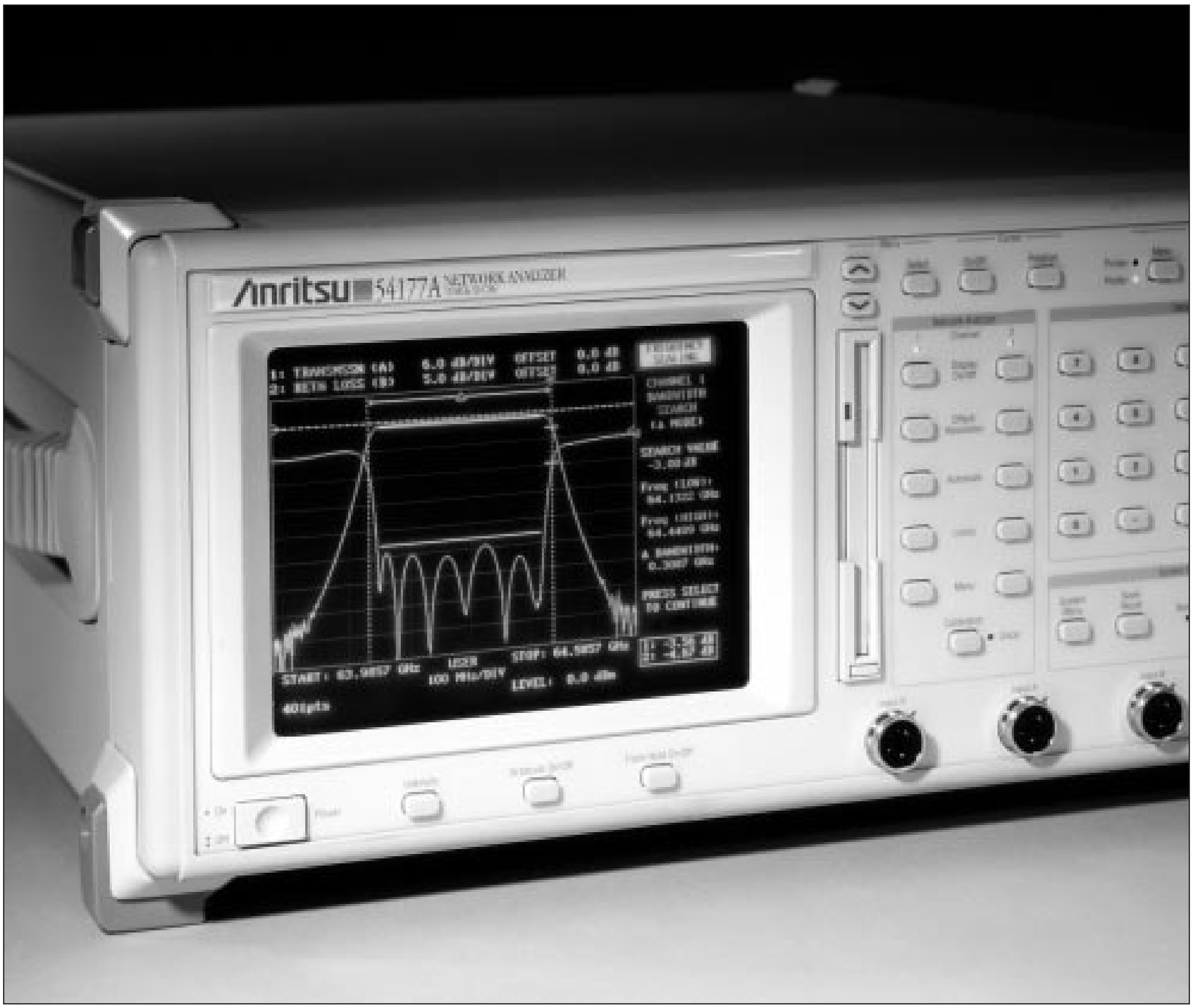
54100A Series

Network Analyzers

Application Note



Using Frequency Multipliers to 110 GHz

Linking the World

INTRODUCTION

Anritsu's 54100A Network Analyzers operate with precision waveguide reflectometers available to 110 GHz. This application note describes how to operate the user-defined scaling, external leveling, and detector offset features of the 54100A to make multiplied and frequency offset measurements accurately.

