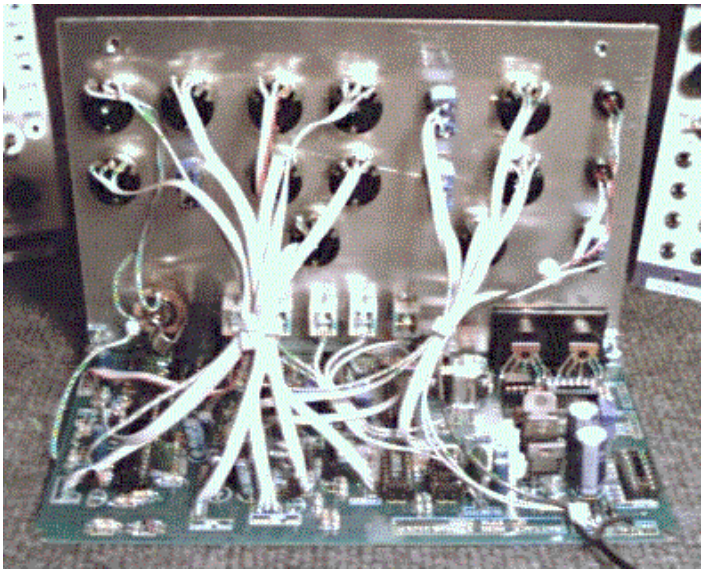
EFM Synthesizers

BassAce - Midi Bass Synthesizer



BassAce Assembly and Setup

The BassAce is a small midi-synth based loosely on the TB303. It can be built many different ways. Depending on how it's configured it can be anything from a simple 303 type box to a full scale mono-synth. The 1/2 FracRac((TM) PAiA) shown here is in the maximum configuration without adding more pc boards. I have included a version of this layout for use with a Hammond case at the end of tis document. Add a VCO4 board, a Dual EG and a small mixer and you've got a full 2-VCO synth.

BassAce Features

- Midi Interface
  - Key CV
  - Mod CV (to VCF cutoff)
  - Gate
  - Slide
  - Accent
- Full-range saw/square VCO
- Sub Octave generator (-1 / -2)
- Moog Type - 4 Pole VCF
- VCA - OTA Type
- VCF Decay/Release Envelope Generator
- VCA Decay Envelope Generator
- TB303 Style Accent

Instructions are written with the board placed so that "BASSACE MIDI SYNTHESIZER" is printed at the top.

Assembly

Decide how "you" want to build it.

You will have to decide how many of the trimmers you wish to replace with pots. **T1 (DAC Scale)** , **T3 (VCO Scale)** and **T4 (VCO HF Scale)** must be **trimmers**. They must be installed and adjusted before the BassAce can be used in any form.

P1 (Tune) - 50K - Master Tune Control - Sets VCO frequency.
P2 (Mix) - 50K - If you install the sub-octave generator (U13) this control allows you to mix or blend to two tone sources.
P3 (VCF EG Decay) - 1M - VCF Decay Control - Sets the time it takes for the VCF envelope generator to fade out.
P4 (Env. Mod.) - 50K - Sets how much of the VCF envelope generator's signal is applied to the VCF.
P5 (Accent) - 50K - Sets how much of the VCF envelope generator's signal is applied to the VCA and VCF resonance corset.
P6 (Cutoff) - 50K - Sets the VCF's cutoff frequency.
P7 (Resonance) - 50K - Sets the amount of the output signal that's reapplied to the VCF input.
P8 (Volume) - 50K - Sets output level.

All of these trimmers may be pots except where noted.

T2 (Glide Length) - 1M - In my opinion this should be a pot. The glide length is set by adjusting this resistor and it's relationship with C11 (0.1uF). You may change it's value to....oh say....2M to 5M or (and) change C11 to 0.47uF to 1.0uF to achieve longer glide times. As listed the total time is pretty short.
T5 (Square Shape) or Pulse Width - 100K - If you don't install the sub-octave generator (U13) you can use this adjustment to set the width of the square wave pulses or connect another 100K resistor to pin 13 for external control. If the sub-octave generator is used this must be a trimmer and ajusted so that the square wave is fairly symmetrical or U13 will not be able to track the vco.
T6 (VCA EG Decay) - 1M - Sets the time it takes for the VCA envelope generator to fade out.
T7 (VCF EG Release) - 1M - Sets the time it takes for the VCF envelope generator to fade out after all keys are released.

