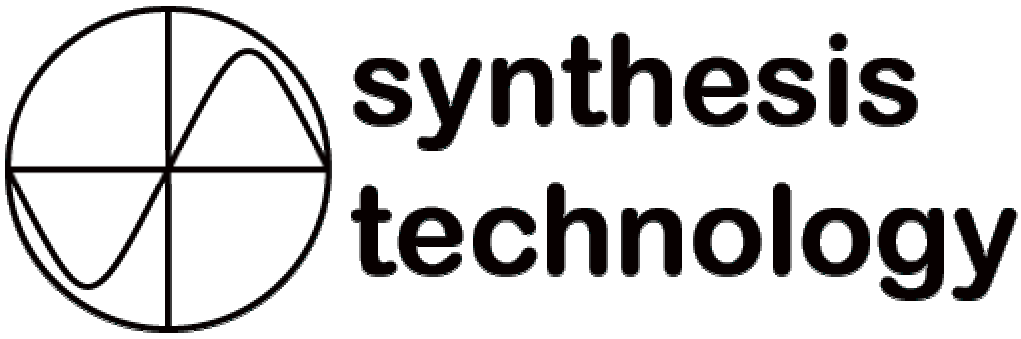


MOTM-480 CS Resonant VCF
Assembly Instructions & Owner's Manual

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

Feb. 11, 2005

MOTM-480 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/Resistor** bag, containing the following 14 parts:

2ea 10µfd, 50V Electrolytic	C28, C29
2ea 1nf (0.001µfd) yellow box caps	C3, C6
4ea 3M3 non-polar electrolytic	C8, C15, C21 and C27
4ea 1N5 (1500pf) polypropylene caps	C12, C13, C19 and C20
2ea 1K 1% 3W Tempco resistor	R9, R17 (see text)

❒ **A pre-stuffed pc board,** containing the following components:

Capacitors

15ea 0.1µfd (marked 104) ceramic axial	C1, C2, C4, C5, C7, C9-11, C14, C16-18, C24-C26
2ea 150pf (marked 151) ceramic axial	C22, C23

Resistors (NOTE! – 1% resistors may be substituted for 5% parts)

10ea 100K 1%	R1, R2, R4, R5, R10, R12, R13, R18, R57, R62
2ea 221K 1%	R3, R11
4ea 54K9 1%	R6, R14, R58, R63
2ea 562K 1%	R7, R15
2ea 4K99 1%	R8, R16
4ea 51K1 1%	R19 – R22
4ea 150K 5%	R23-R25, R68
14ea 10K 5%	R26, R30, R32, R35, R40, R44, R46, R49, R70, R71, R73, R74, R77, R78
8ea 270ohm 5%	R27, R28, R33, R34, R41, R42, R47, R48
6ea 33K 5%	R29, R43, R54, R55, R69, R76
4ea 4M7 5%	R31, R36, R45, R50
6ea 68K 5%	R37, R51, R66, R67, R75, R80
4ea 1K 5%	R38, R52, R56, R61
4ea 6K8 5%	R39, R53, R59, R64
2ea 200K 5%	R60, R65
2ea 1M2 5%	R72, R79

❒ **IC** bag, containing the following 18 parts:

7ea TL072ACP dual op amp	U2, U6, U7, U9 – U12
4ea BC560C PNP transistor	Q3 – Q6
2ea LT1013 op amp	U1, U3
3ea CA3280 dual OTA	U4, U5, U8
2ea SSM2220P PNP array	Q1, Q2

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

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

❒ **Knobs**, 8ea, ALCO PKES90B1/4

❒ **Jacks**, 8ea Switchcraft 112A

❒ **Pots**, 8ea containing the following:

3ea 100K log Spectrol 148-9609-104	VR1, VR2, VR3
1ea 100K lin Spectrol 149-71104	VR4
4ea 100K lin Bourns panel pots	VR5- VR8

❒ **Front panel**

❒ **Mounting bracket**

❒ **Wire** bag, containing the following 12 wires:

2ea long RG-174 coax	J5, J6
3ea short RG-174 coax	J4, J7, J8
1ea 3-wire set 22ga (white/red/black) long	on VR5
1ea 2-wire set 22ga (orange/white) long	J3
3ea 3-wire set 22ga. (orange/white/gray) long	on VR6 – VR8
1ea 2-wire set, 22ga, 3½" (red/black)	J1, J2
1ea Power Cable, 20"	

❒ **Hardware** bag, containing:

4ea #8-32 x 3/8" black screws (for mounting module to rack)
4ea #6-32 x ½" zinc screws (for attaching pc board to bracket)
4ea ¼" aluminum spacers
6ea #6 KEPS nuts (2 for attaching bracket to front panel, 4 for pc board)
7ea small tie-wraps

❒ **Organic Solder AND No-Clean solder (1 bag each type)**

GENERAL INFORMATION

Thank you for purchasing the MOTM-480 VCF. 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 2 to 3 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 day (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-480:

- Soldering iron, 50W max power. Use 700ºF tip/temperature setting
- Small amount of heatsink compound
- Needle-nose or chain-nose pliers
- Diagonal cutters
- Allen key set for securing the knobs ($^1/_{16}$" or 1.58mm)
- Magnifying glass: to read the markings and to inspect solder joints
- DVM (Digital Volt Meter) or oscilloscope (to check the output)
- #1 Philips screwdriver
- Fingernail brush for washing off the organic flux
- Old towel for blotting dry pc board

For more information of tools used and suggestions, see the MOTM FAQ and Tutorial pages at http://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 for 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/CAPACITORS ON THE PRE_STUFFED PC BOARD

The MOTM-480 pc board has most of the resistors and capacitors already inserted, with the leads bent and cut, ready to be soldered. All of these parts use the ***organic*** solder and the board must be thoroughly washed after soldering.

