

This is the Revision B version of the [Birod4 RoboBrick](#). The status of this project is that it has been [replaced](#) by the [BIROD5 RoboBrick](#).

# BIROD2 Robobrick (Revision B)

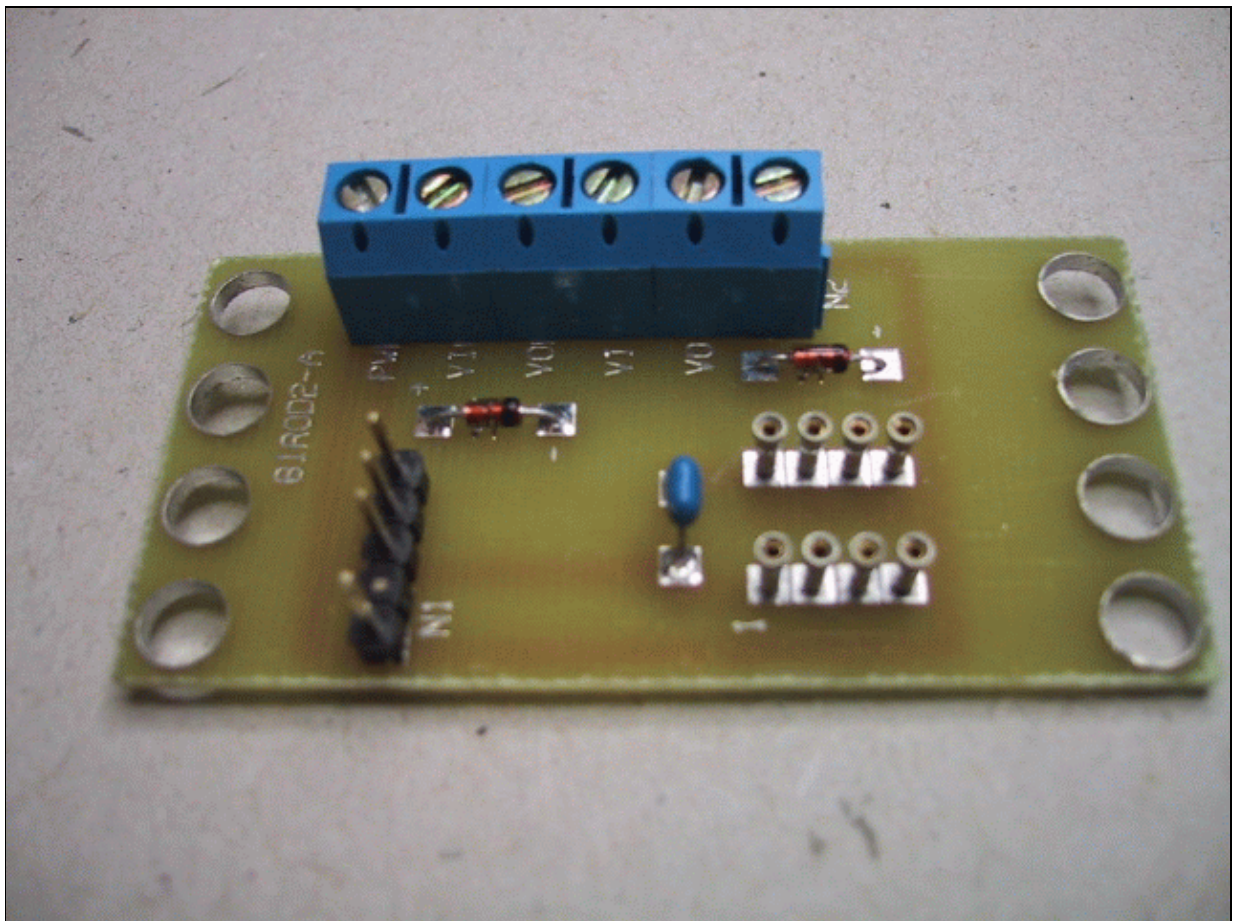
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## 1. Introduction

The BIROD2 RoboBrick is used to connect to up to 2 of the [Sharp](#)<sup>®</sup> GP2D05 IROD (InfraRed Optical Distance) measuring sensors. This version of the Sharp chip provides a single bit of information for when the sensor is within a fixed distance of an object.



