

# Spectrum Analyzers

## 2399B 9 kHz to 3 GHz Spectrum Analyzer

**AEROFLEX**  
A passion for performance.



A spectrum analyzer with outstanding performance and a user friendly visual interface simplifying many complex measurements

- 9 kHz to 3 GHz fully synthesized frequency range
- Lightweight, portable and rugged construction at 9.4 kg
- Excellent TFT color display
- Comprehensive marker facility
- Wide input signal range +30 dBm to -110 dBm
- Optional full range tracking generator
- Semi-automated measurements
- Optional internal pre-amplifier
- Floppy disk drive
- Extremely user friendly MMI reduces risk of operator error
- Auto-Tune facility
- GPIB as standard
- AM/FM demodulation

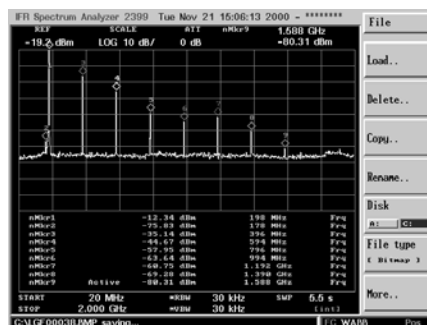
### Portability

With a weight of only 9.4 kg (20.7 lbs.) the 2399B is one of the lightest spectrum analyzers available. A truly portable unit!

### Color Display

The 6.4 inch TFT color LCD in the 2399B provides a clear, bright, sharp display with a 640 x 480 pixel active display area viewable in high ambient light conditions.

### Comprehensive Marker System



Marker Table

The marker system allows up to a maximum of 9 markers to be displayed on the screen at any one time. A marker table shows the frequency and level of each marker selected thus allowing multiple signals to be evaluated simultaneously. In addition to the Normal markers 2399B provides Delta, Peak Search, Peak Track, 1/Delta, Marker Track, Marker to Center and Marker to Reference capabilities.

### Measurement Limits

The Limits facility allows an Upper and/or a Lower Limit to be set on the screen of the 2399B. Should the signal being displayed fall outside either limit a message will appear on the screen showing

### A "Value for Money" Product

The 2399B is the latest in the range of spectrum analyzers from Aeroflex providing exceptional performance at an exceptional price.

### Frequency Accuracy

The local oscillator system in the 2399B is fully synthesized thus providing accurate frequency measurements with 1 Hz resolution.

which limit has been exceeded and how many times this has happened.

### Wide Signal Measurement Range

The 50 ohm input on the 2399B can accept signals between +30 dBm and -110 dBm while providing protection to  $\pm 50$  Vdc.

### Semi-Automated Measurements

The MMI on the 2399B has been designed to simplify many of the measurements required for the evaluation of today's sophisticated communications systems. These include Adjacent Channel Power, X dB Down, Occupied Bandwidth, Channel Power and Harmonic Distortion.

### Auto-Tune Function

Use of this function allows an unknown signal to be quickly captured and displayed on the screen. The 2399B will search its complete frequency range for the highest level signal, capture it and display it in the center of the screen with both the span and resolution bandwidths being automatically set to the optimal state for best viewing.

### Spectral Purity

The phase noise on the 2399B is specified at -90 dBc at 10 kHz offset which allows its use for evaluating the spectral purity and noise performance of systems and sub-systems.

### Signal Demodulation

Demodulation of both AM and FM signals allows full testing on a wide range of communications systems. The demodulated signal can be viewed on the screen and is also available on the internal loud-speaker and on headphones via a connector on the front panel. The fm peak deviation and am modulation depth can be measured using the markers provided in the 2399B.

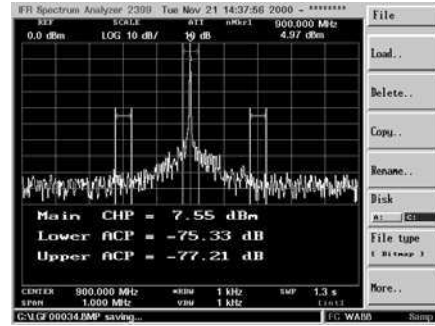
### Information Storage

The 2399B is provided with the capability of internally storing up to 1,000 screen traces and 2,000 operational states. The spectrum analyzer is also fitted with a 3.5 inch FDD (Floppy Disk Drive) for bulk storage.

