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Penguin Robot Rev B Rework Instructions (#27313, #27314, #27315, #27316)

Introduction

The Penguin Robot is a precision-machined 4” tall biped. The Penguin walks forward with a tilt-stride action and turns by sweeping both feet on the ground in opposite directions. Individual movement segments are linked together for this robot to walk.

During a recent design change for the PCBs used on these Penguin robots, an issue with the TXD circuit was discovered which prohibits normal operation of the robot. This problem prevents the robot from operating unless the USB cable is plugged in and connected to a host computer.

The circuit design of the Penguin requires the TXD net to be high when not connected to a PC via the USB port. On the Rev B Battery Board, when the FTDI USB IC (U7) is not powered by the USB port, Pin 1 (TXD) is pulled low. However, the SX48BD/TQ microcontroller needs to have TXD (Pin 9, RA2, on U5) pulled high for proper operation.

To remedy the problem, a modification is needed that will pull the TXD line high when USB power is disconnected, but will also allow proper communication for programming/debugging when the USB cable is connected. This modification consists of cutting the trace for the TXD net between the FTDI chip and the SX48 controller. This connection is replaced with a 10k ohm resistor so that the state of the TXD net at the SX48 can be pulled high while the TXD pin on the FTDI chip is low.

To pull the TXD net high at this 10k resistor, a P-Channel MOSFET is added that is driven by the 5V USB power source. This allows the signal to flow freely between the FTDI chip and the SX48 when the USB cable is connected.

Rework Parts Kit and Tools Required

Bill of Materials for Rework

Part Number	Description	Quantity
150-11031	Resistor, 10k, 0603	1 (4 supplied)
Diodes Inc DMG1013UW-7 (or any equivalent)	P-Channel MOSFET, 20V, SOT-323	1 (4 supplied)
Wire-Penguin-Mod	Wire, 28-30 AWG, Solid, Black	1" (6" supplied)
(555-27313)	(Penguin Battery Board PCB)	(1)
(SCH-27313)	(Penguin Schematic for reference)	(1)

Tool List

- X-acto style hobby knife
- Ohm Meter
- Soldering Iron with a fine point tip
- Solder (PCB is soldered with Lead-Free, but Tin-Lead can be used for the rework)
- No-Clean Flux (pen or liquid preferred, but can be flux core solder)
- Wire Cutters/Strippers
- Tweezers
- Optional, but very helpful items:
    - Magnification Aid (microscope, loupe, magnification light, etc)
    - Q-tips and alcohol

NOTE: The parts used for this rework are very small and in surface mount packages. The rework may be difficult for beginning solderers.

Rework Steps

All rework is performed on the component side of the Penguin Battery Board. The rework is broken into four steps as follows:

1. Trace Cut/Scrape
2. Resistor addition
3. MOSFET addition
4. Jumper wire placement

Apart from the detailed instructions, each step has graphics created from the PCB gerber data to make the rework as easy to understand as possible. The graphics make it easier to see where the traces on the PCB are truly located since the PCB has black soldermask.

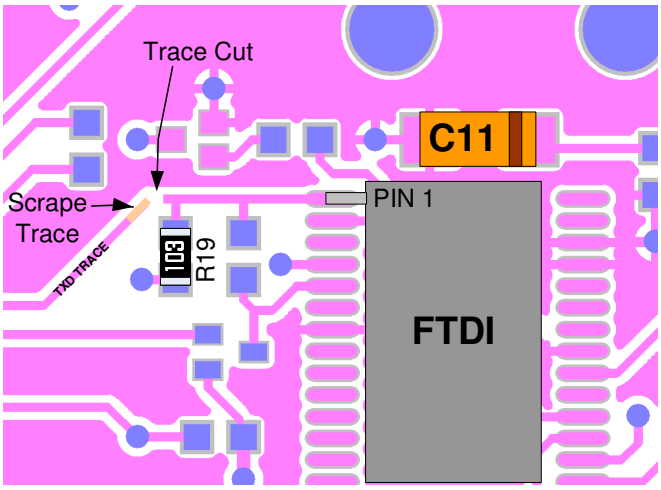
NOTE: It is advised that you run the servo and compass calibrations prior to performing this rework since they can be done with the USB cable connected.

