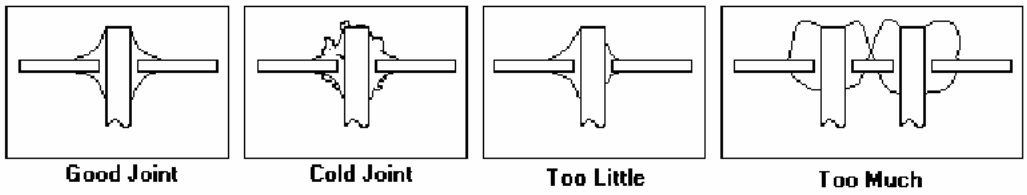
Tek-Bot Remote Control Transmitter Board Construction

Purpose

This tutorial illustrates the procedure for construction of the Transmitter board for the Tek-bot.

A Guide to Soldering

Many of you have soldered once or twice before but most likely very few of you have ever been instructed how to recognize 'good' soldering from 'bad' soldering. There are a few basic concepts involved in soldering that we will detail here, the first being that solder itself melts with heat. Well duh. Part of this simple concept though is the key to making a 'good' solder joint. A good solder joint will conduct electricity well and prevent the component from falling out. Since solder melts with heat we need to be sure that we give enough heat to the solder to get it to melt uniformly, not in clumps. A solder joint that was made without enough heat is called a 'cold joint' (See the figure below). Another problem can be if there is too much or too little solder used for the joint. If too little solder is used the joint will not be strong enough and will likely break. If too much is used there is a risk of a 'solder bridge' being formed (See figures below). An ideal joint should appear 'shiny' even after it cools and should look like the solder is stretched from the pad to the wire.



Pre-Project

Look over the parts list & circuit board and become familiar with the placement of all the components. Be sure to pay special attention to diodes and capacitors that have polarity markings. (*Components that can only go in one way*) Note that the foot prints show in **Fig. 1** will NOT be connected. These are for RF components that will not be part of this lab**. Fig. 2** Shows all the components laid out in the order of the parts lists. We will be placing them in a different order. You may want to print out the parts list or use two monitors if possible.

FIG 1

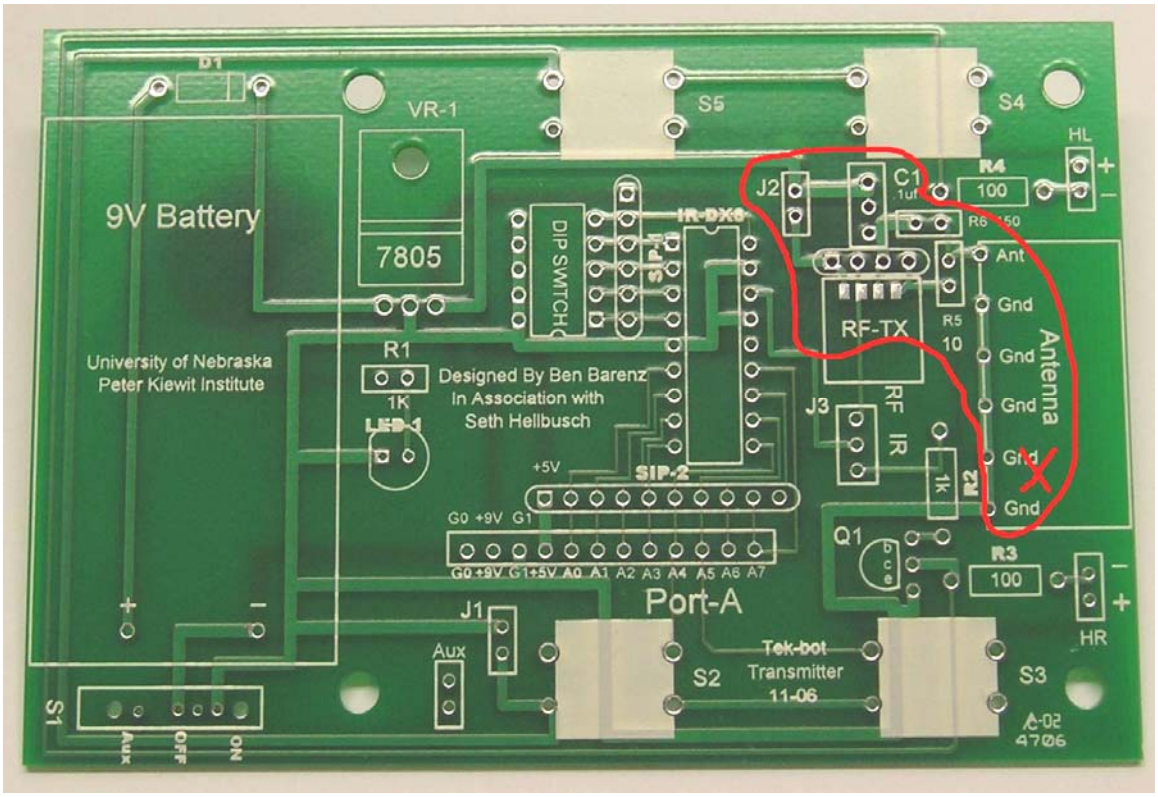
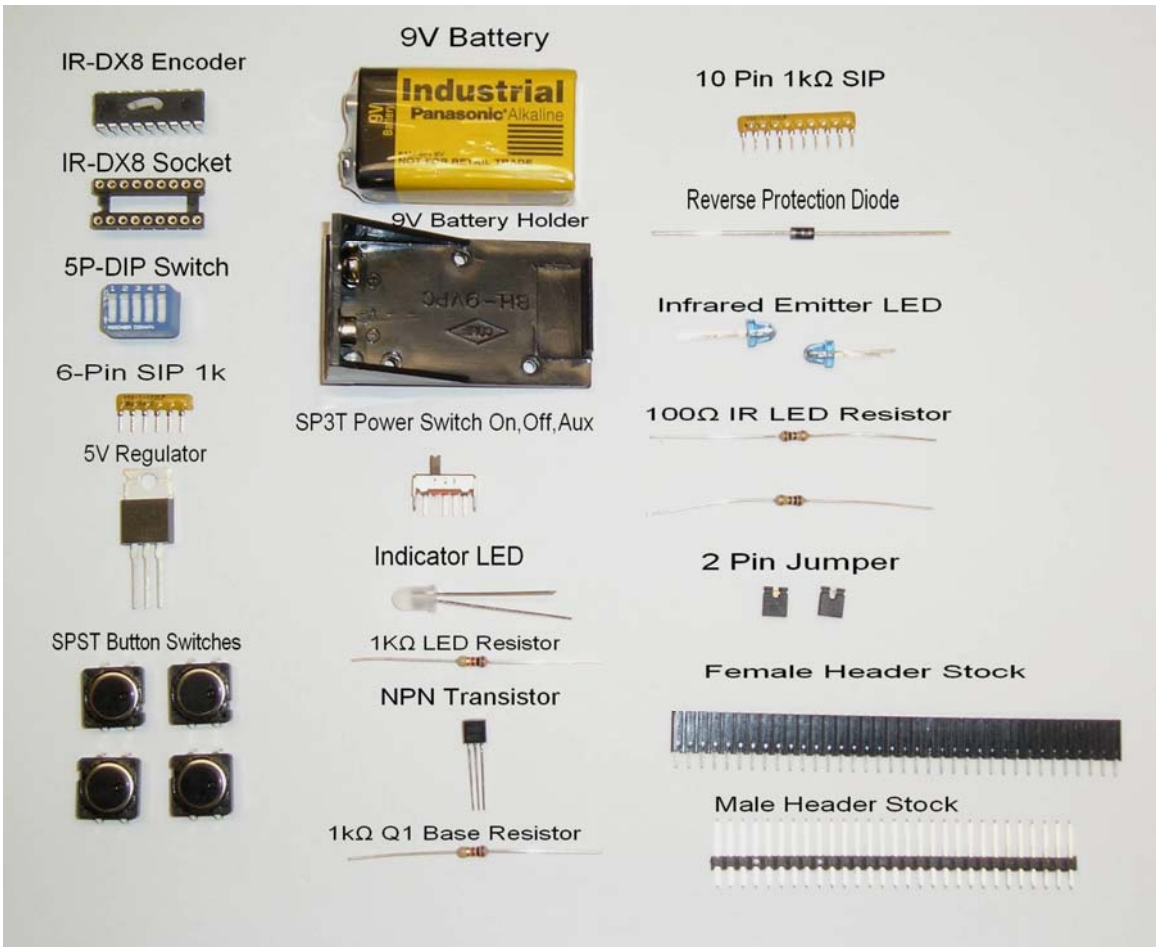

