MOD-SIX_7971 GEN-II V7 Clock assembly notes.
Version 2.3 APR-2013, HCO.
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Revision list.
2.3 remove MEZZ and RPTR 2.0 references.
2.2 Updates for Gen-II-V7 added. Various typos corrected and clarifications added.
2.1 Added RF-LINK Mezzanine board assembly notes.
2.0 Initial release

This document incorporates feedback from individuals who have assembled kit versions of the first and second generations of the MOD-SIX. Their input is very much appreciated, and you can benefit greatly from their contributed experiences.

Please pay special special attention to **BOLD RED** notices. They are of particular importance.

WARNING: This clock utilizes hazardous **High Voltages** to power the Nixie tubes. This voltage is generated from an offline switching power supply, but proper caution should always be exercised when physically interacting with the clock's circuitry. A proper enclosure should also be used at all times to shield and protect the user and any innocent bystanders from the **high voltages** present within this clock.

These are supplemental notes on assembling the MOD-SIX_7971 clock kit. It's assumed you are experienced and comfortable with assembling electronic circuitry and SMD components in particular. Please seek assistance if you are unsure of your soldering ability with fine pitch SMD or lack the proper tools.

Primarily you'll be working from the schematics and parts placement drawings, these notes are just additional hints and techniques to hopefully make the whole assembly process easier.

NOTE: If you wish to have the mill-max pins raised above the PCB it is **VERY** important to solder the pins in before any other components. Please see **separate** document that shows in detail how to install the Nixie socket pins and how to fabricate the copper towers for the colon dots and the am/pm indicator.

Some Terminology:

PSU - Power Supply Unit.
Converts 12 VDC input to intermediate 8 volts, also generates high voltage for the Nixie tubes and neon bulbs..

TDU - Tube Driver Unit.
Converts logic level signals from CPU to drive the nixie tubes and neon indicators.

CPU - Cental Processing Unit.
Contains microprocessor and battery backed Real Time Clock functions.
Supports the GPS wired and wireless RF-LINK circuitry.

RPTR - Standalone GPS repeater unit.
Receives RS232 NMEA messages from SIRF-III compatible GPS receiver and retransmits a synchronized time beacon to the MOD-SIX clock via 2.4 ghz digital radio link. Also reads and broadcasts ambient temperature information.

Some General Notes:
Some extra and possibly alternate components are included in the kits. Don't worry if you have any leftover parts.

You can take advantage of the modular nature of the design to assist in assembling and debugging any problems encountered while constructing the MOD-SIX clock. It's best to assemble and test the **PSU**, then the **CPU** before proceeding onto constructing the **TDU** boards.

After assembling the **PSU** and verifying proper voltages, you can then plug it directly into the **CPU** and test for proper voltages on the **CPU** board.

Please Disable the HV output for these preliminary tests.

You can then assemble a single TDU board and test it in circuit before continuing onto the rest of the clock construction. Each additional completed TDU can be added one at a time, or tested individually.

PSU specific construction notes:
After installing J4, insert the included strap between pins 3&4 on the header to disable the HV module's output.

After assembling the PSU, apply 12 volts DC input, and check for +8 volts at J2.

Change the strap at J4 to enable the HV module and adjust trim pot VR1 to set the HV output to approx 180 volts as measured at J3. Please use caution around any **High Voltages.**

NOTE, the **High Voltage** output **WILL** be enabled if no strap is installed (the enable pin is left floating) The Neon lamp NE1 is installed as an HV live indicator, but will only illuminate if the HV is above approximately 90volts.

U1 - LM7808 T0-220 voltage regulator. 4-40 hardware is included, but a heat sink is not required.

TDU specific notes:
NOTE: If you wish to have the mill-max pins raised above the PCB it **VERY** important to solder the pins in before any other components.

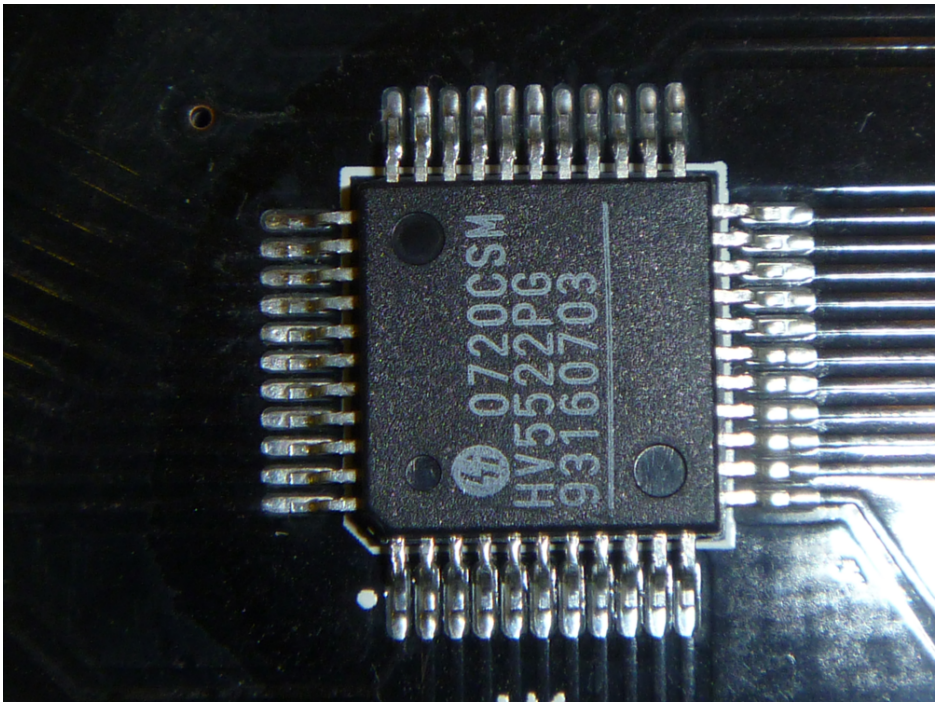
Please see the separate document provided for detailed instructions on installing the Nixie tube socket pins and constructing the copper neon colon & AM/PM towers.

Also note that the pins are elevated off the PCB primarily for aesthetic reasons. There is the idea

that the extended pins may have more spring and stress the tubes less, but it's just a theory. You could certainly mount the pins flush with the PCB, but then you may have to adjust the colon tower tube lengths to maintain alignment..

NOTE: **U1** Pin 1 location. The **HV5522** plastic package has some possibly confusing molding indents. Please take care in properly determining Pin 1 prior to soldering.

HV5522 Proper Pin 1 orientation.



TDU cathode resistors.
The "ABCD" designators on the TDU PCB silkscreen correspond to the 4 different cathode resistor values for the B7971 tubes. Different length cathodes require different current limiting resistors so that the brightness of each segment will match properly. The letters themselves are just an assembly aid to speed up locating the SMD resistors on the PCB. This seemed less error prone than working with the individual resister values The actual resistor values are on the schematic and in the BOM, but are provided here again:

A = 22k B = 24k C = 27k D = 33k

CPU specific construction notes:

J1 - HV. High voltage is not used on the cpu board. A location is provided for a matching header to provide for a more symmetric build. Please take proper precautions around high voltages.

J3 - GPS Mini-Din. **NOTE** This connector is mounted on the **BOTTOM** side of the pcb! Please

install the GPS connector **BEFORE** the RF-MODULE. For custom builds the connector could possibly be top mounted, but the GPS signal and power pins would be moved, and the connector would physically interfere with the RF-MODULE's normal placement.

RF1 - 2.4ghz RF-MODULE. The module is normally installed raised slightly off of the PCB to provide additional clearance for the module's antenna and to improve reception. **NOTE** The RF module should be installed **After** the GPS connector J3. Otherwise it may be difficult or even impossible to solder the GPS connector.

Some kit builders have reported difficulty getting a good solder connection on the plating used on some of the supplied module's header. Additional heating time or the use of some solder flux will help to get a good clean solder joint.

The RF module is only used in conjunction with the RF-LINK option. Depending on how you've decided to configure your clock, you may install the RF-MODULE, the wired GPS MINI-DIN connector, both, or neither. The clock firmware supports all configurations, but only one option may be active at a time.

J4 – ISP. Used to reprogram / upgrade the firmware of the AVR ATMEGA168 MCU. External compatible AVR programming hardware is required.

J5 – EXP. Optional expansion header. For future features. (1PPS output / PIR sensor input)

U3 - Voltage regulator**.** Be sure to properly solder the ground tab of the 78M05.

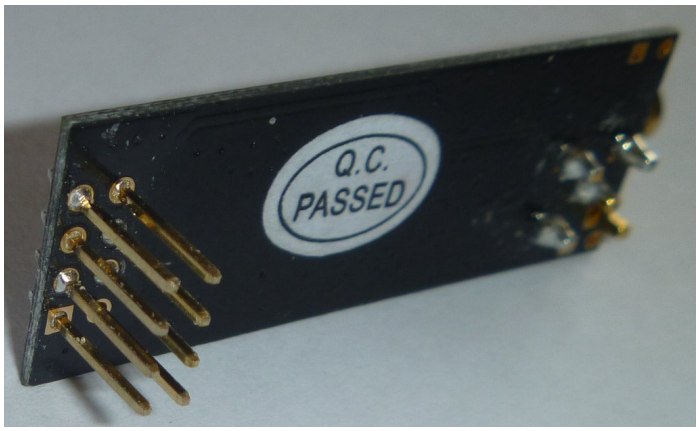
U4 - Voltage regulator TK71734. SOT23-5 package. Take care to properly orient pin 1.

Q1- Photo-transistor**.** The long lead of the photo-transistor is the Emitter. It should be installed towards the front of the clock. **NOTE** that on the GIIV7 and later version clocks the ROHM photo-transistor has been replaced with a **VISHAY** TEPT4400 photo-transistor. **R4** has been changed to 120K to provide a better match to the sensitivity. The TEPT4400's lead detail requires it to be installed at a minimum height above the PCB.

