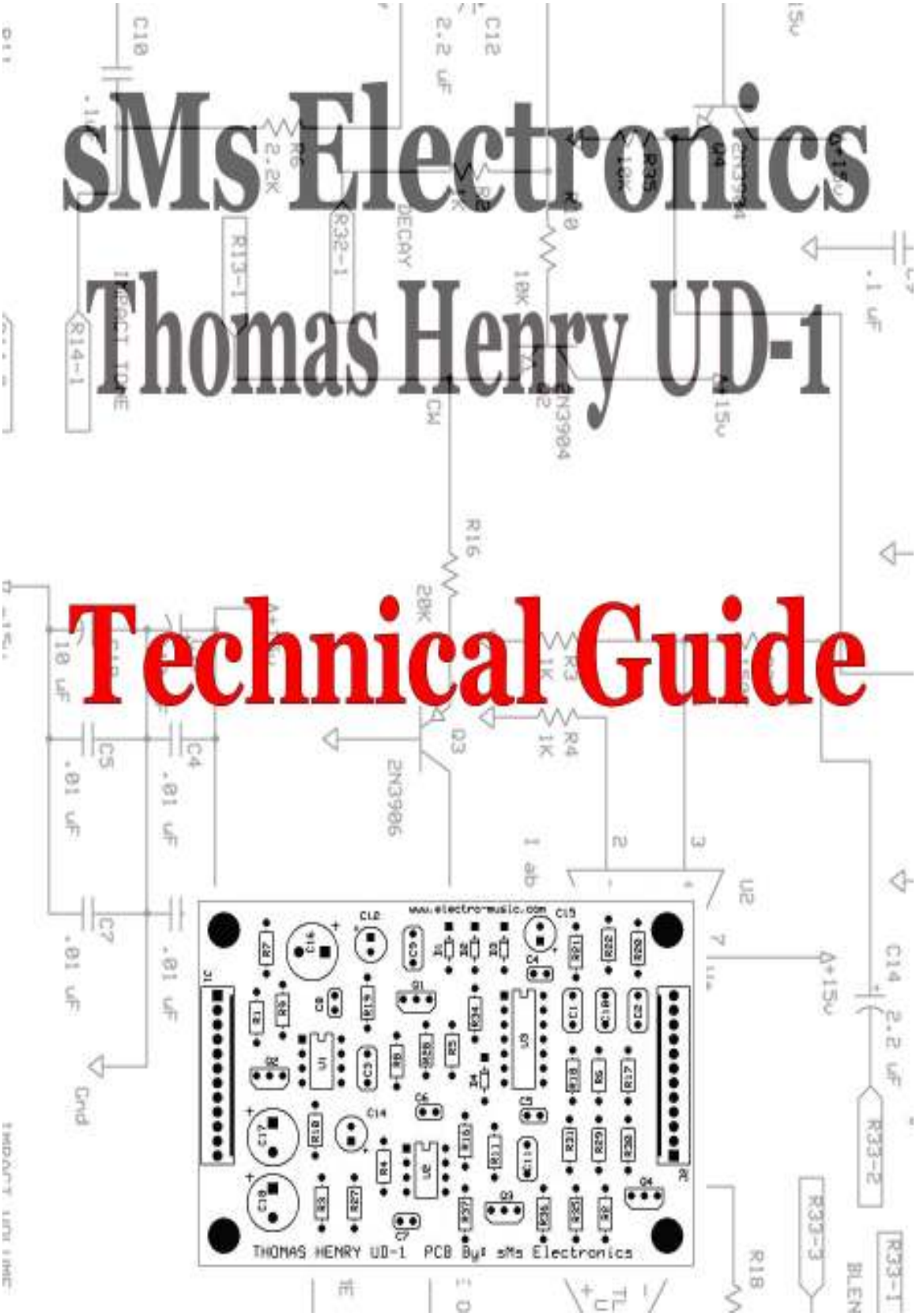
# sMs Electronics

# Thomas Henry UD-1

# Technical Guide



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**sMs Electronics**

**Questions? Contact : Bill Manganaro e-mail: thex@optonline.net**

## NOTES:

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# The UD-1 Drum Voice

Thank you for purchasing this high quality printed circuit board for your Thomas Henry UD-1 Drum Voice from sMs Electronics. Great care has been taken in the design of this board to meet the demands of the serious DIY synthesizer builder. The board has two signal layers, is professionally silk screened, and solder masked for a professional look that will really make your project stand out.

The board has been specifically manufactured with a lead free process to help our natural and work environment.


**The following functional descriptions were written by Scott Stites and are an excerpt from his UD-1 webpage.**

**Be sure to visit Scott's very informative website "Birth of a Synth" - Synthesizer DIY at :**

**http://mypeoplepc.com/members/scottnoanh/birthofasynth/index.html**

Anyone familiar with Thomas' ADV Bass design will recognize the basic architecture of the UD-1 Drum Voice. The UD-1 has an input for pulse, which it uses to 'fire' the drum voice, and, of course an output. Thomas added one more valuable input to the UD-1 - voltage control of the pitch of the drum voice.

