**Home-made DIY e-Drums**

These e-drums are pretty simple to make from MDF and/or plywood, inexpensive wooden embroidery hoops, purchased rims, and fiberglass window screen. They are very low profile, less than 2” thick.

The length of this instruction document might seem to make this look complicated. It’s not – it’s just that I’ve tried to put in as much detail and lots of pictures to help make it all clear. Here are the steps without all the fluff, just to demonstrate how simple it really is:

**BASE:** Cut a circle of ¼” or ½” thick material 2” larger than the head/rim you’re using. Install threaded inserts lined up with the holes in the rim. Add a couple more inserts to attach a mounting bracket if you like. Done.

**SHELL:** Cut out a 1” section from the inner portion of an embroidery hoop. Close up the cut section to make a smaller hoop. Cut off the ends of the outer hoop and tape them together so that it matches the modified inner hoop in size. Glue the two hoops together to form a single hoop. Done.

**HEAD:** Apply glue to both hoops. Lay two layers of screen over the inner hoop. Press the outer hoop over the inner hoop and screen and tighten the thumbscrew. Take out as much slack in the screen as possible. Trim the screen and remove the metal parts. Done.

**RIM:** Use a purchased rim, or cut and drill a “donut” rim from plywood or MDF.

**SENSOR:** Make a sandwich of foam padding, foam tape, and the piezo sensor in the center of the base. Start with foam tape, add foam padding, more tape, the sensor, more tape, and more padding. Attach sensor to a jack or cable. Done.

**DRUM ASSEMBLY:** Place the shell onto the base. Place the head onto the shell. Place the rim over the head. Install screws and washers and tension the head as desired. Done.

OK, now for the detailed instructions.

**Drum Base**

The base is made of ¼” or ½” thick MDF or plywood. Cut a disk 2” larger in diameter than the head size you are using. At each of the lug positions, install one ¼” – 20 threaded insert (for ½” material) or t-nut (for ¼” material). See below for info about choosing material thickness. The diameter of the centerline of the lug positions is 1” greater than the drum size. So a 10” drum has six holes evenly spaced on an 11” diameter circle, on a base that is 12” in diameter. Also, as one option for mounting the drum to a bracket, you can install two more inserts or t-nuts about 3” apart around the center of the base. The lug inserts should be installed from the bottom of the base, while
the mounting bracket inserts should install from the top. In this orientation, the insert’s flange pulls against the base as the screw is tightened, rather than pulling out of the base material. Base can be painted at this time. I recommend black for the top side of the base to reduce its visibility under the mesh head. If you plan to use the drum as a cymbal pad, consider metallic gold paint for the bottom and edge of the base, along with a brass hoop and brass screws! (I got 6” chrome and brass hoops at http://www.drummaker.net).

**A note about base material thickness**

I used ½” MDF for the 10” snare and ¼” MDF for four 6” pads – one tom, a hi-hat, a crash, and a ride. I made five brackets from 1” x 1/8” strips of aluminum to attach the four small pads and the drum module to the snare. (See photos at the end of this document). I made a total of 12 holes on the snare – 6 for the rim lugs and 6 for brackets (with one spare). The snare fits nicely into a standard snare stand, making a compact and portable little kit, and eliminating the need to build a stand. Making the snare from ½” material gives added strength to support the four brackets and pads (and the beatings they take). If all your pads will be individually mounted to a stand of some sort, ¼” material should work just fine for all pads.

Here are a 6” and a 10” base, cut and drilled, and also showing inserts / t-nuts:

![Drilled 6” base (¼” MDF)](image1)
![6” base with T-nuts](image2)
![10” base (½” MDF) with inserts](image3)

(Rim lug inserts installed on opposite side from mounting inserts)

**How to use the Layout Template**

You can use the template at the end of this document to help lay out the drum base for cutting and drilling. Print two copies of the template. IMPORTANT: PRINT WITH “NO SCALING”. Be sure the PDF print dialog Page Scaling option is not set to “Fit to Printer Margins” but rather is set to “None”. Otherwise the templates will not be the correct size. After printing, check the distance from the CENTER crosshairs to the crosshairs on the edge of the 12” base with a ruler, to ensure the template printed correctly.

Rotate one copy 180 degrees (upside down but still facing you), then lay one copy on the other, lining up the Center crosshair and the two Mounting Bracket crosshairs on the two sheets. Holding the copies up against a bright window will help you see through both sheets to get them lined up correctly. Once they’re properly aligned, tape the copies together.
Place the template on the base material. Gently tap a small nail or tack through the intersection of the Center crosshairs. Poke a small hole anywhere along the Base Edge circle for the size base you’re making. Insert the tip of a sharpened pencil into this hole and gently move the pencil and the template in a circle around the nail at the center, keeping the template flat as you turn it. The template acts like a compass, allowing you to draw an accurate circle.

