



EPS I2C PROTOCOL USER MANUAL

Electrical Power System (EPS)

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ELECTRICAL POWER SYSTEM (EPS) I2C PROTOCOL USER MANUAL

This user manual explains in detail the EnduroSat' Electrical Power System (EPS) I²C communication protocol.



Figure 1 - EPS module

1 CHANGE LOG

Date	Version	Note
20/03/2016	Rev 1	

2 ACRONYMS LIST

EPS	Electrical Power System
I ² C	Inter-Integrated Circuit
LSB	Least Significant Bit
MSB	Most Significant Bit
OBC	Onboard Computer

3 COMMUNICATION

I²C interface allows a master device – an Onboard Computer (OBC) to monitor and control the EPS module. The EPS is configured as a slave device with a 7bit address. MSB should be sent first. The operating speed is 400 kHz. The address of the EPS on the I²C is 0x18, but it can be modified based on a customer requirement.

4 I2C PROTOCOL DESCRIPTION

The EPS module can receive two types of command instructions - READ & WRITE. The WRITE command initiate event is “Telecommand”, while the READ commands are used to return results, “Telemetry”. Both commands start with the same 7-bit slave address. ACKnowledge must be received before initiating the transmission of the data.

The returned result of every READ command is always 2 bytes and MSB is received first. The WRITE Command is only one and it's again 2 bytes. In this case MSB is sent first as well. Every bit in this command changes specific port of EPS Microcontroller. If error command is received, the returned result is 0xFFFF. Pull-up 4.7k Ohm resistors are mounted in EPS I²C interface. Typical I²C communication is shown on Figure 2.

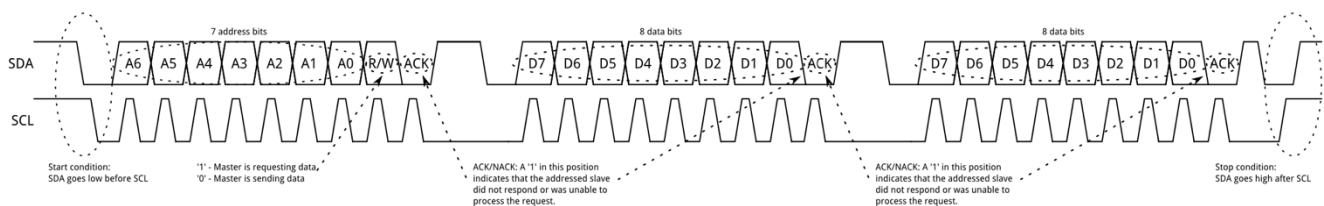


Figure 2.

Full list of READ commands are shown in table 1.

EPS READ COMMANDS			
Name	Command	Bytes Returned	Comment
Battery Voltage	01	2	Batt. BUS voltage - 12 bit ADC Units (from 0 to 4095)
Battery Current	02	2	Batt. BUS current - 12 bit ADC Units
BCR Voltage	03	2	Ext. Battery Pack - 12 bit ADC Units
BCR Current	04	2	Ext. Battery Pack - 12 bit ADC Units
X Voltage	05	2	Solar Panel X axis voltage - 12 bit ADC Units
X- Current	06	2	Solar Panel X- current - 12 bit ADC Units
X+ Current	07	2	Solar Panel X+ current - 12 bit ADC Units
Y Voltage	08	2	Solar Panel Y axis voltage - 12 bit ADC Units
Y- Current	09	2	Solar Panel Y- current - 12 bit ADC Units
Y+ Current	10	2	Solar Panel Y+ current - 12 bit ADC Units
Z Voltage	11	2	Solar Panel Z axis voltage - 12 bit ADC Units
Z- Current	12	2	Solar Panel Z- current - 12 bit ADC Units
Z+ Current	13	2	Solar Panel Z+ current - 12 bit ADC Units
3.3V Current	14	2	3.3V BUS current - 12 bit ADC Units.
5V Current	15	2	5V BUS current - 12 bit ADC Units.
LUP 3.3V	16	2	3.3V Latch-up protected Output Status (ON/OFF)
LUP 5V	17	2	5V Latch-up protected Output Status (ON/OFF)
MCU Temp	18	2	MCU Temperature – Not accurate
Batt. Temp. Sens. 1	19	2	
Batt. Temp. Sens. 2	20	2	
Batt. Temp. Sens. 3	21	2	
Batt. Temp. Sens. 4	22	2	
Inputs Condition	23	2	Bits description in table 2
Outputs Condition	24	2	Bits description in table 3
Power_ON_Cycles	25	2	
V_Under_Voltage	26	2	Battery Protection
V_Short_Circuit	27	2	Battery Protection
V_Over_Temperature	28	2	Battery Protection
MAX_Temp 1	29	2	Batt. Pack 1 Temp.Sens.1
MAX_Temp 2	30	2	Batt. Pack 1 Temp.Sens.2
MAX_Temp 3	31	2	Batt. Pack 2 Temp.Sens.1
MAX_Temp 4	32	2	Batt. Pack 2 Temp.Sens.2

