

2.4GHz Directional Coupler

Arthur Sale, January 2003

Function

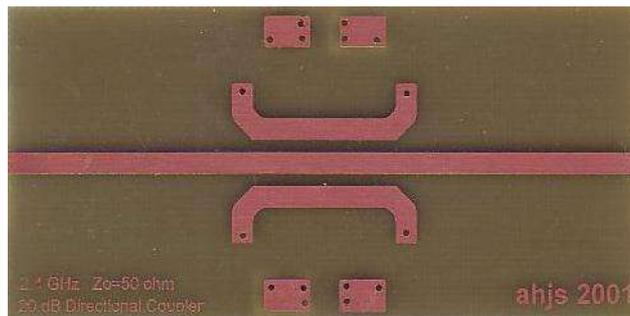
This directional coupler provides capability of measuring the ratio of the forward to reflected power for a 2.4GHz (ISM band) transmission line. This enables correct matching of antennas to be checked. With calibration the forward and reflected power may be deduced.

Construction

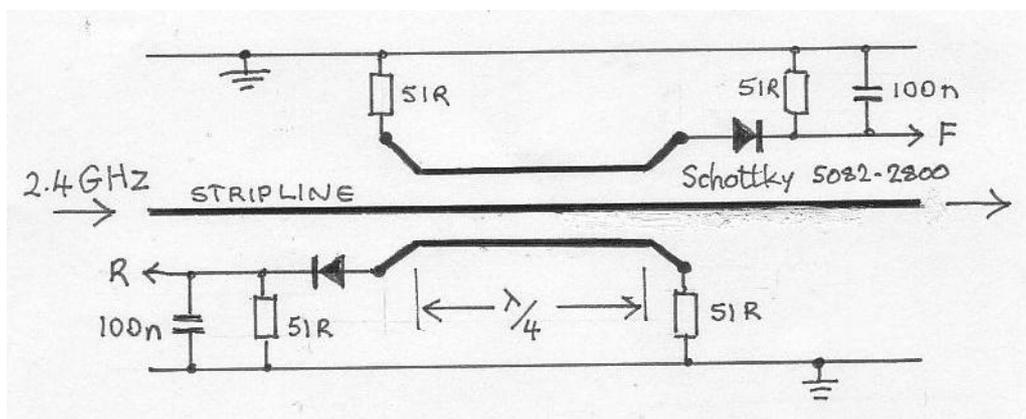
The coupler consists of two main parts.

Radio-frequency part

A custom printed circuit stripline connects rf input to output, designed for $Z_0 = 50\Omega$ (the common coaxial line impedance at these frequencies). Two parallel striplines with the same Z_0 each and quarter wavelength parallel sections pick up a small amount of power from the through line, designed for -20 dB transfer (1% power). The other side of the PCB is a copper ground plane except in the region of the outputs (to right and bottom left patches).



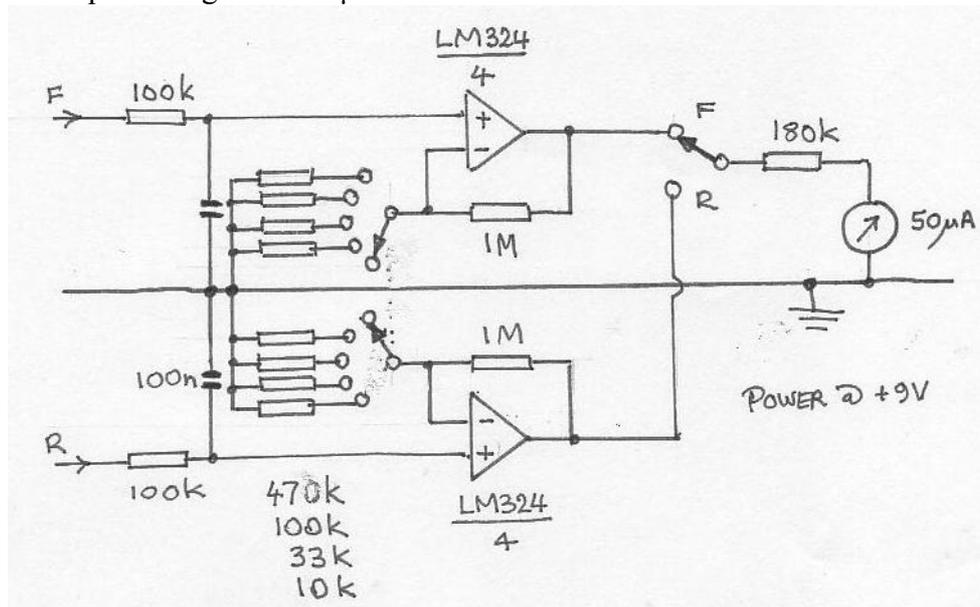
The forward wave in the upper stripline is rectified by a Schottky diode and the smoothed dc fed into the measuring part. The reverse wave in the upper stripline is absorbed by a closely matching 51Ω resistor, so it is not reflected. The lower stripline has the functions reversed. The entire rf part is enclosed in an aluminium case.



Measuring part

The two dc signals fed into this part reflect the voltages picked up in the forward and reverse direction. Each voltage is fed into an operational amplifier circuit with switch

selectable gain of approximately 1, 3, 10, 30 and 100. Another switch selects one of the two output voltages to a 50 μ A meter.



Sensitivity

For example a typical 2.4GHz NIC card might generate 100mW, or 2.23V into 50 Ω . The forward coupler should then pick up 0.23V, and perhaps a dc output of 0.3V. A gain of 30 should produce full-range on the meter (9V, 50 μ A, 180k Ω).

The reflected wave may be negligible if the line is matched to a good antenna; if not some will be reflected and show up on the R setting. This can be tested by leaving the output open (or short-circuiting it), when all the power is reflected and both the F and R readings should be the same.

At low voltages the Schottky diode rectification will gradually fail to be effective.

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