

**dsPIC/PIC 'Command Module' – Adapter Board**  
**RS-EDP-CM-PIM User Manual**

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## 1.0 Introduction

The RS-EDP platform is a system, which has been designed to utilise many different manufacturers' microprocessors. To support Microchip's family of devices, the RS-EDP platform uses an adapter board to connect between the RS-EDP baseboard and the Microchip PIM modules. This is referred to as the EDP-CM-PIM module.

Microchip have most of their MCU's available, pre-mounted on 80 pin and 100 pin PIM modules. These are square in shape and use pin headers to connect down to a daughter board, which in the Microchip system is usually some form of evaluation board.

The RS-EDP therefore uses these modules with an adapter board to gain access to the Microchip portfolio of devices. One adapter board can be used with pretty much all of the Microchip PIM modules, from the 8 bit PIC16Cxx family, through to the 16bit dsPIC family and the new 32bit PIC32 family.

The PIM modules are available to order directly from the RS website, and are separately listed in the catalogue from the RS-EDP platform.

The adapter board is configured as a 'Command Module'. The 'Command Module' in a system dictates whether the whole system is a 3.3V one or a 5.0V one. The module has a link option which decides which of the two voltages is used within the system. The Vcc\_CM line is set to this level by the link option on this adapter module. This Vcc\_CM is used as a reference by the other modules, such as the analogue module for example.

The daughter board remaps the I/O of the PIM module on to the backplane of the RS-EDP system. As the RS-EDP system has a similar concept to the PIM module system from Microchip, you will find most of the PIM modules will correctly map out to the RS-EDP backplane.

During the development of this board, several devices were chosen for trial fits to the RS-EDP system. These included the dsPIC33FJ256MC710, the dsPIC33FJ256GP710 and the PIC32Mx4xxFxxxL devices.

## 2.0 Jumper Options

### Vcc\_CM Command module Voltage Selection Jumper – JP101

The EDP-CM-PIM with a PIM module fitted is designed to be a 'Command Module' in the system. When the module is used as a Command Module, the operating voltage of the complete system needs to be decided via the link option JP101. This provides the back plane with the necessary voltage (Vcc\_CM) to instruct all the other modules that the system is either a 3.3V or 5.0V system. i.e. The Analogue Module for example will provide signals up to 3.3V/5.0V accordingly.

This Vcc\_CM is also used by the RESET circuitry on the base board. The RESET button will not work for example if this link is not made. There are two possible positions for this jumper, position 1-2 for 3.3V and position 2-3 for 5.0V.

Normally the operating voltage of the PIM module PIC device will determine the operating voltage of the system. Hence the selection jumper is altered accordingly, depending on whether you use a 5.0V or 3.3V PIC device.

The Vcc-CM line and operating voltage for the adapter board and the PIM module are usually the same. They are connected via a zero ohm resistors, R103 & R201. It would be possible to de-solder these resistors and to operate the PIM and adapter board at a different voltage to the Vcc\_CM line. Some consideration would have to be given to the different voltages then present in the system and possible bleed paths for current when I/O are possibly at different voltages. The users should check the circuit to ensure safe operation is guaranteed during this case. No further design guidance is offered at this point and this dual voltage feature has not been tested.

Leaving this jumper open would suggest that another module is going to decide what the Vcc\_CM voltage would be.

JP101 – option 1-2	Vcc_CM is set to 3.3V
JP101 – option 2-3	Vcc_CM is set to 5.0V
open	Vcc_CM is decided by another module (DEFAULT)

Table: 01 Vcc\_CM 'Command Module' Voltage Selection Jumper - JP101 options

### Voltage Reference Selector – JP216

The PIM modules have a separate analogue voltage reference supply pin called AVdd. This pin can be connected to either the power supply voltage of the module, Vcc\_PIM, or to an external reference provided through the back plane. If the analogue module is fitted, a voltage reference is provided via the backplane called AN\_Ref. This selector option will allow the user to connect either of the two voltages to the PIM module reference voltage pin. This jumper should also be used in conjunction with the analogue ground zero ohm link. See section on zero ohm links below.