D1- LED. The long lead of the included LED is the Anode. It should be installed towards the rear of the clock. You may substitute a different color if desired. **AESTHETIC NOTE** You may wish to install the LED D1 after installing photo-transistor Q1 to align the heights of the two components.

RPTR-HP V3.2 specific construction notes:

RF1 - The **RPTR-HP** PCB is designed to allow the high power rf module to be installed almost flush with the PCB's top surface . To properly achieve this, the black plastic spacer on the 2x4 header must be removed from the rf module before soldering it onto the RPTR PCB. This is easily accomplished by prying it partially away for the module's PCB with a small bladed screwdriver or blunt knife edge and then just firmly pulling it the rest of the way off the header pins.



RF module after header plastic has been removed.

To avoid the very slight chance of any shorts between the printed circuit boards, the rf module should **NOT** be mounted absolutely flush with the RPTR's pcb. A small piece of thick paper under the module can be used as a temporary shim while the module is being installed. Check alignment carefully before soldering, The four outside ground lugs of the SMA antenna connector only need to be soldered for additional mechanical support if desired. Defer soldering of the SMA ground lugs till after successful testing of the **RPTR-HP** because they are difficult to desolder.

U2 - Voltage regulator **MCP1801** SOT23-5 package. Take care to properly orient Pin 1.

D1,D2, D3 - LEDs**.** The short lead of the LED is the cathode. It is soldered to the square pad. LED A = GREEN, B = YELLOW/ORANGE, & C = RED.

J1 - 2x3 2mm Header is for future expansion / options and is not mounted.

MOD-SIX Diagnostic notes:

CPU
On Power up the green CPU led should light and then extinguish after a couple of seconds. If there are any problems with the RTC subsystem (the RTC chip is not present or the I2C bus is open/shorted) the CPU led will blink rapidly and the clock will not function.

If the rotary encoder is depressed and held while power is applied to the clock, a tube segment bit test pattern will be displayed on the Nixie tubes. It will run continuously until the power is cycled. You can use this to test, and help find possible soldering issues on the **TDU** boards.

TDU
The segment test feature on the **CPU** can be very helpful**.** Individual **TDU** boards may be tested with just the **CPU** and a **PSU**.

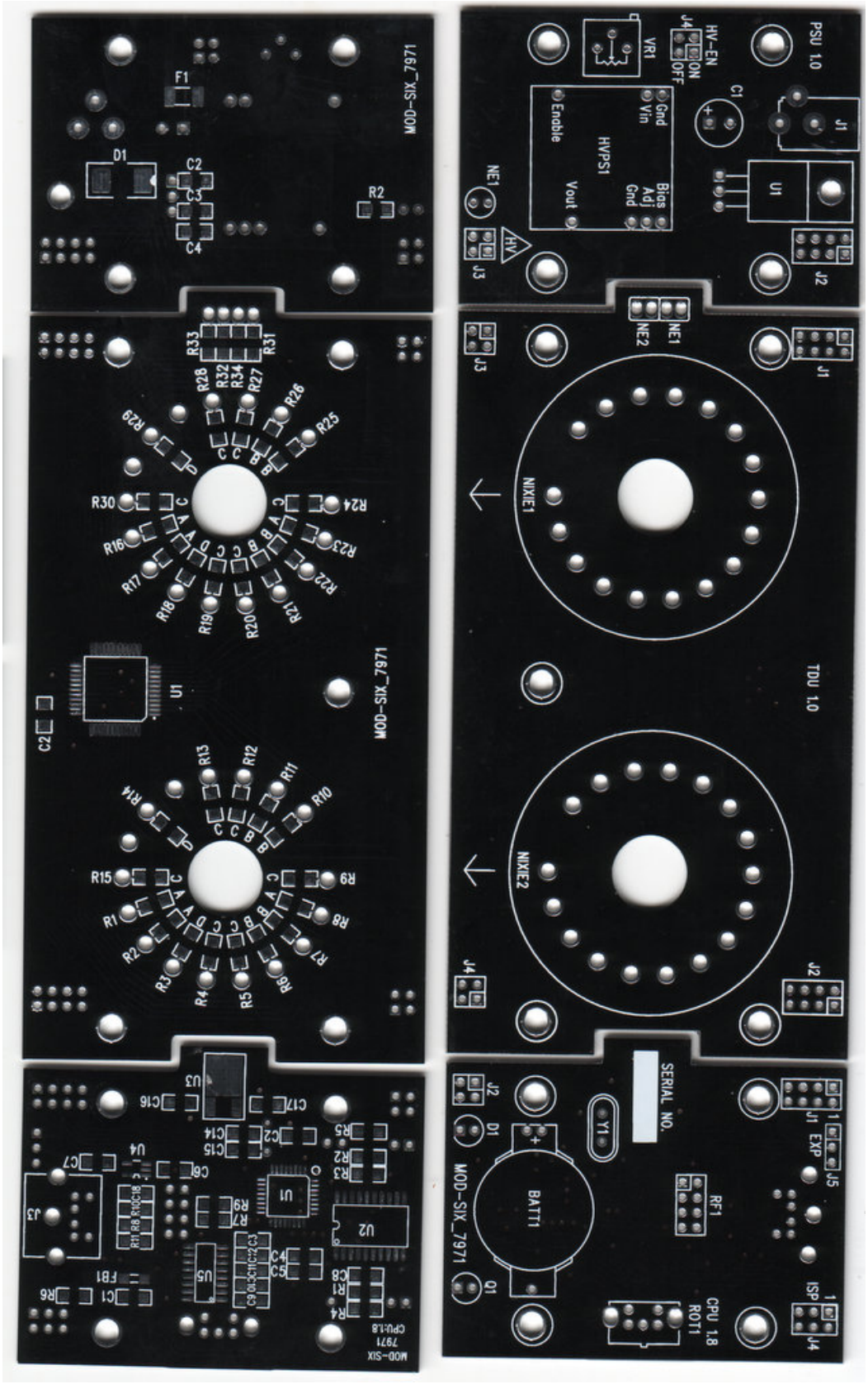
RPTR, RPTR-HP
All three LEDs will flash in order on power up, and then the firmware revision will blink on the

green and yellow LEDs.

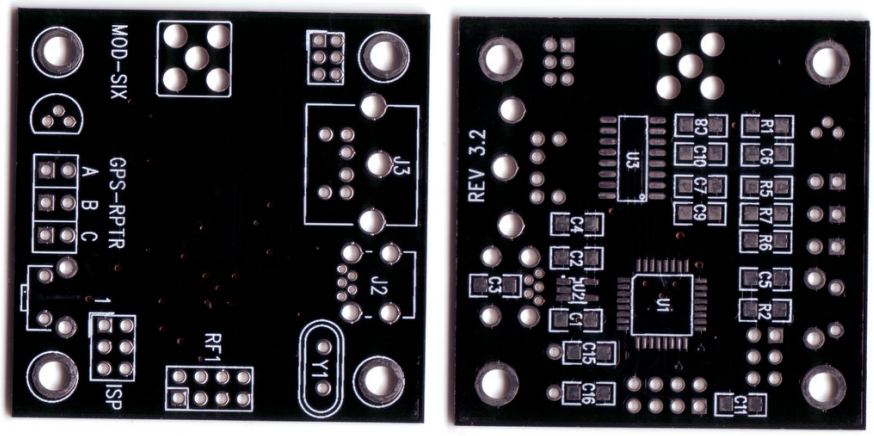
If the RF module is not detected by the **RPTR's** processor on power up, all three LEDs will blink continuously. Check soldering.

If the DS18B20 temperature sensor is not detected on power up the RED LED will light for an extended period after the initial LED power up sequence, but the unit will still operate. Just without reporting the ambient temperature.

PCB Images:



MOD-SIX PSU TDU CPU



RPTR-HP 3.2 PCB

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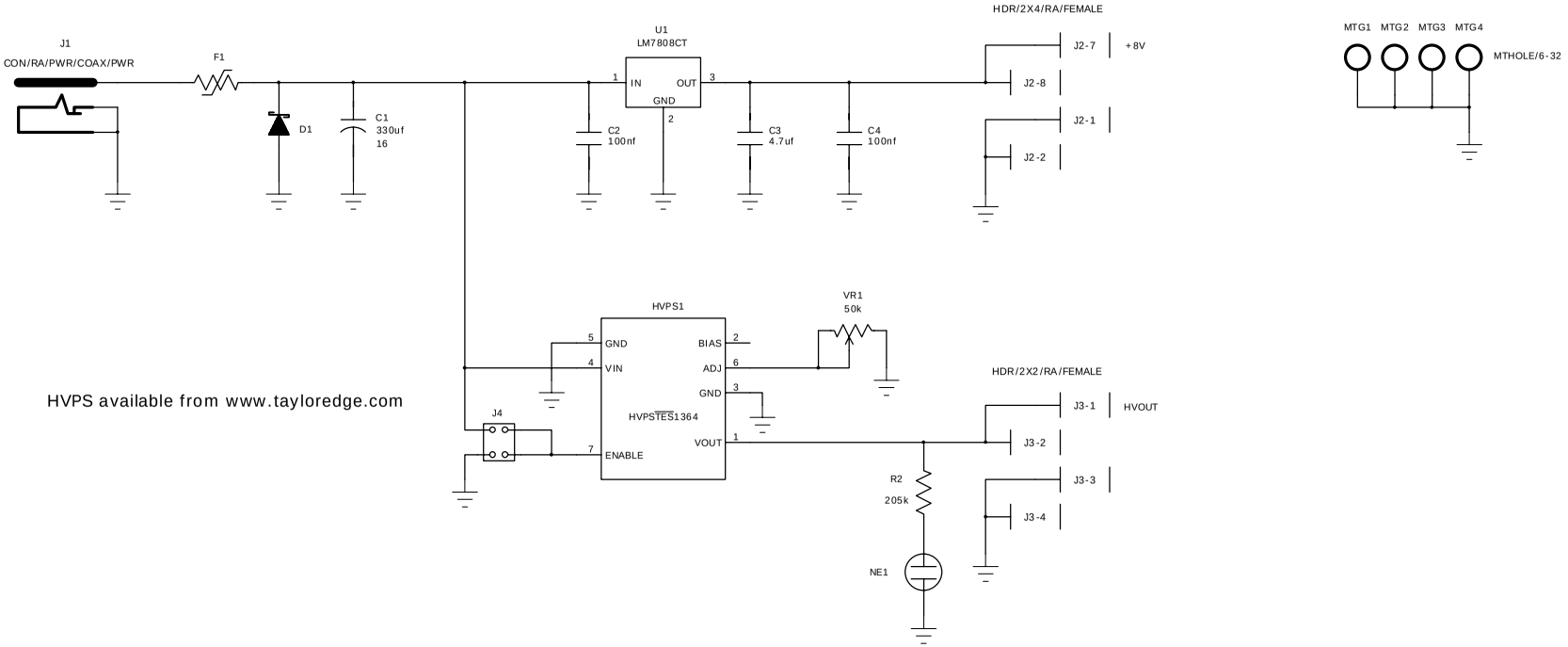