❒ From the bottom of the board, solder (using the organic flux), applying heat to the pad for about a half second first, then applying just enough solder to make a small puddle that looks like a tiny pyramid. Enough solder should flow in the hole such that on the top (component) side, a small amount is on the top pad as well. A ***SMALL AMOUNT***, not a blob!

The rule of soldering: don't use too much, you can always add more!

After soldering all the pre-stuffed resistors and capacitors, wash and dry the pc board.

PART #2: Soldering the ICs & Misc parts

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 (2). 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 CA3280 (3). Solder into U4, U5 and U8. Be sure the parts all point in the same direction: "up".

❒ Locate the LT1013 (2). Solder into U1 and U3.

❒ Locate the SSM2220P (2). Solder into Q1 and Q2.

❒ Locate the TL072ACP (7). Solder into U2, U6, U7, U9, U10, U11 and U12.

❒ Apply a small bit of solder to the via holes. These are the small pads (no components go in them) that allow traces to "change sides" of the pc board. DO NOT SOLDER PADS FOR THE REMAINING COMPONENTS!! The via holes need a **VERY SMALL AMOUNT** of solder.

PART #3: BOARD WASH #2

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

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

❒ Take another break or set the kit aside for later. You are about 75% finished at this point: this is a good stopping-point.

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 #4: CAPACITORS/TEMPCO RESISTORS

Locate the **CAPACITOR/RESISTOR** bag. Set the 2 black TEMPCO resistors aside.

❒ Locate the 1N5 (1500pf) poly caps. (4). They are reddish-brown in color. Solder into C12 and C13 (by U12), C19 (by U7) and C20 (by U11).

❒ Locate the 3M3 non-polar caps. Solder C8 and C15 (by VR1) and C21 and C27 (by U11).

❒ Locate the 1nf (1000pf) yellow box caps (2). Solder into C3 and C6 (near U2).

❒ Locate the 10μfd electrolytics (2). Note that there is a stripe on the NEGATIVE terminal. The pc board has a + on the POSITIVE terminal. Carefully stick the capacitors into C28 and C29 with the stripe ***away*** from the + pad on the board.

❒ Locate the 2 black Tempco resistors. These solder on top of Q1 and Q2. A small amount of heatsink compound is first applied to the tops of Q1 and Q2, and the Tempcos are placed so that the DIP packages are in contact with the bottom of the Tempcos. Be sure the Tempcos are level and flat before soldering.

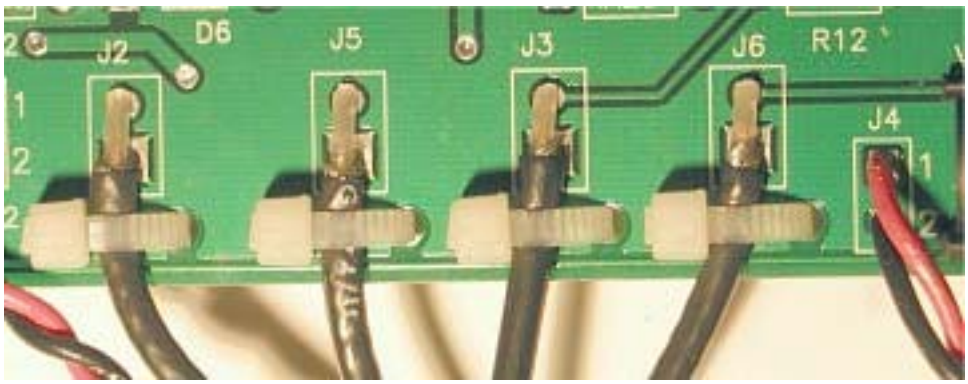
PART #5: FINISHING THE PCB

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

❒ Locate the Spectrol pots (4). **IMPORTANT**: in order for the pc board to properly align with the front panel, each pot must be ***absolutely flat*** on the pc board, with the shafts pointing away from the pc board. Three of the Spectrol pots have shorter leads and are marked 148-9609-104. Solder these pots into VR1, VR2 and VR3. The other Spectrol pot has longer leads and is marked 149-71104. Solder this pot into VR4.

❒ Locate the **WIRE** bag. The MOTM-480 has lots of wires: be very careful when soldering to the pc board in order that the wire colors are correctly into the proper holes.

❒ The long coax wires solder into J5 and J6. A tie-wrap is used on each wire to secure the coax flat onto the pc board. Note that the coax wires have one end stripped back shorter than the other: the short end solders to the pc board. See the photo below for details (***this is a generic photo!***)



❒ Solder the 3 short coax cables into locations J4, J7 and J8. Secure with tie-wrap.

❒ Solder the white/black/red wire into VR5. White into 1, Black into 2 and Red into 3.