S1 (Power Switch) - SPDT - Disconnects the power transformer.
S2 (Midi Channel Select) - 4X DIP - Selects the midi channel the BassAce responds too.
S3 (Wave Select) - SPDT - Selects between Square and Saw waves going into the VCF.
S4 (Sub Select) - SPDT - Selects the -1 or -2 sub-octave going into the VCF.
S5 (Gate/Trigger Select) - SPDT - The BassAce normally has a very short envelope if you want to play longer notes the VCA can be patched to turn on and stay on as long as a key is held down.

Install the IC Sockets.

2 - 8 pin - U4, U16
8 - 14 pin - U5, U8, U9, U10, U11, U12, U13, U14
1 - 18 pin - U6
1 - 20 pin - U7
1 - 16 pin - U15

Be sure the socket you use for U11 has an open middle because we'll need to install a tempco resistor in this space, also pay attention to U16...It's upside down.

Install the resistors and caps.

Note: Place 47K resistors in the spaces for R18,20. Put 10K resistors in the spacces for R17,19

Install U1,U2 and U3

Hookup the power transformer, S1 and install the power LED on the PC Board.
Turn the unit on and test the voltages at the sockets before installing the ICs.

U04 - pin8 (+5)
U05 - pin14 (+5)
U06 - pin(s)4 and 14 (+5)
U07 - pin17 (+5)
U08 - pin4 (+12) , pin11(-12)
U09 - pin4 (+12) , pin11(-12)
U10 - pin14 (+12)
U11 -
U12 - pin4 (+12) , pin11(-12)
U13 - pin14 (+12)
U14 - pin(s)8 and 10 (+12)
U15 - pin6 (-12) , pin11(+12)

U16 - pin4 (-12) , pin8(+12)

Testing the MIDI Interface

Turn the unit off and install U4, U5, U6, U7, and U8.

Hookup a midi keyboard and make sure all 4 switches on S2 are off (open). Set the controller to send midi on channel 1 and connect a midi cable from the midi out port on the keyboard to the midi in port on the BassAce.

Turn the unit back on. This activates the midi interface.
Connect the negative lead of a meter to GND on the pc board.

Connect the positive lead to pin1 of U8.
Adjust trimmer T1 until the voltage at pin1 is -10.50VDC

Connect the positive lead to GATE-CV on the board.
Press a key on the controller. The voltage should rise from 0 to +5VDC and then return to 0VDC when the key is released.

Connect the positive lead to SLIDE-CV on the board.
Press any two keys on the controller. The voltage should rise from 0 to +5VDC and then return to 0VDC when a key is released.

Connect the positive lead to ACCENT-CV on the board.
Strike (hard) any key on the controller. The voltage should rise from 0 to +5VDC and then return to 0VDC when the next key is pressed. If you strike the next key and a midi-velocity value of 64 or more is sent the ACCENT-CV will stay high (+5VDC).

Connect the positive lead to MOD-CV on the board.
Move the mod-controller on the keyboard. The voltage should follow the movement of the controller from 0 to +5VDC and back to 0VDC.

Connect the positive lead to KEY-CV on the board.
Press a few keys on the controller going up and down. The voltage should follow the keyboard rising and falling with the pitch.

Press the lowest key on your keyboard. Chances are this is a C2. The voltage at KEY-CV should be around +1VDC (ie: +0.987) press the key that's an octave up from the key you just pressed. The voltage at KEY-CV should be what ever it was plus +1VDC (ie: +1.987). Adjust T1 (DAC Scale) until it's as close as you can get then try the next octave. Play with T1 until all octaves are as close to 1V apart as you can get.

Turn the unit off.

Testing the Analog Section

Install all remaining ICs making sure U16 is placed in the right way (it's upside down). Now you have to hook up the trimmers and pots. The pc board is laid out is such a way that ribbon cable can be used to hook up all of the pots and switches.

I suggest that the components be hooked up loose on about 8 inches of ribbon cable. This makes it easy to spread out on your bench and set it up. When you get ready to install it in it's case it's fairly easy to kinda wad it all up and use cable ties to make it look nice.....but not yet.....

CAUTION: Do not touch the +/- voltage regulators they are probably going to be hot. We'll put heat sinks on them later but right now it would just be a bigger something that's hot and harder to avoid. The test-unit ran overnight without heat-sinks but I don't want to recommend it. They get hot. If there is room in the permanent home and it's aluminum, you may want to move them off-board and use the case for a heat sink.

NOTE: It you do this it requires isolators for the regulators. Although the case of the positive-regulator is at GND the case of the negative-regulator is not at GND.