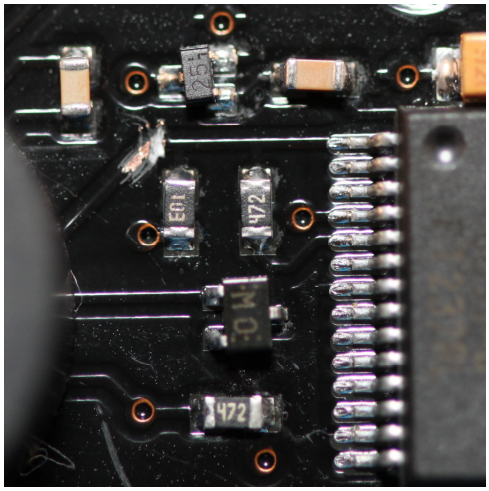
Rework Instructions

STEP 1: Trace Cut and Soldermask Scraping

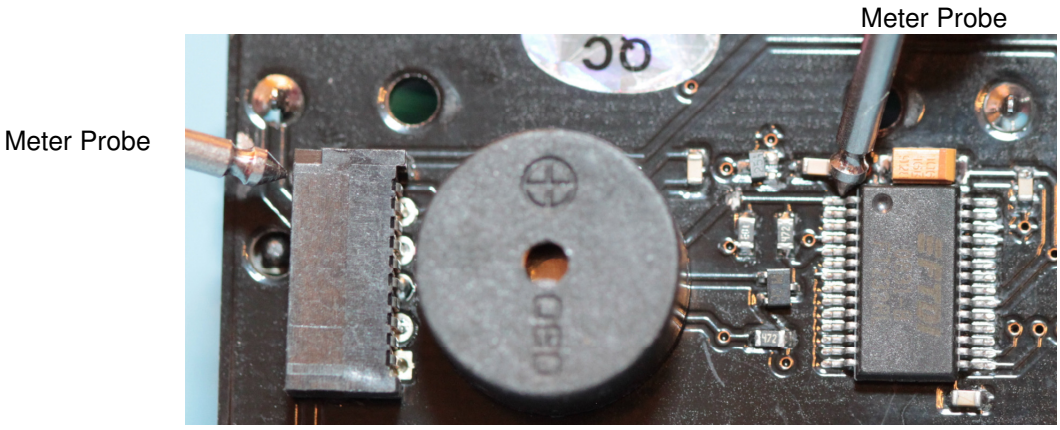
The first step of the rework is to cut the TXD net trace that connects from the FTDI IC, pin 1, to the TXD net on the SX48 controller IC, pin 8. This trace cut can be done in several areas on the PCB, but a specific location is chosen that will allow the added resistor to be soldered to a portion of the exposed trace in the second step.

Using a very sharp hobby knife, cut the trace coming from pin 1 of the FTDI chip just before the point where it bends at a 45 degree towards the speaker. It is best to use a new blade to ensure a clean cut. After cutting the trace, scrape the soldermask off a portion of the TXD trace to the left of the trace cut.





After cutting the trace, use an ohm meter to measure the resistance between Pin 1 on the FTDI and Pin 10 of the Ribbon cable connector as shown.



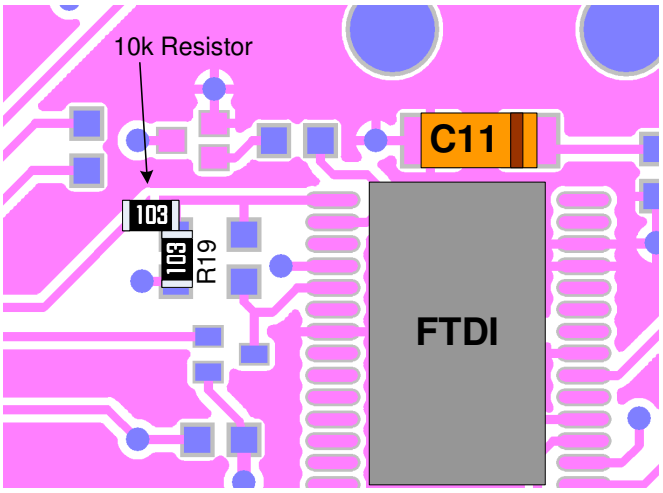
If necessary, two cuts side by side can be done and the thin strip of copper between them can be pulled off. This leaves a definitive gap at the trace cut position.

