The FED PICFlex Development Boards

THE FED PIC Flex Development board offers a host for 28 or 40 pin devices and includes LED's, switches, transistor switches, USB interface, serial port, support circuitry, LCD module support circuitry and also includes an optional In Circuit Programmer

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Contents

1 PIC development boards (PIC Flex)

FED have a number of capable development/evaluation board for PIC devices which are suitable for use with all the examples and the tutorial and full example program. Each board has the following features:

- Supports all standard pin out 16 and 18 series PIC's in 28 or 40 pin packages.
- Has on board 5V, 1A, regulator.
- Links provided to support low power battery operation.
- Serial interfaces for standard 3/5 wire serial communications link selectable as DCE or DTE.
- 20MHz crystal oscillator
- All I/O pins available on 0.1” pitch PCB matrix suitable for standard IDC connectors
- 4 Switches and pull up resistors (with link to allow Switch 4 to drive the PIC reset pin).
- 4 LED's with resistors
- 2 NPN and 1 PNP general purpose transistors with base resistors for driving relays or higher loads.
- Power LED
- Full USB circuitry suitable for applications using USB PIC’s with 28 or 40 pin boards e.g. 18F2550, also included link to switch to allow boot into Microchip USB bootloader.
- In Circuit Serial Programmer (ICSP) standard 6 pin connector
- Optional full on board programmer - connect to the PC and program hex files direct to the on board PIC.
- LCD Module power connector and contrast trimmer.
- Allows for battery or low power operation.

1.1.1 Built in Serial programmer

Please see section 2 for details of the serial programmer if fitted.

1.1.2 Circuit Diagrams

The circuit diagrams are shown in Appendix 1.

1.1.2.1 Connections

The boards external connectors are shown in Table 1.

1.1.2.2 Power Supply

The power supply is from a 1A, 5V regulator. There is no heat sink supplied, and applications using more than 2W MUST provide an external heat sink for the voltage regulator (Typically at 12V input this would be about 150mA or more). The board may be driven by power supplies of 9V or greater, however if the In-Circuit programmer is required then the supply should be greater than 15V - cheap unregulated 12V battery eliminators work very well in this case.

The power supply is connected to U4 and PLED (the serial communications chip and Power LED), and to the rest of the circuit by the link EXTPOW – see Battery operation below.

1.1.2.3 Battery operation

To operate from batteries the link EXTPOW may be cut. This disconnects the power from the regulator to the PIC and the VCC connections on the switches, reset circuitry and the Vcc lands on the development board area. Therefore a battery or external supply may now be connected to the Vcc and Gnd lands and power supply current minimised and controlled by the PIC.

Normally in battery operation the RS232 chip U4 will not be required and it is connected to the power regulator U2 directly along with the power LED. The consumption of U4 is too high for normal battery operation.

If it is required to use the RS232 driver - U4 - with batteries then it is recommended that the regulator U2 should be removed. The link EXTPOW should be cut, and finally the other end of EXTPOW wired to a PIC output pin. Now the PIC can supply power to U4 and the power LED by the output pin and control overall power consumption through use of that pin and sleep modes. The total consumption of the LED and U4 is approximately 15mA, well within the capability of a single PIC output.

1.1.2.4 Reset Circuitry

The reset/Vpp pin is driven by a number of components. By default the PIC will be reset externally by D2, R1 and C12 on power up. The reset pin is also driven by the on board programmer and by the ICSP connector. The reset pin is also available as a PCB pad for I/O RE3 if this is used, however be aware that Vpp will be applied to this pad if the on board or external programmer is used. Similarly I/O pad E3 can be used as another source of reset if required.

Switch SW4 is also available for use as a reset switch. If link RESETSW is made with a short wire link then SW4 will operate as a reset switch to short the MCLR input to ground which may be pressed to manually reset the PIC at any time.

