

Polar Relay for Legacy Teletype Applications
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Now that [my teletype set is back in operation](#), I am exploring what parts do I have that might be useful for a "Terminal Unit" to receive and demodulate the classic two-tone audio frequency shift keyed (AFSK) teletype signal.

Some time in pre-history I acquired this polar relay unit at a swap meet for probably a quarter;



Stevens-Arnold #PR-384 Polar Relay Unit

It sat in a junk box in the garage for at least the last 25 years. I retrieved it one day last year when I spotted it while looking for something else. Today I tested it to estimate the operational conditions for using it, and to reverse-engineer the pinout. This report documents the tests I performed and provides a schematic representation of the unit.

1. Coil Pinouts and Resistance Measurements

		<u>Spec.</u>	<u>Measured</u>
Coil 1	Pins 5-6	1400 Ohms	1355 Ohms
Coil 2	Pins 7-8	1400 Ohms	1348 Ohms

2. Estimate of Coil Currents

I figured that the internal power dissipation is a constraint on the coil current. My teletype set uses 10 milliamps for selector magnet bias current if the line current is set to 20 milliamps. I will assume these same values for the polar relay coils.

$$\text{Coil @ 10mA; } .01 \times .01 \text{ amps}^2 \times 1400 \text{ ohms} = 0.14 \text{ watts}$$

$$\text{Coil @ 20mA; } .02 \times .02 \text{ amps}^2 \times 1400 \text{ ohms} = 0.56 \text{ watts}$$

$$\text{Total internal power dissipation} = 0.70 \text{ watts}$$

Seems like a very reasonable value.

3. Determination of Switch Contacts' Pinout

I used an 11.5 volt DC source to operate one coil at a time (coil current = $1000 \times 11.5/1355 = 8.5 \text{ mA}$), with the following results;

Coil 1 pin 5 +12VDC pin 1 to pin 2 measures zero ohms
 pin 6 RTN

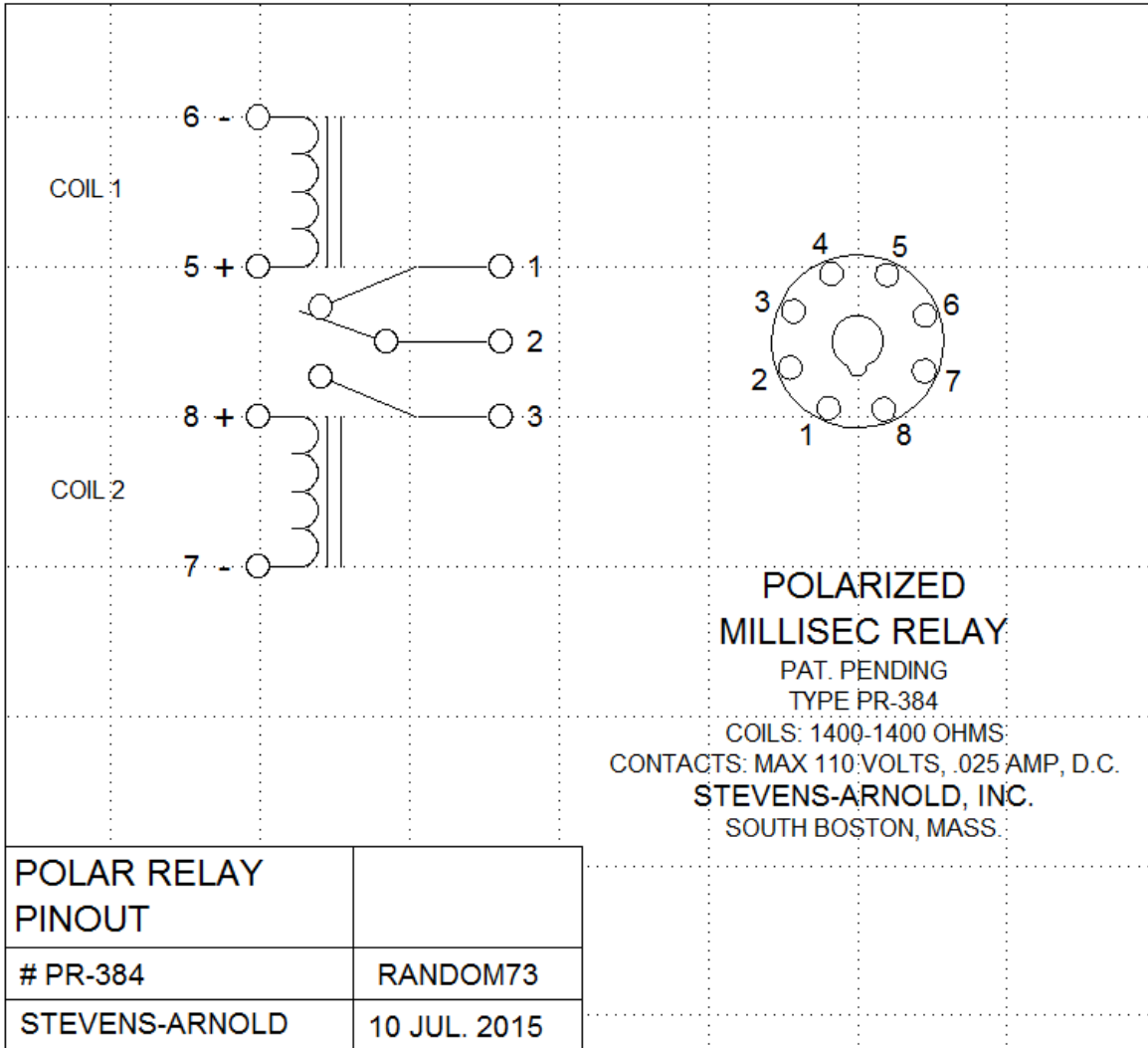
Coil 1 pin 6 +12VDC pin 2 to pin 3 measures zero ohms
 pin 5 RTN