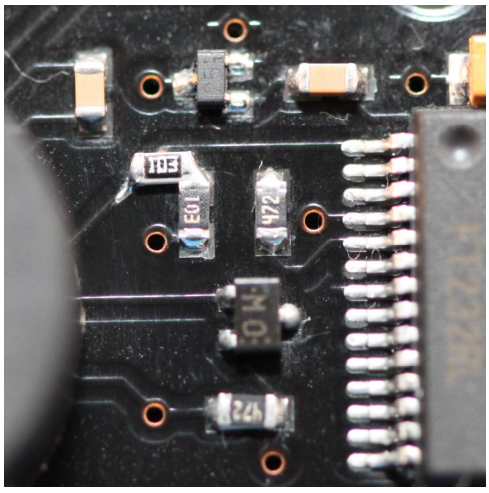
STEP 2: 10k Resistor Addition

Next, the 0603 size 10k resistor needs to be added between the 10k already on the PCB (R19 per schematic) and the exposed section of trace on the TXD net. Tin the exposed trace with solder, being cautious not to create a bridge across the trace cut.

Using tweezers, place the 10k resistor in position to verify that it can be soldered to the tinned trace and top of R19 as shown. You can expose more of the trace as needed to get the proper positioning for the solder connection.

Once the resistor fits properly, solder it into place using your desired method of soldering SMT components. One method is to add solder to the top end of R19, then, using tweezers, position the 10K in place and reflow the solder with the iron to get it into position above R19. Use flux as needed to gain a desirable joint. Solder the second side to the exposed trace.





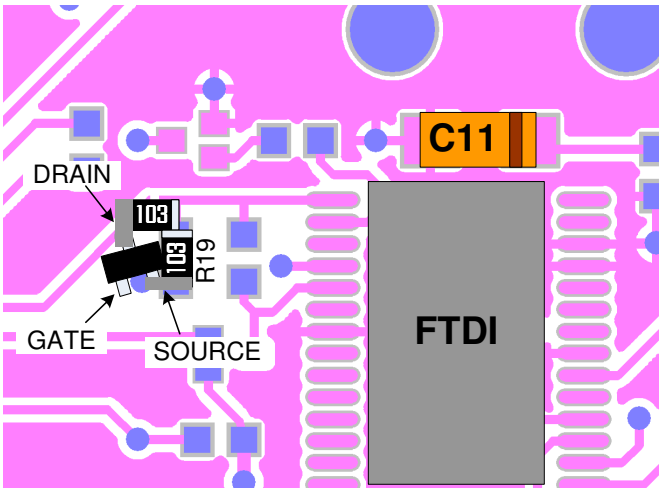
You can use the ohm meter again to measure the resistance between Pin 1 on the FTDI and Pin 10 of the Ribbon cable connector. It should now measure approximately 10k Ohm.

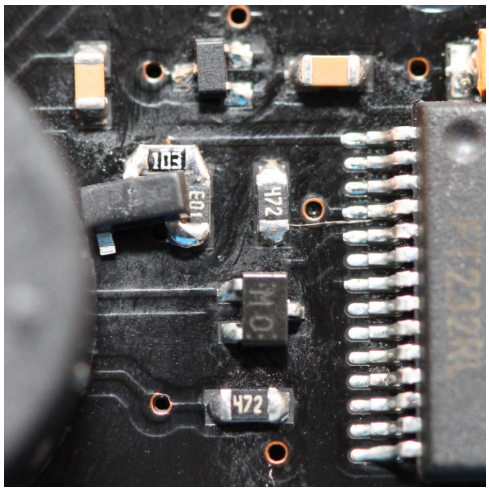
STEP 3: MOSFET Addition

The MOSFET will be placed with the drain connected to the soldered trace cut, the source soldered to the bottom end of R19, and the gate unconnected in this step. The positioning of the MOSFET is only critical for the connections being made. As long as the Drain and Source pins can be connected properly, the MOSFET can be positioned however necessary.