1.1.2.5 ICSP connector

The ICSP connector is provided for external programmers which support ICSP such as the FED PIC Key. The connections on this are as follows :

Pin	Connection	Comment
1	Vpp/MCLR	This is the Vpp input usually this pin will rise to 12V or more when programming the PIC
2	Vdd *	Connected to Vdd on the application board, you WILL need to apply power to the board if the application you have draws more power than can be supplied by your programmer. For the PIC Key this is around 30mA.
3	Gnd	Connect to the application circuit, ground connection.
4	Program Data**	Connected to the PGD pin - RB7
5	Program Clock**	Connect to the PGC pin –RB6.
6	ICD Pin***	Debugger connection – not connected, but may be wired to a PIC pin to use the FED PIC Key debugger.

Link PROG is used to switch the ICSP port between the application PIC and the on board programmer PIC, normally it should be left connected between the left 2 pins to connect the ICSP to the on board PIC. For boards without the on board programmer this link is permanently connected.

1.1.2.6 Input & Outputs

Up to 34 of the PIC I/O's are available on the port connectors at the top of the prototyping area depending on the PIC size (All available I/O pins on ports A to E except A6 and A7). The board markings clearly show the port connections.

Some PIC’s have switchable PORTA bits 6 and 7 with the crystal oscillator so that these port pins become available if internal oscillator options are used. The development board does not route these connections from the crystal to avoid tracking high frequency oscillator signals around the board. If these port connections are required then X1 and capacitors C5 and C6 should be removed and the application wired directly to the pins of X1 which will be Port A bits 6 and 7 in this event.

For 28 pin devices PORT D and PORT E bits 0 to 2 are not available.

1.1.2.7 LED's

The four LED's are connected to PCB pads via 300R resistors, LED 1 is also driven by the programmer during programming to show programmer status.

The Connections are L1 to L4 and are positive going – connect the pad to +5V to light the associated LED.

The power LED is connected to the regulator side of the EXPOW link. When the module is driven from an external supply it will light. If EXTPOW is broken for battery power then this LED is disconnected to avoid it being a drain on battery power.

1.1.2.8 USB

A standard USB B connector is provided for the USB applications on the 28 and 40 pin boards, in addition a links is available on the board to connect the socket power to Vcc and a decoupling capacitor for VUSB is provided. Purchasers of the USB versions of the development board will have all the USB links and components fitted.

To use the USB the decoupling capacitor CUSB should be fitted (this is a 1uF SMD tantalum device) which connects to pin C3.

The link USB POWER may be made or released to power the board from the USB supply if required. This link is also just below the socket and is provided using standard 0.1” header and jumper.

When used with the Microchip USB bootloader it is useful to control the bootloader using a switch. Link USB Boot is made to connect Switch 1 to RB0. FED provide a version of the USB bootloader which will boot into the loader when Switch 1 is pressed and the board reset using the reset switch.

Full details for use with USB is provided in the USB development board manual supplied separately on the CD.

1.1.2.9 Switches

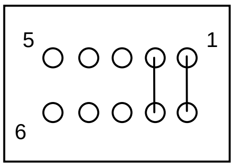
Four switches are provided and connected to PCB pads S1 to S4, they have 10K pull ups and the switch connects to ground when pressed. SW4 may be connected to the reset pin using the RESETSW link if required to make it a reset switch.

1.1.2.10 Serial Port

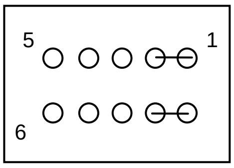
The serial port is connected via J2 to an RS232 modem chip U4 (a commonly used MAX232 compatible device). The serial port may be connected easily to PIC pins C6 and C7 which are the USART hardware pins on most devices which support an internal USART by making links RC6 and RC7 to the left of the 40 pin socket.

The modem chip can be connected to other I/O pins by connecting wires directly to the Rx and Tx pins on those 2 links (the upper end of each link). Rx is the output from the serial port driver, Tx is the input to the serial port driver and should usually be driven by a 1K resistor (R9 is included when Tx is driven by RC6 through the link). The port is fully powered and can be connected to a PC, or to another development board.