The UD-1 allows the user to program the desired drum by breaking the components of percussive sounds into individually controllable parameters.

First of all, we start with the sound of the drum stick striking the drum head - the impact tone. The UD-1 allows the user to select how loud the impact will be. The UD-1 also allows the user to set how how sharp the impact tone will be. For example, the sound of a drum stick striking a woodblock will have a sharper sound than the same drumstick hitting a tom.

Next we concentrate on the pitch of a drum. The pitch of a drum is determined by the shell or body of a drum. Obviously a bass drum has a lower pitch than a tom. The UD-1 allows the user to set the initial pitch of the drum, but it has something

a bit extra - it allows voltage control of the pitch as well! More on that in a bit.....

The UD-1 allows the user to select the waveform used by the simulated percussive instrument. A bass or a tom sound will normally use a triangle waveform, while a woodblock or clave sound may use a square wave. The UD-1 provides a control that fades between full triangle wave to full square wave so that one can tweak in the exact waveform needed to produce the desired percussive sound.

Some percussive voices will have a longer decay than others - for example, a woodblock will decay more quickly than a bass or tom. The UD-1 allows the user to set the duration of the drum sound with the Decay control

When a drumhead is struck, the drum head and even the shell of the drum flexes. This produces a pitch shift in the drum each time it is struck - it will 'flex' briefly to a higher pitch and will quickly lower in pitch over time. The UD-1 allows the user to adjust how much, if any, pitch shift there is each time the drum is 'struck'.

Combining these parameters together allows the user to program a wide range of quite realistic drum effects. One can produce bass, tom, woodblock, clave, and other sounds quite easily with the module. In fact, with the variable decay and pitch bend, it's easily possible to produce those disco-era-killing electronic drum sounds - if one must =0).

The voltage controlled pitch function particularly expands the usability of the drum voice. For example, I've found it possible to use a keyboard and create a drum kit made up of pitched toms or woodblocks. The voltage control of the pitch is not a volts/octave arrangement, but it's quite serviceable for percussive sounds.

I have a hard time making samples of the UD-1. To really do it justice, I would like to sequence it with other parts, but my sequencers were taken off breadboard to make room for other projects. Right now I've got another on breadboard and will try the UD-1 with it, but as of this writing, I only have one sample available.

The sample was taken off of the tail end of a really cheesey recording I made of a patch that used the UD-1. I basically had a VCO, the SN-Voice and the UD-1 all controlled from my keyboard. Hit a note, and the UD-1 fires while the VCO and SN-Voice follow it. While the musical content of the sample is questionable, it certainly demonstrates the sound of the UD-1 in a tom configuration following the CV of my keyboard.

## Anatomy of the UD-1 Drum Voice

The UD-1 is a classic example of Thomas Henry's talent for balancing maximum degree of performance and economy of design. It contains three integrated circuits, yet provides an extremely effective and highly configurable drum voice module.

When a short pulse is applied to the trigger input, it first is processed by a comparator built around IC3A. The reference voltage of this comparator is adjustable (the sensitivity control) so that a wide range of trigger amplitudes can be accommodated.

When the comparator pulse goes high, it illuminates the Status LED. Because for the short duration of the pulse, C9 is provided to stretch this pulse out so that the LED does not react so fast that one cannot see it. The pulse signal from the comparator is then sent to two separate sections of the circuit. The first section generates the impact tone. This section of the circuit has a tone circuit, built around C10-11 and R6, R10 and R14 to provide tone control of the impact signal. This modified signal is then sent through C13 to R21, which adjusts the amplitude of the impact tone.

The other section the comparator pulse goes to is used to generate the envelope signal. C12 , R2 and R32 provide the means to stretch this short pulse into a longer, audible decay signal, with R32, the Decay control, providing a means to program how long it takes the envelope signal to fall to its lowest level.

The envelope signal produced in this section is used to control (A) the amplitude of the shell signal and (B) the dynamic frequency sweep of the shell signal as well.

IC1 produces the shell signal. The 566 is set to provide both square and triangle wave outputs. Either of these two waveforms, or a blend of them, are provided through R33, the Blend control. The frequency of the waveforms produced by IC1 is controlled by three different signals: the initial frequency control, the external control voltage, and the envelope signal delivered from the Sweep pot, R13. The blend of triangle and square wave is delivered to the input of IC2, a CA3080 that is acting as a voltage controlled amplifier.

The envelope signal is applied to the control input of IC2, thus controlling the amplitude of the square/triangle wave signal. This signal is converted to a voltage by IC3C and delivered to R25, the shell volume control.

The impact signal and shell volume signal are then mixed by IC3d and associated components, and are sent through the Master Volume Control to the output of the UD-1 Drum Voice module.

## UD-1 Connectors and Controls

**Trigger Input J1**

Adjustment of the Decay Control allows the user to set the duration, or envelope, of the generated drum sound once an input trigger is detected. For example, a woodblock will have a very, very short decay, while a tom will have a longer decay.