D1
VR-1
S5
S4
HL
9V Battery
7805
J2
C1
1uf
R4
100
R6
150
IR-DX8
DIP SWITCH
Ant
Gnd
Gnd
Gnd
Gnd
Antenna
RF-TX
R5
10
University of Nebraska
Peter Kiewit Institute
R1
1K
Designed By Ben Barenz
In Association with
Seth Hellbusch
LED-1
J3
RF
IR
R2
1k
+5V
SIP-2
G0 +9V G1
G0 +9V G1 +5V A0 A1 A2 A3 A4 A5 A6 A7
Q1
R3
100
Port-A
J1
Aux
Tek-bot
Transmitter
11-06
S2
S3
HR
S1
Aux
OFF
ON
4706

FIG 2


IR-DX8 Encoder
IR-DX8 Socket
5P-DIP Switch
6-Pin SIP 1k
5V Regulator
SPST Button Switches
9V Battery
Industrial
Panasonic Alkaline
9V Battery Holder
SP3T Power Switch On,Off,Aux
Indicator LED
1KΩ LED Resistor
NPN Transistor
1kΩ Q1 Base Resistor
10 Pin 1kΩ SIP
Reverse Protection Diode
Infrared Emitter LED
100Ω IR LED Resistor
2 Pin Jumper
Female Header Stock
Male Header Stock

Parts List

Transmitter Board Parts list			
Part	Description	Circuit ID	Quantity
Encoder	DIP-18 Encoder	IR-ZDX8	1
18-Pin IC Socket for IC-1	DIP18 Encoder Socket	IR-ZDX8	1
5P-DIP Switch	DIP-10 Blue Switch	Dip Switch	1
6-Pin SIP 1k	Yellow SIP Resistor	SIP-1	1
5V Regulator	Big 3 Pin IC	VR-1	1
SPST Button Switches	Black Buttons	S2-S5	4
9V Battery	Duracell	9V	1
9V Battery Holder	Black Plastic Holder	9V Battery	1
SP3T Power Switch On,Off,Aux	Small Silver Slide Switch	S1	1
Indicator LED	Translucent lens	LED-1	1
1KΩ LED Resistor	brown,black,red	R1	1
NPN Transistor	Small 3 pin IC	Q1	1
1kΩ Q1 Base Resistor	brown,black,red	R2	1
10 Pin 1kΩ SIP	PORT-A Pull Up Resistors	SIP-2	1
Reverse Protection Diode	Black with Grey stripe	D1	1
Infrared Emitter LED	Blue/Clear LED	HL,HR	2
100Ω IR LED Resistor	brown,black,brown	R3,R4	2
2 Pin Jumper	small 2pin black	J1,J3	2
2 Pin Female Header	Aux, HL,HR	Aux,HL,HR	3
12 Pin Female Header	PORT-A Power	Port-A	1
2 Pin Male Header	Button Enable Jumper	J1	1
3 Pin Male Header	RF, IR Select Jumper	J3	1
		Total Parts	30

Look over this parts list and the photo and make sure you have all your components. If you have a missing or damaged component alert one of the lab technicians before proceeding.

Tools:

