VERSION 1

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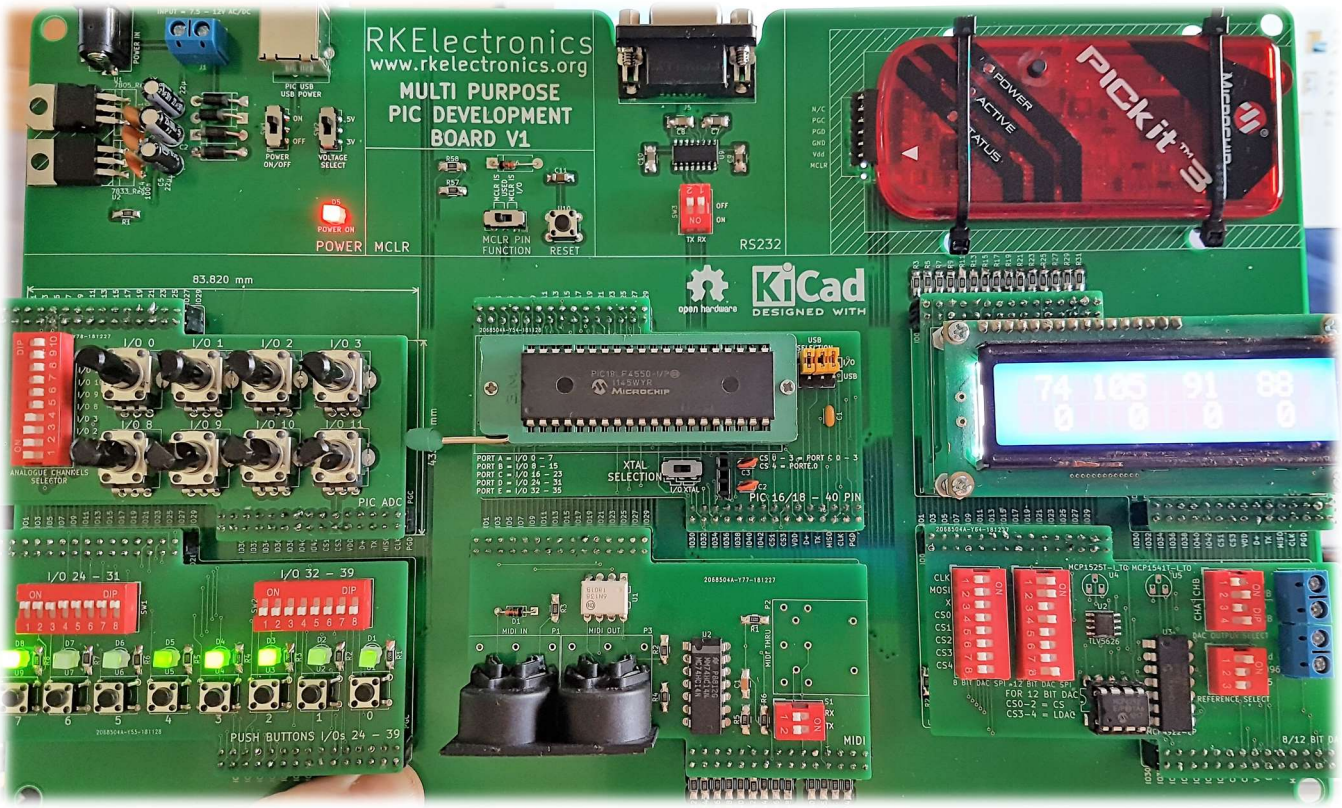

PIC MICROCONTROLLER DEVELOPMENT BOARD

PROJECT MANUAL DOC REF: RKD2

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PREFACE

First of all thank you for downloading this project, I hope that you find it useful, educational or just a good read. Like most of my projects, they are designed and written such that most hobbyist electronics enthusiasts can build the designs using common components and materials.

Where best possible, low cost, easily obtainable components are used within the design. Drawings of electrical schematics, circuit board art work and component placement diagrams are provided with this report.

For more information, please visit my website at;

www.rkelectronics.org

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DESIGN BRIEF

This project is for the design and use of a PIC development tool which is flexible to suit a wide range of PIC based electronic projects.

