	EV2400	Name	Value	Linta ^	Name	Value	Linža ^	Name	Value	Units A	Name	Value	Linta A		DW VERSION	
	Version:0.32	Z Manufacturar Locasa	0x0397	hav	Call 4 Motore	2000	and d		3630	0110					W_TENJION	
~/		Remaining Can Alarm	690	máh	BAT nin votane	15539	ml/	True Full Cha O	6552	méh				2	FW_BUILD	
		Remaining Time Alarm	10	min	B BACK nin voltage	15541	mV	True Full Cho F	9491	cWh	Cel 1 OMax	7085	máb		CHEMIN	
		Z At Pate	-19	mA	E Call 1 Current		-	T ein	21.1	deaC	Cell 2 Olley	7085	máb	*	CHEMUD	
	C1 40	At Rate Time To Full	65535	min	Cell 2 Current	0	mA	T ambient	22.2	deoC	Cell 3 OMax	7107	méh		SHUTDOWN	
	omb	At Rate Time To Empty	13633	min	Cell 3 Current		mA	Cell 1 RaScale	1000		Cell 4 QMax	7090	mAh			
		At Rate OK	1		Cell 4 Current	0	mA	Cell 2 RaScale	1000		Cell 1 QMax DOD0	2603		1	CC_OPPSET	
5		Temperature	22.2	degC	Cell 1 Power	0	cW	Cell 3 RaScale	1000		Cell 2 QMax DOD0	2607		PCH	IG_FET_TOGGLE	
	bo40z50R1	G Votage	15552	mV	Cell 2 Power	0	cW	Cell 4 RaScale	1000	1.1	Cell 3 QMax DOD0	2575				
	4500_1_06	Current	0	mA	Cell 3 Power	0	cW	Cell 1 CompRes	35	mOhm	Cell 4 QMax DOD0	2591		CH	G_FET_TOGGLE	
	Addr: 0x17	Average Current	0	mA	Cell 4 Power	0	cW	Cell 2 CompRes	38	mOhm	G QMax Passed Q	37	mAH	🗶 DS	G FET TOGGLE	
$\sim$	22.2 degC	Max Error	9	%	Power	0	cW	Cell 3 CompRes	37	mOhm	GMax Time	65535	h/16			
		Relative State of Charge	66	%	Average Power	0	cW	Cell 4 CompRes	35	mOhm	🖬 Temp k	3.43			GAUGE_EN	
		Absolute State of Charge	63	%	int Temperature	23.5	degC	PackGrid	2		Temp a	4675			EET EN	
		Remaining Capacity	4317	mAh	TS1 Temperature	22.2	degC	Cell 1 Grid	0		Cell 1 Raw DOD	5216	-		- reigen	
		Full charge Capacity	6552	mAh	TS2 Temperature	22.2	degC	Cell 2 Grid	0		Cell 2 Raw DOD	5184		I	LIFETIME_EN	
		Run time To Empty	65535	min	TS3 Temperature	-53.0	degC	Cell 3 Grid	0	-	Cell 3 Raw DOD	5152	-		IT BEET	
i551 mV		Average Time to Empty	65535	min	TS4 Temperature	205.9	degC	Cell 4 Grid	0	1.1	Cell 4 Raw DOD	5184		-	LIJAESET	
