This document explains how the PMIC and the IHU are communication down to the byte by byte level

PMIC Interface

Detailed Description of PMIC and IHU Interface

Revision: 1.2.1

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1 Hardware Layer

The hardware interface between the PMIC and the IHU is I^2C. It is a standard implementation of I^2C with a clock wire and a data wire. See Wikipedia's [I^2C article](#) for details on how it works.

2 Software Layer

The IHU is the master and the PMIC is a slave, 8b address 0x0E. The data blocks interchanged between the IHU and PMIC are explained in the following sub-sections. For each command, if a command is sent multiple times before its response is read, when read, the response reflects the most recent command.

2.1 Subsystem Power Change

This command is used when a subsystem is desired to be turned off or on. The first byte is the identifier. The second byte is the subsystem. See table below for details. The PMIC replies with the result of the request. See Code SOP Section 6.4.1 for a list of error codes.

Index	0x00	0x01
Function	0x00: Turn off 0x01: Turn on	Subsystem: 0x00: IHU 0x01: IFJR 0x02: ADCS 0x03: ADCS Coils 0x04: Comms 0x05: Comms Amplifier 0x06: Payload 0 0x07: Payload 1 0x08: Payload 2

2.2 Voltage Data Request

This command is used to read the voltage of various locations on the EPS. The first byte is the identifier. The second byte is the location. See table below for details. The PMIC replies with the voltage as an unsigned 16b integers with 100µV/LSB.

Index	0x00	0x01
Function	0x02	0x00: Solar Panel 0 0x01: Solar Panel 1 0x02: Solar Panel 2 0x03: Solar Panel 3 0x04: Solar Panel 4 0x05: Solar Panel 5 0x06: Solar Panel 6 0x07: Solar Panel 7 0x08: Battery A 0x09: Battery B 0x0A: 3.3V Regulator A 0x0B: 3.3V Regulator B

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2.3 Current Data Request

This command is used to read the currents of various paths on the EPS. The first byte is the identifier. The second byte is the path. See table below for details. The PMIC replies with the current as a signed 16b integers with 150µA/LSB.

Index	0x00	0x01
Function	0x03	0x00: Solar Panel 0
		0x01: Solar Panel 1
		0x02: Solar Panel 2
		0x03: Solar Panel 3
		0x04: Solar Panel 4
		0x05: Solar Panel 5
		0x06: Solar Panel 6
		0x07: Solar Panel 7
		0x08: Battery A
		0x09: Battery B
		0x0A: 3.3V Regulator A
		0x0B: 3.3V Regulator B
		0x0C: PR_3.3V-0
		0x0D: PR_3.3V-1
		0x0E: PR_3.3V-2
		0x0F: PR_3.3V-3
		0x10: PR_3.3V-4
		0x11: PR_3.3V-5
		0x12: PR_3.3V-6
		0x13: PR_3.3V-7
		0x14: PR_3.3V-8
		0x15: PR_3.3V-9
		0x16: PR_3.3V-10
		0x17: PR_3.3V-11
		0x18: PR_3.3V-12
		0x19: PR_BATT-0
		0x1A: PR_BATT-1
		0x1B: PR_BATT-2
		0x1C: PR_BATT-3
		0x1D: PR_BATT-4
		0x1E: PR_BATT-5
		0x1F: PR_BATT-6
		0x20: PV_3.3V-0
		0x21: PV_3.3V-1
		0x22: PV_3.3V-2
		0x23: PV_3.3V-3
		0x24: PR_BH-0
		0x25: PR_BH-1
		0x26: PR_DEPLOY

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2.4 Temperature Data Request

This command is used to read the temperatures of various components of the EPS. The first byte is the identifier. The second byte is the component. See table below for details. The PMIC replies with the temperature as a signed 8b integer with 1°C/LSB.

Index	0x00	0x01
Function	0x03	0x00: Solar Panel 0
		0x01: Solar Panel 1
		0x02: Solar Panel 2
		0x03: Solar Panel 3
		0x04: Solar Panel 4
		0x05: Solar Panel 5
		0x06: Solar Panel 6
		0x07: Solar Panel 7
		0x08: Battery A
		0x09: Battery B
		0x0A: 3.3V Regulator A
		0x0B: 3.3V Regulator B
		0x27: PMIC
		0x27: MPPT 0
		0x28: MPPT 1
		0x29: MPPT 2
		0x2A: MPPT 3
		0x2B: MPPT 4
		0x2C: MPPT 5
		0x2D: MPPT 6
		0x2E: MPPT 7
		0x2F: PCB -X -Y
		0x30: PCB -X +Y
		0x31: PCB +X -Y
		0x31: PCB +X +Y

2.5 Power Channel Status

This command is used to read the current status of the power channels, send 0x04. The reply is a 56b value. Each bit corresponds to a specific path being on (1) or off (0), see table below. Bit 0 is the LSB.