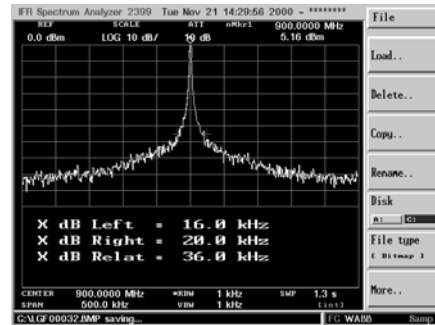
### Interfaces

IEEE 488-2, RS-232 and Printer (PCL5) interfaces are provided as standard on the 2399B allowing its integration into automated test systems and the print out of screen displays.

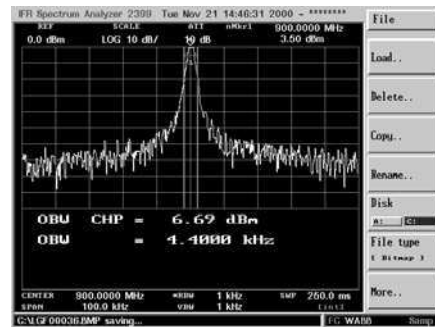
The 2399B has been designed with future flexibility and expansion in mind. The operating system and system memory have the capability to incorporate additional facilities.



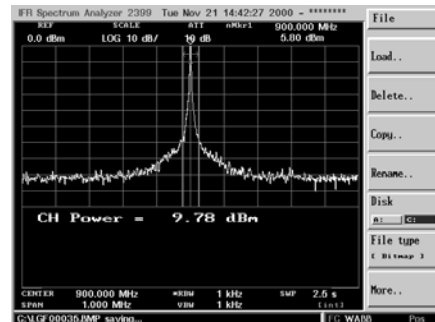
Adjacent Channel Power



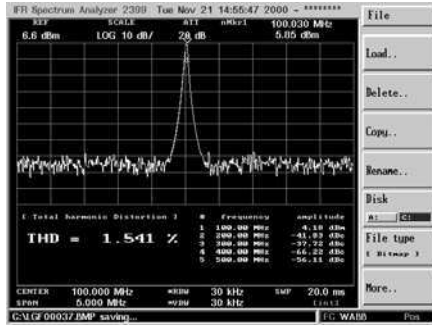
X dB Down



Occupied Bandwidth



Channel Power



Harmonic Distortion

## DISTANCE TO FAULT SOFTWARE OPTION

The 2399B spectrum analyzer is widely used by field installation and maintenance engineers for monitoring the spectral output from cell site transmitters. The new Distance to Fault (DTF) option allows measurement of VSWR of the RF feed cables and, in the event of failing test limits, will then perform a DTF (TDR) measurement to identify the faulty part of the feed system.

Experience shows that one of the biggest causes of degradation or failure of RF communications systems is the transmission line from the base station transceiver to the antenna.

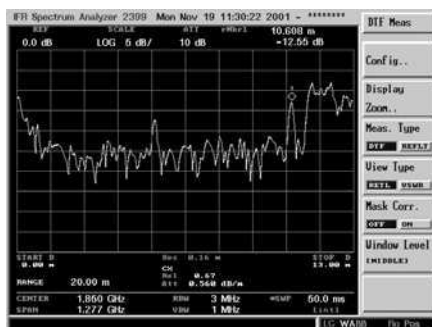
### Testing the Transmission Line

When a new cell site is installed, the key measurement to test the quality of the installation is the VSWR (return loss) of the feed cable when terminated with the antenna system. Poor installation will result in unacceptable return loss (VSWR), reducing the quality of the system.

Even a system that is well within specification when installed may degrade with time due to the effects of weather, corrosion or accidental damage.

### Fast Fault Location (DTF)

The 2399B spectrum analyzer DTF option is designed to enable users to measure VSWR (return loss) routinely and quickly. In the event of failure, switching to DTF mode pinpoints the problem area so that corrective action can be taken.



Distance to Fault

Identifying the faulty component in the system and initiating a repair is simplified, resulting in less system down time. The 2399B DTF measurement is real time so it can identify even intermittent faults.

## Built-in Features

The DTF software option comes with a built-in Transmission Line Database that contains the characteristics of the most commonly used coaxial cables. This eliminates the need to refer to manufacturers' data sheets when configuring the 2399B for DTF operation.