It is often easier to develop microcontroller projects with the use of development tools; which allow user based code to be demonstrated in real time. However, from personal experience, a number of existing development boards can often suffer from one or multiple of the following limitations;

1. Comprehensive designs are often expensive,
2. Carry very little peripherals,
3. Contain peripherals which are not suited to specific projects and therefore are rarely used,
4. Contain peripherals which occupy a large amount of board space thus adding to the cost,
5. Are unable to be changed or support a change in peripherals,
6. Contain a surface mount processor which cannot be removed and thus limiting the use case of the development board.

In reality, the user often choses a development board based on the requirements of the project, however, this can lead to a mounting collection of development boards or restrict the freedom of the design.

The PIC development board design presented here aims to expand on these limitations. The development system makes use of a two PCB board design principle.

The first PCB is a main back plane board which hosts the power supply, MCLR reset circuit, RS232 and PICKIT programmer pin-header. This board serves as an interconnecting board which holds up to six daughter boards.

The second PCB board type is the daughter board component. A standardised PCB design and footprint is used to create a PCB board design which can be added and removed from the main board as desired. The purpose of the daughter board is host either a microcontroller or peripheral circuit for example, a Digital to Analogue Converter (DAC). The design intent is to create daughter boards as required. This project therefore is ongoing.

As part of this project I have designed a number of basic daughter board designs that are available for Gerber / Project file download. For details regarding specific daughter boards please see project document: PIC Controller Development Board – Daughter Board Catalogue, document ref: RKD3, made available with this document location or via my website at

www.rkelectronics.org/PIC_Develoment_Board_Version1

The daughter boards connect to the main board via two 2 x 30 2.54mm pitch pin headers. This allows daughter boards to be created either via a PCB fabrication house or by hand using Vero board.

The purpose of this development board is to address some of the above mentioned limitations by employing the following design specifications;

1. The main board serving as a back plane to interconnect a series of daughter boards, which can feature either a microcontroller or peripheral and thus creating flexibility in design,
2. Use a standardised design of daughter board for easy development of new peripherals or microcontroller types,
3. Allow interconnectivity of daughter boards such that they can be connected together using the common main board back plane or be interconnected together vertically,
4. Only a minimum amount of PCB daughter boards required to create a project,
5. All boards and footprint libraries are made available as open source hardware designs to enable flexibility to make design changes.

Supplied with this project pack is the KiCAD footprint and symbol library files. This will allow you to import the daughter boards into your KiCAD package for personal development of your own daughter board designs. Unfortunately I have not created source files for other CAD packages.

All designs and supplied material here is OPEN SOURCE.

Figure 1 – Two Daughter Board Examples

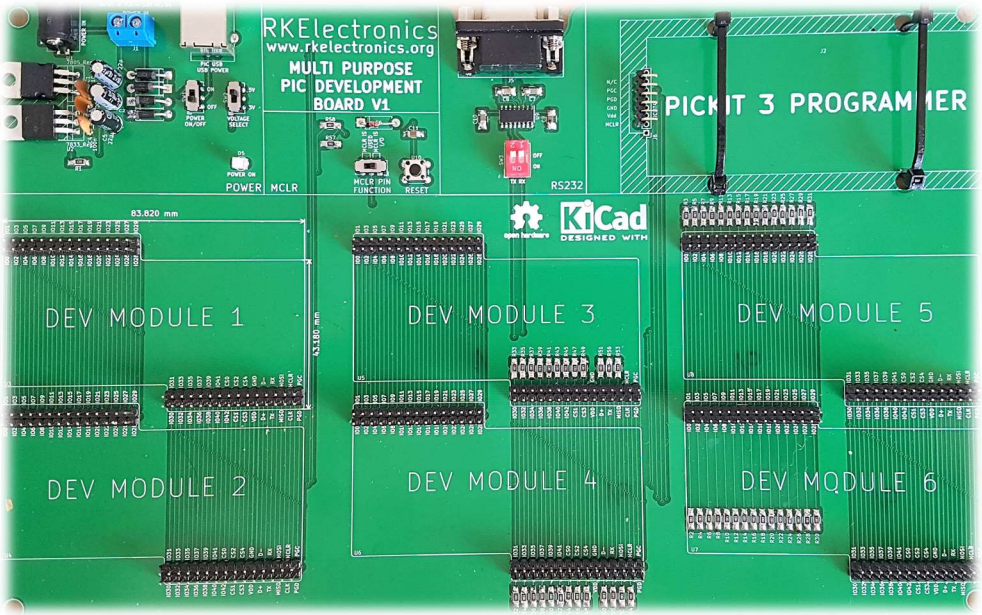


Figure 2 – Main Board of the PIC Microcontroller Development Board

This development in itself is not free from limitations! With any development board design there are always inherent design limits. At time of writing the following limitations are known with this development board design;

