

V05370-01 Data

4S Protector with Fuel Gauge and Cell Balancing

Absolute Maximum Ratings		Min.	Typ.	Max.	Unit	Theory of Operation
Supply Voltage (B+ to B- or P+ to P-)		-0.3		18.0	V	
Operating Temperature		-30		60	°C	
Storage Temperature		-40		85	°C	
Operating Parameters (at TA = 25°C)						The V05370-01 is a 4S protection and fuel gauging solution rated to 20A continuous operation in free air.
Quiescent Current (at VCELL = 3.3V)			10		mA	
Quiescent Current (sleep mode)				400	µA	
Continuous Load				20	A	Overvoltage, under voltage, and overcurrent trips are managed via a TI BQ40Z50-R1 Li-Ion Battery Pack Manager IC driving high-side N-Channel MOSFETs.
Overvoltage						
Cell Overvoltage ¹		3.725	3.750	3.775	V	
Cell Overvoltage Delay Time ¹			10		S	Fuel gauging is also provided by the TI BQ40Z50-R1 device, which is a Coulomb metric counter employing TI's Impedance Track™ technology, thereby eliminating in-service calibration.
Cell Overvoltage Release ¹			3.300		V	
Under Voltage						
Cell Under Voltage ¹		2.475	2.500	2.525	V	Fuel gauge data is fed to the on-board microcontroller (MCU), which transfers the data to the host upon request. Communication to the host is via SMBus Rev 1.1.
Cell Under Voltage Delay Time ¹			10		S	
Cell Under Voltage Release ¹			3.000		V	
Overcurrent and Short Circuit						The TI BQ40Z50-R1 device also controls passive cell balancing, which is only performed when charging or at rest (no charge/discharge current).
Discharge Overcurrent Trip ¹		21.5	22.0	22.5	A	
Discharge Overcurrent Trip Delay Time ¹			5		S	
Discharge Overcurrent Release ¹ (remove load)			8		S	
Short Circuit Current Trip ^{1,2}			200		A	
Short Circuit Current Trip Delay Time ¹			915		µs	
Short Circuit Current Release ¹ (remove load)			5		S	
Charge Overcurrent Trip ¹		21.5	22.0	22.5	A	
Charge Overcurrent Trip Delay Time ¹			5		S	
Over Temperature						Thermal monitoring is supported by providing four external 10 kΩ NTC thermistors, which connect to the fuel gauge.
Charge Over Temperature Trip ¹			65		°C	
Charge Over Temperature Release ¹ (hysteresis)			15		°C	
Discharge Over Temperature Trip ¹			75		°C	
Discharge Over Temperature Release ¹ (hysteresis)			10		°C	To prevent damaging the product, connections must be made in the following sequence (reverse the sequence when disconnecting): 1) B- 2) J4 (before individual cell connections) 3) Battery Stack Negative Voltage Sense 4) Cell 1 Voltage Sense 5) Cell 2 Voltage Sense 6) Cell 3 Voltage Sense 7) Cell 4 Voltage Sense 8) B+
Under Temperature						
Charge Under Temperature Trip ¹			-5		°C	
Discharge Under Temperature Trip ¹			-25		°C	
Under Temperature Release ¹ (hysteresis)			10		°C	
Fuel Gauge SMBus Rev 1.1						
Calibrated Accuracy			1		%	
Clock Frequency		10		100	kHz	
Notes:						
¹ Parameter is factory-programmable to suit customer application.						
² Validated using 4S10P-connected Heater 26650 3200 mA/h cells. Performance may vary if other cells are used.						

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Figure 1 - Simplified Block Diagram:

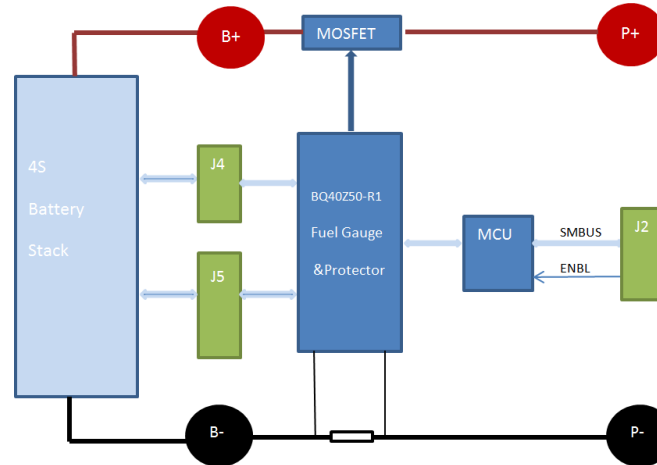
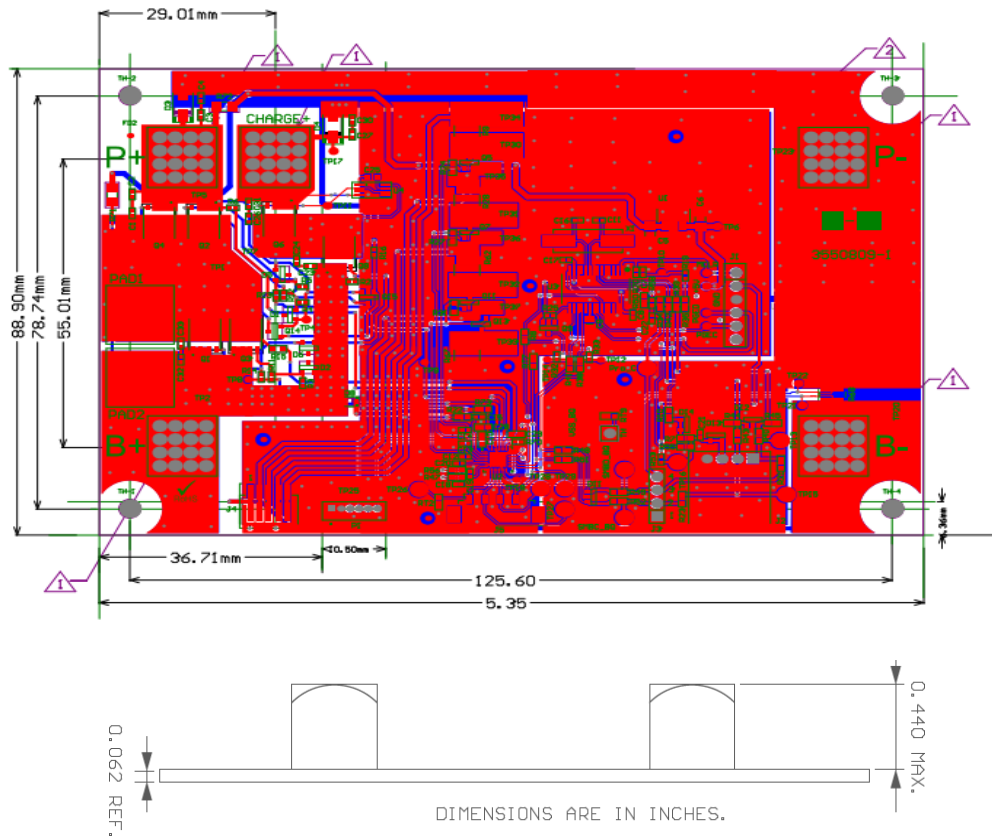


Figure 2 - Mechanical Details:



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Table 1 - Connectivity:

Connector	Mating Information	Pin #	Function
J2	Molex 0050579404 (housing), 0016020069 (contacts)	1	SDA
		2	SCL
		3	ENBL
		4	P-
B+	M6, 7mm depth		B+
B-	M6, 7mm depth		B-
P+	M6, 7mm depth		P+
P-	M6, 7mm depth		P-
J4	Molex 0874390500 (housing), 0874210000 (contacts)	1	Battery Stack Negative Voltage Sense
		2	Cell 1 Voltage Sense
		3	Cell 2 Voltage Sense
		4	Cell 3 Voltage Sense
		5	Cell 4 Voltage Sense
J5	Molex 51021-0800 (housing), 50079-8000 (contacts)	1	External Thermistor 1 Sense
		2	External Thermistor 1 Ground
		3	External Thermistor 2 Sense
		4	External Thermistor 2 Ground
		5	External Thermistor 3 Sense
		6	External Thermistor 3 Ground
		7	External Thermistor 4 Sense
		8	External Thermistor 4 Ground