HVPS available from www.tayloredge.com

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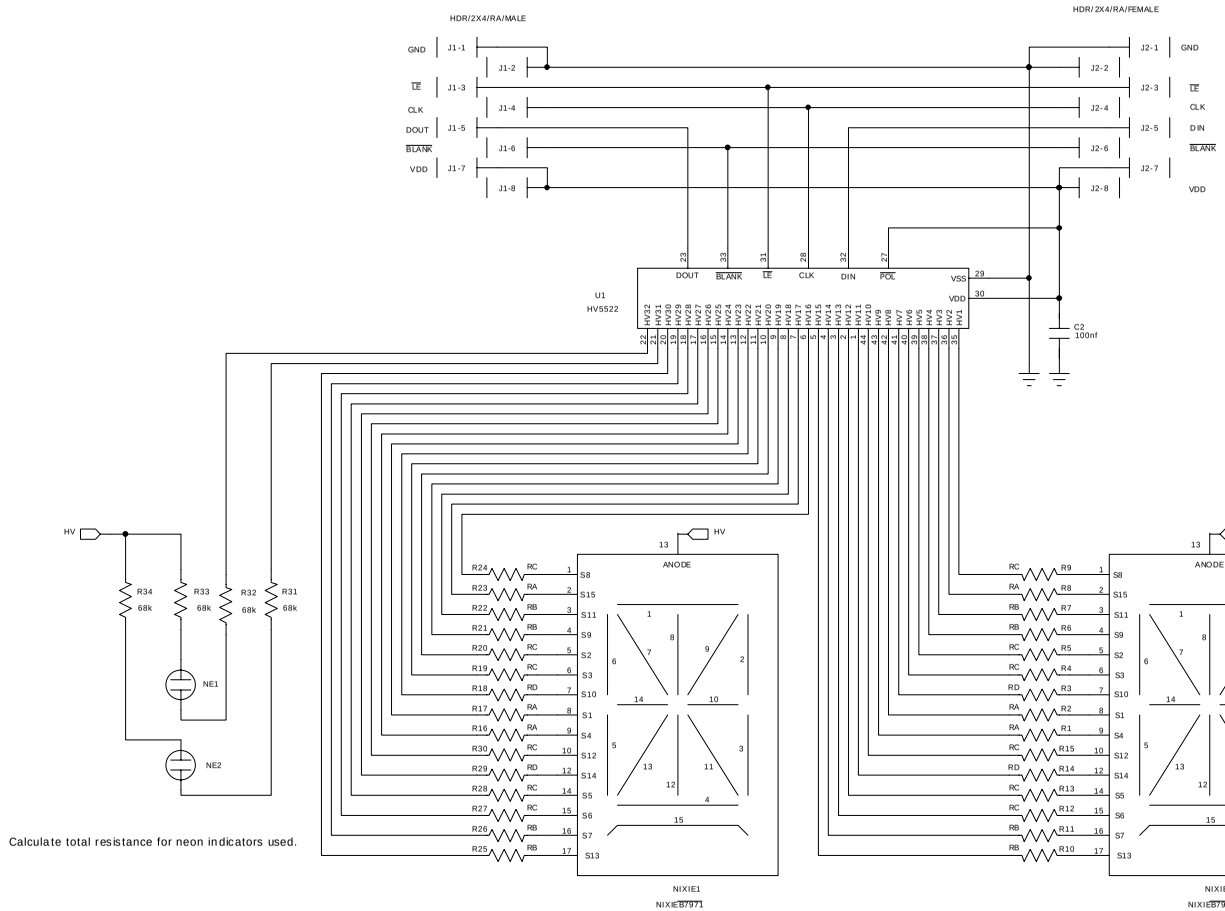
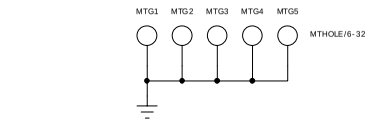


Calculate total resistance for neon indicators used.



Different Nixie segment lengths require different current limiting resistors.

