Microwave

6210 Reflection Analyzer

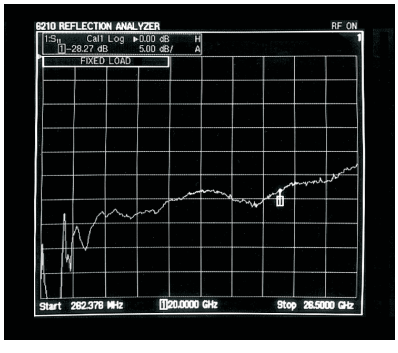
6210 enhances the capability of 6200B series by providing precision reflection coefficient and time domain measurements

- Excellent directivity and test port match for precise measurements of reflection coefficient
- Time domain software for pinpointing impedance discontinuities in devices or systems
- Polar and Smith Chart displays to facilitate matching of devices in circuits
- Fast sweep rate to speed up alignment of components in production test
- Wide range of calibration kits for 3.5 mm, Type N and 7 mm connectors
- Works with standard 6200 series Microwave Test Set for easy upgrade route

The 6210 Reflection Analyzer is designed specifically for precision measurements of reflection coefficient from 250 MHz to 26.5 GHz. 6210 fits underneath a 6200B series Microwave Test Set (MTS) which provides the synthesized signal source and analyzer display to form a single integrated test system. 6210 consists of additional hardware and software to enable error corrected reflection coefficient measurements with both cartesian and polar displays.

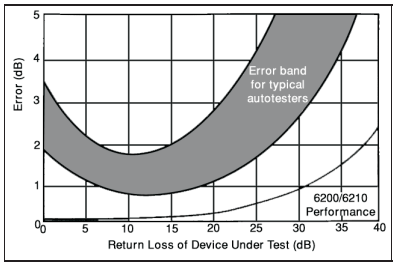
Accurate Return Loss Measurements

Reflection coefficient is the primary performance test for microwave systems and components. Return loss and VSWR are derivatives of reflection coefficient, they can be measured with a standard scalar analyzer and a directional RF bridge such as an autotester. An analysis of return loss measurements using an autotester shows that errors are dominated by test port match and directivity. The 6210 Reflection Analyzer makes error corrected return loss measurements to give improved accuracy and reduced uncertainty. The test port match and directivity achieved with 6210 is significantly better than that obtainable from autotesters.



6210 performs precision reflection coefficient measurements from 250 MHz to 26.5 GHz

Depending upon the test port connector and the quality of the calibration kit a test port match of >40 dB and directivity of >50 dB can be achieved.



Improvement of accuracy obtained with 6210 compared to an autotester.

In production areas this means less stand off due to measurement uncertainty resulting in higher yield and shorter test and rework time. To design engineers it means greater confidence in the quality of the initial design.

The measurement can be displayed in log magnitude, linear magnitude, VSWR, phase, polar, real, imaginary or Smith Chart formats.

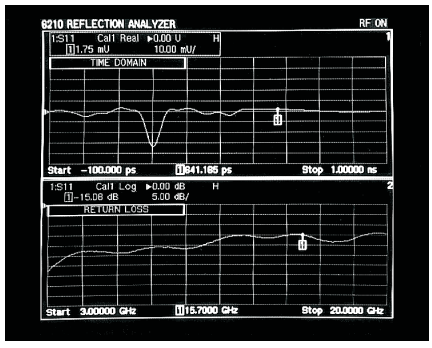
Integration of the synthesized source, reflection analyzer and display unit into one system makes the 6210 ideal for both production testing and design work. The soft key menu structure leads the user through the measurement and prompts appear when data has to be entered. Measurement setups and calibrations can be stored in the instrument memory. The macro facility reduces test time in production areas by automating repetitive test methods.

Time Domain Analysis

For design engineers early iterations of systems or components often need trouble shooting. A poor return loss can be the result of bad connector assembly, unoptimized track layout or incorrect component design. Time domain software gives a display of reflection coefficient against time (or distance) which simplifies diagnosis and pinpoints the problem area. The nature of the problem, capacitive or inductive, can be identified from the reflection coefficient value. Engineers can easily see if the device under test is faulty or needs improved impedance matching between adjacent components.