Now tape the template to the wood so it no longer rotates. Use another nail and a hammer to gently make a mark at the crosshairs for each Lug Hole of the size base you’re making. Don’t tap the nail so hard that it stays in the wood – just enough to mark the location. 6” and 8” bases have four lug holes; 10” and 12” have six. Mark the mounting bracket holes as well if you are using them.

Remove the center nail. The nail hole at the center can be used if you have a circle cutting jig for a router. Otherwise, use a jigsaw to cut out the base. (If cutting a neat circle seems like too much work, there’s nothing to prevent you from making the base square or any other shape, as long as you don’t cut inside the Base Edge circle). Drill holes at the lug locations and install the threaded inserts. CAUTION! Place a scrap of wood under the base when you hammer in the inserts or T-nuts. If you tap them in on a hard surface, you risk damaging the insert making it unusable and ruining the base.

**Drum Shell**

The shells are made from wooden embroidery hoops, available at craft and sewing stores. There are two pieces to the embroidery hoop. The inner hoop is an unbroken circle of wood about 1/8” thick and ½” wide (3/8” wide for the 6” hoops). The outer hoop is a split circle with a thumbscrew that tightens the outer hoop against the inner hoop, holding the embroidery material stretched tightly between the two hoops. The diameter of the inner hoop’s outer surface (the surface that mates to the outer hoop) is equal to the nominal size of the hoop set. That is, a 10” hoop set will have an inner hoop whose outer diameter is 10”:

![Hoop set as purchased](image1)

![“Outer Hoop” (has thumbscrew)](image2)

![“Inner Hoop” (unbroken)](image3)

The shell is made by stacking the two pieces of the embroidery hoop set one on top of the other. The outer diameter of a standard drum shell is 1/8” smaller than the inner diameter of the head. As we’ll see later, the mesh head will be made from an unbroken embroidery inner hoop, whose inner diameter is ¼” smaller than the nominal size – recall
that the hoop’s thickness is about 1/8”. Despite the slightly smaller size compared to a “standard” shell, a standard head and rim will still work. So we have to reduce the diameter of the inner hoop by at least this ¼”. To do this, we’ll cut out a section of the inner hoop and then close it back up at a smaller size. The length of this cutout would need to be ¼” x “pi”, which works out to a bit more than ¾”. To ensure clearance of the head over the rim, let’s round that up to one inch.

Carefully cut the inner hoop open using a coping saw, a sharp knife, or a sharp wire cutter. Now make another cut a distance 1” away from the first cut. In other words, cut out a section from the inner hoop that is 1” long. (If you will always be using purchased heads, you can make the cutout ½” instead, making the shell closer to “standard”). Split the inner hoop cutout section in half along the grain of the wood (so now you have two pieces 1” long). Apply a good wood glue (I like Titebond II) to the outer curved surface of one of these halves, and clamp it to the inside of the inner hoop so that the cutout opening is “bridged” together by this strip. Use small (3/4”) binder clips for clamps. The strip should be positioned away from either of the edges of the hoop:

For the outer hoop, simply cut where the metal thumbscrew brackets end. Discard the metal pieces:
Apply a piece of masking tape to one end of the outer hoop. Now lay the outer hoop over the inner hoop, lining up the outer hoop’s cutout opposite from the inner hoop’s clips. Set the outer hoop between the handles of the clips on the inner hoop to loosely hold it in place:

![Outer hoop held on top of inner hoop between clip handles](image)

Bring the taped and untaped ends of the outer hoop together so that the outer hoop becomes close to the size of the inner hoop all around the shell. When the two hoops match closely, tape the loose end of the outer hoop to secure its size. It’s not critical at this point that the two hoops be *exactly* the same size; just get as close as you can:

![Tape outer hoop ends together so that hoops are close to same size](image)

Cut a wide tongue depressor into 7 pieces ¾” long (or 5 pieces 5/8” long for 6” and 8” drums with 4 lugs). You should now have 4 or 6 rectangular pieces of tongue depressor, one for each lug, plus 2 rounded pieces from the ends. (The last piece might not be ¾” or 5/8”; don’t worry about that).
Lay a drum rim hoop over the two wooden hoops. Line up the gap in the outer hoop halfway between two rim lug holes. Now mark the approximate location of each hole on the outer hoop. Don’t worry about being too precise; just get close.