JP216 – option 1-2	AN Ref is selected as the AVdd signal
JP216 – option 2-3	PIM_Vcc is selected as the AVdd signal (DEFAULT)

Table:02 Voltage Reference Selector Jumper – JP216 options

### Emulation & Programmer Jumpers – JP203, JP208 & JP207, JP210

There are two possible channels to which the emulation and programming system can be connected. These are connected via the daughter board to the programming pins on the PIC or dsPIC MCU. These are usually referred to as EMUCx and EMUDx where x is either 1, 2 or 3. The actual designation and pins used, will depend on the PIC/dsPIC fitted to the module.

Most of the development for the PIM module was based on the highly successful dsPIC33FJ256MC710 module, which effectively maps both EMUC1/D1 and EMUC3/D3 to the emulator connections.

Have a look at your PIM module and identify the pins that are responsible for the programming and flashing of the device. These should be connected to pins 24, 25, 26 and 27 of the PIM module. These pins are then selectable via the link options. The ones not used for programming can be used for other functions within the system. Only two pins are used at any one time for debugging and flashing. Select the correct link options accordingly.

For the emulation/programming system to be able to communicate with the PIC, the fuse options for the microcontroller also need to be correctly set. This is usually done with a few lines of source code.

For the dsPIC33FJ256MC710 device the appropriate fuse option is...

```
/* Fuse In Circuit Debug - 0xf8000e */

_FICD(ICS_PGD1 & JTAGEN_OFF)

/* bit15-bit8 - always set to 1's */
/* bit7 - BKBUG */
/* bit6 - COE */
/* bit5 - JTAGEN */
/* bit4,3,2 - Reserved - write 1's */
/* bit1,0 - ICS<1:0> - 01 - Communicate on PGC3/EMUC3 & PGD3/EMUD3 */

/* Possible options are... _FICD( OPT1_ON & OPT2_OFF & OPT3_PLL )

** Background Debug Enable Bit:
**   BKBUG_OFF      Device will Reset in Debug mode
**   BKBUG_ON       Device will Reset in user mode
**
** Debugger/Emulator Enable Bit:
**   COE_OFF        Reset in clip-on operational mode
**   COE_ON         Reset in operational mode
**
** JTAG Enable Bit:
**   JTAGEN_OFF     JTAG is disabled
**   JTAGEN_ON      JTAG is enabled
**
** ICD communication channel select bits:
**   ICS_NONE       Reserved
**   ICS_PGD3        communicate on PGC3/EMUC3 and PGD3/EMUD3
**   ICS_PGD2        communicate on PGC2/EMUC2 and PGD2/EMUD2
**   ICS_PGD1        communicate on PGC1/EMUC1 and PGD1/EMUD1
**
*/
```

As you can see from here the relevant option is the ICS\_PGD1. For this PIM module we could use channel 3 rather than channel 1, in which case the ICS\_PGD1 options gets replaced with the ICS\_PGD3 option.

JP207 – option 1-2	PIM pin 24 is connected to emulator/programmer
JP210 – option 1-2	PIM pin 25 is connected to emulator/programmer

JP207 – option 2-3	PIM pin 24 is connected to analogue channel AN4 on backplane.
JP210 – option 2-3	PIM pin 25 is connected to analogue channel AN5 on backplane.
JP207 – option – open	PIM pin 24 is not connected (DEFAULT)
JP210 – option – open	PIM pin 25 is not connected (DEFAULT)

Table: 03 Emulation Selection Jumpers - JP207 &amp; JP210 options

JP203 – option 1-2	PIM pin 26 is connected to emulator/programmer (DEFAULT)
JP208 – option 1-2	PIM pin 27 is connected to emulator/programmer (DEFAULT)
JP203 – option 2-3	PIM pin 26 is connected to GPIO33_AD11 on the backplane
JP208 – option 2-3	PIM pin 27 is connected to GPIO34_AD11 on the backplane
JP203 – option – open	PIM pin 26 is not connected
JP208 – option - open	PIM pin 27 is not connected

Table: 04 Emulation Selection Jumpers - JP203 &amp; JP208 options

### I2S Jumper Options – JP202, JP211

On the backplane of the RS-EDP module are some signals dedicated to the serial I2S communication interface (Inter Integrated-circuit Sound).