RA = 22k
RB = 24k
RC = 27k
RD = 33k

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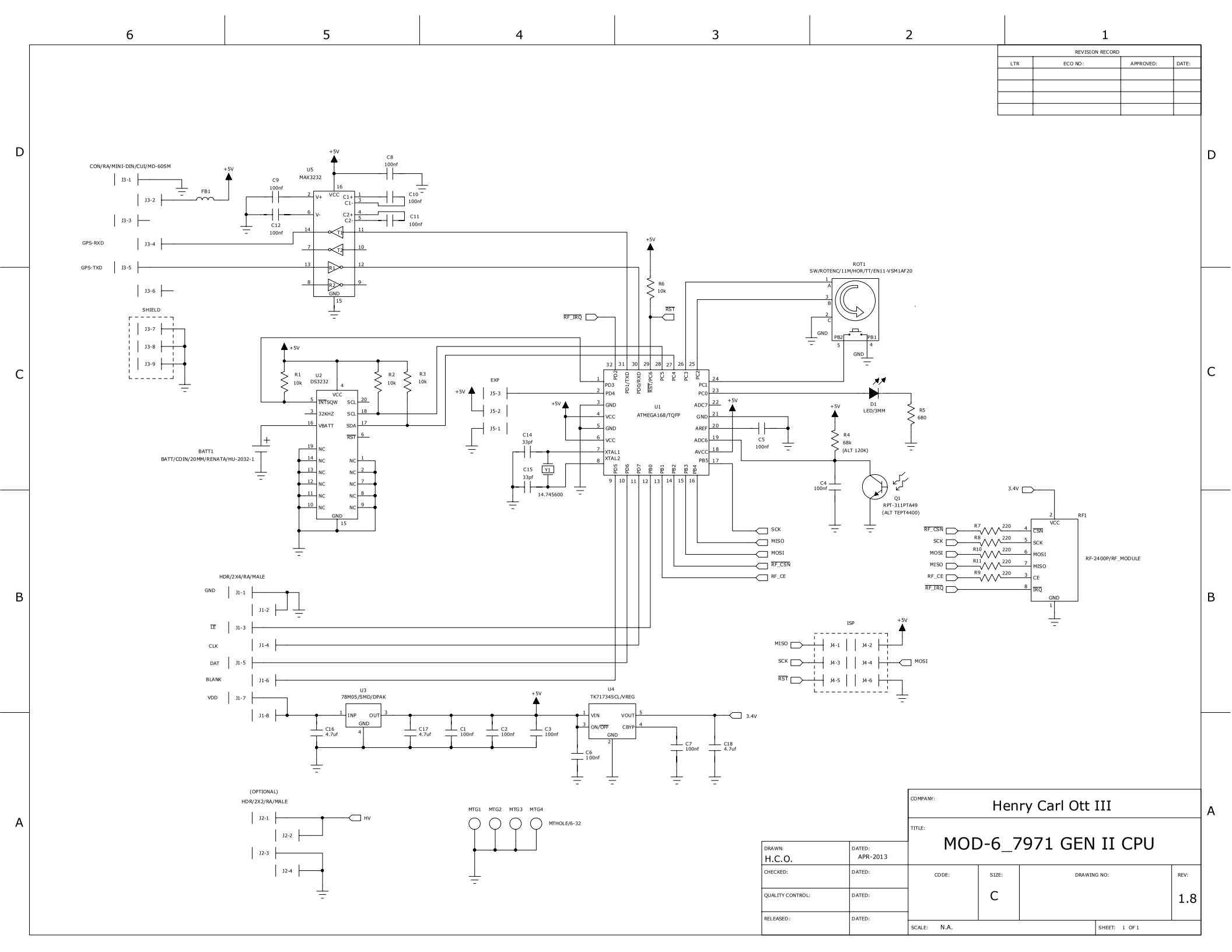
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APPROVED:
DATE:
CON/RA/MINI-DIN/CUI/MD-60SM
J3-1
J3-2
J3-3
J3-4
J3-5
J3-6
GPS-RXD
GPS-TXD
SHIELD
J3-7
J3-8
J3-9
FB1
U5
MAX3232
C8
100nf
C9
100nf
C10
100nf
C11
100nf
C12
100nf
VCC
V+
V-
C1+
C1-
C2+
C2-
T1
T2
R1
R2
GND
+5V
U2
DS3232
R1
10k
R2
10k
R3
10k
INTSQW
32KHZ
VBATT
SCL
SDA
RST
NC
BATT1
BATT/COIN/20MM/RENATA/HU-2032-1
EXP
J5-3
J5-2
J5-1
U1
ATMEGA168/TQFP
PD2
PD3
PD4
GND
VCC
XTAL1
XTAL2
PD5
PD6
PD7
PB0
PB1
PB2
PB3
PB4
PC0
PC1
PC2
PC3
PC4
PC5
PC6
ADC7
AREF
ADC6
AVCC
PB5
C14
33pf
C15
33pf
Y1
14.745600
C5
100nf
C4
100nf
R4
68k
(ALT 120K)
R5
680
D1
LED/3MM
Q1
RPT-311PTA49
(ALT TEPT4400)
R6
10k
RST
RF_IRQ
ROT1
SW/ROTENC/11M/HOR/TT/EN11-VSM1AF20
PB2
PB1
SCK
MISO
MOSI
RF_CSN
RF_CE
3.4V
RF1
RF-2400P/RF_MODULE
R7
R8
R10
R11
R9
220
CSN
SCK
MOSI
MISO
CE
IRQ
HDR/2X4/RA/MALE
J1-1
J1-2
J1-3
J1-4
J1-5
J1-6
J1-7
J1-8
CE
CLK
DAT
BLANK
VDD
U3
78M05/SMD/DPAK
INP
OUT
C16
4.7uf
C17
4.7uf
C1
100nf
C2
100nf
C3
100nf
U4
TK71734SCL/VREG
VIN
VOUT
ON/OFF
CBYP
C6
100nf
C7
100nf
C18
4.7uf
ISP
J4-1
J4-2
J4-3
J4-4
J4-5
J4-6
(OPTIONAL)
HDR/2X2/RA/MALE
J2-1
J2-2
J2-3
J2-4
HV
MTG1
MTG2
MTG3
MTG4
MTHOLE/6-32
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Henry Carl Ott III
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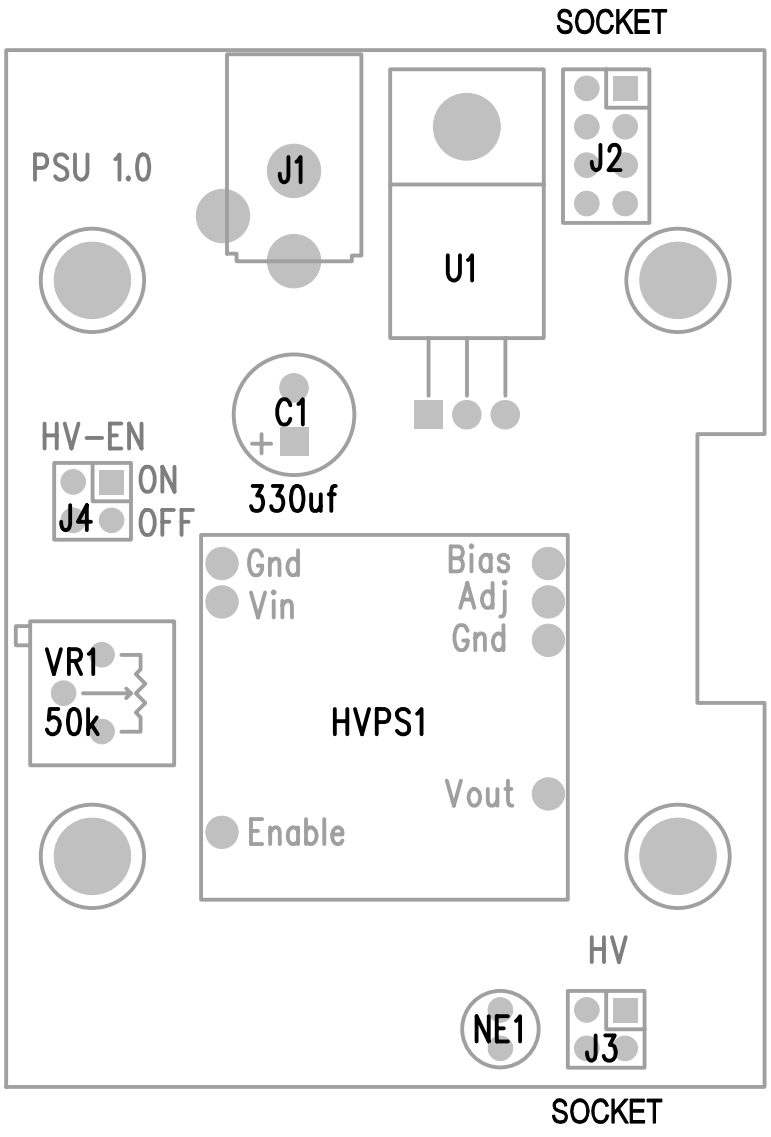
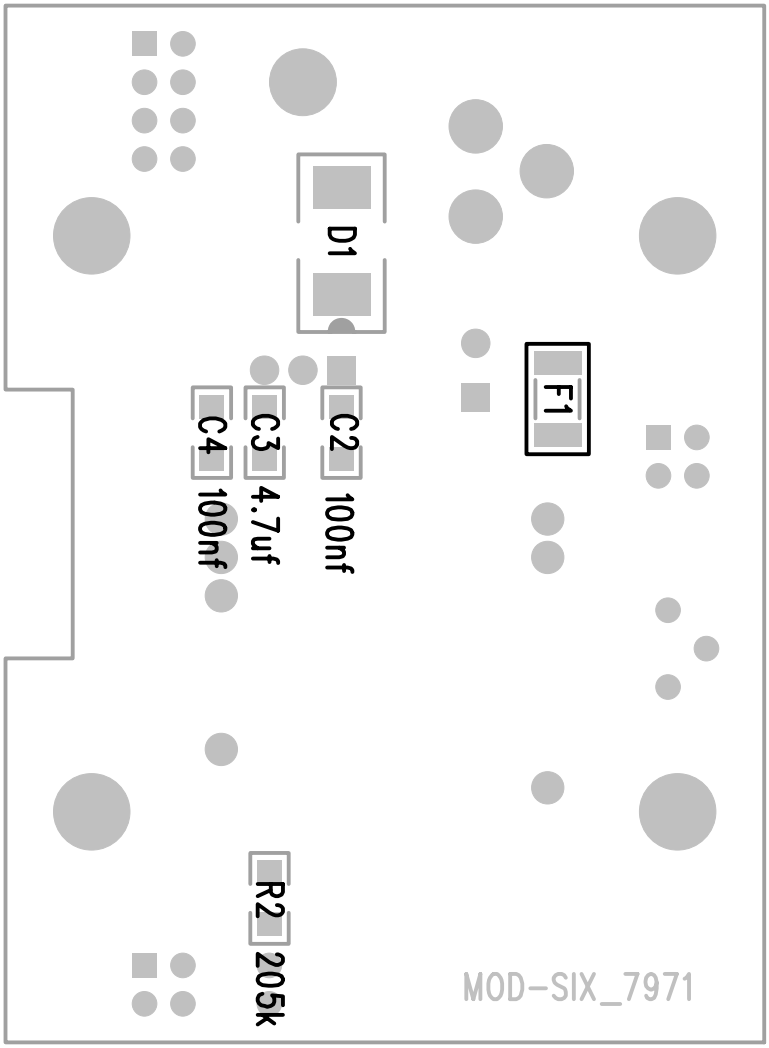


