Sensebridge
making the invisible visible

Step 1

Building North Paw V2.0
Step 1: Electronics

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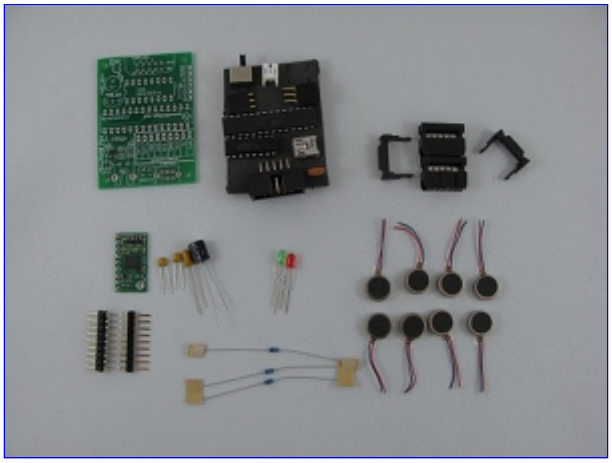
Step 1: Assembling the circuit board …

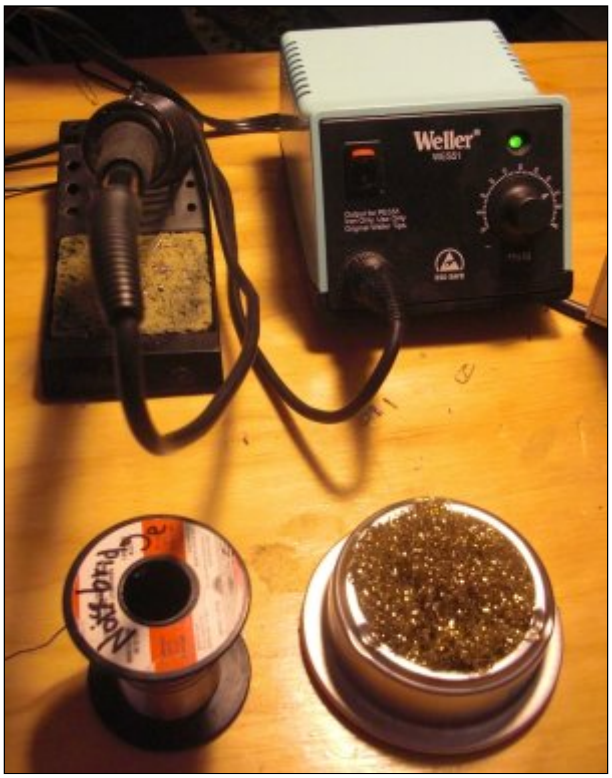


The little electronics bag includes all of this.

- **Custom North Paw V2.0 PCB**
- **2x 10kOhm resistors (held together with paper)**
- **1x 330 Ohm resistor**
- **1x green LED**
- **1x red LED**
- **2x 0.1uF caps (little yellow ones)**
- **1x 1.0uF cap (bigger yellow one)**
- **1x large 47uF electrolytic cap**
- **ATMEGA168 28DIP IC**
- **TPIC 16DIP IC**

- **1×3 and 2×3 right angle female header sockets for compass (NOTE: these parts are no longer required, but may be present anyway)**
- **3 pin resonator (orange)**
- **switch STDP**
- **2×5 male right angle motor socket**
- **Pololu LSM303DLM compass module (in pink bag)**
- **ribbon cable snap with strain relief – two, but you only need one**
- **8x coin-type vibrating motors (not shown)**
- **JST power jack for battery**
- **MAX1555 – SMD device already soldered to the PCB**
- **USB mini-B jack**

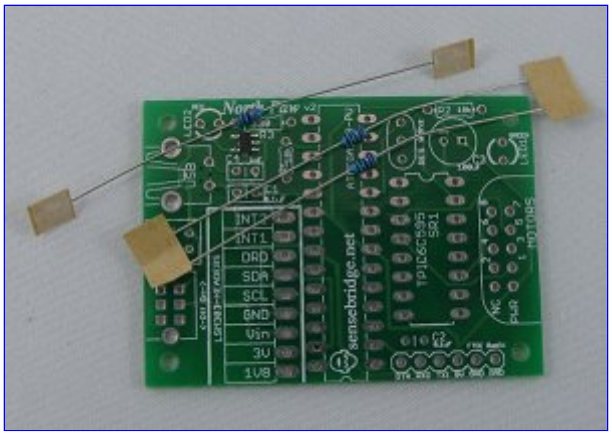
For this set of instructions, you won't need either the ribbon cable snap or the motors, so set them aside in a safe place.



