Building RoboPIC 18F4550

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RoboPIC 18F4550 build manual v0.90



The most up to date documentation will always be available at: http://www.mikronauts.com/robot-controllers/robopic-18f4550/

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Introduction

RoboPIC 18F4550 USB Robot Controller and Development Board was designed for STEM courses in Electronics, Robotics, Ricrocontrollers and Data Acquisition.

The low cost kit is easy to assemble in electronics or physics classes, and the pre-loaded USB bootloader and free development tools significantly reduce the barrier to entry for schools.

Features

- Microchip PIC18F4550 USB microcontroller
- Pre-loaded with USB bootloader so you don't need a programmer
- Mikronauts tests USB and each I/O of the PIC chip before shipping
- large bussed prototyping area for your experiments
- four 10-pin Mikronauts I/O module expansion connectors
- 32 servo compatible headers (30 available for user applications)
- eight servo headers can be externally powered
- RoboPIC can be USB or externally powered
- up to 13 channels of ten bit 0-5V analog input
- Power LED
- User LED on RA4
- Reset button
- 4 pin 5V I2C header
- 5 pin HCOM header
- 6 pin Microchip ICSP header
- Power selection jumper for EXP2 Servo header (Vcc or Vext)
- Power selection jumper for board's Vcc (Vusb or Vext)
- Mounting holes match all Mikronauts prototyping boards
- Mounting holes match Paralax Boe-Bot
- Mounts easily on Magician 2WD and 4WD chassis

Kit Contents



Parts List

Qty	<u>PCB</u>	<u>Part</u>
1		RoboPIC 18F4550 PCB
1	IC1	PIC18F4550
1	Q1	20MHz crystal
1	IC1	DIP40 socket
4	S1, S2, S3, S4	3x8M Servo header
4	EXP-1/2/3/4	1x10F header
2	SERVOPWR, PIC-PWR	1x3M header
1	ICSP	1x6M 90' ICSP header
1	SERIAL	1x5M serial header
1	12C	1x4M I2C header
1	SV2	2x3M header
4		2 pin shunt
1	EXT5VDC	2 screw 0.2" Wago header
2	C1, C2	22pf ceramic capacitor
1	C3	100nf or 220nF ceramic cap
2	C6, C7	100nF ceramic capacitor
2	C4, C5	33uF electrolytic capacitor
2	R2, R3	470 ohm resistor
3	R1, R6, R7	10k ohm resistor
1	R5	2k4 resistor
1	R4	4k7resistor
1	POWER	Red LED
1	RA4LED	Green LED
1	RESET	Tactile Switch
1	USB	USB-B connector

RoboPIC 18F4550 Printed Circuit Board

Here is a top view of where parts are located on the RoboPIC printed circuit board:



RoboPIC 18F4550

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You can refer to this image while building your board, as installing the parts will cover some of the silk screened text indicating where the parts should be mounted.

Please see the **RoboPIC 18F4550 User Manual** for user and programming instructions.

RoboPIC 18F4550 PCB Specifications

- ROHS and Lead Free
- FR4 ENIG 1-oz copper
- 101mm * 79mm
- mounting holes matching those on Mikronauts and Parallax 3"x4" boards

RoboPIC 18F4550 Schematic



General Guidelines

- You should assemble RoboPIC in the order of shortest part to tallest part
- Use a clean soldering iron with a good tip
- after you have assembled the board, make sure that
 - \circ $\,$ there is no short between 5V and GND $\,$
 - $^\circ$ $\,$ there is no short between 3.3V and GND $\,$
 - \circ $\;$ there is no short between 5V and 3.3V $\;$

Assembling RoboPIC 18F4550

I find it easiest to build RoboPIC by installing and soldering the components in the sequence below:

STEP 1:

Q120MHz crystalC1, C222pf ceramic capacitorC3100nf or 220nF ceramic capacitor



STEP 2:

IC1	DIP40 socket
ICSP	1x6M 90' ICSP header



RoboPIC 18F4550

STEP 3:

C6, C7	100nF ceramic capacitor
R2, R3	470 ohm resistor
R1, R6, R7	10k ohm resistor
R5	2k4 resistor
R4	4k7resistor
C4, C5	33uF electrolytic capacitor



STEP 4:

S1,S2,S3,S4 3x8M Servo headers



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STEP 5:

SERIAL1x5M serial headerSV22x3M headerI2C1x4M I2C headerSERVOPWR, PIC-PWR1x3M headers

if you cover the top of the board with cardboard it is easier to flip it over for soldering

if you solder one central on the 1x4 and 1x5 headers first, you can make sure they are straight before soldering the rest.

STEP 6:

EXP-1/2/3/4	1x10F header
POWER	Red LED (bent leg)
RA4LED	Green LED

if you solder one central on the 1x10F headers first, you can make sure they are straight before soldering the rest.



STEP 7:

RESET	Tactile Switch
USB	USB-B connector
EXT5VDC	2 screw 0.2" Wago header



RoboPIC 18F4550

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STEP 8:

IC1	PIC18F4550 careful do not bend pins! Observe anti-static precautions.
Shunts	Set both jumpers for USB position. Above "EXT" left of USB connector.
Tip:	Straighten the PIC18F4550's pins by pressing on a desk before inserting it



Testing RoboPIC

If you have a multi-meter, check for shorts between 5V/GND - don't worry about a high resistance (capacitors) but anything less than say 4k may indicate a problem.