MIN_Temp 1	33	2	Batt. Pack 1 Temp.Sens.1
MIN_Temp 2	34	2	Batt. Pack 1 Temp.Sens.2
MIN_Temp 3	35	2	Batt. Pack 2 Temp.Sens.1
MIN_Temp 4	36	2	Batt. Pack 2 Temp.Sens.2
Temp Sensor 5	37	2	External Temp. Sensor 5
Temp Sensor 6	38	2	External Temp. Sensor 6
Temp Sensor 7	39	2	External Temp. Sensor 7
Temp Sensor 8	40	2	External Temp. Sensor 8
Send Software version	41	2	EPS Software Version
V_BFCharge	42	2	Battery Fast Charge
V_Out_1_Def	43	2	Output 1 Default Value
V_Out_3_Def	44	2	Output 3 Default Value
V_Out_4_Def	45	2	Output 4 Default Value
V_Out_5_Def	46	2	Output 5 Default Value
V_Out_6_Def	47	2	Output 6 Default Value
Charge_Cycles	48	2	

Table 1.

Bits description of result of READ command 23 “Input Condition” is shown in table 2.

READ - Input Condition 23 – BITS Description		
BIT	EPS Parameter	Comment
1	PGood3.3V	3.3V Power Good – <i>Most Significant Bit</i>
2	PGood5V	5V Power Good
3	KS_Lock_Reset	Reset SW Self Lock
4	CmplSTS	Battery Status – Complete
5	ChrgSTS	Battery Status – Charge in progress
6	-	
7	-	
8	-	
9	-	
10	-	
11	-	
12	-	
13	-	
14	-	
15	-	
16	-	<i>Least Significant Bit</i>

Table 2.

Bits description of result of READ command 24 “Output Condition” is shown in table 3.

READ - Output Condition 24 – BITs Description		
BIT	EPS Parameter	Comment
1	SWSelfLock	SW Self Lock – <i>Most Significant Bit</i>
2	VBATTEN	Enable Battery BUS
3	BCROutEN	Enable BCR BUS
4	SHD_3.3V	Enable 3.3V BUS
5	SHD_5V	Enable 5V BUS
6	SA1SHD	Enable X axis SP Step-up Converter
7	SA2SHD	Enable Y axis SP Step-up Converter
8	SA3SHD	Enable Z axis SP Step-up Converter
9	Chrg_I	Fast/Slow Battery Charge
10	SHDChrg	Shutdown Battery Charger (High Level - OFF)
11	OUT1	Output 1 / Payload
12	OUT2	Output 2 / ~LUP5V
13	OUT3	Output 3 / OBC
14	OUT4	Output 4 / UHF
15	OUT5	Output 5 /
16	OUT6	Output 6 / ~LUP3.3V – <i>Least Significant Bit</i>

Table 3.