**CV Input J2**

The CV Input jack accepts a control voltage and is used to dynamically control the pitch of the drum voice.

**Pedal "Pitch" Control Input J4**

Allows a universal volume foot controller pedal to connect to the UD-1 and dynamically control the pitch of the drum voice using the motion of your foot. The UD-1 biases the pedals internal potentiometer so no external DC supply is required.

The UD-1 has been tested with the **Fatar VP-26U** Universal Volume Pedal


**Output J3**

The Output jack outputs the programmed drum voice with each pulse applied to the Trigger Input.

**Sensitivity Control**

The sensitivity control allows one to adjust how sensitive the Trigger Input is - this allows the user to adjust the pulse level that will fire the UD-1. This provides

a greater range of trigger level that can be used with the UD-1. For example, my keyboard puts out a 0 to 5V trigger, but other systems may put out larger or smaller triggers.

**Impact Volume Control**

The Impact Volume Control allows one to adjust how loudly the impact of the simulated drum stick is in relation to the rest of the sound.

**Impact Tone Control**

The Impact Tone Control allows one to adjust the timbre of the impact tone itself. It provides a variable control between bass and treble. The treble area provides a sharper sound, such as a stick striking a woodblock, while the bass area of adjustment provides a lower, more thud-like impact, often associated with bass drums.

**Decay Control**

Adjustment of the Decay Control allows the user to set the duration, or envelope, of the generated drum sound once an input trigger is detected. For example, a woodblock will have a very, very short decay, while a tom will have a longer decay.

**Initial Pitch Control**

The Initial Pitch Control sets the initial or 'resting' shell pitch of the programmed drum voice. If no sweep is programmed into the UD-1 settings, or no control voltage is sent to the UD-1, the pitch of the programmed drum will stay at the setting of this control throughout the entire event of each note produced when a trigger is detected on the Trigger Input.

**CV Range Control**

The CV Range Control determines how much of an effect, if any, the control voltage applied to the Control Voltage input will have on the pitch of the UD-1.

**Sweep Control**

The Sweep Control allows one to adjust how much pitch bend is required to produce a particular drum sound. For example, a tom will start out slightly high in tone and fall immediately. The pitch sweep is controlled by the decay signal, so it follows the decay of the drum sound, starting out high and dropping in pitch along with the envelope. The Sweep Control adjusts how much effect the decay signal has on the pitch of the UD-1.

### Shell Volume Control

The Shell Volume Control allows the user to adjust the relative loudness of the shell volume.

### Blend Control

The Blend Control allows the user to adjust the waveform used for the shell portion of the UD-1. At one extreme of the control's setting, a triangle wave is produced. At the opposite extreme of the control's setting, a square wave is produced. The range in between the two extremes provides a cross fade between triangle wave and square wave.

### Master Volume

The Master Volume Control allows one to adjust the total amplitude of the UD-1 output. At full level, the UD-1 output is around 10Vp-p. This control can be used to attenuate the signal down for devices not equipped to handle synth level signals

## UD-1 Drum Voice Parts List

The list varies slightly from the original. R35-R37, Q4, and J4 have been added

Capacitors (16 WVDC or Better)

| | |
|---|---|
| C1 | 10 pF |
| C2, C3 | .001 uF |
| C4-C7 | 01 uF |
| C8 | 022 uF |
| C9-C11 | .1 uF |
| C12-C15 | 2.2 uF |
| C16 | 4.7 uF |
| C17,C18 | 10 uF |

Semiconductors

| | |
|---|---|
| D1-D4 | 1N4148 |
| D5 | RED LED |
| Q1,Q2,Q4 | 2N3904 |
| Q3 | 2N3906 |
| U1 | NE566 |
| U2 | LM3080 |
| U3 | TL054 / TL074 |

Resistors (All fixed are ¼ Watt, 5% Tolerance)

| | |
|---|---|
| R1 | 560 |
| R2-R4 | 1K |
| R5 | 1.5K |
| R6-R7 | 2.2K |
| R8-R9 | 3.9K |
| R10-R11 | 10K |
| R12-14 | 10K LINEAR POTENTIOMETER |
| R15 | 10K AUDIO POTENTIOMETER |
| R16 20K | |
| R17-R18 | 22K |
| R19 | 27K |
| R20-R22 | 100K |
| R23-R26 | 100K LINEAR POTENTIOMETER |
| R27 150K | |
| R28-R31 | 220K |
| R32-R33 | 500K LINEAR POTENTIOMETER |
| R34 1M | |
| R35 10K | |
| R36 220K | |
| R37 1K | |

**Other Components**

| | |
|---|---|
| J1-J3 | ¼" Phone Jack, N.O. |
| J4 | ¼" Stereo Jack |
| Knobs | Qty 10 |

