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Focus microwaves

Product Note 68

High Isolation Manual Harmonic Tuner Model MHMT-308-2H3H[1]

for manual harmonic optimization of highly saturated (class F) RF modules

Manual Harmonic Microwave Tuners are used for narrow-band RF load pull matching operations with close to independent control of fundamental and harmonic loads. The new manual harmonic tuner design covers both harmonic frequencies 2fo and 3fo and has been derived from Focus' high isolation automatic harmonic tuners (PHT-II). These use two harmonic resonators, instead of one, for each harmonic frequency, in order to increase harmonic tuning isolation. The harmonic frequency can be easily changed by the operators of the tuners using 'off the shelf' and custom made resonators available from Focus Microwaves for any frequency required.

Manual Harmonic Tuners MHMT-308-2H3H-hi can be supplied with 7mm (APC-7) or N connectors. Special designs are available with 3.5mm or 7/16 connectors for high power.

MHMT-308-2H3H-hi Specifications

Frequency range (fo):	0.8–2.4GHz
(Other frequency ranges on request)	
VSWR (2fo):	>40:1, all phases
VSWR (3fo):	>20:1, all phases
Insertion Loss (fo):	<0.2dB
Power handling:	40Watt (APC-7), 200Watt (7/16)
Tuning Isolation:	>25dB (typically 30-40dB)
Bandwidth (2fo, 3fo):	5%

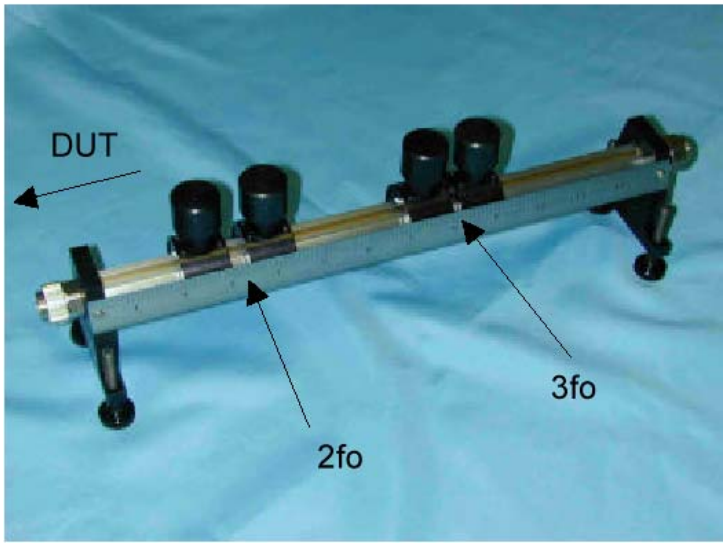

Figure 1: High Isolation Manual Harmonic Tuner

[1] *patent pending*

Frequency Response and Alignment

Manual Harmonic Tuners are aligned and tested on the VNA, which has been calibrated using TRL. Using the distance between two resonators of the same frequency (2fo and 3fo separately) a frequency response as shown in figure 2 can be achieved by the user, after he changes resonators for another frequency. In this case fo=1.95 GHz (2fo=3.9 GHz, 3fo = 5.85 GHz) and the most critical bandwidth (at fo) is 200 MHz (□10%) at 30dB harmonic tuning isolation;

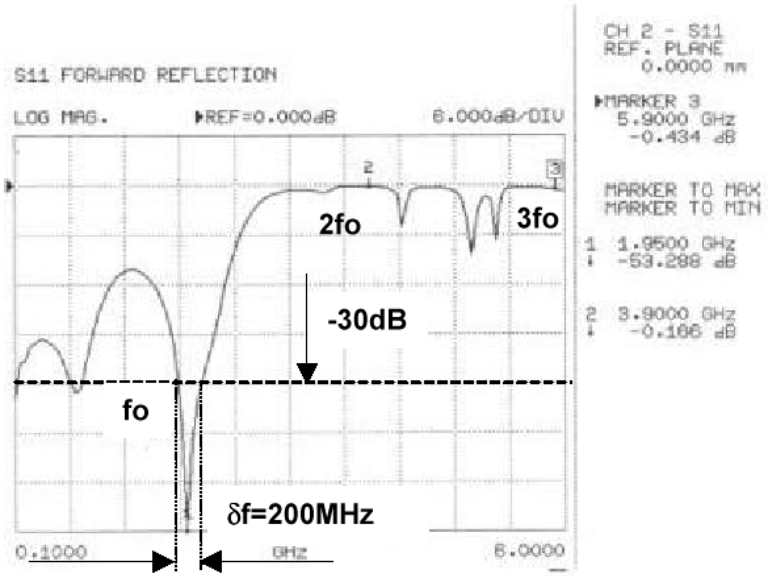

Figure 2: Frequency response of MHMT-308-2H3H-hi, as adjusted after changing resonators. It shows 10% bandwidth at 30dB harmonic tuning isolation.

The return loss obtained at 2fo and 3fo can also be seen from figure 2: It is higher than 0.2dB (2fo) and 0.5dB (3fo) for all phases. This tuner is connected directly to the DUT, before any wideband fundamental tuner. Often the amplifier modules to be tested are pre-matched at the fundamental frequency (on-the-chip) and present some more or less controlled impedance at the harmonic frequencies. Using the MHMT-308-2H3H allows to recover the remaining harmonic power at the output of the DUT and re-inject it into its output port, thus extracting the optimum PAE or Gain from the device.

Using MHMT-308-2H3H in a Harmonic Load Pull Setup

MHMT-308-2H3H has to be inserted in a Load Pull setup between DUT and actual load, as shown in figure 3. It allows optimizing the phase of the reflected harmonic power at 2fo and 3fo in order to maximize Pout, Gain or PAE. An input harmonic tuner can also be used in this setup. It is normally used in order to optimize DUT linearity (IMD, TOI and ACPR).

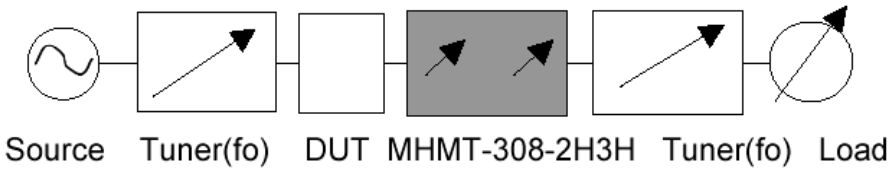

Figure 3: Using an MHMT-308-2H3H in a harmonic load pull setup.