Using tweezers, position the MOSFET in place and verify fit before attempting to solder it.

Add extra solder as necessary to the bottom end of R19 along with flux. Position the MOSFET in place and reflow the solder at R19 to connect it to the Source pin of the MOSFET. Ensure that the Drain pin is in position to be soldered to the exposed trace solderjoint. Once the source pin is soldered in place, solder the drain pin to the solderjoint of the exposed trace.



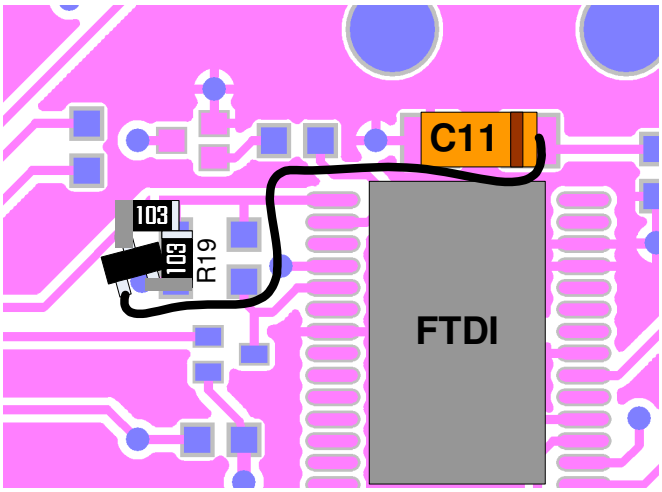


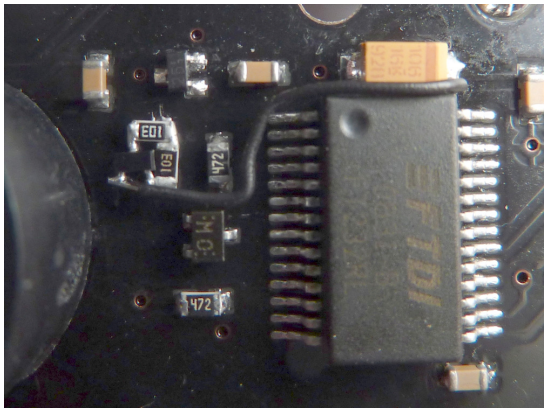
STEP 4: Jumper Wire Addition

The final step is to add a jumper wire from the Gate of the MOSFET to 5VUSB. The nearest and easiest location to connect to 5VUSB is the positive side of C11 (The 10uF cap above the FTDI chip. The cap is a yellow tantalum capacitor marked with 106, the designation for 10uF)

Using wire cutters, cut a piece of wire to length to fit the distance between the Drain pin of the MOSFET and the positive end of C11. The wire can be routed above or below the cap as shown. Once a piece of wire is at the right length with the necessary bends, strip one end approximately 1/16" for the MOSFET pin and 1/8" for the C11 end. After the ends are stripped, verify the wire will fit properly between the two solder points. Adjust bends and strip lengths as needed.

Solder the 1/8" stripped end to the positive side of C11 with the orientation of the wire as close to its final position as possible. Once soldered, use tweezers to adjust bends so that the free end is in position next to the MOSFET's Gate pin, then solder it.





The routing method shown is done so that it will not interfere with the Penguin chassis during mounting.

Testing

The modification can be tested simply be checking the state of pin 10 on the ribbon cable connector with the batteries installed and the power switch on. Pin 10 on the ribbon cable connector should be high when no USB cable is connected. If it is not, ensure that VDD is 5 volts and then doublecheck all of your solder connections.

Of course, the other method of testing is to check and see if your Penguin Robot now works properly when the USB cable is disconnected.