❒ Solder the orange/white wire into J3. White into 1 and Orange into 2.

❒ Solder the 3 white/gray/orange wires into VR6, VR7 and VR8. In all cases, the White goes to 1, the Gray into 2 and the Orange into 3.

❒ Solder the 2 red/black wires into J1 and J2. In both cases, the Red is in 1 and the Black solders into 2.

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

PART #6: FRONT PANEL PREPARATION

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 8 Switchcraft jacks. Notice that from the rear, there is a beveled corner. This corner is ALWAYS CONNECTED TO GROUND. 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 8 jacks/lockwashers, with the beveled corner in the ***upper-right*** corner, into the 8 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.

❒ Attach the 4 blue Bourns pots to the front panel. The 3 lug terminals point "downward", toward the jacks. The lockwasher goes on the inside of the panel, the flat washer on the outside.

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

PART #7: 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 its panel hole when the bracket is screwed down on the 2 threaded posts.

Attach the pc board to the bracket using the 4 screws, spacers and nuts (the nuts go on the bottom of the pc board). Do **not** tighten the nuts all the way, so the pcb can "slide" in the bracket. Next, attach the bracket/pcb to the 2 threaded studs (tighten these 2 nuts all the way). With the 4 pcb nuts still partially tightened, put the 4 flat washers and 4 nuts on VR1-VR4 (on the front of the panel) and tighten. This will "pull" the pcb up against the panel, resting on the 4 pot nuts. **NOW** you tighten the 4 nuts on the bottom of the pcb bracket.

PART #8: FINISH WIRING TO THE PANEL

Please read the following instructions carefully. In order to neatly attach the many wires to the front panel components, the wires are soldered in a specific order. You may find, in some cases, it is easier to first remove a jack from the panel and solder the wires, then reattach it to the panel.

- ❒ Solder the red/white/black wire to VR5, FREQ HP. Red on the left lug, Black on the center, and White wire on the right lug.

- ❒ Solder the white/gray/orange wire in VR6 to the control RES HP. Orange on the left, gray on the center and White on the right lug.

- ❒ Solder the white/gray/orange wire in VR7 to the control FREQ LP. Orange on the left, gray on the center and White on the right lug.

- ❒ Solder the white/gray/orange wire in VR8 to the control RES LP. Orange on the left, gray on the center and White on the right lug.

- ❒ Now you will solder to the 8 jacks. In all cases, the Top lug is NOT connected. The BEVELED lug is the Ground connection: the coax braids all solder to this lug. The wiring is crowded, take your time. Be SURE that you fill the lug's internal hole completely with solder. It doesn't take all that much, but it will secure the wire to the jack.

- ❒ Solder the coax in J4 to the BP OUT Jack. The braid is on the BEVELED lug, the inner conductor is on the LEFT lug. The TOP lug is NOT connected.

- ❒ Solder the coax in J8 to the LP OUT jack.

- ❒ Solder the white/orange wire in J3 to the RES CV jack. White wire to the Left lug, Orange wire to the Beveled lug.

- ❒ Solder coax in J7 to the IN3 Jack.

- ❒ Solder the red/black wire in J2 to the FM IN jack. Red on the Left lug, Black on the Beveled lug.

- ❒ Solder the coax in J6 to IN2 jack.

- ❒ Solder red/black wire in J1 to the 1V/OCT jack. Red on the Left, Black on Beveled.

- ❒ Solder the coax in J5 to the IN1 jack.

❒ Use the 2 remaining tie-wrap to bundle the wires. Use 1 tie-wrap on VR5-8 wiring (attach the tie-wrap behind VR7), the other on the jack wiring.

❒ Rotate all of the front panel pots fully counter-clockwise. Locate the **KNOBS**. Notice each knob has a 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 across it and it will peel off.

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CONGRATULATIONS! YOU HAVE FINISHED BUILDING THE MOTM-480!

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All that's left to do is test it! But before we do, please read the following Theory of Operation.

THEORY OF OPERATION

The MOTM-480 is based on the circuitry in the Yamaha CS-80 polyphonic synthesizer. The exact circuit is not copied. Instead, more modern components are used to mimic the overall architecture of the original design.

The MOTM-480 has 2 identical multi-mode filters connected in series. The filters are called *state-variable filters (SVF)*, but not for the reason you may think. It is true that this filter topology has 3 simultaneous outputs (LP, LP and BP) so it is natural to assume state-variable means….errr…variable outputs. However, the term state-variable is a *mathematical definition*. The original paper describing this particular filter topology (in 1967!) was titled "State-Variable Synthesis for Insensitive Integrated Circuit Transfer Functions". If you remember solving second-order differential equations, you can substitute state variables for the differential and integral terms in the equation, and use algebra (instead of calculus) to solve. I remember like it was yesterday (cough cough).

The 3 outputs of the VCF each have their own equation, and so the mathematical solution is used to describe the filter, NOT the physical implementation. In fact, the SVF is usually implemented as a slightly different configuration called a Fleischer-Tow Biquad (whose output equations are a quadratic equation in the S-domain, but I digress).