To support DTE mode (which allows the board to communicate with most PC’s) then the links on Connector CONFIG must be made as below :

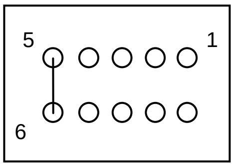


To support DCE mode (which allows the board to communicate with DTE's) then the links on Connector CONFIG must be made as below (note in this case that, if it is installed, then the on board programmer will not work) :



Links connected to pins 3, 4 and 7,8 are used for hardware flow control, see the circuit diagrams for connections.

To loop round the socket (connecting pin 2 to pin 3), simply make the link between pins 5 and 6 :



This hardware is compatible with the FED asynchronous interrupt driven serial communications library functions included with WIZPIC, PIXIE and FED PIC C.

Important note – if the development board is supplied with a built in serial programmer then this will share the serial port and the board will be supplied with the links for CONFIG in place for DTE mode. Normally the serial programmer is inactive and the port may be used by the application. The serial port is enabled by the programming application running on the PC with a "magic" sequence. This is in hex the sequence : 5A,6B,A4,23,FA. It is very unlikely that this sequence will occur by accident in applications. When enabled by the programmer on the PC the PIC on the development board will be held in reset and therefore there is no possibility that the application and programmer PIC's will clash.

1.1.2.11 LCD Module

There are four connections for the power and LCD contrast connections to an LCD module on the left of the prototyping area. The data connections (D4 to D7) and control signals (RS, E, RW) should be connected directly to PIC Port pins – for example 7 bits of Port D maybe used for this purpose.

The 3 connections provided are for pins 1 to 3 of the LCD Module. These pins are by convention (in order) Ground, +Vcc and the LCD bias supply through a preset resistor (RV1).

RV1 and the power pin of the module may be connected directly to +5v by making the link LCD+ above resistor RV1. This would be the normal configuration.

However in battery or low power applications it may be necessary to power the module from a PIC I/O pin (typically module power is around 1mA which is well within the capability of the PIC output drive current). This will allow the module to be powered down in sleep mode. In this case a connection may be made from the left hand end of the connection LCD+ to a PIC I/O. There is also a 100nF decoupling capacitor provided close to the LCD module connector.

1.1.2.12 General purpose transistor switches.

There are 3 general purpose switching transistors provided. Each has a 10K resistor to the base. The maximum switching current for each is 100mA. An example of their use would be to switch on and off an LCD back light with a current consumption of around 50mA which is too great for a PIC output. Other uses might be to drive a relay, to switch higher voltages than the board's 5V supply, or to apply power to peripheral circuitry.

There are 3 transistors, two NPN with the emitter connected to ground, and one PNP with the collector connected to +5v. Thus the NPN transistors can be used to switch connections to ground and the PNP can be used to switch circuitry to +5V.

The connections are as shown from the top of the board down:

Pin	Connection	Notes
Vcc		General purpose VCC
Bpnp	Base resistor of PNP transistor	Connect to PIC output pin, pull high to switch off, low to switch on. Output on pin Cpnp
Cpnp	Collector of PNP transistor	Connect to circuitry to be switched to +5v.
Bnpn	Base resistor of first NPN transistor	Connect to PIC output pin, pull high to switch on, low to switch offf. Output on pin Cnpn
Cnpn	Collector of first NPN transistor	Connect to circuitry to be switched to Ground.
Bnpn (2)	Base resistor of 2nd NPN transistor	Connect to PIC output pin, pull high to switch on, low to switch off. Output on pin Cnpn
Cnpn (2)	Collector of 2nd NPN transistor	Connect to circuitry to be switched to Ground.
Gnd		General purpose ground connection

1.2 Table 1 - Connections for board:

SERIAL - Serial Connector 1,
Asynchronous serial port connector

1	Connected to pins 6 and 4
2	J3 pins 6 and 9
3	J3 pins 1 and 5
5	Ground
7	J3 pin 7
8	J3 pin 3

ICSP – In Circuit Programmer

1	MCLR/Vpp
2	Vcc
3	Ground
4	PGD (usually RB7)
5	PGC (usually RB6)
6	ICD – not connected

P1 - Power

1	Ground
2	NC
3	+9-30V (Note 15V or greater for programming purposes)

1.3 Component List

Design Title	:DevBoard28-40.DSN
Author	:
Revision	:
Design Created	:02 December 2008
Design Last Modified	:06 May 2009
Total Parts In Design	:87

