Mercury System

SB140

HSD Board - Product Datasheet

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Revision History			
Version	Date	Author	Changes
1.0	21/10/2018	Francesco Ficili	Initial Release.

SUMMARY

1. Introduction

The Mercury System (MS in short) is a modular system for the development of connectivity and IoT applications. The system uses various type of electronic boards (logic unit, modems, slave board equipped with sensors and actuators, power boards...) and a complete SW framework to allow the realization of complex applications. Scalability, ease of use and modularity are key factors and are granted by the use of a heterogeneous set of components that allow to assemble the system like a construction made with LEGO© bricks.

The board set which composes the system is made up by the following “families”:

- **Base Board (BB):** It’s the “brain” of the system and contains the main logic unit as well as different communication buses and connector to interfaces the slaves. It also contains a simple power supply system and a recharge unit for a single LiPo cell (it can satisfy the power requirements of simpler systems). It can exist in different variants, depending on the employed microcontroller unit.
- **Modem Board (MB):** this one is the board that allow network connectivity. It can exist in different variant, depending on the network interface (GSM/GPRS, Wi-Fi, BT, Radio…). It’s interfaced to the Base Board with a dedicated serial line.
- **Power Board (PB):** it’s the board that allow to satisfy the particular power requirement of the system, when it’s necessary. They can be vary depending on the particular power requirement to satisfy (high power, solar harvesting, piezo harvesting, etc.).
- **Slave Board (SB):** these are the system’s peripherals, and they vary depending on the specific mounted sensor or actuator. Typical examples are SB with relay, temperature sensors, RGB LED controller, servo controller, accelerometer, etc. They communicate with the BB with I2C or UART and a dedicated command set.
- **Expansion Board (EB):** these are the board that allow planar connection of Mercury boards. There are variants which can contains Displays, battery socket, etc.
- **Brain-Less Board (BL):** these are the controller-less boards. They in general contain really simple sensor or actuators that don’t need the bus interface. There are meant as an alternative to slave boards for cost-sensitive applications.

Slave Boards and Modem Board are provided pre-programmed with a FW which implements a dedicated command set for a high-level management of the boards, while the Base Boards are provided with a SW framework which provides all the low-level services (operative system, device drivers, system services, etc.), leaving to the user only the development of application level logic. Moreover, the Base Board comes with an USB bootloader, so it can be programmed without the need of a flashing device.

Figure 1 shows a typical system connection:

