The PINE BOARD PROJECT

BOB HEIL, K9EID
FIELD STRENGTH METER

The Pine Board Project
FIELD STRENGTH METER

A pine board about 6 x 6 in.
Soldering iron
Rosin core solder
Small screws
Terminal strips (4s or 5s are best)
1n914 Diode
50k Potentiometer (a pot)
Meter 100 micro Amp
.01 Capacitor
RF Choke 2.5mH
Antenna 19 inch piece of solid wire (coat hanger works fine)
DANGER: HIGH VOLTAGE

The Pine Board Project
Use with caution

Careful

CHIP stick
USE with Caution

Careful?

CHIP

STICK

К9МIТ

КАТГРН
The Pine Board Project

THE POWER SUPPLY
POWER SUPPLY

261G6 transformer
3- electrolytic capacitor 20 mfd@ 450 v
2- 1k ohm 2 watt resistor
Fuse holder
Fuse
Power switch
6X5 vacuum tube
Ceramic octal socket
2- solder-type terminal strips – 6 lug
3 lug barrier terminal strip
Pilot light socket
Pilot bulb (6.3v)
AC power cord w/plug

Having trouble finding the parts? Check out these sites.
https://www.tubesandmore.com/
http://gateway-electronics.com/
http://vacuumtubes.com/ (best tube supplier)
6X5GT DATA SHEET

FULL-WAVE VACUUM RECTIFIER 6X5GT

Glass octal type used in power supply of automobile and ac-operated receivers. Outlines section, 13B; requires octal socket. This type may be supplied with pin No. 1 omitted. For maximum ratings, and typical operation, refer to type 6X4.

Refer to chart at end of section.

MEDIUM-MU TRIODE—SHARP-CUTOFF PENTODE 6X8A

Miniature type used as combined oscillator and mixer tube in television receivers utilizing an intermediate frequency in the order of 40 MHz and in AM/FM receivers. Outlines section, 6B; requires miniature 9-contact socket. Types 6X8 and 10X8 are identical with type 5X8A except for heater ratings.

Refer to chart at end of section.

6X9/ ECF200

HIGH-MU TRIODE—SHARP-CUTOFF PENTODE

Miniature type used as 6J4 amplifier tube in television receivers. Outlines section 6B, except has 10-pin base; requires miniature 10-contact socket.

Refer to chart at end of section.
Pine Board Project - High Voltage Power Supply

PARTS:
one - 261G6 transformer (tubesandmore.com)
two - electrolytic capacitor 20 mfd @ 450 v
two - 33k ohm 2 watt resistor
one - fuse holder (tubesandmore.com #S-H259)
one - fuse
one - power switch SPST
one - bridge rectifier (tubesandmore.com, #P-QBR-34)
three - solder-type terminal strips – 6 lug
one - 3 lug barrier terminal strip
one - 4 lug barrier strip
one - pilot light socket
one - pilot bulb (6.3v)
one - 3-wire, AC power cord w/plug

NOTE: a kit of parts is available from Antique Electronics (tubesandmore.com) as item No. P-BH-PS

Circuit Design: Bob Heil, K9EID – 27 Nov 2017
Graphics: W4IQN
"Classic" Plate & Filament - Chassis Mount (261/262 Series)

