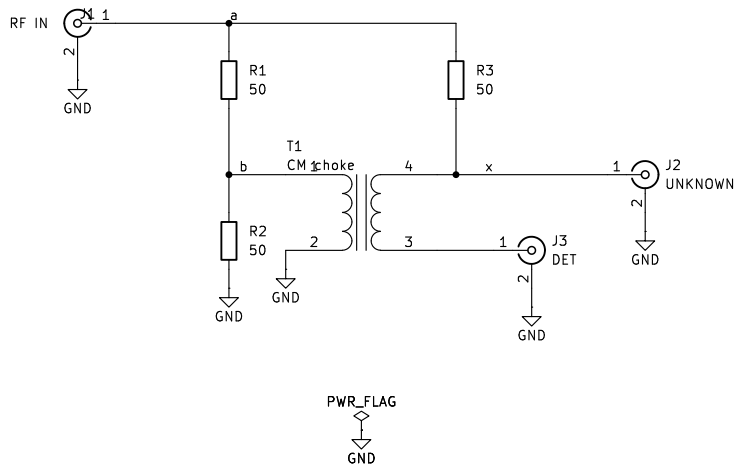
Return-Loss Bridge

160m 80m 40m 30m 20m 17m 15m 12m 10m · 50 Ω · sim-pass
EMRFD p. 2.16

Measures how close a load is to 50 Ω. With a signal generator and a detector, it reads return loss directly in dB.



R1–R3: 50 ohm (use 49.9 ohm 1% or matched 51 ohm, short leads). T1 decouples the floating bridge arm from the grounded detector.

Return loss RL = −20 log|rho| (EMRFD Eq 2.30 as corrected by the errata). Null depth sets the best measurable RL.

BUILD LIST: TICK AS YOU GO

	Ref	Value	Qty	Part / notes
☐	J1	RF IN	1	
☐	J2	UNKNOWN	1	
☐	J3	DET	1	
☐	R1-R3	50 Ω	3	
☐	T1	CM choke	1	bifilar common-mode choke

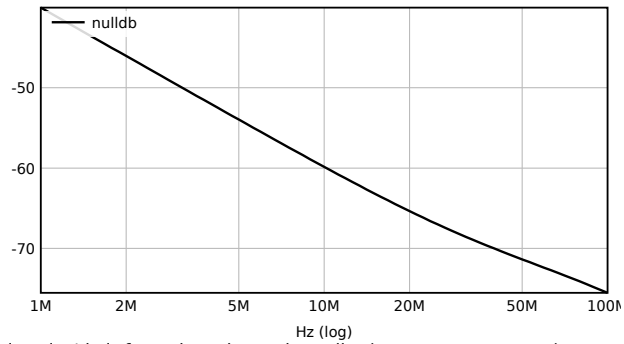
BUILD NOTES

- Use matched, non-inductive resistors. The null depth sets the best RL you can measure (about 50 dB simulated).
- Keep the leads very short and build in a small metal box.

Test: Read the detector with the X port open; that's the 0 dB reference. Then connect a 50 Ω load and confirm a deep null.

CHECK AGAINST

Check	Expect	Basis
Return loss	9.56 dB ± 0.1	simulated
Bridge null depth	50.5 dB ± 3	simulated



ngspice sim/rl.cir from the schematic netlist (not a measurement)

Full page: https://qrpedia.com/circuits/test-gear/return-loss-bridge/
Interactive sim, KiCad project, netlist and errata.

SPECIFICATIONS (FULL)

Spec	Value	Basis	Reference
Return loss	9.56 dB ± 0.1	simulated	sim/rl.cir, Rx = 100 ohm (theory 9.54)
Bridge null depth	50.5 dB ± 3	simulated	sim/rl.cir, Rx = 50 ohm, T1 100 uH k 0.999 assumed

Simulated values are this build's ngspice results (± the build's check tolerance); book and measured values are as published.

HOW IT WORKS

A Wheatstone bridge of 50 Ω arms compares the unknown at the X port with a reference. At a perfect match the bridge balances and the detector sees nothing. T1, a bifilar choke, lets the detector be ground-referenced. Return loss is RL = −20 log|ρ| (EMRFD Eq 2.30 as corrected). An open and a short both read 0 dB, which you use as the calibration reference.

WHERE IT COMES FROM

The classic return-loss bridge from Experimental Methods in RF Design, Chapter 2.

SOURCES

- EMRFD Fig 2.44, p. 2.16 (errata: affects-circuit: Eq 2.30 on p. 2.16 should use the magnitude of the reflection coefficient: RL = -20 log|rho|. The circuit itself is unchanged.)