1. Need a new processor type, then you need to build or design another daughter board, this can lead to increased cost and storage of multiple daughter board designs,
2. Daughter board size can be limiting,
3. Requires the manufacture of a large back plane board,
4. Depending on the number of daughter boards needed is not necessarily cheaper than other development boards on the market,
5. Both the main and daughter boards are not available for sale (sorry) and require either making by hand or via a PCB fabrication house.
6. Supports primarily Serial Peripheral Interface (SPI) communication.

It is worthwhile to note, that at time of writing the cost to manufacture PCBs can be very cost effective. An example comparison website for PCB manufacturing sources is PCBShopper.

ASSUMPTIONS

This project assumes that you have basic knowledge of electronics. This report also assumes that you have some experience with using PIC microcontrollers.

SAFETY

Please note that I do not take any responsibility for any loss, damage or harm caused by the building of this project. This project book comes 'as is'. I have built this project and can confirm it works, and to the best of my ability is safe to use.

PROJECT REQUIREMENTS

Table 1 – Project Requirements

No.	Description
1	The development system will allow a power source to be used from a variety of sources including USB power, barrel jack and terminal block connections. The input voltage range will be 9 – 12 V AC or DC. USB power will utilise 5V.
2	The development system will support both 5V and 3V devices.
3	The development system shall support programming via a PICKIT 3 or 4 and provide suitable connections for this.
4	The development system will provide a Master Clear reset circuitry to support the MCLR function.
5	The development system will include a RS232 circuit.
6	The development system will include removable interconnected daughter boards for supporting multiple peripherals or microcontrollers.
7	Peripherals shall utilise a standard easy to use interconnect method i.e. pin-headers.
8	Main board will include pull down resistors.
9	Design will utilise a system which allows flexible development.

PRICIPLE OF OPERATION

HOW TO USE

1. Connect the required daughter boards to the main board, include only ONE microcontroller board,
2. Connect the PICKIT 3 or 4 into the PICKIT pin header,
3. Connect up a power supply to the board,
4. Select the correct MCLR setting, which is either MCLR pin is I/O or MCLR pin is MCLR,
5. Select the correct voltage, either 5V or 3.3V,
6. Power on the main board.

It is recommended that the MCLR reset circuit is disconnected during programming, this is achieved by moving the MCLR selection switch to the I/O position.

