Conductive Glue And Conductive Thread: Make an LED Display and Fabric Circuit That Rolls Up.

by **mikey77** on December 19, 2007

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Author: PRO mikey77 author's website
I believe that the purpose of life is to learn how to do our best and not give in to the weaker way.

Intro: Conductive Glue And Conductive Thread: Make an LED Display and Fabric Circuit That Rolls Up.

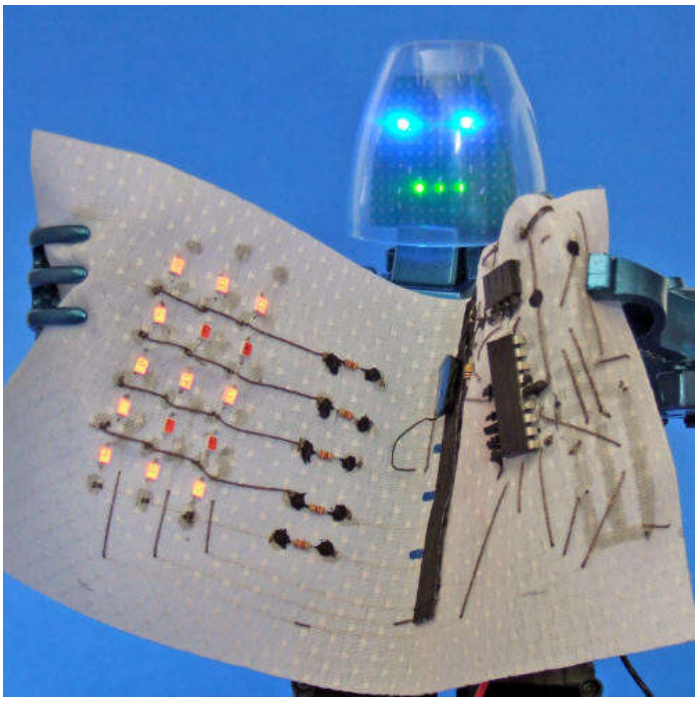
Make your own conductive fabrics, thread, glue, and tape, and use them to make potentiometers, resistors, switches, LED displays and circuits.

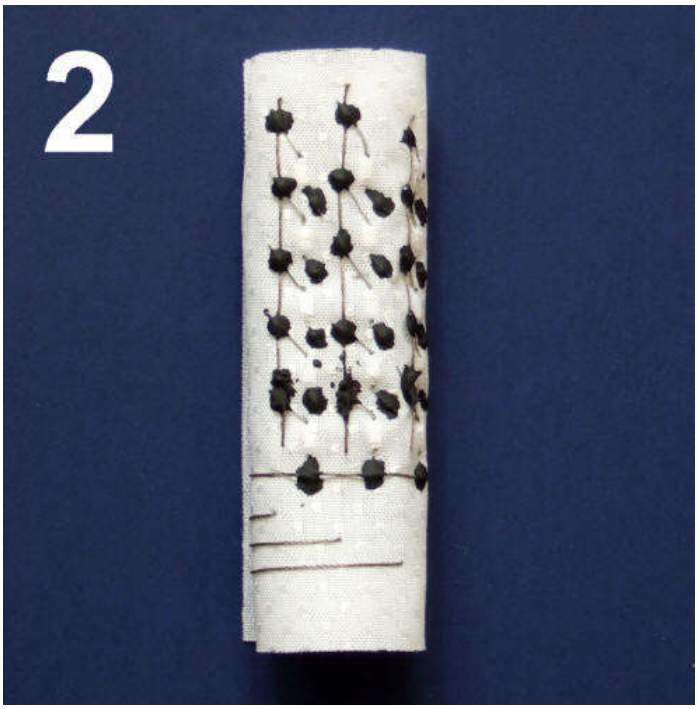
Using conductive glue and conductive thread you can make LED displays and circuits on any flexible fabric. They can be made flexible enough to roll up (see pic2). using the techniques presented here, you can replace solder in many instances and create circuits on almost any hard or flexible surface.

This instructable is the result of some of my experiments with making conductive materials and components. While some of the techniques shown in the following steps were not used in this particular project, they may be something you will find useful for future projects that involve conductive materials.

This instructable will show you how to:

1. Make several kinds of conductive glue, paint and ink.
2. Connect LED displays and micro controllers on fabric using conductive glue and conductive thread.
3. Make magnetic glue, a flexible potentiometer, and a magnetic plug and socket
4. Make your own conductive thread and where to find conductive thread at Wal-Mart.
5. Make conductive fabric, conductive foam, and foam switches, membrane switches and pressure sensors.
6. Make a conductive glue that will glue battery packs and eliminate the battery holder.
7. Program the 18x Picaxe micro controller to display words and numbers.





step 1: Make Conductive Glue, Conductive Paint, and Conductive Ink

To make your own conductive glue, you will be taking an insulator (Liquid Tape rubber or DAP Contact Cement) and turning it into an electrical conductor. This is done by the addition of carbon graphite powder which is a conductor. As the binder (LT or DAP) sets up, the carbon crystal flakes stack on each other and intertwine to make the glue conductive. The result is a flexible conductive glue that will stick well to most things.

The glass circuit doodle in pic3 below, is used to illustrate some of the ways the different glues can be used. Click on the comment squares for details.

Since my first instructable on how to make conductive glue: http://www.instructables.com/id/EYA7OBKF3JESXBI/ I have been experimenting with various conductive materials. In the process, I have come up with a few new mixes using other binders that have somewhat different characteristics than the original conductive rubber glue.

Materials

Performix (tm) liquid tape, black-Available at Wal-Mart or http://www.thetapeworks.com/liquid-tape.htm

DAP "The Original" Contact Cement- available at Wal-Mart or most hardware stores.

Carbon Graphite, fine powder- Available in larger quantities at http://www.elementalscientific.net/
Available in smaller quantities at your local hardware store. It's called lubricating graphite and comes in small tubes or bottles. The brand I used is called AGS Extra Fine Graphite, but no doubt there are other brands that will also work.

Conductive thread-Available in small spools at http://members.shaw.ca/ubik/thread/order.html
or at:
http://www.sparkfun.com/commerce/categories.php?cPath=2_135

Clear contact cement such as Welder Contact Adhesive or Goop- available at Wal-Mart and hardware stores

Tuloul solvent- available at hardware stores

WARNING- All of these mixes involve strong solvents that evaporate into the air quickly. Do this only in a VERY WELL VENTILATED room. The fumes can be harmful. Better yet, do it outside.

All of the mixes below are best mixed in small quantities and used immediately. I have tried storing them in airtight containers but all of them seem to harden up after just a few days. Mix them in a stainless steel or glass container. You can mix them in plastic cups, but you will have to do it fast as most of them will dissolve many plastics.

Glue mix #1 Conductive Glue Using Liquid Tape (LT)
This is the original formula that uses a mix of Liquid Tape and Graphite powder. It results in a flexible conductive rubber that actually shrinks as the solvents evaporate, thus tightening it around whatever it coats. It has the lowest resistance of any of the unfibered mixes (32 ohms per inch). For details on how I measured the resistance see the original instructable (link) on this glue. I find it best for gluing wire to wire, or wire to conductive thread or conductive fabric. It can also be used to make conductive foam (see step 4).

Mix the glue 1-1/2 Graphite to 1 Liquid Tape by volume. Mix it fast in small quantities and use it fast as it tends to evaporate and skin up rather quickly.
I usually use 1/4 teaspoon as my unit of volume.

Mix #2 Conductive Paint Using Liquid Tape
This is the same mix as above with the addition of extra solvent to make it the consistancy of thick paint. Because it is a thinner mix, it has a higher resistance (60 ohms per inch) than the conductive glue. It is useful for making conductive thread and conductive fabric (see step 6). It also sticks better to glass than the thicker glue above.

Mix the paint 1-1/2 Graphite to 1 Liquid Tape to 1 Tuloul by volume.

Mix #3 Conductive Ink Using Liquid Tape
I mainly use this ink for touch up if the glue lines get too sloppy or to re-coat close together joints. Because it is so thinned out, it can have a rather high resistance in the hundreds of ohms per inch. It can also be used to create thin film high value resistors and It may be useful for high voltage applications.

Mix the ink 1-1/2 Graphite to 1 Liquid Tape to 3 Tuloul by volume.

Mix #4 Conductive Glue Using Dap Contact Cement
It turns out that most contact cements will become conductive if you add graphite. Even Elmers rubber cement has very low resistance when mixed with graphite. It is however, a raw latex rubber and I do not trust its longevity as raw rubber tends to deteriorate with time.

The DAP Contact Cement is a more industrial strength rubber and it had the lowest resistance of any of the heavy duty contact cements that I tested. While Its resistance is higher (62 ohms per inch) than the Liquid Tape glue. Its biggest advantage is that it does not shrink as much as the LT glue. It is also much more flexible than anything else I tried. This makes it ideal for coating the surface of fabrics without making them curl, to create conductive fabrics, potentiometers, resistors, switches and sockets.