PSU PARTS PLACEMENT TOP



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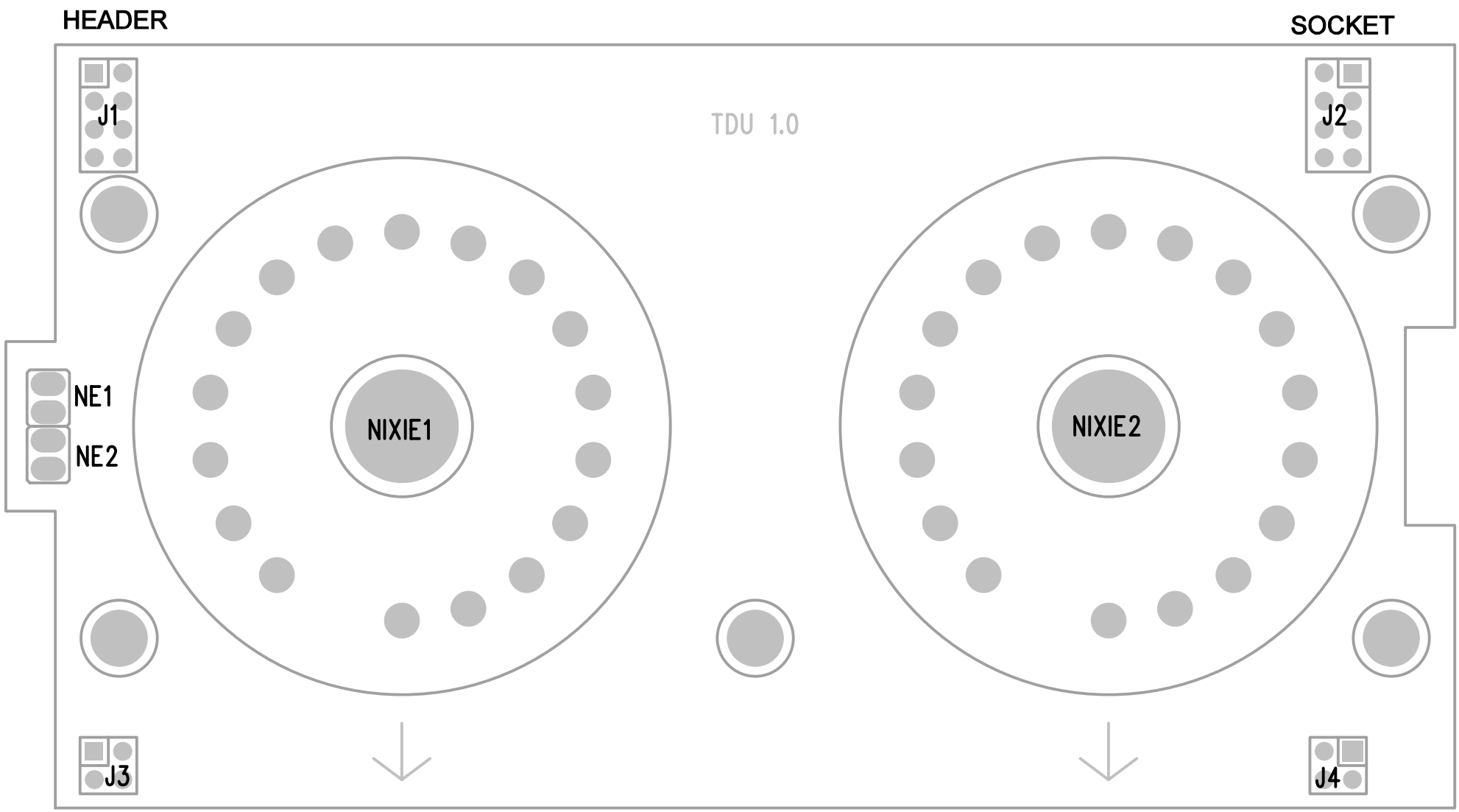
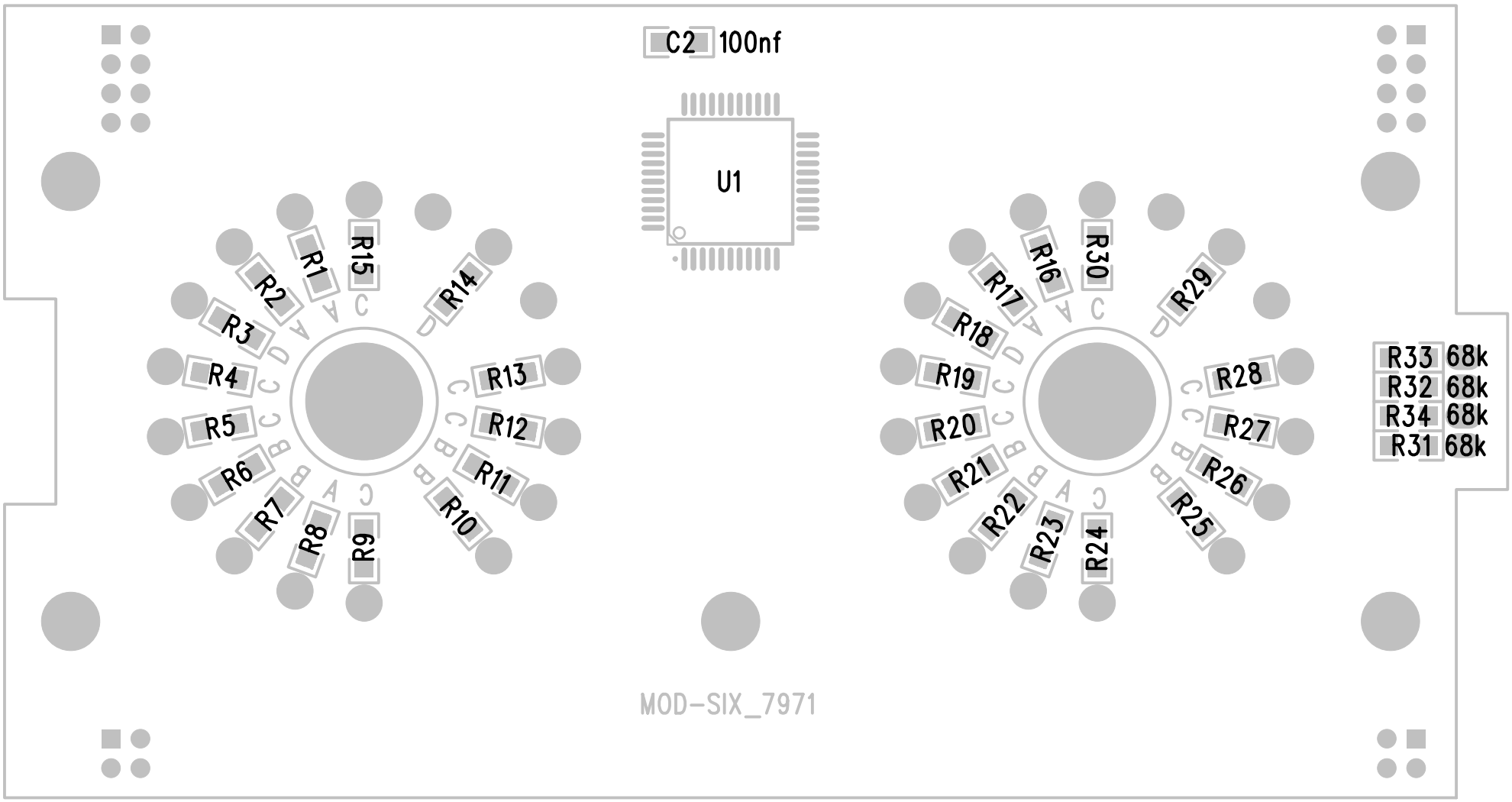
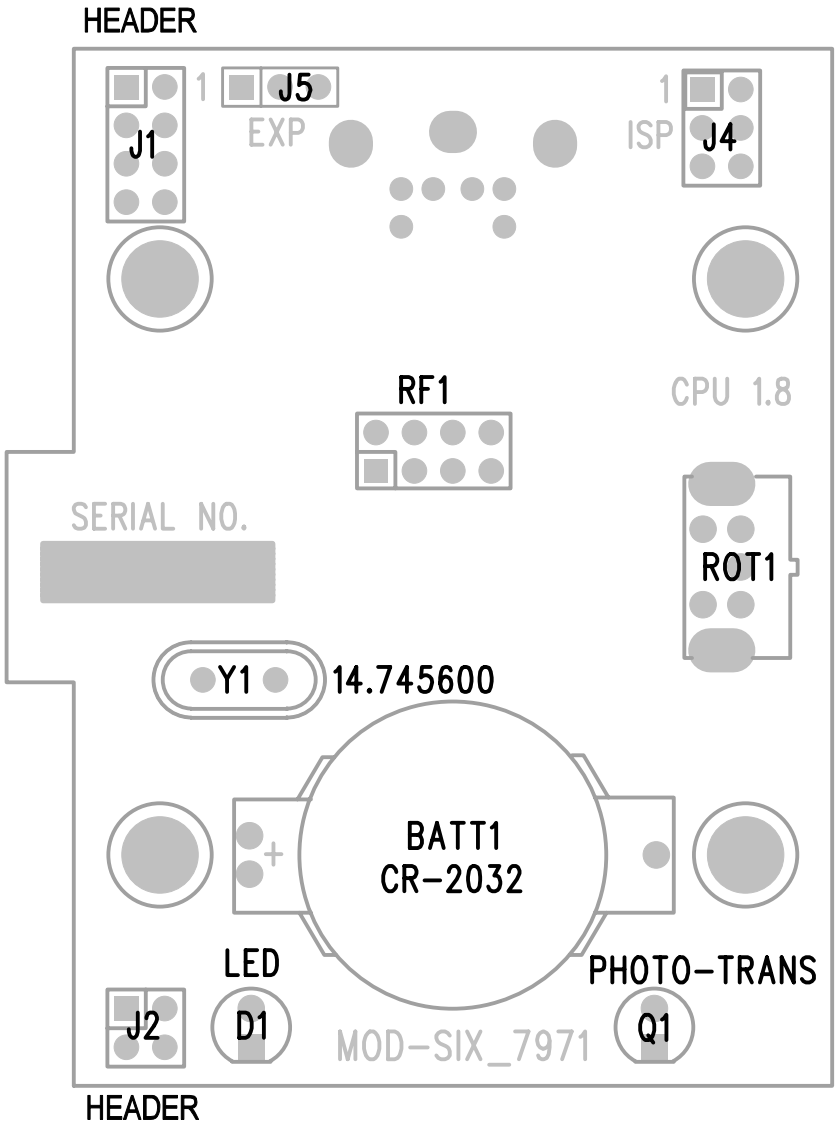


