synthesis technology

MOTM-800 ADSR Envelope Generator
Assembly Instructions & Owner's Manual

Synthesis Technology
6625 Quail Ridge Dr.
Fort Worth, TX 76180
(817) 498-3782
www.synthtech.com

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MOTM-800 PARTS LIST

Please carefully check that all parts are in your kit. If you have a suspected shortage, please call or email. If you get free extra stuff, keep it for next time.

❒ **Capacitor** bag, containing the following 9 parts:

2ea 10mfd, 25V or 50V Electrolytic	C1, C2
1ea 3M3mfd, bi-polar Electrolytic	C9
1ea 1000pf (marked 1N or 102) yellow box	C3
1ea 0.01mfd (marked 10N or 103) yellow box	C4
4ea 0.1mfd (marked 104) ceramic axial	C5, C6, C7, C8

❒ **Resistor** bag, containing the following 16 parts:

4ea 100K 5% (brown, black, yellow)	R5, R6, R10, R11
3ea 10K 5% (brown, black, orange)	R1, R2, R15
3ea 47K 5% (yellow, violet, orange)	R3, R4, R8
2ea 2K 5% (red, black, red)	R13, R14
2ea 1K 5% (brown, black, red)	R12, R16
1ea 5K1 5% (green, brown, red)	R9
1ea 1M 5% (brown, black, green)	R7

❒ **IC** bag, containing the following 9 parts:

1ea TL072 op amp	U3
1ea TLC555CP CMOS timer	U2
1ea HCF4066BE Quad CMOS switch	U1
2ea 2N3904 NPN transistor	Q1, Q2
4ea 1N4148 signal diode	D1, D2, D3, D4

❒ **Misc** #1 bag, containing the following 3 parts:

2ea Axial ferrite beads (plain, gray things)	L1, L2
1ea MTA-156 power connector	JP1

❒ **Knobs**, 4ea, ALCO PKES90B1/4

❒ **Jacks**, 4ea Switchcraft 112A

❒ **Pots**, containing the following:

3ea 1M log, Bourns 91A1DB28D25	VR1, VR2, VR4
1ea 10K linear, Bourns 91A1AB28B15	VR3

❒ **Front panel**

MOTM-800 PARTS LIST (cont)

❐ **Mounting bracket, small**

❐ **Wire** bag, containing the following 6 wires:

3ea RG-174 coax, 4 1/2 inches
1ea 3-wire set 22ga, 2 1/2 inches (white/orange/gray)
1ea 22ga wire 2 ½”
1ea Power Cable, 20”

❐ **Hardware** bag, containing:

4ea #8-32 x 3/8 black screws (for mounting module to rack)
4ea #6-32 x 3/8 zinc screws (for attaching pc board to bracket)
4ea 1/8 inch aluminum spacers
6ea #6 KEPS nuts (2 for attaching bracket to front panel, 4 for pc board)
4ea small tie-wraps

❐ **Organic Solder**
❐ **No-clean Solder**
❐ **PC Board**, MOTM-800

GENERAL INFORMATION

Thank you for purchasing the MOTM-800 ADSR EG. If you have any issues concerning the building or use of the kit, please contact us at (817) 498-3782 or by email: synth1@airmail.net

This kit should take the average builder between 1 and 2 hours. However, please remember this is NOT a speed contest, it is an accuracy contest. There is no rule that you have to complete the entire kit in one session (as long as you wash the flux off!).

Successful kit-building relies on having the proper tools. Here is a list of what you will need to build your MOTM-800.

* Soldering iron, 50W max power
* Needle-nose or chain-nose pliers
* Diagonal cutters
* Allen key set for securing the knobs (1/16")
* Lead bending tool (optional, but makes the job go much faster)
* DVM or oscilloscope (to check the output)

For more information of tools used and suggestions, see the MOTM FAQ and Tutorial pages at www.synthtech.com

HOW TO FOLLOW THE DIRECTIONS

Please read the entire instruction before proceeding. There may be valuable information at the end of the instruction. Each instruction has a check box ❒ next to it. After you complete the instruction, check the box. This way you can keep track of where you are in the process.

VERIFY THE PARTS LIST

❒ Verify that all of the parts are in the kit as shown on the parts list.

A WORD ON SOLDERING

There are 2 very different types of solder used in the kit. Most of the soldering uses 'Organic Flux' solder. ***This is strictly for use on the pc board, and is NOT to be used on the front panel wiring!***

In order for solder to 'stick' to the copper, a chemical called 'flux' is embedded in the solder. The flux leaves a residue on the pc board that should be cleaned with warm water. DO NOT USE SOAP OR OTHER CLEANSERS. Most of the parts in the kits are 'waterproof', and can be washed in the sink. The flux is OSHA approved for flushing down the drain, so don't worry about that! A soft brush is used to gently scrub the board. We recommend a 'fingernail brush', which is about 1" x 2" and can be found for about $1.

