Tracking Generator option User's Guide

(AT6030D)

ATTEN®
INSTRUMENTS

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Chapter 1. General Information

1-1. Introduction

The tracking generator is an optional item of the analyzer. This option of the Tracking generator adds a feature of a Single channel Scalar network analyzer to the analyzer. Using analyzer and the tracking generator option, amplitude characteristics of materials or specific equipments, frequency characteristics, return loss, insertion loss and frequency flatness etc.

The tracking generator can generate a consistent signal level of frequency ranged between 100 kHz ~ 3 GHz. The output level can be changed between 0 dBm and -50 dBm by the unit of 1 dB. Also, it includes the calibration functions so that precise performance measurement is provided.

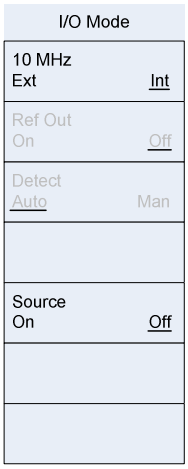
1-2. Specifications

- ▶ Frequency Range : 100 kHz ~ 3 GHz
- ▶ Amplitude Range : 0 dBm ~ -50 dBm
- ▶ Amplitude Resolution : 1 dB
- ▶ Amplitude Accuracy : ±3 dB, Typically ±1.5 dB
- ▶ Amplitude Flatness : ±2 dB, Typically ±1.5 dB
- ▶ Harmonic, Non Harmonic Distortions : < -20 dBc (10 MHz ~ 2.8 GHz),
  Typically < -30 dBc
- ▶ Reverse Power : +30 dBm
- ▶ Impedance : 50 Ω Nominal
- ▶ Connector : N-type Female
- ▶ RF Output VSWR : <1.5 : 1 (@ 10 dB Atten) Typically
- ▶ Calibration Functions : Transmission Calibration, Reflection Calibration
- ▶ Calibration error : < ±0.5 dB

Chapter 2. Operation

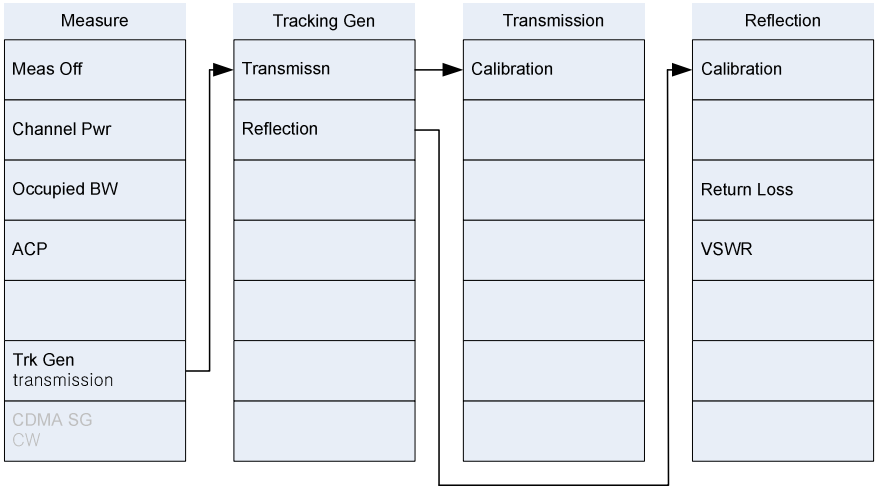
2-1. Menus

The tracking generator option menus are as follows:



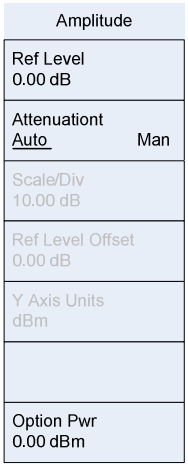
[Figure 2-1] I/O Mode Menu

Once Source is set to On, the LCD display is changed to an option mode and the tracking generator option can be used. Once Source is set to Off, a mode is returned to the Spectrum analyzer mode.



[Figure 2-2] Tracking Gen Menu

The default setup of the tracking generator mode is transmission. Once Source is set to On, the transmission mode is always set. In order to select the Reflection mode, select Reflection from the Tracking Gen menu.