I2S is a high speed serial standard used primarily for digital audio. This digital audio used a clock and a data signal.

The Wikipedia definition of I2S is detailed below.

I<sup>2</sup>S consists, as stated above, of a bit clock, a word select and the data line. The bit clock pulses once for each discrete bit of data on the data lines. The bit clock will operate at a frequency which is a multiple of the sample rate. The bit clock frequency multiplier depends on number of bits per channel, times the number of channels. So, for example, CD Audio with a sample frequency of 44.1kHz, with 32 bits of precision per (2) stereo channels will have a bit clock frequency of 2.8224MHz. The word select clock lets the device know whether channel 1 or channel 2 is currently being sent, since I<sup>2</sup>S allows two channels to be sent on the same data line. Transitions on the word select clock also serve as a start-of-word indicator. The Word clock line pulses once per Sample, so while the Bit clock runs at some multiple of the sample frequency, the word clock will always match the sample frequency. For a 2 channel (stereo) system, the word clock will be a square wave, with an equal number of Bit clock pulses clocking the data to each channel. In a Mono system, the word clock will pulse one bit clock length to signal the start of the next word, but will no longer be square, rather all Bit clocking transitions will occur with the word clock either high or low.

Standard I<sup>2</sup>S data is sent from MSB to LSB, starting at the left edge of the word select clock, with one bit clock delay. This allows both the Transmitting and Receiving devices to not care what the audio precision of the remote device is. If the Transmitter is sending 32 bits per channel to a device with only 24 bits of internal precision, the Receiver may simply ignore the extra bits of precision by not storing the bits past the 24th bit. Likewise, if the Transmitter is sending 16 bits per channel to a Receiving device with 24 bits of precision, the receiver will simply Zero-fill the missing bits. This feature makes it possible to mix and match components of varying precision without reconfiguration.

There are left justified I<sup>2</sup>S streams, where there is no bit clock delay and the data starts right on the edge of the word select clock, and there are also right justified I<sup>2</sup>S streams, where the data lines up with the right edge of the word select clock. These configurations however are not considered standard I<sup>2</sup>S.

The PIM module has support for I2S and data can be transmitted as a master from the PIC/dsPIC or received into the module as a slave from a master somewhere else in the system.

The backplane has two signals for I2S\_WS, one for I2STX\_WS and one for I2SRX\_WS. As the PIC can be either master or slave the user can select the appropriate settings for this.

The backplane also has two signals for the I2S\_CLK as well, one for I2SRX\_CLK and one for I2STX\_CLK. The user can therefore select which one he wants depending on whether the PIC is transmitting as a master or receiving as a slave.

JP202 – option 1-2	I2STX_CLK – PIC is master I2S device
JP211 – option 1-2	I2STX_WS - PIC is master I2S device
JP202 – option 2-3	I2SRX_CLK - PIC is slave I2S device
JP211 – option 2-3	I2SRX_WS - PIC is slave I2S device
JP202 – option – open	I2STX_CLK is not connected (DEFAULT)
JP211 – option – open	I2STX_WS is not connected (DEFAULT)

Table 05: I2S selection jumpers – JP202 & JP211 options

It is worth checking that if other modules are using I2S, which lines are being used.

#### **CAN Bus – Jumper Option – JP204 & JP209**

The jumper options can be used to route the CAN Tx and CAN Rx signals from the PIC/dsPIC on to the backplane. These signals can then be converted to physical layer signals via a communications module. If the CAN bus is not being used or the PIC does not support CAN bus then these signals can be used for other purposes.