The other type of solder is called 'No Clean Flux', because as the name implies it does not require washing. This solder is used on wiring the pots, switches, jacks, etc. This solder is harder to use on the pc board, because even when melted it is not very fluid (about the consistency of toothpaste). We will use it VERY SPARINGLY on the pc board.

OK, let's get started on the board!

PART #1: SOLDERING THE RESISTORS

Since there are more resistors than anything else, we will start here. If you do not know the resistor color code, refer to the parts list. Resistors are not polarity sensitive, but the board will be easier to debug (and look nicer) if you point the first color band in the same direction for all the parts. The color code is also in the README FIRST document that every customer gets with their first order.

❒ Find the **RESISTOR** bag.

❒ Find the MOTM-800 blank pc board. There is a copy (larger than actual size) of the silkscreen which shows where the parts go at the end of this document. It will be useful if you locate the part on the print first, put the part in the board, then 'check off' the silkscreen. All parts are inserted from the side of the board with the white silkscreen (the "top" side).

❒ We will stuff the resistors by value to make things easier. The resistors (and other long-leaded parts) are inserted on 0.4 inch spacing. The important thing is to be sure that the part is sitting all the way down on the board. Push the leads in the holes, push the part on the board, and then bend the leads on the bottom outwards to a 45 degree angle (roughly!). This is called 'cinching the leads': keeps the part from falling out! From the bottom of the board, solder (with the organic flux), applying heat to the pad for about a half second first, then applying just enough solder to make a small, flat puddle.

The rule of soldering: don't use too much, you can always add more! Cut the leads flush with the top of the solder.

Locate the 100K resistors and solder into R5, R6, R10, & R11.

❒ Locate the 10K resistors and solder into R1, R2, & R15.

❒ Locate the 1M resistor and solder into R7.

❒ Locate the 2K resistors and solder into R13 & R14.

❒ Locate the 1K resistors and solder into R12 and R16.

❒ Locate the 5K1 (5.1K) resistor and solder into R9.

❒ Locate the 47K resistors and solder into R3, R4, & R8.

That should be all of the resistors! And guess what: you are about 1/3 of the way done!

PART #2: BOARD WASH #1

❒ Verify all the resistors are in the correct position.

❒ Verify all the resistors are flat on the board. Correct if needed. Check solder joints.

❒ Wash the board in warm water, gently scrubbing both sides.

❒ Shake the board a couple of time, blot dry with an old towel (the leads will frazzle the good towel). Let dry about 15 minutes.

PART #3: CAPACITORS

❒ Locate the **CAPACITOR** bag.

❒ Locate the 1000pf yellow box cap. Top is stamped 1N or 102. Solder into C3.

❒ Locate the 0.1mfd axial ceramic caps, marked 104. Solder into C5 - C8.

❒ Locate the 0.01mfd yellow box cap. Top is stamped 10N or 103. Solder into C4.

❒ Locate the 10mfd electrolytics. Note that there is a stripe on the NEGATIVE terminal. The pc board has a + on the POSITIVE terminal. Carefully stick the capacitors into C1 and C2 with the stripe ***away*** from the + pad on the board.

❒ Locate the 3M3 bi-polar electrolytic. It is dark blue, with the letters BP stamped on it. This type of electrolytic is NOT polarity sensitive.
Solder into C9.

PART #4: MISC and IC STUFF

Almost done with the parts on the pc board! This will finish up the soldering with the organic flux.

❒ Locate the **MISC #1** bag and the **IC** bag.

❒ Locate the ferrite beads. They are axial parts, gray colored with no markings. These are non-polar, and are soldered into L1 and L2.

❒ Locate the MTA-156 power connector. Solder into JP1. Note that the connector has a ‘locking tab’ on one side. This side is the “inside” facing relative to the pc board. Note the silkscreen symbol for JP1 has a line on one side, indicating this is the side where the locking tab goes.

❒ Locate the TL072 op amp. Solder into U3. Note that Pin #1 is the square pad. Pin #1 is the pin near the very small ‘dimple’ in the top of the part. All of the ICs point “to the left” on the pc board. The parts may be marked ‘072BD’ or ‘TL072CP’, depending on manufacturer.

❒ Locate the TLC555CP timer. Solder into U2.

❒ Locate the HCF4066BE switch. Solder into U1.

❒ Locate the 2 2N3904 NPN transistors. Look closely, they are marked on the “flat side” of the part. Note the hole pattern on the pc board has the middle lead slightly forward. Insert the 3 leads, with the bottom of the part about 1/8” from the pc board. DO NOT try to push the transistor all the way down on the board! Solder.

❒ Locate the 1N4148 signal diodes. These are a clear glass axial parts with a black band around one end. Solder into D1, D2, D3, & D4. Notice that the silkscreen symbol has a distinct band on one end. Insert the banded end (called the cathode) into the pc board in the correct pad. All 4 diodes point “down”.

PART #5: WASH THE BOARD AGAIN

❒ Verify all the parts are in the correct locations. Check the diodes and C1 & C2 orientation. Make sure all the ICs are pointing the same way.

❒ Inspect the solder joints. Any solder shorts? Too much solder? Missing joints?