[Figure 2-3] Amplitude Menu

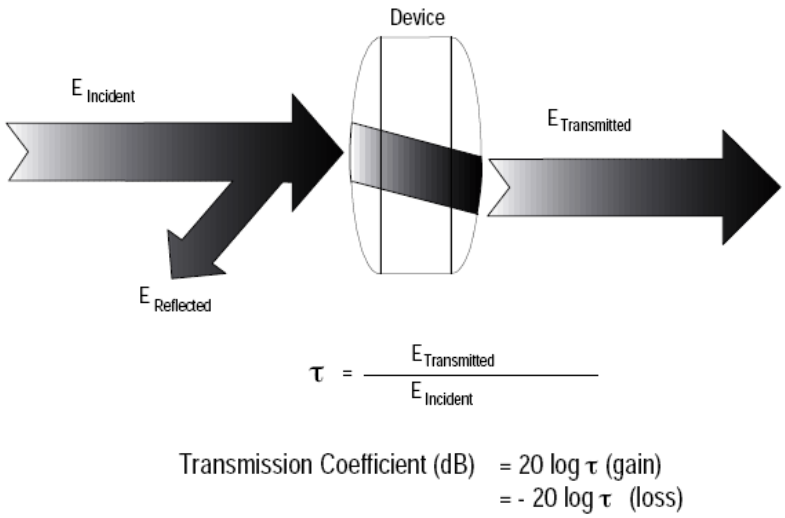
The level of the Tracking generator can be changed from the Amplitude menu. Once Source is set to On and becomes an option mode, it activates the Option Pwr item in the Amplitude menu and the output of the tracking generator can be changed.

2-2. Operations

2-2-1. Transmission

■ Introduction of Transmission

Transmission measures gain or loss of the equipments.



[Figure 2-4] Transmission coefficient

$20 \log \tau = 20 \log [E_{Transmitted}] - 20 \log [E_{Incident}]$

Insertion loss(dB) = $P_{Incident}$(dBm) – $P_{Transmitted}$(dBm)

Gain(dB) = $P_{Transmitted}$(dBm) – $P_{Incident}$(dBm)

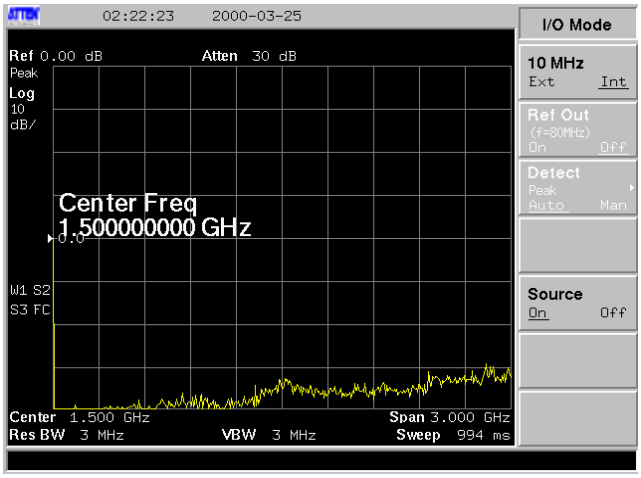
■ Transmission Measurement

The following 4 steps are required for the Transmission measurement.

1. Set Source to on and change to the transmission measurement mode.
2. Set the spectrum analyzer in accordance with the measurement purpose such as frequency, span, RBW etc.
3. Perform the Transmission calibration.
4. Measure the Transmission.

Step 1.

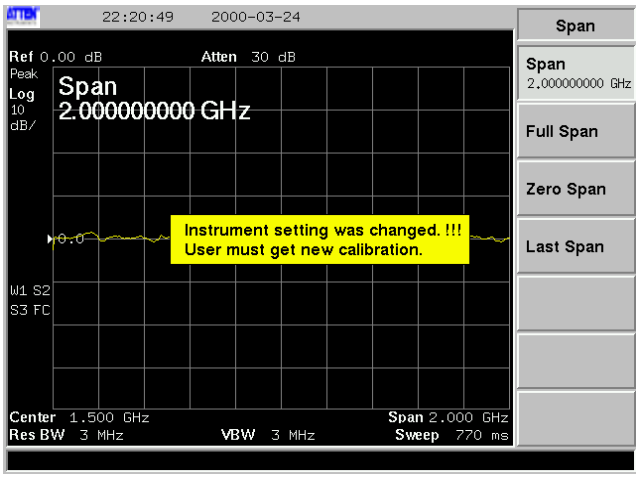
Select I/O DETECT >> Source to set source to on. Then, it changes to the transmission measurement mode. Once Source is set to on, a mode is selected to the transmission measurement mode by default.



[Figure 2-5] Source On

Step 2.

Before the performance of calibration, the spectrum analyzer should be set for the measurement purpose. After the Calibration, if frequency or span is changed, a message, which asks for another calibration under the new setup.