66%		Average Time to Full	65535	min *	Cell Temperature	22.2	deoC Y	StateTime	22175	8 V	Cell 1 Bal Time	0	5 <sup>V</sup>	1	LT_FLUSH	
		Bit Registers										Bt High	tow RSVD		LT_TEST	
ALL DESCRIPTION OF		Name	Value	BII7	885	845		B84	BI3	842	B81	80	• •		PF_EN	
10 500		Battery Mode (high)	0x0081	CapM	ChgM	AM		RSVD	RSVD	RSVD	PB	00	2		DE CLEAR	
1000		Battery Mode (low)		CF	RSVD	RSVI	>	RSVD	RSVD	RSVD	PBS	100	c		PP_CLEAK	
1500 -		Battery Status (high)	0x00C0	OCA.	TCA	RSVI	)	OTA	TDA	RSVD	RCA	RD	A	1	BBR_EN	
0 2000 3		Battery Status (low)		NT	DSG	FC		FD	EC3	EC2	EC1	EO	0		DDD CLEAD	
0 2		Dperation Status A (hi	0x0387	SLEEP	XCHG	XDS4	3	PF	\$\$	SDV	SEC1	SEC	00		DDR_CLEAR	
		Operation Status A (low)		BTP_NT	RSVD	FUSE		RSVD	PCHG	CHG	DSG	PRE	is	1	FUSE_EN	
		Operation Status B (hi	0x0000	RSVD	PSSHUT	EMSH	л	CB	SLPCC	SLPAD	SMBLCAL	10	T		-	
		Operation Status B (lo		SLEEPN	1 XL	CAL_OF	PSET	CAL	AUTOCALM	AUTH	LED	SO	и	Log Panel		C
		Temp Range (high)	0x08	RSVD	RSVD	RSVI	)	RSVD	RSV0	RSVD	RSVD	RSV	/D	Trees	and an	
		Temp Range (low)		RSVD	ОТ	HT		STH	RT	STL	u	U	· · · · ·	Iransacti	on Log	
		Charging Status (high)	0x0004	RSVD	RSVD	RSVI	2	RSVD	RSVD	CCC	CVR	00	8	Name	Cmd Result	t Rei
		Charging Status (low)		VCT	MCHG	SU		N	HV	MV	LV	PV	/			
		Gauging Status	0×D0	CF	DSG	EDV		BAL_EN	TC	TD	FC	FC				
		III Status (high)	0x0719	RSVD	RSVD	RSVI		OCVFR	LOND	RX	QMAX	VD	a			
		IT Status (low)		NSFM	RSVD	SLPOM	AX	QEN	VOK	RDIS	RSVD	RES	ST			
		Manufacturing Status (	0x03F8	CAL_EN	LT_TEST	RSVI		RSVD	RSVD	RSVD	LED_EN	FUSE	_EN			
		Manufacturing Status (		BBR_EN	PF_EN	U_8	N	FET_EN	GAUGE_EN	DSG_TES	T CHG_TEST	PCHG_	TEST			
		Safety Alert A+B (high)	0x0000	RSVD	CUVC	ото		OTC	ASCOL	RSVD	ASCCL	RSV	70			
		Safety Alert A+B (low)		AOLDL	RSVD	000		OCD1	0002	0001	COV	CU	V			
		Safety Status A+B (hig	0x0000	RSVD	CUVC	ото		OTC	ASCOL	ASCD	ASCOL	ASC	C			

