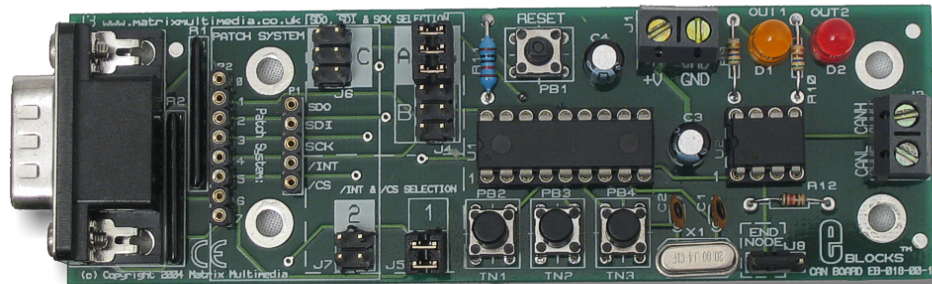


CAN bus board datasheet EB018-00-1



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Appendix 1 Circuit diagram

1. About this document

This document concerns the E-blocks CAN bus board code EB018 version 1.

The order code for this product is EB018.

1. *Trademarks and copyright*

PIC and PICmicro are registered trademarks of Arizona Microchip Inc.
E-blocks is a trademark of Matrix Multimedia Limited.

2. *Other sources of information*

There are various other documents and sources that you may find useful:

Getting started with E-Blocks.pdf

This describes the E-blocks system and how it can be used to develop complete systems for learning electronics and for PICmicro programming.

PPP Help file

This describes the PPP software and its functionality. PPP software is used for transferring hex code to a PICmicro microcontroller.

C and assembly strategies

This is available as a free download from our web site.

3. *Disclaimer*

The information in this document is correct at the time of going to press. Matrix Multimedia reserves the right to change specifications from time to time. This product is for development purposes only and should not be used for any life-critical application.

4. *Technical support*

If you have any problems operating this product then please refer to the troubleshooting section of this document first. You will find the latest software updates, FAQs and other information on our web site:
www.matrixmultimedia.com . If you still have problems please email us at: support@matrixmultimedia.co.uk.

2. General information

1. *Description*

This E-block allows investigation of the CAN bus communication protocol. The board allows CAN to be added PICmicro® microcontrollers and other processors that do not have a CAN peripherals embedded. The board uses both a CAN Controller (MCP2515) and a CAN Transceiver (MCP2551). The CAN controller uses the high speed SPI™ to configure the CAN controller for transmitting and receiving CAN information. The CAN transceiver converts the CAN controller signals into differential signal level used by the CAN bus, and vice versa.

In addition the CAN controller has 3 general-purpose input switches and 2 general-purpose output LEDs. These enable the user to have access to more I/O lines.

Users will need to consult the MCP2515 datasheet for information on programming and using this device. The datasheet for this and the MCP2551 can be found on the Microchip website at: www.microchip.com

A set of jumper links are available which allows the CAN E-block to easily be set for most PICmicro® microcontroller devices. The patch system available on board makes this board compatible with numerous other devices.

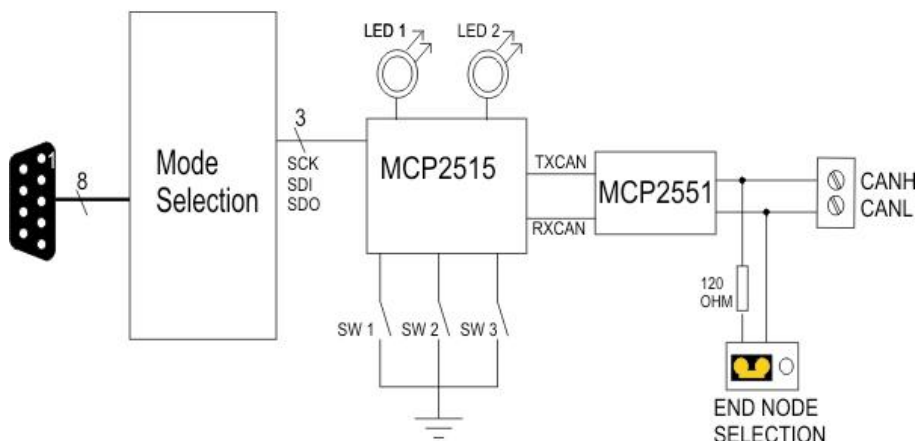
The upstream device (i.e. Multiprogrammer) connected to this board must have an integrated SPI module available, or the firmware must be able to send SPI master-mode compatible waveforms.