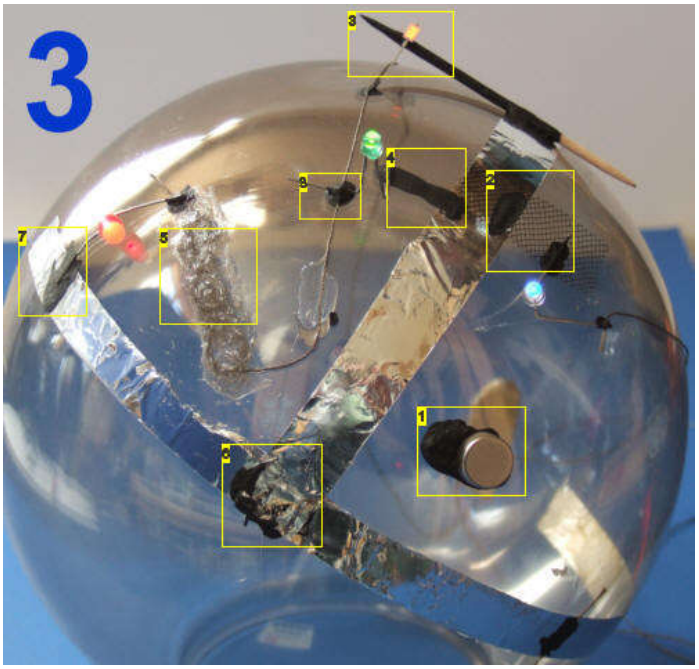
Mix the DAP Contact Cement glue 1-1/2 Graphite to 1 Dap.

Mix #5 Translucent Conductive Glue.
See pic 3B. While I have so far been unable to come up with a clear conductive glue, this is as close as I have gotten. In all of the glues I have been making, I have resisted adding metal powders, or graphite fibers to increase the conductivity, as this makes the glue much more brittle or stiffer. I am trying to keep all the glues flexible as this makes for more interesting possibilities in what can be made conductive. So instead of stiff fibers such as graphite fibers or metal wire, I added flexible conductive thread. And yes, I know, you could just run the thread and skip the glue, but this has interesting artistic possiblilites.

The translucent glue is simply conductive thread that has been unraveled and chopped up into 1/4 inch long pieces. It is then mixed with a clear contact cement such as Welders or Goop. With Welders Contact Cement, I obtained a conductivity as low as 12 ohms per inch.

Mix the translucent glue 1/4 teaspoon clear contact cement with 6 to 12 inches of unraveled and chopped up conductive thread.

Mix #7 Resistor Glue
Mix the resistor glue 1/2 Graphite to 1 Dap contact cement by volume
Less than 1/2 units of graphite can result in a very high resistance or even an insulator.



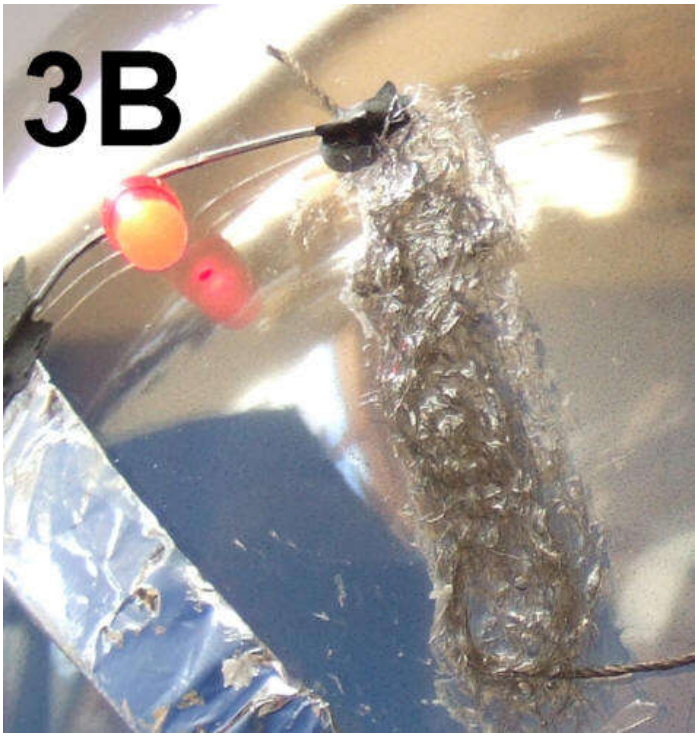
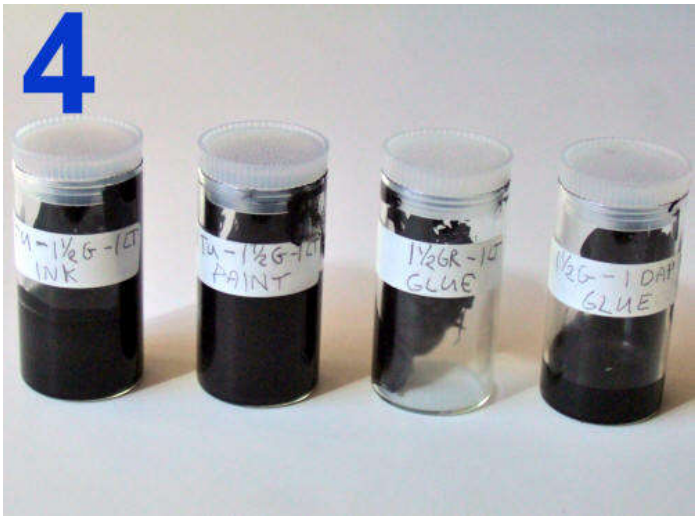


Image Notes
1. Magnetic glue and magnet
2. Conductive netting
3. Toothpick made conductive when coated with glue mix #1
4. Resistor made with mix #7
5. Translucent glue #5
6. Aluminum foil glued to foil with mix #1
7. Led glued to aluminum foil with mix #4
8. LEDs can be glued to glass with mix #1, #2, or #4



step 2: Glue LEDs And Sew A Circuit

The double sided circuit in pic5 is an 3 X 5 alphanumeric LED display that is controlled by a 18x Picaxe micro controller. It can display letters and numbers in preprogrammed sequences that are selected by adjusting the wiper magnet on a flexible potentiometer. The voltage from the potentiometer is measured by an ADC (analogue to digital converter) input of the micro controller to select the different sequences.

You can download a video file that shows the circuit flashing a message at: http://www.inklesspress.com/rollup-circuit.wmv

Materials

Fabric of your choice

Conductive Glue (see previous step)

LEDs available from Electronic Goldmine- http://www.goldmine-elec-products.com/

Conductive thread-Available in small spools at: http://members.shaw.ca/ubik/thread/order.html
Or at: http://www.sparkfun.com/commerce/categories.php?cPath=2_135

1- Choose a fabric-You can glue onto just about any fabric. I have glued onto cotton, nylon, polyester, neoprene, and Dacron. For this project I chose a white polyester fabric used for shower curtains because it tends to lay flat when rolled open. I cut the fabric using a hot knife so that the edges would not unravel. The hot knife was just a 20 watt soldering iron with the tip filed to a knife edge. The hot knife was also handy to melt between glued pins or pads that became shorted from glue overflow.

2- Punch holes for components. If you are using a loose weave fabric your led leads may poke right through. With synthetics like polyester or nylon, you may have to heat up a small wire with a torch to melt holes for your led and IC leads.

3- Tie conductive thread to each led lead wire. I prefer a double overhand knot pulled tight. If you can, it is best to bend and crimp the wire over the thread so it cannot pull lose. This will also lower the resistance of the joint.

Then use mix #1 to glue the thread to the led lead. You can also use paint mix #2, but you will have to do two coats and it has a tendency to flow more than you might like because of capillary action. Try and make sure each connection is coated all the way around. This will seal out most air and moisture and guarantee more than just a mechanical electrical connection to the thread. If you just sew the thread around the component leads without the glue, electrolysis and oxidation of the connection can occur over time. The connections of just a sewn circuit can also loosen over time.

You can also use paint mix #2 to make connections as it tends to flow better around the joint and sticks better to the fabric. The only problem is its higher resistance and its tendency to shrink very thin. This often makes it necessary to do two coats on a joint.

Be very careful when gluing the black bodies of integrated circuits as it is very easy to get a thin and almost invisible coating of the black conductive glue in between the pins. This can short out the pins. Every time I have glued in an IC I have shorted out several of the pins. While this did not damage the IC, I had to spend quite a bit of time with a high power magnifier scraping off the offending glue before the circuit would work.

You can then hand sew the thread to run on either side of the circuit to the appropriate components.

