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About this document

This document concerns the EB013 E-blocks SPI memory and D/A board.

1. Trademarks and copyright
PIC and PICmicro are registered trademarks of Arizona Microchip Inc. E-blocks is a trademark of Matrix Technology Solutions Ltd.

2. Disclaimer
The information provided within this document is correct at the time of going to press. Matrix TSL reserves the right to change specifications from time to time.

3. Testing this product
It is advisable to test the product upon receiving it to ensure it works correctly. Matrix provides test procedures for all E-blocks, which can be found in the Support section of the website.

4. Product support
If you require support for this product then please visit the Matrix website, which contains many learning resources for the E-blocks series. On our website you will find:

- How to get started with E-blocks - if you are new to E-blocks and wish to learn how to use them from the beginning there are resources available to help.
- Relevant software and hardware that allow you to use your E-blocks product better.
- Example files and programs.
- Ways to get technical support for your product, either via the forums or by contacting us directly.

Board layout

1. 9-way downstream D-type connector
2. Patch system
3. SDO, SDI & SCK mode selection jumper pins
4. SPI chip enable mode selection jumper pins
5. SPI serial D/A converter
6. SPI serial FRAM
7. Power screw terminals
8. D/A output
9. Amplifier selection jumper pins
10. Amplifier output screw terminal
11. Headphone socket
12. Volume control for amplifier
13. EPROM/FOAM jumper
14. EPROM socket

General guide for CTS and RTS settings (J7):

<table>
<thead>
<tr>
<th>Jumper settings</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DAC and NVM chip ENABLE set to bit 7 and 6</td>
</tr>
<tr>
<td>2</td>
<td>Patch system</td>
</tr>
</tbody>
</table>

General guide for SDO, SDI & SCK settings (J4&6)

<table>
<thead>
<tr>
<th>Jumper at A</th>
<th>Jumper at B</th>
<th>Jumper at C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC16F7x</td>
<td>PIC16C6x</td>
<td>PIC16F88</td>
</tr>
<tr>
<td>PIC16F7x7</td>
<td>PIC16CC7x</td>
<td>PIC16F87</td>
</tr>
<tr>
<td>PIC16F87x</td>
<td>PIC16F818</td>
<td></td>
</tr>
<tr>
<td>PIC16F87xA</td>
<td>PIC16F819</td>
<td></td>
</tr>
<tr>
<td>Connect to port C</td>
<td>Connect to Port B</td>
<td></td>
</tr>
</tbody>
</table>

If using PIC16F88, insert board to Port B and jumper settings = B & 1
This E-block allows investigation of chip-to-chip serial communication protocols, specifically aimed at the API interface. The board also provides non-volatile memory and a digital to analogue converter. An on board amplifier provides a low current output from the D/A. Also on board is a headphone socket for use in audio applications. Flowcode macros for driving this E-block are available.

A set of jumper links are available which allow the SPI E-block to easily be set for all PICmicro® microcontroller SPI compatible devices. With the patch system available on board makes this board compatible with numerous other devices.

Flowcode macros that makes this device easier to use are available.

1. Features
   - SPI serial non-volatile memory
   - SPI serial digital to analogue converter
   - Flowcode macros available
   - Amplifier output for D/A converter

The EB013 SPI memory and D/A board circuit can be observed on page 7.

1. Connectors
   The design of this product is to enable you to use it with many standard PICmicro® microcontroller devices. This is achieved by identifying the PICmicro that you are using; then selecting the corresponding jumper setting on the SPI board. This will configure the board to the correct pin-out for that PICmicro® microcontroller.

Jumper setting 1 and 2 are used to set the correct pins for /DAC EN and /NVM EN. Jumper setting 1 will route /DAC EN and /NVM EN to bits 7 and 6, respectively on the port you are using. Jumper setting 2 allows you to route these to any of the 8 bits on the port. Note that /DAC EN and /NVM EN are active low, and therefore become functional when a low signal (0V) is applied to them.

The microcontroller that is being used determines which port and which jumper. For example, if a PIC16F877A is being used, the CAN board must be connected to Port A, with the jumper settings to A & 1.

The following tables illustrate the correct jumper settings.

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Circuit description
Table 1. Jumper settings for SDO, SDI & SCK selection

<table>
<thead>
<tr>
<th>Jumper setting A</th>
<th>Jumper setting B</th>
<th>Jumper setting C</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC16F devices</td>
<td>PIC16C devices</td>
<td></td>
</tr>
<tr>
<td>PIC16F72</td>
<td>PIC16C62B</td>
<td>PIC16F87</td>
</tr>
<tr>
<td>PIC16F73</td>
<td>PIC16C63A</td>
<td>PIC16F88</td>
</tr>
<tr>
<td>PIC16F737</td>
<td>PIC16C65</td>
<td>PIC16F818</td>
</tr>
<tr>
<td>PIC16F74</td>
<td>PIC16C66</td>
<td>PIC16F819</td>
</tr>
<tr>
<td>PIC16F747</td>
<td>PIC16C67</td>
<td></td>
</tr>
<tr>
<td>PIC16F76</td>
<td>PIC16C72A</td>
<td></td>
</tr>
<tr>
<td>PIC16F767</td>
<td>PIC16C73B</td>
<td></td>
</tr>
<tr>
<td>PIC16F77</td>
<td>PIC16C74B</td>
<td></td>
</tr>
<tr>
<td>PIC16F777</td>
<td>PIC16C76</td>
<td></td>
</tr>
<tr>
<td>PIC16F872</td>
<td>PIC16C77</td>
<td></td>
</tr>
<tr>
<td>PIC16F873/A</td>
<td>PIC16C773</td>
<td></td>
</tr>
<tr>
<td>PIC16F874/A</td>
<td>PIC16C774</td>
<td></td>
</tr>
<tr>
<td>PIC16F876/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIC16F877/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONNECT BOARD TO PORT C</td>
<td>CONNECT BOARD TO PORT B</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Jumper settings for DAC EN and NVM EN selection