Moving right along, the MOTM-480 uses 2 independent SVF filters connected in a certain way. Internally, there are actually 6 simultaneous outputs, but we elected to only use 2 of them. I'm sure some industrious person can figure out an expansion panel for all 6 :)

Page 1 of the schematic shows the 2 identical control sections for the 2 filters' cutoff frequency. Looking for a moment at the top (HP) section, U3 is just a voltage summer/inverter for the various panel controls and FM input. Note that the FM input is coupled to both filters, as is the 1V/OCT input. Each filter does have independent initial cutoff frequency pots.

The summed DC voltages are attenuated by divider network R14/R17 to be properly scaled to 1V/Oct. I elected not to use a trim here because the 54.9K/1K ratio is within 3% of "correct" and to set a trim more accurate than 3%, an oscilloscope is needed.

The scaled voltage (1V in equals 17.9mv out) feeds the PNP current mirror Q2. The emitters are fed a reference current of 15V/R15 = 26.7μa which is modulated by the Vbe voltage. We want a current out because the OTAs we are using (CA3280) need a control current, not a control voltage.

Now let's examine Page 2 of the schematic. In the lower-left corner, you will see 2 familiar circuits: these are almost identical to the circuits on Page 1. Again, 2 voltage summers/attenuators/PNP current mirrors are used to control the resonance (feedback) VCA sections of the 2 SVFs). These current mirrors are not quite as "fancy" but they get the job done.

If you draw an imaginary line across the center of the page, you can see the 2 identical SVF circuits. The are interconnected by the wire from the top section (U10A, pin 1) to the bottom section (through R68 and C15, into U7A). We will discuss the top section, because it also applies to the bottom one as well.

The 3 audio inputs are summed and AC coupled into U10A. Following U10A are 2 cascaded current-controlled integrators, formed by 1 section of a dual CA3280 OTA (U4) and an op-amp/capacitor (U12B/C12 and U6A/C13). The output of the second integrator is fed back through R55, forming a "closed-loop" system which give the SVF its unique characteristics.

Resonance is achieved by a simple VCA section (U5A) which feeds back a portion of the first integrator's output into U10A. The output of the CA3280 is also a current, so R69 is a simple current-to-voltage converter.

In the SVF, the highpass (HP) response is the output of the summer U10A pin 1, the bandpass (BP) response is the output of the first integrator stage U12B and the lowpass (LP) response is the output of the second integrator U6A pin 1. You will see that only the BP output from the top SVF is brought out to the front panel, after it is amplified by a factor of 10 (R37/R39) by U6B.

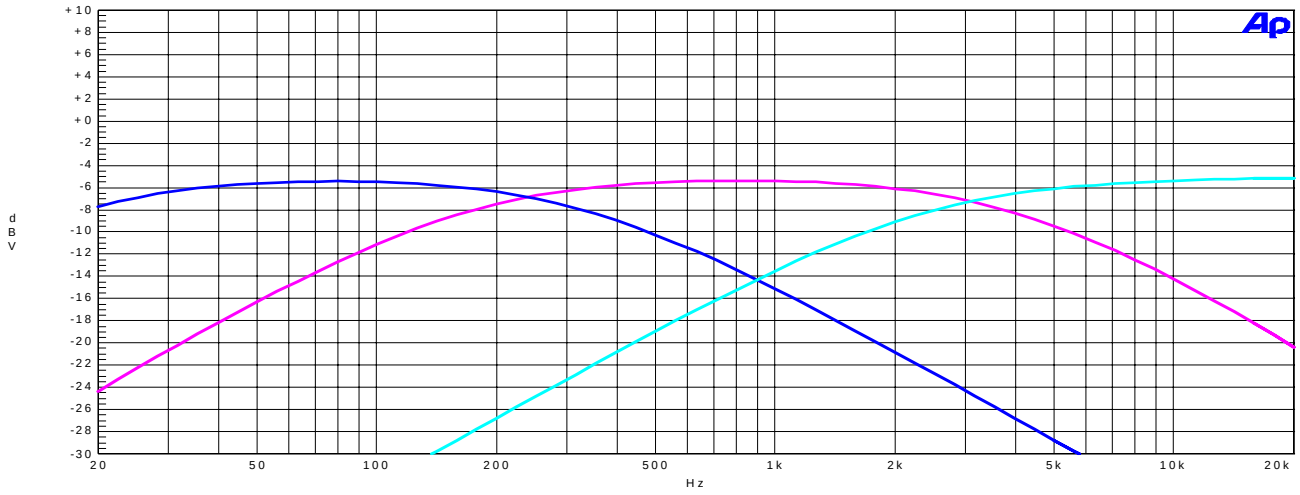
To get that ***CS-80 sound***, two "tricks" need to be used. First, look at the resonance OTA section U5A. See 150pf capacitor C22 in parallel with 1M2 resistor R72? Normally, there is no reason for this network to be there. But in the CS-80 it IS there to limit the self-resonance of the SVF. This network induces a phase-shift so that the SVF can go into high resonance but NOT self-resonance (oscillation). It also imparts a "softness" to the overall sound which is very "CS-80 like" and so it's on the MOTM-480 as well.