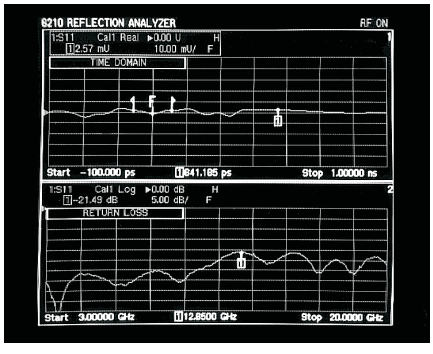
Time domain works by performing an inverse Fourier transform on the frequency domain data. Both lowpass and bandpass modes are available. Lowpass mode simulates a traditional Time Domain Reflectometer (TDR). It can be set up for both step and impulse responses. Low-pass mode can only be used on devices whose frequency characteristics extend down to DC. For frequency selective devices such as waveguide, filters and antennas bandpass mode must be used. The display zoom feature can be used to examine the frequency range of interest with greater clarity rather than the complete range of the calibration.

To overcome the effects of dispersion in waveguide a non linear (warped) frequency sweep can be selected. A normal linear sweep would blur the position of a discontinuity. Warped sweeps allow the discontinuity to be pinpointed accurately.



Time domain response and return loss measurement of a microwave component

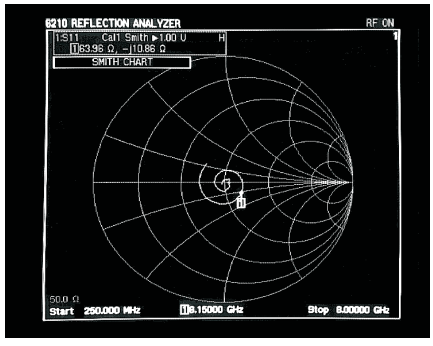
Once a discontinuity has been identified the gating and fencing functions can be used to isolate it mathematically. Fencing allows the user to see what the return loss would be without the effect of a particular fault. Conversely gating allows the user to see what the return loss of a specific fault or discontinuity is. These features are very powerful tools for diagnosing and improving the performance of a system. Knowing the position and severity of faults in a device means that they can be modified in the shortest possible time, speeding up design cycles.



For the same device shown previously, this display shows time domain response with fence around fault and return loss of device with effect of discontinuity removed

Complex Reflection Coefficient

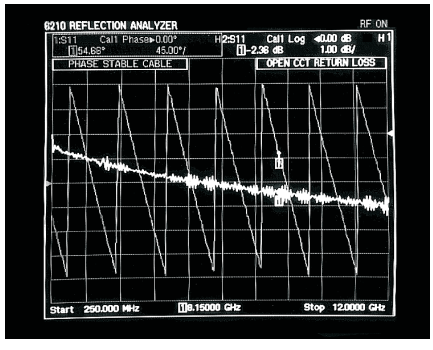
When building up systems which include devices such as transistors, PIN diodes, varactor diodes, capacitors and resistors, it is often necessary to fully characterize these devices. This allows prediction of the performance of a circuit at an early stage of the design reducing the number of design iterations. In order to match consecutive devices in a circuit it is essential to have knowledge of the complex reflection coefficient of each stage (input and output). This enables a matching circuit to be designed to ensure the overall circuit performance meets its specification. 6210 can display complex reflection coefficient in either polar or Smith Chart format. The accuracy of the device characterization can be enhanced by using the time domain gating function and electrical delay.



Smith Chart gives impedance information to aid design of matching circuits

The electrical delay facility of 6210 allows the user to shift the reference plane. When characterizing devices on a substrate or in a test fixture it is often necessary to shift the reference plane to the input of the device. This removes the response of the length of transmission line between the test port and the device input resulting in a display of input impedance of the device.

Phase Display



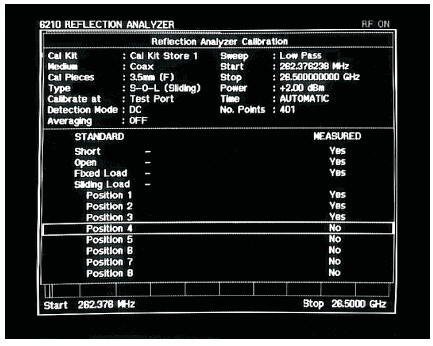
Phase characteristics and open circuit return loss measurement on a phase stable cable

The display can be formatted to show phase in degrees against frequency. This facility is invaluable for testing the phase stability of cables and for phase matching lengths of transmission line such as semi-rigid coax.

A cable with poor phase stability will introduce errors into measurements if moved after a calibration. Storing the phase characteristics of a cable into a trace memory and then comparing with a live trace enables the quality of the cable to be evaluated quickly.