**Board Connectors J1 / J2**

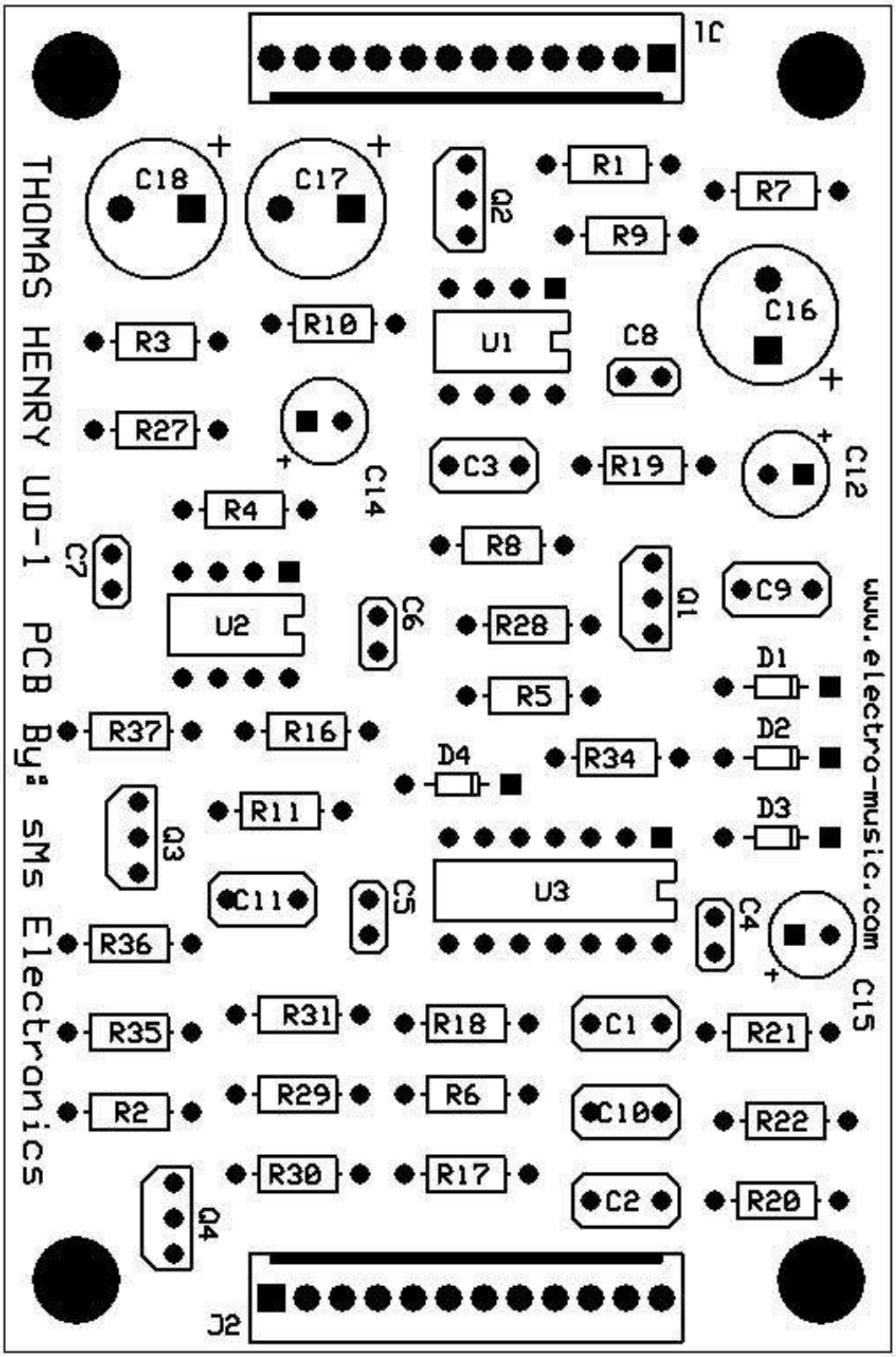
Here is a list of the connector housings, headers and pins used for the UD-1 Drum Voice Board J1 and J2 connectors.

Housing: Molex PN 10-11-2123 (Digikey WM2611-ND) (Mouser 538-10-11-2123)
Header: Molex PN 22-23-2121 (Digikey WM4210-ND) (Mouser 538-22-23-2121)
Terminal Molex PN 08-50-0114 (Digikey WM1114-ND) (Mouser 538-08-50-0114)