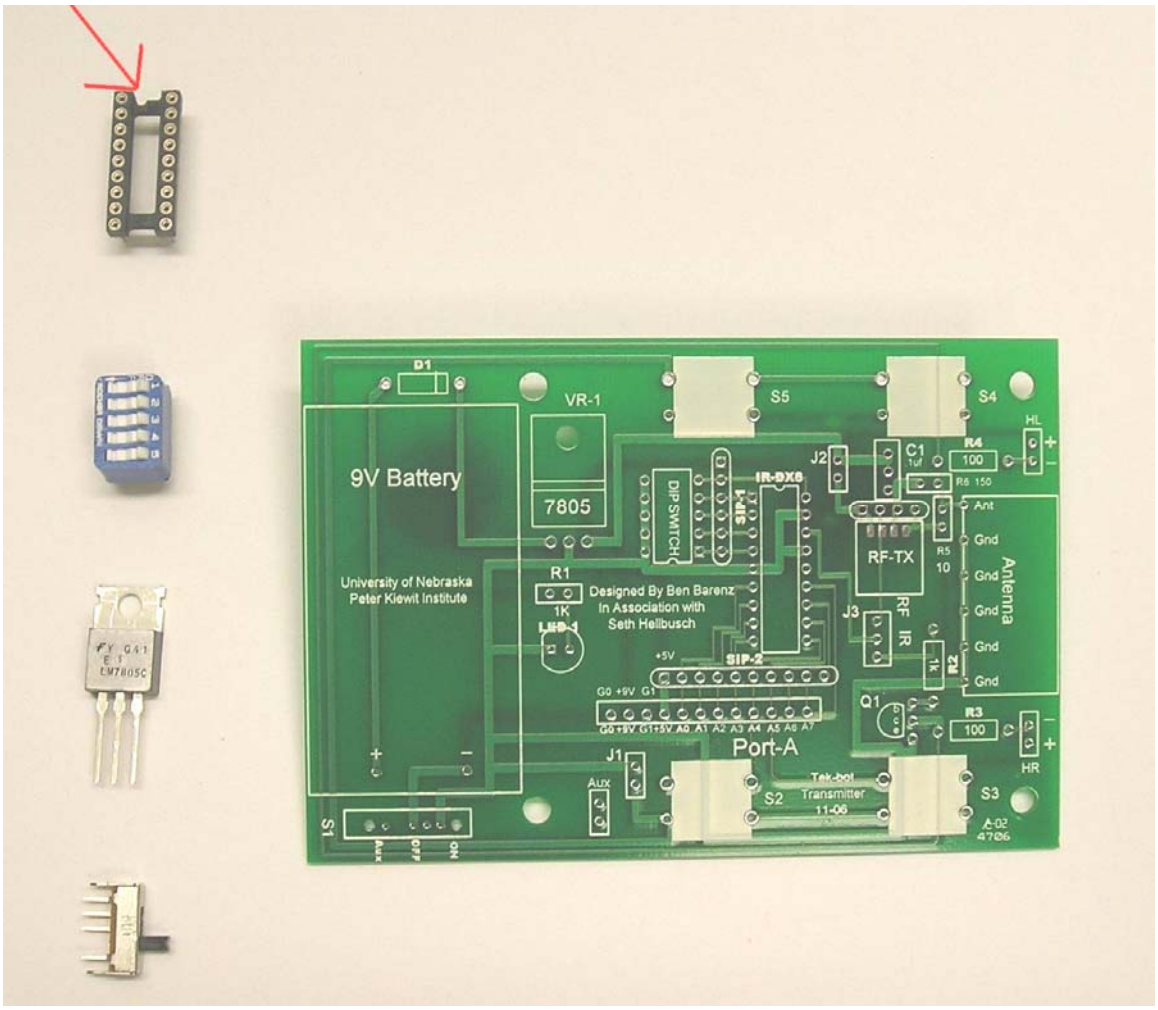
- Soldering Iron
- Flux Core Solder
- Wire cutters
- Small Pliers (Optional)

Assembly

1. The first 4 components we will place are shown in order in **Fig 3**.

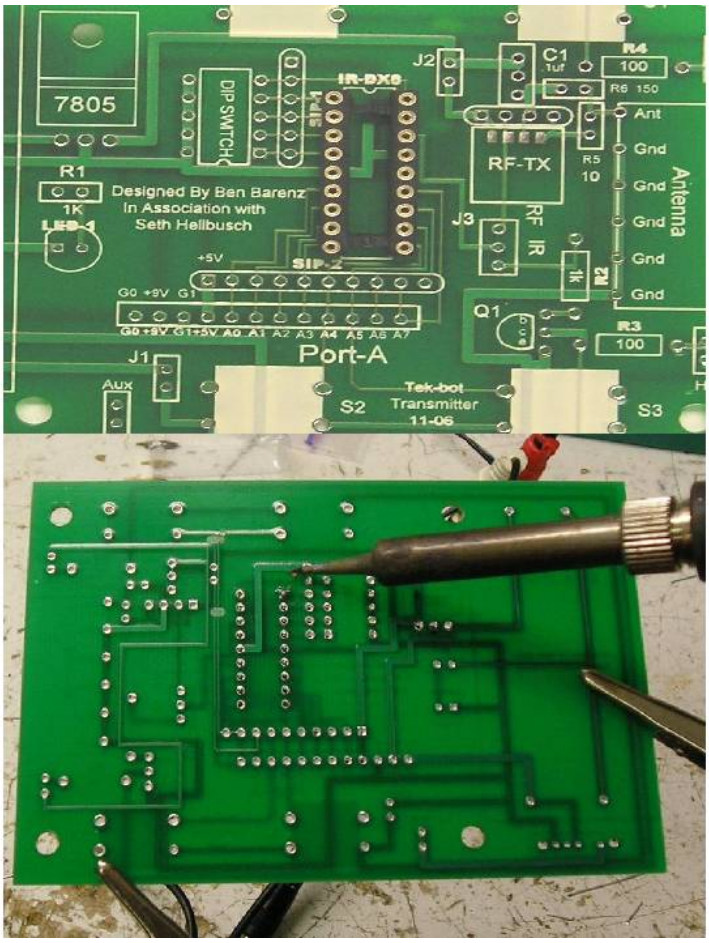
- DIP-18 IC Socket
- 5P-DIP Switch
- 5V Regulator
- Silver Slide Switch

FIG 3



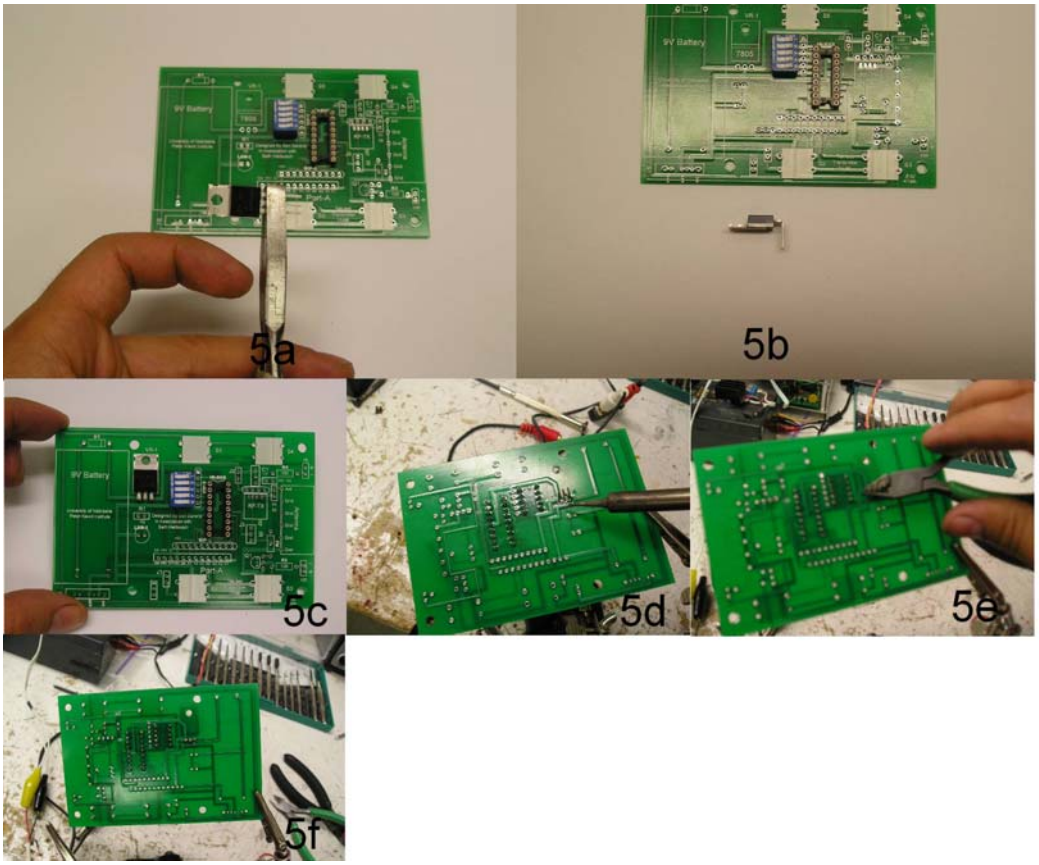
Start by placing the DIP-18 IC socket. The notch goes UP as shown in **Fig 3**. Flip the board over, then while holding the component from the back side solder the first pin in the upper corner. Apply solder then hold the iron tip on the joint for about 1 second then remove. Repeat this process for the rest of the pins as shown in **Fig 4.**