If SMBus interface between PC and battery is established this will be confirmed at left side:

Figure 3 Overview of SMBus connection

Here the connected SMBus Intelligent Reader and the version are specified. Also the Li-Ion Battery pack manager IC's product code inside the connected battery is shown with the battery voltage and charge level just beneath.

loard	- D	Registers 22												- 0	💝 Commi	ands 33	
esh is ON - Cl	lick to Turn OFF	Registers											Start Log	⊗ 2 Scan Refresh	Comma	ands	
		Registers													🤹 D6	EVICE_NUMBER	
Л		-													21	HW_VERSION	
	EV2400	Name	Value	Units ^	Name		Value	Units ^	Name	Value	Units ^	Name	Value	Units ^		FW_VERSION	
7	Version:0.32	Manufacturer Access	0x0387	hex	E Cel	4 Voltage	3888	mV	🖶 Initial E	3530	cWh	Cell 3 DODEOC	0			EW BUILD	
r .		Remaining Cap. Alarm	690	mAh	BAT	pin voltage	15539	mV	True Full Chg Q	6552	mAh	Cell 4 DODEOC	0			PW_BOILD	
		Remaining Time Alarm	10	min	E PAC	K pin voltage	15541	mV	True Full Chg E	9491	cWh	Cell 1 QMax	7085	mAh	1	CHEM_ID	
		At Rate	-19	mA	E Cell	1 Current	0	mA	T_sin	21.1	degC	Cell 2 QMax	7085	mAh			
	SMB	At Rate Time To Full	65535	min	E Cel	2 Current	0	mA	T_ambient	22.2	degC	Cell 3 QMax	7107	mAh		SHUTDOWN	
		At Rate Time To Empty	13633	min	E Cel	3 Current	0	mA	E Cell 1 RaScale	1000		Cell 4 QMax	7090	mAh	-	CC OFFSET	
		At Rate OK	1		🗐 Cel	4 Current	0	mA	Cell 2 RaScale	1000		Cell 1 QMax DOD0	2603				
<b>n</b> .		Temperature	22.2	degC	🗐 Cell	1 Power	0	dW	Cell 3 RaScale	1000		Cell 2 QMax DOD0	2607		PCI	HG_FET_TOGGLE	
	bq40z50R1	i Votage	15552	mV	E Cell	2 Power	0	cW	Cell 4 RaScale	1000		Cell 3 QMax DOD0	2575			AC FET TOGOLE	
	4500_1_06	Current	0	mA	E Cel	3 Power	0	cW	Cell 1 CompRes	35	mOhm	Cell 4 QMax DOD0	2591		- Cr	10_FE1_10000EE	
	Addr: 0x17	Average Current	0	mA	E Cel	4 Power	0	cW	Cell 2 CompRes	38	mOhm	GMax Passed Q	37	mAH	🛷 DS	G_FET_TOGGLE	
MA	22.2 degC	Max Error	9	%	E Pow	/er	0	cW	Cell 3 CompRes	37	mOhm	GMax Time	65535	h/16			
J 🚺		Relative State of Charge	66	%	E Ave	rage Power	0	cW	Cell 4 CompRes	35	mOhm	🗐 Temp k	3.43	-	1	GAUGE_EN	
		Absolute State of Charge	63	%	🗐 int T	emperature	23.5	degC	PackGrid	2		Temp a	4675			FET EN	
		Remaining Capacity	4317	mAh	E TS1	Temperature	22.2	degC	Cell 1 Grid	0		Cell 1 Raw DOD	5216	-			