## 2. Programming

The basic operation is to send a query to the BIROD2 RoboBrick to read the 2 bits of data. The programmer can download a complement mask to cause any of the bits to be complemented prior to reading.

There is an enable mask that allows the programmer to individually enable and disable one or the other IROD. In addition, there is an alternate bit which, when set, causes the IROD's to be alternately strobed. The alternate bit would be set if you are concerned that one sensor might interfere with another.

The BIROD2 RoboBrick supports [RoboBrick Interrupt Protocol](#). The interrupt pending bit is set whenever the formula:

$$L \& (\sim I) \mid H \& I \mid R \& (\sim P) \& I \mid F \& P \& (\sim I)$$

is non-zero, where:

- I is the current input bits XOR'ed with the complement mask (C)
- P is the previous value of I
- L is the low mask
- H is the high mask
- R is the raising mask
- F is the falling mask

and

- ~ is bit-wise complement
- | is bit-wise OR
- & is bit-wise AND

Once the interrupt pending bit is set, it must be explicitly cleared by the user.

The BIROD2 RoboBrick supports both the standard [shared commands](#) and the [shared interrupt commands](#) in addition to the following commands:

Command	Send/ Receive	Byte Value								Discussion
		7	6	5	4	3	2	1	0	
Read Inputs	Send	0	0	0	0	0	0	0	0	Return input values <i>ab</i> (after XOR'ing with complement mask)
	Receive	0	0	0	0	0	0	<i>a</i>	<i>b</i>	
Read Raw	Send	0	0	0	0	0	0	0	1	Return raw data <i>ab</i> (without XOR'ing with complement mask)
	Receive	0	0	0	0	0	0	<i>a</i>	<i>b</i>	
Read Alternate Bit	Send	0	0	0	0	0	0	1	0	Return alternate bit <i>a</i>
	Receive	0	0	0	0	0	0	0	<i>a</i>	
Read Enable Complement Mask	Send	0	0	0	0	0	0	1	1	Return enable mask <i>ee</i> and complement mask <i>cc</i>
	Receive	0	0	0	0	<i>e</i>	<i>e</i>	<i>c</i>	<i>c</i>	
Read High Low Mask	Send	0	0	0	0	0	1	0	0	Return high mask <i>hh</i> and low mask <i>ll</i>
	Receive	0	0	0	0	<i>h</i>	<i>h</i>	<i>l</i>	<i>l</i>	