FIG 4



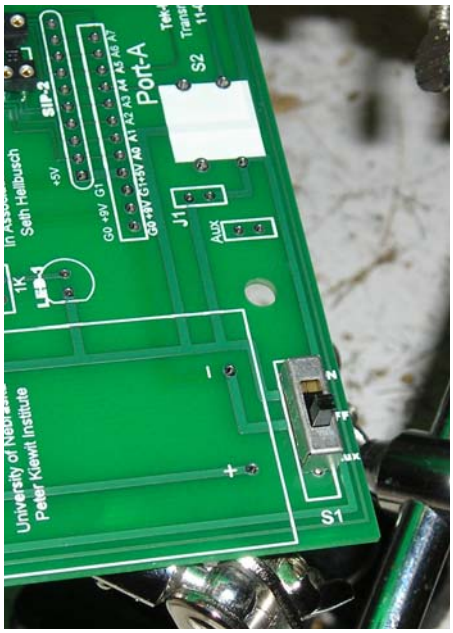
Once the socket is placed, install the DIP switch the same and move on to the Voltage regulator. Using, wire cutters, pliers, or your fingers, bend the leads as show in Fig 5a,5b. Next place the regulator in the correct place as outlined on the silk screen as shown in Fig 5c. Solder 1 pin then use your wire cutters to clip the leads as shown in Fig 5d. Then finish soldering the rest of the pins as shown in Fig 5e, 5f.

FIG 5



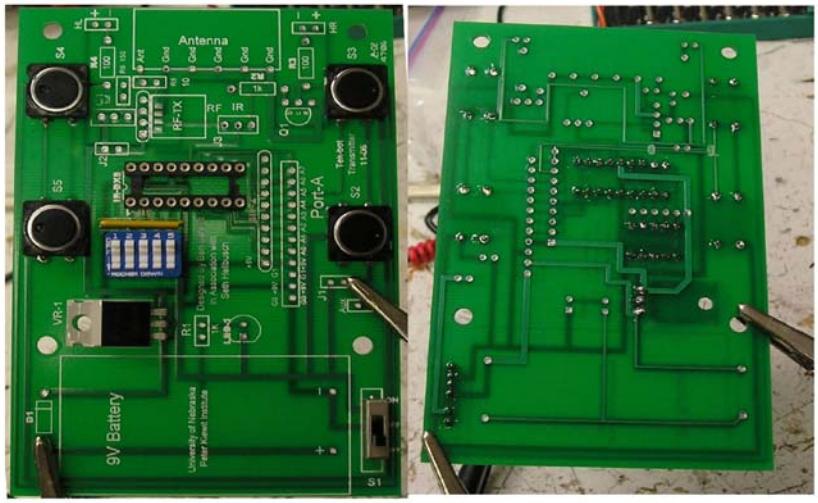
The last component we will place with detail is the slide switch. Observe the orientation of the switch then place in the board and solder as shown in Fig 6.

Fig 6



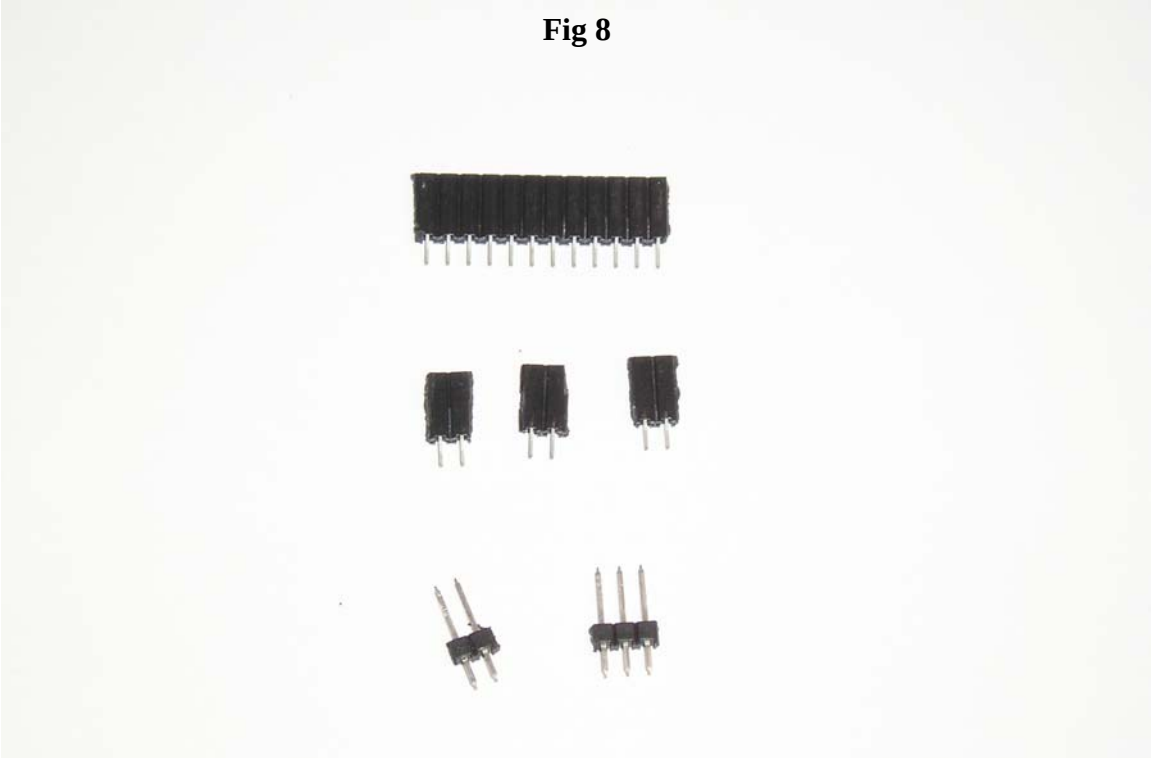
Next Place the 6 pin SIP Resistor and the DIP switch. When placing the SIP make sure the black dot points toward the outside of the board as shown in Fig 7. Next place the 4 push buttons. When placing the buttons, use your clippers or pliers to straighten the leads then carefully press the switches into the board as shown in Fig 7.