Fast Calibration

An intuitive menu structure enables the user to quickly calibrate the 6210. Calibration kits are available for coaxial 3.5 mm, Type N and 7 mm connectors. Waveguide calibrations are also supported. A sliding load can give directivities of over 50 dB for coaxial measurements.



Screen displays lead the user through the calibration procedure

The overall performance of the 6210 is determined by the specification of the calibration kit used. The directivity, source match and response errors can be characterized by measuring known standards. Error correction routines in the 6210 then minimize errors during normal measurements. IFR offer full calibration kits including short and open circuits, fixed and sliding loads, connector gauges, test port adapters and torque spanners. To verify calibrations optional airlines are also available. The calibration kits are supplied in a protective wooden storage box.

Economy calibration kits which include open and short circuits and fixed loads are also available.

Active Device Measurement

For testing some active devices such as PIN and varactor diodes and transistors it is necessary to have a biasing voltage on the output of the test port. The optional bias tee (option 011) allows voltages to be applied to the test port. The internal voltage/current source of the MTS can be used as the supply.

Test Port Flexibility

The use of adapters at the test port to provide the most suitable test port connector does not degrade measurement accuracy. This is because calibration removes the effect of the adapter. Errors associated with scalar analyzers and autotesters using test port adapters are therefore not encountered when using the 6210 Reflection Analyzer.

A range of ruggedized test port cables are available. Test port cables allow error corrected measurements to be made remote from the front panel connector with the choice of test port connectors including 3.5 mm male and female and Type N male and female or 7 mm. All test port cables are phase stable so that repositioning the cable after a calibration will still give good measurement accuracy.

Comprehensive Measurement System

A 6210 can be added to any 6200B series Microwave Test Set. All the features of the 6200B are retained including absolute power measurement, frequency counter, voltage/current source, standard scalar analyzer and synthesized sweep generator. The synthesizer can also be used as a CW signal source.

6210 can be added to an MTS at any time giving an easy upgrade route for users whose measurement requirements become more demanding. The comprehensive marker functions, limit lines, scaling and plotting functions are all available when using the 6210 Reflection Analyzer.

SPECIFICATION

Number of Test Ports

1 for the measurement of S11

Frequency Range (when used with)

6202B	*250 MHz to 2 GHz*
6201B	*250 MHz to 8 GHz*
6200B	*250 MHz to 20 GHz*
6203B or 6204B	*250 MHz to 26.5 GHz*

Dynamic Range (Noise Floor) *(Source set to + 3 dBm)*

250 MHz to 500 MHz	*>50 dB, 60 dB typical*
500 MHz to 18 GHz	*>60 dB*
18 GHz to 26.5 GHz>	*50 dB, 60 dB typical*

Insertion Loss from RF Input to Test Port

Typically 5 + (8 x f / 26.5) dB
where f is the set frequency in GHz

Number of Measurement Points

User selectable 2 to 800

SWEEP TIME

Auto

Sweep time is as fast as possible for the attributes selected

Manual

Sweep time will never be less than the sweep time entered and may be greater depending on constraints imposed by the system hardware, number of points and measurement software processing overhead.

Fastest time (401 points)

300 ms

Settable range

40 ms to 500 s

NOISE REDUCTION

Averaging

1 to 1000 (applied instrument wide)

Smoothing

0.01% to 20% of span, resolution 0.01%

CALIBRATION

Calibration Types - *1 Port*

COAX	***WAVEGUIDE***
short, open, fixed load	short, offset short, fixed load
short, open, sliding load	short, 2 x offset shorts
short, offset short	sliding load.

In addition the ability to specify sex and connector type of the test port

Number of cal points

Same as number of measurement points

Calibration kits (optional)

Economy – Type N and 3 5 mm
Full – Type N, 3.5 mm and 7 mm

Calibration stores

4, with number of calibration points user selectable from 2 to 800
Additional storage is available via memory card (optional accessory)

REFLECTION ANALYZER SYSTEM PERFORMANCE

Dependent on calibration kit used. Specifications assume a 2 hour warm up period from power on and an ambient temperature of 23°C ±3°C

N type calibration kit (economy)

Directivity	
<2 GHz	*>40 dB*
2 GHz to 18 GHz	*>30 dB*
Source Match	
<2 GHz	*>30 dB*
2 GHz to 18 GHz	*>24 dB*
Frequency response	*Within ±0.25 dB*

N type calibration kit (full)

Directivity	*>40 dB*
Source Match	*>30 dB*
Frequency response	*Within ±0.2 dB*

7 mm type calibration kit (full)