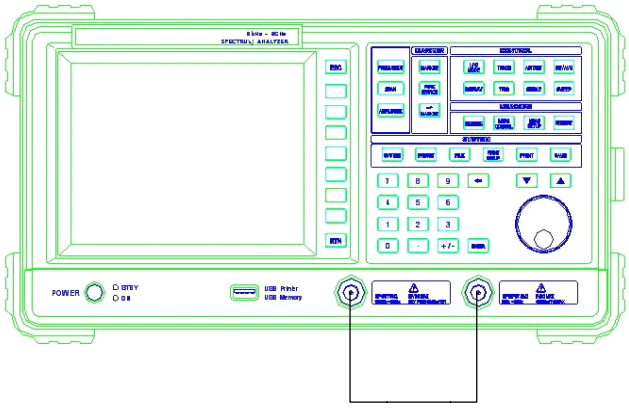


[Figure 2-6] Calibration Request Message

In case there is no need to perform calibration again, for example, when frequency is back to the original span frequency after the change of the original span frequency, push the ESC key, remove the calibration request message, and continue the measurement.

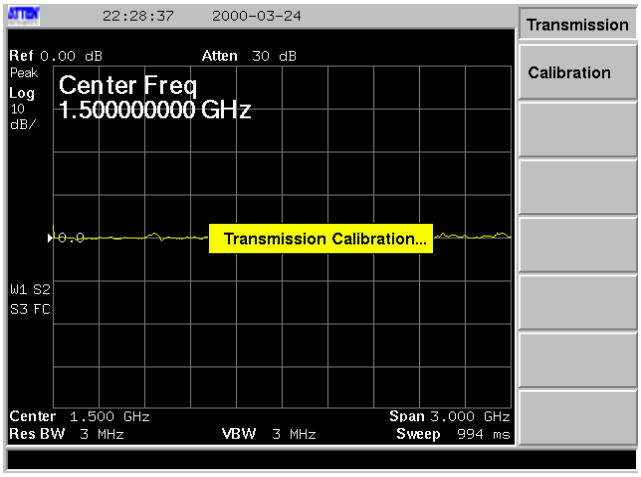
Step 3.

Once the spectrum analyzer is set as desired in accordance with the measurement purpose, the output of the tracking generator and the input of the spectrum analyzer are connected with each other by the calibration cable, as shown in Figure 2-7.



[Figure 2-7] Transmission Calibration Configuration

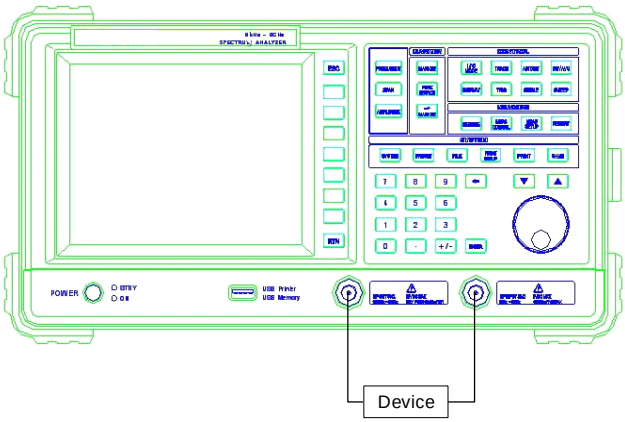
Select MEASURE >> Trk Gen >> Transmissn >> Calibration to perform the transmission calibration.



[Figure 2-8] Transmission Calibration Performance Message

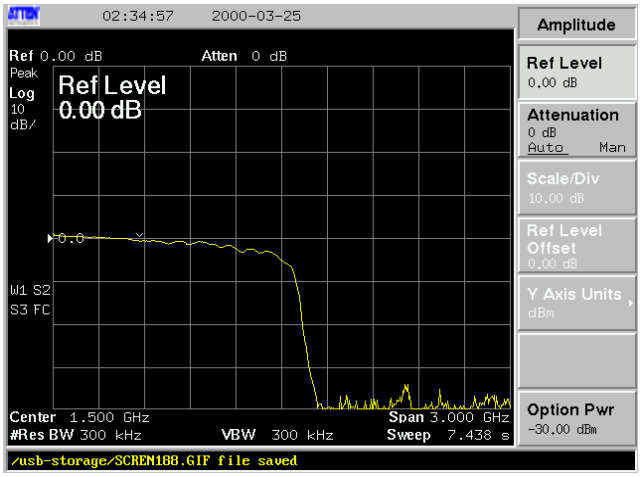
Step 4.

Once the transmission calibration is completed, the measurement device is connected between the output of the tracking generator and the input of the spectrum analyzer in order to measure the transmission as shown in Figure 2-9.