Setup

To complete the following setup you will need a midi capable referance keyboard and a way to mix the audio signals from the BassAce and the referance keyboard so that the tuning can be compaired.

Enter the basic patch.

VCO	VCF	VCA
Glide - 0 Tune - 0 Mix - 100% VCO Waveform - Ramp (Saw) Sub-Octave - (-1)	Env. Mod - 0 Decay - 10 Cutoff - 10 Release - 10 Resonance - 0	Decay - 10 EG - Gate Accent - 0 Volume - 5

Turn the unit on.

Check for +/-12VDC and +5VDC.

Press a key on the controller a few times and adjust the volume.
Press C2 on the controller and adjust the TUNE pot until it's close.
Press C3 on the controller and adjust the SCALE TRIMMER (T3) pot until it's close.
Play C2 and C3 back and forth adjusting the SCALE TRIMMER until they are close.
Play the next to highest C and the highest C octave on your keyboard and adjust HIGH-TRIM (T4) until its right.

NOTE: All of the trimmers interact you will have to play with it to get it tuned properly.

Check all controls for their function. Due to the way it's wired with ribbon cable some controls may work in reverse. Simply unsolder the wires and turn them over and solder it back into place.

Once setup is complete, you will want to play with it for a while and redo the setup. Have fun with your BassAce.

Midi Select

Channel	S2- 4,3,2,1	Channel	S2-4,3,2,1
1	0000	9	1000
2	0001	10	1001
3	0010	11	1010
4	0011	12	1011
5	0100	13	1100
6	0101	14	1101
7	0110	15	1110
8	0111	16	1111

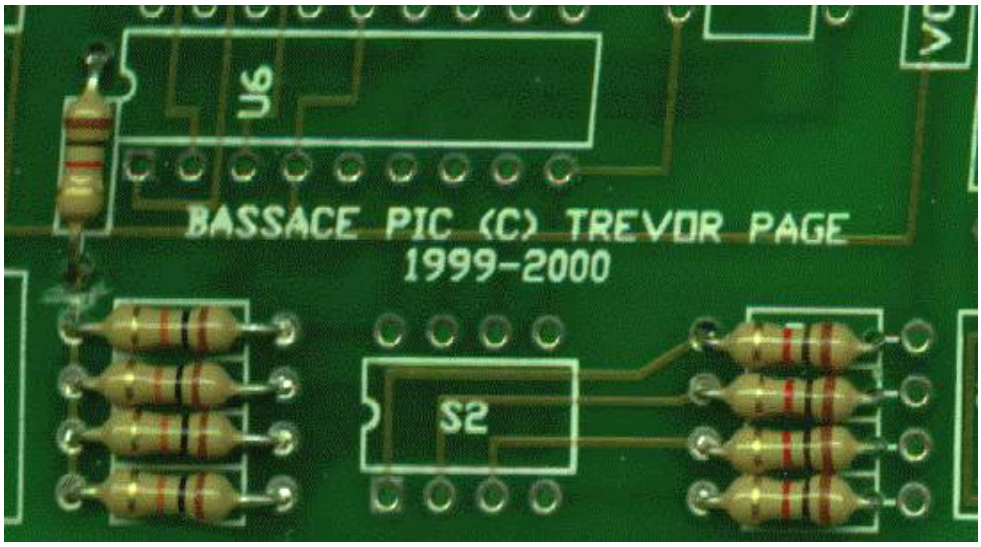
Parts List

C6, C7	22 pf	Capacitor - Ceramic	2
C25	.05 uf	Capacitor - Ceramic	1
C18, C19, C20, C21, C22, C23	0.1 uf	Capacitor - Ceramic	6
C8, C9	10 pf	Capacitor - Ceramic	2
C13, C14, C15	100 pf	Capacitor - Ceramic	3
C10, C11, C12	.01 uf	Capacitor - Ceramic/Epoxy	3
C17	220 uf / 16V	Capacitor - Electrolytic	1
C16, C24, C26, C27	10 uf/35V	Capacitor - Electrolytic	4
C3, C4, C5	1.0 uf	Capacitor - Electrolytic	3