JP204 – options 1-2	PIM pin 87 is routed to CAN TX on backplane
JP209 – options 1-2	PIM pin 88 is routed to CAN RX on backplane
JP204 – options 2-3	PIM pin 87 is routed to GPIO35_AD10
JP209 – options 2-3	PIM pin 88 is routed to GPIO36_AD1
JP204 – option – open	PIM pin 87 is not connected (DEFAULT)
JP209 – option – open	PIM pin 88 is not connected (DEFAULT)

Table:06 CAN Bus selection – JP204 & JP209 options

**USB Link Options – JP212, JP213, JP214, JP215**

The RS-EDP is equipped with several lines for USB communication including a separate USB host and a separate general USB. The PIM module can have access to both of these signals via connections present on the adapter board.

JP212 – option 1-2	PIM pin 90 is routed through to D+
JP214 – option 1-2	PIM pin 89 is routed through to D-
JP212 – option 2-3	PIM pin90 is routed through to GPIO32_AD3
JP214 – option 2-3	PIM pin89 is routed through to GPIO31_AD12
JP212 - option – open	PIM pin 90 is not connected (DEFAULT)
JP214 – option – open	PIM pin 89 is not connected (DEFAULT)

Table: 07 USB selection jumpers – JP212 &amp; JP214 options

The USB link options can further be routed to either the USB host channel or the standard USB connections on the back plane.

JP213 – option 1-2	D+ is routed to USB HOST D+
JP215 – option 1-2	D- is routed to USB HOST D-
JP213 – option 1-2	D+ is routed to USB DEV D+
JP215 – option 1-2	D- is routed to USB DEV D-
JP213 – option – open	D+ is not connected (DEFAULT)
JP215 – option – open	D- is not connected (DEFAULT)

Table: 08 USB Connections - JP213 &amp; JP215 options

Note: USB On The Go uses additional signals as well, notably USB ID, and VBUSON. These can be routed on to the backplane. Check the PIM module configuration to see the pins actually used for these.

**32KHz Sub Clock Option – JP205 & JP206**

The adapter module has been designed to support a 32KHz watch crystal sub clock. To enable this feature for the PIM modules that can support it, JP205 & JP206 should be inserted as detailed in the table below. If the 32KHz sub clock is not required, it can be bypassed and the circuitry re-routed to the backplane GPIO signals.

JP205 – option 2-3	PIM pin 73 is routed to 32KHz circuitry
JP206 – option 2-3	PIM pin 74 is routed to 32KHz circuitry
JP205 – option 1-2	PIM pin 73 is routed to GPIO0 on the backplane
JP206 – option 1-2	PIM pin 74 is routed to GPIO1 on the backplane
JP205 – option – open	PIM pin 73 is not connected (DEFAULT)
JP206 – option – open	PIM pin 74 is not connected (DEFAULT)

Table: 09 Sub clock jumpers – JP205 &amp; JP206 options



**Vdd\_Core Jumper – JP201**

The VDDCORE voltage is usually managed on the PIM module itself with various jumpers and capacitors to ensure this voltage is correct. The PIM adapter module provides some additional flexibility with this function. For normal operation it should be left disconnected.

JP201 – option open	The VDDCORE voltage will be managed by the PIM module (DEFAULT)
JP201 – option 1-2	The VDDCORE voltage is Vcc_CM
JP201 – option 2-3	The VDDCORE voltage is SGND

Table: 10 The VDDCORE Jumper – JP201 options

**3.0 Zero Ohm Links****Analogue Ground Reference – R104**

The analogue ground from the back plane can be made to be the same as the signal ground if required. AD signals can be passed from the analogue module to the command module. These analogue signals have their own separate ground return. The signal ground and the analogue ground can be connected together on the PIM module adapter board via a zero ohm link resistor R104.