WRITE Command Bits description is shown in table 4. All BITS that are not specified in the comment section can be switched on at “High Level”

EPS WRITE COMMAND – BITS Description		
BIT	EPS Parameter	Comment
1	SWSelfLock	SW Self Lock – <i>Most Significant Bit</i>
2	VBATTEN	Enable Battery BUS
3	BCROutEN	Enable BCR BUS
4	SHD_3.3V	Enable 3.3V BUS
5	SHD_5V	Enable 5V BUS
6	SA1SHD	Enable X axis SP MPPT Step-up Converter
7	SA2SHD	Enable Y axis SP MPPT Step-up Converter
8	SA3SHD	Enable Z axis SP MPPT Step-up Converter
9	Chrg_I	Fast/Slow Battery Charge
10	SHDChrg	Shutdown Battery Charger (High Level - OFF)
11	OUT1	Output 1 / Payload
12	OUT2	Output 2 / ~LUP5V (High Level ON Output1 and OFF LUP5V)
13	OUT3	Output 3 / OBC
14	OUT4	Output 4 / UHF
15	OUT5	Output 5 /
16	OUT6	Output 6 / ~LUP3.3V (High Level ON Output6 and OFF LUP3.3V) – <i>Least Significant Bit</i>

Table 4.

5 CONNECTOR PINOUT

5.1 Connectors Location

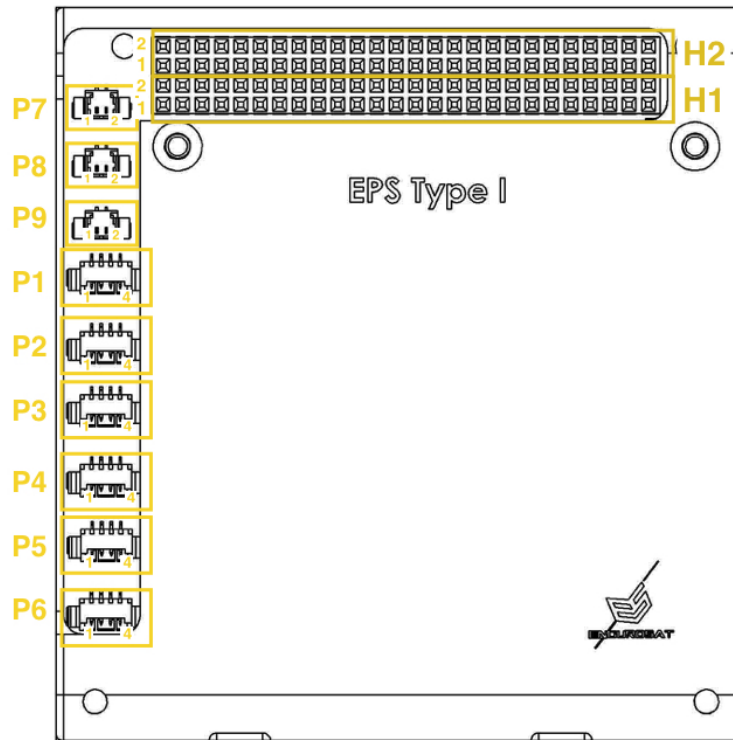


Figure 3 - Connectors location and pinout

5.2 H1 - Stack Connector

Pin	Mnemonic	Dir	Description
H1-32	5VUSB		
H1-33	UART RX		(Optional – Hardware Customizable)
H1-35	UART TX		(Optional – Hardware Customizable)
H1-41	I ² C SDA		
H1-43	I ² C CLK		
H1-48	LUP1 3.3V		
H1-51	LUP2 5V		

5.3 H2 - Stack Connector

Pin	Mnemonic	Description
H2-3	OUT1	General Purpose Output
H2-4	OUT2	General Purpose Output
H2-5	OUT3	General Purpose Output
H2-6	OUT4	General Purpose Output
H2-7	OUT5	General Purpose Output
H2-8	OUT6	General Purpose Output
H2-25	5V BUS	
H2-26	5V BUS	
H2-27	3.3V BUS	
H2-28	3.3V BUS	
H2-29	GND	
H2-30	GND	
H2-31	GND	
H2-32	GND	
H2-41	BCR Out	
H2-42	BCR Out	
H2-43	BCR Out	
H2-44	BCR Out	
H2-45	VBATT BUS	
H2-46	VBATT BUS	