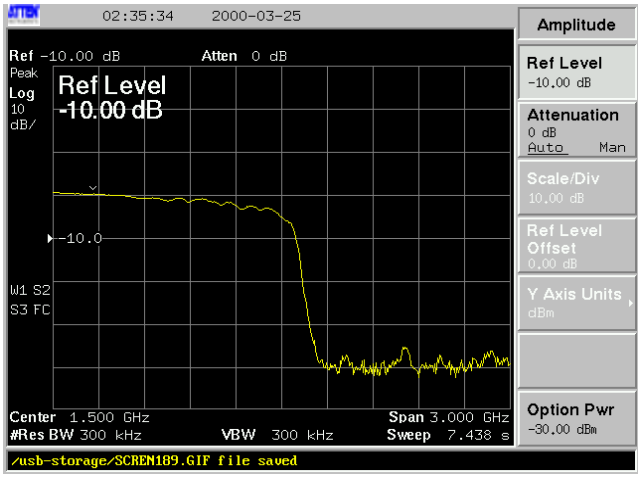
[Figure 2-9] Transmission Measurement Configuration

■ Example 1. Low Path Filter Frequency Response Measurement



[Figure 2-10] LPF(Low Pass Filter)Transmission Measurement

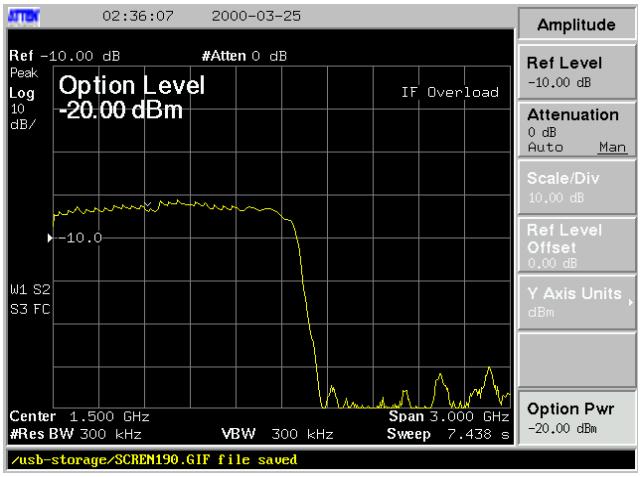
When the reference level is set to 0 dB, it is difficult to measure frequency response accurately over the high frequency area. To solve this problem, change the reference level and increase the noise level as shown in the Figure 2-11.



[Figure 2-11] Reference Level Change

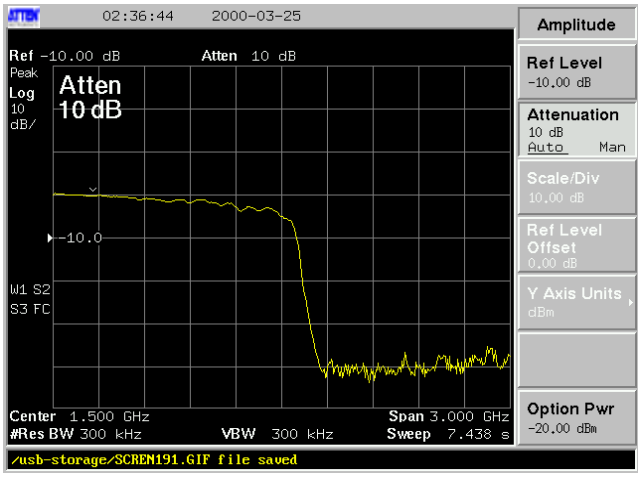
By changing the reference level to -10 dB, it is possible to measure the response of high frequency bandwidth accurately. If lower noise level measurement is required for accurate measurement, decrease RBW. However, the sweep time will increase.

■ Example 2. Attenuation Setup



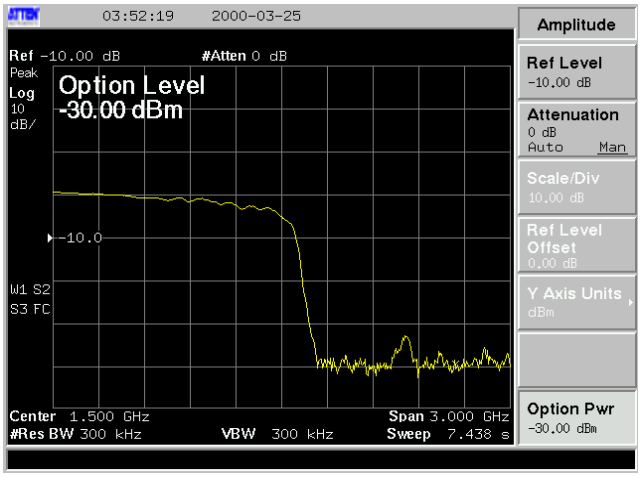
[Figure 2-12] Spectrum Analyzer Input Level Excess

Currently, since the spectrum analyzer's attenuation is set to 0 dB (manual) and the tracking generator's output is set to -20 dBm, -20 dBm is inputted as the internal input of the spectrum analyzer. Because of this, IF Overload is marked on the upper right side of the window and distortion of the measurement is found in the low frequency area.