FIG 7



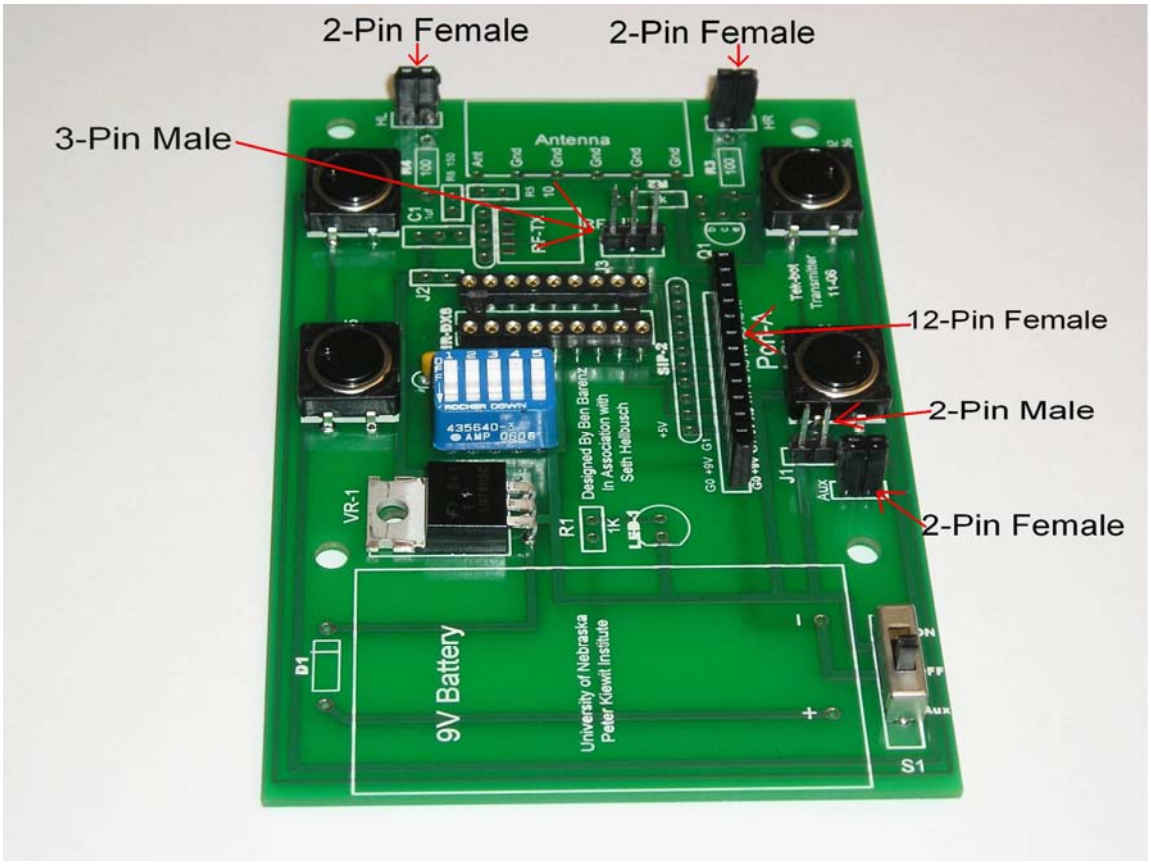
Next we will cut and place the headers. Using the wire cutters, cut one 12-Pin long female header and 3 2-Pin headers. Then cut 1 2-Pin long male header and 1 3-Pin male header as shown in Fig 8. When cutting the headers be sure to cut them square and make sure the whole headers is intact before placing.

Fig 8



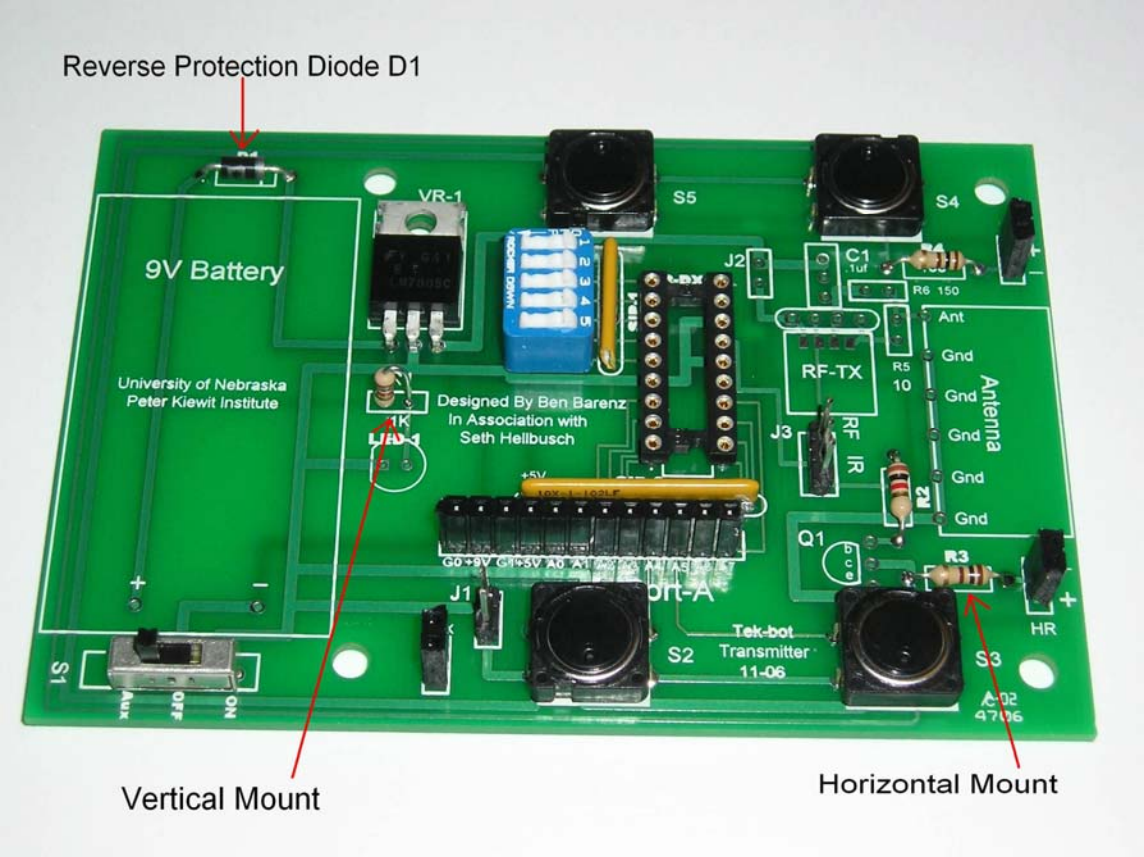
Next solder in each header in their respective locations as shown in Fig 9.