Directivity	*>50 dB*
Source Match	*>40 dB*
Frequency response	*Within ±0.1 dB*

3.5 mm type calibration kit (economy)

Directivity	
<2 GHz	*>40 dB*
2 GHz to 26.5 GHz	*>25 dB*
Source Match	
<2 GHz	*>30 dB*
2 GHz to 26.5 GHz	*>22 dB*
Frequency response	*Within ±0.4 dB*

3.5 mm type calibration kit (full)

Directivity	*>40 dB*
Source match	*>30 dB*
Frequency response	*Within ±0.2 dB*

REFLECTION ANALYZER CHANNEL FEATURES

DOMAINS

Frequency

Modes

CW, F1-F2, CF/span, frequency list sweep, harmonic

frequency sweep, waveguide frequency sweep.

Ability to blank frequency information to be restored by PRESET.

Resolution

1 Hz settable

Six digits displayed on graticule

POWER

Sweep range

25 dB
85 dB with MTS attenuator option

Resolution

0.01 dB settable

Offset

Ability to enter offset (per channel) between source and display

TIME

Time domain response for impedance discontinuity analysis

Stimuli

Lowpass step
Lowpass impulse
Bandpass impulse

Resolution (26.5 GHz sweep)

Reflection (in air transmission lines)
Lowpass 0.7 cm
Bandpass 1.4 cm

Point Spacing

<0.01 cm

Windowing

Kaiser Bessel - user definable.

Gating

User definable start, stop and shape.

Fencing

User definable start, stop and shape.

VOLTAGE/CURRENT

Ability to sweep rear panel V/I output in the range
–15 V to +15 V(±15 mV, 2.5 W max) or in the range
–150 mA to +150 mA (±300 mA, 1.25 W max)

Voltage resolution

1 mV

Current resolution

10 mA

REFLECTION ANALYZER CHANNEL FEATURES
RESPONSE

Format

Cartesian:	*Logarithmic magnitude, Linear magnitude, Phase, VSWR, Real, Imaginary.*
Polar:	*Smith and Inverse Smith chart, Logarithmic magnitude, Linear magnitude.*

Scaling

Magnitude - Log format 0.01 dB/div to 20 dB/div in 1, 2, 5 sequence
Lin format 10-12 units/div to 103 units/div

Phase - Cartesian: 0.1°/div to 180°/div
Polar: 45°/div

Reference Level Position

Any graticule line

Reference Level Value

–99.99 to +99.99 all units except VSWR
1 to 100 VSWR

MEASUREMENT MANIPULATION

Display

Display live measurement
Display trace memory
Display user defined expressions involving subtraction and division on a live measurement and a trace memory
Measurement Hold applied per trace

Complex limit lines

Four stores of 12 segments each. Each segment defines an upper and a lower limit line. Any store can be applied to any cartesian trace

MARKERS

Eight per trace, any one of which can be enabled to become the active marker, plus a separate delta marker.

Marker domain resolution

Frequency -	*Six digits by default. User has the ability to select 1 Hz resolution*
Power -	*0.01 dB*
Voltage -	*1 mV*
Current -	*10 mA*

Marker Response Resolution

Magnitude	*Log*	*0.01 dB*
	Lin	*Six digits*
Phase	*0.01°*	

Marker functions

Active marker, delta marker, minimum, maximum, search left, search right, 'N-dB' bandwidth, peak-to-peak response.

Reference Plane Extension

User definable
Electrical Delay - ±1 s maximum or ±300,000 km
Phase Offset - ±360° maximum

Non-Dispersive Media

Can enter delay as either physical length (m) or electrical delay (s). Relative velocity (Vr) and relatively permittivity (er) may be entered.

Characteristic Impedance

User definable, default 50 Ω

Waveguide Cut Off Frequency

User definable

TEST PORT CONNECTOR

Ruggedized precision 3.5 mm male
Maximum Input Power - 0.5 W

POWER SUPPLY

Consumption - 50 W maximum (in addition to MTS)

SIZE

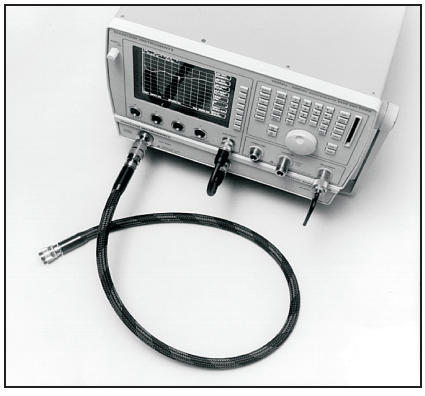
46 mm high, 325 mm wide 450 mm deep

WEIGHT

6.5 kg (including interconnecting cables and fixing kit)

OPTIONAL BIAS TEE

Bias Voltage Range - ±42 V
Current Range - 0.5 A max
Insertion Loss - <1.5 dB



Ruggedized test port cables are available with 3.5 mm, Type N and 7 mm connectors

VERSIONS AND CALIBRATION KITS

When ordering please quote the full ordering number information.