Trick #2 is how the 2 sections are interconnected. On the CS-80, and hence the MOTM-480, the HP output of SVF #1 feeds the audio input of SVF #2. Yamaha could have picked the BP or the LP outs, but they chose the HP out and so do we. But…..since these filters are in series, we want to pick the "correct" output from the second SVF to get a "musically useful" signal, and that's the LP output (U11A). This allows us to create a *variable bandpass response* because we purposely split the controls into the upper section (HP FREQ/HP RES)

and the lower section (LP FREQ/LP RES). So, you the user can independently set the 2 “corners” of a bandpass filter, each with its own resonance. Sure, the jack is labeled “LP OUT” and we certainly can get a standard LP output. But in most cases, you will discover the best-sounding patches use a mixture of HP/LP settings to generate this modified BP response.

Here are a few graphs off the Audio Precision showing different frequency response plots for different panel settings. Originals are at www.synthtech.com/files/motm480plots.pdf

Audio Precision A-A FREQUENCY RESPONSE 02/14/05 19:31:38

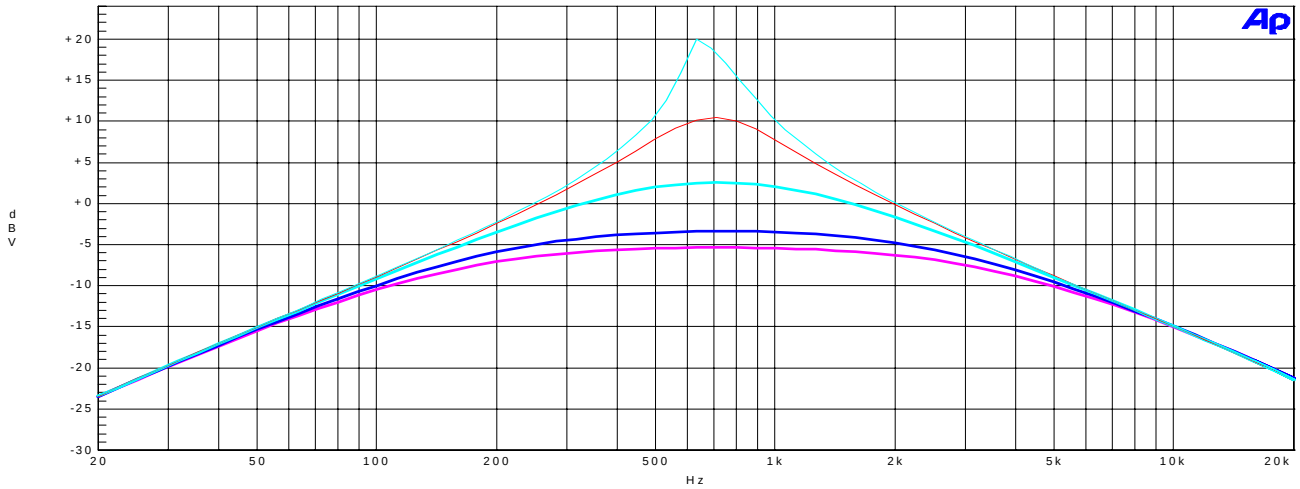


Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Magenta	Solid	3	Anlr.Level A	Left	
2	1	Blue	Solid	3	Anlr.Level A	Left	
3	1	Cyan	Solid	3	Anlr.Level A	Left	

MOTM-480 BP OUT Frequency response. Setting are HP RES = 0, and HP FREQ settings at tick marks 2, 5 and 8.

A-A FREQ RESP.at2

Audio Precision A-A FREQUENCY RESPONSE 02/14/05 19:37:24



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Magenta	Solid	3	Anlr.Level A	Left	
2	1	Blue	Solid	3	Anlr.Level A	Left	
3	1	Cyan	Solid	3	Anlr.Level A	Left	

MOTM-480 BP OUT Frequency response at different resonance settings. HP FREQ = 5, HP res varies from 0 to 8.

A-A FREQ RESP.at2

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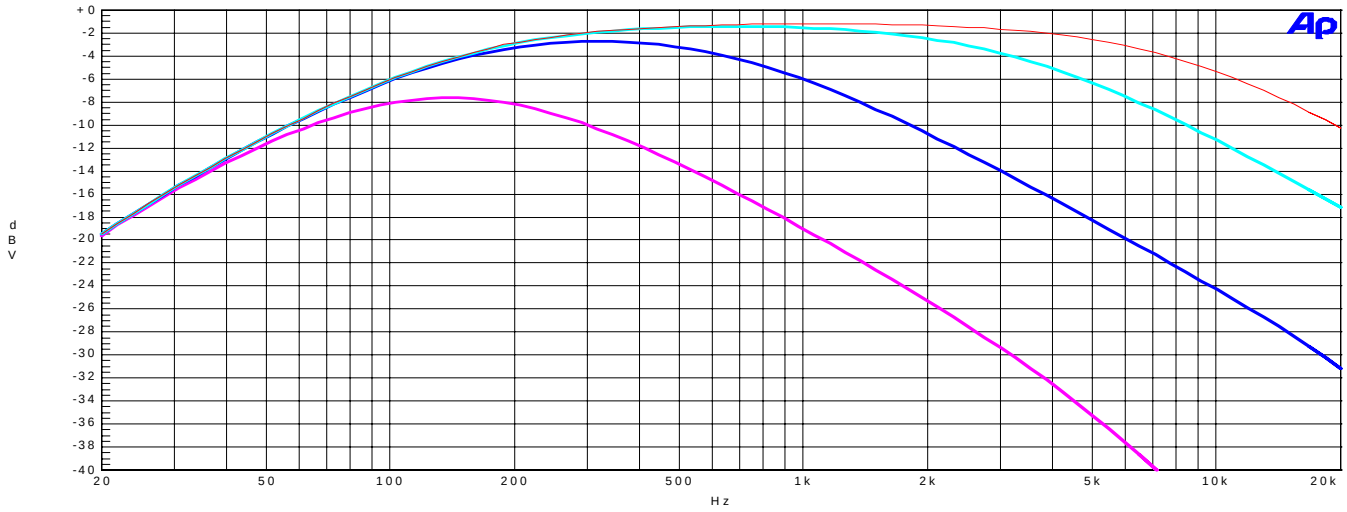
Audio Precision A-A FREQUENCY RESPONSE 02/14/05 19:52:37