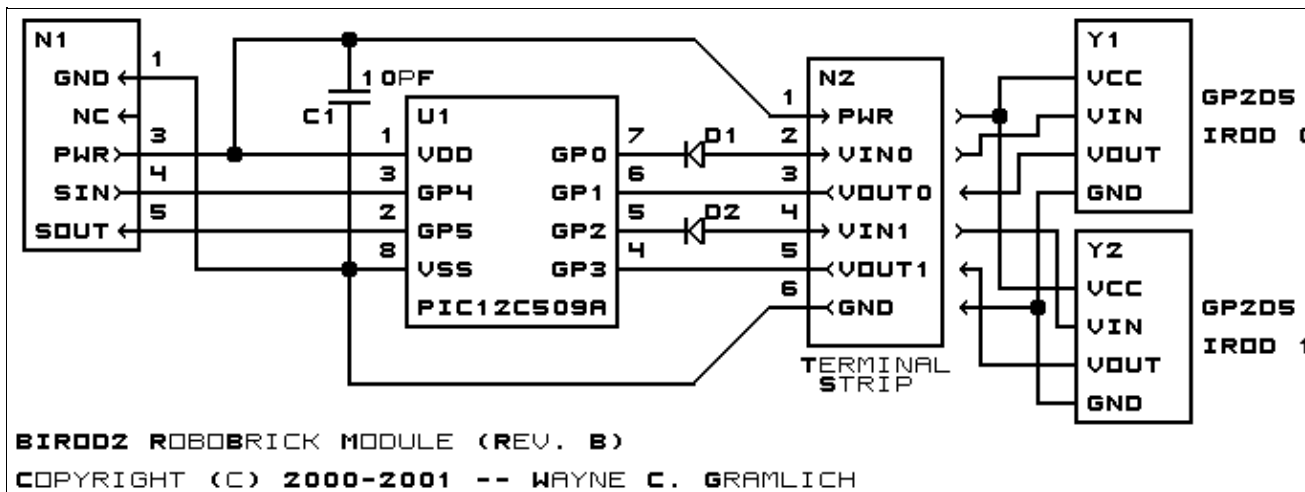
Read Raising Falling Mask	Send	0	0	0	0	0	1	0	1	Return raising mask <i>rr</i> and falling mask <i>ff</i>
	Receive	0	0	0	0	<i>r</i>	<i>r</i>	<i>f</i>	<i>f</i>	
Set Alternate Bit	Send	0	0	0	0	0	1	1	<i>a</i>	Set the alternate bit to <i>a</i> .
Set Enable Complement Mask	Send	0	0	0	1	<i>e</i>	<i>e</i>	<i>c</i>	<i>c</i>	Set enable mask to <i>ee</i> and complement mask to <i>cc</i> .
Set High Low Mask	Send	0	0	1	0	<i>h</i>	<i>h</i>	<i>l</i>	<i>l</i>	Set high mask to <i>hh</i> and low mask to <i>ll</i> .
Set Raising Falling Mask	Send	0	0	1	1	<i>r</i>	<i>r</i>	<i>f</i>	<i>f</i>	Set raising mask to <i>rr</i> and falling mask to <i>ff</i> .
Read Interrupt Bits	Send	1	1	1	0	1	1	1	1	Return the interrupt pending bit <i>p</i> and the interrupt enable bit <i>e</i> .
	Receive	0	0	0	0	0	0	<i>e</i>	<i>p</i>	
Set Interrupt Bit Commands	Send	1	1	1	1	0	<i>c</i>	<i>c</i>	<i>c</i>	Execute <a href="#">shared set interrupt command</a> <i>ccc</i> .
<a href="#">Shared Commands</a>	Send	1	1	1	1	1	<i>c</i>	<i>c</i>	<i>c</i>	Execute shared command <i>ccc</i> .

### 3. Hardware

The hardware consists of a circuit schematic and a printed circuit board.

#### 3.1 Circuit Schematic

The schematic for the Birod2 RoboBrick is shown below:



The parts list kept in a separate file -- [birod2.ptl](#).

The table below provides the color code for connecting Sharp® GP2D05's to the BIROD2 RoboBrick:

IROD Pin	Symbol	Wire Color	Connect To	RoboBrick Pin
1	V <sub>in</sub>	Green	VIN0 or VIN1	2 or 4
2	Ground	Black	GND	1
3	V <sub>out</sub>	Blue	VOUT0 or VOUT1	3 or 5
4	V <sub>cc</sub>	Red	PWR	6

## 3.2 Printed Circuit Board

The available printed circuit boards are listed below:

[birod2\\_back.png](#)

The solder side layer.

[birod2\\_front.png](#)

The component side layer.

[birod2\\_artwork.png](#)

The artwork layer.

[birod2.gbl](#)

The RS-274X "Gerber" back (solder side) layer.

[birod2.gtl](#)

The RS-274X "Gerber" top (component side) layer.

[birod2.gal](#)

The RS-274X "Gerber" artwork layer.

[birod2.drl](#)

The "Excellon" NC drill file.

[birod2.tol](#)

The "Excellon" NC drill rack file.

## 4. Software

The BIROD2 software is available as one of:

[birod2.ucl](#)

The  $\mu$ CL source file.

[birod2.asm](#)

The resulting human readable PIC assembly file.

[birod2.lst](#)

The resulting human readable PIC listing file.

[birod2.hex](#)

The resulting Intel<sup>®</sup> Hex file that can be fed into a PIC12C5xx programmer.

The BIROD2 test software is available as one of:

[birod2\\_test.ucl](#)

The  $\mu$ CL source file.

[birod2\\_test.asm](#)

The resulting human readable PIC assembly file.

