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1.1 DESCRIPTION

The ARP Axxe is a completely variable synthesizer, ideal for live performance operation. The Axxe provides many of the features of more expensive synthesizers and can act as a nucleus of a larger synthesizer system by interfacing with other ARP instruments.

The Axxe contains one Voltage Controlled Oscillator, one Voltage Controlled Filter, one Voltage Controlled Amplifier, a Low Frequency Oscillator, Keyboard Control Voltage Memory/Sample and Hold, Noise Generator, and ADSR Envelope Generator.

1.2 SPECIFICATIONS (subject to change without notice)

VOLTAGE CONTROLLED OSCILLATOR
Frequency Range: 16Hz to 15kHz
Waveform: Sawtooth, Square, Pulse, dynamic pulse
Warm-up Drift: 1/30 Semitone half turn on "Tune" Control Range: 1/4 semitones
Max. Vibrato Depth: 1 octave
Max. Vibrato Depth: +1/2 octaves
Max. ADSR Frequency Shift: 4 octaves
Pulse Width: 5% to 50%
Pulse Width Modulation: LFO, 44% - ADSR, 44%

NOISE GENERATOR
Noise Spectrum Typo: pink, ±3 dB, 20Hz to 70kHz

VOLTAGE CONTROLLED FILTER
Frequency Range: 19Hz to 16kHz
Maximum usable Q: approx. 30
Resonance: 9 to self-oscillate
VC Request: approx. 1 Volt, as same as VCO
Max. ADSR Sweep: 10 octaves

VOLTAGE CONTROLLED AMPLIFIER
Dynamic range: 50dB

ADSR ENVELOPE GENERATOR
Attack Time: 5ms to 10 seconds
Decay Time: 12ms to 10 seconds
Sustain Time: 0 to 100s of peak release Time: 10ms to 10 seconds
LFO Waveform: sine, square
Frequency Range: 0.2Hz to 20Hz
Max. pitch deviation in VCO: 2.5 octaves
Max. frequency deviation in VCF: 2.5 octaves

1.3 SIGNAL FLOW

The Voltage Controlled Oscillator (VCO) produces continuous sawtooth and pulse wave outputs. The frequency of the VCO can be modulated by the ADSR, LFO sine wave and square wave, and Sample and Hold.

The output of the VCO and the Noise Generator are processed through the Voltage Controlled Filter (VCF) and Voltage Controlled Amplifier (VCA). The ADSR Envelope Generator control the VCF and VCA. The Keyboard Control Voltage Memory circuit doubles as a Sample and Hold.
### 2.6 ADSR

The ADSR envelope generator circuit provides a negative going DC voltage to control the VCF cutoff and the VCA.

**ATTACK:** When a key is depressed, the gate voltage (TP3) rises from -15 volts to 0 volts and the pulse drive on J1-1 drops to ±10 volts. Q7, C15, and Z5A prevent Z5B from charging faster than about 10 milliseconds. The delay pulse on Z5A pin 3 is used for the LFO reset pulse through C10. When the output of Z5B changes from high to low, -15 volts is applied through CR10 and R46 to the noninverting input of follower Z6. During the attack mode, Q10 is off, and R45 is disconnected from ground. Z6 directly follows the voltage on pin 3 and applies -15 volts through CR12, R50 to charge integrating capacitor C18 down.

**DECAY AND SUSTAIN:** Z7 is a buffer amplifier following the voltage on capacitor C18. The output of ADSR voltage approaches -13 volts, Q8 begins to turn off and R33 lowers the voltage on pin 13 of Z5D. Z5C and Z5D is a bistable latch. When pin 13 falls below the threshold of the nand gate (about -7.5 volts) the output of Z5E changes from high to low applying -15 volts from pin 10 of Z5 through CR8, R42, and CR8 thus holding Q8 off. Q10 now turns on and the voltage divider consisting of R45 and R46 establishes the Sustain Level. CR12 is now reversed biased and capacitor C18 discharges through R49 and CR11 to the level at Z5 pin 3.

**RELEASE:** When the gate voltage is removed, Q9 turns on which turns on Q11. The remaining voltage on capacitor C18 discharges through R55, R54 and Q11 to ground. The output of Z7 is applied to the input of follower Z6 through R53 thereby preventing the sustain and decay charge paths from affecting the release time. Z8E, Z8B and Z8C invert the output of the ADSR to control the VCO and VCF.