"CLASSIC" LOW POWER PLATE & FILAMENT OR BIAS TRANSFORMERS

- Primary 115 VAC, 60 Hz.
- Designed for small power or bias supplies, test equipment, preamps etc.
- Models 261C8, 261E9, and 261G6 can also be used with full wave C.T. rectifiers.
- Economical, two hole, channel bracket, chassis mount.
- Minimum 5" long leads.
- Convenient 6.3 or 12.6 volt filament/auxiliary winding.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>VA</th>
<th>A.C. Secondary #1 RMS</th>
<th>A.C. Filament Sec. #2 RMS</th>
<th>Schematic Figure #</th>
<th>Dimensions (Inches)</th>
<th>Wt. (Lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>261C4</td>
<td>17.5</td>
<td>250V C.T. @ 65ma</td>
<td>0.3V @ 1A</td>
<td>1</td>
<td>2.25</td>
<td>1.56</td>
</tr>
<tr>
<td>261C8</td>
<td>29</td>
<td>250V C.T. @ 91ma</td>
<td>0.6V @ 1A</td>
<td>1</td>
<td>3.06</td>
<td>1.90</td>
</tr>
<tr>
<td>261E9</td>
<td>45</td>
<td>250V C.T. @ 130ma</td>
<td>0.8V @ 1A</td>
<td>1</td>
<td>4.02</td>
<td>2.20</td>
</tr>
<tr>
<td>261G6</td>
<td>63</td>
<td>240V @ 220ma</td>
<td>0.2V @ 4A</td>
<td>2</td>
<td>4.50</td>
<td>2.00</td>
</tr>
<tr>
<td>261H6</td>
<td>7</td>
<td>240V @ 43ma</td>
<td>0.5V @ 1A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>262B12</td>
<td>6</td>
<td>240V @ 45ma</td>
<td>0.5V @ 1A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>262B24</td>
<td>7</td>
<td>120V @ 27ma</td>
<td>12.0V @ 0.3A</td>
<td>1</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>263B6</td>
<td>12</td>
<td>120V @ 120ma</td>
<td>0.5V @ 0.8A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>263B12</td>
<td>12</td>
<td>120V @ 120ma</td>
<td>0.5V @ 0.8A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>262E6</td>
<td>16</td>
<td>120V @ 15ma</td>
<td>12.0V @ 0.3A</td>
<td>1</td>
<td>2.01</td>
<td>1.09</td>
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<tr>
<td>262E12</td>
<td>18</td>
<td>120V @ 27ma</td>
<td>12.0V @ 0.6A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
<tr>
<td>262E24</td>
<td>24</td>
<td>120V @ 100ma</td>
<td>0.8V @ 1.6A</td>
<td>2</td>
<td>2.01</td>
<td>1.09</td>
</tr>
</tbody>
</table>

Figure 1

Figure 2

Figure 3

G = MTG. HOLE

B = REF.

C = A
NOTE: For EQ, eliminate the red section and add the blue section. For no EQ, eliminate the blue section and add the red section.
Mounting the Heil XT-1 Transformer

1. Cut a long (3/8" wide) strip of thin metal (Coke can)

2. Bend the metal strip to tightly fit the transformer frame and drill a mounting hole.

3. Put a few drops of epoxy on the transformer frame and slide the metal strip into place. Clamp until glue dries.

4. Screw to Pineboard, bolt to chassis, or attach to mic jack mounting screw.
<table>
<thead>
<tr>
<th>QTY</th>
<th>ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>12AX7 tube</td>
</tr>
<tr>
<td>[ ]</td>
<td>tube socket (9 pin miniature)</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 tube socket stand-off ½”</td>
</tr>
<tr>
<td>[ ]</td>
<td>3 solder-type (6 lug) terminal strip *</td>
</tr>
<tr>
<td>[ ]</td>
<td>barrier-type (4 lug) terminal strip</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 electrolytic capacitor 10mfd @ 450v</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 electrolytic capacitor 10mfd @ 25v</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 ceramic disc capacitor 0.0047 mfd</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 ceramic disc capacitor 0.001 mfd</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 ceramic disc capacitor 0.001 mfd **</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 ceramic disc capacitor 0.01 mfd</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 ceramic disc capacitor 0.047 mfd</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 ceramic disc capacitor 0.1 mfd **</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 choke, 2.5 mH ***</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 resistor 1k Ω</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 resistor 100k Ω</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 resistor 100k Ω **</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 resistor 1M Ω</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 variable resistor 50k Ω</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 variable resistor 50k Ω **</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 variable resistor 10k Ω **</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 knob for above</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 knobs for above **</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 ¼” phone jack</td>
</tr>
<tr>
<td>[ ]</td>
<td>2 ¼” phone plug</td>
</tr>
<tr>
<td>[ ]</td>
<td>1 switch, SPDT **</td>
</tr>
</tbody>
</table>