KEY COMPONENTS OF THE MAIN BOARD

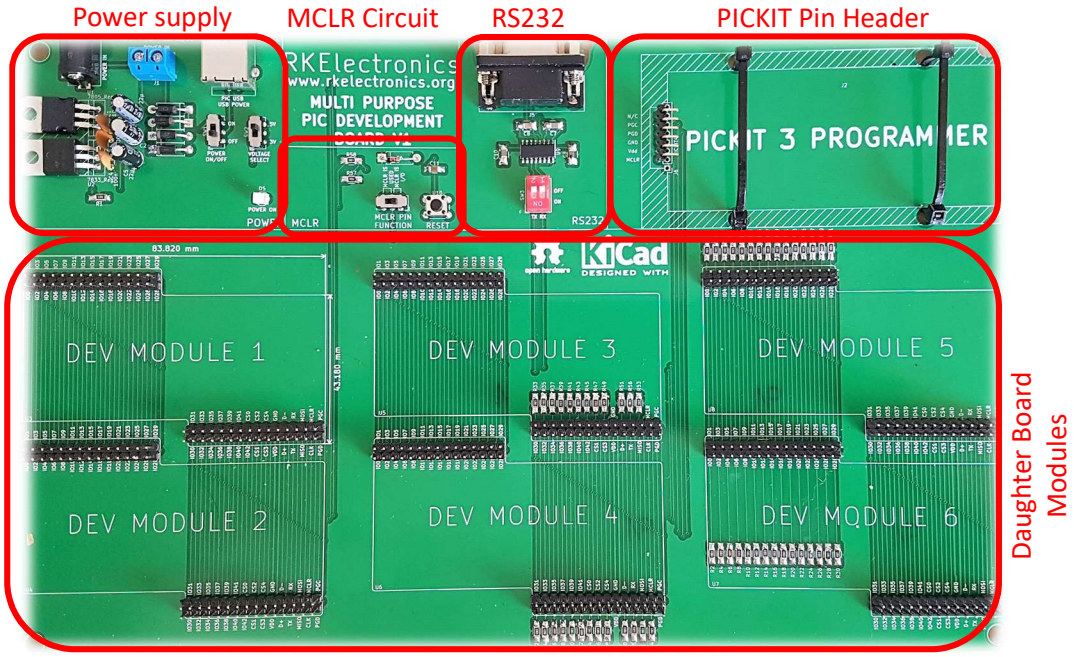


Figure 3 – Main Board Features

BOARD INTERCONNECT DETAILS

The main board and daughter board interconnect include the following busses;

1. 43 dedicated I/O lines for either analogue or digital,
2. VDD and GND power supply,
3. 5 dedicated SPI Chip Select (CS) lines,
4. SPI Buss for MOSI, MISO and CLK lines,
5. I^2C shared as part of the SPI buss,
6. Dedicated TX and RX lines for RS232, RS485 and MIDI,
7. Dedicated D+ and D- lines for USB data,
8. Dedicated PIC programming lines, MCLR, PGD and PGC.

Due to the nature of SPI chip select lines, these lines are shared with various I/O lines. The sharing of which I/O line depends on the microcontroller daughter board used. It is intended that the connection of the CS lines to the microcontroller will be done on the daughter board. For example, for the PIC16/18 40 Pin USB daughter board for PIC18F4550 the CS lines share I/O pins 16, 17, 18, 19 and 32, which equates to PIC pins Port C0, C1, C2, C3 and E0. For this reason it is required for all peripheral boards using SPI to include a switch or breaker method to disconnect unused or other utilised CS lines.

Due to the nature of the RS232 TX and RX and USB D+ and D- lines, these lines are also shared with various other I/O lines. For this reason it is required for all peripheral boards using RS232, RS485 or USB to include a switch or breaker method to disconnect unused or other utilised TX, RX, D+ and D- lines.

The I/O lines are routed to various microcontroller pins, which pins are detailed within the daughter board schematic or the PCB silkscreen. Usually ports are routed to;

1. Port A = I/O lines 0 – 7,
2. Port B = I/O lines 8 – 15,
3. Port C = I/O lines 16 – 23,
4. Port D = I/O lines 24 – 31,
5. Port E = I/O lines 32 – 35,

Other PIC types such as dsPIC30/33 and 24 series will use different wiring arrangements.