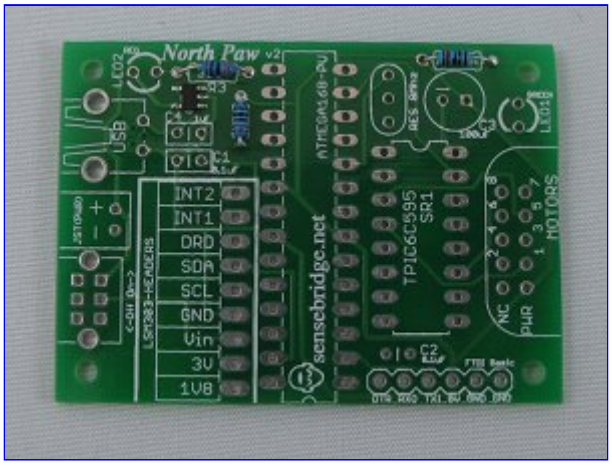
You'll need a solding iron and some solder.

If you've never soldered before, check out this awesome Soldering is Easy! comic tutorial. That'll be enough to get you past Step 1, but in Step 2 you'll need more advanced soldering skills. Practice makes perfect!

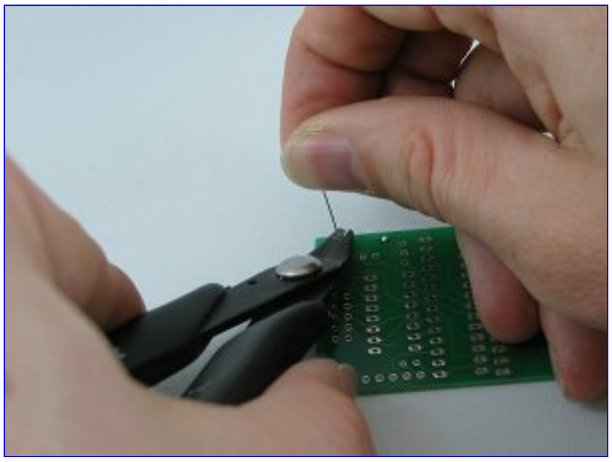
The North Paw board is pretty well labeled as to where the various parts go, but there are several tricks, so be sure to read at least the section about the compass jacks. From here forward, if I refer to a place on the board, I am assuming that the board is oriented as shown in this picture: with the North Paw name upright at the top left.



Start soldering with the shortest components first… this makes it easy to turn the board over and solder on the bottom, where nothing is in your way. So we start with the resistors. Two of them are the same, and one is different, just look at the colored stripes. The one that is different is the 330 ohm, it goes near the top left corner of the circuit as shown.