Note: J5 pins 2, 4, 6, and 8 are internally connected to ground

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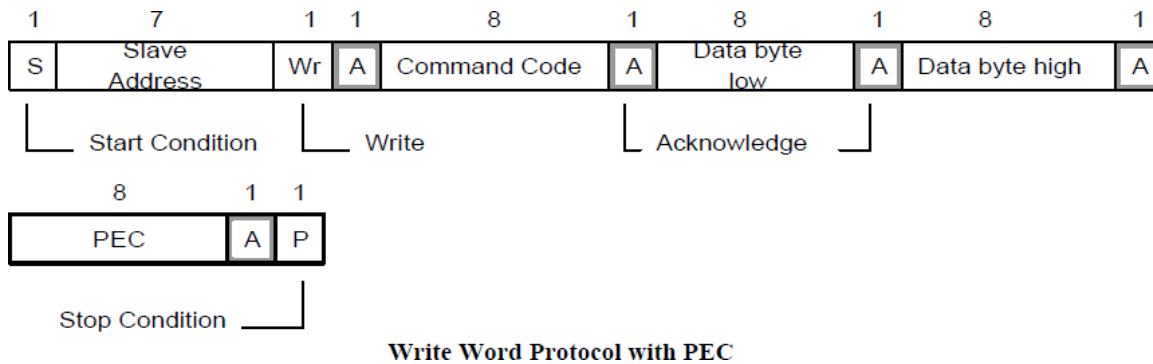
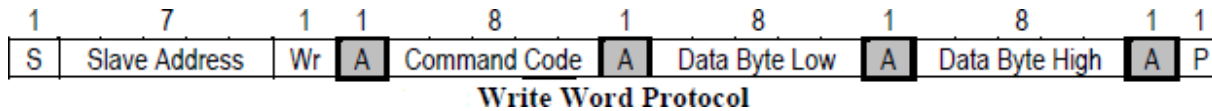
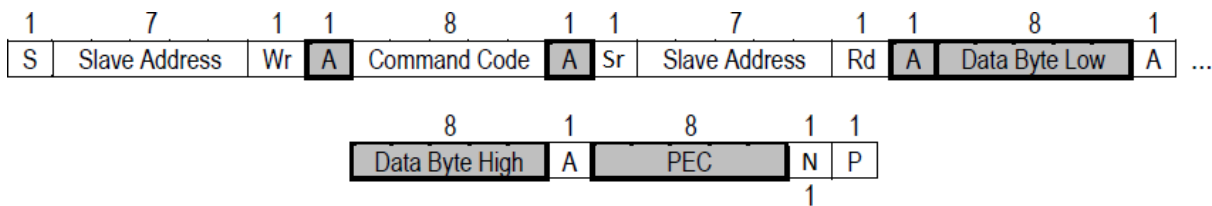
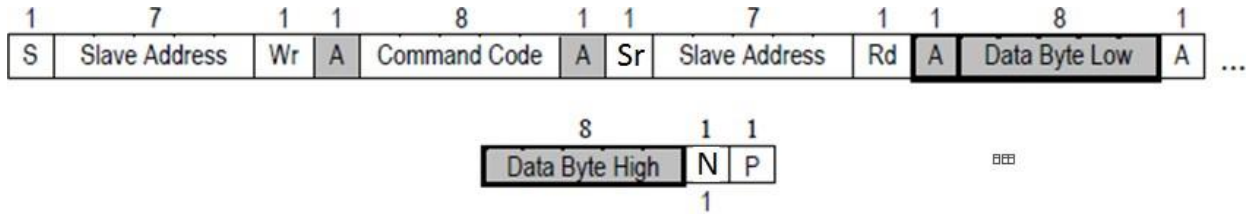


External Communication:

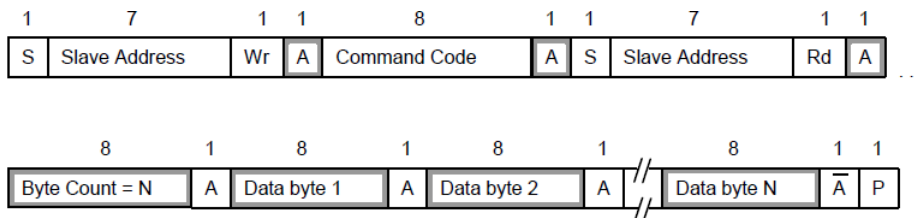
The BMS operates as a slave device when communicating with external devices.

Battery Pack Slave Address: The 7-bit device address (ADDR) is the most significant 7 bits of the hex address and is 0001011 (fixed). The 8-bit device address is therefore 0x16 for write, and 0x17 for read.