**Miscellaneous Items:**

IC Sockets, Front Panel, Knobs, Wire, Solder

## UD-1 Part Placement Diagram


THOMAS HENRY UD-1 PCB By: sMs Electronics
www.electro-music.com
J1
J2
C18
C17
C16
C15
C14
C12
C11
C10
C9
C8
C7
C6
C5
C4
C3
C2
C1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R16
R17
R18
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R20
R21
R22
R27
R28
R29
R30
R31
R34
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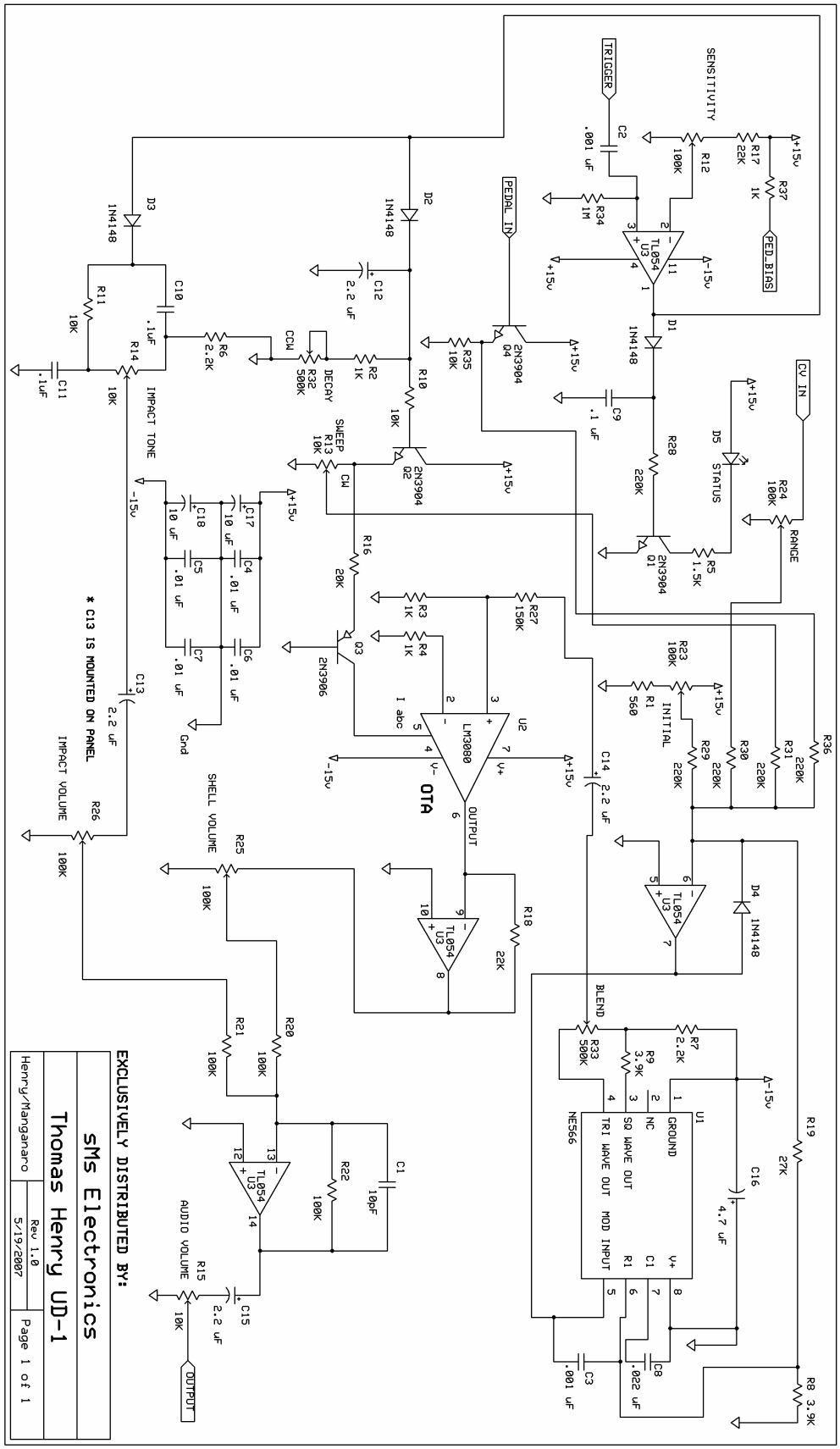
Q2
Q3
Q4
U1
U2
U3
D1
D2
D3
D4