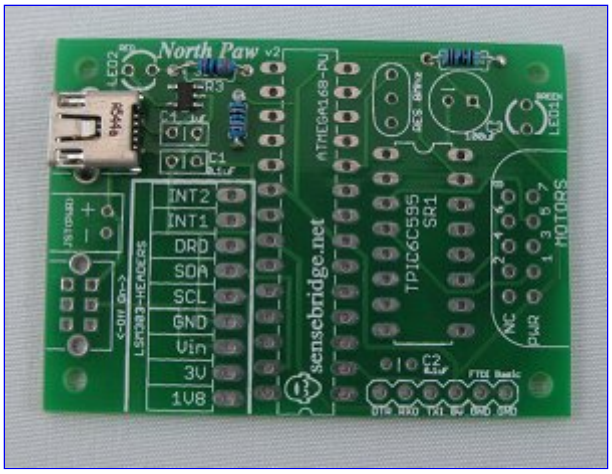


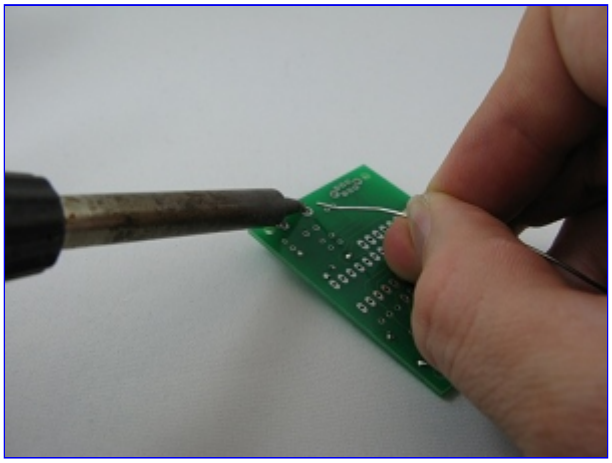
The 330 ohm resistor goes near the top middle, as shown. Insert the leads from the top, then bend them a little outward so that they stay in place by themselves. This makes it easier to solder them.



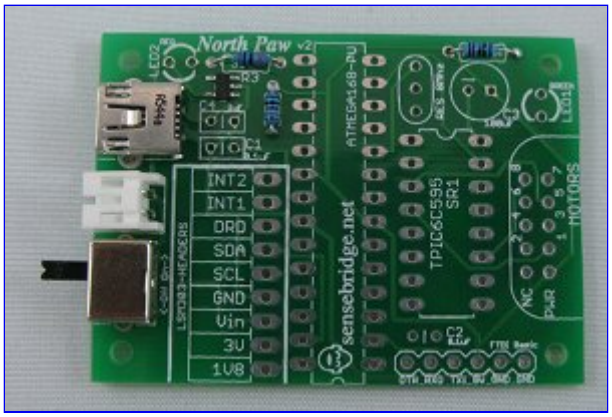
Once you have soldered them, clip the extra lead length off. Important Safety Tip: please hold onto the lead as shown as you clip it, to prevent it from shooting off and poking someone in the eye. That would be bad. Learn this safety tip now and make it a habit, and hackers everywhere will feel safer :-). Solder the other two resistors in as well, and clip their leads.

Find the USB jack and solder it in now. Use the single 1×3 jack as a prop if necessary to keep the USB in as you solder it. It requires a lot of solder to make the big holes full – watch out later because it takes a long time to melt that much solder, and it makes the metal USB port very hot. There are three little pins that you will not solder at all – these are the data pins, which our circuit does not use. Do not attempt to solder them – because there are no pads,





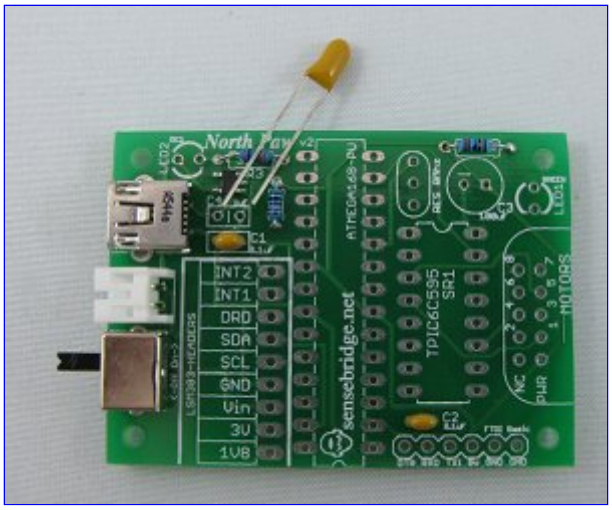
it will not work. We use the USB only for the 5V power, to charge the LiPo.

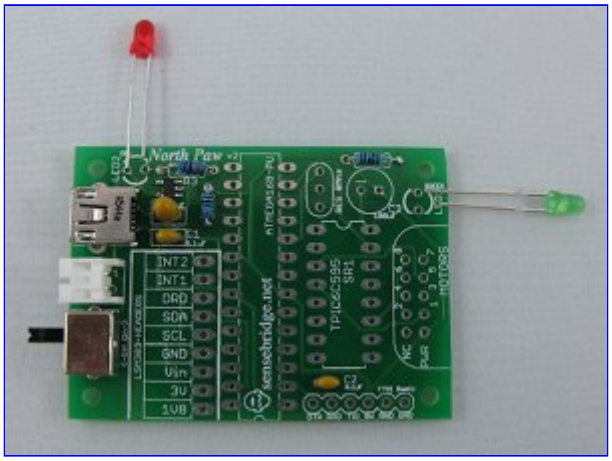


Solder in the JST jack and the switch. Again with the switch, be careful, it will be very hot after soldering!