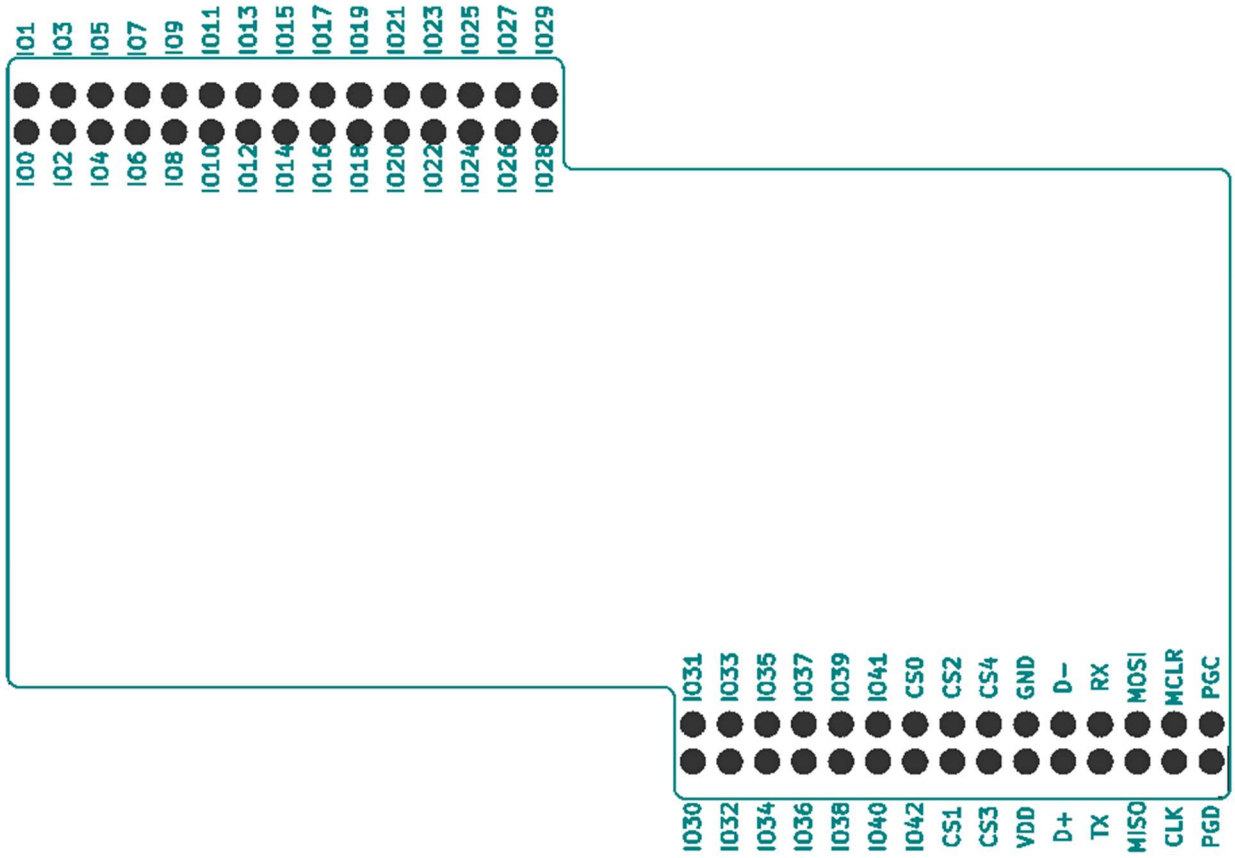


Figure 4 – Daughter Board Pinout

PRINTED CIRCUIT BOARD

GENERAL ARRANGEMENT (MAIN BOARD)

