Mercury System

EB210

Expansion Display 16x2 Board - Product Datasheet

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Revision History			
Version	Date	Author	Changes
1.0	28/10/2018	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:

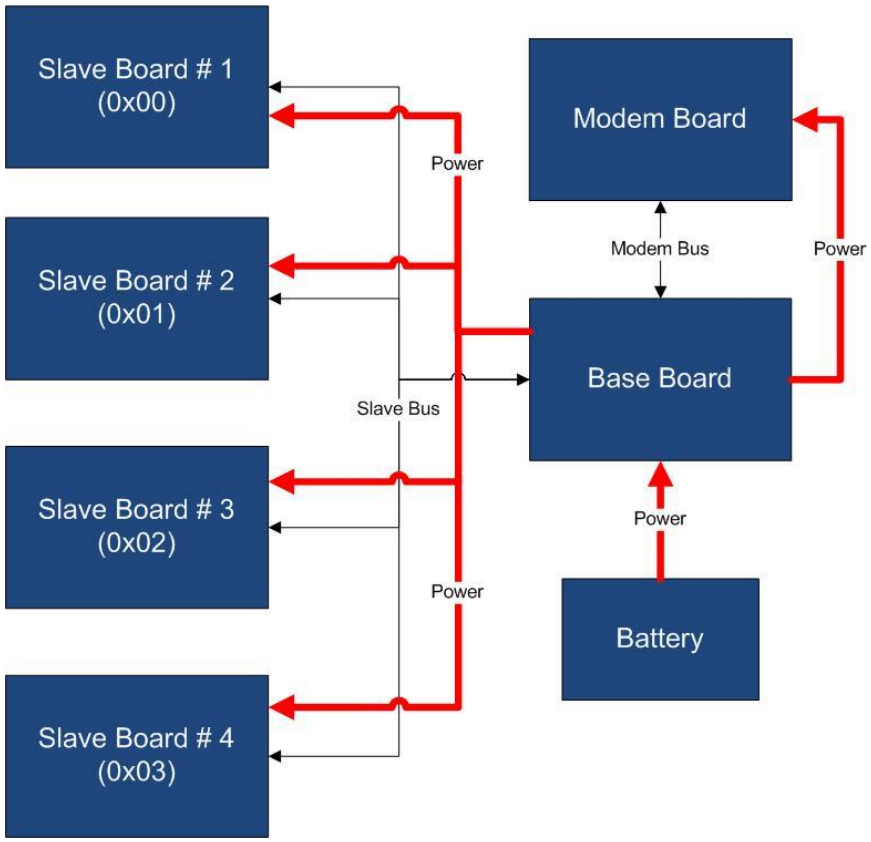


Figure 1 - Typical System Connection

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 EB210 is a Mercury System expansion board with integrated alphanumeric 16x2 display. The board allows the classic planar expansion offered by Mercury System expansion board, and at the same time provides a way to build a simple User Interface. Figure 2 shows the EB210 block diagram. The heart of the system is a PIC16F1829 8-bit RISC microcontroller, produced by Microchip Technology Inc.