### 2.7 VCA

The VCA attenuates signals from the output of the VCF. The gain of the VCA is determined by the amount of current supplied to the differential pair Z8C, 8. The ADSR output is connected to the control input (pin 3, Z8B) via the VCA 'ADSR' slider R170. R171 manually controls the VCA gain. The control rejection trimmer (R180) minimizes the effect of control voltage changes on the output of the VCA by balancing the current through Z8A and Z8B. CR19, CR20 and R179 provide output protection to prevent external voltages from entering the AXME circuits through the output jack.

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### 2.8 VCO

Control voltages from the keyboard, initial frequency, and Fine Tune sliders, the sample and hold circuit, LFO square wave and sine wave, and the ADSR are summed on the base of Q12. Q12 and Q13 are a linear voltage to exponential current converter; for every volt applied to one of the control inputs of the VCO, Q13 will conduct twice as much current. C22 is the integrating capacitor; it is initially charged to fifteen volts and discharges through R96 and Q13 toward ground. Q13 determines the discharge time of the capacitor and therefore the oscillator frequency. Q15 buffers the voltage on C22 and supplies it to a comparator; Z98 and Z9A. Pin 2 of Z9A is fixed at about 7.5 volts. When the voltage on pin 4 of Z9B decreases to below 7.5 volts, Z9A turns on Q16 which supplies +15 volts to the gate of Q14. Q14 then charges capacitor C22 back to +15 volts to start the cycle over again.

R91, C21 and R92 supply current to Q13 as the frequency of the oscillator is increased to prevent the oscillator from going flat, due to the recovery time of the circuit. Q17 is an emitter follower which takes the sawtooth from pin 3 of Z9B and supplies it to the oscillator output. The sawtooth waveform on the emitter of Q17 is 7.5 volts peak to peak, and ±7.5 volts offset.

### 2.9 VCF

Audio signals from the VCO, noise generating, and the external audio input are summed on the base of Z12E. Z12E and Z12B are a differential amplifier. Four series RC circuits comprised of capacitors C26, 27, 28, and 29 and the emitter-base junction resistances of Z10C-D, Z10B-E, Z11C-D, and Z11B-E provide pole low-pass filtering. Varying the amount of current through the pairs of transistors changes the resistive value of the emitter-base junction, thereby changing the cutoff frequency of the filter. Control voltages from the filter frequency sliders, calibrate trimmer, CV pedal, keyboard CV, ADSR, LFO triangle are summed on the base of Q20. Q20 and Q19 are an exponential current converter; for each volt applied to the control input (Q20 base) the current through Q19 will double. Q19 controls the current through the filter ladder thus controlling the filter cutoff. R145, the control rejection trimmer, balances the current through both halves of the filter ladder which minimizes the effect of control voltages on the filter output.

Q18 and Z13A are a high impedance differential amplifier which brings signals from the filter ladder up to about one volt peak to peak. R144, the resonance slider, provides a manually adjustable amount of feedback from the output of the filter to the inverting input of the filter (Z12B, Base). When enough of the output signal is supplied via the resonance slider to the inverting input, the VCF will begin to oscillate, producing a sine wave.

**NOTE:** This filter is used in older models only. See the Service Revision section of this manual for the current type.
### BOARD TRIMS AND ADJUSTMENTS  
**SECTION 3**

<table>
<thead>
<tr>
<th>REF. NO.</th>
<th>TRIMMER</th>
<th>TRIM PROCEDURE</th>
</tr>
</thead>
</table>
| **R76** | VCO CALIBRATE | 1. Monitor TP-6 with a frequency counter.  
2. Pin low "C" on the keyboard.  
3. Put the Transpose and Pitch Bend controls in the 'normal' (mid) position.  
4. Set the 'Tune' control on the front panel in the mid position.  
5. Adjust trimmer R76 for a 130 Hz, sawtooth wave (± 2 Hz). |
| **R74** | VCO V/OCT | 1. Monitor TP-6 with a frequency counter or strobe tuner.  
2. Pin low "C" on the keyboard.  
3. Put the Transpose and Pitch Bend controls in the 'normal' (mid) position.  
4. Put the S/H switch in the down position and put all sliders in the minimum position.  
5. Adjust the 'Tune' control on the front panel to exactly 130Hz *or* 'C' on a strobe tuner.  
6. Pin high "C" on the keyboard.  
7. Adjust trimmer R74 for exactly 1040Hz, or 'C' three octaves higher than step 5 on the strobe tuner.  
8. Repeat steps 1 through 7 until the frequency is correct on low "C" and high "C".  
  