Outer hoop gap halfway between lug holes
Mark near lug holes

Get a bunch of small binder clips ready. For this next step you’ll have to work quickly so the glue doesn’t begin to set too much while you’re still working. Lift off the outer hoop and apply wood glue all the way around the “top” edge of the inner hoop. Set the outer hoop back in place. Now apply glue to two of the rectangular tongue depressor pieces. (If the tongue depressor pieces have a natural “curve” or warp across the grain, apply glue on the outer side of the curve so it fits better against the curved hoops). Place the two tongue depressor pieces on either side of the bridge, on the inside the hoops, so that they connect the two hoops together at the first set of lug hole marks nearest the bridge. Install with the grain running up and down (crossing the seam). Adjust the two hoops to line up as closely as possible, then clip in place. Also press the two hoops together at the clamp points. Position the pieces away from the edges of the hoop assembly (approximately centered over the seam):

Center pieces away from hoop edges
Press hoops together after clamping
Install pieces where marks are, then add clamps
Continue shaping and clamping around the shell, working from the inner hoop “bridge” to the outer hoop “gap”. When you have placed the last of the rectangular pieces, cut one of the leftover tongue depressor end pieces in half along the grain. Glue and clamp them at the two ends of the outer hoop, right next to the square “hole” formed by the gap. Remember to position them away from the edges. Press the two hoops together all around the shell to encourage their edges to bond. Set this aside to dry.

After the glue is dried, remove the clips. Lightly sand the outside of the shell to smooth the joint and remove excess glue. Also, sand the top outside “bearing edge” of the shell to round over the edge, so the head does not catch and tear after it’s installed. (The top edge is opposite the edge with the rectangular “hole”). There is nothing critical about this since we aren’t concerned with the acoustic performance as we would be with acoustic drums. We simply want to “soften” the sharp edge. At this point, the shell can be painted. I recommend flat black for the inside of the shell to reduce its visibility under the head. Note also that not much of the outside of the shell will be visible under the rim, so if making it all flat black is easier for you, go for it.
Mesh Heads

The shells made this way will work with standard purchased mesh heads and rims. You can also make your own mesh heads and rims. The mesh heads are made from another embroidery hoop set along with fiberglass window screening. These heads will be slightly smaller than purchased heads, and so will have a bit more play under the rim when the drum is assembled.

If you want to paint the head hoops, now is the time to do so. Only the outside surface of the outer hoop needs to be painted (again, flat black is recommended). If you do paint it, avoid getting paint on the inner surface of the outer hoop, so that the glue will adhere better.

Cut two pieces of screen, with at least 2” to spare all the way around the hoop. Unscrew the thumbscrew of the outer hoop as far as it will go without coming out:

Apply a generous amount of wood glue to the outer surface of the inner hoop and also to the inner surface of the outer hoop. The glue coating should be thick and even, but not runny. By soaking into the wood and bridging through virtually every hole in the screen between the hoops, the glue will make it just about impossible for the screen to pull out:
Set the inner hoop down and lay one piece of screen over it. Lay the second piece of screen over that, rotated about 45 degrees. Keep both layers roughly centered over the hoop:

Be sure the outer hoop is opened as far as the thumbscrew will allow. Now press the outer hoop down over the screen layers and around the inner hoop. Tighten the thumbscrew as much as possible. Keep the edges of the two hoops even:
Turn the head over (open side up). Pull up on the screen between your thumbs and forefingers, while at the same time pushing down on the hoops with the tips of your thumbs and forefingers, to take up some of the slack across the head. (Sort of a “pinch-roll-push” action.) Try not to let the two hoops separate while you do this and don’t pull too much screen from between the hoops – we want to leave as much glue in the joint as possible. Work your way around the head. The idea is not to make the head “tight” but only to get out most of the wrinkles and slack. The head will still be somewhat loose when you finish with this:

Starting opposite of the thumbscrew, apply a clamp, tighten the thumbscrew more, apply clamps about an inch or so away on both sides of that one, tighten, repeat, until you reach the open ends of the outer hoop going in both directions. This should make the two hoops mate closely, with the glue trapping the screen head between them. Keep the hoops lined up with each other. Take up any more screen slack that forms, especially near the gap at the thumbscrew. Put your last two clamps go at the very ends of the outer hoop. Clean up any stray glue with a damp rag. Set the head aside to dry thoroughly.
After the glue has thoroughly dried, remove the thumbscrew and carefully break or cut off the two metal tabs so the head will fit nicely under the rim. Don’t try to pull off the metal pieces or remove the rivets; chances are good you’ll break the wood rim in the process. Trim the screen flush with the bottom of the head’s rim:

Rim

Purchased standard drum rims (hoops) work well and look good, but if you want to go totally DIY, cut a “donut” with an inner diameter of 6”, 8”, 10” or 12”, and an outer diameter 2” greater. Drill lug holes. Sand and paint as desired.