SENSITIVITY
TRIGGER
PEDAL IN
PED. BIAS
CV IN
STATUS
RANGE
INITIAL
DECAY
SWEEP
IMPACT TONE
IMPACT VOLUME
SHELL VOLUME
AUDIO VOLUME
BLEND
OUTPUT
OTA
LM3080
TL054
NE566
2N3904
2N3906
1N4148
* C13 IS MOUNTED ON PANEL
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Thomas Henry UD-1
Henry/Manganaro
Rev 1.0
5/19/2007
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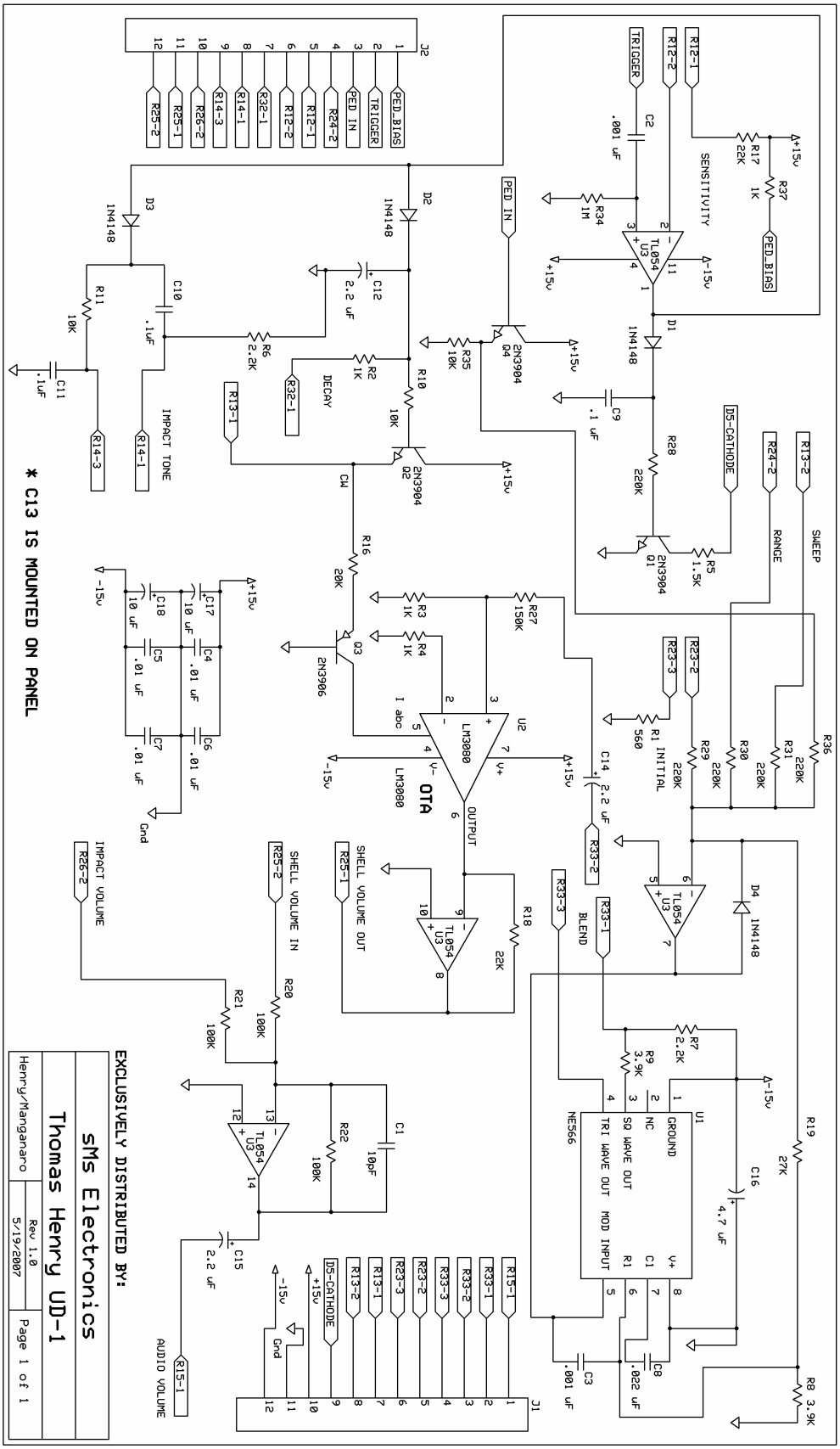
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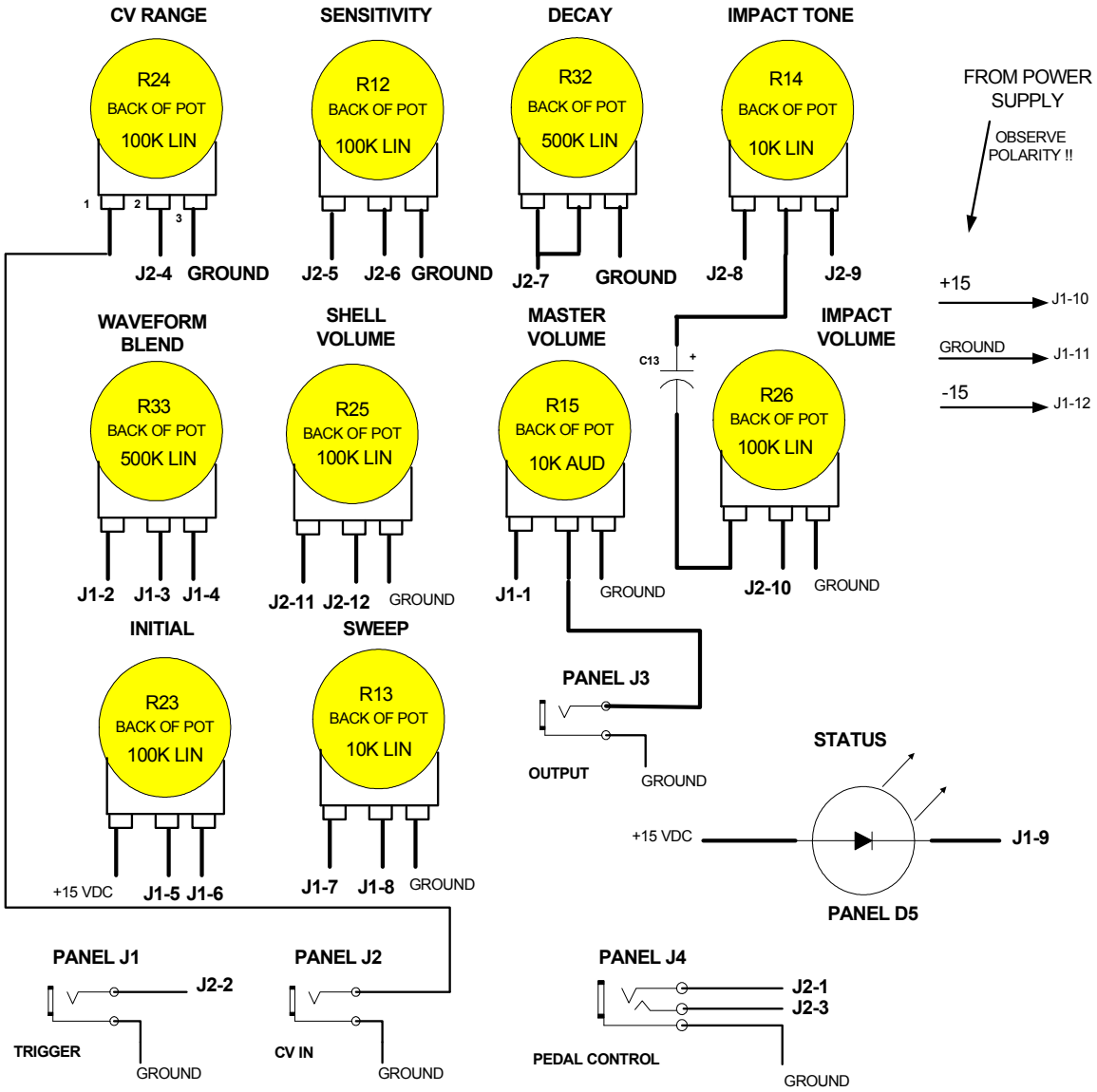
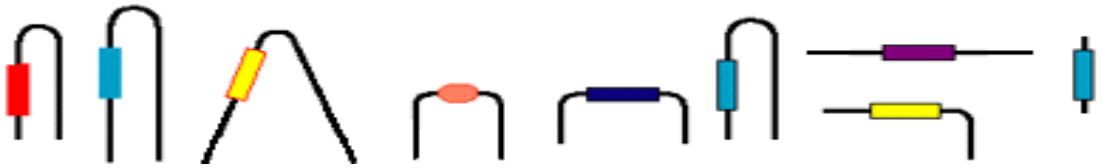
OTA
LM3080
TL054
NE566
GROUND
SQ WAVE OUT
TRI WAVE OUT
MOD INPUT
TRIGGER
PED IN
PED_BIAS
SENSITIVITY
DECAY
IMPACT TONE
SWEEP
RANGE
BLEND
SHELL VOLUME IN
SHELL VOLUME OUT
IMPACT VOLUME
AUDIO VOLUME
D5-CATHODE
+15v
-15v
Gnd