* trim length as necessary

** parts needed for the optional EQ circuit

*** choke is available from:

onlinecomponents.com, item: Bourns 6302

NOTE: a kit of parts is available from Antique Electronics (tubesandmore.com) as item P-BH-MP
1. Anode Triode Number 2
2. Grid Triode Number 2
3. Cathode Triode Number 2
4. Heater (Triode 2)
5. Heater (Triode 1)
6. Anode Triode Number 1
7. Grid Triode Number 1
8. Cathode Triode Number 1
9. Heater Center tap
The Pine Board Project

THE AM TRANSMITTER
Pine Board Project – AM Transmitter

coils: MFJ #404-0811-1 (1 ¾” diameter, 10 turns per inch 41 turns – tap at turn #14 from antenna for 40m)

NOTES:
XTAL: FT243 type crystal
80 meter = 3.885 MHz
40 meter = 7.290 MHz

Audio from Preamplifier

6V6

6AG7

22kΩ, 1W

2.5 mH

4.4 H, 50 mV

transmit

B+ (150 – 300 VDC)

6.3 VAC

tube filament wiring

Circuit Design: Bob Heil, K9EID – July 2017
Graphics: W4IQN
Pine Board Project - AM Transmitter Tube Wiring

6AG7 (bottom)

10 mfd, 450v +
22 kΩ, 1 watt

6V6 (bottom)

100 kΩ
100 Ω
47 mfd 50v

Circuit Design: Bob Heil, K9EID – July 2017
Graphics: W4IQN
## Pine Board Project - AM Transmitter

<table>
<thead>
<tr>
<th>QTY</th>
<th>ITEM</th>
<th>SUPPLIER/PART #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6V6 tube</td>
<td>(A) 6V6GT</td>
</tr>
<tr>
<td>1</td>
<td>6AG7 tube</td>
<td>(A) 6AG7</td>
</tr>
<tr>
<td>2</td>
<td>tube socket (8 pin octal)</td>
<td>(B) P-ST8 250MT</td>
</tr>
<tr>
<td>4</td>
<td>stand-off, ¾&quot; - 1&quot; long for above</td>
<td>(F) #58031</td>
</tr>
<tr>
<td>4</td>
<td>solder-type (6 lug) terminal strip *</td>
<td>(B) P-0702H</td>
</tr>
<tr>
<td>1</td>
<td>barrier-type (4 lug) terminal strip</td>
<td>(C) BB375-4</td>
</tr>
<tr>
<td>1</td>
<td>electrolytic capacitor 10mfd/ @ 450v</td>
<td>(B) C-ET10-450</td>
</tr>
<tr>
<td>1</td>
<td>electrolytic capacitor 47mfd @ 50v</td>
<td>(B) C-ET47-50</td>
</tr>
<tr>
<td>1</td>
<td>silver mica capacitor 500 pf</td>
<td>(B) C-SM500</td>
</tr>
<tr>
<td>1</td>
<td>silver mica-capacitor 100 pf</td>
<td>(B) C-SM100</td>
</tr>
<tr>
<td>1</td>
<td>ceramic disc capacitor 0.001 mfd</td>
<td>(B) C-D-2000.001</td>
</tr>
<tr>
<td>1</td>
<td>polypropylene capacitor 0.0047 mfd</td>
<td>(B) C-LD0047-630</td>
</tr>
<tr>
<td>1</td>
<td>variable capacitor 365 pf, single gang</td>
<td>(B) C-V365</td>
</tr>
<tr>
<td>1</td>
<td>knob for above</td>
<td>(B) P-K300</td>
</tr>
<tr>
<td>1</td>
<td>resistor 100 Ω</td>
<td>(B) R-1100</td>
</tr>
<tr>
<td>2</td>
<td>resistor 22 kΩ, 1 watt</td>
<td>(B) R-E22K</td>
</tr>
<tr>
<td>1</td>
<td>resistor 56 KΩ</td>
<td>(B) R-156K</td>
</tr>
<tr>
<td>1</td>
<td>resistor 100 KΩ</td>
<td>(B) R-1100K</td>
</tr>
<tr>
<td>1</td>
<td>RF choke 2.5 Mh</td>
<td>(G) Bourns #6302</td>
</tr>
<tr>
<td>1</td>
<td>DC filter choke 4 H, 50 ma</td>
<td>(B) P-CF 22707</td>
</tr>
<tr>
<td>1</td>
<td>coil: MFJ #404-0811-1</td>
<td>(D) 404-0811-1</td>
</tr>
<tr>
<td>1</td>
<td>crystal FT-243 type 3.885 MHz**</td>
<td>(E) 3885mHz</td>
</tr>
<tr>
<td>1</td>
<td>socket for crystal (above)</td>
<td>(E) FT243 plastic</td>
</tr>
<tr>
<td>1</td>
<td>antenna jack (SO-239)</td>
<td>(D) MFJ-7721</td>
</tr>
<tr>
<td>1</td>
<td>alligator clip</td>
<td>(D) MFJ-755-5002</td>
</tr>
<tr>
<td>1</td>
<td>switch, DPST</td>
<td></td>
</tr>
</tbody>
</table>