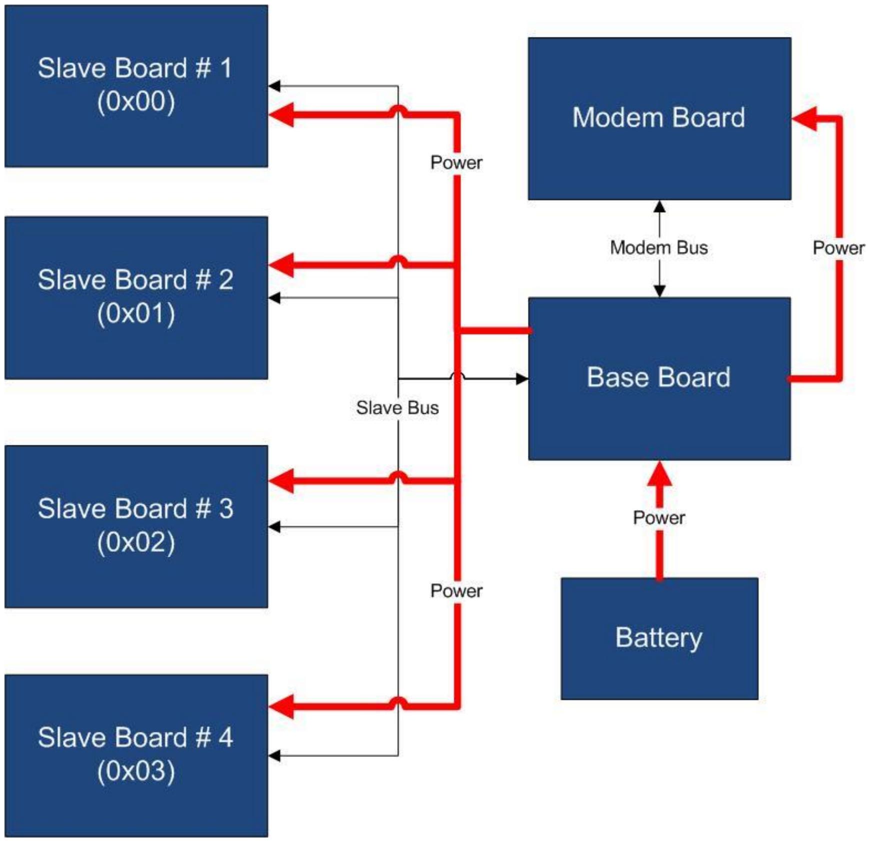

Figure 1 - Typical System Connection

Examples of application fields of MS are:

- Home automation System,
- IoT applications,
- Connectivity Applications,
- Monitoring and control Systems,
- Remote Control,
- Industrial Process control,
- Robotics applications,
- Test benches,
- Etc…

2. Block Diagram

The SB140 is a 4-channel HSD (High Side Driver) board, able to control load up to 1A per channel. Figure 2 shows the SB140 block diagram. The heart of the system is a PIC16F1829 8-bit RISC microcontroller, produced by Microchip Technology Inc.

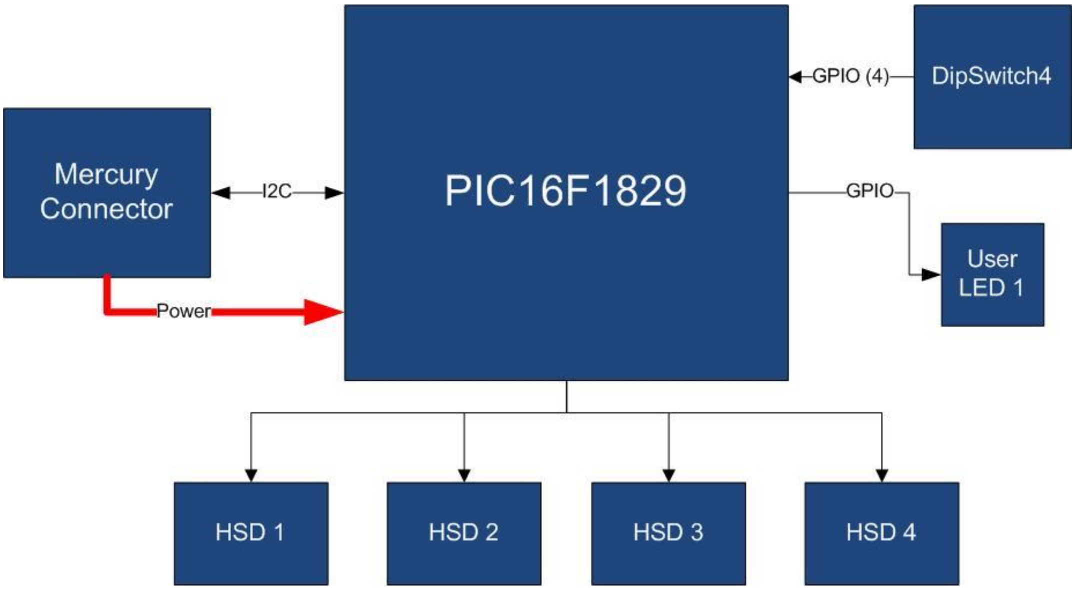

Figure 2 - Block Diagram

The main characteristics of the employed MCU are resumed in Table 1:

Table 1 - MCU characteristics

Parameter Name	Description
Program Memory Type	Flash
Program Memory (KB)	14
CPU Speed (MIPS)	8
RAM Bytes	1,024
Data EEPROM (bytes)	256
Digital Communication Peripherals	1-UART, 1-A/E/USART, 1-SPI, 1-I2C1-MSSP(SPI/I2C)
Capture/Compare/PWM Peripherals	2 CCP, 2 ECCP
Timers	4 x 8-bit, 1 x 16-bit
ADC	12 ch, 10-bit
Comparators	2
Temperature Range (C)	-40 to 125
Operating Voltage Range (V)	1.8 to 5.5
Pin Count	20
XLP	Yes

The SB140 is connected to the BB by means of I2C bus. The address of the board could be dynamically set by means of a 4 positions dip switch, allowing up to 15 address values (address 0x00 is reserved for I2C general call broadcast addressing scheme).

Table 2 resumes the SB140 board main characteristics:

Table 2 – Board Characteristics

Parameter	Description	Notes
Board Type	Slave Board (SB)	
Supported Bus	I2C	
Addressing	Dip Switch 4	
Peripheral Description	4 HSD Channels	ST VN7040A

3. Hardware

This section goes deeper in the HW details of SB140. Figure 3 depicts the most important components of the board:

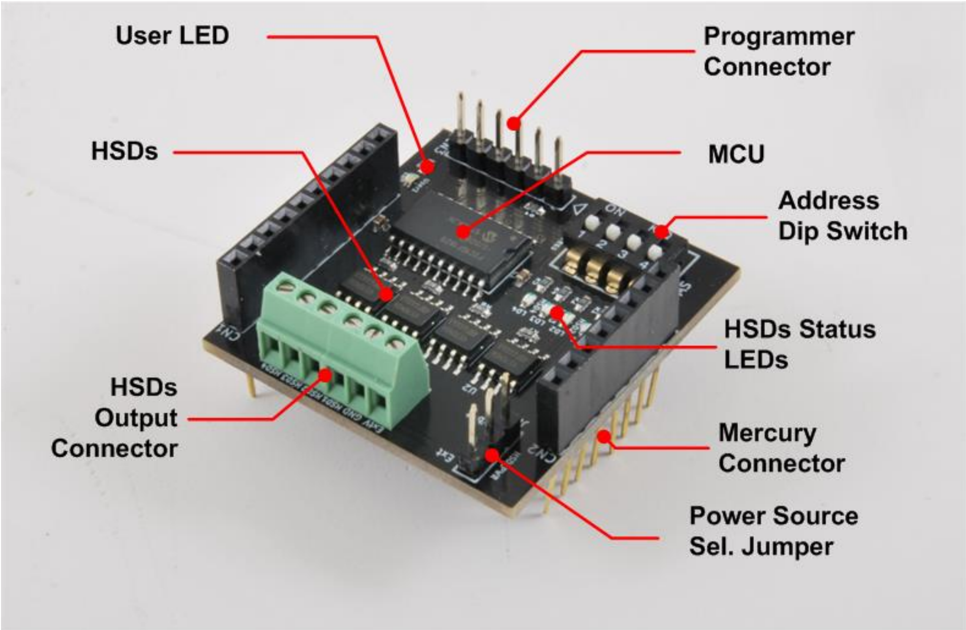

Figure 3 - Hardware Highlight

Table 3 provides a description of board's main components:

Table 3 – Hardware characteristics

Name	Description
User LED	Board User LED, by default it's configured as heartbeat LED (periodic pulses).
HSDs	The SB140 is equipped with 4 ST HSD driver model VN7040A.
HSD Output Connector	Output HSD connector. Contains the 4 HSDs channels, GND reference and the External Power Connector.
Mercury Connector	Mercury connector used to interface the board with the others MS boards.
Address Dip Switch	Dip Switch to set the address of the board within the Mercury System.
MCU	PIC16F1829 main controller board.
Programmer Connector	PicKit 3 Microchip Programmer/debugger connector. It is directly connected to the MCU debug port, in order to allow advanced debugging and programming features, if needed.
HSDs Status LEDs	LEDs that indicate the HSD channels status (ON or OFF).
Power Source Sel. Jumper	Jumper to select from internal (Vbat) or externally provided (via Ext_Vdd pin of HSD Output Connector) power source.