		Full charge Capacity	6552	mAh	E TS2	Temperature	22.2	degC	Cell 2 Grid	0		Cell 2 Raw DOD	5184	-	1	LIFETIME_EN	
		Run time To Empty	65535	min	E TS3	Temperature	-53.0	degC	Cell 3 Grid	0	-	Cell 3 Raw DOD	5152	-		IT DECET	
51 mV		Average Time to Empty	65535	min	ETS4	Temperature	205.9	degC	Cell 4 Grid	0	-	Cel 4 Raw DOD	5184	-		- Erijkeser	
56%		iii Average Time to Full	65535	min	Cell	Temperature	22.2	deoC *	StateTime	22175	8 <sup>v</sup>	I Gil Cell 1 Bal Time	0	5 °	1	LT_FLUSH	
		Bit Registers											Bt High	Bit Low RSVD	-	LT_TEST	
		Name	Value	B#7		885	B#5		B84	B#3	B#2	B#1	BI	10 ^		PF_EN	
500		Battery Mode (high)	0x0081	CapM		ChgM	AM		RSVD	RSVD	RSVD	PB	0	0		DE CLEAR	
1000		Battery Mode (low)		CF		RSVD	RSVI	)	RSVD	RSVD	RSVD	PBS	0	c	-	TT_CLEMIT	
1500		Battery Status (high)	0x00C0	OCA.		TCA	RSVI	)	OTA	TDA	RSVD	RCA	RT	A		BBR_EN	
2000 5		Battery Status (low)		INIT		DSG	FC		FD	EC3	EC2	EC1	EC	:0			
0 1		Dperation Status A (hi	0x0387	SLEEP		XCHG	XDS4		PF	\$\$	SDV	SEC1	SE	C0		BBR_CLEAK	
		Operation Status A (low)		BTP_N	т	RSVD	FUSE		RSVD	PCHG	CHG	DSG	PR	ES	1	FUSE_EN	
		Operation Status B (hi	0x0000	RSVD		PSSHUT	EMSH	л	CB	SLPCC	SLPAI	SMBLCAL	N	π	-		-
		Operation Status B (lo		SLEEP	М	XL.	CAL_OF	SET	CAL	AUTOCALM	AUTH	LED	SO	м	Log Panel		0
		Temp Range (high)	0x08	RSVD		RSVD	RSVI	)	RSVD	RSVD	RSVD	RSVD	RS	VD			
		Temp Range (low)		RSVD		OT	HT		STH	RT	STL	ut	U	т	Iransact	ion Log	
		Charging Status (high)	0x0004	RSVD		RSVD	RSVI		RSVD	RSVD	CCC	CVR	00	R	Name	Cmd Re	isult Re
		Charging Status (low)		VCT		MCHG	SU		N	HV	MV	LV	P	/			
		Gauging Status	0xD0	CF		DSG	EDV		BAL_EN	TC	TD	FC	F	D			
		☐ IT Status (high)	0x0719	RSVD		RSVD	RSVI	)	OCVFR	LOND	RX	QMAX	VE	iQ.			
		IT Status (low)		NSFM		RSVD	SLPQM	4X	QEN	VOK	RDIS	RSVD	RE	ST			
			0x03F8	CAL_E	N	LT_TEST	RSVI	>	RSVD	RSVD	RSVD	LED_EN	FUSE	EN			
		Manufacturing Status (							FFT FN	GAUGE EN	DEC TE	ST CHG TEST	PCHG.	TEST			
		Manufacturing Status ( Manufacturing Status (		BBR_E	N	PF_EN	0,0		101,011	ONDOC_CH	030_10		T GHO				
		Manufacturing Status ( Manufacturing Status ( Safety Alert A+B (high)	0x0000	BBR_E RSVD	N	PF_EN CUVC	ото		OTC	ASCOL	RSVD	ASCCL	RS	VD			
		Manufacturing Status ( Manufacturing Status ( Safety Alert A+B (high) Safety Alert A+B (low)	0x0000	BBR_E RSVD AOLD	N I	PF_EN CUVC RSVD	OTD OCD	• • •	OTC OCD1	ASCOL OCC2	RSVD 0CC1	ASCOL	RS	VD V			