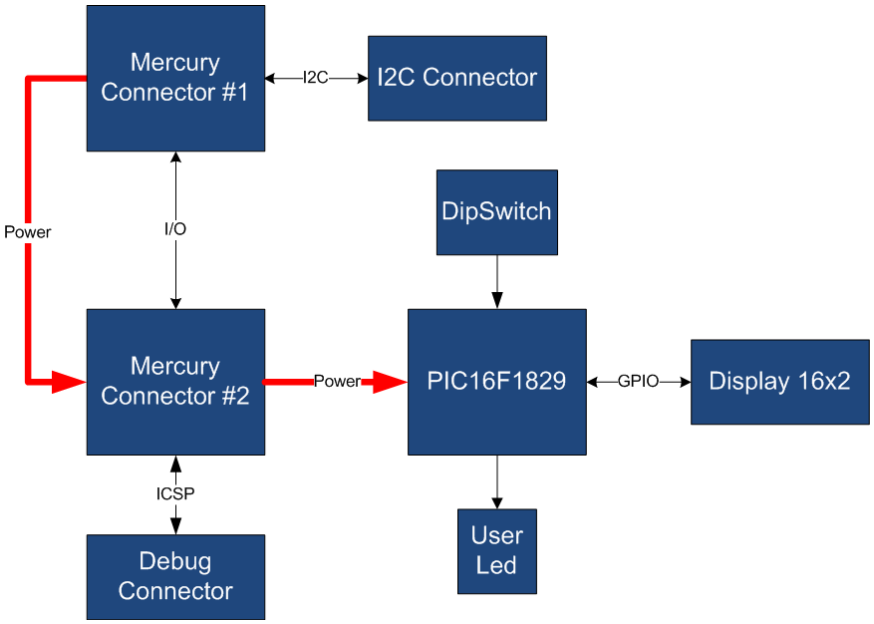


Figure 2 - Block Diagram

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 EB210 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 EB210 board main characteristics:

Table 2 – Board Characteristics

Parameter	Description	Notes
Board Type	Expansion Board (EB)	
Supported Bus	I2C	
Addressing	Dip Switch 4	
Peripheral Description	Alphanumeric 16x2 LCD Display	

3. Hardware

This section goes deeper in the HW details of EB210. Figure 3 depicts the most important components of the board:

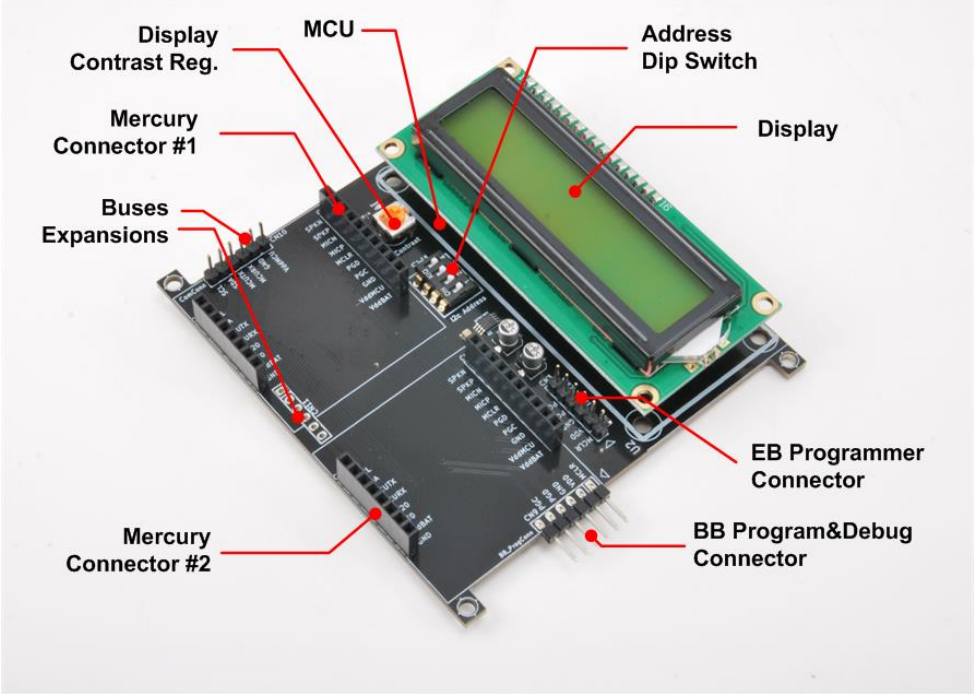


Figure 3 - Hardware Highlight

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

Table 3 – Hardware characteristics

Name	Description
Mercury Connectors #1 and #2	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.
EB Programmer Connector	PicKit 3 Microchip Programmer/debugger connector. It is directly connected to the EB (Expansion Board) MCU debug port, in order to allow advanced debugging and programming features, if needed.
BB Program&Debug Connector	PicKit 3 Microchip Programmer/debugger connector. It is directly connected to the BB (Base Board) MCU debug port, in order to allow advanced debugging and programming features, if needed.
Display	16x2 Alphanumeric LCD Display.
Display Contrast Reg.	Potentiometer for display contrast regulation.
Buses Expansion	Expansions connectors that carry power as well as I2C and UART connection.

