

## NOTES

## General Notes:

- This circuit is adapted from the original work by Michael A. Maynard (K4ICY).
- It was modified to buffer the output of the Twin-T oscillator, a variable gain stage was added to serve as the volume control, and the audio amplifier stage was simplified.
- The capacitors marked "Poly." are polyester, but this is not critical. Common MLCC types could be used.
- All capacitors without a type designation are as follows: non-polarized are MLCC and polarized are electrolytic.
- The schematic on this page is appropriate for building the circuit on a breadboard or perfboard. See subsequent pages for modifications suitable for mounting in an enclosure.

## Twin-T Oscillator Section:

- Capacitors C2 and C3 should be close to each other in value, and the parallel combination of C4 and C5 should be close to the sum of the C2 and C3.
- Likewise R2 and R3 should be close to each other in value.
- RV1 (Pitch) will yield a somewhat more linear frequency adjustment if it has a reverse logarithmic taper.

## Audio Amplifier Section:

- A standard polarized electrolytic capacitor could be used for C16, with the negative terminal connected to SPK1.

Original circuit designed by Michael A. Maynard (K4ICY).  
[http://k4icy.com/weekend\\_radio\\_3tr-audio-amp.html](http://k4icy.com/weekend_radio_3tr-audio-amp.html)

## STATUS:

Breadboarded and working.  
 Ready to commit to PCB.

Dimensional Tolerances (unless specified otherwise)		
2	3	
Places	Places	Angles
±0.010	±0.005	±1 Deg

DRAWN BY J. BENSEN

ISSUED 2020-09-01

**BE** **BENSEN ENGINEERING**  
<https://github.com/JeffB-BE>  
<https://www.youtube.com/channel/UCjZB0LE4ZC2Q2T13gbietnw>

Twin-T Code Practice Oscillator :  
Schematic

SIZE	DWG NO	REV
A		A
SCALE	NONE	SHEET 1 OF 6

D

C

B

A

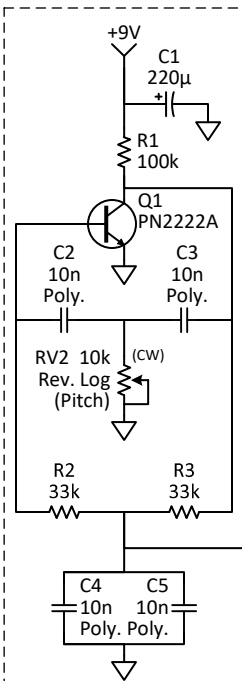
D

C

B

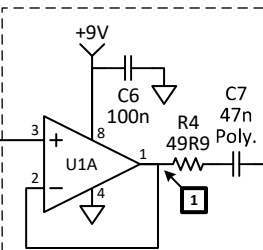
A

## Twin-T Oscillator



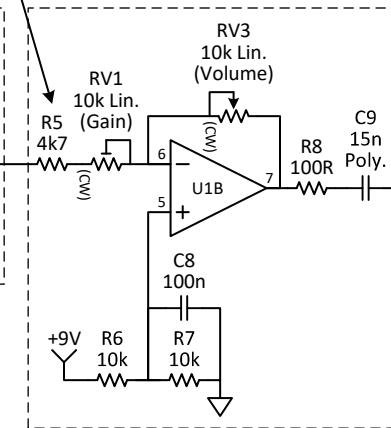
Set at test. May need to be anywhere from 0 Ohms to several k Ohms to achieve maximum clean LM386 output power, depending upon the actual values of RV1 and RV3.