[Figure 2-13] Spectrum analyzer attenuation Change

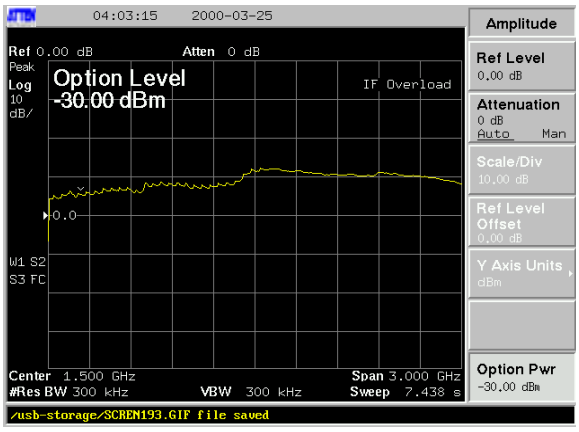
Spectrum analyzer's attenuation is now changed to 10 dB. Then, spectrum analyzer's internal input becomes -30 dBm, the IF Overload mark disappeared from the upper right side of the LCD and normal measurement can be performed. If the spectrum analyzer's attenuation is set to Auto, it can produce the most accurate measurement in most measurements.



[Figure 2-14] Tracking generator Output Level Decrease

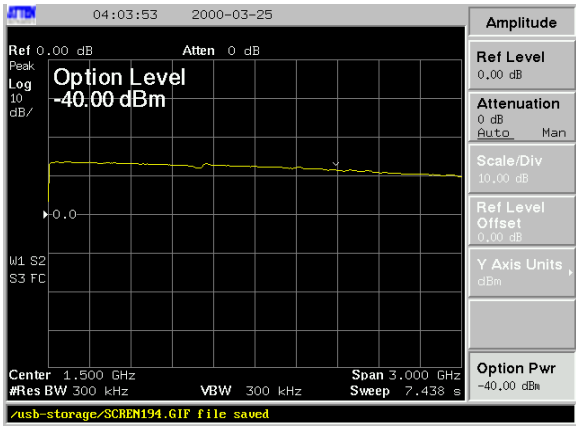
This time, the spectrum analyzer's attenuation is set to 0 dB and the tracking generator's output level is changed to -30 dBm. Then, because -30 dBm is inputted as the spectrum analyzer's internal input as same as in Figure 2-13, IF Overload mark disappeared from the upper right side of the window and normal measurement can be performed. Even though the current measurement's attenuation is set to Auto, it still has 0 dB Attenuation.

■ Example 3. Amplifier Gain Measurement



[Figure 2-15] Amplifier Gain Measurement 1

Figure 2-15 shows the frequency response characteristic of the amplifier that amplifies 14 dB. It shows the distortion of the wave in the low frequency bandwidth and IF Overload mark on the upper right side of the window. Since the tracking generator's output is -30 dBm and the spectrum analyzer's attenuation is 0 dB, high power is inputted, which is amplified by the amplifier that is in test by the spectrum analyzer's internal input.



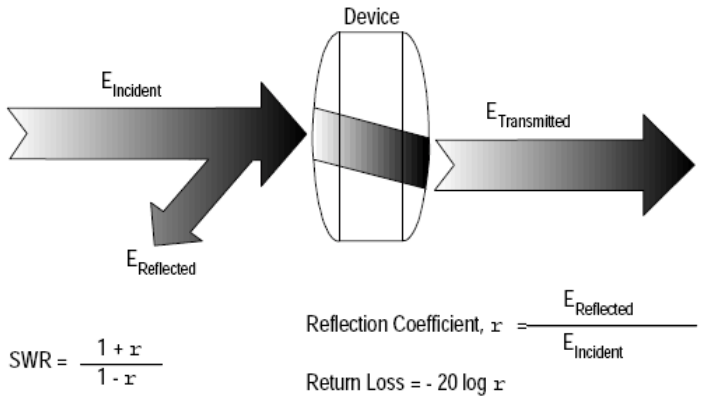
[Figure 2-16] Amplifier Gain Measurement 2

As shown in Figure 2-16, if the tracking generator's output decreases to -40 dBm, normal measurement can be performed in the low frequency bandwidth. Also, the same result can be obtained if the spectrum analyzer's attenuation increases in the Manual mode while maintaining the tracking generator's output.