R104 – option populated	SGND and VAGND are shorted together on the PIM adapter (DEFAULT)
R104 – option removed	SGND and VAGND are not connected on the PIM adapter

Table: 11 Analogue Ground Reference link R104

**PIM Voltage Vcc\_PIM & Vcc\_CM Connection - R103**

This connects the Vcc\_CM voltage to the operating voltage of the PIM adapter module. The default setting for this is to populate this position with a zero ohm link. This is discussed more in the section on jumper settings, for the Vcc\_CM.

With this link in place the voltage used on the PIM adapter module will be made the same as for the Vcc\_CM voltage which is selectable via link option JP101.

R103 – option – populated	Vcc_PIM adapter board & Vcc_CM are connected together.(DEFAULT)
R103 – option - removed	Vcc_PIM adapter board is not connected to the Vcc_CM line

Table: 11 Adapter board voltage Vcc\_PIM &amp; Vcc\_CM Connection – R103

**PIM Module Voltage & PIM Adapter Module Voltage – R201**

The PIM module operating voltage can be made the same as the operating voltage for the PIM adapter board by inserting the zero ohm link, R201 on the board. This is the normal setting for operation and should not be removed without good reason.

R201 – option – populated	The Vcc_PIM adapter voltage is connected to the Vcc_PIM on the module.(DEFAULT)
R202 – option - removed	The supply voltage for the adapter board is disconnected from the PIM module.

Table : 12 Adapter board voltage to PIM voltage connection – R201

**Main Oscillator Selections – R202, R203, R204**

The main oscillator on the PIC/dsPIC devices can be selected as either, an internal RC oscillator, an external Xtal resonator type or an external clock module. The adapter board has been designed to accommodate all of these options.

To use the internal RC oscillator the zero ohm links, R203 and R204 need to be removed.

To use an external crystal or ceramic oscillator then the zero ohm links R202, R203 need to be populated.

To use an external clock oscillator module the module needs to be soldered on to the board. R203 and R204 should be removed.

Clock Type	R202	R203	R204
External Xtal (DEFAULT)	Removed	Populated	Populated
External Clock module	Don't care	Removed	Removed
Internal RC	Don't care	Removed	Removed

Table:13 Main Oscillation Selection Links

## Hardware Setup

Select the appropriate jumper and link options for your design and then insert your PIM module into the adapter board. Once inserted, plug the adapter board into the RS-EDP base board along with the Communication Module. The communications board is fitted with a nine way D connector, which is mapped to one of the serial channels on the PIM module. Connect this to the host PC. Power up the RS-EDP board via the power adapter provided.

Check the Vcc\_CM voltage on the break out connector of the base board, to see if it is what you have selected via the Vcc\_CM jumper. If all is ok, the +5V, the 3.3V and the Vcc\_CM voltages should be present on the break out connector.

The green power on LED lamp should illuminate when power is applied. Press the reset button and the red LED should illuminate. This should go off when the button is released.

## 4.0 Software Support

### dsPIC33FJ256MC710

The Microchip adapter board is designed to be used with Microchip PIM modules and the user is expected to have some familiarity with the series of MCU's he is looking to use.

As the adapter board can be used with many platforms including PIC16Cxx, dsPIC30Fxxxx, dsPIC33FJxxxx and PIC32 devices it is not possible to provide a whole series of drivers for all of these devices.

The basic development work done was using a dsPIC33FJ256MC710 device a 16 bit device from the latest generation of dsPIC devices from Microchip. Consequently driver support is included for this part to communicate with the analogue module, the digital module, the communications module, and the MC2 motor drive module. It may be worth purchasing one of these PIM modules so you have a working reference by which you can check the base board and the modules.

The software was written and developed using MPLAB Version 8.14 and the C30 compiler from Microchip. These are available to download free of charge from Microchips web site, although some registration is required to obtain the compiler.

The software drivers allow the user to read signals from most of the popular peripheral boards and also to control the motors for the MC2 module.

These modules can be tested via a test menu, which will require the use of the 'Communications Module' and a terminal emulator for the host PC.

The configuration of the terminal emulator is as follows...

The serial configuration at the time of writing this support documents is as follows.  
Check the C source code to see if this has changed since this document was written.