4. Pinouts

This section highlights the pinouts of EB210 connectors.

Mercury Connector

The Mercury Connector is the connector which interfaces the BB210 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	CN1,2 – 1	This pin is connected to the main power source.
VddMcu	CN1,2 – 2	This pin is connected to MCU regulated positive voltage reference (3,3V).
GND	CN1,2 – 3	This pin is connected to the board reference voltage.
IO11/PGC	CN1,2 – 4	This pin is connected to BB PGC (Program Clock) line, for advanced debugging features, and can be alternatively be used as generic IO (IO11).
IO10/PGD	CN1,2 – 5	This pin is connected to BB PGD (Program Data) line, for advanced debugging features, and can be alternatively be used as generic IO (IO10).
MCLR	CN1,2 – 6	This pin is connected to BB MCLR (Reset) line.
IO9	CN1,2 – 7	This pin is connected to BB generic IO6 line.
IO8	CN1,2 – 8	This pin is connected to BB generic IO7 line.
IO7	CN1,2 – 9	This pin is connected to BB generic IO8 line.
IO6	CN1,2 – 10	This pin is connected to BB generic IO9 line.
GND	CN5,6 – 1	This pin is connected to the board reference voltage.
VddBat	CN5,6 – 2	This pin is connected to the main power source.
IO5/INT0	CN5,6 – 3	This pin is connected to BB INT0 line and can be alternatively be used as generic IO (IO5).
IO4/INT1	CN5,6 – 4	This pin is connected to BB INT1 line and can be alternatively be used as generic IO (IO4).
McuRx/IO3	CN5,6 – 5	This pin is connected to BB UART Rx line and can be alternatively be used as generic IO (IO3).
McuTx/IO2	CN5,6 – 6	This pin is connected to BB UART Tx line and can be alternatively be used as generic IO (IO2).
SDA/IO1	CN5,6 – 7	This pin is connected to BB I2C SDA line (Data Line) and can be alternatively be used as generic IO (IO1).
SCL/IO0	CN5,6 – 8	This pin is connected to BB I2C SCL line (Clock Line) and can be alternatively be used as generic IO (IO0).

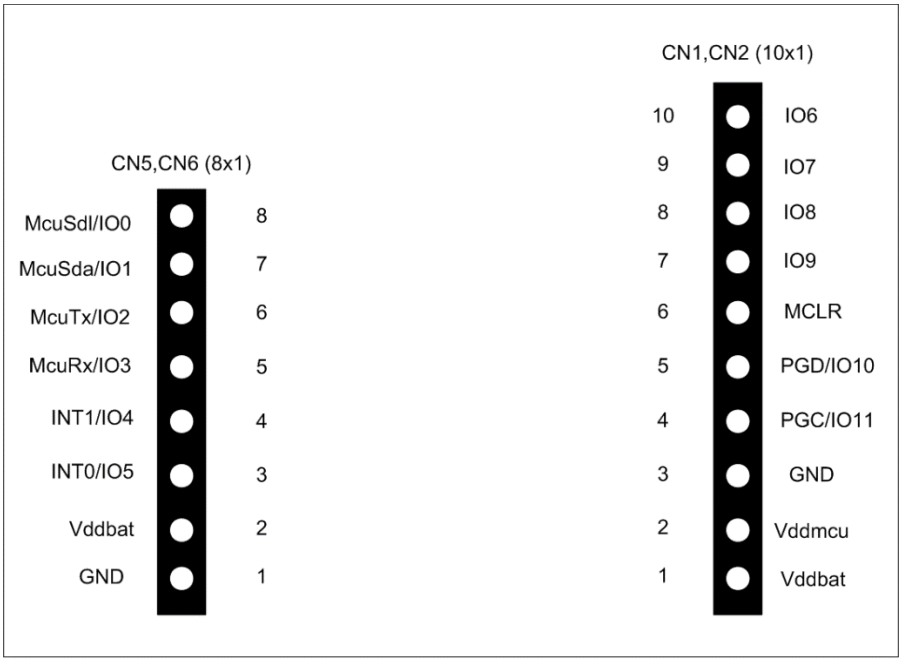


Figure 4 - Mercury Connector Pinout

EB Programmer Connector

The EB Programmer Connector is the connector which allows to re-program the EB210 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 – EB 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.