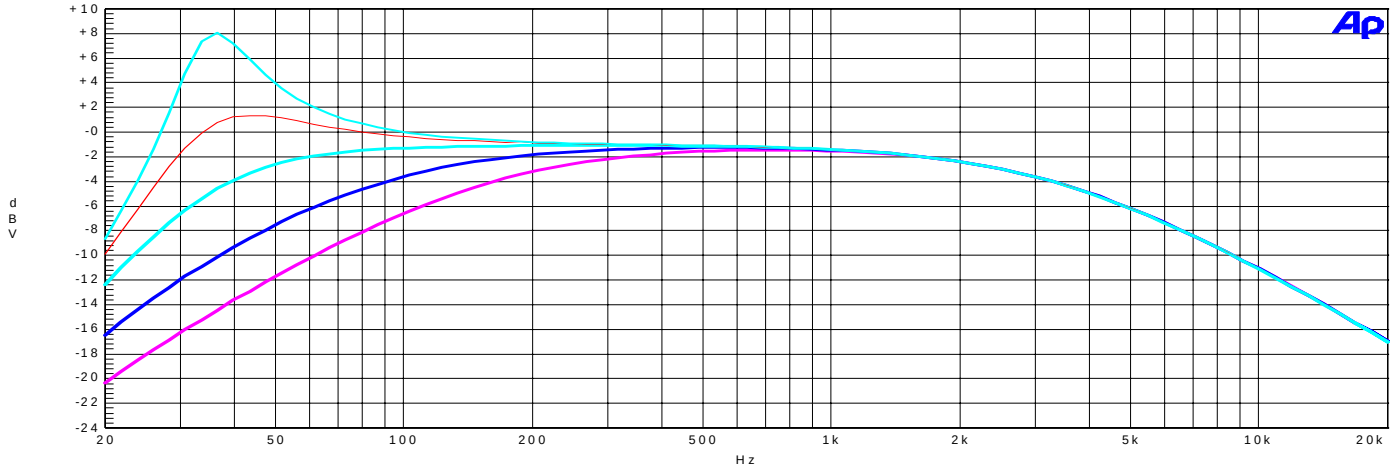


Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Magenta	Solid	3	Anlr.Level A	Left	
2	1	Blue	Solid	3	Anlr.Level A	Left	
3	1	Cyan	Solid	3	Anlr.Level A	Left	

MOTM-480 LP OUT response with HP FREQ=0, LP FREQ varies from 4 to 9. Both RES setting = 0.

A-A FREQ RESP.at2

Audio Precision A-A FREQUENCY RESPONSE 02/14/05 20:03:09



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Magenta	Solid	3	Anlr.Level A	Left	
2	1	Blue	Solid	3	Anlr.Level A	Left	
3	1	Cyan	Solid	3	Anlr.Level A	Left	

MOTM-480 LP OUT with LP FREQ = 8, HP FREQ = 1.5, LP RES = 0. HP RES is varied from 0 to 8.

A-A FREQ RESP.at2

PRELIMINARY CHECK-OUT & TROUBLESHOOTING/USE

The first thing to remember: this filter *will not self-oscillate* - Blame Yamaha :)

Checkout is straightforward: use a VCO to input a square or pulse into IN1. Set all panel pots to "5" and check for audio outputs at LP OUT and BP OUT. Remember, the BP OUT is only dependent on the top SVF working. If that isn't functional, then chances are LP OUT will be dead (unless to have a wiring issue with the coax). Adjust the HP and LP FREQ pots and listen to the different responses.

One thing to remember: the BP OUT is ONLY affected by the HP controls. The LP OUT is affected by both HP/LP sets of controls. This can be a little confusing at first.

If there are problems, check the following:

a) No missing solder joints?
b) All of the ICs point in the same direction
c) Check the wiring to the pots. Verify the proper colored wire goes into the proper hole.
d) Verify the jack wiring.