C1, C2	470 uf / 35	Capacitor - Electrolytic	2
U13	4013	CMOS Dual D Flip Flop *	1
U10	4066	CMOS Quad Bilateral Switch *	1
X1	4MHZ	Crystal - Metal Can	1
J2, J3	5 Pin Din PCB	DIN - Midi	2
D1, D2	1N4001	Diode - Rectifier	2
D3, D4, D5	1N4148	Diode - Signal	3
U7	TLC7528CN	Dual 8-Bit DAC - 20 pin DIP	1
U8	LM324	IC Opamp - Quad JFet *	1
U8, U9, U12, U16	TLO74CN	IC Opamp - Quad JFet *	4
U4	6N138	IC Opto Isolator - 8 Pin Dip	1
U15	LM13600	IC OTA - Dual	1
U11, U14	LM3046	IC Transistor Array *	2
REF	LM336Z-5.0	IC Voltage Reference - TO-92	1
U1	7812	IC Voltage Regulator +12	1
U3	LM7805	IC Voltage Regulator +5	1
U2	7912T	IC Voltage Regulator -12	1
J4	1/4" Jack	Jack - 1/4"	1
J1	1/8" Mini Jack	Jack - 1/8"	1
U6	16F84-04/P-ND	Pic Microcontroller - 18 Pin DIP	1
P1, P2, P4, P5, P6, P7, P8	50K	Pot 16mm Panel Mount Linier	7
P3	1M	Pot 16mm Panel Mount Linier	1
R15, R23, R28, R33, R34, R35, R37, R38, R39, R41, R42, R43, R44, R45, R61, R66, R80	100K	Resistor	17
R2, R3, R4, R40	220K	Resistor	4
R72	22K	Resistor	1
R1	1.5K	Resistor	1
R5, R10, R11, R12, R16, R26, R30, R46, R49, R50, R51, R52, R53, R54, R55, R62, R63, R75	1K	Resistor	18
R6, R7, R8, R9, R17, R19, R25, R27, R31, R32, R47, R60, R65, R68, R69, R70	10K	Resistor	16
R14, R16	2.2K	Resistor	2
R22	150K	Resistor	1
R29	4.7K	Resistor	1
R36, R57, R58	470K	Resistor	3
R48, R56	2.7K	Resistor	2
R67, R71	1M	Resistor	2
R18, R20, R21, R59, R78, R79	47K	Resistor	6
R73	100R	Resistor	1
R74, R77	68K	Resistor	2
R64	33K	Resistor	1
R24	1K	Resistor - Tempco	1
S1, S3, S4, S5	SPDT	Switch - Mini Toggle on/off *	4
S2	4X DIP RA	Switch 4X Dip	1
	XFM1	Transformer 12VAC	1
Q1, Q5, Q7, Q8, Q9, Q10, Q11, Q12, Q13	2N3904	Transistor - GP NPN	9
Q2, Q3, Q4, Q6, Q14	2N3906	Transistor - GP PNP	5
T3	50K	Trimmer - Multiturn Cermet	1
T4	10K	Trimmer - Multiturn Cermet	1
T1, T5	100K	Trimmer - Multiturn Cermet	2

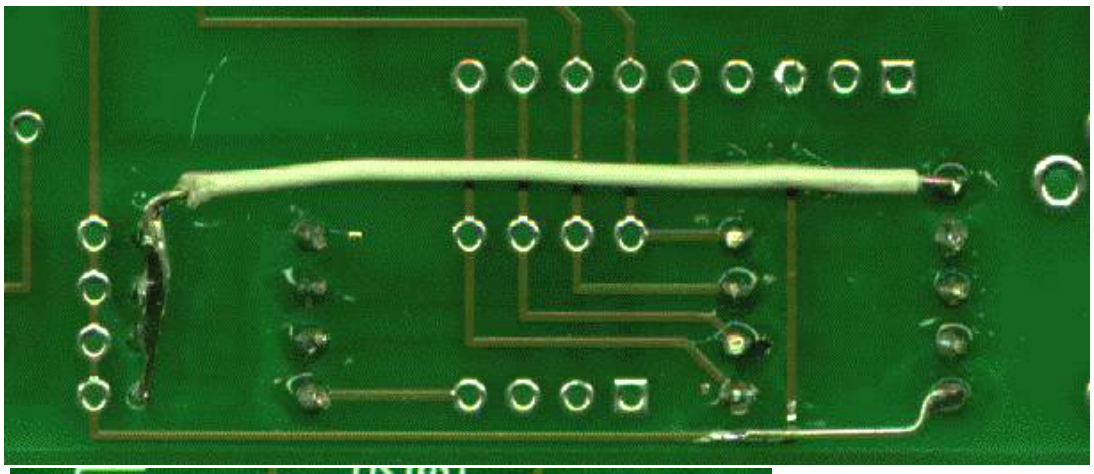
T2, T6, T7	1M	Trimmer - Multiturn Cermet	3
U5	74LS04	TTL Hex Input Converter	1