*IF MORE ACCURACY IS DESIRED, TUNE TO 130.8127826Hz* |
| **R62** | TRANSPOSE CAL | 1. Monitor TP-6 with a frequency counter or strobe tuner.  
2. Pin low "C" on the keyboard.  
3. Put the Transpose and Pitch Bend controls in the 'normal' (mid) position.  
4. Adjust the 'Tune' control on the front panel to exactly 130Hz.  
5. Put the Transpose control in the 'Up Two Octaves' position.  
6. Adjust trimmer R62 for exactly 520Hz, or 'C' two octaves higher than step 4. |
| **R70** | PITCH BEND CAL | 1. Monitor TP-6 with a frequency counter or strobe tuner.  
2. Pin low "C" on the keyboard.  
3. Put the Transpose and Pitch Bend controls in the 'normal' (mid) position.  
4. Adjust the 'Tune' control on the front panel to exactly 130Hz.  
5. Put the Pitch Bend control fully clockwise.  
6. Adjust trimmer R70 for exactly 290Hz, or 'C' one octave higher than step 4. |
| **R114** | VCO PULSE WIDTH | 1. Monitor TP-7 with an oscilloscope.  
2. Put all sliders in fully down position.  
3. Adjust the time base of the oscilloscope so that exactly one complete cycle is displayed.  
4. Adjust trimmer R114 for exactly 50% pulse width (square). |
| **R180** | VCA CONTROL REJECT | 1. Monitor the Audio Output of the Axxe with an oscilloscope.  
2. Put the LFO Frequency slider fully up.  
3. Put the VCA ADSR slider fully up.  
4. Put the KY9D Repeat switch in the Auto Repeat (down) position.  
5. Put all other sliders fully down.  
6. Adjust R180 for minimum signal amplitude. |

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### POWER SUPPLY TRIMS

<table>
<thead>
<tr>
<th>REF. NO.</th>
<th>TRIMMER</th>
<th>TRIM PROCEDURE</th>
</tr>
</thead>
</table>
| **R196** | CVF CVR 'RJ | 1. Monitor TP-6 with an oscilloscope.  
2. Put Filter and Resonance slider fully down.  
3. Put LFO slider % up.  
4. Put ADSR filter control slider up full and turn on Auto Repeat. (All other sliders down.)  
5. Adjust R196 for minimum amplitude. |
| **R165** | VCF V/OCT | 1. Monitor TP-6 with a frequency counter or strobe tuner.  
2. Put the VCF Resonance slider fully up.  
3. Pin low "C" on the keyboard.  
4. Raise the VCF keyboard CV slider.  
5. Put the S/H switch in the down position.  
6. Adjust the VCF Frequency slider on the front panel to exactly 130Hz, or 'C' on the strobe tuner.  
7. Pin high "C" on the keyboard.  
8. Adjust trimmer R165 for a frequency of 1040Hz, or 'C' three octaves higher than step 6.  
9. Repeat steps 1 through 8 until the frequency is correct on high "C" and low "C". |

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### SECTION 4 BOARD TEST POINTS

<table>
<thead>
<tr>
<th>TEST POINT</th>
<th>FUNCTION</th>
<th>SET UP</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
</table>
| TP-1       | NOISE GENERATOR OUTPUT |         | 2.5V  
            |          |         | -2.5V  
| TP-2       | LFO SQUARE WAVE | 1. Put LFO Frequency slider fully up. |  
            |          |         | 14.3V (Typical) | -14.0V  
|            |          |         | PERIOD = 50 msec. (Typical) |
### SECTION 5 INTERFACING INFORMATION

#### 5.1 MASTER/SLAVE TUNING INSTRUCTIONS

Select one Axxe as the master unit and put it to the left of the slave unit. Instructions in the left column refer to the master unit, while the right column refers to the slave. Ensure to follow the sequence of operations for both units.

**INSTRUCTIONS FOR 'MASTER' UNIT:**

1. Connect High or Low output to amplifier.
2. Connect a patch cord to the CV output jack and the CV input of the slave unit.
3. Pin low ‘C’ on the keyboard.
4. Raise the VCO Square Wave slider.
5. Put the VCF FREQ slider up fully.
6. Raise the VCA GAIN to a comfortable level.
7. Put the TRANSPOSE and PITCH BEND controls in the normal (mid) position.
8. Put the S/H switch and all other sliders in the off or normal position.
9. Using the 'TUNE' control on the front panel, tune the master unit to unison with the slave unit.
11. Pin low ‘C’ and check that the two units are still tuned to unison (repeat steps 10 through 12 if not in tune).
12. Remove patch cord from CV output.
13. Pin high ‘C’ on the keyboard.
14. Repeat steps 15 through 18 until master and slave units are in tune on low ‘C’ and high ‘C’.
15. Check section 3 (Board Trims) to verify calibration of pitch bend and transpose switch.