2. *Features*

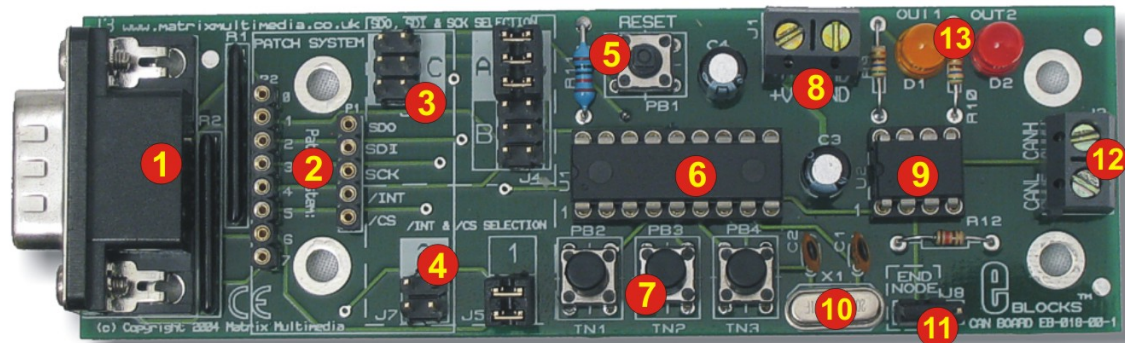
- Transmit and receive via CAN bus
- Enable non CAN embedded processors access to CAN protocol
- Configure CAN controller using high speed SPI™ protocol
- Access to dedicated Input and Output lines on the CAN controller

3. *Block schematic*

Block schematic



3. Board layout



EB018-74-2.cdr

1. 9-way downstream D-type connector
2. Patch system
3. SDO, SDI & SCK selection jumper pins
4. /CS and /INT enable selection jumper pins
5. Reset button
6. MCP2515 chip
7. 3 x Dedicated Input switches
8. Power screw terminals
9. MCP2551 chip
10. 20MHz crystal
11. End node selection jumper
12. CAN bus screw terminal
13. 2 x Dedicated Output LEDs

General Guide for SDO, SDI & SCK settings:

Jumper at A	Jumper at B	Jumper at C
PIC16F7x	PIC16F88	Patch System
PIC16F7x7	PIC16F87	
PIC16F87x	PIC16F818	
PIC16F87xA	PIC16F819	
Connect to Port C	Connect to Port B	

General Guide for /INT and /CS settings:

Jumper Settings	Description
1	Hardwired /CS and /INT selection /CS = Bit 0, /INT = Bit 6
2	Patch System

If using a PIC16F88, insert board to Port B and jumper settings = B & 1

4. Testing this product

The following program will test the circuit. The test file can be downloaded from www.matrixmultimedia.com.

1. System Setup

Master system:

EB006 Options	Setting
Power supply	External, 14V
PICmicro device	16F877A
SW1 (Fast/Slow)	Don't care
SW2 (RC/Xtal)	Xtal
Xtal frequency	19.6608MHz
Port A	
Port B	LCD board EB005
Port C	CAN board EB018
Port D	
Port E	
Test program	CAN_FT_M.HEX

EB018 Options	Setting
Patch system	A,1
End node jumper J8	End node

Slave system:

EB006 Options	Setting
Power supply	External, 14V
PICmicro device	16F877A
SW1 (Fast/Slow)	Don't care
SW2 (RC/Xtal)	Xtal
Xtal frequency	19.6608MHz
Port A	
Port B	LCD board EB005
Port C	CAN board EB018
Port D	
Port E	
Test program	CAN_FT_S.HEX

EB018 Options	Setting
Patch system	A,1
End node jumper J8	End node

Also CAN_H and CAN_L screw terminal need to be wired together. CAN_H to CAN_H, and CAN_L to CAN_L.

2. Test Procedure

Messages will appear on the Master LCD display. The buttons and LED's on the Master CAN board are not used during this test.

Visual clues will appear on the Slave CAN board's LED's (OUT1 and OUT2). The user is required to press the IN1, IN2 and IN3 buttons on the Slave CAN board as the test progresses.

- 1) Wire power to all boards.
- 2) Configure system and board options as above.
- 3) Download the test programs to the Multiprogrammers
- 4) Press RESET on EB006 Multiprogrammers

- 5) Apply power to both multi-programmer boards. Initial state is:
 1. LCD = "Press Slave 1"
 2. OUT1 = on; OUT2 = on
- 6) Press IN1
 1. LCD = "Press Slave 2"
 2. OUT1 = on; OUT2 = off
- 7) Press IN2
 1. LCD = "Press Slave 3"
 2. OUT1 = off; OUT2 = on
- 8) Press IN3
 1. LCD = "!!!! PASSED !!!!"
 2. OUT1 & OUT2 = flashing at the same time

This will fully test the functionality of the board

Error conditions

If an illegal CAN message is received by the Master system, the LCD will display "Sequence error". RESET must be pressed on both multi-programmers (**NOT** the reset on the CAN boards) and the test procedure must be restarted.

If the buttons are pressed in the wrong sequence or more than one is pressed at the same time, the LED's on the Slave CAN board will begin flashing alternately. Again, it is best to restart both multi-programmer programs by pressing their RESET buttons

5. Circuit description

The circuit as can be seen in the circuit diagram below (See Appendix 1 – Circuit diagram), is made up of two main components: the CAN Controller (MCP2515) and the CAN Transceiver (MCP2551).