Bit Index	Result
00	PR_3.3V-0 from 3.3V Regulator A
01	PR_3.3V-0 from 3.3V Regulator B
02	PR_3.3V-1 from 3.3V Regulator A
03	PR_3.3V-1 from 3.3V Regulator B
04	PR_3.3V-2 from 3.3V Regulator A
05	PR_3.3V-2 from 3.3V Regulator B
06	PR_3.3V-3 from 3.3V Regulator A
07	PR_3.3V-3 from 3.3V Regulator B
08	PR_3.3V-4 from 3.3V Regulator A

09	PR_3.3V-4 from 3.3V Regulator B
10	PR_3.3V-5 from 3.3V Regulator A
11	PR_3.3V-5 from 3.3V Regulator B
12	PR_3.3V-6 from 3.3V Regulator A
13	PR_3.3V-6 from 3.3V Regulator B
14	PR_3.3V-7 from 3.3V Regulator A
15	PR_3.3V-7 from 3.3V Regulator B
16	PR_3.3V-8 from 3.3V Regulator A
17	PR_3.3V-8 from 3.3V Regulator B
18	PR_3.3V-9 from 3.3V Regulator A
19	PR_3.3V-9 from 3.3V Regulator B
20	PR_3.3V-10 from 3.3V Regulator A
21	PR_3.3V-10 from 3.3V Regulator B
22	PR_3.3V-11 from 3.3V Regulator A
23	PR_3.3V-11 from 3.3V Regulator B
24	PR_3.3V-12 from 3.3V Regulator A
25	PR_3.3V-12 from 3.3V Regulator B
26	PR_BATT-0 from VBATT-A
27	PR_BATT-0 from VBATT-B
28	PR_BATT-1 from VBATT-A
29	PR_BATT-1 from VBATT-B
30	PR_BATT-2 from VBATT-A
31	PR_BATT-2 from VBATT-B
32	PR_BATT-3 from VBATT-A
33	PR_BATT-3 from VBATT-B
34	PR_BATT-4 from VBATT-A
35	PR_BATT-4 from VBATT-B
36	PR_BATT-5 from VBATT-A
37	PR_BATT-5 from VBATT-B
38	PR_BATT-6 from VBATT-A
39	PR_BATT-6 from VBATT-B
40	PV_3.3V-0 from 3.3V Regulator A
41	PV_3.3V-0 from 3.3V Regulator B
42	PV_3.3V-1 from 3.3V Regulator A
43	PV_3.3V-1 from 3.3V Regulator B
44	PV_3.3V-2 from 3.3V Regulator A
45	PV_3.3V-2 from 3.3V Regulator B
46	PV_3.3V-3 from 3.3V Regulator A
47	PV_3.3V-3 from 3.3V Regulator B
48	PR_BH-0 from VBATT-A
49	PR_BH-0 from VBATT-B
50	PR_BH-1 from VBATT-A
51	PR_BH-1 from VBATT-B
52	PR_DEPLOY from VBATT-A
53	PR_DEPLOY from VBATT-B

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2.5 Solar Panel Channel Status

This command is used to read the current status of the solar panel channels, send 0x05. The reply is a 16b value. Each bit corresponds to a specific path being on (1) or off (0), see table below. Bit 0 is the LSB.

Bit Index	Result
00	PV_IN-0 to VIN-A
01	PV_IN-0 to VIN-B
02	PV_IN-1 to VIN-A
03	PV_IN-1 to VIN-B
04	PV_IN-2 to VIN-A
05	PV_IN-2 to VIN-B
06	PV_IN-3 to VIN-A
07	PV_IN-3 to VIN-B
08	PV_IN-4 to VIN-A
09	PV_IN-4 to VIN-A
10	PV_IN-5 to VIN-A
11	PV_IN-5 to VIN-B
12	PV_IN-6 to VIN-A
13	PV_IN-6 to VIN-B
14	PV_IN-7 to VIN-A
15	PV_IN-7 to VIN-B

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3 Example Communication

3.1 Simple Data Request

In this example, the IHU wants the voltage of solar panel 2.

```
IHU: [0x0E]0x0203    [PMIC write] voltage? solar panel 2
     PMIC reads the voltage and stores the value into its buffer
IHU: [0x0F]           [PMIC read]
PMIC: 0xBFEC          (49132 * 100µV = 4.9132 V)
```

3.2 Repeated Request

In this example, the IHU wants the voltage of solar panel 2 but asks for the 3.3V-A regulator first.

```
IHU: [0x0E]0x020A    [PMIC write] voltage? 3.3V-A regulator
     PMIC reads the voltage and stores the value into its buffer
IHU: [0x0E]0x02032   [PMIC write] voltage? solar panel 2
     PMIC reads the voltage and stores the value into its
     buffer. The voltage of the 5.0V rail is discarded.
IHU: [0x0F]           [PMIC read]
PMIC: 0xBFEC          (49132 * 100µV = 4.9132 V)
```

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