❒ Wash the board under warm water. Scrub gently. Dry.

THIS IS A GOOD STOPPING PLACE TO REST OR PUT THE KIT AWAY UNTIL LATER.

You are now finished with the Organic flux solder. All soldering past this point is using the No-Clean solder. You do not have to wash the board anymore.

PART #6: FINISHING THE PCB

You will now solder in the remains parts on the pcb in preparation for wiring to the front panel. USE THE NO-CLEAN SOLDER. BE CAREFUL!

❒ Locate the 3 Bourns 1M log pots. **IMPORTANT**: in order for the pc board to properly align into the front panel, each pot must be absolutely flat on the pc board, with the shafts pointing away from the pc board. NOTE: the 3 holes the leads go in are small ***on purpose.*** The leads will go into the holes, you will have to be gentle and slowly press the part down onto the pc board. Solder the pots into VR1, VR2, and VR4.

❒ Solder the Bourns 10K linear pot into VR3.

❒ Locate the **WIRE** bag. Note that the pre-stripped wires all have a short end and a longer end. THE SHORT END GOES IN THE PC BOARD.

❒ Locate the 3 pieces of RG-174 black coax cable. Again, note that one end has longer wires stripped than the other. The short ends will go in the pc board in positions J2, J3, & J4. Look at the pc board. Notice that in positions J2 – J4, there is a large hole pad (lower pad) and a smaller pad (top hole). The braided wire is soldered into the larger hole. The smaller, inner conductor goes in the top hole.

Note there is a row of ‘plain’ holes along the bottom, under J2 - 4. These holes are for threading the small white tie-wraps for holding the coax against the pc board. The holes are designed so that coax exits the pads directly under. The coax then lies between the 2 holes. The tie wrap enters the left hole from the top, comes out the right hole from the bottom, and is then secured so that the coax is tightly held against the top of the pc board. Note that the tie wraps must thread from the top, or there may not be sufficient room between the pc board and the mounting bracket. The excess tie wrap is cut off. See the illustration pages.

❐ Solder, then tie-wrap the 3 short coax cables J2, J3, & J4. Trim the excess tie-wrap. NOTE: because of the way the coax is made, chances are more of the braid will go in the hole than the inner conductor. This is normal, unlike all the other parts and wires. The secret is to get the coax firmly soldered and tied down. You may find it easier to tie-wrap first, then solder.

❐ Find the 3-wire bundle (has a tie wrap in the middle). Note that the ends of the wire are stripped, but there is a small piece of insulation still on the wire. Slide this off, and apply a small bit of solder to the ends: this is called "tinning the lead". It just keeps the wire from unfraying. Remember, the shorter exposed end goes into the pc board.

Solder the WHITE into the TOP hole (#3) of J1.

❐ Solder the ORANGE wire into the MIDDLE hole (#2) of J1.

❐ Solder the GRAY wire into the bottom square hole (#1) of J1. Tie-wrap the wires to the pc board.

❐ Solder the small 22ga wire into the TRIG MOD hole.

YOU ARE NOW FINISHED WITH THE PC BOARD WORK! BREAK TIME.

PART #7: FRONT PANEL PREPERATION

You will now attach components to the front panel. It is HIGHLY recommended that you use a set of hollow shaft nut drivers, NOT PLIERS, to tighten the nuts. This prevents scratching. NOTE: all references to part orientation is from the REAR of the panel.

❐ Locate the 4 Switchcraft jacks. Notice that from the rear, there is a beveled corner. This corner is ALWAYS CONNECTED TO GROUND, USUALLY WITH THE BRAIDED CONDUCTOR. Each jack has a flat washer, a lockwasher, and a ½" hex nut. Remove the nuts and washers from each jack. Place aside. Keep the lockwasher on the jacks.

❐ Insert the 4 jacks/lockwashers, with the beveled corner in the ***upper right*** corner, into the 4 holes. Place the flat washer on the jack, then the hex nut. Hold the jack with one hand on the backside, keeping it 'square'. Tighten the hex nut with a nut driver. NOTE: when tight, not much of the exposed threads of the jack are exposed.

Check to see that each jack has the bevel in the upper right corner, and all jacks are neatly lined up.

You are now ready to attach the pc board to the bracket, and then wire up to the panel.

PART #8: ATTACH PC BOARD TO BRACKET/PANEL

❒ In the **HARDWARE** bag, locate 4 #6-32 x 3/8 screws, 6 #6 KEPS nuts, and 4 spacers.

❒ Locate the mounting bracket. The pc board attaches to the bracket, with the 4 screws threading from the top of the board, through the spacers, through the bracket, and then out the bottom of the bracket. The #6 KEPS nut attaches on the bottom of the bracket. Note the bracket has 2 long mounting flanges with a hole in each. These attach to the 2 threaded studs sticking out of the rear of the panel. The 4 pots each stick in it's panel hole when the bracket is screwed down on the 2 threaded posts.