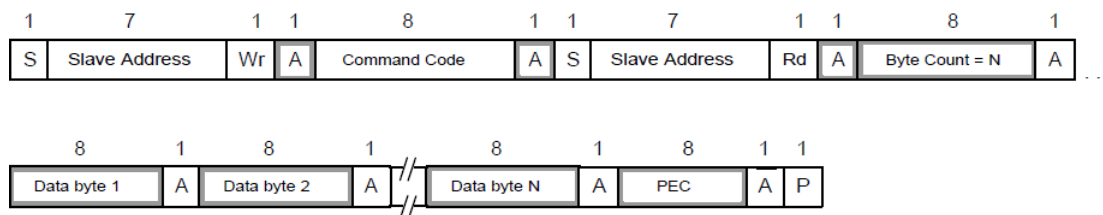
Communication is based on SBS read/write, with/without PEC word, and read block protocol.



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Block Read



Block Read with PEC

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Table 2 - External SBS Commands:

CMD	Mode	Name	Format	Unit
0x01	Read Word	OperationStatus ¹	Unsigned	--
0x03	Read Word	Battery Mode	Unsigned	--
0x08	Read Word	Temperature	Unsigned	0.1 °K
0x09	Read Word	Voltage	Unsigned	mV
0x0a	Read Word	Instantaneous Current	Signed	mA
0x0b	Read Word	Average Current	Signed	mA
0x0c	Read Word	Max Error	Unsigned	%
0x0d	Read Word	RSOC	Unsigned	%
0x0f	Read Word	Remain Capacity	Unsigned	mA/h
0x10	Read Word	Full Charge Capacity	Unsigned	mA/h
0x12	Read Word	Average Time to Empty	Unsigned	Min
0x13	Read Word	Average Time to Full	Unsigned	Min
0x15	Read Word	Charging Voltage	Unsigned	mV
0x16	Read Word	Battery Status	Unsigned	--
0x17	Read Word	Cycle Count	Unsigned	Cycles
0x18	Read Word	Design Capacity	Unsigned	mA/h
0x19	Read Word	Design Voltage	Unsigned	mV
0x1b	Read Word	Manufacturer Date	Unsigned	--
0x1c	Read Word	Serial Number	Unsigned	--
0x20	Read Block	Manufacturer Name		ASCII
0x21	Read Block	Device Name		ASCII
0x3c	Read Word	Cell Voltage 4	Unsigned	mV
0x3d	Read Word	Cell Voltage 3	Unsigned	mV
0x3e	Read Word	Cell Voltage 2	Unsigned	mV
0x3f	Read Word	Cell Voltage 1	Unsigned	mV
0x51	Read Word	Safety Status	Unsigned	--
0x53	Read Word	PFStatus	Unsigned	--
0x88	Write Word (with PEC)	Shut Down ²	Unsigned	--
0x89	Write Word (with PEC)	Seal ²	Unsigned	--
0x90	Write Word (with PEC)	Lifetime ³	Unsigned	--
0x91	Write Word (with PEC)	PFEnable ³	Unsigned	--
0x70	Read Word	Check Seal Mode ⁴	Unsigned	--
0x71	Read Word	Check Lifetime and PFEnable Status ⁵	Unsigned	--

Notes:

¹ The word returns the lowest two bytes of 0x54 Operation Status of bq40z50 SBS command.

² The word can be any value, but needs to be with PEC.

³ The word can be any value, but needs to be with PEC. If the function is enabled, it toggles to disabled when the word is written. The function toggles back to enable the next time that the word is written.

⁴ To check the Seal Mode, using command 0x70 to Read SMB Word, the reading result is the same as Bq40z50 Operation Status A. Bit definition is shown below. The user can determine whether it is sealed or not by checking the condition of the SEC1 and SEC0 bits. If both SEC1 and SEC0 are set, it is sealed.

SLEEP	XCHG	XDSG	PF	SS	SDV	SEC1	SEC0	BTP-INT	RSVD	FUSE	RSVD	PCHG	CHG	DSG	PRES
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⁵ To check, using command 0x71 to Read SMB Word, the reading result is the same as bq40z50 Manufacturing Status. Bit definition is shown below. The user can determine whether it is enabled or disabled.

15	14	13	12	11	10	9	8
CAL_TEST	LT_TEST	RSVD	RSVD	RSVD	RSVD	LED_EN	FUSE_EN
7	6	5	4	3	2	1	0
BBR_EN	PF_EN	LF_EN	FET_EN	GAUGE_EN	DSG_EN	CHG_EN	PCHG_EN

Document Revision History:

Revision	Date	Reason/Description of Changes	Modified By
1	17 Jan 2021	Initial Release	KG

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