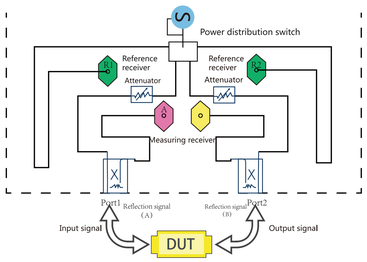
TRANSCOM INSTRUMENTS

Vector Network Analyzer Basics

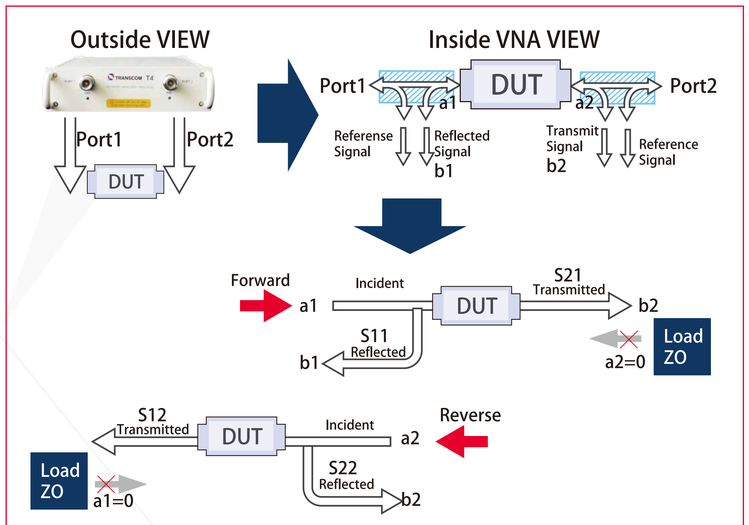
VNA Fundamental

A typical vector network analyzer contains a signal source, signal separation devices and a set of receivers. The signal source is used for generating incident signal. Signal separation devices is used for separating reference and incident signals. The incident signal stimulates Device-Under-Test (DUT), then receivers is used for receiving transmitted signal and reflected signal. With processor unit, S parameters could be obtained by calculation.



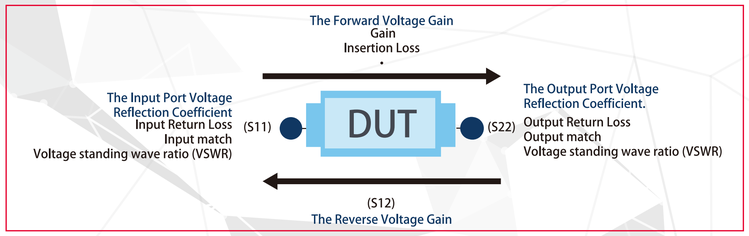
S-parameters Basics

Scattering parameters or S-parameters (the elements of a scattering matrix or S-matrix) describe the electrical behavior of linear electrical networks when undergoing various steady state stimuli by electrical signals. Many electrical properties of networks of components (inductors, capacitors, resistors) may be expressed using S-parameters, such as gain, return loss, voltage standing wave ratio (VSWR), reflection coefficient and amplifier stability.



S-Parameter Theory view

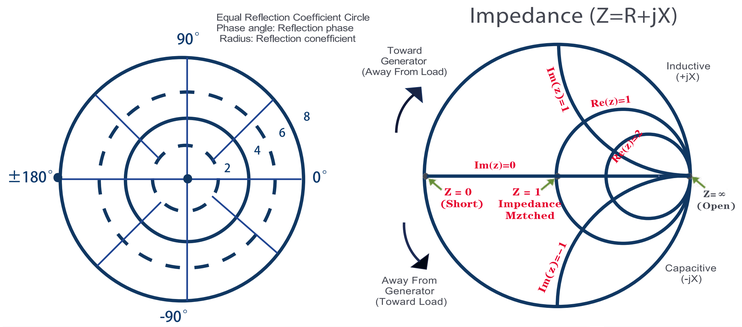
$S_{11} = \frac{\text{Reflected}}{\text{Incident}} = \frac{b_1}{a_1}\Big\|_{a_2=0}$	$S_{22} = \frac{\text{Reflected}}{\text{Incident}} = \frac{b_2}{a_2}\Big\|_{a_1=0}$
$S_{21} = \frac{\text{Transmitted}}{\text{Incident}} = \frac{b_2}{a_1}\Big\|_{a_2=0}$	$S_{12} = \frac{\text{Transmitted}}{\text{Incident}} = \frac{b_1}{a_2}\Big\|_{a_1=0}$



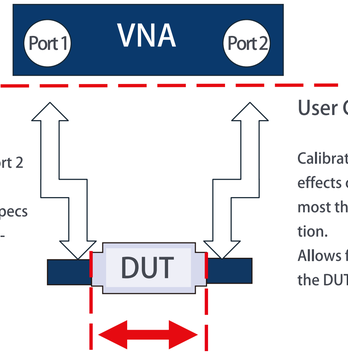
Smith Chart

Smith Chart is a graphical aid or nomogram designed for electrical and electronics engineers specializing in radio frequency (RF) engineering to assist in solving problems with transmission lines and matching circuits. The Smith chart can be used to simultaneously display multiple parameters including impedances, admittances, reflection coefficients, scattering parameters, noise figure circles, constant gain contours and regions for unconditional stability, including mechanical vibrations analysis. The Smith chart is most frequently used at or within the unity radius region.