Attach the pc board to the bracket. The 2 mounting flanges are located in between VR1 & VR2, and next to VR4. The flanges will point upwards when the pc board is sitting on the bracket. Note that the bracket holes for the pc board are actually oblong. This is to allow adjustment for the pc board to firmly press up against the back of the panel. As a start, set the 4 screws ALL THE WAY TO THE LEFT of the oblong holes. ***Loosely*** tighten the 4 KEPS nuts on the bottom.

❒ THIS IS A VERY IMPORTANT STEP, SO PAY ATTENTION AND READ ALL OF IT BEFORE PROCEEDING!

Note that each of the 4 pots on the pc board have 2 hex nuts and a flat washer. Remove the first hex nut and the washer. Set aside.

What you will do now is adjust the remaining hex nuts so that when the bracket is all the way down on the panel's threaded studs, all the pot hex nuts touch the rear of the panel.

Screw (by hand) each hex nut on the pots so that it is all the way on (touching the face of the pot). Now, pick up the pc board/bracket assembly and carefully slide it over the 2 threaded studs, making sure the pots are aligned in the holes. Use 2 #6 KEPS nuts and tighten the bracket to the panel.

❒ Loosen the 4 KEPS nuts on the bottom of the bracket. Slide the pcb ALL THE WAY TO THE RIGHT AS FAR AS IT WILL GO, so that the 4 pot nuts are all pressing against the panel. By hand, put hex nuts on the outside threads of VR1 and VR4 to keep the pc board in place. Now, tighten the 4 KEPS nuts on the bracket. The pcb and bracket should be secure, with no gaps visible between the panel and the pot nuts. You may need to loosen the nuts on the pots, so that they are touching the back of the panel. Again, make sure each pot's nut is touching the back of the panel (no gaps!). There will be a gap from the edge of the *pc board* to the panel.

❒ Remove the hex nuts on VR1 & VR3. For all 4 pots, first put on the flat washer, Then the hex nut. Tighten with a ½" nut driver.

PART #9: FINISH WIRING TO THE PANEL

❐ Now you will solder the coax wires to the jacks. You will solder the top row of jacks first, then the bottom row. Note that from the rear, the jack lugs are referred to as 'LEFT', 'TOP', and 'BEVEL'. The left lug is the signal from the outside plug, the top lug is the switched signal, that is disconnected when a plug is inserted, and the bevel is ALWAYS ground.

❐ Solder the TRIG (J2) coax into the jack. The braid goes to the BEVEL, the inner wire goes to the LEFT lug. Solder the wire in the TRIG MOD hole to the TOP lug (switched connection).

❐ Solder the WHITE wire in GATE (J1) to the LEFT lug of the GATE jack.

❐ Solder the ORANGE wire of J1 to the TOP lug of GATE jack.

❐ Solder the GRAY wire to the BEVEL lug of the GATE jack.

❐ Solder the coax in OUT - (J4) to the LEFT lug of the OUT - jack. Solder the braid to the beveled side.

❐ Solder the coax in OUT + (J3) to the LEFT lug of the OUT + jack. Solder the braid to the beveled side.

❐ Rotate all of the front panel pots fully counter-clockwise. Locate the **KNOBS**. Notice each knob has a thin white line on it. Place the knob on the pot shaft, align the white line to the '0' tick mark and tighten the hex screw. The silver part of the knob has a protective clear plastic overlay that can be removed if desired. Gently rub with your fingernail and it will peel off.

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CONGRATULATIONS! YOU HAVE FINISHED BUILDING THE MOTM-800!

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All that's left to do is test it! But before we do, please read the following Theory of Operation. The MOTM-800 can be used in several ways, depending on your type of keyboard, MIDI-to-CV converter, or drum triggers.

ELECTRICAL THEORY OF OPERATION

Envelope generators work by charging and discharging a capacitor at different rates. The ATTACK pot VR1 sets the charge rate of the capacitor C9. There are 2 discharge rates: DECAY set by VR2 and RELEASE, set by VR4. The DECAY discharge is to the voltage level set by SUSTAIN pot VR3. The RELEASE discharge is to ground.

A “true” ADSR EG needs two input signals: a GATE and a TRIGGER. These are generated by MIDI-to-CV converters that are normally use to control your MOTM (we suggest the Kenton Pro2000).

A GATE signal is normally at ground (0 volts). When a key is pressed on the keyboard, the GATE signal goes to a positive voltage, usually +5V (although some keyboards can output up to +12V). As long as the key is held down, the GATE is on.

A TRIGGER is a short pulse that happens only at the ***beginning*** of a note being pressed. Not all keyboards will produce a TRIGGER pulse (Roland SH-101 for example). In these cases, you will not get ‘true’ ADSR function (explained later).

In order to emulate some older monophonic keyboard actions, MIDI-to-CV converters can be set up to send a new TRIGGER pulse out if a key is down, and a lower key is then pressed. The GATE never goes low, but a new TRIGGER pulse is generated. The newer note will then ATTACK (the old note is sitting at the SUSTAIN point).

Lastly, some drum triggers are only that: TRIGGERs. There is no GATE output. You whack the pad, and a short pulse comes out.