18 Resistors

Quantity:	References	Value
10	R1, R6-R8, R10, R12, R14-R16, R18	10K
6	R2-R5, R13, R17	300R
1	R9	1K
1	R11	47R

17 Capacitors

Quantity:	References	Value
11	C1-C4, C8, C9, C12-C15, C17	100n
2	C5, C6	22p
4	C7, C10, C11, C16	10u

6 Integrated Circuits

Quantity:	References	Value
1	U1	PIC18F4520
1	U1A	PIC18F2520
1	U2	7805
1	U3	PIC16F628A
1	U4	MAX232
1	U5	78L12

5 Transistors

Quantity:	References	Value
2	Q1, Q3	BC557
3	Q2, Q4, Q5	BC548

5 Diodes

Quantity:	References	Value

1	D1	1N4001
3	D2-D4	1N4148
1	D5	1N4741A

36 Miscellaneous

Quantity:	References	Value
1	CONFIG	DCE-DTE
1	CUSB	1u
8	EXTPOW, FC, LCD+, RC6, RC7, RESETSW, USB BOOT, USB POWER	CONN-SIL2
3	ICSP, LEDS, SWITCHES	CONN-SIL6
5	L1-L4, PLED	LED
2	LCDPOWER, PORTE	CONN-SIL4
1	P1	DINPOWER
5	PORTA, PORTB, PORTC, PORTD, TRANSISTORS	CONN-SIL8
1	PROG	CONN-SIL3
1	RV1	RES-PRE
1	SERIAL	CONN-D9F
4	SW1-SW4	PCB SWITCH
1	USB1	USBCONN
1	X1	CRYSTAL
1	X2	RESONATOR

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Some components are not supplied on smaller boards

2 Using the in-circuit programmer

The programmer will handle most PIC's in the 12, 16 and 18 series. It shares the serial port – note that USB to serial converter leads work fine with the programmer if your PC or laptop does not have a serial port.

2.1 Power Supply

To use the programmer then the power supply to the module should be greater than 17 VDC and less than 28VDC at around 150mA. (Two 9v batteries or an unregulated battery eliminator work well). Use a 2.1mm DC power plug so that the centre terminal is positive. Wire a serial cable as shown below (or use a commercially available cable as the connections on the programmer are standard).

2.2 Serial cable

A standard commercial serial cable is the best, or directly plug in a USB to serial converter.

Programmer	PC end connector type :			
PL101	9 way Male	9 way Female	25 way Female	25 way Male
2	3	2	3	2
3	2	3	2	3
5	5	5	7	7

2.3 Operation

The operation of the programmer is described in the programmer manual which is installed with the PC programmer application on the CD. Bit rate is 57600.

2.4 Use of shared serial port

The serial programmer shares the serial port with the application and the board will be supplied with the links for CONFIG in place for DTE mode. Normally the serial programmer is inactive and the port may be used by the application. The serial port is enabled by the programming application running on the PC with a “magic” sequence at 57600bps. This is in hex the sequence : 5A,6B,A4,23,FA. It is very unlikely that this sequence will occur by accident in applications. When enabled by the programmer on the PC the PIC on the development board will be held in reset and therefore there is no possibility that the application and programmer PIC’s will clash.

2.5 Use with other boards

The programmer on the development board can be used as a general purpose programmer using the ICSP port as an output. The application PIC U1 MUST be removed in this case.