**INSTRUCTIONS FOR 'SLAVE' UNIT:**

1. Connect High output to EXT AUD input of master unit.
2. Raise the VCO Square Wave slider.
3. Put the VCF FREQ slider up fully.
4. Raise the VCA GAIN fully.
5. Put the TRANSPOSE and PITCH BEND controls in the normal (mid) position.
6. Put the S/H switch and all other sliders in the off or normal position.
7. Using VCO V/OCT trimmer (R74), tune the slave unit to unison with the master unit.
8. Remove patch cord from CV input.
10. Adjust the 'TUNE' control on the front panel so that slave and master are tuned to unison.
12. Adjust trimmer R5 (+15 V, power supply) until the master and slave are tuned to unison.

#### 5.2 SYSTEMS INTERFACING WITH OTHER ARP SYNTHESIZERS

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<tr>
<th>Axxe</th>
<th>SE-4</th>
<th>2600</th>
<th>2800</th>
<th>2950</th>
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<tbody>
<tr>
<td>Gate Output</td>
<td>—</td>
<td>Gate Jack</td>
<td>Gate Input</td>
<td>Gate Input</td>
</tr>
<tr>
<td>Trigger Output</td>
<td>—</td>
<td>Trigger Jack</td>
<td>Trigger Input</td>
<td>Trigger Input</td>
</tr>
<tr>
<td>CV Output</td>
<td>—</td>
<td>CV Output (disconnect K760)</td>
<td>CV Input (newer models only)</td>
<td>CV Input</td>
</tr>
<tr>
<td>EXT AUD Input</td>
<td>Output 1</td>
<td>L or R Output</td>
<td>High Output</td>
<td>High Output</td>
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</table>

**WHEN THE AXXE IS TO BE USED AS A SLAVE (CONTROLLED) UNIT, CONNECT: TO:**

<table>
<thead>
<tr>
<th>Axxe</th>
<th>SE-4</th>
<th>2600</th>
<th>2800</th>
<th>2950</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Input</td>
<td>Gate Output</td>
<td>Gate Jack</td>
<td>Gate Output</td>
<td>—</td>
</tr>
<tr>
<td>Trigger Input</td>
<td>Trigger Output</td>
<td>Trigger Jack</td>
<td>Trigger Output</td>
<td>—</td>
</tr>
<tr>
<td>CV Input</td>
<td>—</td>
<td>CV Output</td>
<td>CV Output</td>
<td>—</td>
</tr>
</tbody>
</table>
7.1 POWER SUPPLY CIRCUIT DESCRIPTIONS

7.1.1 VOLTAGE SOURCE

CRI4 is a full wave bridge rectifier supplying about plus and minus 28.5 volts to the regulating circuitry. CI and CS filter out ripple on the supply lines.

7.1.2 +15 VOLT SUPPLY

Z1 contains a voltage reference which supplies about 7.4 volts to pin 6 of Z1. This fixed voltage is connected through pins 5 to the non-inverting input of an op amp. The output of the op amp is connected to an emitter follower, also located inside Z1, which controls the current amplifier. The power supply normally delivers +15 volts to the output; if the voltage should change, the voltage at the junction of R3 and R6 will also change. This point is connected to the inverting input of the op amp through pin 4 of Z1. If the voltage at this point should drop, the output of the op amp will rise, turning on the emitter follower and the current amplifier, thus increasing the output voltage. Similarly, if the voltage at the resistor junction should increase, the voltage on the output of the op amp will decrease which limits the current through the current amplifier and lowers the output voltage. R5 and the +15 volt trimmer sets the voltage level on the inverting input of the op amp and thus sets the output voltage of the supply.

7.1.3 +15 VOLT CURRENT LIMITING

When enough current flows out of the positive power supply to cause a 7.5 volt drop across R2, the transistor connected to pins 2 and 3 of Z1 turns on, effectively shorting the base of the emitter follower to the output voltage of the +15 supply. Q1 in turn supplies less current to the output.