The MOTM-800 can handle all three scenarios: GATE & TRIG, GATE only, or TRIG only.

Look at the schematic. The MOTM-800 is based around 2 chips: a 555 timer (U2) and a quad CMOS switch (U1). The 555 is NOT being used as a timer: rather, we are using the ‘inside guts’ as a collection of devices. Specifically, we are using the internal flip-flop and voltage comparator. The CMOS switches are normally open, and are closed when a voltage of +15 is on the control pin. These are not perfect switches, they will have a on resistance of about 60 ohms. This ON resistance sets the shortest charge/discharge times for the cap C9.

Look at C9. One end is tied to ground. The other end is tied to 3 of the CMOS switches. This is the manner the ADSR envelope ‘cycles’ through each section. All we need to do is control when each switch opens and closes. The op amp U3 is used as a buffer for the voltage on the cap. The buffered voltage is either divided by 2 (by R13 & R14) for the + OUT signal, or inverted by U3B (for the – OUT signal). The reason for this division will be explained shortly.

Let’s start with the ATTACK portion. Since ATTACK is a charging function, we need to connect C9 to a voltage source. This is the function of switch U1D. When the voltage on pin 6 is +15V, the switch closes. This charges C9, by a rate set by VR1, towards +15V.

But why +15V to charge?? Don’t we want (eventually) a +5V envelope out? If we are dividing by 2, why don’t we charge to +10V?

The reason is that a charging capacitor (in theory) will NEVER get to a ‘final’ charge. In practice, internal leakage and resistance in the cap also causes the voltage to ‘droop’ a little. Therefore, we cheat! We purposely set the charging voltage *higher* than what we really want. In this case, we charge the cap towards +15V, but stop charging when we get to +10V.

The RELEASE portion is just the opposite of ATTACK: instead of charging, we discharge the cap to ground. This is done by switch U1A, which is tied to RELEASE pot VR4. When pin 13 is +15V, the switch closes and the cap C9 discharges through VR4 to ground. This forms the RELEASE portion of the envelope. Of course, we need to turn OFF switch U1D in order to do this.

The DECAY/SUSTAIN portion is a little trickier. This is done using switch U1B, VR2 (DECAY), VR3 (SUSTAIN) and importantly R9. Assume C9 is charged to +10, and switch U1D opens. If we then close U1B, what does the voltage on C9 do? Well, it goes to the voltage set by divider R9 & VR3, at the rate set by VR2. Note that if R9 is not set to the right value, instead of discharging to a lower voltage, the cap will actually *charge* to some *higher* voltage! So we choose R9 to set our max “sustain” voltage at (10K/(15.1K)*15V) or 9.9V (remember, the actual output is divided by 2).

From the above discussion, you should now see how each portion of the A, D, S, & R are generated. All we need now is some ‘control logic’ to sequence the analog switches in the proper order.

The MOTM-800 control logic consists of NPN transistors Q1 & Q2, the 555 timer U2, switch section U1C, and the 2 diodes D2 & D3.

Let’s assume for the first discussion that our keyboard generates BOTH a GATE and a TRIGGER pulse. Once we trace the operation in this mode, the other 2 modes will make more sense!!

Assume you have a GATE plugged in (which disconnects tricky resistor R15) and a TRIGGER plugged in. With no key pressed, the GATE is 0V. Transistor Q1 is OFF, which means it’s collector pin is +15V. This +15V in turn turns ON transistor Q2, which means it’s collector pin is at 0V (we just made a complicated wire??!?). The reason it is done this way is that we need a GATE and a NO_GATE signal. Transistors Q1 & Q2 do this cheaply. Diode D1 is to protect Q1 in case the GATE voltage goes below ground (like you plugged a LFO into it!).

The NO_GATE signal is used to control switch U1A, the RELEASE portion. We want a RELEASE when the GATE goes away. So, just sitting there, the cap C9 is held in discharge.

Now let’s turn our attention to the “not-a-timer this time” U2. Pin 4 is the RESET pin. If it is at ground, the 555 turns off. The GATE signal (collector of Q2) controls this pin. If we have no GATE input, the 555 is OFF. When the GATE goes ‘high’, the 555 is armed and ready to work.

So, THAT is why tricky resistor R15 is used on the switched portion of the jack J1. If your setup has TRIGGER only, R15 provides a “phantom GATE” signal that arms the 555 timer. More on this later.

Now that the 555 is armed, we need a TRIGGER pulse. Pin 2 of the 555 is an input to a SET/RESET flip-flop. When the 555 sees a trigger pulse, the flip-flop SETs, and pin 3 goes to +15. We interface to the ‘outside world’ by using a resistive divider R5 & R6 to set the trip level of the flip-flop to about 7.5V. Then, we AC couple to the 555 with capacitor C3. This forms a “glitch circuit” that will set the 555 with our +5V input TRIGGER signal.