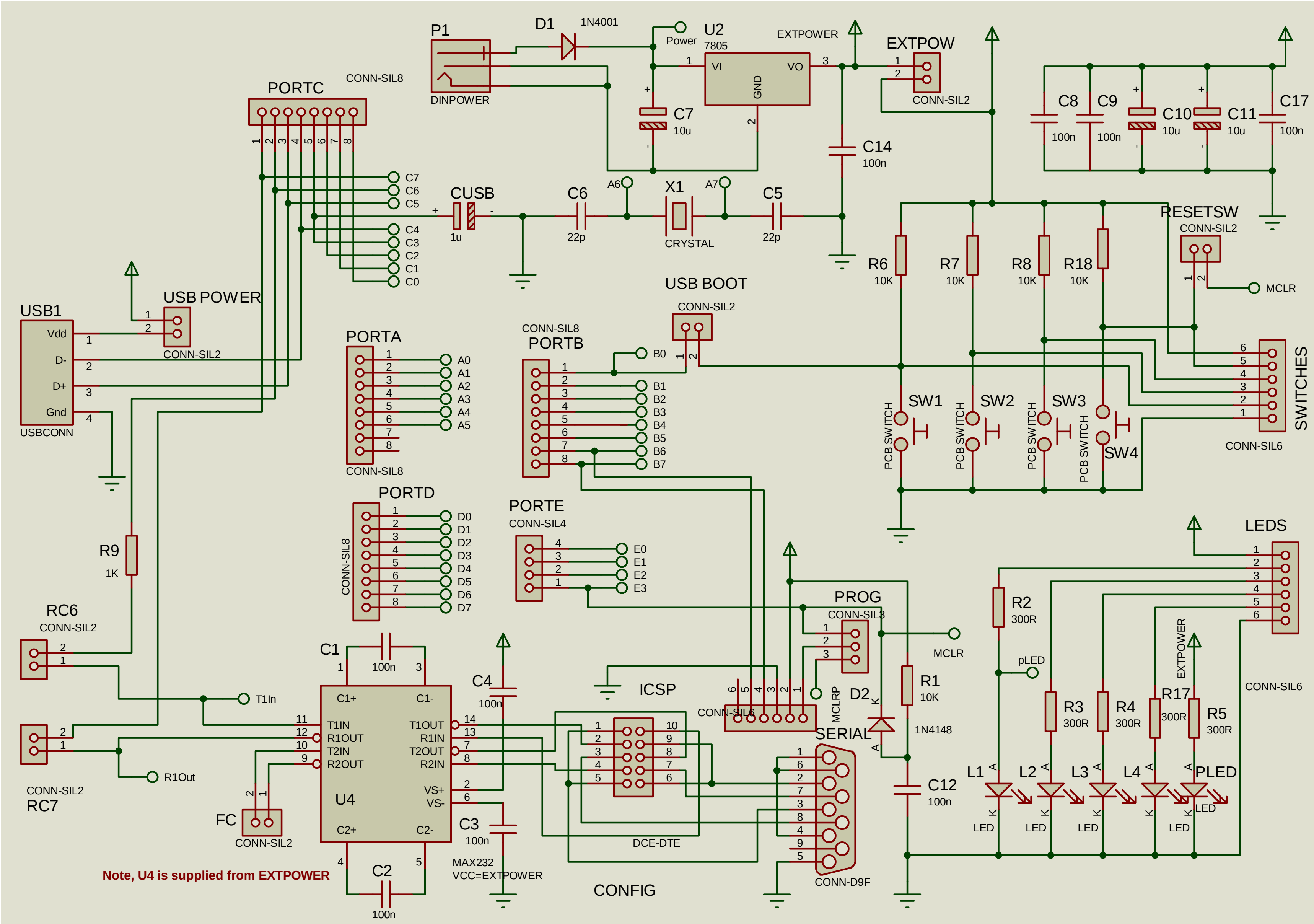
In this case the port connections are standard ICSP connections as follows :

Pin	Connection	Comment
1	MCLR	This is the Vpp input and should be connected to the MCLR / Vpp pin of the application PIC.
2	Vdd *	This pin is connected to 5V and may be used to power the application. If the application is self powered then this pin may be left unconnected.
3	Gnd	Connect to the application circuit, ground connection.
4	Program Data**	Connected to the PGD pin - RB7 normally
5	Program Clock**	Connect to the PGC pin – RB6 normally.
6	Not Used	Not used