Coil 2 pin 7 +12VDC pin 1 to pin 2 measures zero ohms
 pin 8 RTN

Coil 2 pin 8 +12VDC pin 2 to pin 3 measures zero ohms
 pin 7 RTN

4. Drawing

The relay seems to be working fine. Now I can draw the schematic representation;



5. Application Example:

Coil 1 as Line coil @ 20 mA positive current into pin 5
 Coil 2 as Bias coil @ 10 mA positive current into pin 8

Line mark condition will overcome the bias current, to open contacts 2 and 3, and close contacts 1 and 2.

Line space condition will allow the bias current to open contacts 1 and 2, and close contacts 2 and 3.

I recently measured 109 volts DC, + or - 0.2 volts, for the open circuit voltage of my teletype set's Line 1 current loop. The polar relay contacts are rated 110 volts DC maximum, so it should be OK (barely) to use this relay to key the 60mA current loop from my teletype set.

6. Example Current Sources for Polar Relay Coils

The 11.5 volts DC source was only for relay continuity testing purposes. In actual use the current source for the relay coils should consist of a supply voltage of 100 to 200 volts DC in series with suitable resistances that establish the 10mA and 20mA current flows.

Example 10mA Bias circuit;

With 135 volts DC, the total bias circuit resistance should be 13,500 ohms. Since the coil resistance is 1400 ohms (approximately), the remaining bias circuit resistance should consist of $13,500 - 1,400 = 12,100$ ohms, dissipating $.01^2 \times 12,100 = 1.21$ watts. A 10kohm, 2 watt resistor in series with a 5kohm, $\frac{1}{2}$ watt potentiometer can provide this resistance exactly.

Example 20mA Line circuit;

With 135 volts DC (and no voltage drop across the keyer of this circuit), the total line circuit resistance should be 6,750 ohms. Since the coil resistance is 1400 ohms (approximately), the remaining line circuit resistance should consist of $6,750 - 1,400 = 5,350$ ohms, dissipating $.02^2 \times 5,350 = 2.14$ watts. A 4.7kohm, 5 watt resistor in series with a 1kohm, $\frac{1}{2}$ watt potentiometer can provide this resistance exactly.

If a vacuum tube is used as the keyer of the line circuit, then the voltage drop across the tube at 20mA plate current must be accounted for, as well as the 1400kohms coil resistance, in determining the remaining required circuit resistance.