The TRIGGER pulse causes pin 3 to go high, which turns on U1D, charging cap C9 for the ATTACK phase. Now we turn our attention to the 555, pin 6. This is the *threshold* input to reset the internal flip-flop. The voltage that causes a reset is 2/3 of Vcc, or +10V. How convenient! This is how we turn off the ATTACK, and turn on the DECAY/SUSTAIN circuits. U1C is acting as an inverter, which is connected to diode D2. This diode, D3 and R8 form an AND gate. When the voltages on the cathodes are both +15V, pin 12 of U1B goes to +15V. This turns on the DECAY/SUSTAIN cycle, which happened when the threshold pin of the 555 reaches +10, resets the internal flip-flop, and drives pin 3 off.

C9 then discharges through VR2 towards the sustain voltage set by VR3. Now, the circuit waits for the GATE input to go to ground. This turns on U1A, discharging C9 through VR4, thus completing the ADSR cycle.

The MOTM-800 features a re-triggerable ATTACK. If the GATE is high, and you get a new TRIGGER, this will set the 555’s flip-flop, disconnect the DECAY/SUSTAIN logic, and close U1D again for a new ATTACK cycle.

MODES OF OPERATION

In this section, we will discuss how the MOTM-800 is used in various applications. Of course, these are only a few things to try. Experiment!

GATE & TRIGGER INPUTS USED

Generates an ADSR cycle as the note is pressed. IF your system generates a new trigger when a key is pressed while another key is still down, the new trigger generates an ATTACK/DECAY phase. MIDI-to-CV converters, such as the Kenton Pro-2000, can be set to generate new triggers on newer notes played.

GATE ONLY

Many keyboards with “CV & GATE” outputs do not have triggers. Therefore, the TRIGGER jack on the MOTM-800 is left unconnected.

The TRIG MOD wire generates a “fake trigger” pulse when the GATE input goes high. This causes the MOTM-800 to generate a full ADSR cycle without a trigger pulse. However, unless your keyboard drops the GATE momentarily when a new key is pressed, the new ATTACK/DECAY portion will not be generated. Most Roland synths with CV/GATE outputs (SH-101, etc) do in fact drop the GATE signal.

TRIGGER ONLY

This is used mainly with drum pad devices. When the pad is struck, the circuitry outputs a short pulse. If you only drive into the TRIGGER jack, then a "false GATE" is provided by resistor R15.

Therefore, the MOTM-800 acts like a 'standard' ADSR EG, receiving new triggers when the GATE is still high. As discussed previously, this causes a new ATTACK phase, followed by a DECAY/SUSTAIN phase. There is no RELEASE because the GATE is always there (via R15).

What useful waveform(s) can we generate? The most common use is called an AR envelope, although the MOTM-800 uses an A-D cycle. If you turn SUSTAIN to 0 (remember RELEASE is ignored), then the ATTACK and DECAY pots will set the envelope. This is how you 'stretch' the narrow TRIGGER pulses into longer envelopes.

However, the SUSTAIN pot is still functional. If the pot is NOT zero, then the output of the MOTM-800 will be the SUSTAIN voltage with no TRIGGER. In other words, a D.C. bias voltage will be on the envelope, instead of ground. This is also quite useful! One novel use of a "spare" MOTM-800 is to *not connect anything* to GATE or TRIGGER, and use the OUT + and OUT – jacks as positive and negative bias voltages to other modules!!

CONNECTING LFOS TO THE MOTM-800

If you want to have a 'stream' of envelopes generated by a LFO, connect the LFO SQUARE output to the GATE input of the MOTM-800. Of course, the combined ATTACK and RELEASE pot settings (cycle time of the envelope) must be less that the period of the LFO driving signal. Diode D1 will clip off the negative portion of the LFO waveform, protecting the base-emitter junction of Q1.

USE OF THE MOTM-800 ADSR EG

The most common use of an envelope generator is to control the volume profile of each note. To do this, you need a Voltage Controlled Amplifier (VCA), like the MOTM-110. The MOTM-800 generates control voltages, not audio signals. The OUT + jack is patched to the CV IN jack of the VCA. The output audio from your patch is to the IN of the VCA. When you play a note, the envelope controls the output volume of the note.

Also, most synthesizer patches simultaneously modulate the cutoff frequency of a Voltage Controlled Filter (like the MOTM-400) with a *different envelope* shape that controls the VCA. Therefore, a “standard” synthesizer patch uses 2 MOTM-800s, one for the VCA and one for the VCF.

Since the output of the MOTM-800 is a control voltage, you can use it for controlling the MOTM-700 Dual 2:1 VC Router. Long ATTACK/RELEASE envelopes can switch in/out audio sources.

TROUBLESHOOTING

If your MOTM-800 does not work, please verify ALL of the following before contacting us. The following reference directions assume that you are looking at the pc board with the panel to the right and the power connector to the left.

- ❒ All of the IC are pointing the same way: all notches are ‘to the left’
- ❒ C1 & C2 stripes are both pointing upwards.
- ❒ D1 and D2 banded ends are both pointing downwards.
- ❒ Transistors Q1 & Q2’s flat sides are facing to the right.
- ❒ The braided wire on the coax goes to the beveled side of the jacks.
- ❒ The board has all the right parts in all the right places.
- ❒ No solder shorts or missing joints.