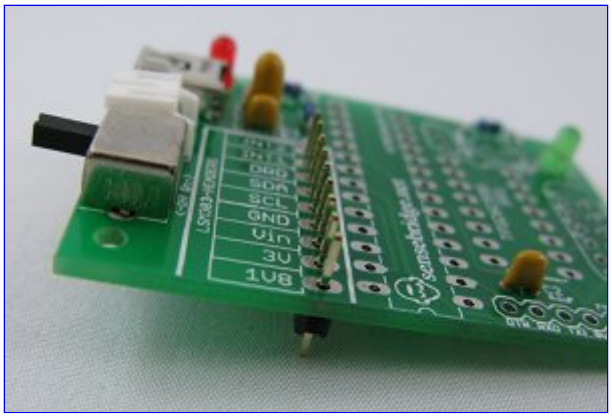
There are three capacitors in the kit. The large one goes in the hole nearest the USB jack. The positive leg goes in the hole nearest the USB jack. If one leg is longer than the other that's the positive leg. If they're the same length, there will be a tiny + mark on the front, above the positive leg.

The other two capacitors go in just above the compass socket and beside the ATMEGA at the bottom right, and their orientation does not matter.



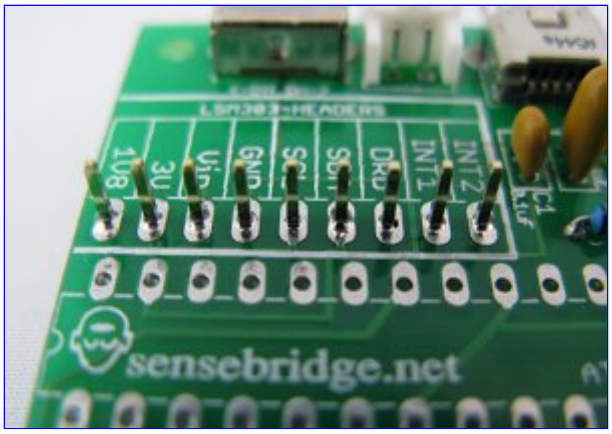


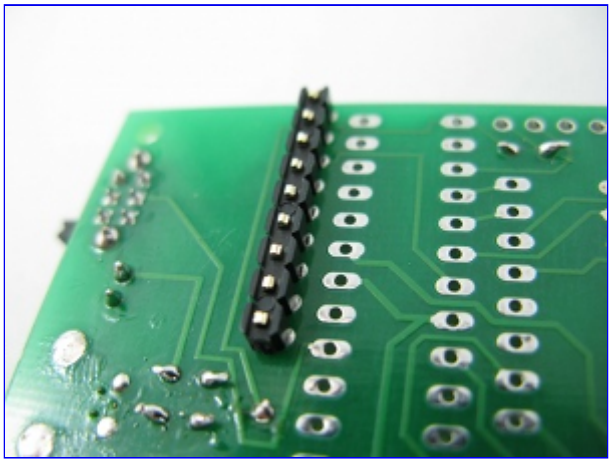
There are two LEDs in the kit, red and green. LEDs are polarized: orientation matters. If you feel up the LED head, there is a flat side, the flat side fits into the board where the white outline shows the flat part. Alternately, you can put the long-leg side in as shown, to the left for the upper-left LED and to the top for the LED on the top-right.



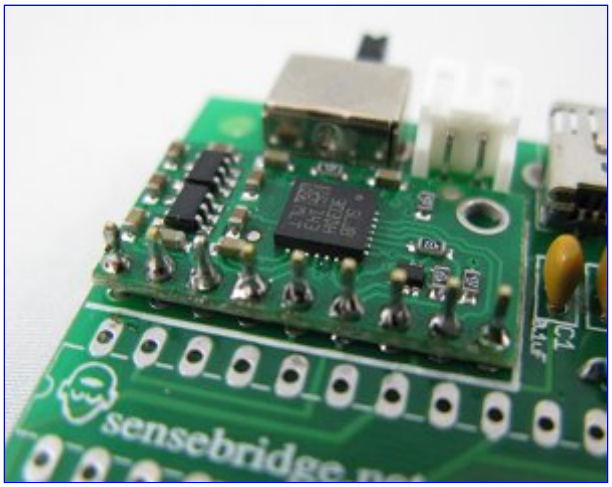
We're now going to solder in the compass module. This will be a two step process. First we'll solder in the headers, using only enough solder to hold them in place, and then we'll solder the module unto the headers.

