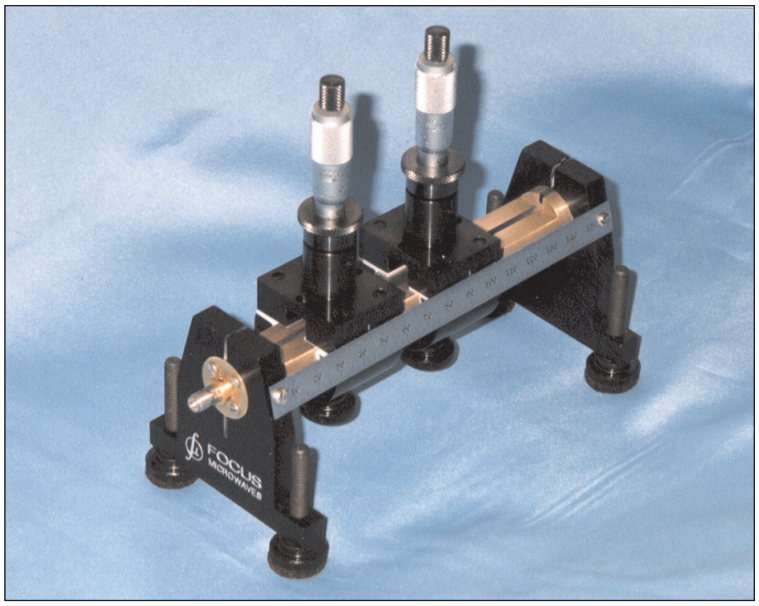
Manual Tuners Help Make Precise Load Pull and Noise Measurements

A new family of Manual Microwave Tuners MMTs) is offered by Focus Microwaves, Inc. The new tuners generate high CSWR (10~20:1) using a single probe, and more than 40:1 when the second, independently movable probe is used for prematching. The smooth sliding mechanism of the manual tuners provides high tuning stability and position accuracy, and is insensitive to vibrations and mechanical jitter. The MMTs are available from 400 MHz to 50 GHz, and can be equipped with a wide variety of connectors: GPC-7, N, 3.5, K and 2.4 mm.



▲ **Figure 1. Photo of a Microwave Manual Tuner (MMT) from Focus Microwaves.**

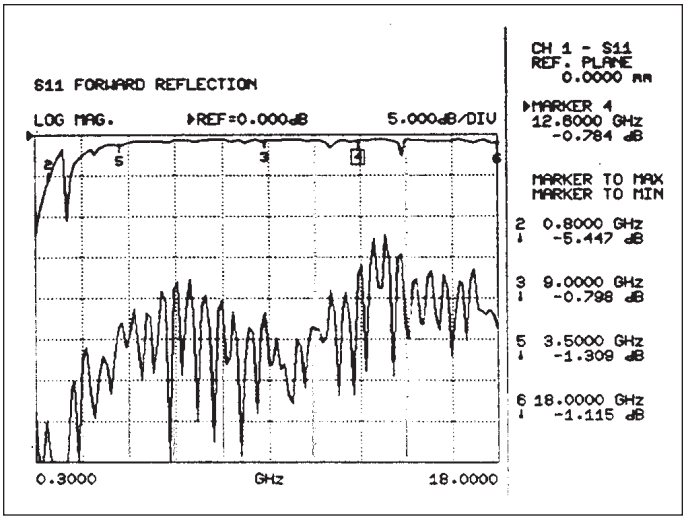
Manual Microwave Tuners (Figure 1) are designed for critical RF impedance matching operations, like load pull and noise measurements. MMTs use parallel plate airlines (slablines) and one or two sliding carriages with one vertical micrometer screw and a microwave probe (slug) each. The microwave probes and slablines are designed to generate high reflection factors over a very wide frequency band, such as 0.8 to 18 GHz with a typical VSWR of 20:1. The two independently adjustable carriages allow mutual prematching of the probes and thus selectively generate extremely high VSWR of greater than 50:1. The sliding mechanism and the probes ensure long lasting operation, high reproducibility and insensitivity to vibrations. MMTs are manufactured for frequencies from 400 MHz to over 40 GHz, using many different connector types.