2-2-2. Reflection

■ Introduction to Reflection

Scalar reflection represents how efficiently RF power input is transmitted to the equipment. Generally, RF power which is entered into the equipment is not transmitted to the equipment with 100% efficiency. The RF power which is not transmitted is reflected toward the input source. Here, the ratio of the reflected RF power to the RF power transmitted to the equipment is called the reflection coefficient.



[Figure 2-17] Reflection coefficient

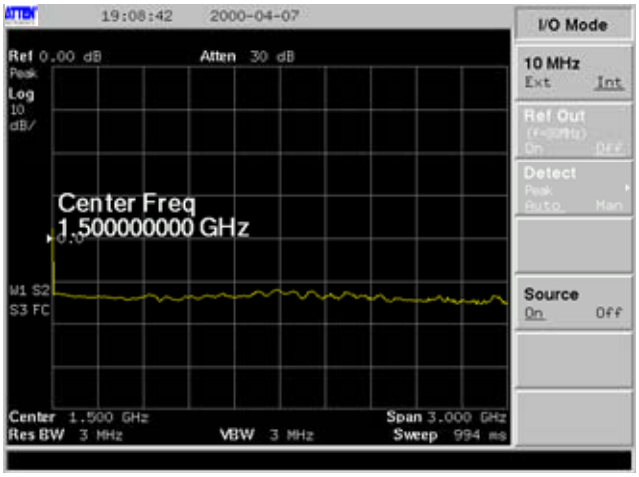
■ Reflection Measurement

As the same in the transmission measurement, the reflection measurement requires the following 4 steps.

1. Set Source to on and change a mode to the reflection measurement mode.
2. Set the spectrum analyzer as desired such as Frequency, span, RBW etc.
3. Perform reflection calibration.
4. Measure reflection.

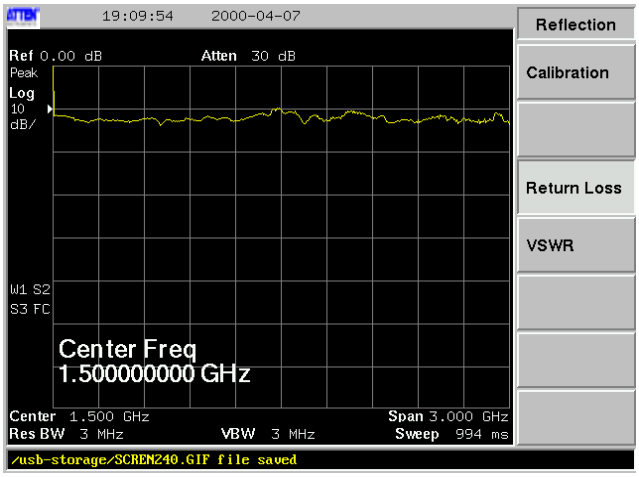
Step 1

Set Source to on. By default, the transmission measurement mode is selected. In order to change to the reflection measurement mode, select MEASURE >> Trk Gen >> Reflection.



[Figure 2-18] Transmission Measurement Mode

The transmission measurement mode is confirmed by the reference cursor's placement on the middle left of the window.

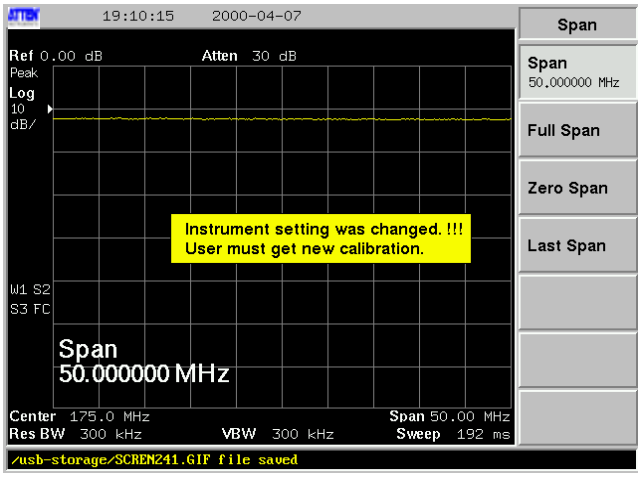


[Figure 2-19] Reflection Selection

Select MEASURE >> Trk Gen >> Reflection. The change to the reflection measurement mode is confirmed by the reference cursor placement on the upper left side of the window.

Step 2.

Before the performance of calibration, the spectrum analyzer should be set for the measurement purpose. After the Calibration, if frequency or span is changed, a message, which asks for another calibration under the new setup.