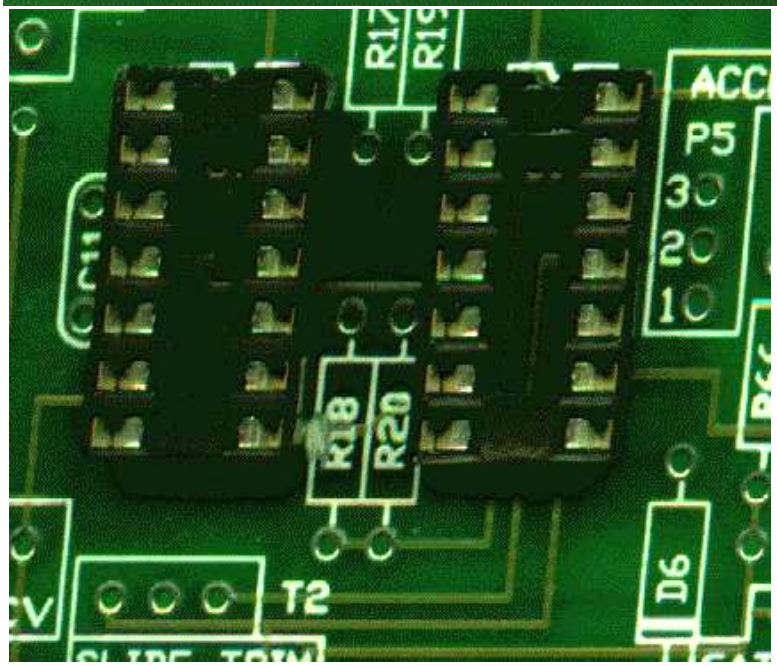
I made a few modifications. The best way to do this is using an x-acto or similar hand held blade. Cut across the trace once or twice lightly to form a path before applying enough pressure to cut the trace. Make sure the cut is completely through by using a meter set to the ohm scale. It should be open.



FIX 1

This involves cutting one trace and installing two jumpers. To make it nice you will need to drill 4 holes with a wire bit just to the right of the labels for R10,11,12 and 13 and to the left of the current pads in the GND trace for these resistors. Install (1K) resistors in the spaces for R5,10,11,12, and 13. Placing the right side in the pads connected to S2 and the left side of the resistor wires in the holes you just drilled. Tie the loose ends of these resistors together under the board. Cut the trace between R5 and R9 on the top of the board. Leaving pads for R6,7,8 & 9 connected together and R5 connected to U4 pin8 (+5V). Install (10K) resistors in the spaces for R6,7,8 and 9. Connect the trace you just separated connecting R6,7,8 & 9 together to the GND trace under the board going to U6 pin5. Use a short piece of insulated wire to connect the raw junctions of R10,11,12 & 13 to the +5V side of R5 on the bottom of the board. If you choose not to drill holes. The loose ends can be connected together on the top of the board and a short jumper placed from the loose ends to the +5V side of R5.