Piezo Sensor

Cut a 2” square block of foam padding the same thickness as the height of the shell (1” thick for 10” – 12” or ½” thick for 6” – 8”). A suitable source of dark-colored foam is “air conditioner weatherstrip”, sold as a 42” length of 2¼” x 2¼” dark gray foam (enough for dozens of drums!). A serrated bread knife works well to slice the foam block. Attach to the top side of the base at the center using two sided foam tape. Apply another piece of foam tape to the top of the foam block, set the sensor on the tape, and add another piece of foam tape over the sensor and wires. Cut a second piece of foam padding 2” square by about ¼” thick. Cut this in quarters (four 1” x 1” squares) and place one on top of the stack.

When placing the piezo sensor, cut the two pieces of foam tape long enough for the wires coming off the sensor to sandwich between about ¼” of tape. This will hold the wires and prevent them from pulling off of the sensor. Now wire the sensor to a jack or to a cable as you prefer. A rim sensor piezo can be attached to the inside of the shell using foam tape.
Cut a 1” thick x 2” square plus four ¼” thick x 1” squares

Sensor on foam tape; capture about ¼” of wires on tape

Second piece of foam tape to cover sensor & enclose wires

1” square on top to complete sensor assembly

Side view: 1” thick foam, foam tape, sensor, foam tape, ¼” thick foam

Place the shell on the top side of the base with the “softened” bearing edge up. Locate the tongue-depressor pieces next to the lug inserts on the base. If you hard-wired a cable to the sensor, the rectangular “hole” in the shell will clear the cable. (Use a self-adhesive cable anchor and wire tie inside the shell to strain-relieve a hard-wired cable). Place the head over the shell. Place the rim over the head, and secure to the base with ¼ - 20 x machine screws (1½” for ½” base thickness; 1¼” for ¼” thick) and washers. At first, install the screws and washers only finger tight, then center the shell and head under the rim before tightening the rim. Since we’re not worried about tuning the head, adjust the tension for best feel. Don’t over-tighten. There’s no need to permanently attach the shell to the base; the pressure from the lug screws will hold the shell firmly in place. (You might need to adjust the position of the shell and head a bit as you tighten the lug screws, to keep things centered).

Piezo sensor assembly and shell on base, ready for head and rim. Cable anchor with wire tie acts as strain relief for connection of cable to sensor.
Here are photos of my kit, complete with faux bass drum head and stick holder. The head is attached by Velcro to a PVC-pipe assembly that slips over the snare stand. The head is ¼” MDF. I sprayed it with spray adhesive and stuck a piece of colorful fabric to it. After trimming the fabric around the edge, I made an edge banding of aluminum tape to simulate a rim. The head shown is 18” diameter because that’s all the ¼” MDF I had left over. A larger head would probably look better. I’ll let you figure out how to make the PVC part!

About my Kick and Hi-Hat Pedals

My kick “pedal” is nothing more than a fixed plywood wedge to which I’ve attached a piezo sensor. It activates when I tap on it with my foot. This might or might not work for you depending on how important a real pedal’s “feel” is to you.

The hi-hat pedal is built almost the same way as the kick pedal, except that it is hinged. A spring keeps the pedal platform “up” when my foot is off of it. I wired and positioned two “microswitch” style limit switches to give me three positions: closed, half, and open. (Try Radio Shack 275-016 or 275-017). My drum module (Roland TD3) senses half-open when a resistor of 22K is detected across the pedal input. Other modules might require a different resistor value, or might not even sense half-closed at all. If you don’t need half-closed sensing, eliminate Switch 2 and the resistor.

Here is a description of the wiring:

**Switch 1:** Normally Open (NO) across connector. Adjust switch to close near bottom of pedal travel.

**Switch 2:** Normally Open (NO) in series with 22K resistor across connector. Adjust switch to close at half position.
So when the pedal is all the way up, both switches are off and the connector looks like an open circuit (detected as “UP PEDAL”). At the halfway point Switch 2 turns on, making the connector look like a 22K resistor (detected as “HALF CLOSED”). At the fully depressed position, Switch 1 turns on, making the connector look like a short circuit (detected as “PEDAL CLOSED”).