4. Pinouts

This section highlights the pinouts of SB140 connectors.

Mercury Connector

The Mercury Connector is the connector which interfaces the SB140 with the rest of Mercury System. The connector's pinout is depicted in Figure 4 and Table 4 explains the meaning of each single pin (NC stands for "Not Connected").

Table 4 - Mercury Connector Pinout

Pin Name	Pin Number	Description
VddBat	CN1 – 1 CN2 – 2	This pin is connected to the main power source.
VddMcu	CN1 – 2	This pin is connected to MCU regulated positive voltage reference (3,3V).
GND	CN1 – 3 CN2 – 1	This pin is connected to the board reference voltage.
SDA	CN2 – 7	This pin is connected to I2C SDA line (Data Line).
SCL	CN2 – 8	This pin is connected to I2C SCL line (Clock Line).

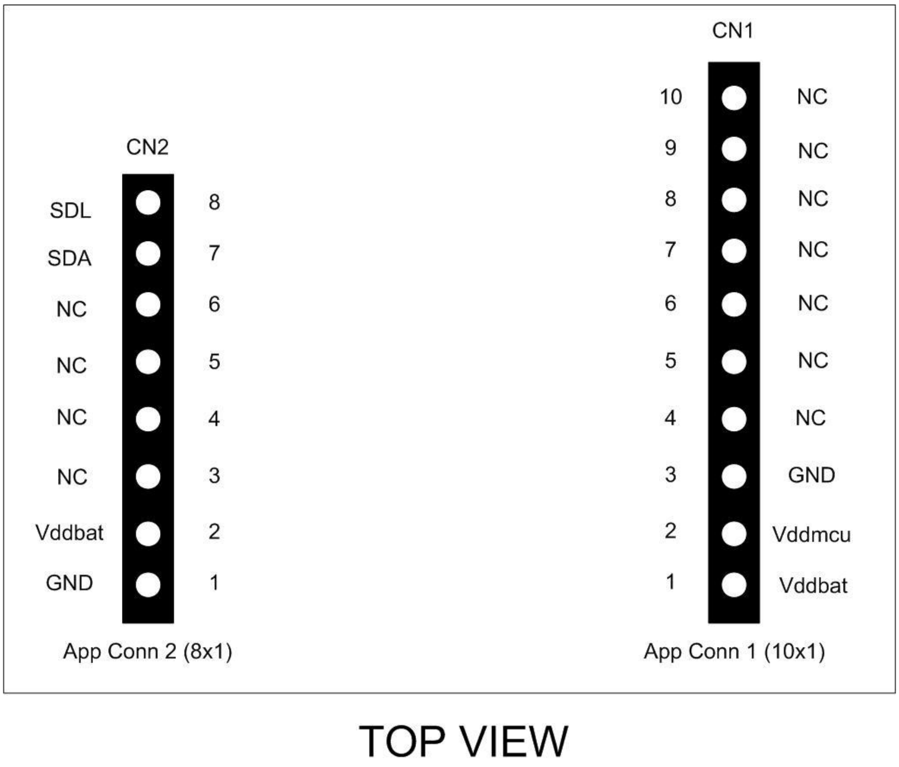

Figure 4 - Mercury Connector Pinout

Programmer Connector

The Programmer Connector is the connector which allows to re-program the SB140 using Microchip Technology ICSP (In-Circuit Serial Programming) interface. The connector's pinout is depicted in Figure 5 and Table 5 explains the meaning of each single pin (NC stands for "Not Connected").