7.1.4 -15 VOLT SUPPLY

The -15 volt supply derives its regulation from the +15 volt supply through RB. When the output of the -15 volt supply is at the correct voltage, the junction of R8 and R12 is zero volts. The base of Q2 is referenced to zero volts through RB. Should the output of the supply increase, the voltage on the base of Q3 will also increase which begins to turn off Q3. Q2 conducts more current thus turning Q4 on harder. Q4 drives the current amplifier Q5 which will then conduct more current thereby lowering the output to -15 volts.

7.1.5 -15 VOLT CURRENT LIMITING

When enough current is drawn from the -15 volt supply to cause a 7 volt drop across RB, Q6 turns on which applies 28 volts to the base of Q4 thus shutting Q4 and Q5 off.

![NAND Gate Diagram](Image)

2N3904 2N3906

1 = >7.5V
0 = <7.5V

![IC Diagram](Image)

LM301AN LM145B

TOP VIEW

CD4011AE CA3086
SECTION 8 AXXE PARTS LIST

2300 PARTS LIST

ORDER PARTS BY ARP PART NUMBER

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>ARP PART NUMBER</th>
<th>ARP/MFG NUMBER</th>
<th>DESCRIPTION</th>
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<td>C9, Q9, Q2, Q7, Q10, Q11, Q12, Q13</td>
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<td>0414</td>
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<td>Q17, Q18, Q19, Q20, Q21, Q22, Q23</td>
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<td>2N3906</td>
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<td>Q30, Q31, Q32, Q33, Q34, Q35, Q36</td>
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<td>2300029</td>
<td>Transistor, NPN, PNP</td>
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<td>A8080-012</td>
<td>Transistor, Noise, Sel. 2N5172</td>
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<td>2N5910</td>
<td>Transistor, Silicon, PNP</td>
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<td>A2605-003-1</td>
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<td>1N6926</td>
<td>FET, P Channel</td>
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<td>IMP866</td>
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<td>Q79, Q80, Q81, Q82, Q83, Q84, Q85</td>
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<td>A2603-008/SL1998</td>
<td>OP AMP(LM358)Sel.</td>
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<td>R1, R2, R3, R4, R5, R6, R7, R8</td>
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<td>A2603-009/SL19985</td>
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<tr>
<td>Z1, Z2, Z3, Z4, Z5</td>
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<td>CA3006</td>
<td>Quad/0 Input NAND GATE(CD4011AE)</td>
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<td>R29, R30, R31, R32, R33, R34, R35</td>
<td>1000105</td>
<td>SA-21</td>
<td>THERMISTOR, 1.87K 3%</td>
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<td>R36, R37, R38, R39, R40, R41, R42</td>
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<td>B2601-010-2</td>
<td>Rotary Pot, 10K Lin.</td>
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<td>B2601-010-3</td>
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<td>B2601-000-3</td>
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<td>R78, R79, R80, R81, R82, R83, R84</td>
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<td>R85, R86, R87, R88, R89, R90, R91</td>
<td>1900081</td>
<td>02-481-0001</td>
<td>Side Pot, 1000 Lin.</td>
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2300 POWER SUPPLY PARTS LIST

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<thead>
<tr>
<th>REFERENCE</th>
<th>ARP PART NUMBER</th>
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<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>Q1, Q2, Q3, Q4, Q5</td>
<td>1300306</td>
<td>2N6170 to D4204</td>
<td>NP W Power Transistor</td>
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<td>Q6, Q7, Q8, Q9, Q10</td>
<td>1302002</td>
<td>2N3904</td>
<td>Silicon Transistor, NPN</td>
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<tr>
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<td>2N3906</td>
<td>Silicon Transistor, PNP</td>
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<td>Q15, Q16, Q17, Q18</td>
<td>1200401</td>
<td>2N5458</td>
<td>+15 Regulator I.C.</td>
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<td>IN4448</td>
<td>Rectifier Diode, 75V, 200MA.</td>
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<tr>
<td>T1, T2, T3, T4</td>
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<td>TAG-2010/35-50/20</td>
<td>10µf, Tant. 35V Capacitor</td>
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<tr>
<td>R1, R2, R3, R4, R5</td>
<td>1400202</td>
<td>B41020-250/50</td>
<td>2µf, Elect. 50V Capacitor</td>
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<tr>
<td>C6, C7, C8, C9, C10</td>
<td>5701203</td>
<td>C2040-008</td>
<td>Power Transformer</td>
</tr>
<tr>
<td>T5, T6, T7, T8</td>
<td>1700402</td>
<td>MDV-1/8</td>
<td>Slo-Blow Fuse, 1/8 AMP</td>
</tr>
</tbody>
</table>