If you do not want to bother with glue and you are good at sewing, Laura Beauchly has worked out a whole system to sew all kinds of components onto fabric. She has also done some interesting things using laser cut conductive fabrics to make flexible circuits. Details available at: http://www.cs.colorado.edu/~buechley/

She even has designed some sew able components available at: http://www.sparkfun.com/commerce/categories.php?cPath=2_135

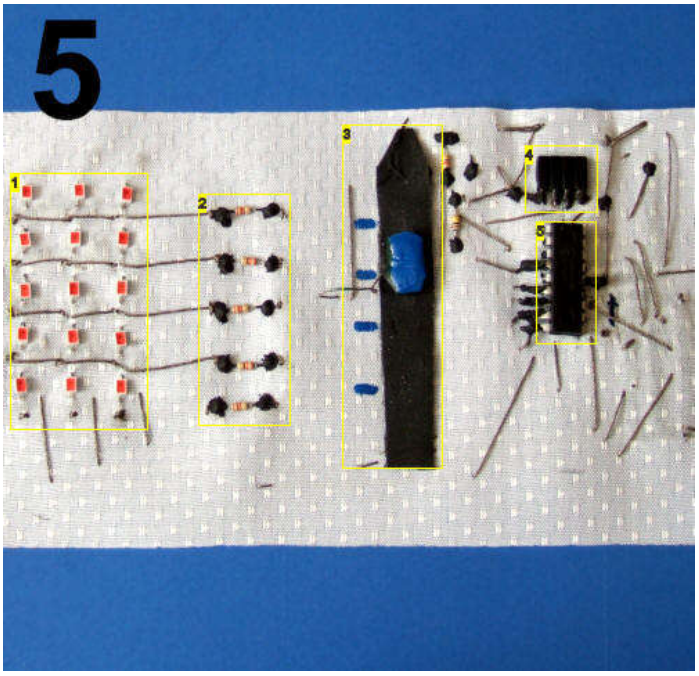


Image Notes
1. 3x5 alphanumeric LED display
2. LED dropping resistors
3. Flexible fabric potentiometer with blue wiper magnet used as a four position switch using one input pin
4. Four pin socket for power and programming the Picaxe
5. 18x Picaxe micro controller

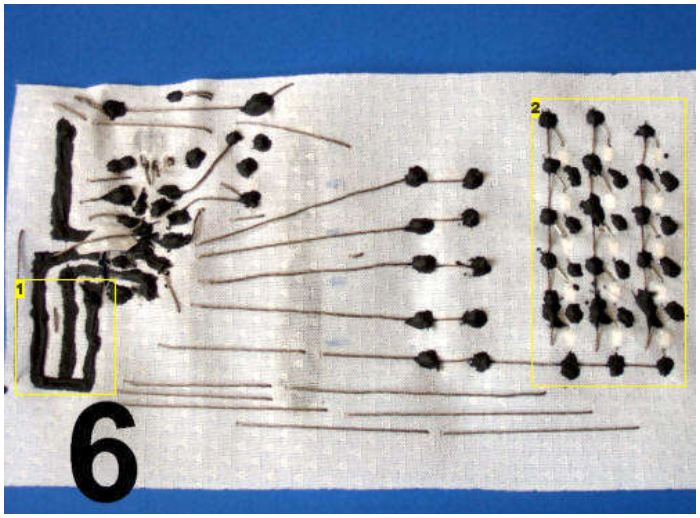


Image Notes
1. Grounding resistors for unused inputs made using mix #7 resistor glue
2. Back of LED display

step 3: Make Magnetic Glue, a Flexible Potentiometer, and a Plug and Socket

Magnetic Glue
To make a flexible potentiometer or a magnetic plug and socket or a magnetic power switch, we need a glue or paint that will attract magnets. Magnetic paint is available commercially and is somewhat expensive. Obviously the paint is not actually magnetic, it is only a paint with a powdered metal filler, usually iron, that attracts magnets. This glue is similar.

You can mix up your own ferromagnetic glue using iron powder available at: http://www.elementalscientific.net/ Or you can take a strong magnet, put it inside a plastic bag and run it through some dirt or sand at the beach or in an arroyo. It will pick up black iron ore also known as magnetite. Use the magnet in a bag to refine the mineral particles until they are mostly the small black particles with the lighter dirt or sand removed. These particles are ferrimagnetic, which means they will attract a magnet but will not tend to become magnetized.

Mix #6 Ferromagnetic or ferrimagnetic glue
Mix the magnetic glue 1-1/2 iron powder or iron ore to 1 DAP contact cement by volume.

Make a flexible potentiometer

Use the techniques described in step 6 to make conductive fabric using Mix #7 Resistor glue. After it dries, you can then cut it using scissors into a long strip about 1/4" wide by 3" long (pic 7c). You can then coat the back with a thickness of about 1/32" to 1/16" of Ferromagnetic glue. This gave me a potentiometer with a resistance that varies from about 30K to 200 ohms. It was later glued with contact cement onto the fabric circuit.

Mix #7 Resistor glue
Mix the resistor glue 1/2 Graphite to 1 Dap contact cement by volume

The wiper contact (see pic 7a) is a neodymium magnet that is first tied with conductive thread and then coated (see pic 7b) with conductive glue mix #1. The conductive wiper, attracted by the ferromagnetic glue on the back, can then be slid along the length of the flexible resistor, to vary the resistance.

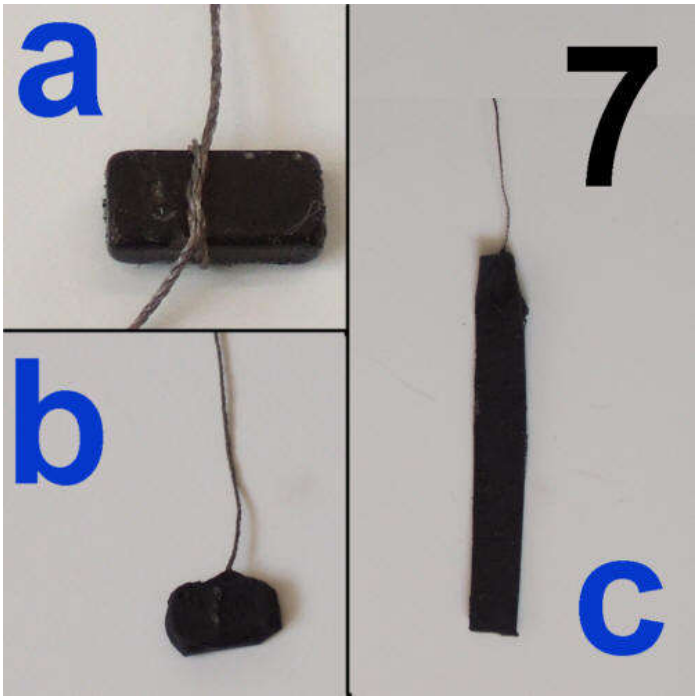
Make a Magnetic Plug and Socket
For the socket (see pic 9a), sew conductive thread in a loop for each contact and then cover it with mix #4. Place something flat and non-sticky such as silicon caulk coated glass on top of the contacts as they dry to create a flat surface. After they have dried, coat the back side with mix #6, ferromagnetic glue.

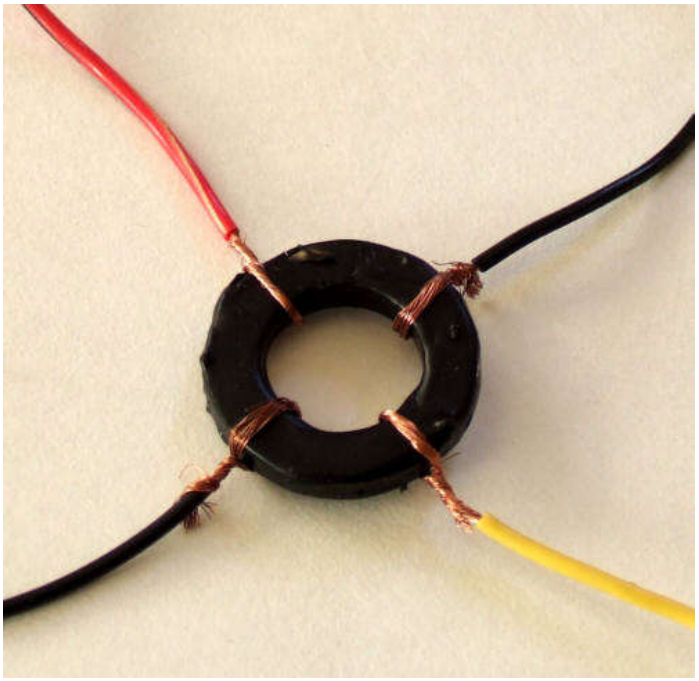
For the plug, a ring magnet works well. Most neodymium magnets are metal plated to protect them from deterioration, so they are electrically conductive. If you are making a plug with several contacts you will first have to coat the magnet with a non conductive glue such as DAP or Welder or Goop contact cement. After it dries, you can then wrap wires (pic 8) where you want the contacts and coat each one with conductive mix #4. Place it on a non stick flat surface such as silicon caulk coated glass or wax paper to flatten the contacts as they dry. Pic 9b shows the completed magnetic plug and socket. On the one I made, the resistance of the contacts between the plug and the socket was 80-100 ohms. Certainly low enough for signal transfers.

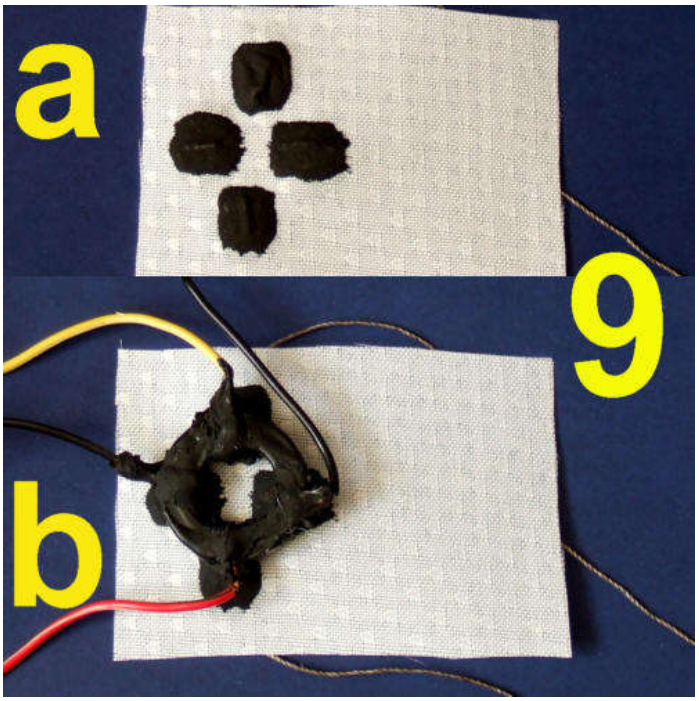
Make a Magnetic Power Switch
Pic 9B shows a simple switch using a plated neodymium magnet. First sew two separate contacts using doubled conductive thread. Then coat the back with magnetic glue leaving enough room above the contacts to dock the wiper magnet. To turn it on you simply slide the magnet over the two thread contacts. The one I made had an on resistance of about 1.16 ohms with a 3/16" x 3/8" magnet. With a thinner 1/16" x 1/4" magnet it had a resistance of about 1.63 ohms when on.