If you still cannot get the module to perform correctly, please contact us by phone at (817) 498-3782 or by email to synth1@airmail.net

SPECIFICATIONS
MOTM-480 CS-MODE VCF

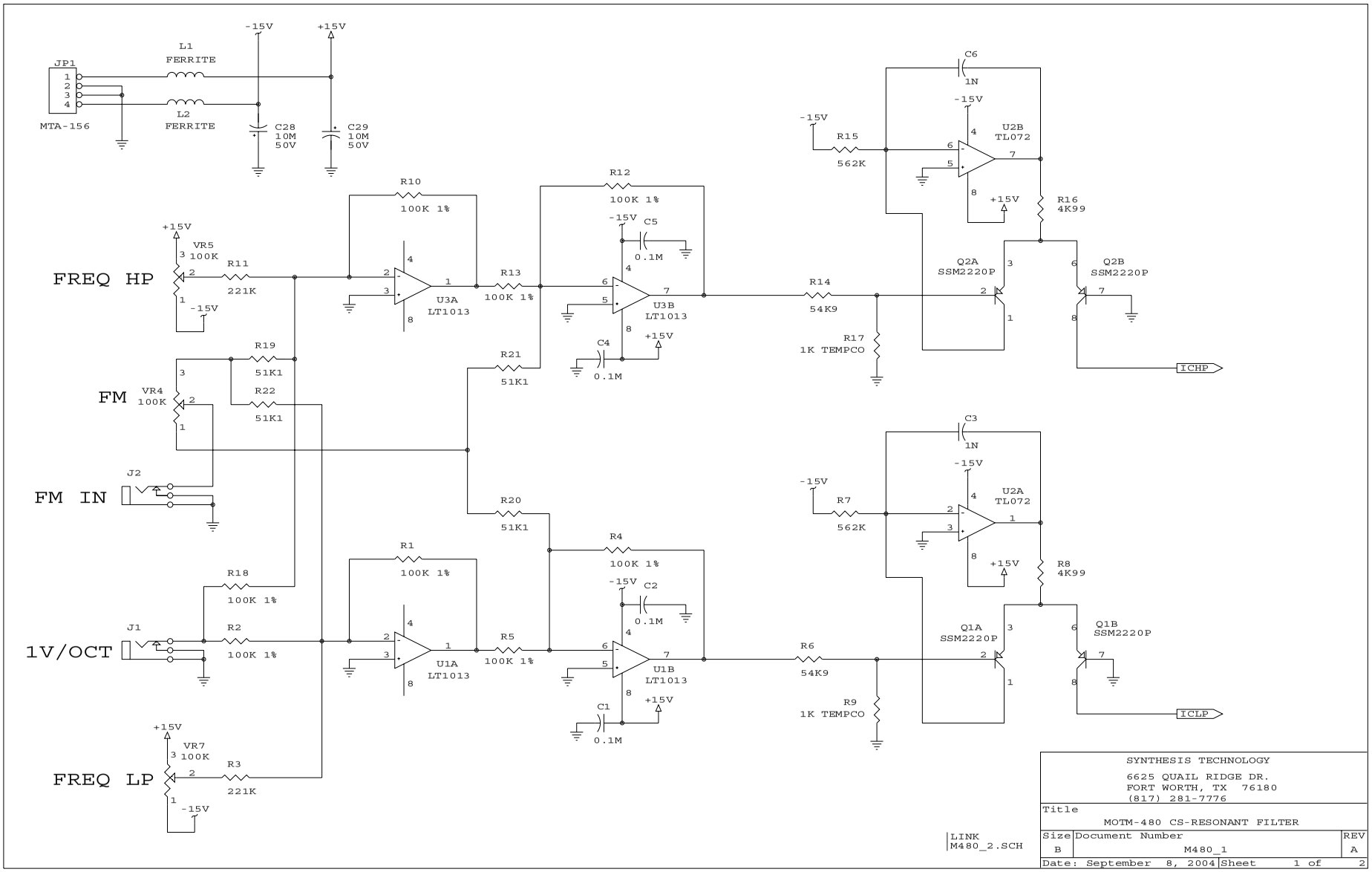
Audio Input Range	10V pk-pk nom.
Control Voltage Range	-7V/+7V
Output impedance	1000 ohms, nom.
Frequency Range	20Hz – 18Khz nom.