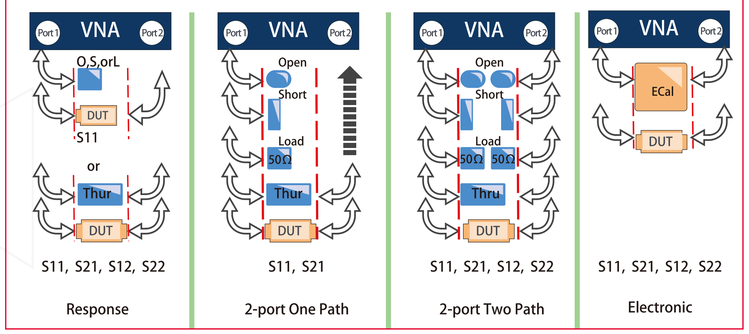
Most of VNAssupport Smith Chart format display, used for displaying impedance and admittance.



Understanding VNA Calibration



Calibration Methods



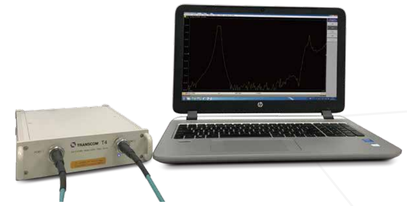
Categories of Vector Network Analyzers

VNA is the multimeter in the RF industry. VNA could be divided into many categroies: bench-top VNA, modularized VNA and multi-ports VNA.

Bench-top Performance USB VNA T4

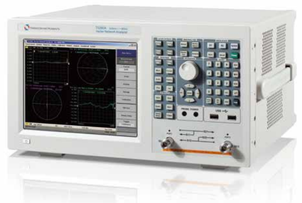
T4 USB Vector Network Analyzer offers wide dynamic range,low noise level, high resolution scanning with laboratory and research grade performance. T4 covers frequency range of 1MHz to 4GHz with 2-port and 2-pass that competitive with most of the bench-top VNAs on the market. The T4 provides measurement convenience by offering end user excellent performance and attractive pricing. T4 suitable for laboratory, manufacturing and many other safety testing environment.

- Dynamic Range：>120 dB (IFBW=10 Hz), 123dB typical
- Low Noise Level：<-120 dB (IFBW=10 Hz)
- Low Trace Noise：10 mdB rms (IFBW=3 kHz)
- High Measurement Speed：250 μs/point (IFBW=30 kHz)
- High Effective Directivity：>42 dB



High Performance Dual Ports VNA T5280A

T5280A bench-top vector network analyzer offers the high RF performance, wide frequency range and versatile functions. The T5280A is the economic solution for manufacturing and R&D engineers evaluating RF components and circuits .

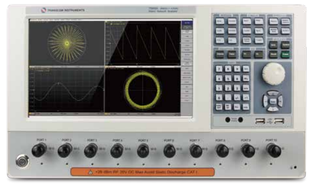


- Frequency Range：300kHz to 8GHz
- Dynamic Range：>125 dB (IFBW=10 Hz), 130 dB typical
- Low Noise Level：<-120 dB (IFBW=10 Hz)
- Low Trace Noise：1 dBm rms (IFBW=3 kHz)
- High Measurement Speed：100 μs/point (IFBW=30 kHz)
- High Effective Directivity：>45 dB

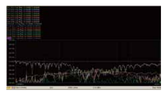
Real Multi-Ports VNA: Ten ports Matrix VNA T5840A

T5840A is a new generation of multiport matrix vector network analyzer . It can be widely applied to the research, development and test of RF devices in the fields of communication, medical care, scientific research and electronics. It can carry out parallel test on DUT with 10 ports under standalone operation, thereby greatly improving test efficiency and reducing test cost.

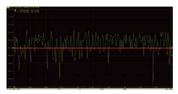
- Frequency range：300kHz to 4.5GHz
- Number of test ports：2-port basic unit (2~10 ports to be selected arbitrarily)
- Dynamic range：>120dB（IFBW 10Hz）typ. 123dB
- Power range：-50 to +10dBm
- Power accuracy：±1.0dBm
- IF bandwidths：10Hz to 100kHz
- Trace noise：0.002dBrms



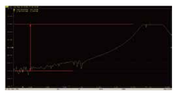
Key VNA Parameters



Trace Noise
Low trace noise can improve measurement stability and accuracy.



Noise
Generated by the VNA itself, have an effect on the measurement results.



Frequency Range
Low noise, large dynamic range helps to improve the accuracy and width of the test.

S-Parameter
Multi-ports matrix vector network analyzer can carry out parallel test on DUT with multi-ports, thereby improving test efficiency.

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