TDU PARTS PLACEMENT TOP

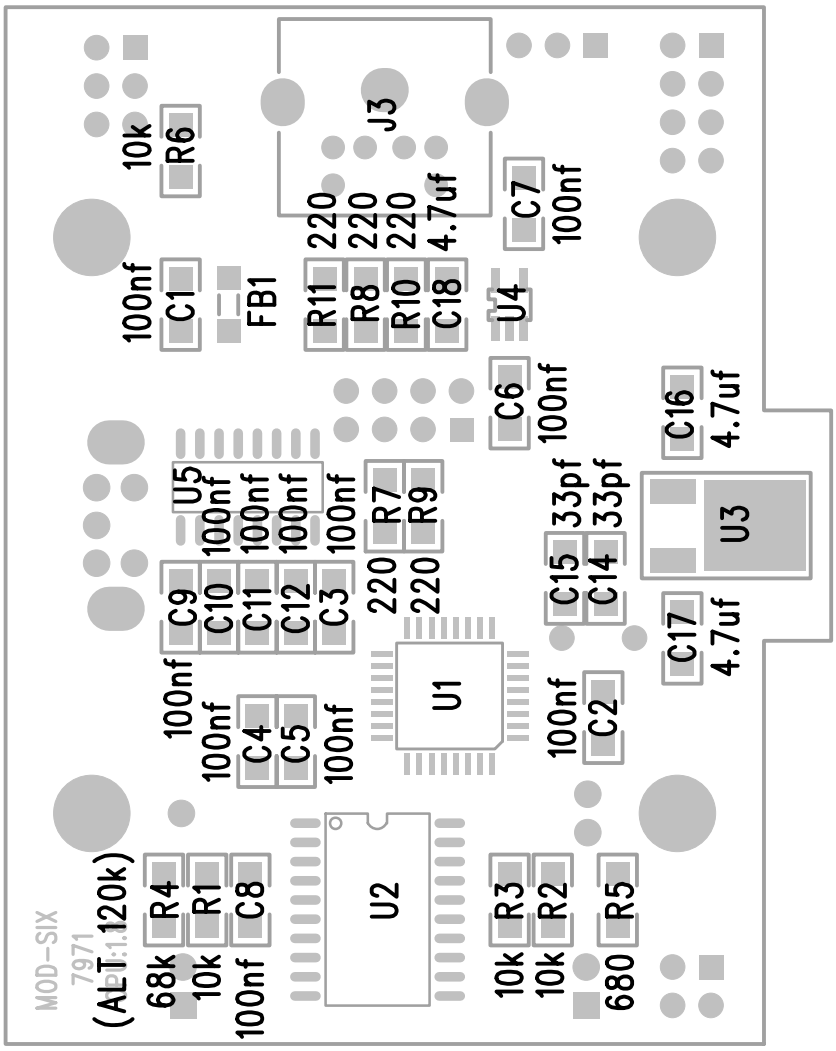


TDU PARTS PLACEMENT BOTTOM

RA=22k RB=24k RC=27k RD=33k



CPU PARTS PLACEMENT TOP



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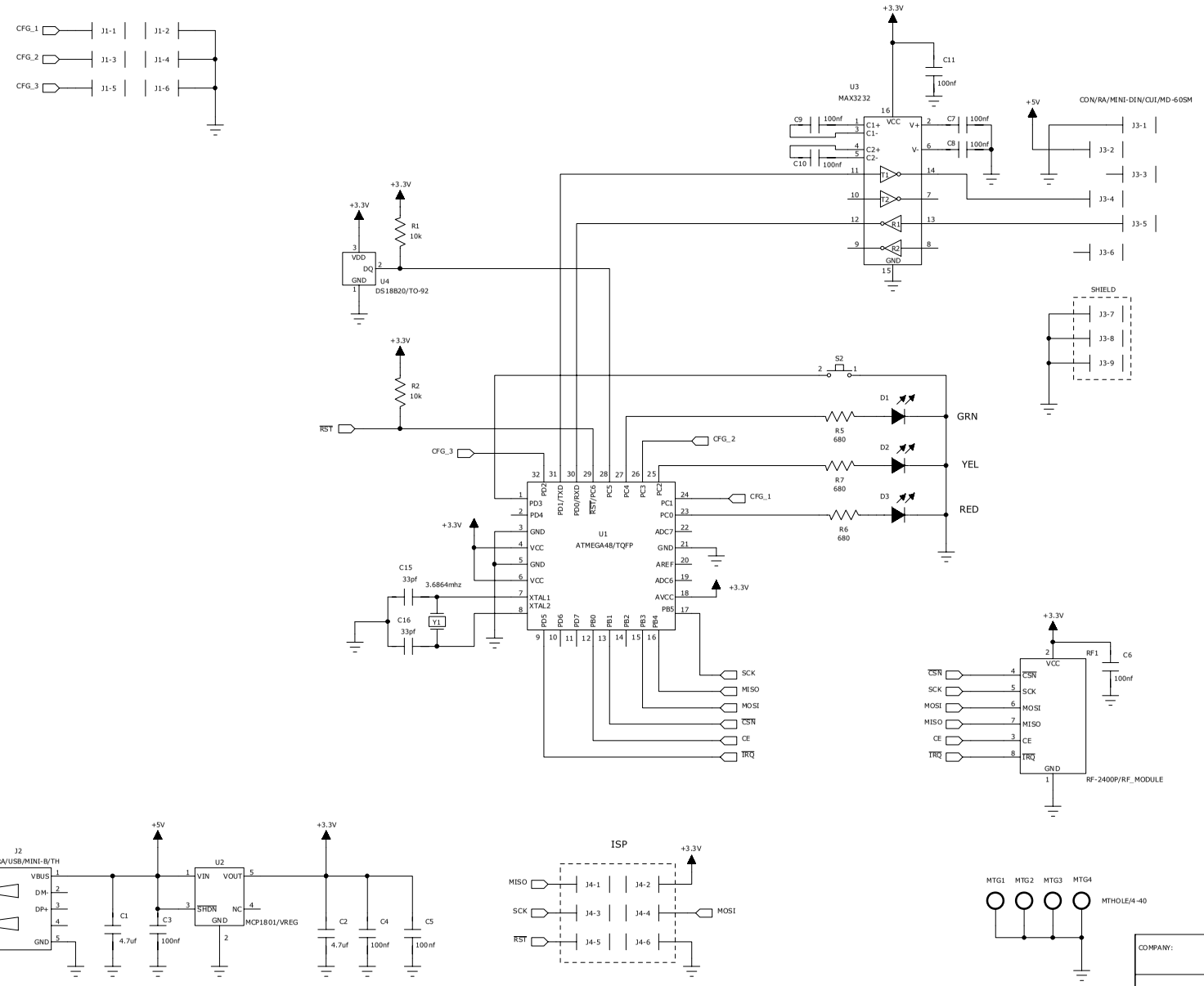

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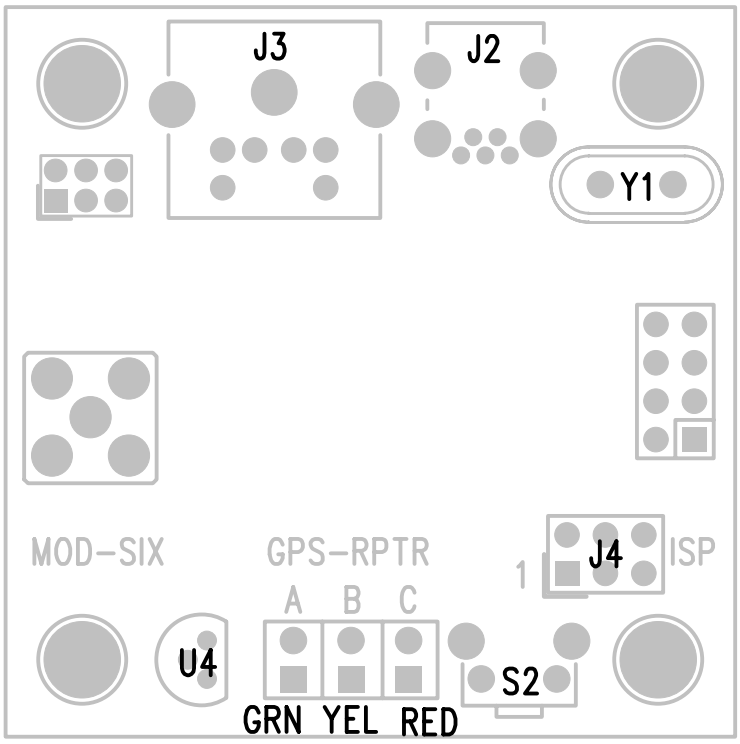
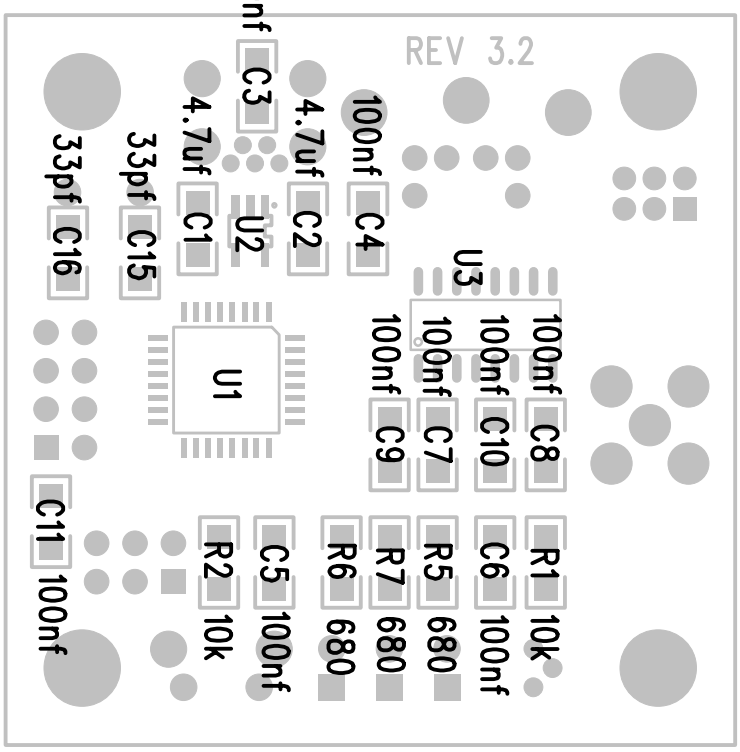