Manual Microwave Tuners at a Glance

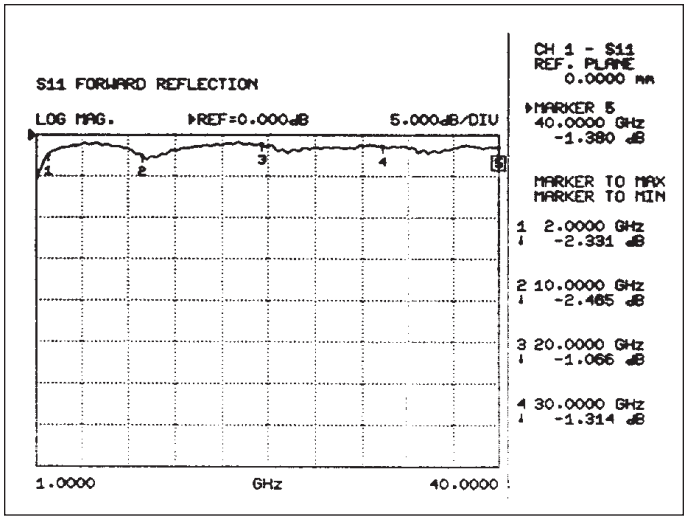
Frequency range:	0.4 to 40.0 GHz
VSWR tuning range:	1.04:1 to 20:1
Phase tuning range:	0 to 360 degrees
Instantaneous bandwidth:	up to five octaves
VSWR with prematching:	up to 50:1
Insertion loss:	0.1 to 0.9 dB
Connectors:	GPC-7, 3.5, 2.9, N, SMA, K

Tuning and repeatability

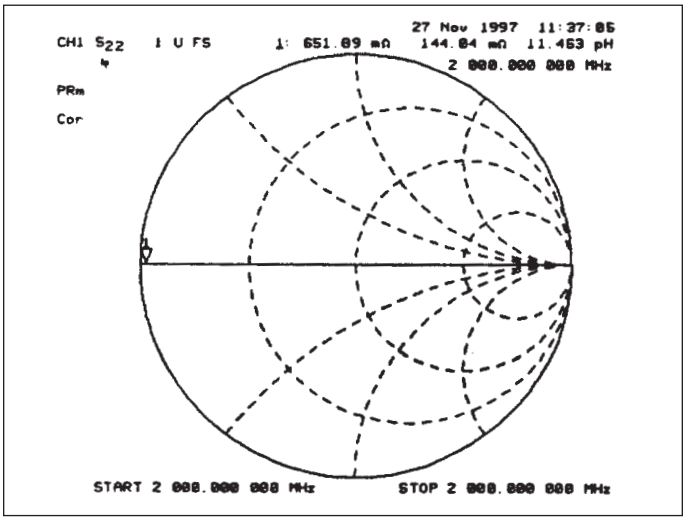
Figures 2 and 3 show the tuning capability of various MMT models with two RF probes mounted on two independent carriages. Model 1808 (Figure 2) covers 0.8 to 18 GHz, with GPC-



▲ **Figure 2. $\Gamma_{min}/\Gamma_{max}$ of the MMT-1808.**



▲ **Figure 2. $\Gamma_{min}/\Gamma_{max}$ of the MMT-4002.**



▲ **Figure 3. High Γ (Z ≈ 0.65Ω) generated using prematching capability of Manual Tuners at 2.0 GHz.**

Setting	S_{11},f_{11}	S_{12},f_{12}	S_{21},f_{21}	S_{22},f_{22}	Loss (dB)
1	0.883 –36.2	0.372 33.1	0.369 33.0	0.839 –76.1	L=2.038
2	0.883 –36.3	0.366 32.6	0.364 32.5	0.842 –76.5	L=2.151
3	0.887 –35.8	0.366 32.5	0.363 32.4	0.841 –76.8	L=2.024
4	0.884 –35.8	0.369 32.8	0.367 32.8	0.837 –76.8	L=2.059
5	0.884 –35.7	0.373 33.0	0.371 33.0	0.835 –76.7	L=1.964
6	0.891 –37.2	0.352 31.7	0.350 31.6	0.847 –76.7	L=2.229
7	0.890 –36.2	0.354 31.9	0.352 31.8	0.852 –77.2	L=2.193
8	0.887 –35.5	0.367 32.6	0.365 32.5	0.843 –77.1	L=1.987
9	0.884 –36.1	0.364 32.4	0.361 32.4	0.838 –76.9	L=2.168
10	0.883 –36.1	0.365 32.7	0.363 32.6	0.832 –76.6	L=2.178

▲ **Table 1. Repeatability of Manual Tuning using the MMT-1808 at 3 GHz.**

7 connectors, while model 4002 (Figure 3) covers 2 to 40 GHz with K connectors. Figure 4 shows the "prematched" tuning range, where one probe is used to increase the tuning range of the second one, in a narrow frequency range around 17 GHz. Table 1 summarizes tuning repeatability data. To obtain this data, the tuning probe was re-positioned manually and the network analyzer S parameters were measured via GPIB and saved in a PC file.

Conclusion

Manual Microwave Tuners (MMTs) are a reliable, low cost, yet still very accurate, tuning method for microwave load pull and noise measurements. MMTs are available from 0.4 to 50 GHz and provide very high VSWR through prematching using two horizontally and vertically independent probes. ■

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