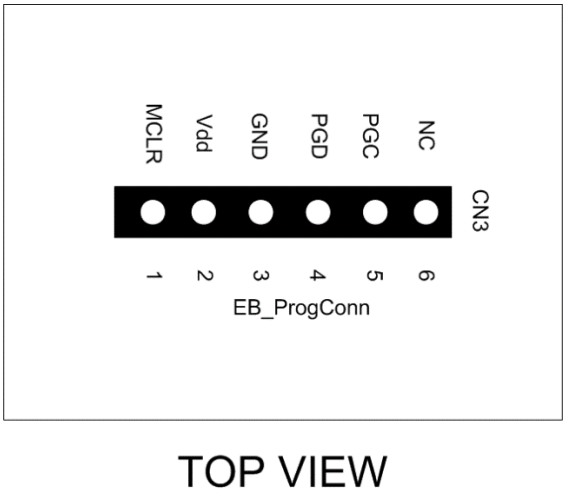


Figure 5 - EB Programmer Connector Pinout

BB Programmer Connector

The BB Programmer Connector is the connector which allows to re-program the BB (Base Board) using Microchip Technology ICSP (In-Circuit Serial Programming) interface. The connector's pinout is depicted in Figure 6 and Table 6 explains the meaning of each single pin (NC stands for "Not Connected").

Table 6 – BB Programmer Connector Pinout

Pin Name	Pin Number	Description
MCLR	CN9 – 1	Microcontroller Master Clear (RESET) pin.
Vdd	CN9 – 2	Positive power supply reference.
GND	CN9 – 3	Negative power supply reference.
PGD	CN9 – 4	Program Data pin.
PGC	CN9 – 5	Program Clock pin.

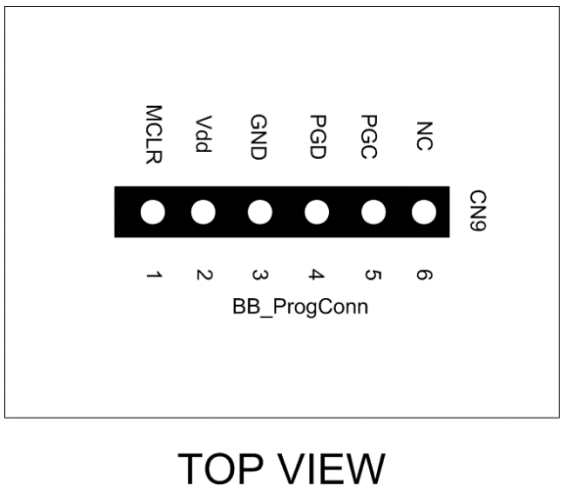


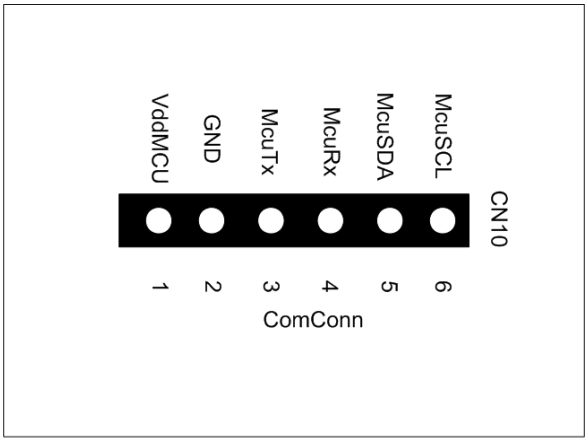
Figure 6 - BB Programmer Connector Pinout

Communication Connector

The Communcation Connector allow the connection of the communication buses (UART and I2C) to other boards. The connector's pinout is depicted in Figure 7 and Table 7 explains the meaning of each single pin (NC stands for "Not Connected").