#### At right side there is a Command bar, several buttons and a table

Figure 4 Command

As example here it is possible to set battery in shipping mode for transportation (only if the State of Charge is <30%) or shut it down. The table shows the results of the executed command.

- ø ×

## The Command Screen

It is also possible to manually enter commands to receive information from the battery, or set some data. To get to this screen select the Advanced Comm SB tab at the top of the screen:

🚳 Registers 🤝 Data Memory 😴 Commands 🌉 Calibration 🔐 BHA Authentication 🎯 Advanced Comm SMB 🛓 Chemistry 🎚 Firmware 闄 Watch 📱	Data Graph 📴 Errors
Couldant Z C D C Register 2	" 🗖 🧔 Commands 🕮 👘 🗖
Ceshoard U Veshoard	
Auto Batrash is DN Effection Tara Office Registers	N _ O Commands
	Start Log Scan Refresh
Register	DEVICE_NUMBER
	HW VERSION
FV2400 Name Make 1988 O Name Make 1988 O Name	Value IInte A Name Value IInte A
Version:0.32 Value on the Cell A Manufacturer Access On State On State Cell A Manue 3588 of Cell A Manufacturer Access	1980 One Coll 2 DOPED 0
Remaining Cap. Alarm 690 mAb B RAT bit votage 19539 mV B True Full Cha C	State
Remaining Time Alarm 10 min BACK nin voltage 15541 mV True Full Char	9491 cWb Cell 1 OMax 7085 mbb Cell 1 OMax
At Bate .19 mA @ Cel 1 Current 0 mA @ T sim	21.1 deoC 🗐 Cel 2 Olfax 7085 máb
At Rate Time To Full 65535 min Cell 2 Current 0 mA	22.2 deoC III Cell 3 OMax 7107 mAh SHUTDOWN
Af Rate Time To Empty 13633 min Cell 3 Current 0 mA Cell 1 RaScale	1000 - Cel 4 OMax 7090 mAh
At Rate OK 1 - W Cell 4 Current 0 mA W Cell 2 RaScale	1000 - III Cell 1 QMax DOD0 2603 - CC_OPESEI
Emperature 22.2 deaC ECel 1 Power 0 cW ECel 3 RaScale	1000 - III Cel 2 QMax DOD0 2607 - PCHG FET TOGGLE
hydrasopt IIV Design of the second se	1000 - Gel 3 QMax DOD0 2575 -
4500 1 06 Ecurrent 0 mA E Cell 3 Power 0 c/W E Cell 1 CompRe-	s 35 mOhm CHG_FET_TOGGLE
Addr: 0x17 III Average Current 0 mA IIII Cell 4 Power 0 cW III Cell 2 CompRer	s 38 mOhm iii QMax Passed Q 37 mAH PISG FET TOGGI F
22.2 degC B Max Error 9 % B Power 0 cW E Cell 3 CompRes	s 37 mDhm @ QMax Time 65535 h/16
III Relative State of Charge 66 % III Average Power 0 cW III Cell 4 CompRet	s 35 mOhm 🗑 Temp k 3.43 - 🛹 GAUGE_EN
Absolute State of Charge 63 % Int Temperature 23.5 degC PackGrid	2 - iii Temp a 4675 - e cst cal
Remaining Capacity 4317 mAh TS1 Temperature 22.2 degC Cell 1 Grid	0 - Cell 1 Raw DOD 5216 -
Pull charge Capacity 6552 mAh III TS2 Temperature 22.2 degC III Cell 2 Grid	0 - 🔟 Cel 2 Raw DOD 5184 - 🖉 LIFETIME_EN
Run time To Empty 65535 min TS3 Temperature -53.0 degC Cell 3 Grid	0 - 🗑 Cel 3 Raw DOD 5152 -
15551 mV BAverage Time to Empty 65535 min BTS4 Temperature 205.9 degC Cell 4 Grid	0 - III Cel 4 Raw DOD 5184 - LI_RESET
56% Average Time to Full 65535 min V Cell Temperature 22.2 deoC V StateTime	22175 s V Cel 1 Bal Time 0 s V LT_FLUSH
Bit Registers	BELINGH BELLOW RSVD
Name         Value         BI7         BI5         BI5         BI4	813 812 811 800 A PF.EN
Store Store Store Revealed All RSVD	RSVD RSVD P6 CC
Stone tone Battery Mode (low) Of RSVD RSVD RSVD RSVD	RSVD RSVD P05 ICC PF_CLEAR
1500 USAN Battery Status (high) 0x0000 OCA TCA RSVD OTA	TDA RSVD RCA RTA #BBR.EN
2000 John Jann Battery Status (low) NIT DSG FC FD	EC3 EC2 EC1 EC0
Operation Status A (hl., 0x0387 SLEEP XCHG XDS0 PF	SS SDV SEC1 SEC0 PBR_CLEAR
Operation Status A (low) BTP_NT RSVD FUSE RSVD	PCHG CHG DSG PRES ELISE EN
Operation Status 8 (hl 0x0000 RSVD PSSHUT EMSHUT CB	SLPAC SLPAD SMBLCAL BIT
Operation Status B (Io SLEEPM XL CAL_OFFSET CAL	AUTOCALM AUTH LED SDM Log Panel Clear Log
Temp Range (high) 0x08 RSVD RSVD RSVD RSVD	RSVD RSVD RSVD RSVD RSVD
Temp Range (low) RSVD OT HT STH	RT STL LT UT Transaction Log
Charging Status (high) 0x0004 RSVD RSVD RSVD RSVD	RSVD CCC CVR CCR Name Cmd Result Read A
Charging Status (low) VCT MCHG SU IN	RV MV LV PV
Gauging Status 0xD0 CF DSG EDV BALLEN	TC TD FC FD
Gradua (high) 0x0719 RSVD RSVD RSVD OCVFR	LDMD RX QMAX VDQ
IT Status (low) NSFM RSVD SLPGMAX OEN	VOK RDIS RSVD REST
Manufacturing Status ( 0x03F8 CAL_EN LT_TEST RSVD RSVD	RSVD RSVD LED_EN FUSE_EN
Manufacturing Status ( BBR_EN PF_EN LF_EN FET_EN	GAUGE_EN DEG_TEST CHG_TEST PCHG_TEST
Safety Alert A+B (high) 0x000     R5VD     CUVC     OTD     OTC	ASCOL RSVD ASCOL RSVD
Safety Aert A+B (low) AOLDL RSVD 0C02 0C01	0662 0661 60V 60V
is jsaftety Status A+B (hig 0x0000 RSVD CUVC 0TD 0TC	ASCD ASCC ASCC