# UD-1 FRONT PANEL WIRING DIAGRAM




**sMs Electronics**
**Thomas Henry UD-1 PCB Assembly**

## Construction



**NOTE ABOUT ESD**

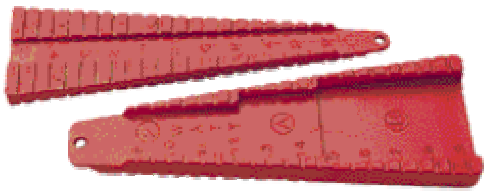

**It is generally good practice to wear ESD protection when working with electronic components to prevent possible damage or stress. Most electronics workbenches should have some form of ESD protection like wrist straps, cords, and an ESD mat as shown below. At the very least, make sure you have momentarily grounded yourself before handling the components of the board or the completed board assembly.**

**ESD strap, resistance cord, and mat**

## Starting Construction

Start by sorting out and identifying all your components. If you bought your components from sMs Electronics and some are missing, the wrong value, or damaged, send an e-mail to Bill Manganaro C/O sMs Electronics at thex@optonline.net about the problem and it will quickly get resolved.

Once you have identified your components, start by installing the fixed resistors. I find that using a lead bending tool works very nicely as shown below.

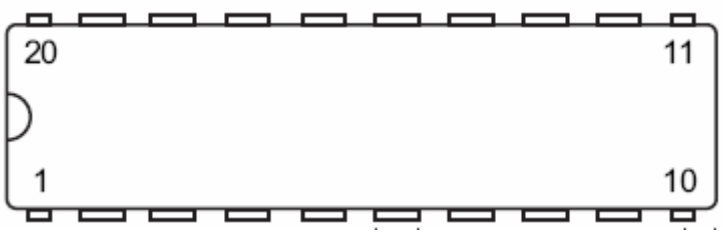


**Lead forming "Christmas Tree"**

You can also use round nose pliers to form the resistor leads. After forming the leads, install the resistors in accordance with the parts placement diagram and parts list provided. Place the resistor such that the body is flush against the PC board's surface. Once in place, bend the leads out at 45-degree angles on the solder side. Cut off the excess lead length with your diagonal cutters. With the resistors leads bent this way, they will not fall out and long leads will not be in the way when soldering. Do this for all the resistors then solder them all in place. Make sure your board has good topside solder flow as well as the bottom. Generally a bit of RMA flux works well to allow the solder to wick to the top of the printed circuit board.