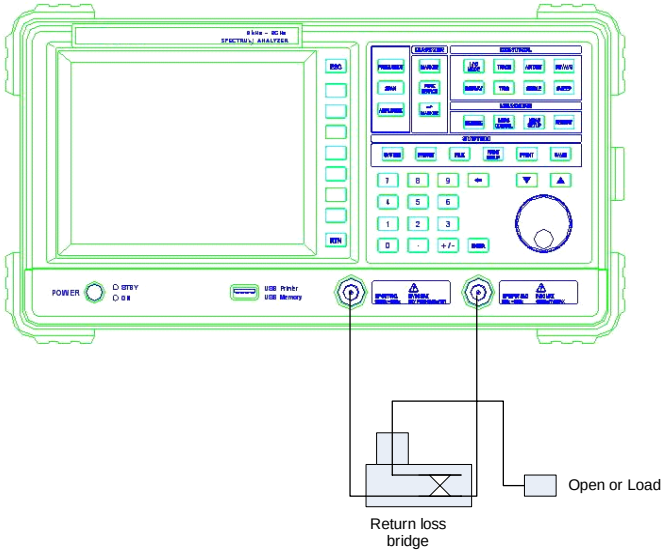


[Figure 2-20] Calibration Request Message

In case there is no need to perform calibration again, for example, when frequency span is back to the previous frequency span, push the ESC key, remove the calibration request message, and continue the measurement.

Step 3.

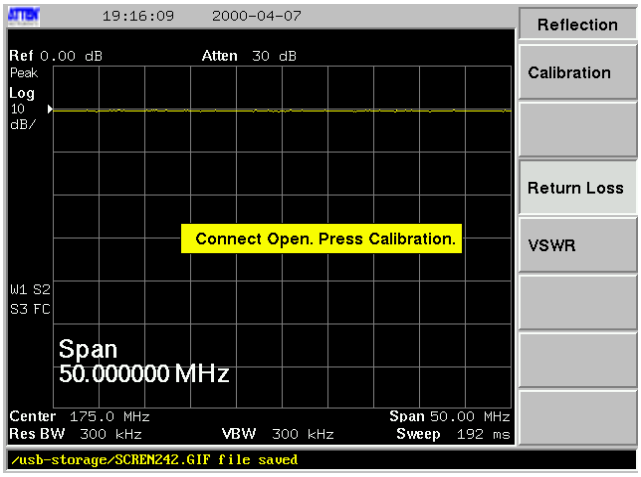
If the spectrum analyzer is set for the measurement purpose, it is configured as shown in Figure 2-21.



[Figure 2-21] Reflection Calibration Configuration

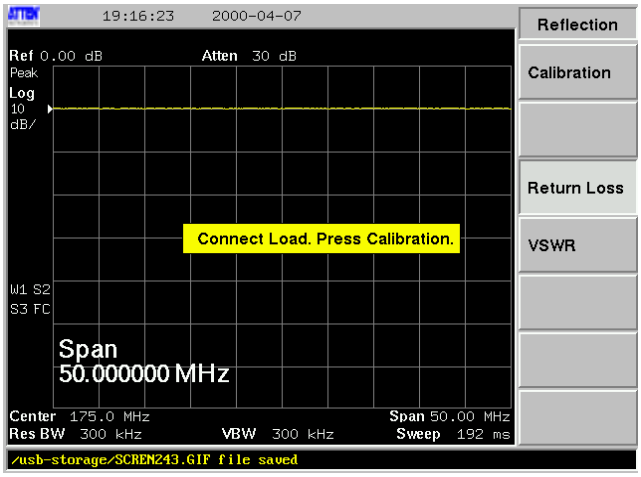
Select MEASURE >> Trk Gen >> Reflection >> Calibration in order to perform the reflection calibration.

Reflection calibration is divided into two steps. Firstly, calibration is performed while open termination is connected to the return loss bridge or without the connection. Secondly, calibration is performed while the return loss bridge is connected to 50 Ω load termination.



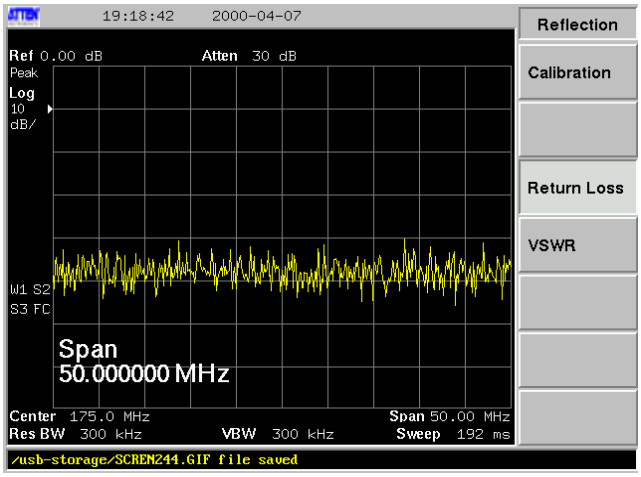
[Figure 2-22] Reflection calibration (Open termination)

Select MEASURE >> Trk Gen >> Reflection >> Calibration to trigger a message box as shown in Figure 2-22. Then while the return loss bridge is connected to the open termination, push the calibration button.