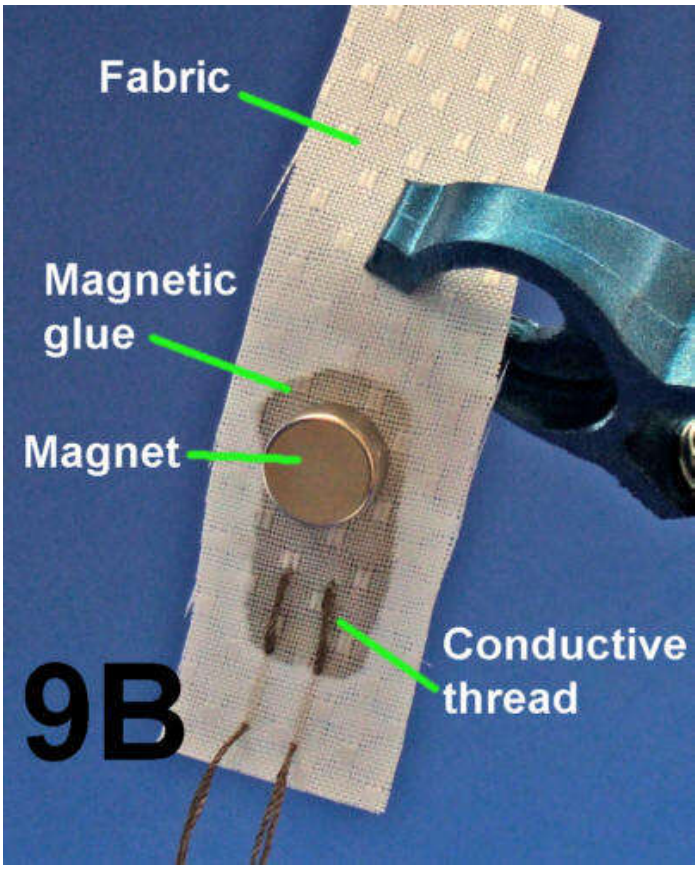
The resistance is even lower if 24 gauge, tinned solid copper wire is used as the contacts. I got a resistance of .02 ohms with wire.

With more contacts around the magnet dock even rotary switches can be made. Or with two magnets--DPDT switches can be made.









step 4: Make Conductive Foam and Switches

While these components were not used in this project, I thought some might be interested in how this can be done.

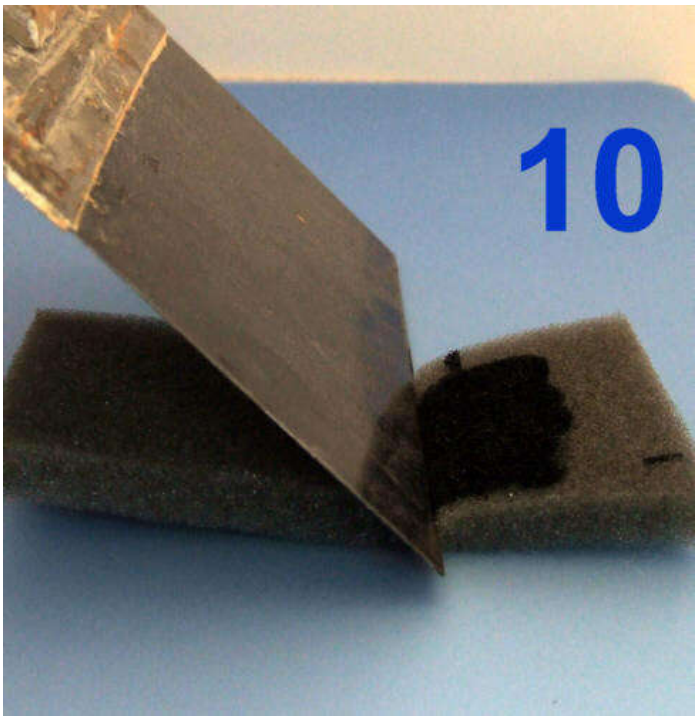
Make Conductive Polyurethane Foam
You can make open cell Polyurethane foam--the kind used for foam paint brushes and pillows and cushions--conductive by coating it with conductive mix #1 (See Pic 10). Use a metal spatula or a plastic spreader such as an old credit card and apply glue on the surface of the foam and quickly spread it thin by compressing the foam with the spreader. If you wait too long the solvents will start to dissolve the foam. Flip the foam over and do it again adding more glue as necessary. Make sure the glue is evenly distributed and worked as thin as you can. Make a larger piece of foam than you will need as some of it may have too much glue and end up stiff as it dries. After it has dried, cut out the softest most flexible part to use for your switch button.

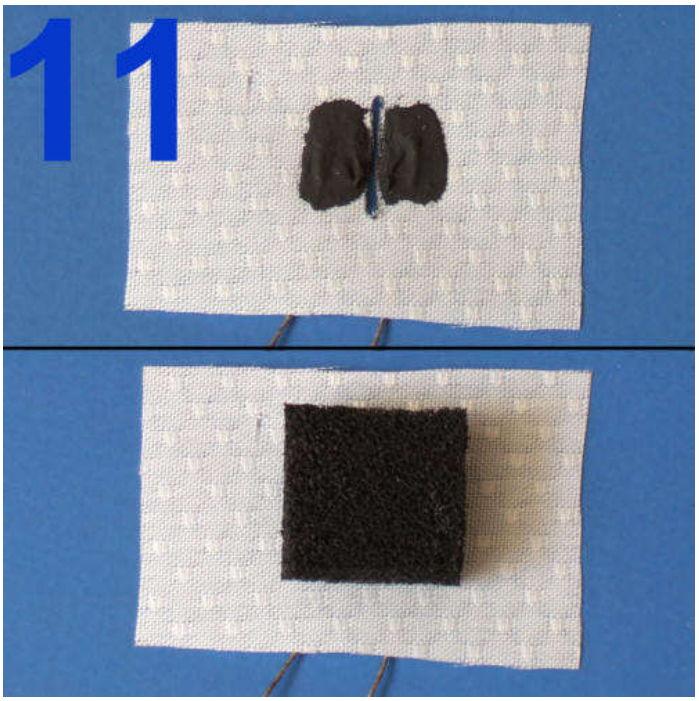
Make Conductive Polyester Foam.
Polyester foam, the white fibered kind also used for pillows and cushions, can also be made conductive using the method above.

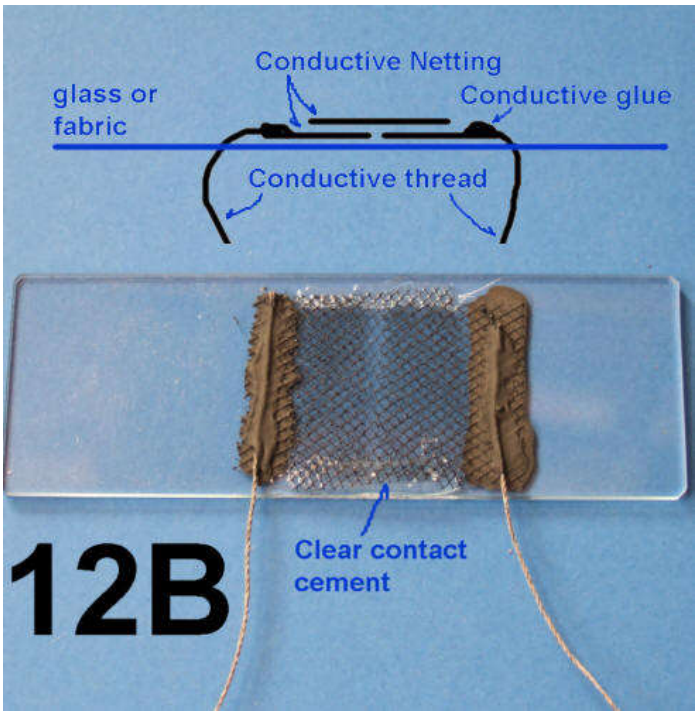
Make Foam Switches and Foam Pressure Sensors
Pic 11a shows how you can make two conductive pads with conductive thread embedded, using conductive glue #4. Then you can glue a conductive foam square button (3/4" x3/4") to one of the pads to create a pressure sensitive switch (pic 11b). The resistance of the switch I made varies with pressure from about 5K ohms to 100K ohms. With no pressure, the resistance is even higher. So it can be used as a switch or as a pressure sensor.

Make a Membrane Switch
A very thin, nearly transparent membrane switch can be made (see pic 12 and 12B) using nylon or polyester netting fabric. See step 6 on how to make the conductive fabric. The netting I used had about 24 squares per inch. You can then glue two small squares of the fabric to glass or another fabric using glue #4 on the edges with conductive thread embedded. Leave a small gap between the squares. Glue another square of the conductive fabric over the two squares using a clear contact cement like Welder. If you are gluing onto fabric, you can put an insulating netting with four to eight squares per inch underneath the top conductive fabric to keep it from turning on if the base fabric is bent.