[birod2\\_test.lst](#)

The resulting human readable PIC listing file.

[birod2\\_test.hex](#)

The resulting Intel<sup>®</sup> Hex file that can be fed into a PIC12C5xx programmer.

## 5. Issues

The following fabrication issues came up:

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- The holes in N1 are too large (size 3) and should be made smaller (size 2.)
- The label says BIROD2–A instead of BIROD2–B.
- Move the labeling of N2 to the left.
- Think about trying to build and BIROD3 or BIROD4 using a PIC16C505.
- Think about switching over to PIC16C505 and adding a couple of LED's that show the state of each sensor and a couple of LED's that indicate if they are on or not.

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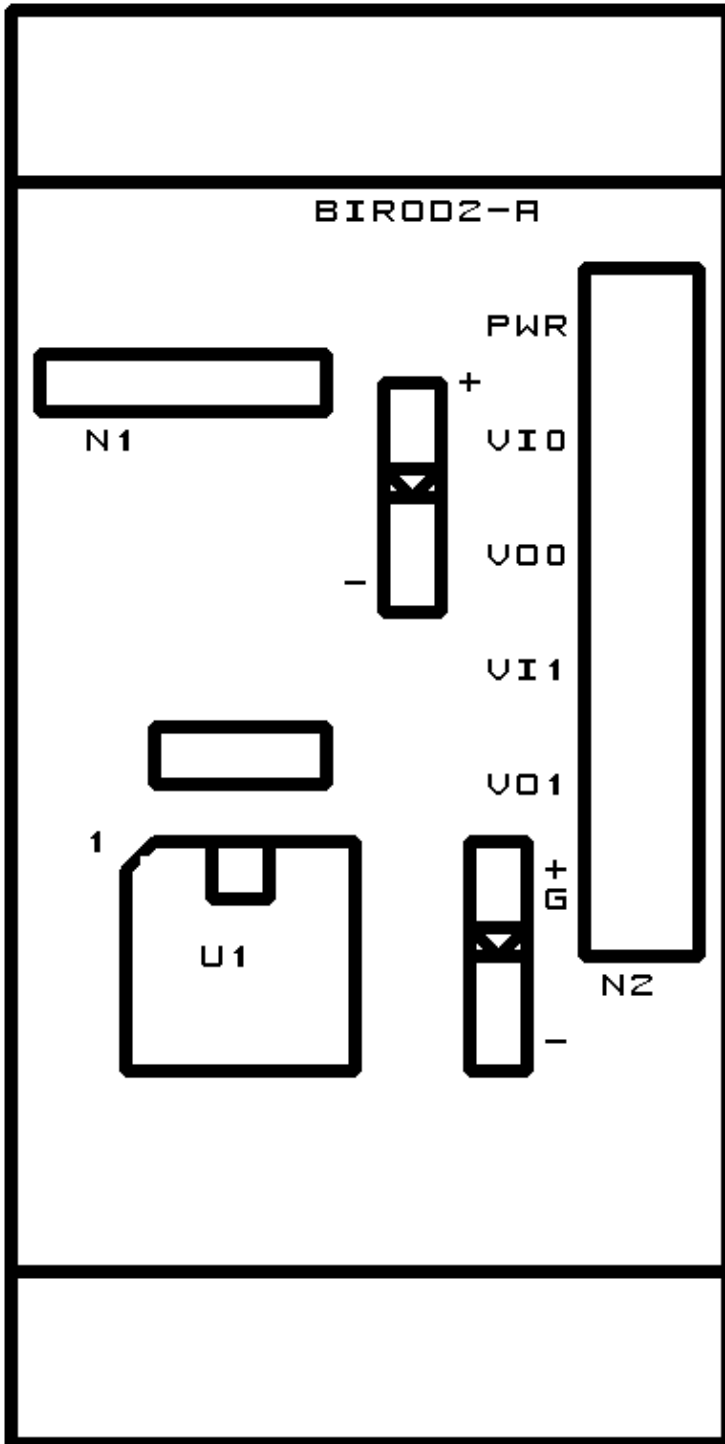
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## A. Appendix A: Parts List