Shown here is what the headers should look like after you solder them – try to make sure they are perfectly straight up, and use as little solder as possible, so that there will not be any solder lumps that will hold the module up in the air when we place it on top of these headers



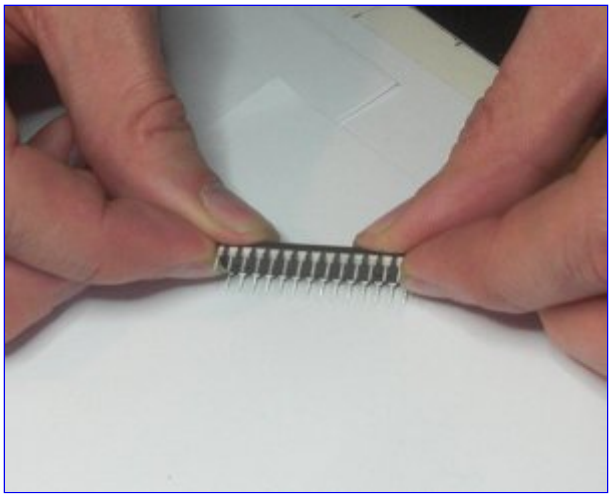


Cut the small nubs of the headers on the bottom, to be sure that your enclosure will close properly later

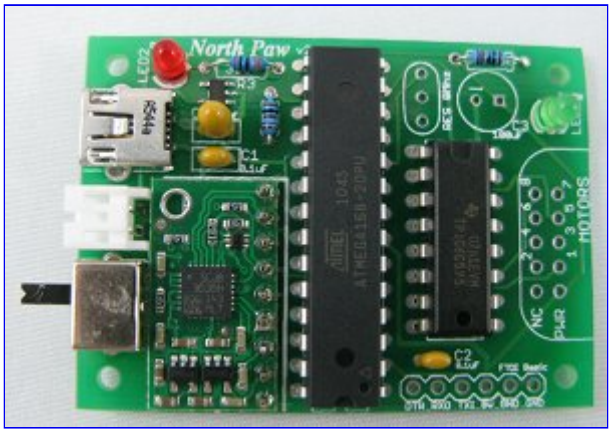


Now place the LSM303 module on top of the header pins, as shown. There is only one orientation where the components are still on the top, so you can't actually get this wrong. Try to solder it so that the module rests flat on the main North Paw board. If it doesn't rest completely flat, don't sweat it too much – a few degrees won't make a large difference. If worse comes to worse, you can put a flat object (like card stock) under the module to keep it flat, even if the pins are holding it up on edge. Being flat (parallel, both in x and y, to the board) is more important than resting on the North Paw PCB.

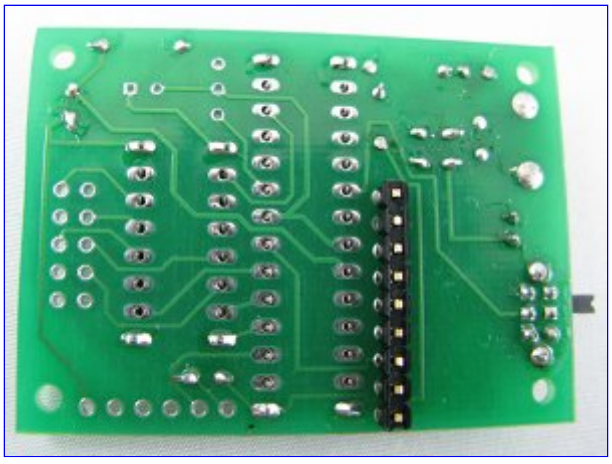
Both the ATMEGA and the TPIC are regular PDIP parts, which typically means that the leads are angled outward a tiny bit compared to the standard footprint holes. If you grab the edges of the part and press the leads into the table, you can bend them all in at once. I usually use two hands; the important thing is not to press on the leads on the top, as if you press on just a few of them you will bend those leads



more than the rest and that will be trouble. Repeat for both sides of each device.