The membrane switch shown has an open resistance of about 1 meg ohms and a closed resistance of 13k ohms. Certainly low enough to input into a microprocessor or other digital circuit.







step 5: Glue Batteries to Eliminate The Battery Holder or Make a Magnetic Battery Holder

The problem with using small button cell batteries to create a small circuit, is that the battery holder often has as big a volume as the battery itself. If you are trying to make very small battery powered circuits, you can glue the batteries together to create a power pack. This can be useful when making circuits that do not have much room for a holder.

For example, when I was building a one cubic inch robot (pic13B), using a standard size 18x Picaxe, space was at a premium. Even with a custom made battery holder, the contacts took up 2/7 of the usable volume of the batteries and holder.

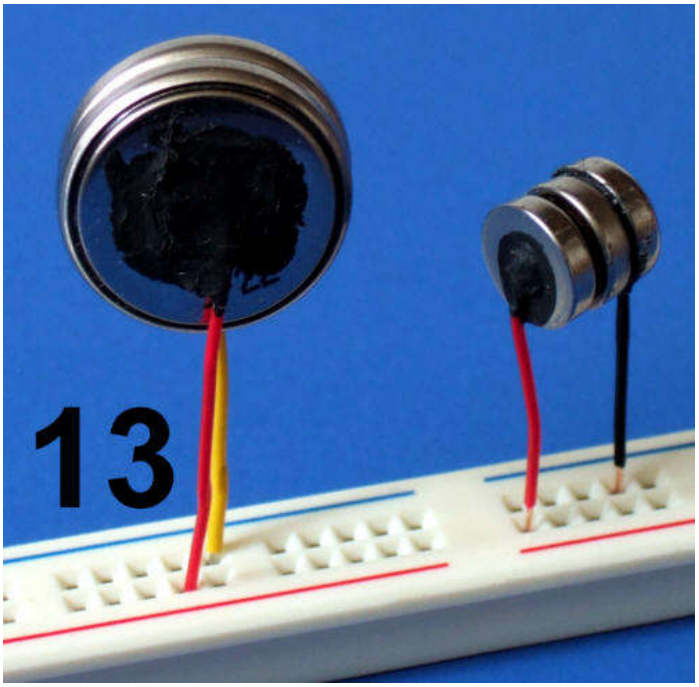
The 2032 3 volt button cells and many other batteries are steel or stainless steel which is a difficult metal to glue to. The DAP glue #4 seemed to glue the best but had a rather high resistance (about 3 ohms between batteries and wires). So I added some chopped up conductive thread to the mix and reduced it to 1.3 ohms.

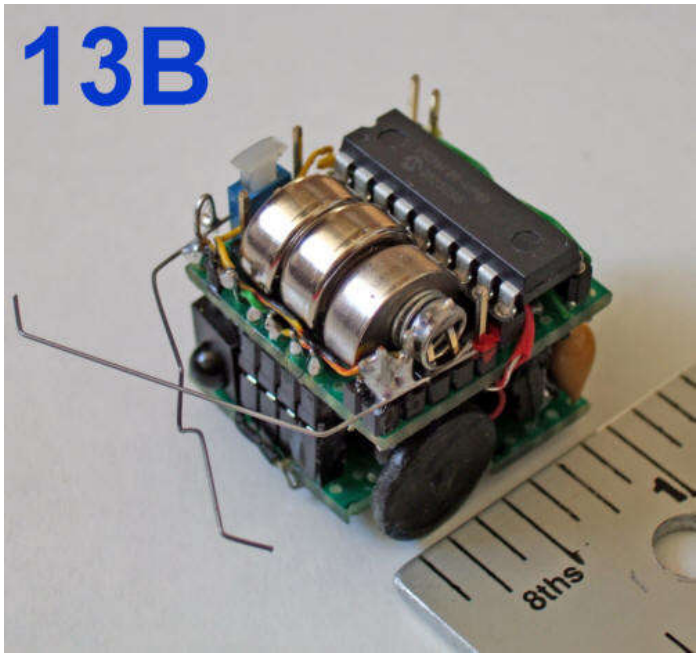
This is trickier than it looks. It is very easy to short out the batteries especially when you are gluing between two button cells. Practice with some dead batteries to find out just the right amount of glue to put between the cells without shorting them out.

I had planned to add a 6 volt battery pack to the roll up circuit, but I ran out of time.

Battery Glue Mix #8: 1/4 teaspoon graphite to 1/4 teaspoon DAP Contact Cement to 6-12 inches of chopped up conductive thread. I unraveled the conductive thread which is composed of about 100 fibers as I cut it into 1/8 to 1/4 inch lengths.

Make a Magnetic Battery Holder with Power Switch
When the volume of the battery holder is not critical, magnets work well to create a holder even on a fabric circuit. The batteries, contacts and fabric are held between two strong magnets. In Pic13C you can see how insulating liquid tape was used to create a docking position for the smaller wiper magnet. It is simply slid onto the battery to turn on the power. The wiper was wrapped and twisted with 22 gauge stranded wire and then glued on the top side to keep it in place. For very flexible stranded wire I like to use servo wire.





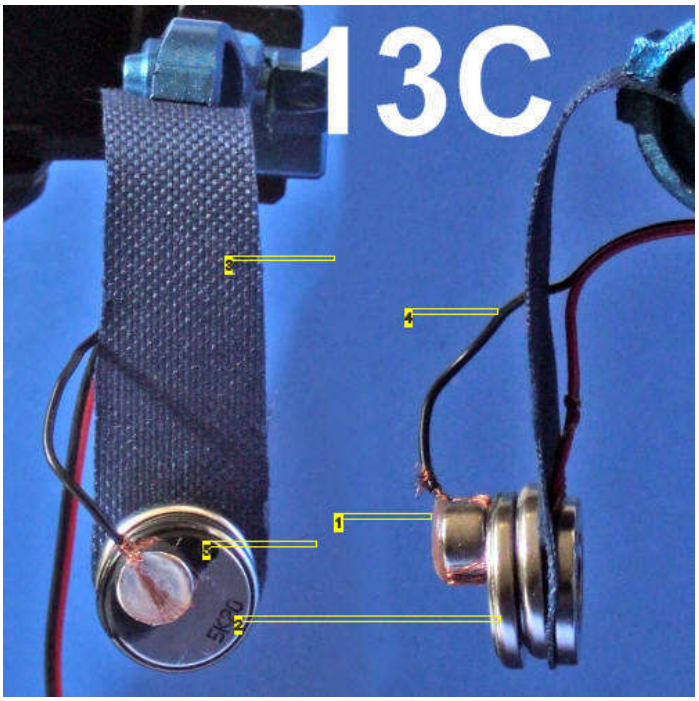


Image Notes
1. Contact cement to hold wire around magnet
2. Two-2032, 3 volt batteries
3. Nylon pack cloth
4. Servo wire
5. Insulating Liquid Tape or contact cement to dock the magnet and turn off power.

step 6: Make Conductive Fabric, Conductive Thread, and Conductive tape

Make Conductive Fabric
You can make various fabrics conductive by coating them with the spatula method. Simply take conductive glue mix #4 and spread it thin and even on the surface using a plastic credit card or metal spatula (pic 17). Pic 18 shows the resulting coated fabric that can then be cut to size. For minimum resistance it usually takes a second coat after the first has dried. The resistance is usually around 300 to 1,000 ohms per inch. This is too high for most low power transmission, but can be useful for sending signals across flexible joints or for making switches and sensors. It may also have high voltage possibilities. I have not had time to try it, but it may be possible to plate this kind of conductive fabric with copper or nickel and decrease the resistance dramatically. Pic 16 shows the flexibility of the resulting conductive fabric.

Make an Almost Transparent Conductive Fabric
I have successfully coated nylon, cotton jean material, neoprene and polyester. Using the method above, you can even coat nylon or polyester netting fabric which results in an almost transparent fabric. See pic14. Pic 15 shows the 20 squares per inch fabric under a 50x magnification. You can see that the resulting conductive coating is quite thin.

If you are interested in buying metal plated conductive fabrics that are somewhat expensive but have very low conductivity, (.1 ohm to 5 ohms per inch) you should check out: http://www.lessemf.com They have a great selection of conductive fabrics.

Make Conductive Thread
By running thread through glue mix #1 or #4 and holding it down in the mix with a notched Popsicle stick, you can make most threads conductive. See pic 19. To make sure they dry straight, you should hang them with one end weighted until they are dry. I have successfully coated nylon fishing line, cotton thread, Dacron thread, and cotton yarn. Generally, the larger the diameter of the thread, the less the final resistance. With two coats, the resistance is around 700 ohms to 2k ohms per inch.

With this kind of resistance, this do it yourself conductive thread is not going to replace the commercial conductive thread, the best of which has a resistance of around 2 ohms per inch and is more flexible and easier to sew. It is however, useful for transferring signals and creating thin low power resistors. It may also be useful for some high voltage applications. It might be possible to plate this kind of conductive thread with copper or nickel and significantly decrease the resistance.