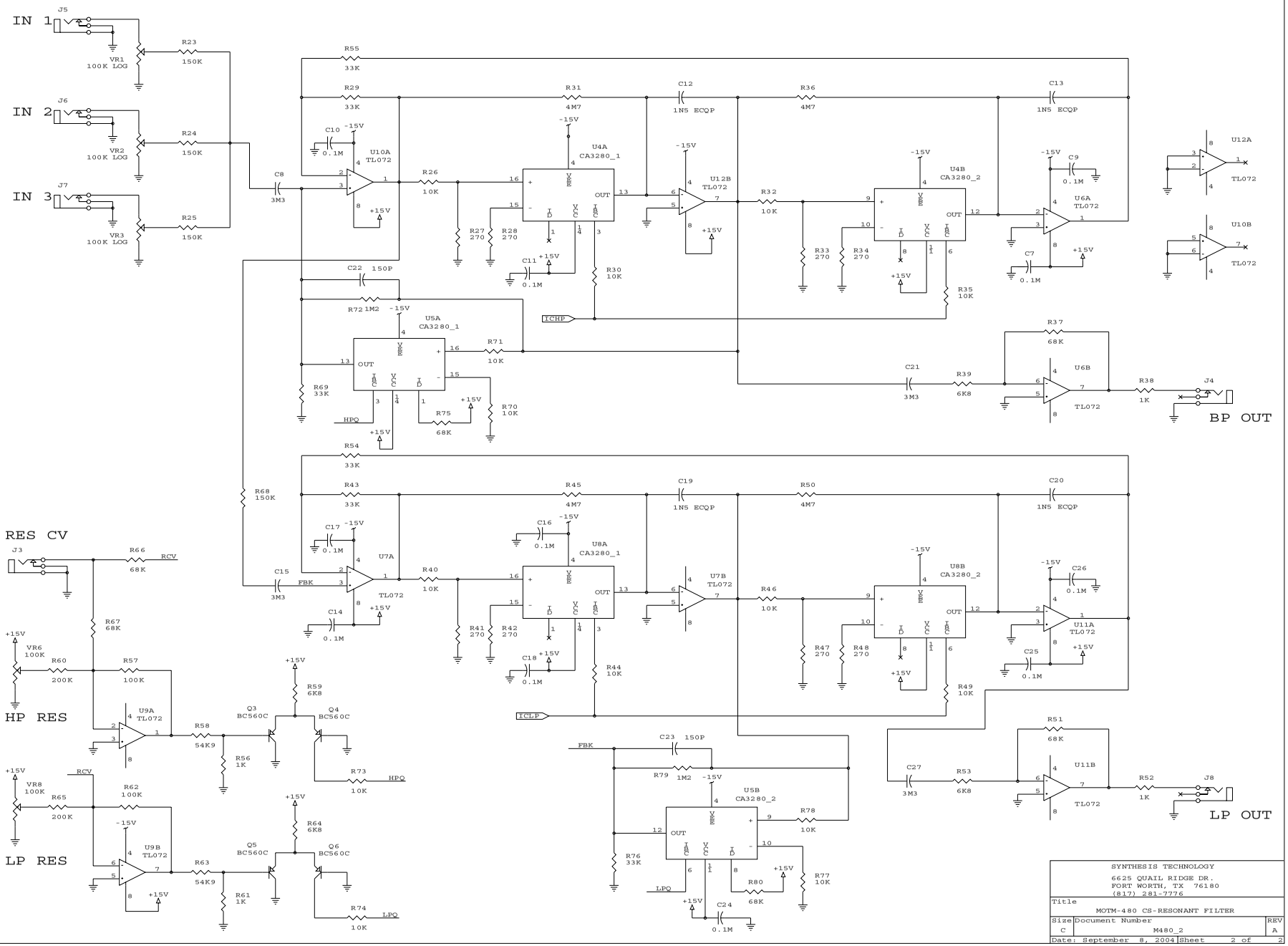
CONTROLS

HP FREQ	sets HPF section initial cutoff
HP RES	sets HPF resonance
LP FREQ	sets LPF section initial cutoff
LP RES	sets LPF resonance
IN1, IN2, IN3	input attenuation of audio inputs
FM	reversing attenuator for both HP/LP

GENERAL

Power Supply	-15VDC @ 28ma +15VDC @ 28 ma
Size	2U x 5U 3.45□ x 8.72□ 88mm x 221.5mm
Depth behind panel	4.5□ (114mm)


JP1
MTA-156
L1
FERRITE
L2
FERRITE
-15V
+15V
C28
10M
50V
C29
10M
50V
FREQ HP
VR5
100K
R11
221K
R10
100K 1%
R12
100K 1%
C5
0.1M
U3A
LT1013
U3B
LT1013
R13
100K 1%
R14
54K9
R17
1K TEMPCO
C4
0.1M
R21
51K1
C6
1N
U2B
TL072
R15
562K
R16
4K99
Q2A
SSM2220P
Q2B
SSM2220P
ICHP
FM
VR4
100K
R19
51K1
R22
51K1
FM IN
J2
R20
51K1
1V/OCT
J1
R18
100K 1%
R2
100K 1%
R1
100K 1%
R4
100K 1%
C2
0.1M
U1A
LT1013
U1B
LT1013
R5
100K 1%
R6
54K9
R9
1K TEMPCO
C1
0.1M
C3
1N
U2A
TL072
R7
562K
R8
4K99
Q1A
SSM2220P
Q1B
SSM2220P
ICLP
FREQ LP
VR7
100K
R3
221K
LINK
M480_2.SCH
SYNTHESIS TECHNOLOGY
6625 QUAIL RIDGE DR.
FORT WORTH, TX 76180
(817) 281-7776
Title
MOTM-480 CS-RESONANT FILTER
Size
B
Document Number
M480_1
REV
A
Date: September 8, 2004
Sheet 1 of 2


IN 1
IN 2
IN 3
RES CV
HP RES
LP RES
BP OUT
LP OUT
SYNTHESIS TECHNOLOGY
6625 QUAIL RIDGE DR.
FORT WORTH, TX 76180
(817) 281-7776
Title
MOTM-480 CS-RESONANT FILTER
Size C
Document Number M480_2
REV A
Date: September 8, 2004
Sheet 2 of 2

SYNTHESIS TECHNOLOGY
MOTM-480
REV A
-15 GND +15
JP1
L1
C28
C29+
Q1
Q2
Q3
Q4
Q5
Q6
VR1
VR2
VR3
VR4
VR5
VR6
VR7
VR8
J1
J2
J3
J4
J5
J6
J7
J8
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
TL072
CA3280
1013
ON TOP
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
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C26
C27
R1
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R79
R80
1 2 3