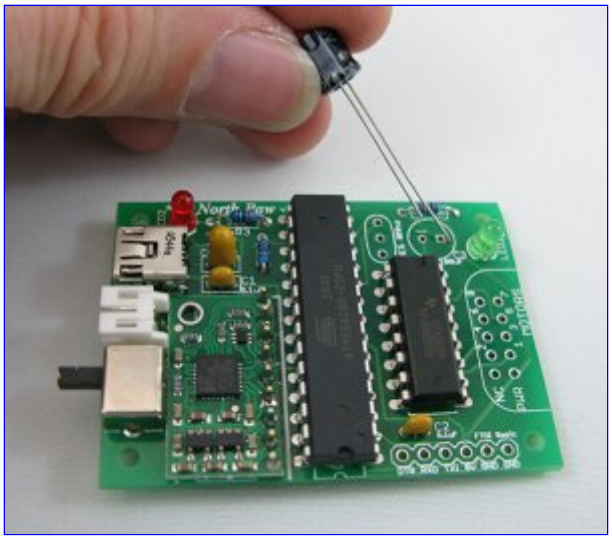


Place the ATMEGA and the TPIC into their holes. Note the orientation: the little circular indent on the ATMEGA should face down, while the indent on the TPIC should face upwards. The silkscreen has little matching half-circle marks to guide you.

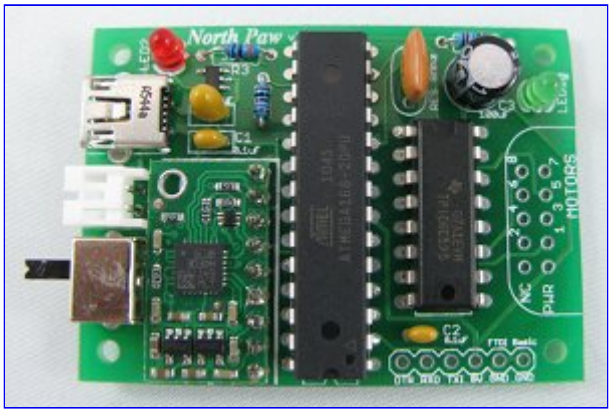


For soldering the ATMEGA and TPIC, I find it handy to first "tack" the four corners of each part, to make sure that they don't move while you solder the huge numbers of pins. Go ahead and tack the corners down and then finish soldering the ICs in.

The round barrel object is a big 100uF capacitor. It is polarized, meaning that it must be wired in a particular orientation. The stripe on the barrel is the negative side. You can think of the stripe as a big "negative" dash: -. The negative strip goes towards the ATMEGA, equivalently, the short leg goes into the hole labeled with the negative sign. This cap stores the energy necessary to get the motors

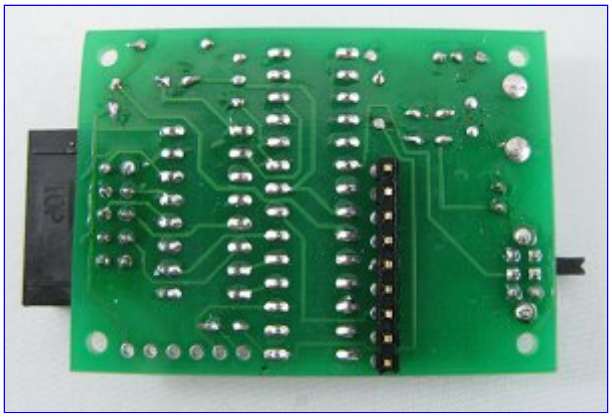


started, so that their big draw on starting doesn't brown-out the rest of the circuit.



The little orange part with three leads is an 8MHz resonator. It goes between the ATMEGA and the motor socket, just below the sensebridge logo. Solder from the bottom as per usual. Then clip the leads, these resonators have kind of medium length leads and you don't want to leave those longer lengths hanging around.

Finally, the big 5×2 keyed motor socket goes in. Solder happily since after this component, Step 1 is done! Before proceeding on to the next step you should look over all your solder joints and make sure they are all nice and shiny and complete. You may also wish to clean your circuit if there is any flux on it (this will depend largely on what kind of solder you used and how much). Typical procedure involves isopropyl alcohol and a toothbrush.



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North Paw V2.0, for help contact eric@sensebridge.net

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