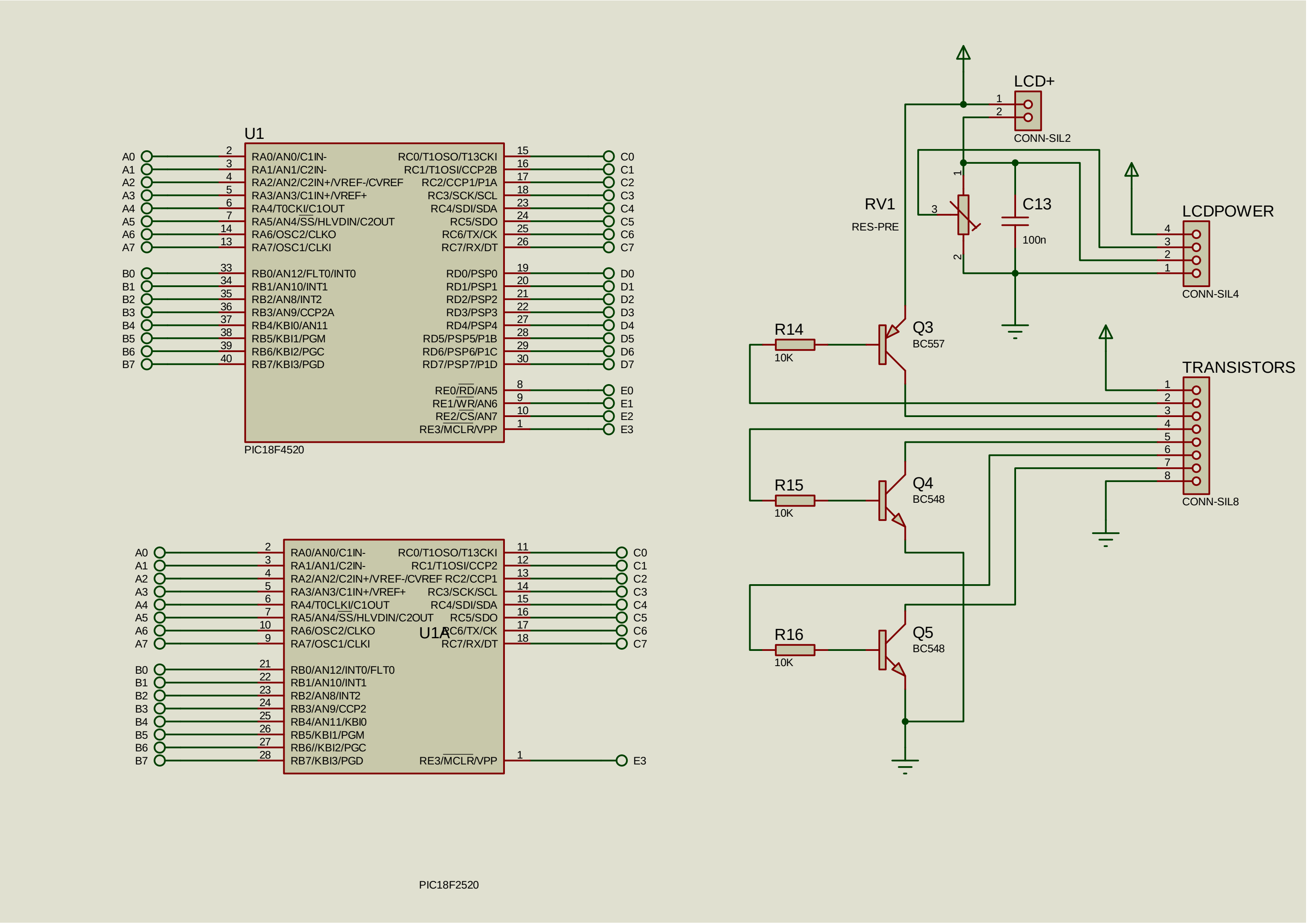
The PROG link should be connected so that the jumper connects the lower two pins on the connector.