Parts Suppliers:
- (A) SND Tube Sales, www.vacuumtubes.com
- (B) Antique Electronics, www.tubesandmore.com ***
- (C) Radio Daze, www.radiodaze.com
- (D) MFJ, www.mfjenterprises.com
- (F) Ace Hardware
- (G) onlinecomponents.com

Pine Board: Hobby Lobby “wood pile”

* trim length as necessary
** For 40 meter operation, add a crystal 7.290 MHz
*** a kit of parts is available from Antique Electronics (www.tubesandmore.com), item: P-BH-PBAMT
6V6 DATA SHEET

6V6 GT
BEAM POWER TUBE

Pin Element
1 none-6V6GT
2 Heater (Filament)
3 Plate (Anode)
4 Screen Grid
5 Control Grid
6 none
7 Heater (Filament)
8 Cathode

DESCRIPTION AND RATING

The 6V6-GT is a beam-power pentode designed for use in the audio-frequency power output stage of television and radio receivers. In this application, it is capable of supplying high power output with high efficiency, high fidelity, and low third and higher-order harmonic distortion. The 6V6-GT may also be used as a triode-connected vertical-deflection amplifier in television receivers.

Except for heater ratings, the 5V6-GT is identical to the 6V6-GT. In addition, the 6V6-GT, as a result of its controlled heater warm-up characteristic, is especially suited for use in television receivers which employ series-connected heaters. When the 6V6-GT is used in conjunction with other 600-ma heaters which exhibit essentially the same heater warm-up characteristic, heater voltage surges across the individual tubes are minimized during the warm-up period.

ELECTRICAL
Cathode-Grid Unpoten.
Heater Voltage, AC or DC
Heater Current
Heater Warm-up Time
Direct Inter-electrode Capacitances

MECHANICAL
Mounting Position
Envelope
Base

MAXIMUM RATINGS

DC Plate Voltage
Peak Plate-Pulse Plate Voltage
Screen Supply Voltage
Screen Voltage
Peak Negative Grid-Number 1 Voltage
Plate Dissipation
Screen Dissipation
DC Cathode Current
Peak Cathode Current
Heater-Cathode Voltage
Heater Positive with respect to Cathode
DC Component
Total DC and Peak
Heater Negative with respect to Cathode
Total DC and Peak
Grid-Number 1 Circuit Resistance
With Fixed Bias
With Cathode Bias

GENERAL ELECTRIC

PHYSICAL DIMENSIONS
**6AG7 DATA SHEET**

**6AG7 PENTODE**

**DESCRIPTION AND RATING**

The 6AG7 is a metal, power-amplifier pentode primarily designed for use in the output stage of video amplifiers. The tube is capable of operating at high plate current levels and exhibits high transconductance and high power sensitivity.