1. *CAN Controller – MCP2515*

The MCP 2515 CAN Controller enables the user to add a CAN bus a system where CAN is not already embedded into the processor. The device uses the high speed SPI protocol to configure the CAN controller to allow the system to transmit and receive CAN messages.

The MCP2515 provides masks and filters that can filter away messages that are not wanted. Both standard and extended frames are implemented, including remote frames, as is Data byte filtering of the first two data bytes.

The device has 3 dedicated Inputs, which are connected to 3 input switches on the CAN board (IN1, IN2 and IN3). These switches can also be configured as Request-To-Send pins, which allow the user to manually request transmission of each transmit buffer.

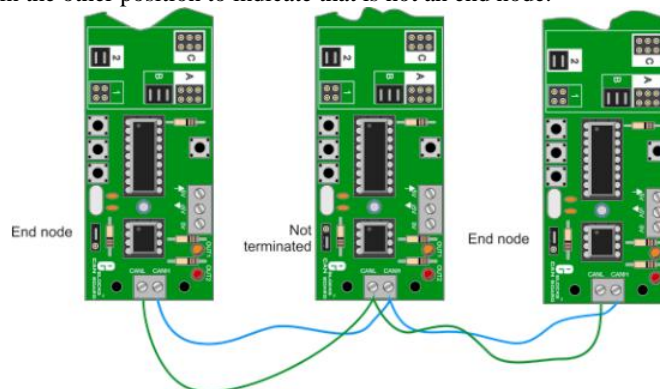
There are also 2 dedicated outputs. These are connected to LEDs D1 and D2. The pins connected to the LEDs can be configured as buffer-full indicators indicating that message has been successfully received.

Users will need to consult the MCP2515 datasheet for information on programming and using this device. The datasheet for this can be found on the Microchip website at: www.microchip.com

2. *CAN Transceiver – MCP2551*

The MCP2551 CAN transceiver is an interface between the CAN controller and the CAN bus. It converts the logic levels of the CAN controller and the differential signals levels of the CAN bus. It will also convert from the CAN bus signals to TTL logic level for the CAN controller.

The CAN_H and CAN_L outputs are connected to the screw terminal J2. Also there is a link block (J8) that allows the user to determine if this CAN node is the end terminal, by adding a termination resistor. As can be seen in the diagram below, the two outer CAN boards have the link block for J8 in the “END NODE” position. The middle CAN board has the link in the other position to indicate that is not an end node.



CAN bus diagram showing “End nodes” in use.

For more information please look at the datasheet for this device which can be found at: www.microchip.com

3. Jumper settings

The design of this product enables you to use this board with many standard PICmicro devices. This is achieved by identifying the up-stream device, then selecting the corresponding jumper setting on the CAN board. This will configure the board with the correct pin-out for the PICmicro selected. Jumper setting A, B, and C are used for selecting the appropriate pins for SDO, SDI and SCK: the dedicated SPI lines. Jumper settings 1 and 2 are used to set the correct pins for /CS and /INT.

The microcontroller that is being used determines which port and which jumper. For example, if an 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:

Jumper Setting A		Jumper Setting B	Jumper Setting C	
PIC16F devices	PIC16C devices			
PIC16F72	PIC16C62B	PIC16F87	PATCH SYSTEM	
PIC16F73	PIC16C63A	PIC16F88		
PIC16F737	PIC16C65	PIC16F818		
PIC16F74	PIC16C66	PIC16F819		
PIC16F747	PIC16C67			
PIC16F76	PIC16C72A			
PIC16F767	PIC16C73B			
PIC16F77	PIC16C74B			
PIC16F777	PIC16C76			
PIC16F872	PIC16C77			
PIC16F873/A	PIC16C773			
PIC16F874/A	PIC16C774			
PIC16F876/A				
PIC16F877/A				
CONNECT BOARD TO PORT C		CONNECT BOARD TO PORT B		

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

The following table (Table 2) shows the settings that can be used for /CS and /INT:

Jumper Setting 1		Jumper Setting 2	
/CS	/INT	/CS	/INT
Bit 6	Bit 0	Patch	Patch

Table 2. Jumper settings for /INT and /CS selection

The Patch System allows the user to route SDO, SDI, SCK, /CS and /INT to any of the 8 input bits required. This allows great flexibility, as the user can then use a different device other than those specified in Table 1. When using the CAN Board with up-stream devices that are not mentioned in the above table, such as Atmel AVR® Board or other processor boards, then the patch system will be required.

4. Using Microcontrollers with embedded CAN

Some microcontrollers have an inbuilt CAN module, but these still need to be interfaced to the CAN bus using a transceiver chip such as the MCP2551 on this E-Block. Such microcontrollers can use the transceiver chip on this E-Block by removing the MCP2515 controller chip and using the patch system to link the appropriate TXCAN and RXCAN pins of the microcontroller to pins 1 and 2 of the vacated MCP2515 socket.

5. 3.3V operation

This board is not compatible with 3.3V systems.

Appendix 1 – Circuit diagram