## Analog Buffer

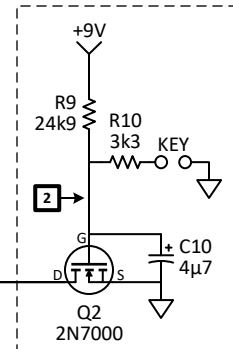


U1 = TLV272

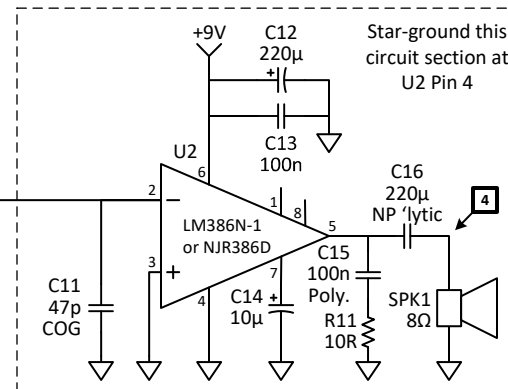
## Gain Stage



## Keying and Envelope



## Audio Amplifier



Star-ground this circuit section at U2 Pin 4

## LEGEND:

- 1 Oscilloscope probe locations

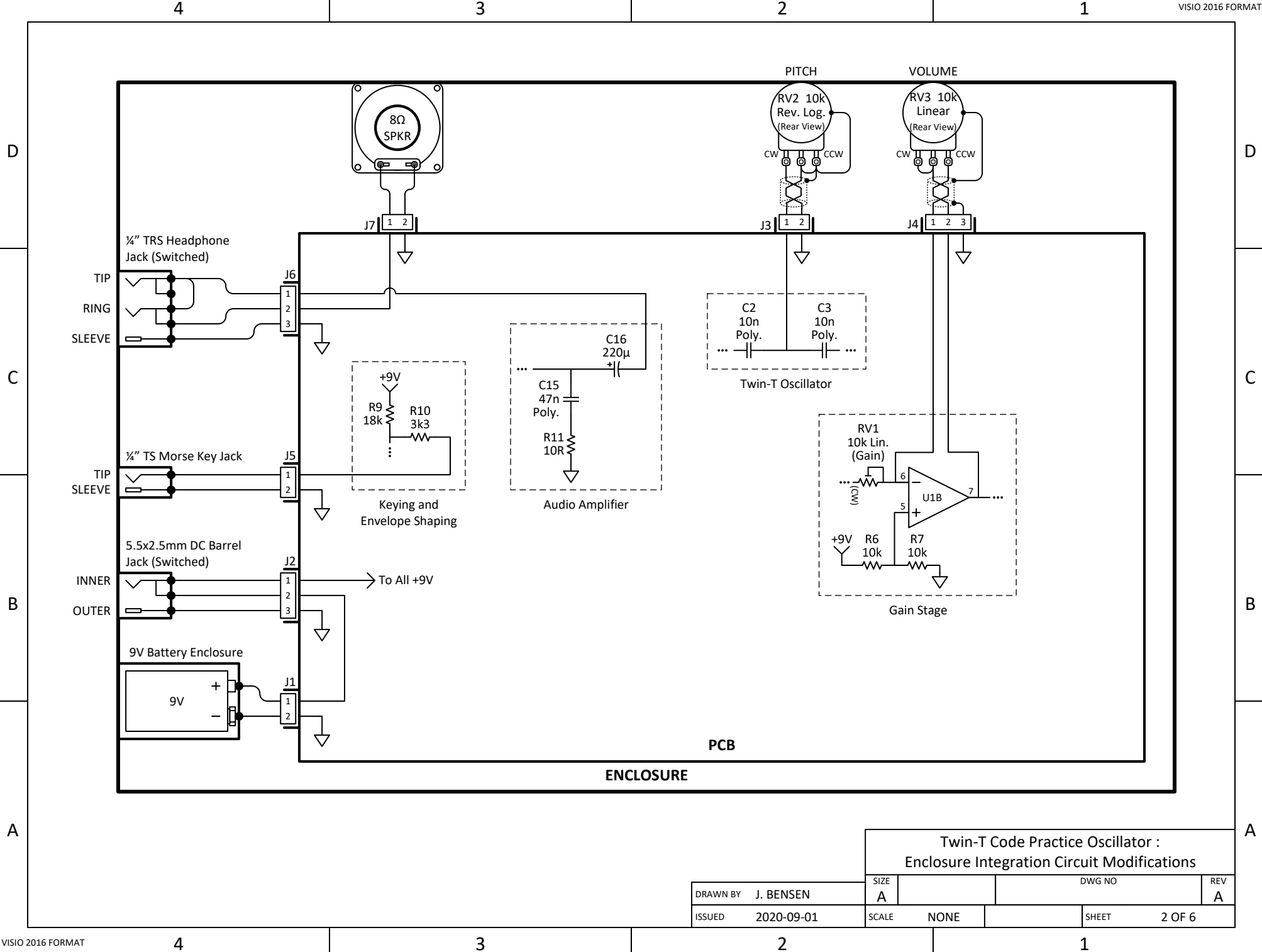
## Circuit Measurement Notes:

- Probe location 1 shows the buffered oscillator waveform. A frequency counter can also be attached here.
- Probe location 2 shows the shape of the key's effect on Q2's gate as influenced by the RC combinations of R10 (key actuate) and C9, or R9 (key release) and C9.
- Probe location 3 shows the effect of the Envelope Shaping and Keying circuit on the signal. This is also the input signal to the audio amplifier.
- Measuring the AC RMS levels of probe locations 3 and 4 allows calculation of amplifier gain.



© 2020 Jeffrey A. Bensen, based upon work © 2018 by Michael A. Maynard. This is a derivative work and is not endorsed by Michael A. Maynard.

Hardware design licensed under CERN-OHL-S V2  
 Documentation licensed under CC BY-SA 4.0



Twin-T Code Practice Oscillator : Enclosure Integration Circuit Modifications			
DRAWN BY	J. BENSEN	SIZE	A
ISSUED	2020-09-01	SCALE	NONE
		DWG NO	
		SHEET	2 OF 6
		REV	A



4

3

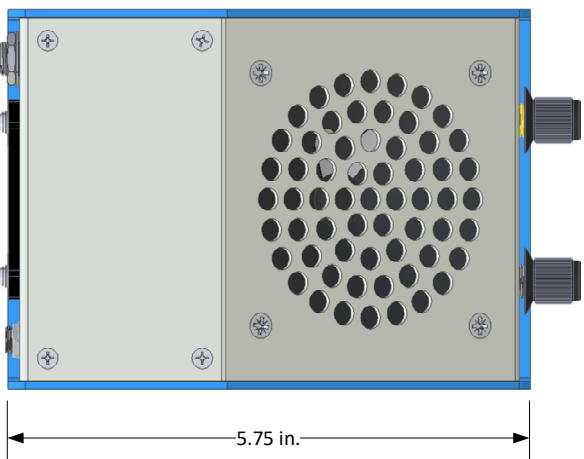
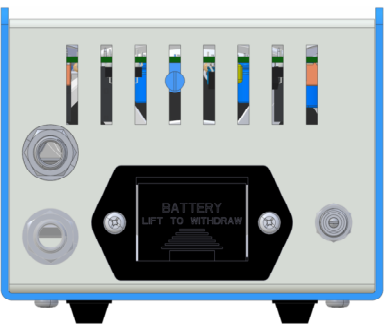
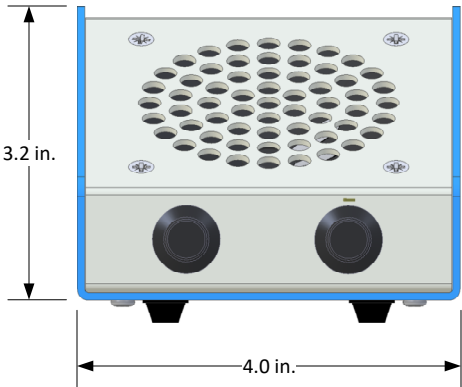
2