Basic Setup

Figure 1 shows RF connections with the 54147A. Option 16 provides +15 Vdc bias.

Note

The 54100A detector offset function provides excellent absolute power measurement capability with the waveguide detectors. The offset level is determined using an Anritsu ML2438A Power Meter.

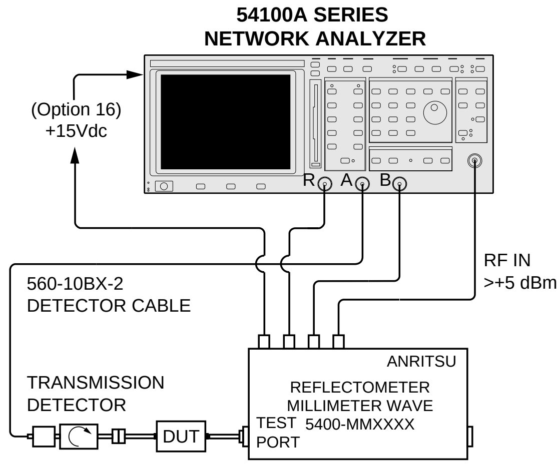


Figure 1
Basic setup for multiplying the output frequency of the 54100A

The multipliers are designed to operate with any 12.5 GHz to 18.75 GHz source providing at least +5 dBm output power and –60 dBc harmonics.

The low input harmonics are required to meet the multiplier's output spurious harmonic specification of –55 dBc (–60 dBc typical). Higher source harmonics, such as the –20 dBc performance common to existing millimeter frequency extensions, cause significant errors. For example a –20 dBc spurious level has a maximum error of more than ±2.0 dB measuring devices with more than 10 dB return loss.

Figure 2 identifies return loss error magnitude due to source harmonics. In transmission measurements, sub-harmonics and crossing spurs from excessive input source harmonics can make filter tuning impossible.

The 54100A Network Analyzers ulitize broadband detectors. Accurate device characterization requires that harmonics and spurious signals be significantly lower than power level of the test's fundamental frequency.

