PEAK READING ADAPTER FOR COLLINS 312B-X (any) WATTMETER

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A peak reading option on wattmeters seems a long time in coming, since SSB has been around for several decades. I guess, since the licensing rules were based on average power, no one cared about peak power readings. Now that we can't operate in comfort without peak readings, we find that some manufacturers are claiming peak reading meters and delivering, instead, SLOW average reading meters. Some even deliver two speeds, SLOW and SLOWER - switchable. They have people going heLOO00000ORADDio. In any case, this is why my friend in Bolingbrook, Illinois wanted a real peak reading circuit put into his tuner's wattmeter. Since he trades tuners like some people change bands, I had to build a couple and the word got out, "Hey wow...how about building one for the old B-4?". Well here goes......

A peak reading circuit should go to the peak power level quickly, and hold. The decay of the reading determined by an adjustable time constant. A switch or diode is required in the charging circuit to a storage capacitor. Using a very high impedance voltage follower circuit (opamp) to read the capacitor voltage, we can then put the resistor of our choice across the capacitor to determine the decay time. This is like an AGC circuit with a fast attack and slow (adjustable) decay time.

Most wattmeters, including the B-4 or B-5, consist of a directional power detector circuit which develops a current thru a resistor in series with a meter (or a couple of resistors, switchable, in series with a meter, for selecting more than one scale). In our modification we cut the meter loose, and substitute for it, a resistor exactly equal to the meter resistance. The load on the detector circuit, and the calibration of the meter, remain unchanged. The peak circuit, including this resistor, is installed between the range resistors and the meter, and may be switched in and out as desired.

The voltage (on the order of 0.2 volts) across the new resistor is then amplified in order to take full advantage of the dynamic range of the opamps. The nonlinearity of the diode drop is eliminated by putting the diode inside the feedback loop of the amplifier. The time constant of the decay of the peak reading is affected only by the resistance we connect across the capacitor if we connect the feedback (gain determining) resistor of the circuit around both opamps instead of just around the first opamp. A resistor in series with the meter limits the current to the original value. Calibration and design rules are noted in the accompanying schematics.

This design can be used with any metering circuit, with modification of parts values depending upon the meter resistance and full scale current thru the meter.
PDC-1 ASSEMBLY DETAILS

1. Use a 25-40 watt soldering pencil with a small tip.
2. Be sure to solder BOTH sides of the circuit board at points:
3. Install and solder OP-AMP "U1" first.
4. Install diodes and resistors next.
5. Install potentiometers next.
6. Install disc ceramic capacitors next and electrolytics last.
7. Connect 6.3 vac or 6-12vdc to the proper location (Fig. 1).
8. Connect output and input to the DPDT switch used to switch the PDC-1 in and out of the metering circuit.

NOTE: Be sure to observe proper polarity with the diodes, electrolytics and the 358 OP-AMP!
PARTS LIST

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R0</td>
<td>1Ω</td>
</tr>
<tr>
<td>R1</td>
<td>680Ω</td>
</tr>
<tr>
<td>R2</td>
<td>500Ω</td>
</tr>
<tr>
<td>R3</td>
<td>20KΩ</td>
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<tr>
<td>R4</td>
<td>1MΩ</td>
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<tr>
<td>R5</td>
<td>20KΩ</td>
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<tr>
<td>R6</td>
<td>10KΩ</td>
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<tr>
<td>R7</td>
<td>560KΩ</td>
</tr>
<tr>
<td>R8</td>
<td>30KΩ</td>
</tr>
<tr>
<td>C1</td>
<td>100μF to 470μF (approx.)</td>
</tr>
<tr>
<td>C2</td>
<td>0.01μF</td>
</tr>
<tr>
<td>C3</td>
<td>0.01μF</td>
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<tr>
<td>C4</td>
<td>10μF</td>
</tr>
<tr>
<td>C5</td>
<td>0.01μF</td>
</tr>
<tr>
<td>D1</td>
<td>1N4004 (or equivalent)</td>
</tr>
<tr>
<td>D2</td>
<td>1N914</td>
</tr>
<tr>
<td>U1</td>
<td>LM358</td>
</tr>
</tbody>
</table>

Printed Circuit Board

THE PEAK CIRCUIT:

NOTES:
1. Capacitors rated to 20 volts or more.
2. Resistors all 1/4 watt (R0 is a fuse and must be 1/4 watt).
3. U1 is an LM358 dual opamp, an LM324 quad opamp can be substituted.