RPTR-HP 3.2 PARTS PLACEMENT TOP



RPTR-HP 3.2 PARTS PLACEMENT BOTTOM

CPU PCB								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1	U3		78M05/SMD/DPAK	Generic	LOW POWER 5 VOLT REGULATOR	LM78M05	SMD
2	1	U1		ATMEGA168\TQFP	Atmel	Microcontroller	ATmega168A-20AU	Pre-Programmed
3	1	BATT1		BATT\COIN\20MM\RENATA\HU-2032-1	Renata	BATTERY HOLDER	HU2032-LF	
4	12	C1-12	100nf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
5	2	C14-15	33pf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
6	3	C16-18	4.7uf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
7	1	J3		CON/RA/MINI-DIN/CUI/MD-60SM	CUI	MINI-DIN CONNECTOR	MD-60SM	**Bottom Mounted!**
8	1	U2		DS3232	MAXIM	RTC W/TCXO 20-SOIC		
9	1	FB1		FB1206	Generic	Ferrite Bead 1206	non critical	>100ma
10	1	J5		HDR/100/1X3	Generic	.100 MALE HEADER	EXP	Optional Expansion connector
11	1	J2		HDR\2X2\RA\MALE	FCI	2X2 .100 RA MALE HEADER	68021-204HLF	
12	1	J1		HDR\2X4\RA\MALE	FCI	2X4 .100 RA MALE HEADER	68021-208HLF	
13	1	J4		HEADER\2X3	Generic	2X3 .100 MALE HEADER		ISP Connection
14	1	D1		LED/3MM	Generic	3mm LIGHT EMITTING DIODE		Default Green Color / Long Lead = Anode
15	1	U5		MAX3232	MAXIM	RS-232 DRIVER/RECEIVER	MAX3232CSE	
16	1	Q1		PHOTO-TRANS\ROHM\RPT-311PTA49	ROHM	Photo Transistor	RPT-311PTA49	Long Lead = Emiter
16 ALT	1	Q1 (Q1-ALT)		Alternate Phototransistor.	VISHAY	Photo Transistor	TEPT4400	Long Lead = Emiter (shipped with GENII-V7 Clocks)
17	4	R1-3 R6	10k	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		
18	5	R7-11	220	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		
19	1	R5	680	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		
20	1	R4 (R4-ALT)	68k (120k)	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		Alternate value of 120k used with TEPT4400 Q1
21	1	RF1		RF-2400P/RF_MODULE	Various	NRF24L01P 2.4GHZ RF Module	MOD-NRF24L01P	
22	1	ROT1		SW/ROTENC/11M/HOR/TT/EN11-VSM1AF20	TT Electronics/BI	ROTARY ENCODER RA W/SWITCH	EN11-VSM1AF20	Mounting hardware not used.
23	1	U4		TK71734SCL/VREG	TOKO	3.4V LDO SOT23-5	TK71734SCL	
24	1	Y1	14.7456	XTAL_HC-49US	ABRACON	Quartz Crystal HC49/US PKG	ABL-14.7456MHZ-B2	14.7456 MHZ 18pf
25	1	KNOB1			KILO	Knob or Rotary Encoder	OEDA-50-2-5	

TDU PCB								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1	C2	100nf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
2	1	J4		HDR\2X2\RA\FEMALE	Sullins	2X2 .100 RA FEMALE HEADER	PPPC022LJBN-RC	
3	1	J3		HDR\2X2\RA\MALE		2X2 .100 RA MALE HEADER	68021-204HLF	
4	1	J2		HDR\2X4\RA\FEMALE	Sullins	2X4 .100 RA FEMALE HEADER	PPPC042LJBN-RC	
5	1	J1		HDR\2X4\RA\MALE		2X4 .100 RA MALE HEADER	68021-208HLF	
6	1	U1		HV5522	Supertex	32-Channel HV Serial to Parallel Converte	HV5522PG-G	PQFP. could also substitute higher voltage HV5530PG
8	1	NE1		NEON\UPRIGHT\MINI		Small Neon Bulb NE-2 6X15		See project documentation for mounting options.
9	1	NE2		NEON\UPRIGHT\MINI		Small Neon Bulb NE-2 6X12		See project documentation for mounting options.
10	34	NIXIE1-2		NIXIE\B7971	Burroughs	Nixie Tube	B7971	Use milmax 0327-0-15-01-34-27-10-0, 0327-0-15-01-34-27-10-0, or equiv pins for socket. See project documentation.
11	6	R1-2 R8 R16-17 R23	RA	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 Watt	Nominal 22k	See schematic for value.
12	8	R7 R10-11 R21-22 R6 R25-26	RB	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 Watt	Nominal 24k	See schematic for value.
13	12	R15 R4-5 R19-20 R9 R12 R24 R13 R27-28 R30	RC	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 Watt	Nominal 27k	See schematic for value.
14	4	R18 R3 R29 R14	RD	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 Watt	Nominal 33k	See schematic for value.
15	4	R31-34	68k	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 Watt		

PSU PCB								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1	C1	330uf	CAP/RAD/3.5MM/8MM	Generic	Cap Radial 2.5mm Pin Spacing 8mm Dia.		16-25V Bulk Decouple.(supplied with HVPS)
2	2	C2 C4	100nf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
3	1	C3	4.7uf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
4	1	J1		CON\RA\PWR\COAX\PWR	CUI STACK	COAXIAL POWER JACK 2.0MM	PJ-102A	Tapered pins (not slots)
5	1	D1		DIODE\SHOT\SMC\30BQ040	Vishay	Diode 3A 40V	30BQ040	Reverse polarity protection. Optional/non-critical

6	1	F1		FUSE\POLY\SMD\1812	Littlefuse	PTC Resettable Fuse	1812L110/16DR	16V 1.1 HOLD 1.95 TRIP
7	1	J3		HDR\2X2\RA\FEMALE	Sullins	2X2 .100 RA FEMALE HEADER	PPPC022LJBN-RC	
8	1	J4		HDR\2X2\STRAP	Generic	2X2 .100 MALE HEADER		
9	1	J2		HDR\2X4\RA\FEMALE	Sullins	2X4 .100 RA FEMALE HEADER	PPPC042LJBN-RC	
10	1	HVPS1		HVPS\TES\1364	Taylor Electronics	High Voltage Module	1364 HVPS-H	www.tayloredge.com
11	1	U1		LM7808CT	Generic	VOLTAGE REGULATOR	LM7808CT	LM7808CT
12	1	NE1		NEON	Generic	Small Neon Bulb NE-2		
13	1	R2	205k	RES\SMD\1206	Generic	SMD resistor 1206 1/8W		
14	1	VR1	50k	VRES/375/SIDE	Generic	Multi Turn Trim Pot		0.375"
15	1				Generic	#4-40 X 3/8" SS SHS and Lock Nut		Voltage regulator anchor. No Heatsink required.

Clock Mechanical and Misc. Hardware								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1				Custom	Alum. Base Plate 3-1/2" X 19-3/4" X 1/4"		
2	1				Custom	Acrylic top		
3	23				Generic	#6-32 X 5/8" Hex Steel/Zinc.standoffs F/F		
4	23				McMaster	#6-32 X 3/8" SS Allen Socket screws	# 92196A146	
5	23				McMaster	#6-32 X 1/2" Steel Philips PanHead	# 90272A148	
6	23				McMaster	#6 Nylon washers - Black	# 90295A376	
7	12				McMaster	#4-40 X 1/8" SS SHS - Outer edge		Cosmetic
8	4				McMaster	#4-40 Flat washers steel/cad plated	# 98032A421	
9	4					1" X 1/2" Rubber Feet		
10	4				McMaster	#4-40 X 3/8" SS Allen Socket screws for rubber feet	# 92196A108	
11	8				Custom	.062" Copper Tubing / Towers pieces		
12	2				Custom	.062" Copper Tubing / AM/PM pieces		
13	10				Generic	1/16" Clear Heat shrink		
14	4					1/4" Diameter Clear Rubber Bumber	# SP-HE00121	www.cabinetparts.com
15	1	Power Supply	12V 1.5A		Various	12VDC 1.5 Amp Minimum power Supply		2.1mm ID center positive coaxial power connector

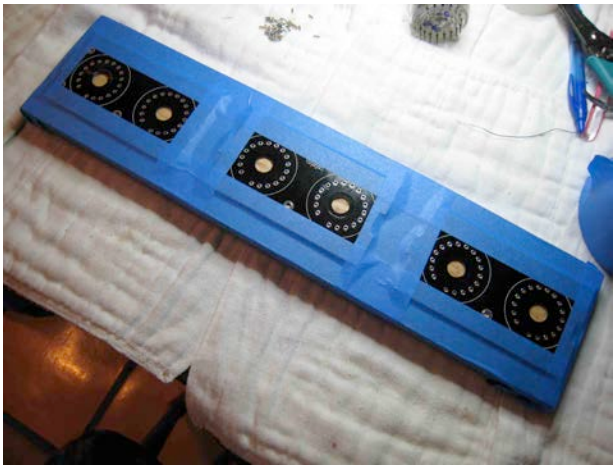
RPTR-HP 3.2 PCB								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1	U1		ATMEGA48/TQFP	Atmel	Microcontroller	ATmega48A-AU	Pre-Programmed
2	2	C1-2	4.7uf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
3	9	C3-11	100nf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
4	2	C15-16	33pf	CAP\SMD\1206	Generic	SMD Capacitor 1206		
5	1	J3		CON/RA/MINI-DIN/CUI/MD-60SM	CUI	MINI-DIN CONNECTOR	MD-60SM	
6	1	J2		CON/RA/USB/MINI-B/TH	Generic	USB Mini-B connector		Through Hole. Only used for power. No USB support.
7	1	U4		DS18B20/TO-92	Maxim	1-Wire Temperature Sensor	DS18B20	TO-92 pkg
8	1	J4		HDR/100/2X3	Generic	2X3 .100 MALE HEADER		ISP Connection
9	1	J1		HDR/2MM/2X3/TH	Generic	2X3 2mm Header	DNP	Expansion / Not Mounted
10	3	D1-3		LED/3MM	GENERIC	LIGHT EMITTING DIODE		Long Lead = Anode
11	1	U3		MAX3232	MAXIM	RS-232 DRIVER/RECEIVER	MAX232CSE	SO-16
12	1	U2		MCP1801/VREG	Microchip	3.3V LDO SOT23-5	MCP1801	
13	2	R1-2	10k	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		
14	3	R5-7	680	RES\SMD\1206	Generic	SMD Resistor 1206 1/8 watt		
15	1	RF1		RF-2400P/RF_MODULE	NORDIC	RF-MODULE WITH PA & LNA		Requires external antenna
16	1	S2		SW/PB/RA/TACTILE/5MM	Bossun	Tactile Switch/RA 3×6×4.3	TS-0XX	
17	1	Y1	3.6864	XTAL_HC-49US	ABRACON	Quartz Crystal HC49/US PKG		18pf

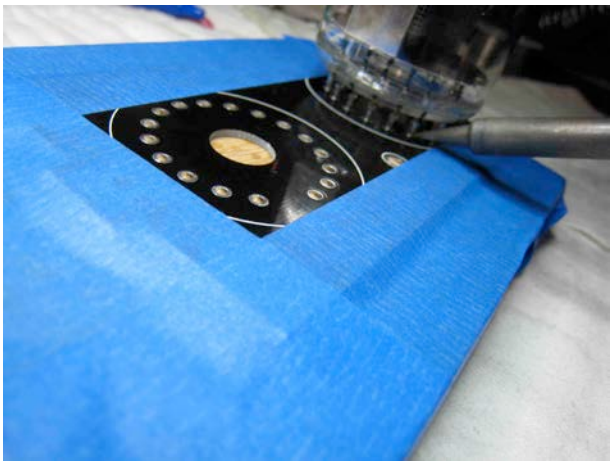
RPTR Mechanical and Misc. Hardware								
Item #	Qty	Ref.	VALUE	Part Name	Mfg.	Description	PART NUMBER	Note
1	1			RPTR-TOP-PLATE	Custom	Clear Acrylic Top Plate		
2	1				Various	Lot. Mounting hardware.		
3	1			RPTR-PLATE	Custom	Aluminium Base Plate.		
4	1			PS-USB	Various	5 Volt USB Power Supply		500ma Minimum
5	1				Various	USB A - Mini B power Cable		

ATTENTION: If you wish to install tube pins raised up vs. flush with the TUBE PCB's you MUST install pins first before installing any other components!