1

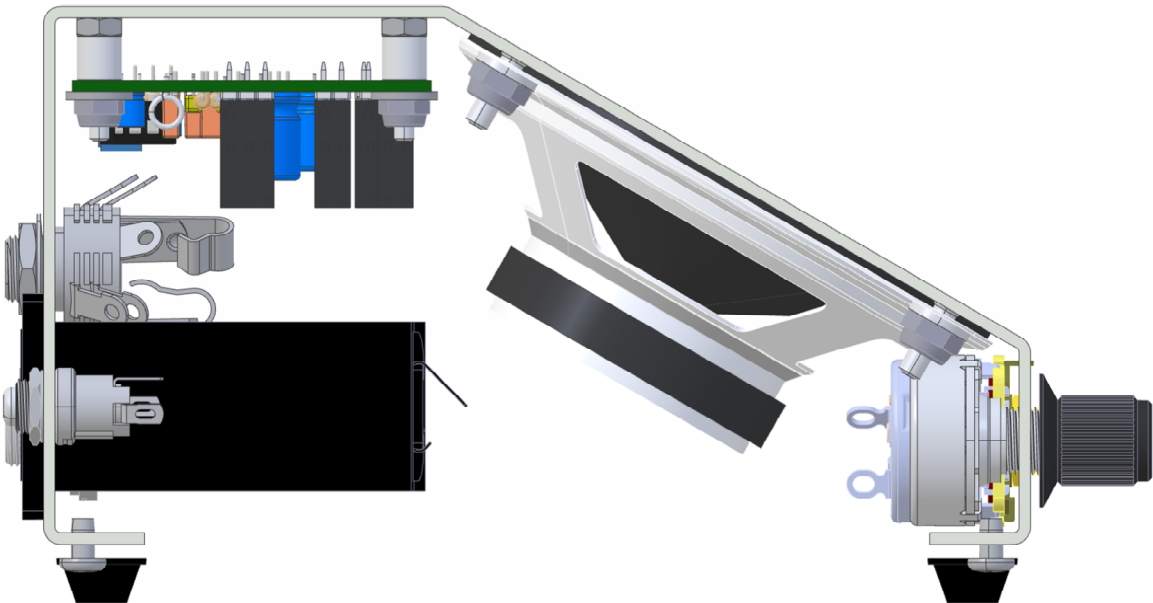
Front View

Rear View

Top View



Side View (Inside)



Enclosure is  
Hammond 1456CE3WHBU

See file  
"Twin-T\_Morse\_CPO\_Fab-Drawings.pdf"  
for mechanical layout and drill templates.

