

Technical Tips.

Hybrid Transformers

The older telecommunication circuits used for remote control of radio base stations were 2 wire circuits, and probably DC circuits (no inline amplification).

In recent times, say the last ten years, private wire circuits tend to be presented to the user as a 4 wire circuit. If you are about to order a circuit for control of a remote base station, then do yourself a favour and make sure it is presented as a 4 wire line.

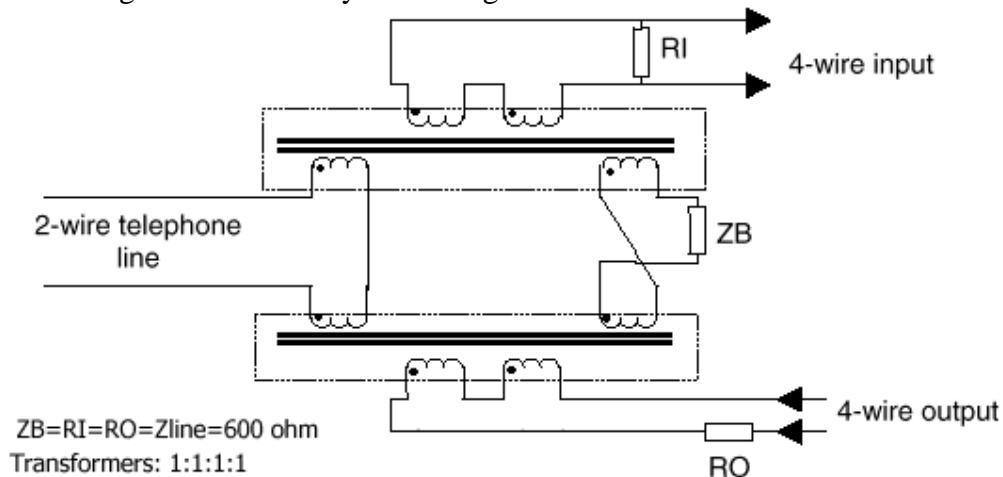
However, if you already have a 2 wire line and need to attach one of our controllers, or controller base station combinations, then you will need to convert from 4 wire to 2 wire at the control end and back to 4 wire at the base station.

If the base station is line equipped, then it probably has a hybrid built in to cope with 2 to 4 wire conversion.

When we speak of 4 wire working we mean 2 wires are used for incoming audio, and 2 wires are used for outgoing audio. Where signalling or tone detection is involved in the system, it is important that coupling between the different pairs (Cross talk) is kept to a minimum, and should be at least -25db relative to tone detection thresholds.

The hybrid itself is a simple device constructed from two transformers interconnected in such a way as to cause a 180° phase shift between the 4 wire source pairs. In other words, the audio you send up the line is not coupled to nor reflected back along the adjacent pairs. If this were to become the case, then all sorts of system problems would become apparent. When the hybrid is "matched" to the impedance of the line, the reflective nature of the coupling is at a minimum.

Here is a diagram of a basic hybrid configuration



In the above diagram R_0 and R_1 represent the telephone line impedance, and Z_B should be of a value which matches the telephone line impedance. In reality, Z_B will be variable because the impedance of each telephone line will differ slightly.

It should however be noted that the **unit will not adjust to balance** if any part of the hybrid is left un-terminated.

Factory setting and testing.

At the factory the unit is tested and despatched have been set using 600Ω pure resistance.

In this test, the 2 wire port is terminated in 600Ω and the 4 wire side are connected to an audio source (600Ω), and an ac milli-voltmeter (600Ω), thus all the ports are correctly terminated.

The audio oscillator is set for a known output level say -10dBm , and the level which appears on the milli-voltmeter is adjusted to a maximum null (minimum reading) by adjusting the variable resistor ZB. When this is the case the hybrid is in balance.

At this point the milli-voltmeter is moved to the 2 wire port and the resistor is moved to where the milli-voltmeter was connected. The level of the audio now showing on the milli-voltmeter is that which is input from the oscillator minus the hybrid loss. The loss should not exceed -2dB .

In the field setting.

As previously stated, telephone lines in the real world have differing impedance and losses. To compensate for differing impedance, the hybrid must be brought into impedance balance by adjusting the resistor ZB, remembering that balance will not be achieved if one or more ports of the hybrid are left un-terminated.

Connect up your hybrid transformer, half of the 4 wire line to the controller RX input, 600Ω the other half to the controller TX 600Ω . Terminate the two wire side into the incoming telephone line. Modulate the receiver with an appropriate signal from a signal generator such that an output of -10dBm is seen on the RX side of the 4 wire circuit. Place an oscilloscope or high impedance milli-voltmeter on the TX side of the 4 wire circuit and adjust the variable resistor ZB for minimum reading, (maximum null). The hybrid is now balanced for the telephone line in use.

If the remote end of the line also requires the installation of a hybrid unit, then the same procedure should be followed.

If the base station is configurable 2 or 4 wire working, then it already has a hybrid unit built in and you should follow the radio manufacturer's instructions for balancing the hybrid.

Joe Bell AWCSL Ltd.