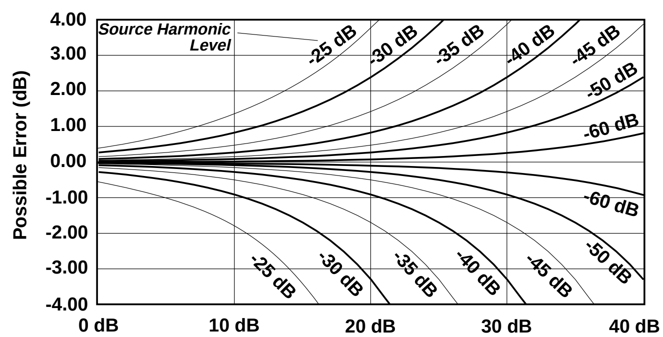


Figure 2
Return Loss accuracy due to source harmonics

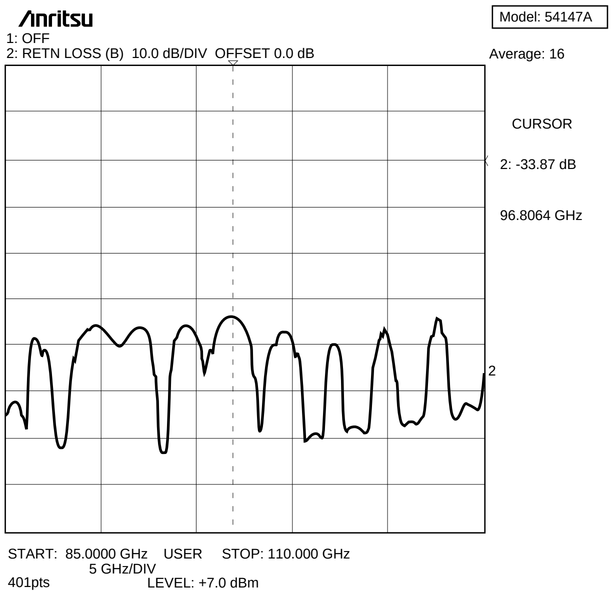


Figure 3

This return loss plot of a tunable load illustrates high directivity and sensitivity of the measurement. No interference from source match or source harmonic problems are evident.

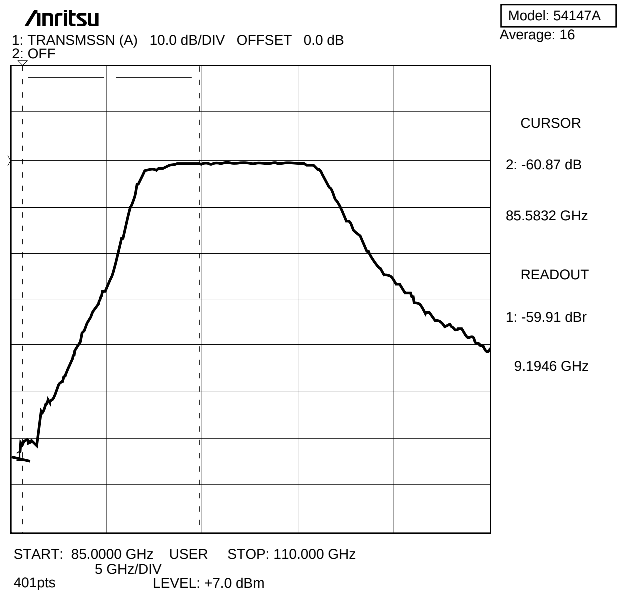


Figure 4

Ultra low harmonics, sub harmonics, and spurious allow excellent broad band measurement dynamic range and accuracy – duplicating performance previously available only with receiver based instruments such as Vector Network Analyzers.

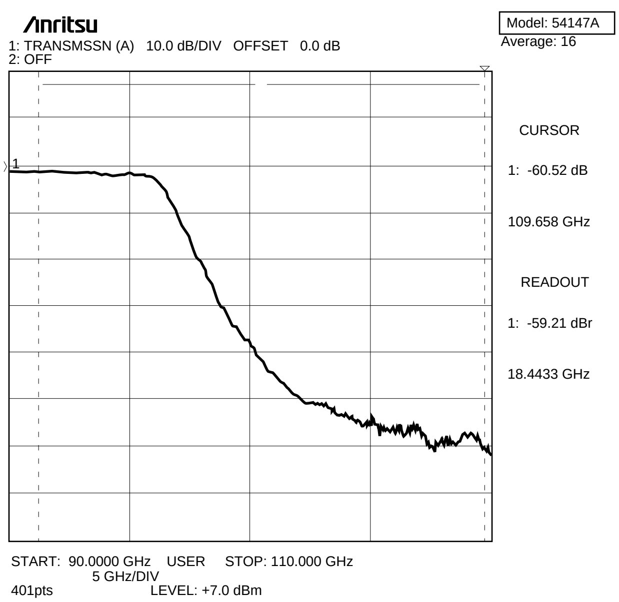


Figure 5

The plot displays 60 dB dynamic range and good isolation at both the detector and the reflectometer source – allowing the true filter characteristic to be clearly visible.