Baud rate: 115,200 baud  
Data bits: 8  
Stop bits: 1  
Parity: None  
Flow control: None

Start MPLAB and open up the MPLAB project, 'PIM\_dsPIC33FJ256MC710\_General'.

Plug in the emulator/programmer into the PIM adapter board and attempt to connect to it.

Try starting with the Real-ICE connected as a programmer and selected for 'Release' rather than 'Debug'. Recompile the code and ensure all of your paths are correct for the project and then attempt to flash the board.

The fuse options you have selected may be important at this stage and make sure you have the correct oscillator selections and the correct debug/programmer setting for the fuse options. For the dsPIC mentioned and the provided software the fuse options can be viewed in the header file called 'fuse\_options.h'

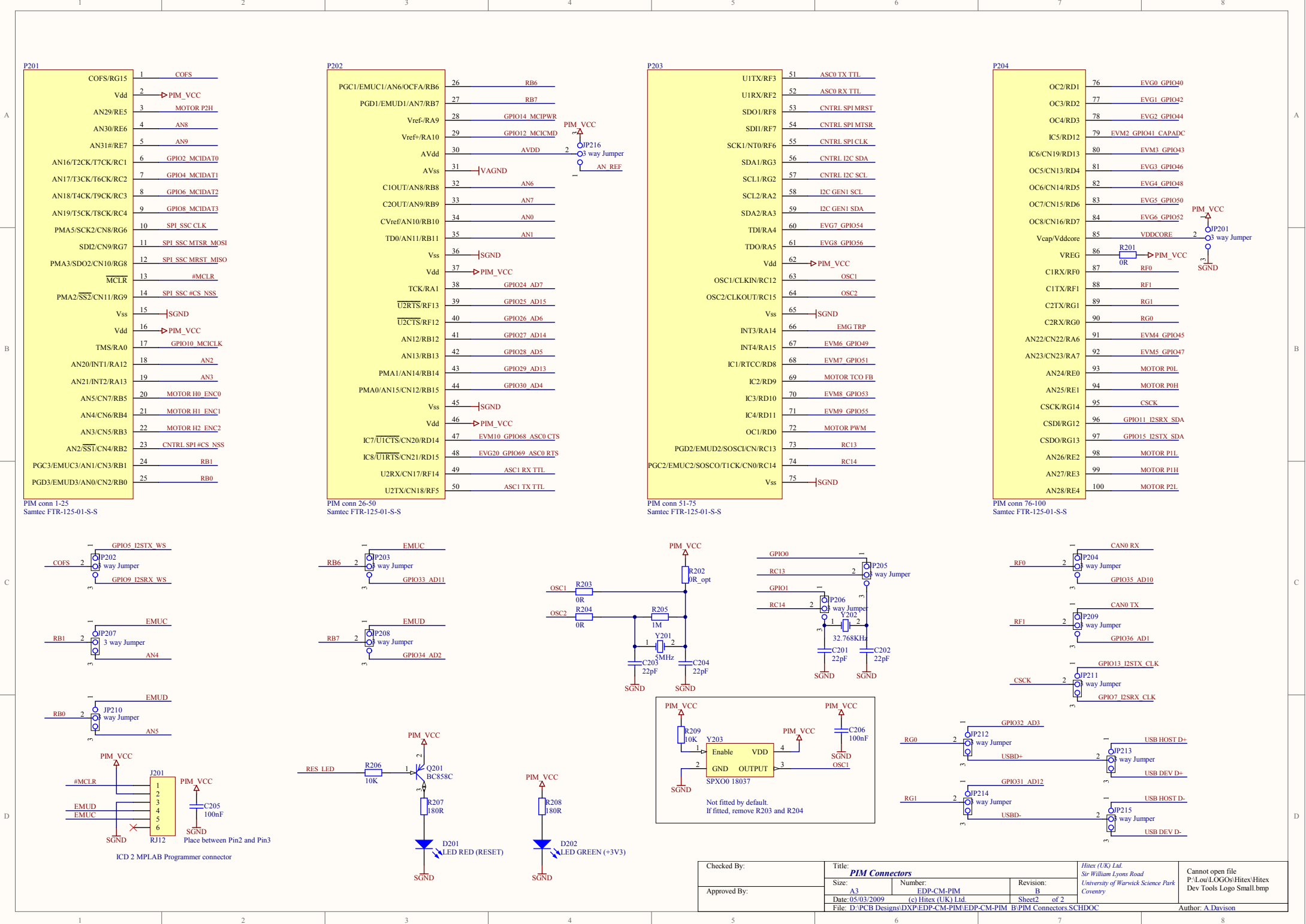
The emulator selection is important and this is detailed in the sections relating to jumper options earlier, and must be read before proceeding.