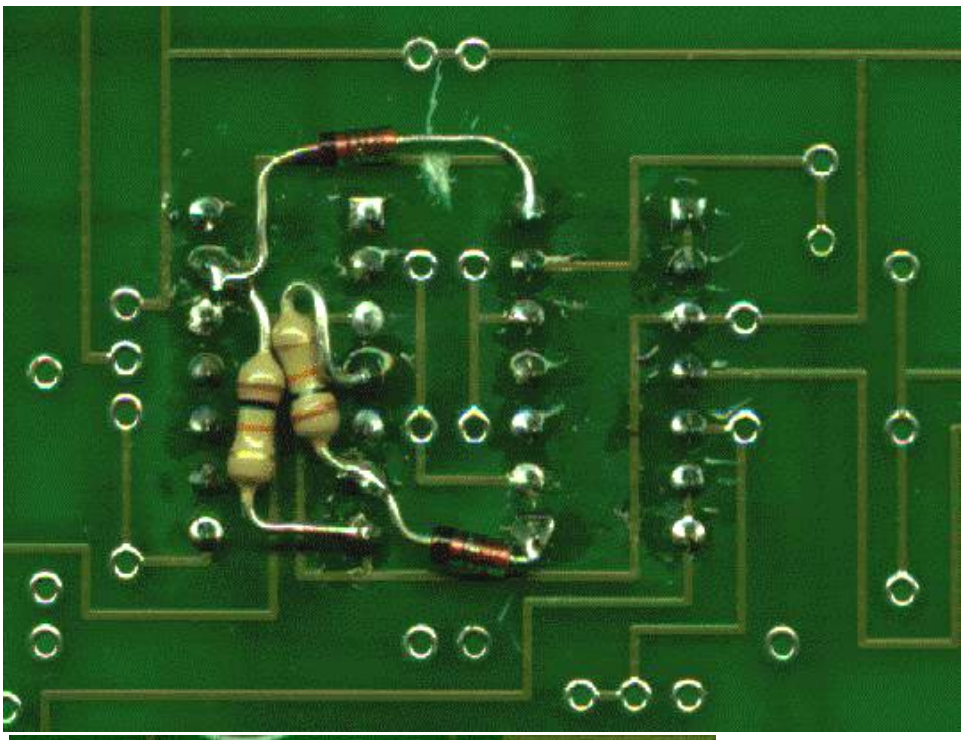




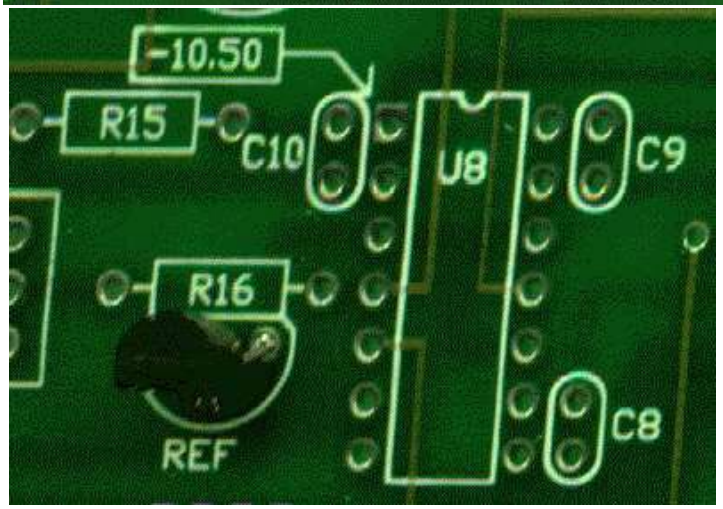
FIX 2

Cut the trace between U9 pin14 and U10 pins12,13 on the bottom of the board. Install a signal diode (1N4148) from U9 pin14

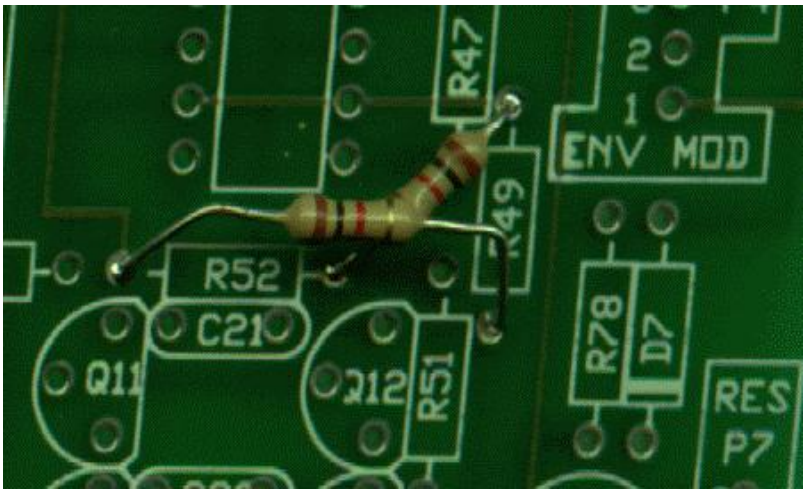
to U10 pins12 ,13. Then connect a (10k) resistor from U10 pins 12 ,13 to GND.
Cut the trace between U9 pin8 and U10 pins5,6 on the top of the board.
Install a signal diode (1N4148) from U9 pin8 to U10 pins5, 6. Then connect a (10k) resistor from U10 pins5,6 to GND.