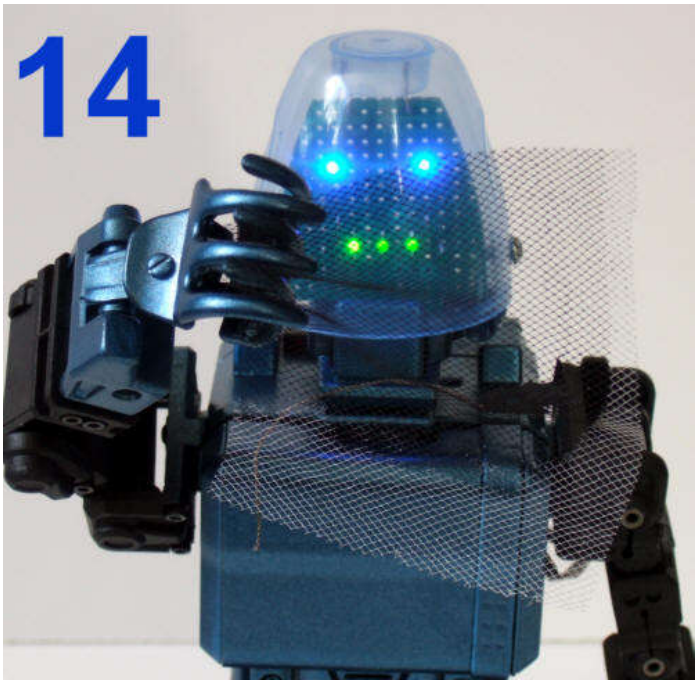
Conductive Thread at Wal-Mart
Wal-Mart sells a thread in their fabric department that is conductive. It is called: Coates Metallic Decorative Thread. It comes in a silver or gold color but I have had the best luck with the silver thread. It is unfortunately coated with a very thin clear polymer that insulates the spiral wound thin metal inside and probably keeps it from oxidizing. This prevents you from simply hooking up a test meter to measure resistance.

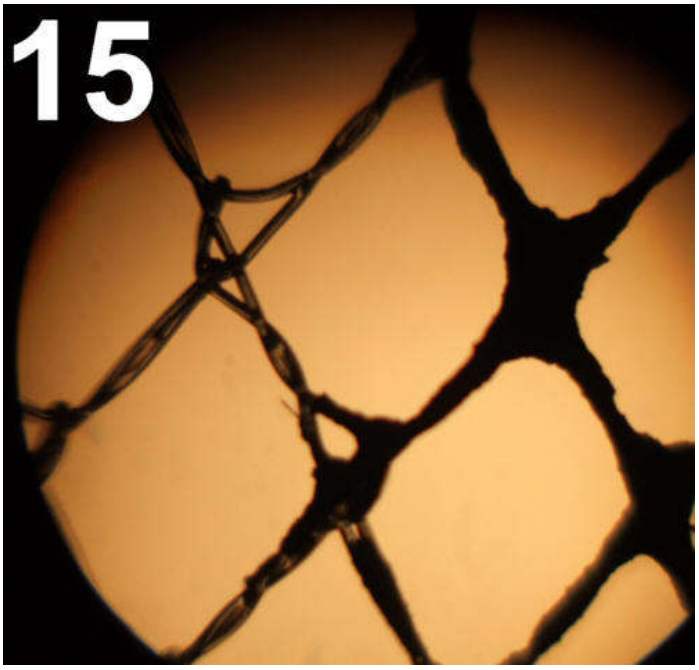
I have tried scraping the surface and I have tried various solvents to try and melt off the coating without much success. You can, however, use conductive glue mix #1 to glue wires or regular conductive thread to the ends of a length of the Coats thread. The glue joints will add resistance, but they make this very thin thread (it is thinner than the commercial conductive thread) usable for conducting signals. Since they are insulated with a plastic coating they can be bundled together without shorting and run like wires. The resistance varies depending on the quality of the glue joint, but it usually results in a resistance of about 80 to 200 ohms per inch for a one foot length of thread.

Make Conductive Duct Tape
You can make the back of most tapes, including duct tape, conductive by coating one or two coats of mix #4 on the back side of the tape. If you want to use the tape for electromagnetic shielding, you can also coat the adhesive side with mix #4 and then wrap the tape around whatever it is shielding before the glue dries. A bit messy, but it works. For duct tape, the resistance is about 200 to 300 ohms per linear inch.

Make Conductive Aluminum Tape
You can make a more conductive tape using regular aluminum foil (see pic 20). For instance, if you want to transmit low power DC across a wall, you can cut the foil about 1/2" wide and glue it flat with Dap contact cement or Goop. Where you need to glue two strips together for longer runs or to turn corners, you can use conductive glue mix #1. While 1/2" wide aluminum foil has a resistance of about .1 ohms per foot, glued splices 1" long and 1/2" wide tend to have a resistance of 3-4 ohms. You can then use the same mix to glue on LEDs or other components to the foil. If you paint over with a good latex paint, you can make most of the circuit almost invisible.

Another way that works well and is less messy, is to coat the duct tape or aluminum foil with conductive glue #4 and wait until it is fairly dry but still sticky and then press it onto a surface. If you put on the right thickness of glue this can eliminate the ooze out and it will work similar to regular tape.



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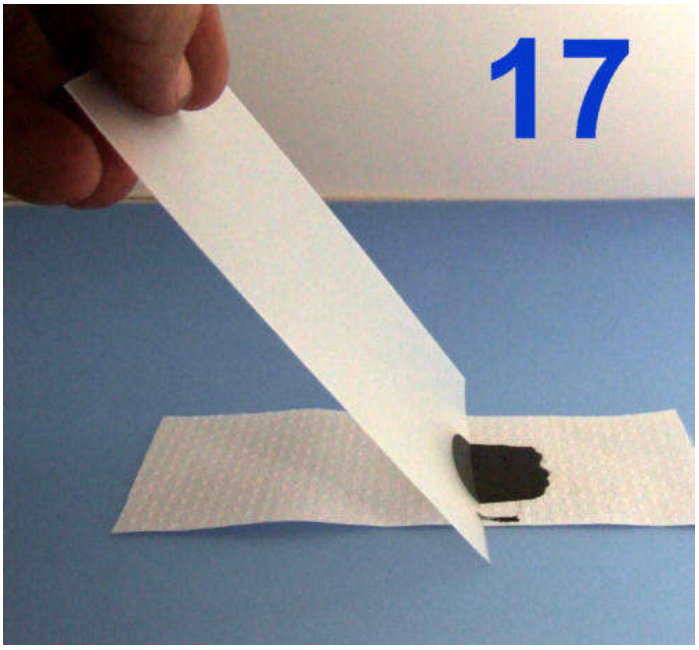
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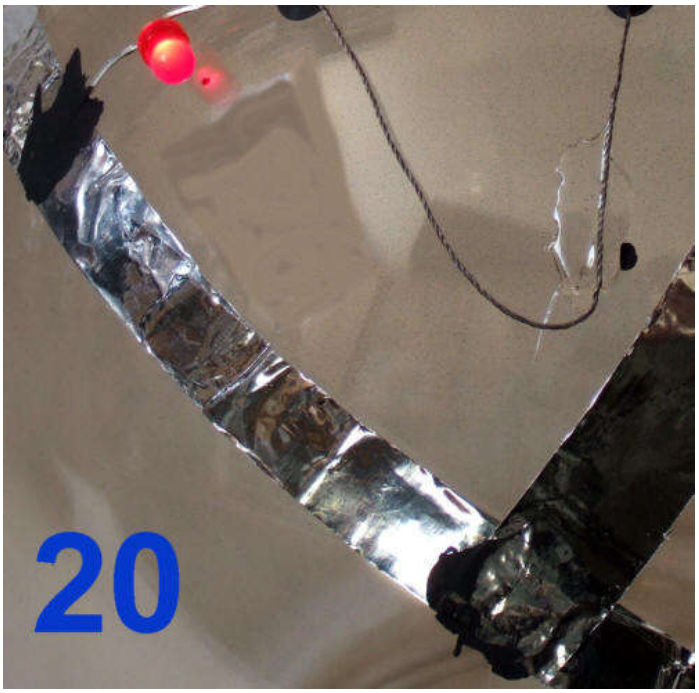


step 7: Conductive Glue and Sew a Picaxe Microcontroller Circuit

I have chosen the 18x Picaxe micro controller for this project because it is inexpensive and perhaps the easiest to wire and program of any micro controller I have seen. The Picaxe micro controllers are also very forgiving. In over twenty projects that I have done, I have often mis wired connections or shorted outputs and have yet to burn one out.

Picaxe chips and programming cables and software are available from: http://www.hvwtech.com/default.asp
Or: http://www.futurlec.com/Components.shtml

A very good manual on programming the Picaxe in Basic is available free from: http://www.rev-ed.co.uk/picaxe/

In this particular project, the 18x Picaxe is programmed to light the 3 by 5 led matrix in a sequence of letters or numbers to spell out messages. By varying the input voltage to an ADC (analog to digital converter) input, the potentiometer (see step 3) made out of flexible conductive fabric, is used to choose different messages. It becomes effectively, a one input multi-switch.

I originally glued in dropping resistors R1-R5 in order to make sure I did not overload the Picaxe outputs. It turned out that the combination of glue joints and conductive thread created enough resistance that the resistors were unnecessary. So, I shorted them out on the back with conductive thread.

The four pin socket was to be for power in and serial programming. It did not work out well as there was not enough room to sew and glue the thread on adequately. The connections eventually came loose with use. In the future, I would solder some short wires on first and splay them out to have more room to glue.