FIG 9



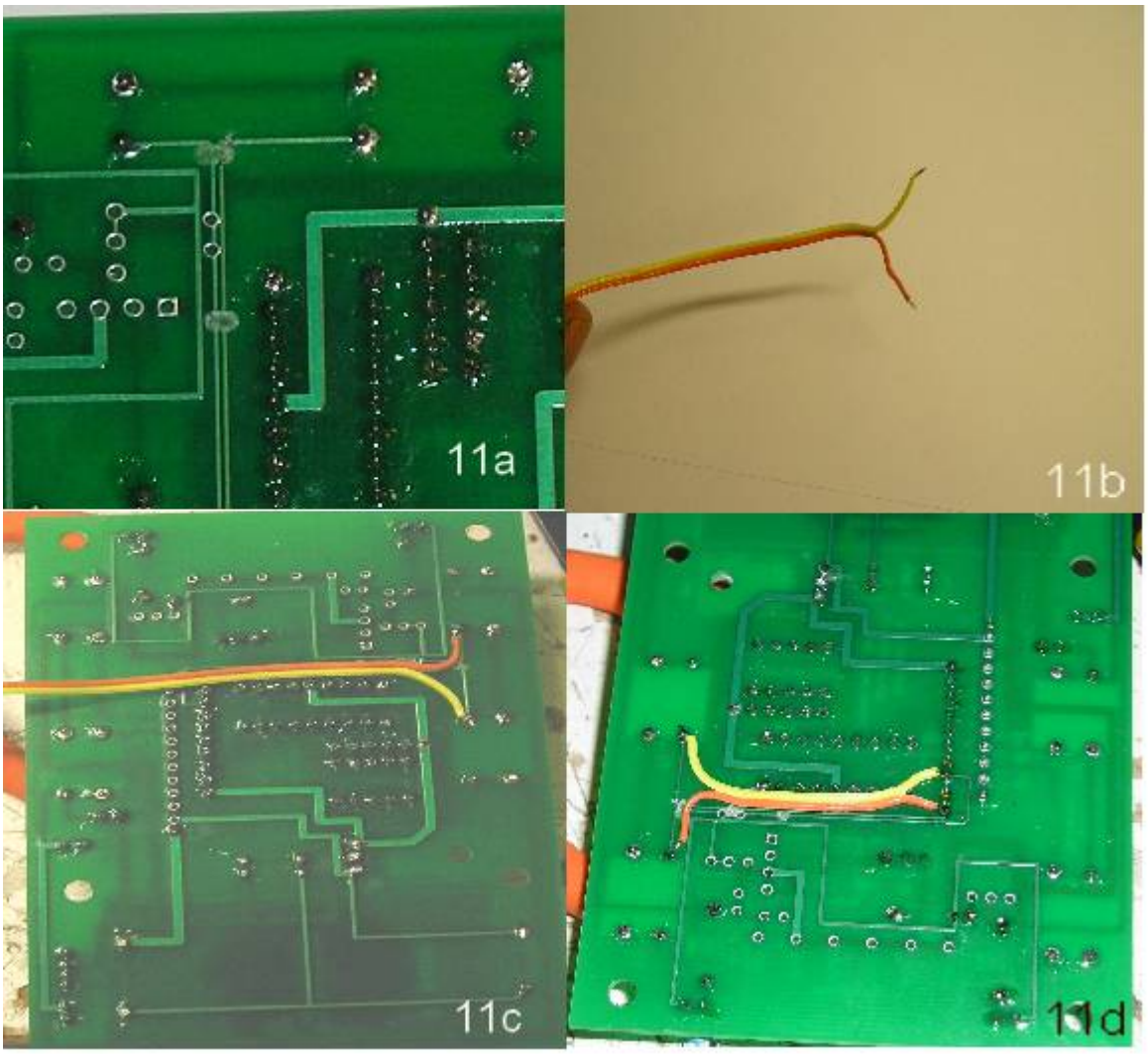
Once the headers are placed, insert the 10-Pin SIP resistor making sure the black dot is facing the battery holder. Next we will be placing the resistors. There are 4 resistors to place, R1,R2,R3,R4. R1 & R2 are 1kΩ (Brown,Black,Red) and R3,R4 are 100Ω (Brown,Black,Brown). R1 must be placed in a vertical orientation and the rest are in the horizontal as shown in Fig 10. Once the resistors are placed insert the reverse protection diode D1. This is the larger black diode with a grey stripe at one end. Place the grey strip along with the silk screen orientation as shown in Fig 10.

FIG 10



Unfortunately there was a mistake on this board and a power and ground trace were crossed. The shorted traces have already been removed and we only have to add two wires to fix the problem. Fig 11a shows the removed trace that we need to make a jump wire for. Cut off two pieces of wire approximately 4” long and strip as shown in Fig 11b. Next solder each wire to the switch outputs as shown in Fig 11c. Clip the wires slightly past the 12-Pin Header and strip a small amount off each end. Finally solder the topmost switch pin to top most pins in the 12-Pin header (Orange wire) then the bottom most switch pin the bottom most pin in the header (Yellow wire). That’s all, the connections should look like Fig 11d.

FIG 11



Almost done, next we will place the indicator LED. Take care to notice the orientation of the LED. The Flat side of the LED must line up with the flat spot on the silk screen. Next place the transistor in the allotted space marked out by the silk screen as shown in Fig 12. Pay special attention to the orientation of the transistor as marked on the silk screen. The last soldered component will be the battery holder. Before the battery holder can be attached it must be secured with glue. If a hot glue gun is available place a generous portion on the bottom then insert and solder as shown in Fig 13.