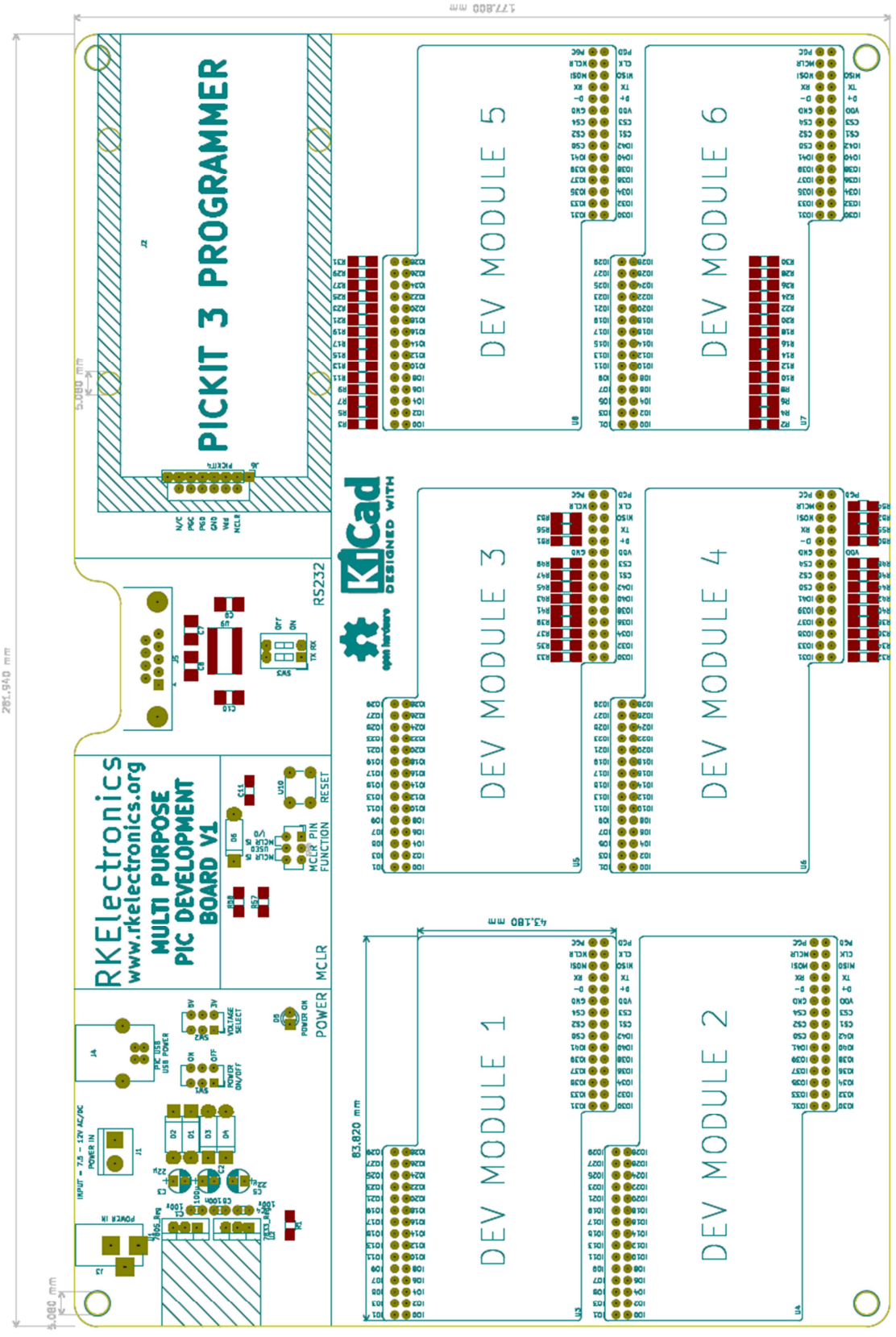


Figure 5 – Main Board General Arrangement Drawing

GENERAL ARRANGEMENT (DAUGHTER BOARD)