If you still can not get the module to perform correctly, please contact us by phone/fax at (888)818-MOTM or by email to synth1@airmail.net

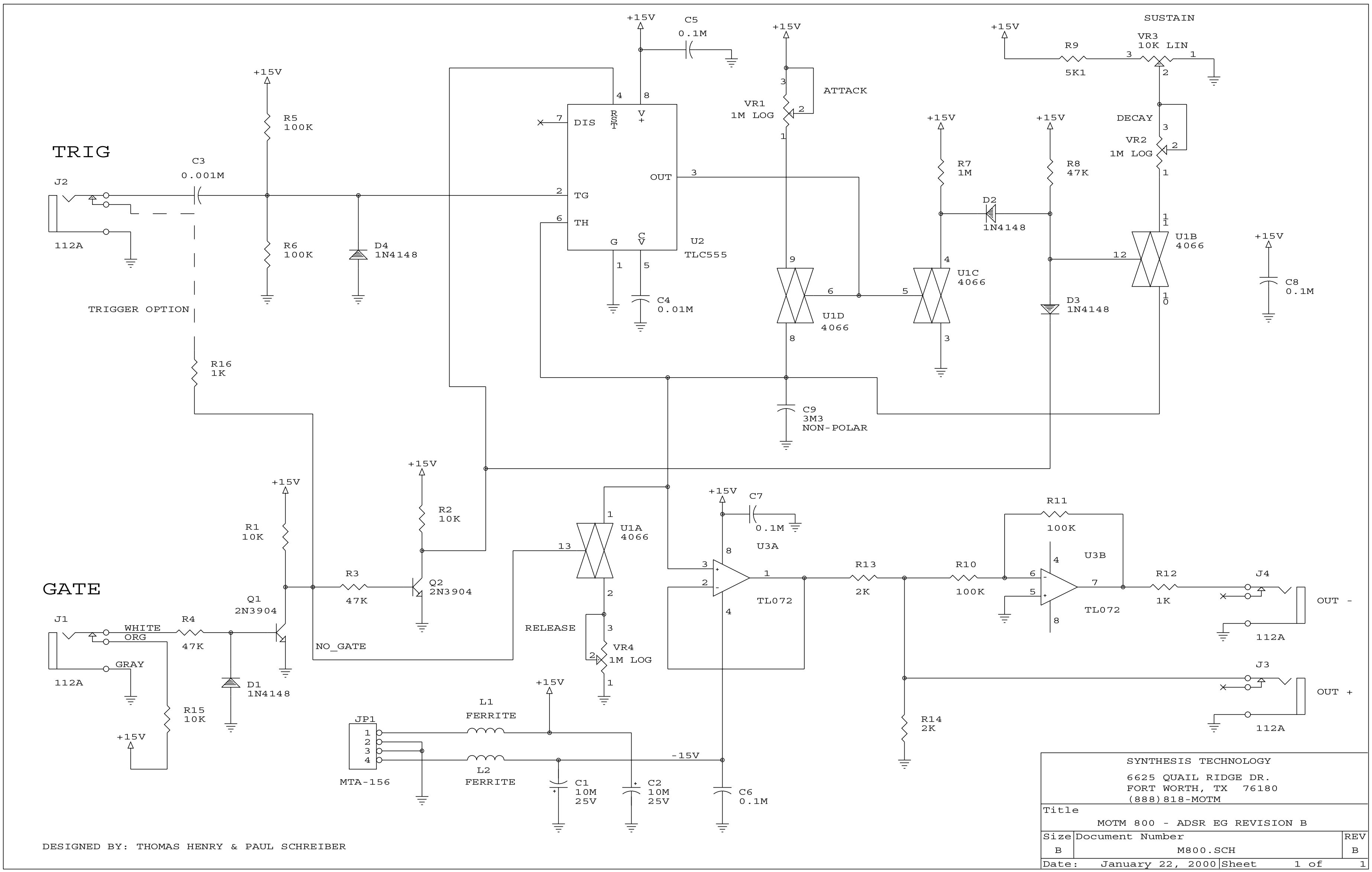
Thank you for purchasing the MOTM-800 kit.

SPECIFICATIONS
MOTM-800 ADSR ENVELOPE GENERATOR

ATTACK, DECAY, RELEASE time	1ms to 14 seconds, typical
SUSTAIN voltage	0 to +4.95V
GATE input voltage	0 to +13V
TRIGGER input voltage	+4.0V, min +13V max.
TRIGGER input pulse width	500uS, min.
Output Impedance	1K typical