FIG 12

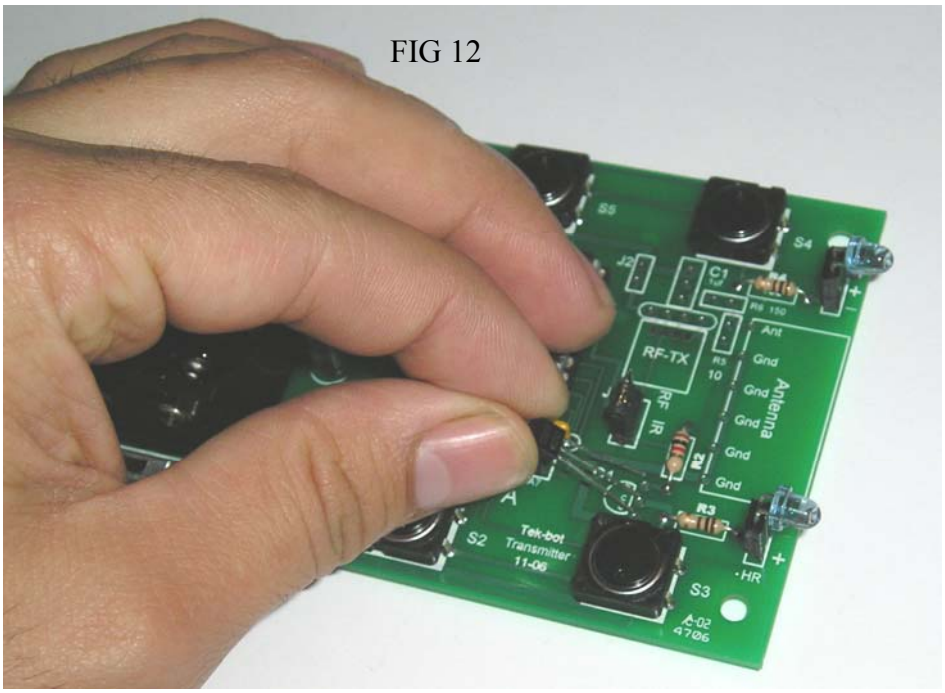
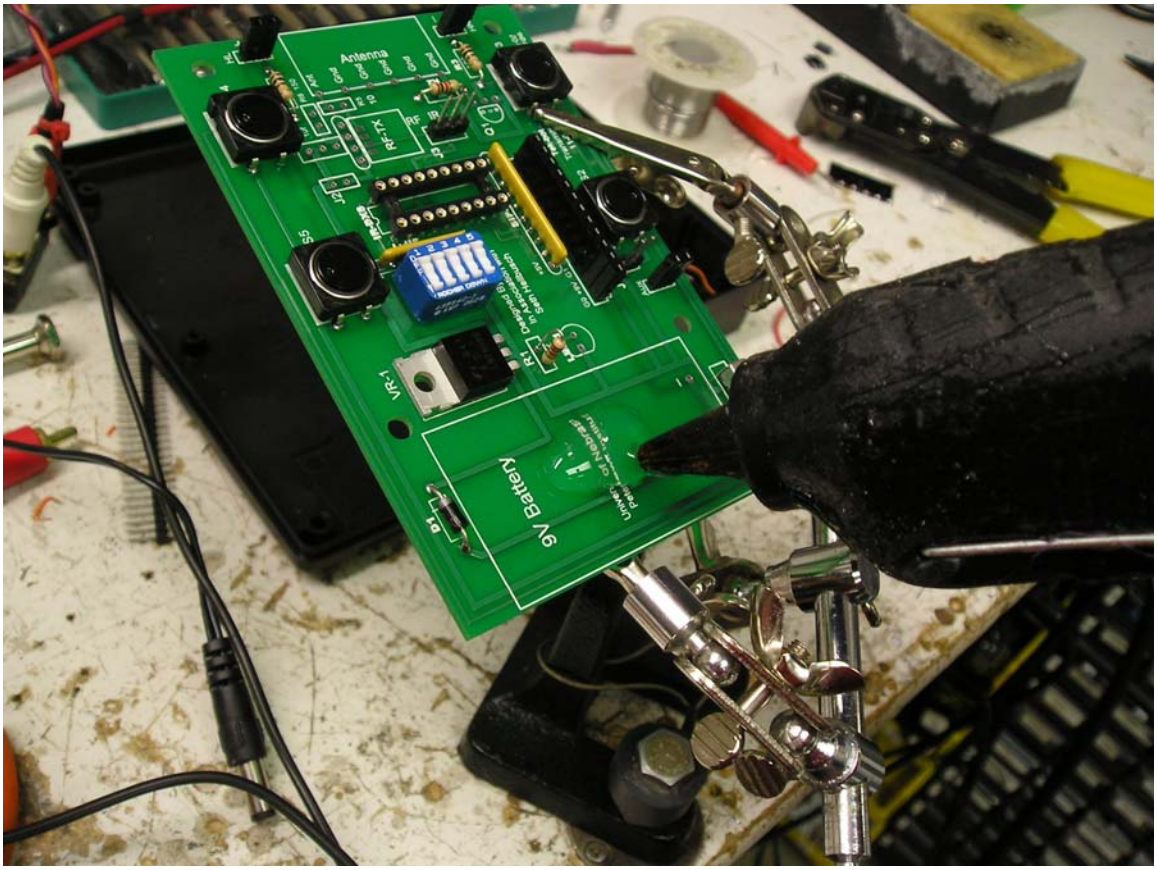

S5
S4
J2
C1
RF-TX
R3
10
Ant
Gnd
Gnd
Gnd
Gnd
Gnd
Antenna
RF
IR
R2
R3
S2
Tek-bot
Transmitter
11-06
S3
HR

FIG 13


Antenna
RF-TX
VR-1
9V Battery

Were done soldering but we need still have a few loose ends. First, bend and cut the IR Emitter LED's and place them into HL and HR. Take care to bend the LED with the proper orientation to the polarity marked on the board as shown in Fig 14. Then insert the IR-DX8 into the DIP-18 socket with the notch facing the left as shown in Fig 15. Then place the two jumpers on J1 & J3 to enable the buttons and IR respectively. The last step is to insert the battery and start using your Infrared transmitter. Take a close look at Fig 15 and make sure your board looks like this. Now you're done! For fun, try removing the battery and inserting it backwards. You will see the Indicator LED change to Red indication the polarity is reversed. The Reverse protection diode will prevent any damage to the components.