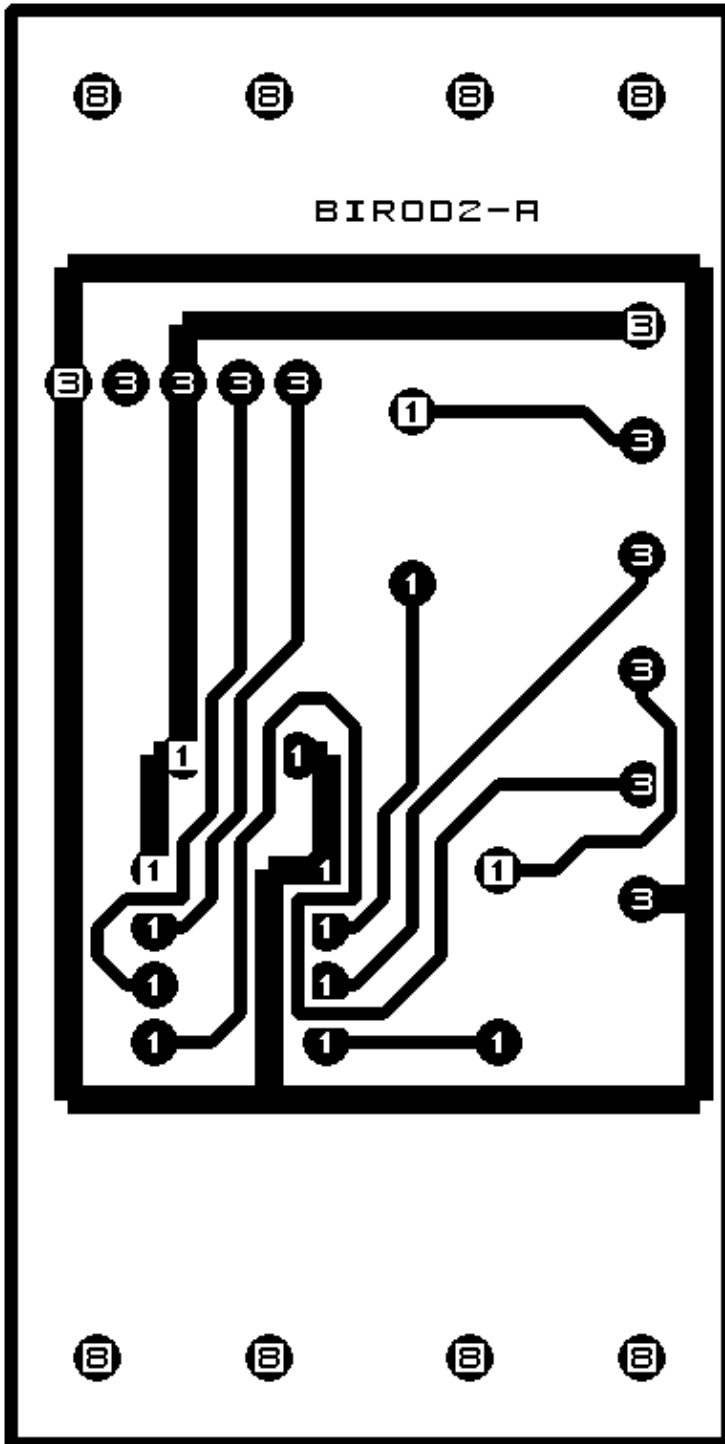
```
# Parts list for BIROD2 RoboBrick (Rev. B)
#
C1: Capacitor10pF - 10 pF Ceramic Capacitor [Jameco: 15333]
D1-2: 1N4148 - Small Signal Diode [Jameco: 36038]
N1: Header1x5.RBSlave - 1x5 Male Header [5/40 Jameco: 160881]
N2: TerminalStrip6.BIROD2 - 6 Junction Terminal Strip [2 Jameco: 189667]
U1: PIC12C509.BIROD2 - Microchip PIC12C509 [Digikey: PIC12C509A-04/P-ND]
```

## B. Appendix B: Artwork Layer





### C. Appendix C: Back (Solder Side) Layer



### D. Appendix D: Front (Component Side) Layer