[Figure 2-23] Reflection calibration (Load termination)

After open termination calibration, a message appears, which asks for the load termination calibration, as shown in Figure 2-24. Calibration is performed while the return loss bridge is connected to the load termination.

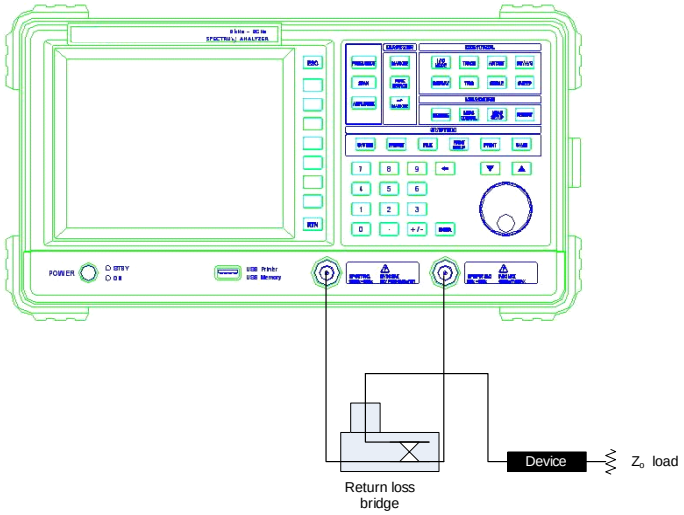


[Figure 2-24] Reflection Calibration Completion

Once the reflection calibration is completed under the setup, the following window will appear. Currently since 50Ω load termination is mounted to the return loss bridge, the return loss is around 40 dB.

Step 4.

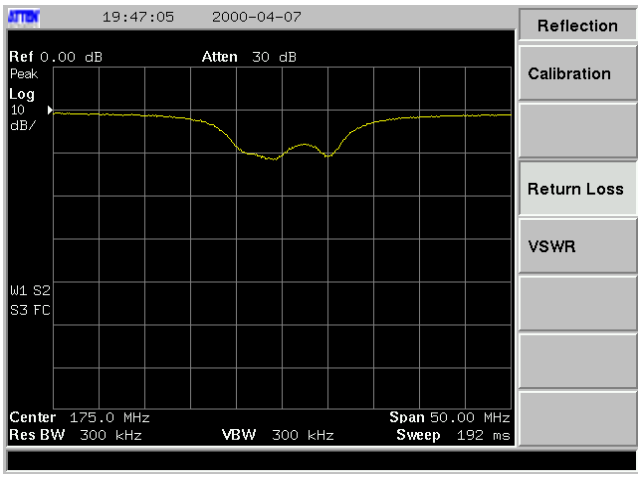
If reflection calibration is completed, the device is connected as shown in Figure 2-25 and measure reflection.



[Figure 2-25] Reflection Measurement Configuration

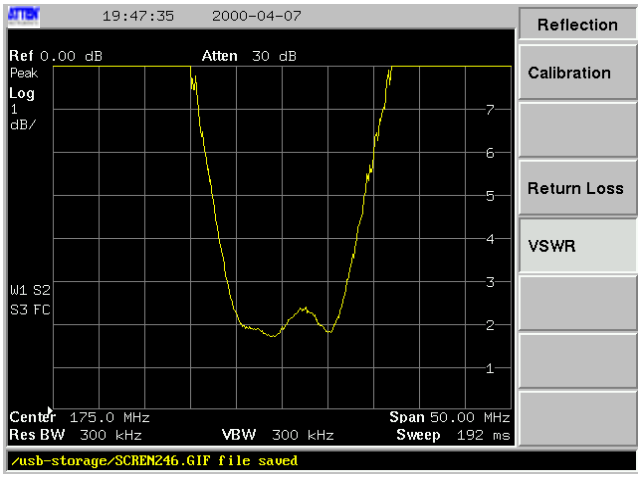
2-2-3. Measurement Examples

■ Example 1. Center frequency 175 MHz Bandpass filter Return loss Measurement



[Figure 2-26] Reflection Measurement (Return Loss)

■ Example 2. Center frequency 175 MHz Bandpass filter VSWR Measurement



[Figure 2-27] Reflection Measurement (VSWR)