Appendix A

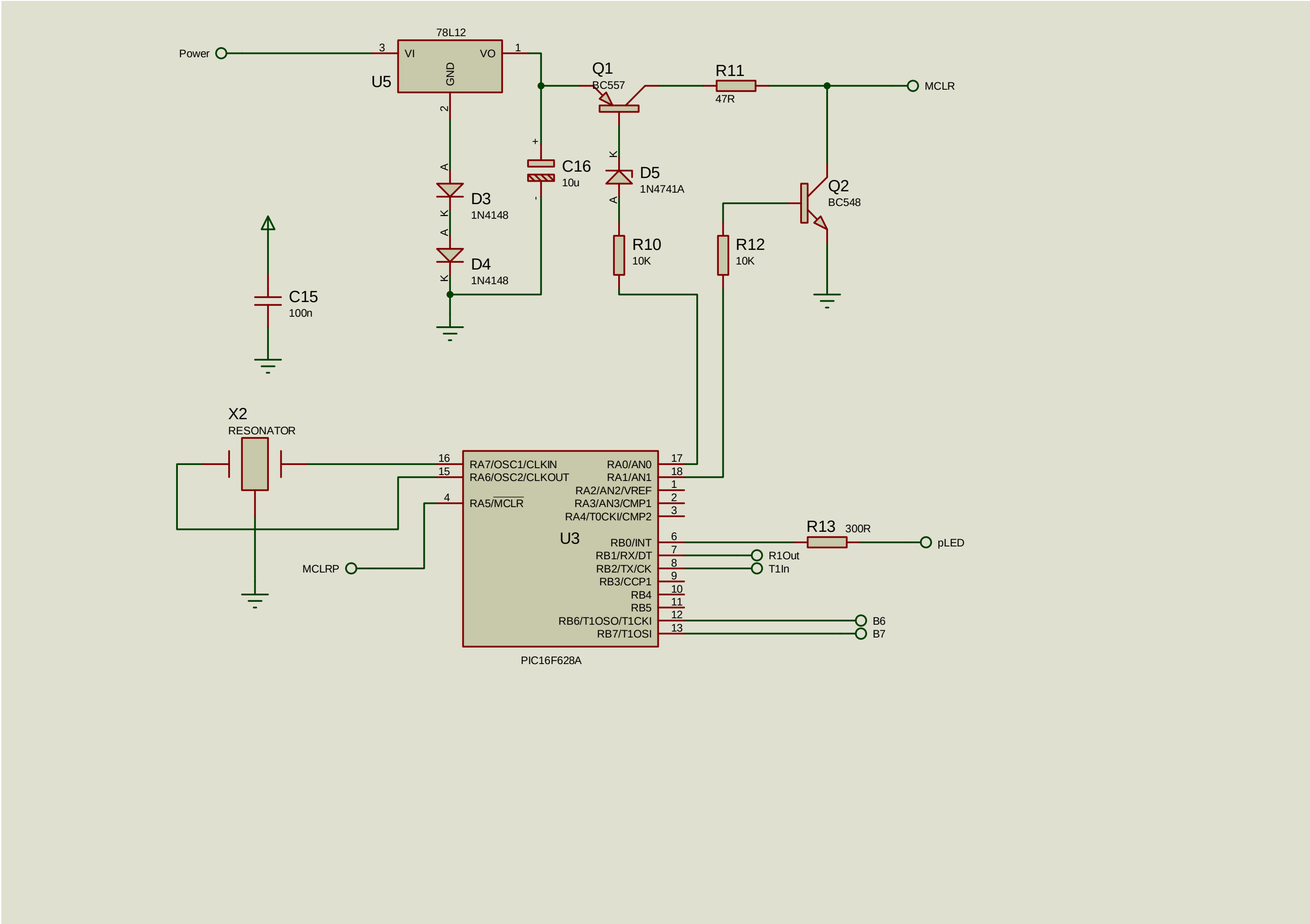
Circuit Diagrams



PIC Flex 28/40 pin Development Board – Sheet 1 – Power and peripheral components



PIC Flex 28/40 pin Development Board – Sheet 2 – PIC, LCD and transistor circuits



PIC Flex On board serial programmer - option