Nixie Tube PIN receptacle installation:

Select a tube with the straightest pins. If any appear bent, CAREFULLY straighten them with needle nose pliers before proceeding. Grabbing the pins too close to the glass envelope can cause breakage. Install a pin receptacle on each of the seventeen Nixie Tube pins, and ensure that all receptacles are completely seated to the base of the pin. With the component side down, place the blank clock Tube boards onto a flat surface. Firmly tape (2" blue Scotch Brand painters tape works well) the edges of the three tube boards to a 'throw-away' section of hardwood, masonite, or smooth surfaced plywood. Be sure to tape the PCBs down very firmly so that they are held flat against the surface and immobilized. Now, position the tube with the pins attached into the hole pattern of one of the tube positions. Press down slightly to make sure the pins are seated into the receptacles and the receptacles are flat against your hard surface and the tube stands straight. Carefully apply heat with your soldering tip to the bottom of the tube pin and the solder tinned pin hole, being careful not to touch the glass tube envelope with your iron. Allow solder to flow into the joint and build up around the base of pin. Do not leave your iron here for an extended period of time. Being careful not to jostle the tube, move to a pin opposite the pin you just soldered and solder that pin to stabilize the tube. Continue the process until all pins are soldered, then remove the tube. When removing the tube, press down on the PCB so as not to break the seal between the bottom of the PCB and the hard surface. Repeat process for the remaining 16 pins.





Colon and AM/PM Tower and Construction: (These are a bit tricky and take some concentration and your best work)

There are 10 lengths of .0625” copper tubing in your kit; 2 each of 3.5”, 3.25”, 2.125”, 1.875” and .9300”. There are also 6 NE-2 Neon bulbs in your kit; three - 6X15mm, two 6X12mm and one additional 6X12 NE2 used on the Power Supply board. There is also a 36” length of 1/16” clear heat shrink included with the kit. Begin with the upper NE2 tower section using the one 3.5” length and one 3.25” length of copper tubing and the largest 6X15 NE2. Slide one 3.5” length on one leg of the NE2 and one 3.25” length on the other leg. The glass tongue of the NE2 should be parallel with the 2 lengths of tubing (see pic) While Holding the 2 copper tubing lengths together with the offset in length at the NE2 end, grasp the NE-2 and slowly and gradually bend the NE2 leads creating a smooth bend until the NE-2 is perpendicular to the tubing lengths.

Lay this assembly on a soft work surface and flush the ends of the tubing away from the NE2. Place a small amount of weight on the flushed end and prop a metal heat sink under the NE2 end just below the offset. (See image below) Position the NE2 approx ¼” away from the shorter length of tubing. Apply liquid flux to the NE2 lead and the tubing at the junction point. Be sure you have a heat sink below this joint as it keeps the heat localized. Heat the joint with your soldering iron and apply solder until the joint is filled and a small mound of solder is formed. Repeat the process other upper NE2 tower section.
Cut the leads on the two 6X12 NE2’s to 1-1/2”. Repeat the process for the 2 lower tower NE2 sections using the 2.125” and 1.875” lengths, but use the 6X12 NE2 for this section of the tower.

Locate the remaining 6X15 NE2 and cut the leads to 1/2”. Slide the 2 small 11/16” pieces of copper tubing on the leads and position the bottom of the NE2 ¼” above the tubing. Solder the two 11/16” pieces of copper tubing to the leads being sure to use liquid flux as before.

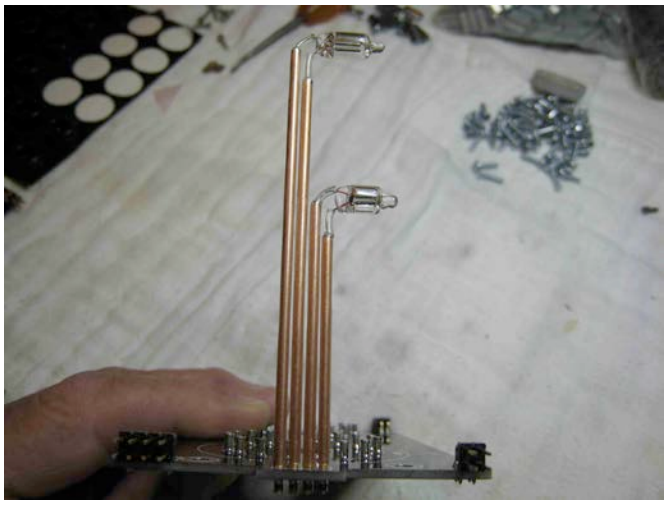
Next, clean all flux from the copper tubing using acetone or another suitable cleaner. Next, cut the following lengths of 1/16” clear heat shrink from the 36 length supplied:

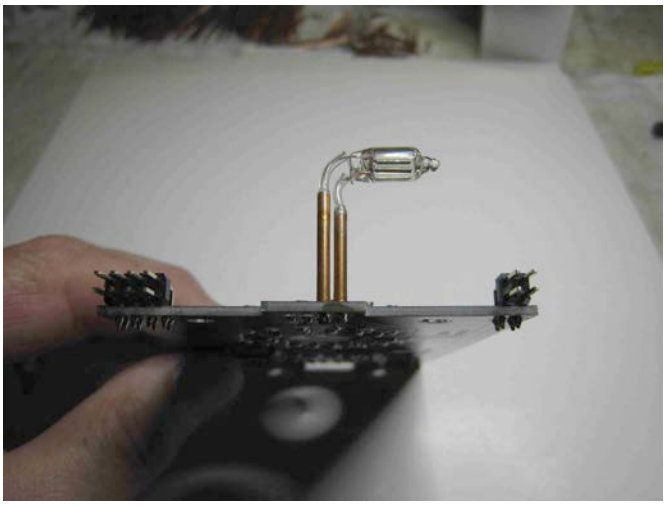
Two 3-1/2””
Two 3-5/16”
Two 2-1/16”
Two 1-7/8”
Two 11/16” (for right angle mounted AM/PM these lengths should be 1.125” and .875”)

Apply the appropriate length piece of heat shrink to each leg of all sections. There should be an approximate ¼” bare section of copper tubing at the bottom of each tubing section. Be sure to slide the heat shrink all the way past the copper tubing and against the NE2, making contact with the NE2. You may have to bend up the legs of the tower sections a bit to make this easier. Shrink all sections with a heat gun.

Insert one of the completed upper tower sections in the REAR set of holes marked NE1 on the tube side of the PCB tube board. BE SURE the NE2 is facing forward, as indicated by the arrows on the front of the board. Secure the PCB with the NE2 “tongue” facing standing up and the tower section facing away from you. You should be looking at the solder side of the tube board and the tower section is facing away from you. Take a measurement here. Gently press the tower into the mounting hole so that the bottom of the heat shrink sections are flush against the top of the PCB. Support the tower so that it is as close to perpendicular to the PCB as possible. The horizontal center of the NE2 should be approximately 3-3/8” from the top of the PCB. If it’s not, something is wrong. Most likely the heat shrink was cut incorrectly. Correct this before doing anything else or the NE2’s will be in the wrong place with respect top the tube numerals. Apply liquid flux to the protruding copper tubing on the solder side of the PCB. Make sure the heat shrink is still flush against the top of the PCB. Even though the tower section is not perpendicular secure the tallest 3.5” tube by applying solder to the joint. This will take a few seconds to become hot enough to solder the entire piece will act as a heat sink. Do not solder the other yet. Position a small machinist square or a small 3” X 3” block of wood you know is square up against the ‘down side’ of the tower section and the top of the Mouser pins. While reheating the joint you just soldered, gently press the section into ‘square’ when the joint reheats. Remove the heat and hold for just a second. Do not solder the 3.25” upright yet. Now, insert the lower tower section. Take another measurement. The horizontal center of the NE2 should be approximately 1-15/16”” from the top of the PCB. If it is not, fix it. As with the 1st section solder just the rear tube. Now reheat and align to the upper tower section. Eyeball this section to make sure all 4 tubes are in line. If not, reheat and adjust. Once aligned, solder the remaining 2 tubes. Adjust the NE2’s until they’re right.

Cut the leads on the remaining NE2 to 5/8”. Slide the 2 small copper tubing pieces on the leads leaving approx ¼” from the bottom of the NE2 to the top of the tubing. Solder as before with liquid flux. Apply the 2 small pieces of heat shrink to the AM/PM NE2 again, with the heat shrink up flush against the bulb. Insert the AM/PM NE2 in the forward set of holes next to the Hours/Tens tube and solder from the underside, making sure the heat shrink is flushed up to the PCB. Eyeball till perpendicular to the PCB.





alternate method