<table>
<thead>
<tr>
<th>Jumper setting 1</th>
<th>Jumper setting 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAC EN</td>
<td>DAC EN</td>
</tr>
<tr>
<td>NVM EN</td>
<td>NVM EN</td>
</tr>
<tr>
<td>Bit 7</td>
<td>Bit 6</td>
</tr>
<tr>
<td>Patch</td>
<td>Patch</td>
</tr>
</tbody>
</table>

The following table (table 2) shows the settings that can be used for DAC EN and NVM EN.

2. SPI devices

NON-VOLATILE MEMORY (NVM)

The NVM that is used on this board is FRAM. The device is the FM25640. It is a 64Kb FRAM memory device that uses the high-speed industry standard SPI interface.

The memory architecture is organised into 8, 192 x 8 bits, which are accessed using a total of four pins: data-in (SI), data-out (SO), clock (SCK) and chip select (/CS). The FRAM device has a superior write cycle to that of the same pin-out EEPROM devices, with no write delays.

For more information on this device please refer to the datasheet, which is located on the ELSAM CD that is supplied with all upstream devices. This information can also be found on our E-blocks members area website at: www.matrixtsl.com/eblocks and also on Ramtron’s website at: www.ramtron.com

A FRAM is fitted as standard; however by placing the jumper (J11) onto the EPROM side (left hand side) will disable the FRAM and enable an insert EPROM (eg. 25LC640 device) to be used.

DIGITAL TO ANALOGUE CONVERTER (DAC)

The DAC is an 8-bit digital to analogue converter that operates using an SPI compatible interface. The device is a MAX5385, manufactured by Maxim. The MAX5385 offers full 8-bit performance with less than 1 LSB integral / differential non-linearity error. The MAX5385 has a full-scale output voltage of (0.9 x VDD - 1LSB) with an output buffer of unity gain.

The Matrix ELSAM CD has the datasheet for the device. This information can also be found on our website and on Maxim’s website.

Screw terminal J9 allows direct access to the output of DAC. Jumper J2 should be positioned with in link in the section “DAC” labelled on the board to get access to the DAC output at screw terminal J9.

SPI ENABLE LINES

The SPI protocol allows for multiple devices to be connected to the same data (SDI, SDO) and clock lines (SCK). Therefore the each device has a device enable input. When a device is reading or writing data via the SPI lines that device’s enable line must be activated. Setting the enable signal low for that device does this.

3. Amplifier

The amplifier circuit is a current amplifier circuit that can be used for audio application. Screw terminal J10 allows direct access to the amplifier output. To access
the amplifier circuit jumper J2 should be positioned so that the link is in the section “AMP” labelled on the board.

The amplifier can be used to drive headphones via the on-board headphone socket J8. The volume of the output can be adjusted using the volume control potentiometer RV1, which also allows correct biasing of the transistor in the amplifier circuit.

The amplifier circuit can be used to drive loudspeakers with load impedance down to 8 ohms. The loudspeaker should be connected via screw terminal J10. These screw terminals (J10) will give direct access to the amplifier output.

4. 3.3V operation
The FRAM fitted at the factory is not 3.3V compatible. However users can fit an EPROM (e.g. 25LC540) which is 3.3V compatible. The MAX 5385 D/A is compatible with 3.3V systems.

Protective cover

Most of the boards in the E-blocks range can be fitted with a plastic cover as an optional extra. These covers are there to protect your E-blocks board therefore extending the life of the board. The covers also prevent the removal of external components while still allowing for the adjustment of applicable parts on the board.

12mm M3 spacers, anti-slip M3 nuts and 25mm M3 bolts can be used to attached the cover to the board. These are not included but can be bought separately from our website.

The order code for the EB013 SPI memory and D/A board is EB713.
Circuit diagram

This system includes:

- J1 3-WAY SCREW CONN
- J2 3-WAY SCREW CONN
- J3 3-WAY SCREW CONN
- J4 3-WAY SCREW CONN
- J5 3-WAY SCREW CONN
- J6 3-WAY SCREW CONN
- J7 3-WAY SCREW CONN
- J8 STEREO JACK
- J9 3-WAY SCREW CONN
- J10 3-WAY SCREW CONN

Patch System:
Allows TX, RX, CTS and RTS to be connected to any of 8 connections of the 9-way D-type connector.