Figure 5 Location of Advanced Comm SMB tab

Below screen with several sections will be opening:

File View Window Help	v			5 //
🚳 Registers 🐲 Data Memory 🏅	🕻 Commands 🔟 Calibration 🔐 SHA Authentication 🐲 Advanced Comm SMB 🗼 Chemistry 🔣 Firmware 📗 GPCPackager 🖉 Watch 🔤 Data Graph 🔤 En	015		
🍠 DashBoard 🔍 🗆	Common SMB      Common SM		Commands 🕅	
Auto Refresh is ON - Click to Turn OFF	Advanced Comm SMB	4 B 🔳 🔒	Commands	
bqStudio Version: 1.3.101	Advanced Comm		DEVICE_NUMBER	^
1	Config		HW_VERSION	
EV2400	Target Address 17 23		PW_VERSION	
Versiona.sz	(Hex) (Dec)		FW_BUILD	
			CHEM_ID	
5 AD	Word Read/Write		SHUTDOWN	
V 1	Sand Cond 10 16 Her V		IATA_SHUTDOWN	
	(Hex) (Dec)		CC_OFFSET	
bq40z50R2 4500.2.11			PCHG_FET_TOGGLE	
Addr: 0x17 23.1 deaC	Read Word 09 9 Dr		CHG_FET_TOGGLE	
	(Hex) (Dec)		DSG_FET_TOGGLE	
			GAUGE_EN	
	Write Word Ox		FET_EN	
14347 mV	(Hex) (Dec)		LIFETIME_EN	
26%	First Deviding		LT_RESET	
	Block Type		LT_FLUSH	
	Read Block 20 32		✓ LT_TEST	
-1000 1000	(Hex) (Dec) 0x		PF_EN	
E 1500 1500 E			PF_CLEAR	
0	Write Block		BBR_EN	
	(Hex) (Dec) UK		BBR_CLEAR	~
	ASCI		Log Panel	Clear Log
	Transferra		Transaction Log	
	TimeStamp Target Ad Operation Command Length Data (Hex-Value) Status		Name Cmd Resul	t Read A
		TEXAS INSTRUMENTS		

Figure 6 Advanced Comm SMB screen

The first section on top is the Config section, showing the address of the connected battery (17h). Please do not change this address.

#### The next section is the Word read/write section.

File View Window Help			-	ы <u>х</u>
🚳 Registers 🐲 Data Memory 💈	commands 📃 Calibration 🔐 94A Authentication 🏄 Advanced Comm 9MB 🦼 Chemistry 🔣 Firmware 👖 GPCPackager 🚂 Watch 📟 Data Graph 🜉 Errors			
🖋 DashBoard	Begisters 🐲 Advanced Comm SMB 🔢		Commands 🕸	
Auto Refresh is ON - Click to Turn OFF	Advanced Comm SMB	4 B 🖬 🔒	Commands	
bqStudio Version: 1.3.101	Advanced Comm		DEVICE NUMBER	^
Λ	Config		HW VERSION	
EV2400	Target Address 17 23		FW_VERSION	
Version:0.32	(Hes) (Dec)		FW_BUILD	
~			CHEM_ID	
540 Child	Word Read/Write		SHUTDOWN	
	Contrained to be Her v		IATA_SHUTDOWN	
	(Her) (Dec)		CC_OFFSET	
500.2.11			PCHG_FET_TOGGLE	
Addr: 0x17 23.1 degC	Read Word 09 9 0x		CHG_FET_TOGGLE	
	(Hex) (Dec)		DSG_FET_TOGGLE	
			GAUGE_EN	
	Write Word 0x		FET_EN	
14347 mV	(Hex) (Dec)		LIFETIME_EN	
26%	Block Basel Write		LT_RESET	
	Block Type		LT_FLUSH	
	Read Block 20 32 A Hex V		LT_TEST	
-1000 1000	(Hex) (Dec) 0x		PF_EN	
- 1500 1500 - - 2000 2000 -			PF_CLEAR	
0	Write Block (Para) 0(		BBR_EN	
	(res) (Lex)		- DON_CLEAR	*
	ASCII		Log Panel	Clear Log
	Transaction Log		Transaction Log Name Cmd Result	Read A
	TimeStamp Target Ad Operation Command Length Data (Her-Value) Status			
		•		
	40	TEXAS INSTRUMENTS		