If you are able to flash the PIM module with this code then you should see some serial output on the terminal emulator when the code starts to run. Problems with flashing code would almost certainly be due to the fuse options not being correct or the link and jumper options not being correctly set.

Work through the menu options provided with the test suite. The default oscillator configuration provided is for the external crystal populated on the adapter module.

If you are having problems with the oscillator, then change the fuse setting to run with on board high speed RC oscillator. The code to do this is included and commented out in the 'fuse\_header.h' There is also a #define in the 'defines.h' header file which needs to be changed also.





Quantity	Designator	Comment	Description	Footprint	Notes
4	C201, C202, C203, C204	22pF	Capacitor, 22pF, 50V, COG, 0603	CAPC1608N	
1	C205	100nF	Capacitor, 100nF, 0603	CAPC1608N	
1	D101	BAT54XV2T1G	Schottky Diode, BAT54	SOD-523	
1	D201	LED RED (RESET)	Typical RED PLCC2 LED	3.5X2.8X1.9 RD	
1	D202	LED GREEN (+3V3)	Typical BLUE SiC LED	3.5X2.8X1.9 GR	
1	J201	RJ12	RJ12 6 way Jack, ICD 2 Pinout	85502-5007	
16	JP101, JP201, JP202, JP203, JP204, JP205, JP206, JP207, JP208, JP209, JP210, JP211, JP212, JP213, JP214, JP215, JP216	3 way Jumper		HDR1X3	
1	P101	Tyco Amp 140 Way	140 way connector, 0.8mm pitch	TycoAmp 140 HDR	
1	P102	Tyco Amp 100 Way	100 way connector, 0.8mm pitch	TycoAmp 100 Hdr	
1	P201	PIM conn 1-25	SIL, 25 way, 1.27mm pitch, SMD header, PIM connections 1-25	FTR-125-01-S-S	
1	P202	PIM conn 26-50	SIL, 25 way, 1.27mm pitch, SMD header, PIM connections 26-50	FTR-125-01-S-S - 26-50	
1	P203	PIM conn 51-75	SIL, 25 way, 1.27mm pitch, SMD header, PIM connections 51-75	FTR-125-01-S-S - 51-75	
1	P204	PIM conn 76-100	SIL, 25 way, 1.27mm pitch, SMD header, PIM connections 76-100	FTR-125-01-S-S - 76-100	
1	Q201	BC858C	pnp Transistor SMD	SOT23-3N	
2	R101, R206	10K	Resistor, Resistor, 10K, 0603	RESC1608N	
1	R102	2K2	Resistor, 2K2, 0603	RESC1608N	
4	R103, R104, R201, R203, R204	0R	Resistor, 0R, 0603	RESC1608N	Only available in Reel 5000
1	R202	0R_opt	Resistor, 0R, 0603	RESC1608N	Not Fitted
1	R205	1M	Resistor 1M, 0603	RESC1608N	
2	R207, R208	180R	Resistor, 180R, 0603	RESC1608N	
1	Y201	5MHz	Crystal Oscillator	HC49/4H_SMX	
1	Y202	32.768KHz	Crystal Oscillator	FX255	
1	Y203	5MHz-XO91050UCTA	5MHz Crystal Oscillator	XO91	Not Fitted