REFLECTION ANALYZER

Order Numbers

6210	250 MHz to 26.5 GHz Reflection Analyzer

Options

Option 011	Bias tee
Option 012	Retrofit version

Supplied with

43138/328	Auxiliary signal channel cable
43138/283	Auxiliary data cable
43138/284	Auxiliary power cable
43138/366	RF interconnection cable – N type
43138/367	RF interconnection cable – 3.5 mm

Note: The 6210 Reflection Analyzer can be supplied as part of a system with one of the 6200B series Microwave Test Sets above or as a retrofit version for fitting to an existing 6200B series Microwave Test Set. Microwave Test Sets must be fitted with software issue 2.0 or higher. Contact your local IFR Service Center if a software upgrade is required.

TEST PORT CABLES

	Phase stability 0 2 x f (GHz) degrees
54311/155	Rugged 3.5 mm female to 7 mm
54311/156	Rugged 3.5 mm female to N type male
54311/157	Rugged 3.5 mm female to N type female
54311/158	Rugged 3.5 mm female to rugged 3.5 mm male
54311/159	Rugged 3.5 mm female to std. 3.5 mm female

50 Ω FIXED LOADS

	Specification as for calibration kits
54421/009	7 mm Fixed Load
54421/010	3.5 mm (f) Fixed Load
54421/011	3.5 mm (m) Fixed Load
54421/012	N Type (f) Fixed Load
54421/013	N Type (m) Fixed Load

ACCESSORIES

54112/157	Soft carrying case
54124/028	Front stowage cover for assembled MTS and 6210

Full and Economy calibration kits are available with 3.5 mm, Type N and 7 mm connectors

BOXED CAL KITS IN 3.5 MM

Order numbers

54424/009 Economy comprising

2 x short circuit (male and female)
2 x open circuit (male and female)
2 x fixed load (male and female)
Female/female precision adapter

Fixed load return loss

<2 GHz	40 dB
2 GHz to 26.5 GHz	25 dB

Optional Accessories

54425/005	Gauge kit (3.5 mm), comprising:- 2 x Gauges (m) and (f), adapter and gauge blocks
54152/001	3.5 mm torque wrench
54311/164	3.5 mm male/male matched adapter
54311/165	3.5 mm male/female matched adapter

54424/007 Full comprising

As economy kit including optional accessories plus 2 x sliding load (male and female)

Optional Accessory

54425/003	Precision 15 cm airline (3.5 mm)

BOXED CAL KITS IN 7 mm

Economy not available

54424/001 Full comprising

Short circuit	Open circuit
Fixed load	Sliding load
Collet extractor	Torque wrench
Gauge and gauge block	

Rugged 3.5 mm (female) to 7 mm adapter

Fixed load return loss

<2 GHz	50 dB
2 GHz to 18 GHz	30 dB

Optional Accessories

54425/001	Precision 30 cm airline (7 mm)
54311/163	Rugged 3.5 mm (female) to 7 mm adapter
54421/009	Fixed matched load (return loss as above)

BOXED CAL KITS IN TYPE N

Order numbers

54424/005 Economy comprising

2 x short circuit (male and female)
2 x open circuit (male and female)
2 x fixed load (male and female)
Rugged 3.5 mm to N(m) Adapter
Rugged 3.5 mm to N(f) Adapter

Fixed load return loss

<2 GHz	40 dB
2 GHz to 18 GHz	30 dB

Optional Accessories

54425/004	Gauge kit (N type), comprising:- 2 x Gauges (m) and (f), adapters and gauge blocks
54311/166	N type male/male matched adapter
54311/167	N type male/female matched adapter
54311/168	N type female/female matched adapter

54424/003 Full comprising

As economy kit including optional accessories plus 2 x sliding load (male and female)

Optional Accessory

54425/002	Precision 30 cm airline (N type)

Note: Calibration kits and accessories carry a one year warranty excluding wear and tear and misuse.

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