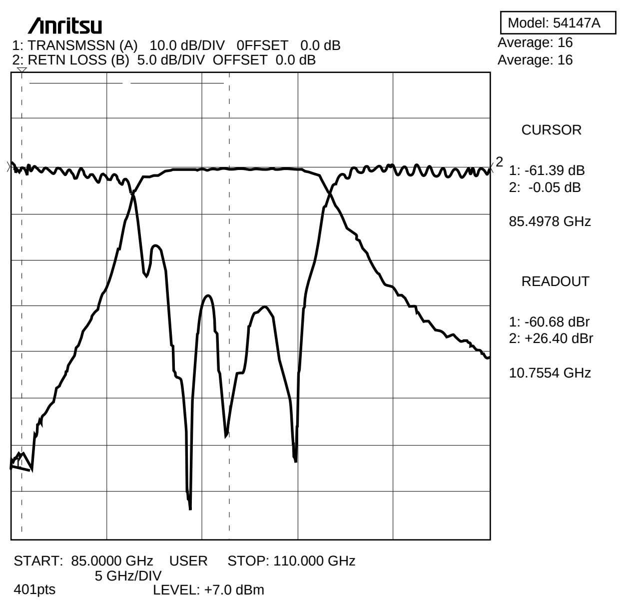


Figure 6

Note that the transmission amplitude is slightly lower at the leading part of this filter's passband. The Reflectometer clearly shows poor return loss in this region. If the Reflectometer had high harmonics or poor source match, this undesirable characteristic would be difficult to identify.

The input of the multiplier is equipped with isolation and a gain stage driving the 4x (V-band 50-75 GHz) or 6x (W-band 75-110 GHz) multiplier diodes. The multiplier design incorporates intermediate and post filter stages for the low –60 dBc harmonic performance. The post filters can be removed for higher output power or replaced with through waveguide.

The post filter is followed by a waveguide isolator to improve source match – a critical characteristic for testing devices with return loss values between 0 and 10 dB. The reflection and reference couplers provide 40 dB typical directivity.

The novel package reduces a bench full of waveguide and detector components into about nine inches. As a single package, the multiplier is convenient and much more rugged than previous test stands using discrete waveguide and detector test components.

Frequency Scaling

The **User Scaling** menu is accessed through the **Applications** menu under the **SYSTEM MENU** front panel key. The new selection automatically adjusts the horizontal frequency axis, cursors, and marker displays.

> **NOTE**
>
> *Cursors may be set to automatically search for key device characteristics, such as 3 dB Bandwidth.*

External Leveling

Figure 7 shows how leveled output power at the multiplied frequency may be achieved using the optional external leveling. Two low VSWR, 3 dB attenuators are used to improve test accuracy when measuring low insertion loss devices.

1. Select the 54100A output power to 7.0 dBm
2. Press the **EXTERNAL LEVELING** front panel key, then
3. Press **SELECT** to activate the automatic level calibration function. (See the 54100A operation manual for more information on the automatic level calibration function.)

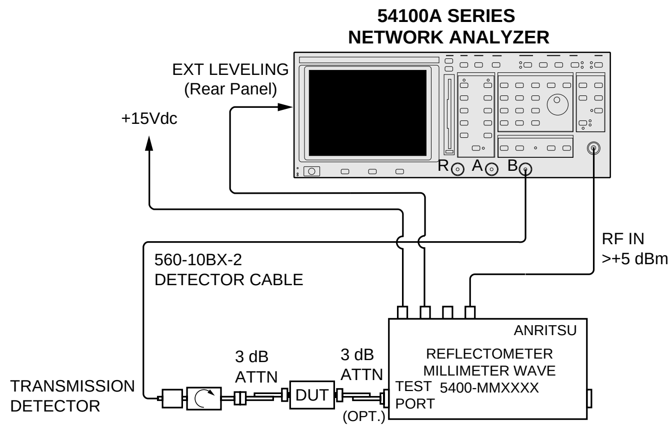


Figure 7

Setup for leveling the output from the 54100A

> **NOTE**
>
> *The optional external leveling feature improves power flatness at the multiplier output or at the output of active devices.*

The CRT display should indicate LEVELING PASSED, and the UNLEVELED light on the front panel should not blink as the frequency is swept. If the automatic scaling is unable to level the multiplier output, try another 54100A output power setting and repeat steps 2 and 3.

CE

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