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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: 1.1.2



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# 1 Hardware Layer

The hardware interface between the PMIC and the IHU is I2C. It is a standard implementation of I2C with a clock wire and a data wire. See Wikipedia’s [I2C article](https://en.wikipedia.org/wiki/I%C2%B2C) for details on how it works.

When this document reference multiple components that exist on both boards of the EPS, the first half of instances are referenced to the hardware selected primary board and the second half reference the secondary board. The software defined roles of primary and secondary do not affect the reference in this document.

# 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 1 for details. The PMIC replies with the result of the request. This reply is read at 0x80. See table 2 for a list of results.

Table 1: Subsystem Power Change Request

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

Table 2: Subsystem Power Change Reply

|  |  |
| --- | --- |
| Value | Result |
| 0x00 | Change Success |
| 0x01 | Failed: Limited power |
| 0x02 | Failed: Overcurrent |

## 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 3 for details. The PMIC replies with the voltage as an unsigned 16b integers with 100µV/LSB. This reply is read at 0x82.

Table 3: Voltage Data Request

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x02 | 0x00: Solar Panel 0  0x01: Solar Panel 1  0x02: Solar Panel 2  0x03: Solar Panel 3  0x04: Battery 0  0x05: Battery 1  0x06: 3.3V Rail  0x07: 5.0V Rail |

## 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 4 for details. The PMIC replies with the current as a signed 24b integers with 100µA/LSB. This reply is read at 0x83.

Table 4: Current Data Request

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x03 | 0x00: Solar Panel 0 In  0x01: Solar Panel 1 In  0x02: Solar Panel 2 In  0x03: Solar Panel 3 In  0x04: Battery 0  0x05: Battery 1  0x06: 3.3V Rail  0x07: 5.0V Rail  0x08: MPPT 0 Out  0x09: MPPT 1 Out  0x0A: MPPT 2 Out  0x0B: MPPT 3 Out  0x0C: 3.3V Channel 0  0x0D: 3.3V Channel 1  0x0E: 3.3V Channel 2  0x0F: 3.3V Channel 3  0x10: 3.3V Channel 4  0x11: 3.3V Channel 5  0x12: 5.0V Channel 0  0x13: 5.0V Channel 1  0x14: Unregulated Channel 0  0x15: Unregulated Channel 1  0x16: Unregulated Channel 2  0x17: Unregulated Channel 3  0x18: Unregulated Channel 4  0x19: Unregulated Channel 5  0x1A: Battery Heater 0  0x1B: Battery Heater 1 |

## 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 5 for details. The PMIC replies with the temperature as a signed 8b integer with 1°C/LSB. This reply is read at 0x84.

Table 5: Temperature Data Request

|  |  |  |
| --- | --- | --- |
| Index | 0x00 | 0x01 |
| Function | 0x03 | 0x04: Battery 0  0x05: Battery 1  0x06: 3.3V Rail Regulator 0  0x07: 5.0V Rail Regulator 0  0x08: MPPT 0  0x09: MPPT 1  0x0A: MPPT 2  0x0B: MPPT 3  0x1C: 3.3V Rail Regulator 1  0x1D: 5.0V Rail Regulator 1  0x1E: PMIC 0  0x1F: PMIC 1  0x20: PCB +X+Y 0  0x21: PCB +X+Y 1  0x22: PCB +X-Y 0  0x23: PCB +X-Y 1  0x24: PCB -X+Y 0  0x25: PCB -X+Y 1  0x26: PCB -X-Y 0  0x27: PCB -X-Y 1 |

## 2.5 Power Channel Status

This command is used to read the current status of the power channels. The reply is a 16b value. Each bit corresponds to a specific channel being on (1) or off (0), see table 6. This status is read at 0x85.

Table 6: Power Channels

|  |  |
| --- | --- |
| Value | Result |
| 0x0001 | 3.3V Channel 0 |
| 0x0002 | 3.3V Channel 1 |
| 0x0004 | 3.3V Channel 2 |
| 0x0008 | 3.3V Channel 3 |
| 0x0010 | 3.3V Channel 4 |
| 0x0020 | 3.3V Channel 5 |
| 0x0040 | 5.0V Channel 0 |
| 0x0080 | 5.0V Channel 1 |
| 0x0100 | Unregulated Channel 0 |
| 0x0200 | Unregulated Channel 1 |
| 0x0400 | Unregulated Channel 2 |
| 0x0800 | Unregulated Channel 3 |
| 0x1000 | Unregulated Channel 4 |
| 0x2000 | Unregulated Channel 5 |

# 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) (0x82) (PMIC read) (voltage buffer)

PMIC: (0x00BFEC) (4.9132 V)

## 3.2 Repeated Request

In this example, the IHU wants the voltage of solar panel 2 but asks for the 5.0V rail first.

IHU: (0x0E) (0x0207) (PMIC write) (voltage? 5.0V rail)

PMIC reads the voltage and stores the value into its buffer

IHU: (0x0E) (0x0203) (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) (0x82) (PMIC read) (voltage buffer)

PMIC: (0x00BFEC) (49132 \* 100µV = 4.9132 V)