Twin-T Code Practice Oscillator :  
Enclosure 3D Renderings

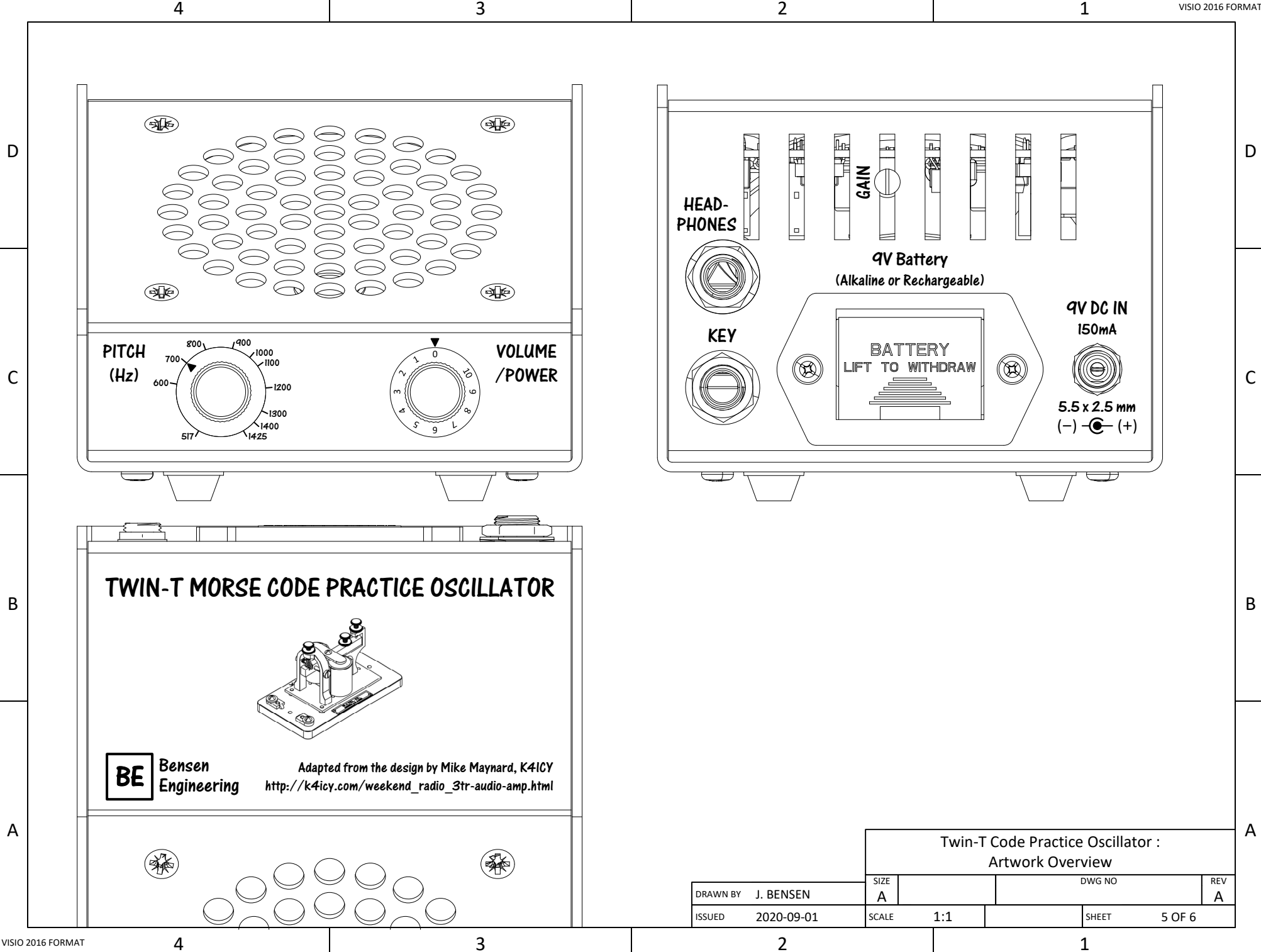
DRAWN BY J. BENSEN		SIZE A	DWG NO		REV A
ISSUED	2020-09-01	SCALE	NONE	SHEET	4 OF 6

4

3

2

1



Twin-T Code Practice Oscillator : Artwork Overview			
DRAWN BY	J. BENSEN	SIZE	A
ISSUED	2020-09-01	SCALE	1:1
		DWG NO	
		SHEET	5 OF 6
		REV	A

4

3

2

1

D

D

C

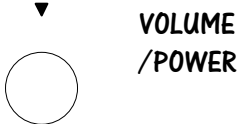
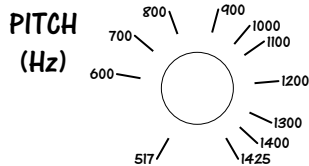
C

B

B

A

A



HEAD-  
PHONES



KEY



GAIN

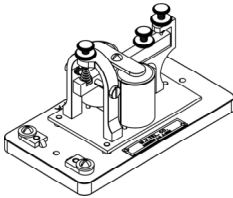
9V Battery  
(Alkaline or Rechargeable)

9V DC IN  
150mA



5.5 x 2.5 mm  
(-) (+)

TWIN-T MORSE CODE PRACTICE OSCILLATOR



Adapted from the design by Mike Maynard, K4ICY  
[http://k4icy.com/weekend\\_radio\\_3tr-audio-amp.html](http://k4icy.com/weekend_radio_3tr-audio-amp.html)

Twin-T Code Practice Oscillator : Printable Artwork				
DRAWN BY	J. BENSEN	SIZE	DWG NO	
		A	A	
ISSUED	2020-09-01	SCALE	1:1	SHEET
				6 OF 6

4

3

2

1