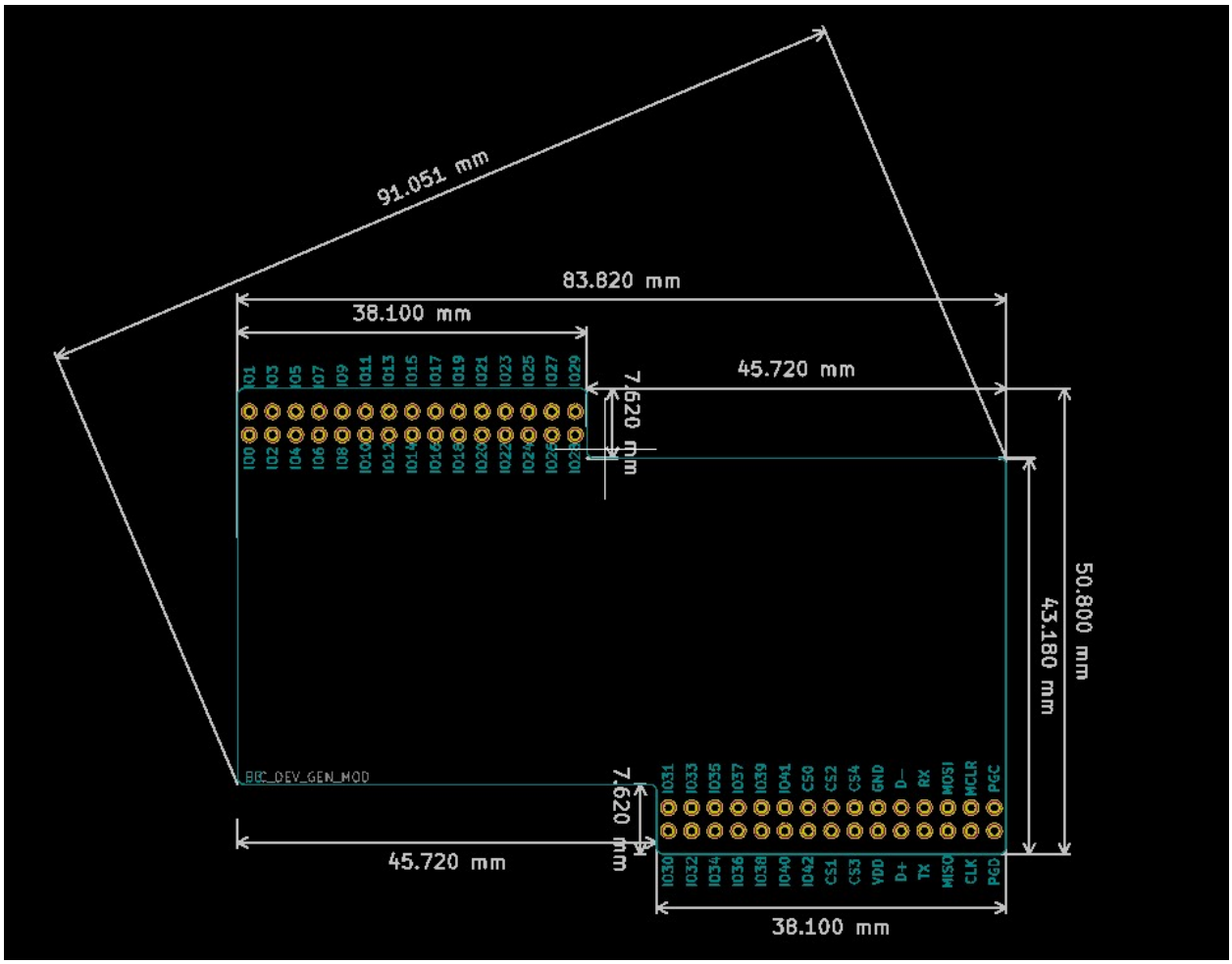
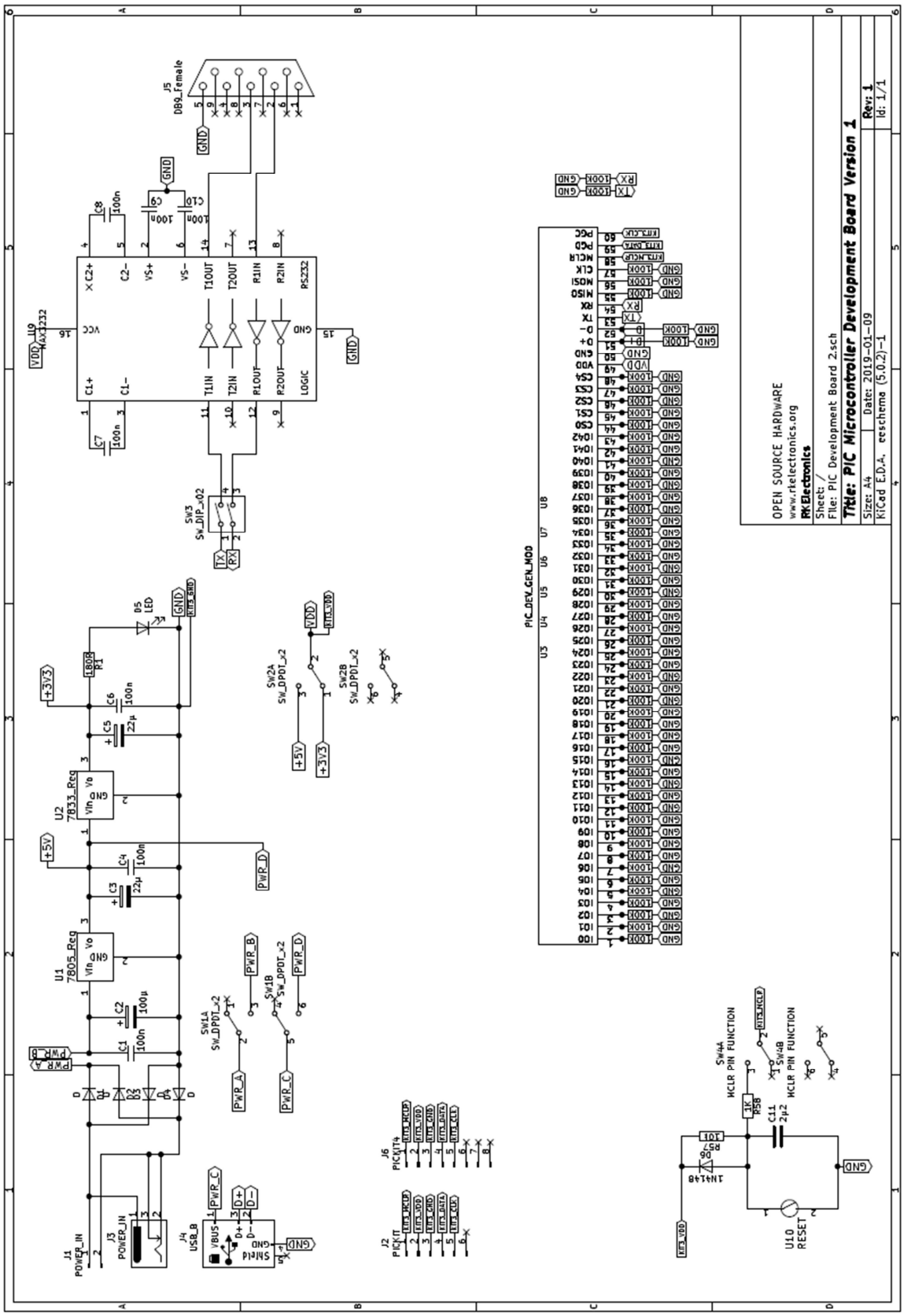