Also check for a short between Pin 1 & Pin 4 of the two I2C connectors, as any short at the voltage regulation would show up there.

As you can see I built a test rig allowing me to check each I/O pin.

Here is a photo of the RoboPIC assembled for the purpose of taking photographs for this manual running the I/O test:





Programming RoboPIC

Using a PicKit 3 programmer you can use any programming language that supports the PIC18F4550 microcontroller to program RoboPIC.

If you don't have an ISP programmer, don't worry – RoboPIC 18F4550 comes pre-loaded with a USB boot loader compatible with Pinguino, and by modifying linker scripts, also compatible with SDCC and MPLAB-X.

If you are new to microcontrollers, using the Pinguino IDE is the easiest way of getting your feet wet.

There are plenty of examples on the Wiki, and the Pinguino libraries have a lot of very useful functions.

RoboPIC I/O pin definitions

Here is a pin map for RoboPIC, including what pins are used for the user LED and analog inputs.

EXP-1	Used for Pinguino analog inputs
RA0	AN0
RA1	AN1
RA2	AN2
RA3	AN3
RA5	AN4
RE0	AN5
RE1	AN6
RE2	AN7
EXP-2	Use for servo motors
RA4	LED
RC0	
RC1	
RC2	
RD0	
RD1	
RD2	
RD3	
FXP-3	Use for digital I/O
EXP-3 RD7	Use for digital I/O
EXP-3 RD7 RD6	Use for digital I/O ICSP ICSP
EXP-3 RD7 RD6 RD5	Use for digital I/O ICSP ICSP
EXP-3 RD7 RD6 RD5 RD4	Use for digital I/O ICSP ICSP
EXP-3 RD7 RD6 RD5 RD4 RC7	Use for digital I/O ICSP ICSP
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6	Use for digital I/O ICSP ICSP RXD
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5	Use for digital I/O ICSP ICSP RXD TXD USB D+
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D-
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D-
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USE for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USB for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USB for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6 RB5	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USB for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6 RB5 RB4	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USE for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6 RB5 RB4 RB3	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USE for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6 RB5 RB4 RB5 RB4 RB3 RB2	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- USE for digital I/O
EXP-3 RD7 RD6 RD5 RD4 RC7 RC6 RC5 RC4 EXP-4 RB7 RB6 RB5 RB4 RB3 RB2 RB1	Use for digital I/O ICSP ICSP RXD TXD USB D+ USB D- Use for digital I/O

For details of the I/O pins, please see the PIC18F4550 data sheet.

RoboPIC Software Compatibility

To develop software for RoboPIC 18F4550 you will need a computer or laptop that can run one of the development environments below:

- Microchip MPLABX with Pickit 2&3
- SDCC compiler with any compatible PIC programmer
- Pinguino with the pre-loaded bootloader
- any other PIC18F4550 compatible development tool

SDCC, Pinguino IDE are free, and there is a free version of MPLABX+C8, and are available for PC's running Windows, OS/X and Linux.

The Pinguino libraries include Arduino-like servo, PWM and other libraries, or you can roll your own using MPLABX or SDCC.

NOTE:

RoboPIC 18F4550 works with ANY computer or SBC that support USB CDC using the boot loader.

If you do not wish to use the bootloader pre-loaded into the PIC18F4550, you will need a hardware ICSP programmer.

Pinguino Web Site links:

main site	www.pinguino.cc	downloads, blog, links to wiki & forums
wiki	wiki.pinguino.cc	documentation, examples
forums	forum.pinguino.cc	support for IDE, libraries

Appendix A: Required Tools

- 25W-40W fine tip soldering iron or temperature controlled soldering station
- wire snippers
- phillips screw driver
- pliers

Appendix B: Software

Pinguino IDE v11

http://www.pinguino.cc/download.php

Microchip MPLABX

http://microchip.wikidot.com/tools:what-do-i-need

SDCC compiler

http://sdcc.sourceforge.net/

Appendix C: Data Sheets

PIC18F4550 http://ww1.microchip.com/downloads/en/DeviceDoc/39632e.pdf

Appendix D: Support

For RoboPIC 18F4550 supportforums.mikronauts.comFor Pinguino supportforum.pinguino.ccFor MPLAB-X support, please seewww.microchip.com/forumsFor SDCC support, please seesourceforge.net/p/sdcc/discussion/

Initial Release

Appendix E: Frequently Asked Questions

Q: Where can we buy RoboPIC?

A: Currently you can buy RoboPIC:

Directly from us: Please email us at **mikronauts@gmail.com** with desired quantity and postal address, we will be happy to send you a quote. We accept PayPal from verified buyers.

From our Ebay store: http://www.ebay.com/sch/mikronauts/m.html

From our Tindie store: https://www.tindie.com/stores/mikronauts/

Q: Are quantity and educational discounts available for RoboPIC?

A: Yes! We are happy to offer quantity based discounts to our educational users and distributors. Please contact us for a custom quote.

Q: Can we make our own RoboPIC printed circuit boards?

A: I am afraid not. While RoboPIC is an open platform in that it is fully documented, with source code available for its libraries and demo applications, RoboPIC is a commercial product, and may not be copied.

Q: Do you have any distributors in <name of country>?

A: We are working hard to set up our distribution network. Please email your favorite web stores and have them contact us if they are interested in RoboPIC.