Table 5 - Programmer Connector Pinout

Pin Name	Pin Number	Description
MCLR	CN3 – 1	Microcontroller Master Clear (RESET) pin.
Vdd	CN3 – 2	Positive power supply reference.
GND	CN3 – 3	Negative power supply reference.
PGD	CN3 – 4	Program Data pin.
PGC	CN3 – 5	Program Clock pin.

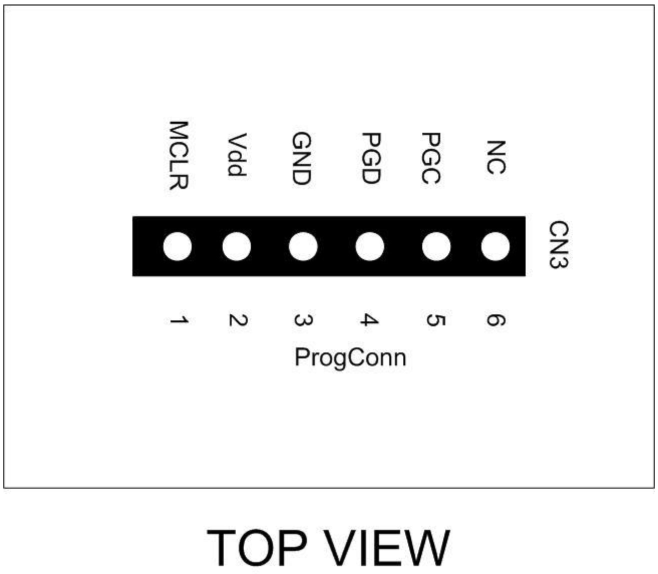

Figure 5 - Programmer Connector Pinout

HSD Connectors

The Relay Connectors interface the SB140 onboard relays. The connector's pinout is depicted in Figure 6 and Table 6 explains the meaning of each single pin.

Table 6 - HSD Connectors pinout

Pin Name	Pin Number	Description
Ext_Vdd	CN4 – 1	External Power Source screw terminal pin (must be selected with Power Source Sel. Jumper).
GND	CN4 – 2	GND Reference.
HSD1_Out	CN4 – 3	HSD Channel 1 Output pin.
HSD2_Out	CN4 – 4	HSD Channel 2 Output pin.

HSD3_Out	CN4 – 5	HSD Channel 3 Output pin.
HSD4_Out	CN4 – 6	HSD Channel 4 Output pin.