I ran out of time, so I was unable to install a glued battery pack below the Picaxe chip as I had originally planned.

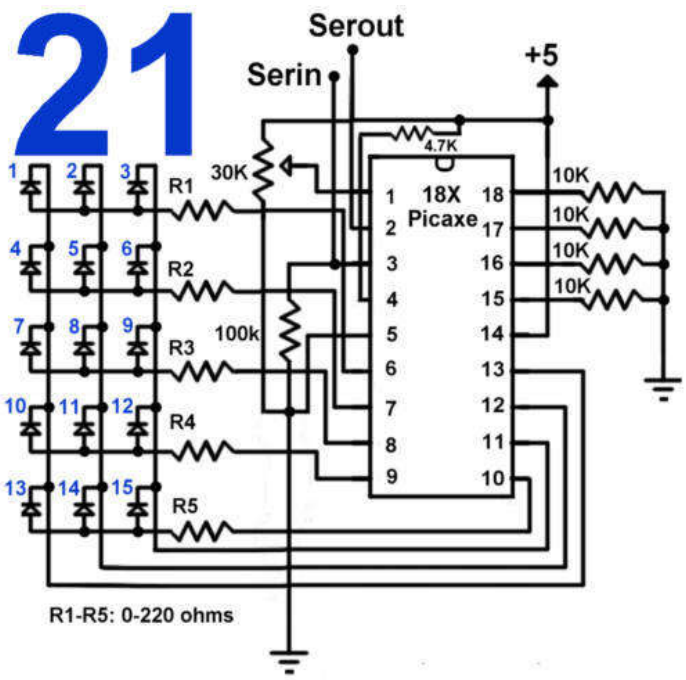
I chose to glue the whole circuit and avoid soldering just to see if I could work out the techniques required. But, it is no doubt faster to solder rather than to glue up the basic connections of a micro controller. A more practical method for future projects would be to solder the Picaxe chip, batteries, plugs, and most of the resistors on a long narrow circuit board. The board would be the width that you want the circuit to fold up at. The thread would then be run to the input switches, potentiometers, or other sensors and the outputs to the LEDs to make the circuit flexible. I have seen several commercial products that roll up done in this way.

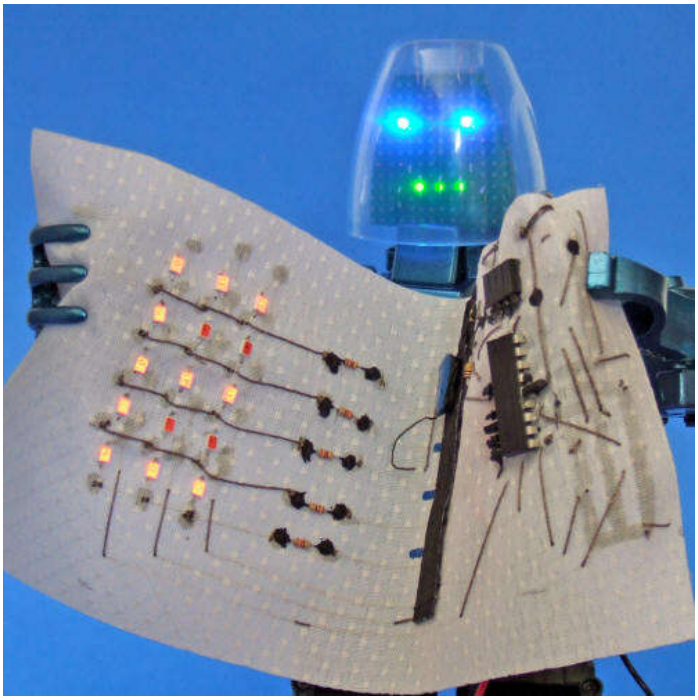
If you want to make the circuit more rugged, I would suggest coating all of the IC pins and any other delicate conductive glue joints with clear contact cement so that they are solidly attached to the fabric.

You can download the Basic program code for the Picaxe at: http://www.inklesspress.com/rollupcircuit.txt

For other possible circuits to try that use the Picaxe, you can check out some other projects I have done at: http://www.inklesspress.com/picaxe_projects.htm

The Possibilities of Using Flexible Circuits
I have just begun to explore the possibilities of flexible circuits using conductive materials. You may not want to build a circuit that completely rolls up. But the techniques presented here show how you can make circuits on any flexible material including hats, paper, pants, rubber, T-shirts, gloves, socks, wallets, inflatables, or jackets. You can also make flexible sensors and displays of various kinds. The limit--is your imagination.





Related Instructables

Conductive Fabric: Make Flexible Circuits Using An Inkjet Printer. by mikey77

Musical Bra by sarahlayne

Make Conductive Glue and Glue a Circuit by mikey77

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Three Fabric Buttons by Plusea

Oh sew stylish - iPod control in a bag's handle by aniomagic

Comments

50 comments **Add Comment** **view all 53 comments**

kcchen_00 says: Jun 10, 2010. 12:36 AM **REPLY**
Will the conductive glue cause scratches in plastics or glass with prolonged contact? Or is the carbon graphite powder fine enough to protect against unwanted wear?

kamaljassal says: Mar 15, 2010. 2:11 AM **REPLY**
We still awaits your reply.
Do your paint stripper would also strips the silver ink which we do use before electrofoaming.

please revert asap.

kamaljassal says: Mar 16, 2010. 8:40 AM **REPLY**
one querry that makes us able Do your paint stripper would also strips the silver ink which we do use before electrofoaming

8bit says: Apr 23, 2010. 1:38 PM **REPLY**
What silver ink? Also, what is electrofoaming?

chrispix says: Jan 14, 2010. 12:43 PM **REPLY**

I'd like to lay down conductive strips on a door, but the lengths are long, and the glue alone would create too much resistance. If I used the conductive glue to attach conductive thread to the door, would that effectively reduce the resistance over a longer distance (say a few feet) to the resistance of the thread?

madscientist167 says: Oct 27, 2009. 1:48 PM **REPLY**

does school glue work with this

Xynck says: Jul 19, 2008. 7:07 PM **REPLY**

Could you lay a line of Conductive Glue from wrist to fingertip to wrist, stick an LED on your fingertip, connect the glue to battery terminals, and have it work?

mikey77 says: Jul 21, 2008. 6:01 PM **REPLY**

Yes, but as I have mentioned in the comments below, this conductive glue contains POISONOUS solvents which would be absorbed by the skin and enter the bloodstream. Not a good idea. A better idea would be to use conductive thread or conductive fabric and a non-toxic glue such as spirit gum (used to glue on latex molds for makeup) to run the thread or fabric to LEDs that were pre-glued to the conductive thread or fabric with conductive glue and dried..

madscientist167 says: Oct 26, 2009. 3:14 PM **REPLY**

would it be possible to use elmers school glue for this i have to do with it

ddarko says: Oct 5, 2009. 10:33 PM **REPLY**

Great instructable! I'm curious as to how much heat this could produce and how quickly. I'd like to use this on a fabric which I want heated to approx 30 degrees but it needs to heat up and cool down to ambient temperature pretty quickly, in a matter of a seconds. Does this sound achievable using typical batteries considering the modest temperature requirement? I'm willing to experiment but would really appreciate a professional opinion on the matter.

Edwin Lee says: Jun 19, 2009. 3:49 AM **REPLY**

where you get the robot?

Wesley666 says: Feb 1, 2009. 6:08 PM **REPLY**

The conductive ink/paint/glue used powdered graphite. I want to know if you could use powdered copper?

mettaurlover says: Jan 7, 2009. 9:36 PM **REPLY**

im gonna use this technique to turn my winter gloves into tazers:)

nap70 says: Dec 16, 2008. 7:28 AM **REPLY**

Your instructable helped me convert my nice dance pads for my (now deceased) PS2 to work on my Xbox 360. My kids are so happy! My kids are DDR fanatics. I bought them nice dance pads for the PS2 a long time ago. After the PS2 died, I got the game with pad for the 360. The kids hate the pad that comes with the game. But no one seems to make the nicer pads for the 360. So I decided to open up the pads to see what I can learn. The two are basically the same design, even the traces line up. But I had no idea how to attach the plastic sensor to the circuit board. A google search for conductive adhesive led me here. I'm so glad it worked. I still have to convert the other dance pad. I will try to make an instructable for that and link to this article.

BlackDidThis says: Oct 7, 2008. 6:52 AM **REPLY**

Wow ;
What in informative Instructable!
I actually signed up JUST to be able to post on this and rate it!

I was once planning on making my wife a **"Taser" glove** as a fun(cool) project so that she could use for self deffence or what not outside (gets pretty cold here) without needing to rush to her purse or anything.

My original idea was to pour an attractive latex addition to an inexpensive glove I purchased some while earlier (they were called "jogging" gloves). And to try burying wires from the battery and high-voltage in the design (She has to be able to wear it outside remember?).
Well it doesn't take much to figure out that wires do not exactly stretch like a glove would! I was just too caught up with the "cool looking gadget" idea to correctly analyse correct functionality even though I was so busy evaluating of her ergonomics, cushion pads, her hand mould and etc...

As an alternative ; I was thinking of how we used to copper plate polyester statues we made in the academy and then chemically treated them to look like Bronze. I was thinking if there would be a way to do the same since to be able to electroplate it we used to paint it with a strong mix of (in that project) coppered paint, making it conductive.
Why couldn't I paint an insulated glove (Was NOT a good idea with such a high voltage)?