**GENERAL**

**ELECTRICAL**
- **Cathode**—Coated Unipotential
- **Heater Voltage, AC or DC** 6.3 Volts
- **Heater Current** 0.65 Ampere
- **Direct Inter-electrode Capacitances**
  - Grid to Plate (g1 to p), maximum 0.06 μF
  - Grid to Plate (g2 to p), maximum 0.13 μF
  - Plate to Grid (g1 to p), maximum 7.5 μF
  - Grid-Number 1 to Grid-Number 2 (g1 to g2), approximate 3.8 μF
  - Grid-Number 1 to Cathode (g1 to k), approximate 5.2 μF
  - Heater to Cathode (h to k), approximate 10.7 μF

**MECHANICAL**
- **Mounting Position**—Any
- **Envelope**—MT-8, Metal Shell
- **Base**—86-21, Small Water Octal 8-Pin

**MAXIMUM RATINGS**

**DESIGN-CENTER VALUES**
- **Plate Voltage** 300 Volts
- **Screen Voltage** 300 Volts
- **Positive DC Grid-Number 1 Voltage** 0 Volts
- **Plate Dissipation** 90 Watts
- **Screen Dissipation** 1.3 Watts
- **Heater-Cathode Voltage**
  - **Heater Positive with Respect to Cathode** 90 Volts
  - **Heater Negative with Respect to Cathode** 90 Volts
- **Grid-Number 1 Circuit Resistance**
  - **With Fixed Bias** 0.25 Megohms
  - **With Cathode Bias** 1.0 Megohms

**TERMINAL CONNECTIONS**
- **Pin 1—Shell and Grid Number 3 (Suppressor)**
- **Pin 2—Heater**
- **Pin 3—No Connection**
- **Pin 4—Grid Number 1**
- **Pin 5—Cathode**
- **Pin 6—Grid Number 2 (Screen)**
- **Pin 7—Heater**
- **Pin 8—Plate**

**PHYSICAL DIMENSIONS**

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**BASING DIAGRAM**

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**GENERAL ELECTRIC**

**Specifications ET-72686 dated 8-66**
**PARTS LIST**

1 – switch DPST (Home Depot #540366)
1 – relay 120vac coil, 3PDT, Deltrol 1663PDT (eBay $10)
1 – socket for relay (available from relay supplier)
3 – SO239 coax socket
1 – 6.3 volt pilot lamp
1 – socket for lamp
1 – solder terminal strip
RG-8x coax

NOTE: parts listed in blue are optional
PARTS LIST

1 – switch DPST (Home Depot #540366)
1 – relay 120vac coil, 3PDT, Deltrol 1663PDT (eBay $10)
1 – socket for relay (available from relay supplier)
3 – SO239 coax socket
1 – 6.3 volt pilot lamp
1 – socket for lamp
1 – solder terminal strip
RG-8x coax

NOTE: parts listed in blue are optional

Circuit Design: Bob Heil, K9EID – 12 Dec 2017
Graphics: W4IQN
BAND-SWITCH LAYOUT

Circuit Design: Bob Heil, K9EID – Apr 2018
Graphics: W4IQN
VIDEO LINKS

Pine Board Project  https://www.youtube.com/watch?v=n7ppok22Xw0
Ham Nation FS Meter  https://youtu.be/Wg0fbYrJHfs
Ham Nation Pwr Supply 1  https://youtu.be/MwFoiHLeqaU
Ham Nation Pwr Supply 2  https://www.youtube.com/watch?v=PdqYMFotriY
Ham Nation Pwr Supply 3  https://www.youtube.com/watch?v=u7TquIsL6L4
Ham Nation Pwr Supply 4  https://www.youtube.com/watch?v=BjwjqUG43n4
Ham Nation Pwr Supply 5  https://www.youtube.com/watch?v=-vNL_rkZ7JU
Ham Nation Pwr Supply 6  https://www.youtube.com/watch?v=hvvalZ5F31A
Ham Nation In operation  https://www.youtube.com/watch?v=bXQWpvnCF7I
How Vacuum Tubes Work  https://www.youtube.com/watch?v=nA_tgIygvNo
The Vacuum Tube 1943  https://www.youtube.com/watch?v=SoMTPzYqqxA
US Army Signal Corp  https://www.youtube.com/watch?v=04sCi50B5CY
Antenna Switch  Antenna Switch Video (TWiT)
ANY QUESTIONS?

The Pine Board Project