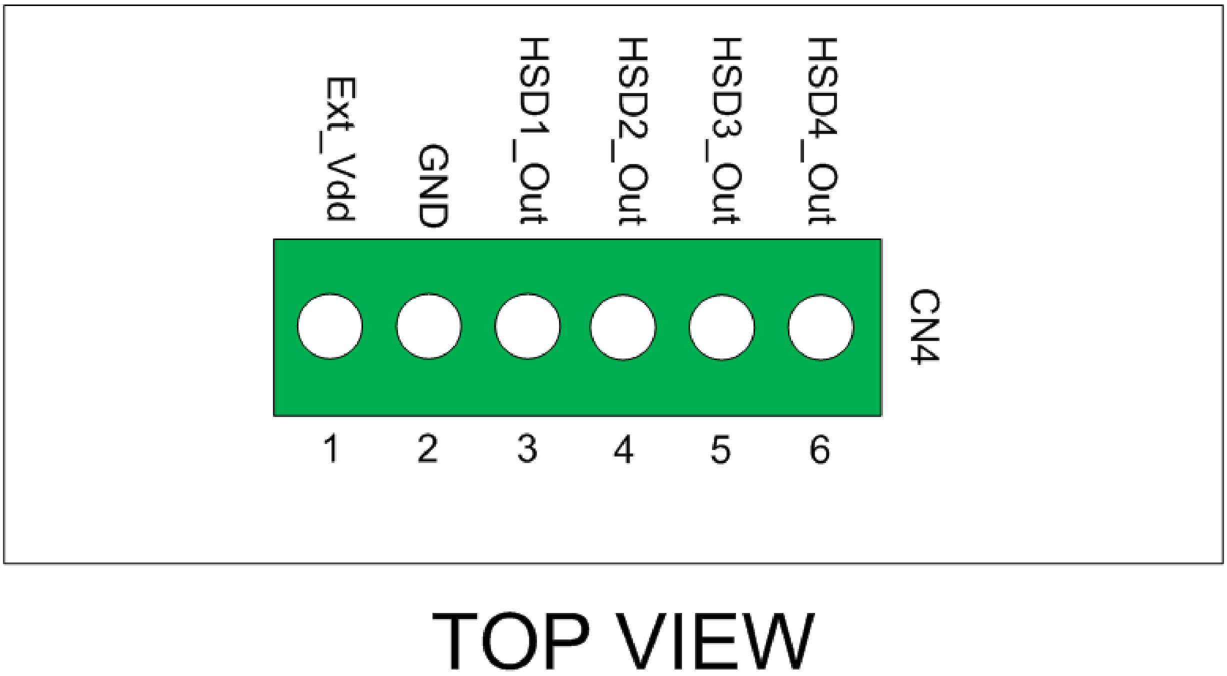

Figure 6 - HSD Connectors pinout

5. Command Set

Specific Command Set

The SB140 board supports both the MS Generic Command Set (see document MS_Generic_Command_Set) and a set of specific commands (also called Specific Command Set).

Table 7 lists the SB140 Specific Command Set:

Table 7 - Command Set

Code	Cmd Name	Parameters	Description
0x50	Set HSD Status	HsdSts (1 byte)	Set the status of HSDs. The HSD status is mapped as bitfield in the HsdSts parameter (each bit represents an HSD channel, only the first 4 bits are used.)
0x51	Impulse HSD1 Seconds	ImpulseLen (2 byte)	Generates an impulse of duration equal to ImpulseLen for HSD 1 (ImpulseLen parameter is in seconds).
0x52	Impulse HSD2 Seconds	ImpulseLen (2 byte)	Generates an impulse of duration equal to ImpulseLen for HSD 2 (ImpulseLen parameter is in seconds).
0x53	Impulse HSD3 Seconds	ImpulseLen (2 byte)	Generates an impulse of duration equal to ImpulseLen for HSD 3 (ImpulseLen parameter is in seconds).
0x54	Impulse HSD4 Seconds	ImpulseLen (2 byte)	Generates an impulse of duration equal to ImpulseLen for HSD 4 (ImpulseLen parameter is in seconds).
0x55	Impulse all HSDs Seconds	ImpulseLen (2 byte)	Generates an impulse of duration equal to ImpulseLen for all HSDs (ImpulseLen parameter is in seconds).
0x60	Request HSDs Status	None	Request the HSDs current status. This command prepares one byte which represents the status of HSDs as bitfield in the response buffer, an I2C read request must be issued to read the prepared value.

Examples

Some examples of Specific Command Set usage are listed below:

1) Set of HSD1 output On and HSD2,3,4 output Off: **[0x50] [0x01]**
2) Set of HSD1,3 output Off and HSD2,4 output On: **[0x50] [0x0A]**
3) Set of all HSDs Outputs On: **[0x50] [0x0F]**
4) Generate 10s impulse on HSD1 channel: **[0x51] [0x0A]**

5) Generate 5s impulse on HSD2 channel: **[0x52] [0x05]**
6) Request HSD status: **[0x60] + Read Operation on I2C bus**

6. Technical Specifications

Table 8 resumes the board technical specifications:

Table 8 - Board Technical Specifications

Parameter	Max	Typ	Min	Unit	Notes
Supply Voltage	3.6	3.3	2.0	V	
Current Cons. (Normal)		10		uA	
Current Cons. (Peak)		1		mA	
Current Cons. (Low Power)		100		nA	
Startup Time		100		mS	
Output Ch. Max Current	1			A	Each channel.