| | |
|---|---|
| R5 | Check _____ |
| R6-R7 | Check _____ |
| R8-R9 | Check _____ |
| R10-R11 | Check _____ |
| R16 | Check _____ |
| R17-R18 | Check _____ |
| R19 | Check _____ |
| R20-R22 | Check _____ |
| R27 | Check _____ |
| R28-R31 | Check _____ |
| R34 | Check _____ |
| R35 | Check _____ |
| R36 | Check _____ |
| R37 | Check _____ |

Next install the diodes, transistors, and integrated circuits. Be sure to observe the polarity of all these devices. You may want to use sockets for the IC's instead of placing the IC's directly into the board for ease of maintenance and troubleshooting. The diagram below illustrates where pin one is. This is the square pad on the UD-1 board.




**Ttypical DIP IC Outline showing pin (1) orientation**

| | |
|---|---|
| D1-D4 | Check _____ |
| Q1, Q2, Q4 | Check _____ |
| Q3 | Check _____ |
| U1 | Check _____ |
| U2 | Check _____ |
| U3 | Check _____ |

***NOTE: D5, LED, is mounted at the front panel as illustrated on the front panel wiring diagram .***

Next, install all the capacitors noting the polarity of the electrolytic capacitors. Note that the black striped side is the negative (-) terminal of the device as shown below.


**Electrolytic capacitor polarity identification**

The Mylar and ceramic capacitors are not polarized so no need to worry about their polarity when installing.


**Mylar Capacitors (No polarity)**


**Ceramic Capacitors (No polarity)**

| | |
|---|---|
| C1 | Check _____ |
| C2, C3 | Check _____ |
| C4-C7. | Check _____ |
| C8 . | Check _____ |
| C9-C11 | Check _____. |
| C12-C15 | Check _____ |
| C16 | Check _____ |
| C17,C18 | Check _____ |

***NOTE: C13 is mounted at the front panel as illustrated on the front panel wiring diagram .***

If you have, install the J1 and J2 headers. Make sure they are flush with the circuit board. The construction of you UD-1 is complete.

| | |
|---|---|
| PCB J1 | Check _____ |
| PCB J2 | Check _____ |

**Board Connectors**

J1 and J2 headers can accommodate the following MOLEX part numbers for a more professional interconnect solution instead of soldering flying leads onto the board. The list shows not only the MOLEX part number but a DigiKey and Mouser part numbers as well. It is highly recommended that you purchase these parts and construct two small cable assemblies with leads about 12” long or as

long as you require to reach the front panel. You can get away without using a crimping tool by soldering, very carefully, the wire to the terminals then inserting them into the housing. Too much solder and you will not be able to get the terminal into the housing. If you want to crimp the pins and want to purchase the hand crimp tool, the Mouser Electronics part number is shown below.

**Mouser Part Number: 538-64016-0042** **36.76 USD as of this writing.**

Housing: Molex PN 10-11-2123 (Digikey WM2611-ND) (Mouser 538-10-11-2123)

Terminal Molex PN 08-50-0114 (Digikey WM1114-ND) (Mouser 538-08-50-0114)

### Front Panel Wiring

The front panel upon which this project is mounted is a very personal thing and thus is left up to you to design. There are many form factors such as MOTM, Frac Rack, Eurorack, etc. Check to see that you have all the components listed below for mounting to your front panel. Please refer to the front panel wire diagram on page 11. You will also need to mount the board on standoffs. The board mounting hole size is 1/8" (0.125").

| | |
|---|---|
| J1-J3 | ¼" Mono Jack, N.O. |
| J4 | ¼" Stereo Jack |
| R12-14 | 10K LINEAR POTENTIOMETER |
| R15 | 10K AUDIO POTENTIOMETER |
| R23-R26 | 100K LINEAR POTENTIOMETER |
| R32-R33 | 500K LINEAR POTENTIOMETER |
| D5 | RED LED |
| C13 | 2.2 uF Electrolytic Capacitor |

## Internet References for Electronic Parts

### Mouser Electronics:

http://mouser.com/

### All Electronics:

http://allelectronics.com/

### Digikey

http://digikey.com/

**Small Bear Electronics:**

http://www.smallbearelec.com/home.html

**Debco Electronics:**

http://www.debcoelectronics.com/

**Futurlec Electronics:**

http://futurlec.com/

**JDR Micro Devices:**

http://www.jdr.com/interact/default.asp

**Arcade Chips:**

http://www.arcadechips.com/index.php

**Jameco Electronics:**

http://www.jameco.com/

**Allied Electronics:**

http://www.alliedelec.com/

**Newark Electronics**

http://www.newark.com/