GENERAL

Power Supply	-15VDC @ 5 ma +15VDC @ 10 ma
Size	1U x 5U 1.74” x 8.72” 44.2mm x 221.5mm
Depth behind panel	2.43 inches 61.6mm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J2
112A
C3
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TRIGGER OPTION
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+15V
R5
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R6
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D4
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GATE
J1
WHITE
ORG
GRAY
R4
47K
D1
1N4148
R15
10K
Q1
2N3904
R1
10K
NO_GATE
R3
47K
Q2
2N3904
R2
10K
U2
TLC555
DIS
TG
TH
OUT
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CV
RST
V+
C5
0.1M
C4
0.01M
VR1
1M LOG
ATTACK
U1D
4066
C9
3M3
NON-POLAR
U1C
4066
R7
1M
D2
1N4148
R8
47K
D3
1N4148
U1B
4066
SUSTAIN
R9
5K1
VR3
10K LIN
DECAY
VR2
1M LOG
C8
0.1M
U1A
4066
RELEASE
VR4
1M LOG
C7
0.1M
U3A
TL072
R13
2K
R10
100K
R11
100K
U3B
TL072
R12
1K
J4
112A
OUT -
J3
112A
OUT +
R14
2K
JP1
MTA-156
L1
FERRITE
L2
FERRITE
-15V
C1
10M
25V
C2
10M
25V
C6
0.1M
DESIGNED BY: THOMAS HENRY & PAUL SCHREIBER
SYNTHESIS TECHNOLOGY
6625 QUAIL RIDGE DR.
FORT WORTH, TX 76180
(888)818-MOTM
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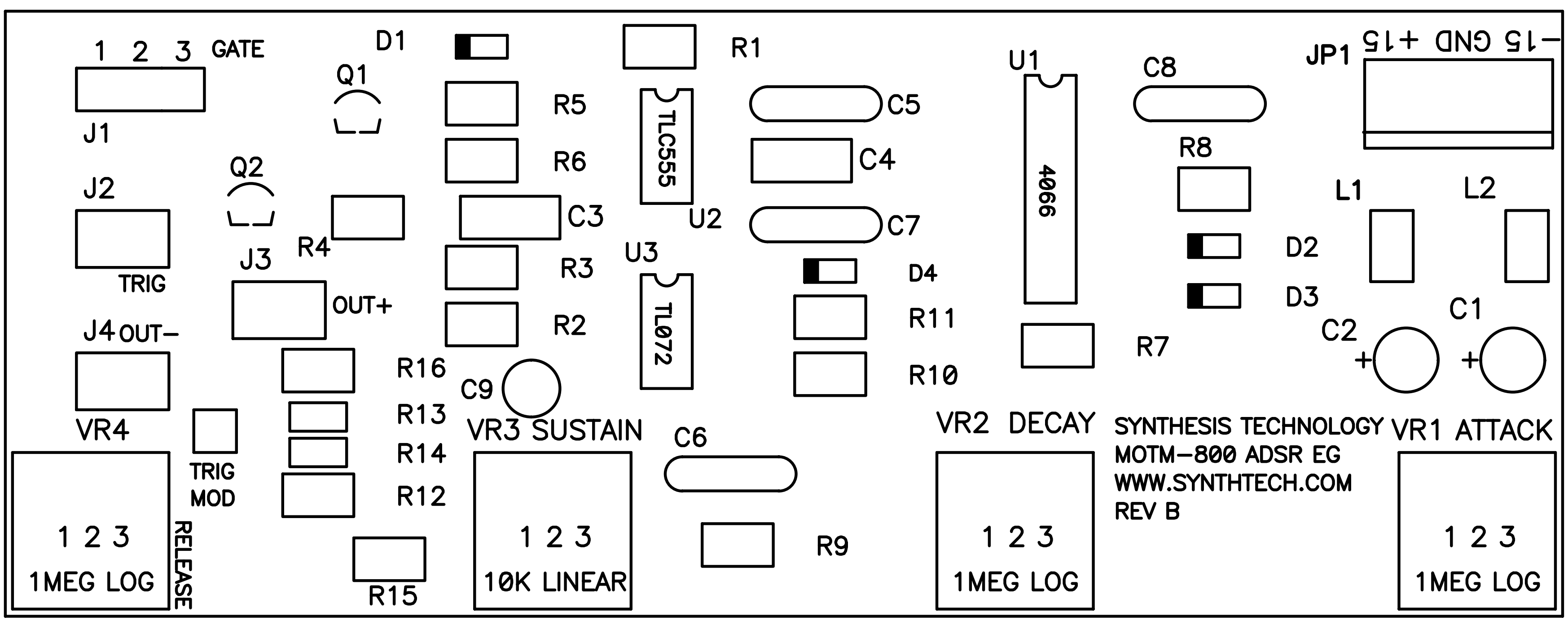
Sheet 1 of 1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VR4
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RELEASE
R16
R13
R14
R12
R15
C9
VR3 SUSTAIN
TLC555
U2
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TL072
C6
R9
C5
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C7
D4
R11
R10
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4066
R7
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+15 GND −15
L1
L2
C2
C1
+
+
VR1 ATTACK
SYNTHESIS TECHNOLOGY
MOTM−800 ADSR EG
WWW.SYNTHTECH.COM
REV B
1 2 3
1MEG LOG
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10K LINEAR
1 2 3
1MEG LOG
1 2 3
1MEG LOG