Figure 7 Word Read/Write section

This section allows to insert commands to read or writes words. A word is composed of two hexadecimal letters or numbers, for example 0xA5. The 0x just signifies hexadecimal notation. A hexadecimal command can be entered directly.

For commands that set values, a hexadecimal word of data can be entered, which sets that value to the registers of the battery. More information about this topic can be found on Page 11 of this manual.



The next section is the Block Read/Write section. For read or write multiple bytes of data.

Figure 8 Block Read/Write section

Battery Management Studio ( bqStudio ) 1.3.10     File View Window Help			-	a ×
🔇 Registers 🥽 Data Memory 💈	Commands 🔟 Calibration 🄐 SHA Authentication 🐲 Advanced Comm SMB 🛓 Chemistry 🔣 Firmware 🞚 GPCFactager 📗 Watch 🔤 Data Graph 🔤 Errors			
🖋 DashBoard	0 Registers W Advanced Comm SM8 20		Scommands 🕸	•
Auto Refresh is ON - Click to Turn OFF	Advanced Comm SMB	4 🗗 🔳 🔒	Commands	
bqStudio Version: 1.3.101	Advanced Comm		A DEVICE NUMBER	^
Ω	Config		HW VERSION	
EV2400	Target Address 17 23		PW VERSION	
Version:0.32	(Hes) (Dec)		FW_BUILD	
~			CHEM_ID	
	Word Read/Write		SHUTDOWN	
	Commissional to 1 to 1 to 1 to 1 to 1 to 1		IATA_SHUTDOWN	
	Hen Oreci		CC_OFFSET	
bq40z50R2 4500 2 11			PCHG_FET_TOGGLE	
Addr: 0x17 23.1 degC	Read Word 09 9 Ox		CHG_FET_TOGGLE	
~U~🔂	(Hex) (Dec)		DSG_FET_TOGGLE	
			GAUGE_EN	
	Winke Word 0 v		<ul> <li>FET_EN</li> </ul>	
14347 mV	(nec) (Dec)		LIFETIME_EN	
20%	BlockRead/Write		LT_RESET	
	Block Type		LT_FLUSH	
500 500	Read Block 20 32		LT_TEST	
1000 1000	(Her) (Dec) 0z		PF_EN	
			PP_CLEAK	
0	Winte Work: (Here) Dr.		RBR CLEAR	
			Les Parel	~
	ASCI		Transaction Los	Clear Log
	Transaction Log		Name Cmd Result	Read A
	TimeStamp Target Ad Operation Command Length Data (Her-Value) Status			
		v		
	49	TEXAS INSTRUMENTS		

Finally, the Transaction Log shows the results from executed commands:

Figure 9 Transaction Log section

### As example, when running the RRC Manufacturer Name read command(0x20) the result might be:

Block Read/Write									
			Block			Туре			
Read <u>B</u> lock 20 (He	32 (Dec)		0x 52 52 43		< >	Hex v			
Write Block	(Hex)	(Dec)	0x		~ ~				
Transaction Log									
TimeStamp	Target Ad	Operation	Command	Length	Data (Hex-Value)			Status	
2021-11-01 09:	17	Rd Block	20	3	52 52 43			Success	

Figure 10 Result for executing Manufacturer Name

In both the Block section and Transaction Log the result is visible. If a RRC battery is connected and command 0x20h (Manufacturer Name) is entered the result will be "0x53 0x53 0x43". The program converts the responding hex-value in the ASCII field as "RRC":

