

Reducing Line Voltages for PT Boards

NOTE: The information in this application note pertains to both the SmartTAP PT and the Passport PT boards.

Purpose

The PT1609 measures the voltage difference across tip and ring to determine the line state (on-hook or off-hook) of a POTS line. In the on-hook state, a typical station battery value is 48 Volts (CO side) or 24 Volts (PBX side). When the phone is taken off-hook, the value usually drops to a range of 7 to 13 Volts.

The SmartTAP PT is designed to respond to a range of 3 to 16 Volts as an off-hook event. In some scenarios, when a phone is taken off-hook the measured voltage remains at a higher level and does not fall within this defined range. As a result, the board will not respond with an off-hook event. This can be due to a short distance (short copper pair run) to the CO, a reduced impedance (protective circuitry) in the battery supply, or may be related to the Terminal Equipment.

This application note describes how to use tap resistors to reduce line voltages on the tapped line. When a phone is taken off-hook the voltage value will drop within the specified range of the PT board. Tap resistors can be spliced into the loop just prior to the PT tap. These tap resistors use the loop current drawn by the phone to drop the voltage even further to fall within the range detected by the PT.

Application

Step 1

Objective: Determine Off-hook Voltage, V_0 of Terminal Equipment (TE or phone)

Equipment: Voltmeter

Take the phone off-hook and measure the voltage across tip and ring of the TE, preferably at the location where the tap for the signal for the PT will be made.

Off-hook Voltage $V_0 =$ _____

NOTE: Depending on your particular location, the V_0 measurement may vary significantly between different channels. Therefore it is important to measure all or a large enough sample of the lines to be tapped.

Step 2

Objective: Determine Off-hook Loop Current, I_{Loop} , drawn by TE

Equipment: Ammeter, OR 10 Ohm Resistor and Voltmeter

If using an Ammeter:

Insert the ammeter in line with the TE (either tip or ring). Record the measured amperage when the TE is off-hook. (In general the value will be non-zero when the TE is off-hook and very near zero otherwise.)

Off-hook Current $I_{Loop} =$ _____

If using the 10-Ohm resistor:

Place the 10-Ohm resistor in line with the TE (either tip or ring). Record the voltage measured across the 10-Ohm resistor when the TE is off-hook. (In general the voltage will be non-zero when the TE is off-hook and very near zero otherwise).

Off-hook Voltage across 10 Ohm resistor $V_{10\Omega-Loop} =$ _____

Compute the off-hook current by dividing the measured voltage by 10:

$$\text{Off-hook Current } I_{Loop} = \frac{V_{10\Omega-Loop}}{10}$$

NOTE: Depending on your location, I_{Loop} may vary from line to line.

Step 3

Objective: Determine Tap Resistor Value, R_{Tap} , Needed to Drop Voltage

Equipment: Calculator

It is desired that the off-hook voltage on the TE side of the tap resistors, V_0 , fall within the range of 7 to 13 Volts for ideal PT detection of line state. Using the value of the loop current and the required tap resistor voltage drop, the value of the tap resistor can be determined as follows.

NOTE: A good value for V_1 is 11 volts.

$$R_{Tap} = \frac{V_0 - V_1}{2 \cdot I_{Loop}} = \text{_____}$$

Step 4

Objective: Determine Power Rating of Tap Resistors

Equipment: Calculator

Resistors are sensitive to the amount of power that they dissipate. The most common resistors can safely dissipate ¼ Watt. (The power, in Watts, is the product of the resistance value and the square of the current through the resistor). To determine what rating is necessary, calculate the power dissipated in the off-hook state, $W_{Off-Hook}$.

$$W_{Off-Hook} = R_{Tap} \cdot (I_{Loop})^2$$

The power rating of the tap resistors must be greater than $W_{Off-Hook}$, by a factor of 2. For instance, if your watt rating comes out as ¼, then use ½ watt resistors. Resistors usually come in ¼, ½, and 1 Watt ratings and above.

Example:

Assume line values have been measured as such:

$$V_0 = 18V$$

$$I_{Loop} = 35mA$$

To drop the line off hook voltage from 18V to 11V:

$$R_{Tap} = \frac{18 - 11}{2(35mA)} = 100 \Omega$$

$$W_{Off-Hook} = (35mA)^2 100 \Omega = 0.1225W$$

Derrating by 2:1 gives the value of 0.2450W. In this case it is safe to use 1/4 Watt resistors.

Step 5

Objective: Install Tap Resistors and Verify Suitable Voltage Drop

Equipment: Voltmeter

Figure A below, shows the placement of the tap resistors. Note that the tap for the PT is on the TE (phone) side of the tap resistors to take advantage of the voltage drop across the tap resistors.

Once the tap resistors are installed and the line is operational, measure the voltage across the TE (same as across the PT tap) and verify that it falls well within the range of 7 to 13 Volts when the phone is off-hook.

NOTE: Be advised that different lines could have different off-hook voltages because of line conditions (i.e. line length to individual phones) and values may have to be calculated to ensure proper voltage drop.

Figure A: Wiring Diagram