Figure 6 – Daughter Board General Arrangement Drawing

SCHEMATIC DIAGRAM



BILL OF MATERIALS

Table 2 – Schematic References

U3	PIC_DEV_GEN_MOD	SW3	SW_DIP_x02	R19	100K	R44	100K
U4	PIC_DEV_GEN_MOD	D5	LED	R20	100K	R45	100K
U5	PIC_DEV_GEN_MOD	J1	POWER_IN	R21	100K	R46	100K
U6	PIC_DEV_GEN_MOD	J3	POWER_IN	R22	100K	R47	100K
U7	PIC_DEV_GEN_MOD	J4	USB_B	R23	100K	R48	100K
U8	PIC_DEV_GEN_MOD	SW1	SW_DPDT_x2	R24	100K	R49	100K
D1	D	SW2	SW_DPDT_x2	R25	100K	R50	100K
D2	D	J2	PICKIT	R26	100K	R51	100K
D3	D	R2	100K	R27	100K	R52	100K
D4	D	R3	100K	R28	100K	R53	100K
C1	100n	R4	100K	R29	100K	R54	100K
C2	100µ	R5	100K	R30	100K	R55	100K
U1	7805_Reg	R6	100K	R31	100K	R56	100K
C3	22µ	R7	100K	R32	100K	SW4	MCLR PIN FUNCTION
C4	100n	R8	100K	R33	100K	R58	1K
U2	7833_Reg	R9	100K	R34	100K	D6	1N4148
C5	22µ	R10	100K	R35	100K	U10	RESET
C6	100n	R11	100K	R36	100K	C11	2µ2
R1	180R	R12	100K	R37	100K	R57	10k
C7	100n	R13	100K	R38	100K	J6	PICKIT4
C8	100n	R14	100K	R39	100K		
C9	100n	R15	100K	R40	100K		
C10	100n	R16	100K	R41	100K		
U9	MAX3232	R17	100K	R42	100K		
J5	DB9_Female	R18	100K	R43	100K		

Table 3 – Bill of Materials

QTY	Value	Description
4	1N4007	Rectifier Diode
6	100nF	1206 Capacitor
1	100µF	Capacitor
2	22µF	Capacitor
1	2.2µF	Capacitor
1	7805	5v regulator
1	7833	3v3 regulator
1	MAX3232	RS232 transceiver IC
1	DB9 Female	DB9 Connector
1	SW_DIP_x02	Switch
3	SW_DPDT_x2	DPDT slide switch
1	Barrel Jack	Barrel Jack
1	LED	
1	USB Type B	USB Connector
1	1N4148	Small Signal Diode
1	Tactile Push	Tactile push button
1	1k	1206 resistor
1	10k	1206 resistor
55	100k	1206 resistor