Block Read/Write						_						
			Block			Туре						
Read Block 20	0 32		52 52 43			∧ Hex	~					
			0x									
(11	ex) (Dec)					~						
Write Block						~						
		(2.)	0x									
	(Hex)	(Dec)										
	(Hex)	(Dec)				~						
	(Hex)	(Dec)				~						
	(Hex)	(Dec)	ASCII RRC			~						
Transaction Log	(Hex)	(Dec)	ASCII RRC			~						
Transaction Log	(Hex) Target Ad	(Dec)	SCII RRC	Length	Data (Hex-Valu	<ul> <li>e)</li> </ul>				 Statu	5	
Transaction Log TimeStamp 2021-11-01 09:	(Hex) Target Ad 17	(Dec)	ASCII RRC Command 20	Length 3	Data (Hex-Valu 52 52 43	<ul> <li>c)</li> </ul>		 	 	 Statu	5	
Transaction Log TimeStamp 2021-11-01 09:	(Hex) Target Ad 17	(Dec) Operation Rd Block	Command 20	Length 3	Data (Hex-Valu 52 52 43	e)				Statu	5	
Transaction Log TimeStamp 2021-11-01 09:	(Hex) Target Ad 17	(Dec) Operation Rd Block	Command 20	Length 3	Data (Hex-Valu 52 52 43	e)				Statu Succ	5	

Figure 11 Location of ASCI field

If command is executed successfully this will be confirmed at right side in Status field.

## Executing Commands

This chapter explains how you can run your own commands. Below is a table of commands that can be run, as well as what data types the command needs or returns.

Further the R/W Type of this command is shown. This explains where to input the command. *Table 1This table contains the commands that can be run.* 

Data	Command	Data Type	R/W Type
Manufacturer Name	0x20	Hexadecimal ASCII	Read Block
Battery Name	0x21	Hexadecimal ASCII	Read Block
Chemistry	0x22	Hexadecimal ASCII	Read Block
Specification: ID3.1 VS0 IPs0	0x1a	Unsigned Int	Read Word
Serial Number	0x1c	Number	Read Word
Manufacturing Date	0x1b	Formatted Word	Read Word
Voltage	0x09	Unsigned Int	Read Word
Voltage Measured			
Current	0x0a	Unsigned Int	Read Word
Temperature	0x08	Unsigned Int	Read Word
NTC Measured			
Relative Charge	0x0d	Unsigned Int	Read Word
Remaining Capacity	0x0f	Unsigned Int	Read Word
Full Capacity	0x10	Unsigned Int	Read Word
Absolute Charge	0x0e	Unsigned Int	Read Word
Design Capacity	0x18	Unsigned Int	Read Word
Design Voltage	0x19	Unsigned Int	Read Word
Cycle Count	0x17	Unsigned Int	Read Word
Max Error	0x0c	Unsigned Int	Read Word
Charging Voltage	0x15	Unsigned Int	Read Word
Charging Current	0x14	Unsigned Int	Read Word
Time to empty	0x11	Unsigned Int	Read Word
Time to full	0x13	Unsigned Int	Read Word
Capacity Alarm	0x01	Unsigned Int	Read/Write Word
Time Alarm	0x02	Unsigned Int	Read/Write Word

# Troubleshooting

#### Question: Why does the Battery Management Studio Software not detect the connected battery?

**Answer:** Check if the cables are all connected properly using the Initial Setup chapter of this manual. If everything is connected properly and it is still not working, press the black circle on the battery shaped indicator:

chargeable Smart Battery Pack Li-Ion 寄子电池组 / 二次鋰電池組 RRC RRC2054-2 刑品律 al Voltage 标称电压/ Capacity 额定容量 6900mAh 99.4Wh Max. Charge Voltage 充电限制电压 Max. Charge Current 充电限制电流 16.8Vdc 4.83A Read battery and device instructions before use! Caution IS 16046/IEC 62133 8

When pressing on indicator button, and battery is not in shipping mode, one or more green LEDs are active depending on status of charge. If no LED is active the battery can be in shipping mode or empty.

To wake the battery (exit shipping mode) insert it in the RRC charger. The charger will need a few seconds to take the battery out of shipping mode.

When configurations files, for addressing the BQ40Z50 fuel gauge during testing, are needed, please contact Texim Europe. We can provide these files.