To no success I retreated to the *original idea* of giving wires a certain distance for motion and to put it all 'under' the glove.
Where safety was a concern though that maybe a rubber glove underneath would be a good idea and etc...

As you may guess:
The project has been on hold for some time, due to impracticalness at the period of "just begining".

Now that I read your instructable;
I am full with many new ideas! If nothing; a few of my other glove projects had involved a glove that you would not need to take off in cold weathers to be able to use your touch-pad (there are two that I use often, a very thick one that is also battery operated for really cold weathers, and another that is more

what a liner with conductive thread patches.

For all honesty; after my failure and no demand for such a “weapon/toy”; I didn’t experiment with other metals or binders… (Also due to lack of time and too many other projects to attend to)

Would you recommend the conductive glue or paint you have experimented with for such voltages ranging from 400 volts on (depending on the feed it gets up to a nasty 1100 even. It is something almost all of us must have done at some time with an old flash... nothing too new there)

I will try to experiment with your combinations first chance I get though.

THANK you for the inspiration!

Black

jdrews says: Sep 11, 2008. 7:38 AM **REPLY**

Thanks for your instructable mikey77!

As a sidenote:
If any of you have trouble finding "Tuloul solvent", I believe it's a typo. I think it's Tuluol solvent, or more commonly known as Toluene. Here's a wikipedia page:
http://en.wikipedia.org/wiki/Toluene

absalom says: Jul 31, 2008. 3:28 PM **REPLY**

i'd love to get this conductive glue working. got the DAP contact cement & the graphite.. made a thick pulpy mess that conducts nada... i tried several different mixtures from goopy to liquid. also, i am trying to make switches conducting 5v. what am i doing wrong?

mikey77 says: Aug 1, 2008. 6:32 PM **REPLY**

As I have said in the comments below, the purer the graphite the better the conductivity. Lubricating graphites may have additives that will increase the resistance. The only accurate way to measure the resistance of conductive glues is to embed good conductors in the mix. Measuring the surface of the conductive glue will not give you accurate results. I hope this helps.

Redgerr says: Jul 21, 2008. 10:49 AM **REPLY**

W O W... thats all i can say, this is absolutely amazing!!!!1!!1!

guitarman63mm says: Jul 8, 2008. 5:27 PM **REPLY**

Is there a more cost-effective method of conductive paint? Or maybe copper foil is more my deal for reducing interference. . .

Richard123 says: Jun 30, 2008. 4:56 PM **REPLY**

Ah, Mikey, Mikey--the answer to my online wishes. I replaced two chips in a word processor and the work was successful but I did some damage to a flexible printed circuit. A word processor which works "great" but no space bar action is sub-par I think. A circuitwriter would be $30 and not available at all locally. Besides, the printed circuit includes black resistive lands (for some reason) and so to make a long story short your technology fits the bill. Not only that, but after reading about the liquid tape experiment, I found I could not obtain that locally, but then discovered the later essays. I had graphite and I had the Dap. So I am in business! So far I have been experimenting with acrap print circuit. I found that a looser more flowing mix is not good enough. It must be thicker than what one would desire for ease od application. Unless, the looser batch will improve with age? It is still quite pliable. But the stiffer mix makes a strong enough joint even if it is not smooth. I have not yet attempted a final repair. I will have to approimate the original resistances--even though I don't know why any resistance should be introduced to begin with. But I think I stand a chance. And the investment so far stands at $2.46 for extra graphite just so I have plenty. I cannot praise you ingenuity enough and I think your freedom from inhibiting structures bodes well for your creativity.

srikr125 says: Jun 25, 2008. 4:08 AM **REPLY**

hello folks!! does anyone know if there is any p-type conductive glue that can be used in polymer led...

mightywombat says: Apr 22, 2008. 7:38 PM **REPLY**

This is awesome stuff, all dozen-odd versions! I especially LOVE the tiny nano-sumo robot. Do you have any instructions or anything on how I might begin to make one?

mikey77 says: Apr 23, 2008. 12:23 PM **REPLY**

I am working on an instructible that will detail how it was made. I will post the link here after it is published.

mightywombat says: Apr 23, 2008. 2:24 PM **REPLY**

Awesome. I can't wait to see it!

mikey77 says: Jun 12, 2008. 7:08 PM **REPLY**

You can find my instructable on building small robots here: http://www.instructables.com/id/Building-Small-Robots-Making-One-Cubic-Inch-Micro/

mightywombat says: Jun 12, 2008. 7:38 PM **REPLY**
Cool! I'll go look at it right now.

gzzysd says: Mar 24, 2008. 12:18 AM **REPLY**
It is made of special silver conductive material. After solidify completely. The products' adhesive has flexible and conductive effects. Conductive adhesive is mainly applies to which request Conductive and flexible connectivity. Should be thinking about Metals (or conductivity) of the material electrolytic corrosion, When you choice. This high Conductive adhesive can also be use to bond and fix such as Metal, Glass, Rubber and Porous or open mesh liner.

gzzysd says: Mar 24, 2008. 12:16 AM **REPLY**
I have conductive adhesive production methods ï¼ÂŒAlso have ready-made products!

hornbadoing says: Jan 30, 2008. 5:55 AM **REPLY**
sweet soldering withought soulder lol

lifelong-newbie says: Mar 23, 2008. 2:30 PM **REPLY**
In relation to this comment; if you were o use this substance as solder, how would you go about removing it ("desoldering")?

lifelong-newbie says: Mar 22, 2008. 4:32 PM **REPLY**
I dont understand the layout of this instructable, how exactly would i go about making magnetic glue/paint? please help me out

mikey77 says: Mar 22, 2008. 8:36 PM **REPLY**
Step 3 explains how. Use mix #6 for a glue that will attract magnets. For a flexible paint that will attract magnets you can use iron powder, iron filings or iron ore (magnetite found in sand) and mix it with DAP Contact Cement that has been thinned with toulol. If you are painting a larger area, you can use latex paint instead of the Contact Cement. Obviously, the thinner the coating, the less it will attract the magnets.

lifelong-newbie says: Mar 23, 2008. 1:31 PM **REPLY**
Thanks, that clears it up a little

nf119 says: Feb 12, 2008. 7:25 PM **REPLY**
Wow! This belong in a research journal. Love the 1" Robot. You put lots hard work into this. Again what a fine instructable!

The_pyrogeek says: Jan 7, 2008. 3:09 PM **REPLY**
Pretty cool, I will have to try this sometime... Keep up the good work! :)

Dr_Acula says: Dec 23, 2007. 2:50 AM **REPLY**
Nifty. I've been playing recently with flexible solar cells (available on ebay and other places). Could provide a flexible power supply for this instructable. Picaxes rock, and if you ever get stuck there are hundreds of very helpful people who can help you out at http://www.picaxeforum.co.uk/

lamedust says: Jan 7, 2008. 11:36 AM **REPLY**
Are they expensive? I hear they print them now, I challenge myself first, then everyone else here to figure out a similar process for printing solar panels. _BG

Dr_Acula says: Jan 7, 2008. 2:25 PM **REPLY**
About the same price as inflexible ones. Available on ebay - search for 'flexible solar'. You could easily sew them into clothes.

lamedust says: Jan 7, 2008. 11:35 AM **REPLY**
Hey, I'm working on something that's similar to what you are. I've tried using aluminum powder with a silkscreening clear base, that didn't work. But, I'll certianly give the graphite powder a shot. Also I picked up some liquid Nickel that people use to fix conductive traces and I'll let you know how that goes. Cool project, I like how you looked at it electronically! -bg

hondagofast says: Dec 28, 2007. 3:25 PM **REPLY**
You could make a light up kite or something with this.... If only I hadn't blown all my money on manga...

frickelkram says: Dec 22, 2007. 12:45 AM **REPLY**

Cool idea ... it gives many possibilities for diy projects. Thank you!

Kiteman says: Dec 20, 2007. 11:27 AM **REPLY**

I have never checked, but is the carbon fibre used in composites conductive? Could threads be teased from the weave and spun together to make a conductive thread?

Ale_G says: Dec 21, 2007. 5:49 PM **REPLY**

carbon fibre is definitely conductive, when I work with it (usually loose fibres to strenghten some areas of my model planes) I make sure to work carefully and away from electronic appliances like PCs and TVs; the very thin fibers are wisp like and can float in the air easily, if the get inside a, for example, computer they may end up causing a short.

thecheatscalc says: Dec 20, 2007. 7:02 PM **REPLY**

I know carbon fiber to some extent is conductive... never tested it to much of an extent... Definitely not an insulator! They use carbon foam for antistatic protection when packaging microchips after all...

blksheep says: Dec 20, 2007. 7:52 AM **REPLY**

Have you every tried this with an epoxy? I was thinking fiberglass resin. I know that FG resin doesn't conduct, but I thought that maybe by using your technique it would be possible.

mikey77 says: Dec 20, 2007. 8:29 AM **REPLY**

I have tried several epoxies with no luck. Most conductive epoxies use expensive silver particles to become conductive. I have not tried fiberglass resin.

rimar2000 says: Dec 20, 2007. 3:58 AM **REPLY**

Nice, interesting, ingenious, useful, very good work. Thanks.

xtank5 says: Dec 19, 2007. 8:09 PM **REPLY**

Now if only I had the money to buy the materials. Can't wait to try it though.

snax says: Dec 19, 2007. 7:31 PM **REPLY**

nice !!!!! this will be very usefull great job

view all 53 comments