FIG 14

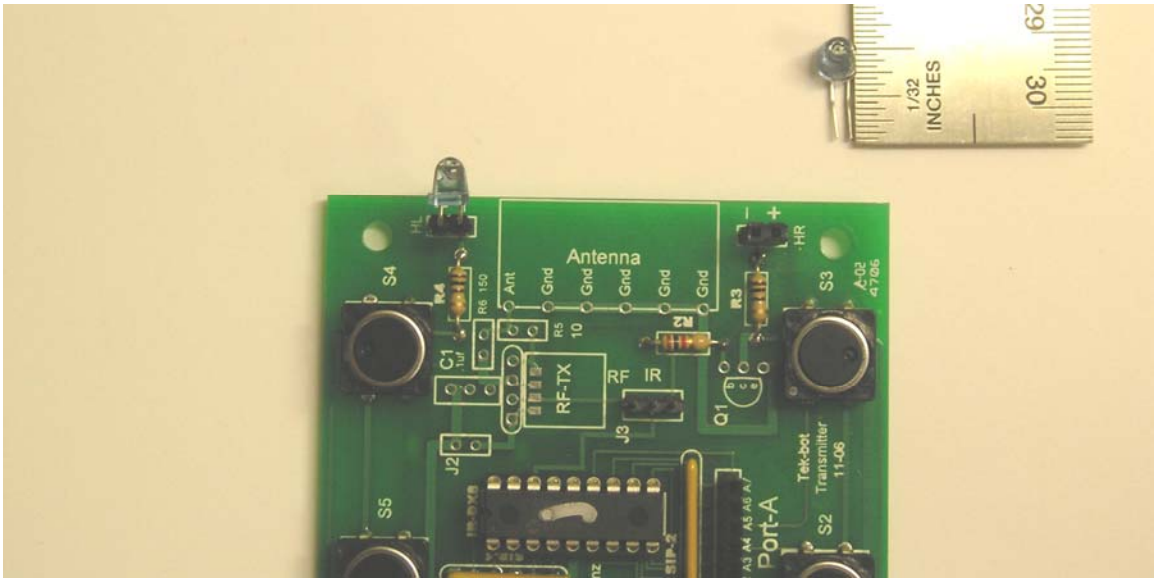
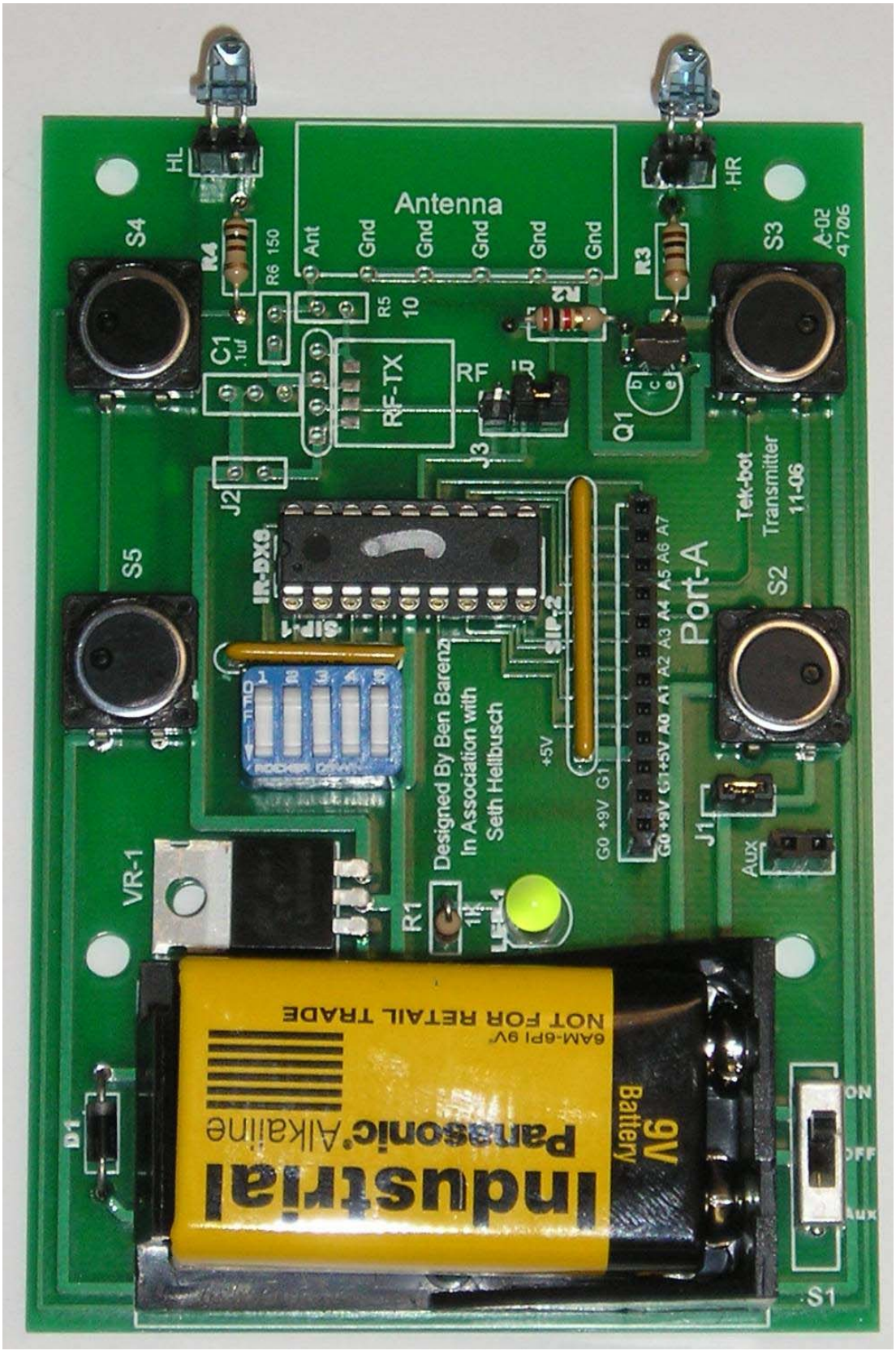


FIG 15


Antenna
Ant
Gnd
Gnd
Gnd
Gnd
Gnd
HL
HR
S4
S3
S5
S2
S1
R4
R6 150
R5
10
R3
R2
C1
.1uf
RF-TX
RF
IR
Q1
J2
J3
J1
Aux
IR-DXO
SIP-1
SIP-2
Port-A
A0 A1 A2 A3 A4 A5 A6 A7
G0 +9V G1 +5V
Tek-bot
Transmitter
11-06
Designed By Ben Barena
In Association with
Seth Hellbusch
VR-1
R1
1K
LED-1
D1
Industrial
Panasonic Alkaline
9V Battery
6AM-6PI 9V
NOT FOR RETAIL TRADE
ON
OFF
AUX