Table 7 – Comm Connector Pinout

Pin Name	Pin Number	Description
VddMcu	CN10 – 1	This pin is connected to MCU regulated positive voltage reference (3,3V).
GND	CN10 – 2	Negative power supply reference.
McuTx	CN10 – 3	BB UART Tx Line.
McuRx	CN10 – 4	BB UART Rx Line.
McuSDA	CN10 – 5	BB I2C SDA Line.
McuSDL	CN10 – 6	BB I2C SCL Line.



TOP VIEW

Figure 7 - Comm Connector Pinout

Expansion Connector

The Expansion Connector allow to connect the EB210 with another Expansion Board. The connector's pinout is depicted in Figure 8 and Table 8 explains the meaning of each single pin (NC stands for "Not Connected").

Table 8 – Expansion Connector Pinout

Pin Name	Pin Number	Description
VddMcu	CN11 – 1	This pin is connected to MCU regulated positive voltage reference (3,3V).
GND	CN11 – 2	Negative power supply reference.

VddBat	CN11 – 3	This pin is connected to the main power source.
INT0	CN11 – 4	BB INT0 Line.
McuSDA	CN11 – 5	BB I2C SDA Line.
McuSDL	CN11 – 6	BB I2C SCL Line.

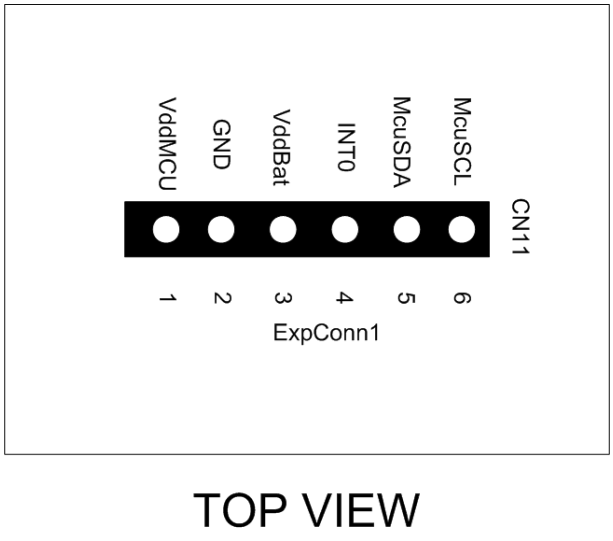


Figure 8 - Expansion Connector Pinout

5. Command Set

Specific Command Set

The EB210 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 9 lists the EB210 Specific Command Set:

Table 9 - Command Set

Code	Cmd Name	Parameters	Description
0x50	Display Send Cmd	Cmd (1byte)	Send a command to the LCD display (support the standard HD44780 command set).
0x51	Display write string	Len (1 byte) String (16 byte)	Write a string to the LCD display (the first byte must be string length in characters, and the remaining bytes the string to write).
0x52	Display BL control	BL (1 byte)	Control display backlight (0 OFF, 1 ON).
0x53	Display Clear Scr	None	Clear the Display.
0x54	Display Line 1	None	Move cursor to display Line1.
0x55	Display Line 2	None	Move cursor to display Line2.

Examples

Some examples of Specific Command Set usage are listed below:

1) Write “Hello World!” to the display: **[0x51] [0x0C] [0x48] [0x65] [0x6C] [0x6C] [0x6F] [0x20] [0x57] [0x6F] [0x72] [0x6C] [0x64] [0x21]**
2) Set Backlight On: **[0x52] [0x01]**
3) Clear the display: **[0x53]**

6. Technical Specifications

Table 10 resumes the board technical specifications:

Table 10 - 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	