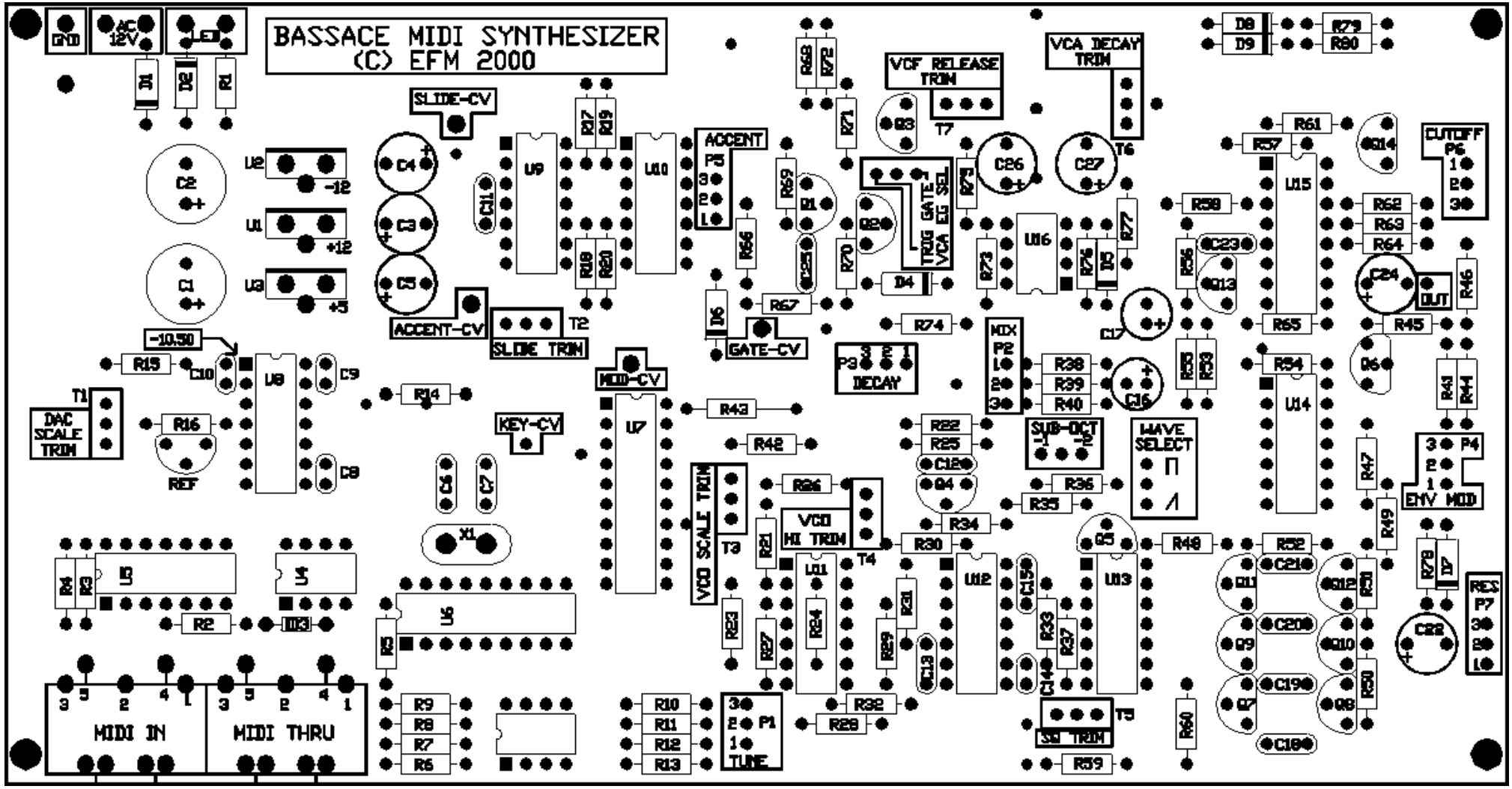


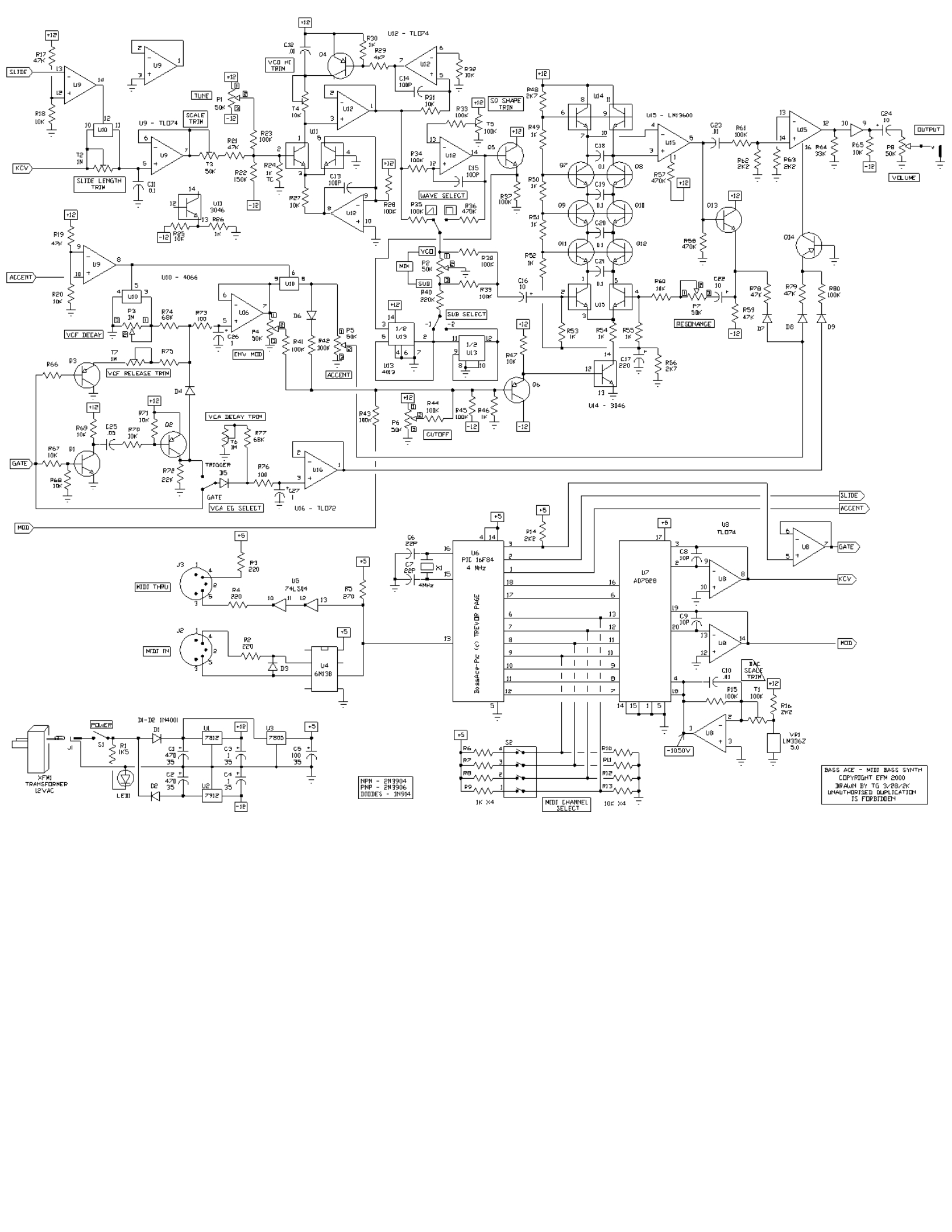
FIX 3
The silk-screen for the REF is in backwards. When installing the REF reverse it so that the rounded side of the package is aligned with the flat side of the silk-screen.



FIX 4
Place R49 and R52 as shown.




BASSACE MIDI SYNTHESIZER
(C) EFM 2000
GND
AC 12V
SLIDE-CV
ACCENT-CV
SLIDE TRIM
ACCENT
GATE-CV
MOD-CV
KEY-CV
VCF RELEASE TRIM
VCA DECAY TRIM
TRIG GATE / VCA EG SEL
DECAY
MIX
SUB-OCT
WAVE SELECT
CUTOFF
ENV MOD
DAC SCALE TRIM
REF
VCO SCALE TRIM
VCO HI TRIM
TUNE
SQ TRIM
OUT
MIDI IN
MIDI THRU


U12 - TL074
U9 - TL074
U10 - 4066
U15 - LM13600
U14 - 3046
U16 - TL072
U8 TL074
SLIDE
ACCENT
GATE
KCV
MOD
OUTPUT
VOLUME
TUNE
SCALE TRIM
SLIDE LENGTH TRIM
VCO MT TRIM
SQ SHAPE TRIM
WAVE SELECT
VCO
MIX
SUB
SUB SELECT
VCF DECAY
ENV MOD
ACCENT
VCF RELEASE TRIM
VCA DECAY TRIM
TRIGGER
VCA EG SELECT
CUTOFF
RESONANCE
MIDI THRU
MIDI IN
POWER
DAC SCALE TRIM
MIDI CHANNEL SELECT
BossAce-Pic (c) TREVOR PAGE
XFMR TRANSFORMER 12VAC
LED1
D1-D2 1N4001
NPN - 2N3904
PNP - 2N3906
DIODES - 1N914
1K X4
10K X4
-10.50V
BASS ACE - MIDI BASS SYNTH
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