DESIGN CONSIDERATIONS:
1. The value of R1 and R2 is adjusted to equal the resistance of the meter, which in the 3123-4 is about 1000 ohms. However, this can also be varied somewhat in order to calibrate the circuit. Adjust R2 while switching the peak circuit in and out to make the peak reading equal to the average reading with CW power on the meter.
2. The ratio R7/R3 is adjusted to amplify the voltage appearing at the input to a value equal to the voltage at pin 6 minus about 2 volts in order to utilize the full dynamic range of the opamp. The full scale voltage at the output of U1b is then equal to UVIN + (R7/R3). In the 3123-4, the input voltage is 200 volts ± 1000 volts equals 0.2 volts. The power supply voltage is 19.14 times 6.3 vac = 120.7 volts. Then, 8.9 volts equals 6.9 volts full scale. Using a 6 volt battery divided by 0.2 equals a required gain of 30, the gain being (1+R3/R2). Setting R3 equal to 20K, we calculate R7 = (30 - 1) times 20K. So R7 = 580K (not a standard value—use 560K).
3. The resistor R8 is selected to limit the current to the meter to the original full scale value of 200 volts. 6 volts divided by 200 volts equals 30K ohms. This resistor is compensated for by the adjustment of R2.
4. The decay time of the reading is set by R4 + R5. A maximum time constant of 10 seconds would be 10μF times 10K. Using a 10μF pot and 20K then gives a 51 to 1 range of adjustment. That is, 10.8 seconds to 0.82 seconds.
5. Problems in calibrating, particularly agreement between the 200 and 2000 watt scales, are usually due to RF getting into the peak circuit, and can be solved by moving ground connections.

CIRCUIT PLACEMENT IN THE 3123-4:

- PEAK DETECTOR CIRCUIT
- DPDT Switch
- METER
- FORWARD 200
- FORWARD 2000
- REFLECTED 200
- REFLECTED 2000
- FORWARD 2000
- Directional Coupler 2
- G3
- OUT here, to insert DPDT switch.
NOTES FOR USING THE PDC-1 IN THE BIRD 43 WATTMETER

The first option with the Bird 43 is how you can wire the PDC-1 into the wattmeter. In the diagram with the schematic, the DPDT switch is shown switching the input AND the output of the PDC-1 in and out of the metering circuit. This allows the option of switching from average to peak readings on the wattmeter. This is fine in the case of a wattmeter being used in the shack connected to a power supply. However, in the case of portable meters, like the Bird 43, the 9v battery is connected all the time; whether the PDC-1 is in use or not. In order to extend battery life, here is a suggestion; Use half of the DPDT switch to change the input connections for the selection of peak or average readings. Use the other half of the switch to turn the battery power on and off with the peak circuit. The output of the PDC-1 can be left connected to the plus side of the meter movement along with the average reading connection with no side effects. The 30K to 51K ohms at R8 is high enough in value to isolated the PDC-1 from the average readings.

The second option is to take care of a slight amount of offset voltage on the PDC-1 which causes the meter zero to shift up with the circuit in line as opposed to when the meter is showing average readings. This zero shift is about one needle’s width in size and is still within the 5% tolerance for accuracy that Bird specifies. If you would like to adjust the offset out and zero the needle closer, here is what you need: 1-50K ohm trim pot and 2-1Meg ohm 1/4 watt resistors. Connect one side of the pot to ground, and the other side of the pot in series with one of the 1Meg resistors to +9v. Connect the wiper of the trim pot in series with the second 1 Meg resistor to pin 2 of U1. This terminal is one of the three that has to be soldered on the top side of the circuit board. It is the terminal that is connected to the trace that goes up at a 45 degree angle to the top of R7. All ground points should be taken to the negative terminal of the meter. Adjust the pot to bring the needle down just until the needle reaches the zero point, no further. The parts required for this modification can be ordered through HI-RES Communications for $1.00.

The third option is to optimize the PDC-1 specifically for the Bird 43. All that is required to accomplish this is changing the value of three resistors. R1 = 1.2K, R7 = 1 Meg, and R8 = 51K. All other values remain unchanged. The reason is to get more use of the operating range of the opamps. The opamps will operate linearly from near zero to within approx. 3 volts of the power supply. Using the approx. 1411 ohms input resistance (1.2K plus some of the 500 ohm variable which mimics the internal resistance of the original meter movement), and the original gain of the circuit (approx. 30) results in a max signal range of 1.27 volts. With a 9 volt power supply, there is unused "head room" of almost 5 volts. 20K and 1M gives us a gain of 50 which uses more of the head room (at least 2+ volts out of the 6 available). There are probably no noticeable benefits of this change in an analog meter circuit such as this, but it is closer to optimum. Of course the output resistor has to be changed to 50K (51K) instead of 30K to re-establish the original full scale current into the meter. One could go all the way to a gain of 140 or so before running out of head room, but there is need to leave some safety space for a drooping battery. A gain of 140 would be say 20K and 2.8M (2.7M). Then you would need about 140K (130K) at the output.