## SPECIFICATION

### FREQUENCY

#### Tuning Range

9 kHz to 3 GHz

#### Resolution

1 Hz

#### Frequency Span Width

100 Hz/div to 300 MHz/div in 1, 2, 5 step selections (auto-selected)  
Zero span and Full span (9 kHz to 3 GHz)  
Manual selection of Start, Stop and Span

#### Span Accuracy

±3% of indicated span width

#### Readout Accuracy

±(span accuracy + frequency standard accuracy + 50% of RBW)

#### Stability

Residual FM <100 Hz p-p at 1 kHz RBW, 1 kHz VBW, (p-p in 20 ms)

#### Noise Sidebands

-90 dBc/Hz at 10 kHz offset measured at 2.9 GHz  
-98 dBc/Hz at 100 kHz offset measured at 2.9 GHz

### FREQUENCY COUNTER

#### Resolution

1 Hz, 10 Hz, 100 Hz, 1 kHz

#### Accuracy

±(Reference frequency error + frequency readout accuracy + counter resolution ±1 count)

#### Sensitivity

<-70 dBm from 50 kHz to 3 GHz

## AMPLITUDE

### Measurement Range

+30 dBm to -110 dBm

### DANL

	Amp Out (typ)	Amp In (typ)*
50 kHz to 100 kHz ≤95 dBm amp out,	-105 dBm	-117 dBm
100 kHz to 3 GHz ≤105 dBm amp out,	-115 dBm	-127 dBm
300 Hz RBW, 10 Hz VBW		

\* When fitted as option 07

### 1 dB Compression Point

-10 dBm minimum 100 kHz to 3 GHz at 0 dB attenuation

### Displayed Range

100 dB in 10 dB/div log scale  
50 dB in 5 dB/div log scale  
20 dB in 2 dB/div log scale

10 dB in 1 dB/div log scale  
10 divisions with linear amplitude scale

#### Amplitude Units

Log scale mode dBm and dBmV  
Linear scale mode V ( $\mu$ V, mV, etc.) or dBV (dBmV only)  
Quasi-Peak mode dB $\mu$ V, dBmV or dBm

#### Display Linearity

5 and 10 dB/div,  $\pm 0.15$  dB/dB,  $\leq \pm 1.5$  dB over 10 divisions  
1 and 2 dB/div,  $\pm 0.5$  dB over 10 divisions  
Linear,  $\pm 10$  % of Reference Level over 10 divisions

#### Frequency Response

$\pm 1.5$  dB from 10 MHz to 3 GHz and  $\pm 2$  dB from  
9 kHz to 10 MHz with 10 dB RF attenuation

### ATTENUATOR

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#### Range

0 dB to 50 dB in 10 dB steps selected manually or automatically coupled to the Reference Level

#### Accuracy

$\pm 0.5$  dB/step up to a 1.5 dB maximum

### REFERENCE LEVEL

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#### Range

-110 dBm to +30 dBm with 1 kHz filter using 1 dB/div scale

#### Accuracy

$\pm 1.5$  dB (50 kHz to 3 GHz)

#### Resolution

0.1 dB steps

#### Residual Spurious

$\leq -85$  dBm (input terminated, 0 dB attenuation)

#### Harmonic Distortion

$\leq -60$  dBc (-40 dBm input at 0 dB attenuation)

#### Intermodulation

$\leq -60$  dBc (100 MHz to 2.9 GHz at -30 dBm input)

#### Other Spurious

$\leq -60$  dBc (10 MHz to 2.9 GHz at -30 dBm)

### RESOLUTION BANDWIDTH

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#### Selection

300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz + 10 Hz, 30 Hz, 100 Hz (option 05)

#### Accuracy

$\pm 20$  %

#### Selectivity

60 dB/3 dB ratio <15:1  
except 3 MHz filter 50 dB/3 dB ratio <15:1  
60 dB/6 dB ratio <12:1 for 9 kHz and 120 kHz Quasi-Peak filters

#### Switching Error

$\pm 1.0$  dB

#### Video Selection

10 Hz to 1 MHz in 1-3-10 sequence plus full BW

### SWEEP

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#### Rate (full screen)

50 ms to 1000 s in 1-2-5 sequence, 25  $\mu$ s to 20 s in Zero Span

#### Sweep Rate Accuracy

20% for <100 ms, 10% for all other sweep rates

#### Trigger Source

External, Line, Video, Free Run

#### Trigger Modes

Continuous, Single

#### Trigger Level

Internal Trigger: Adjustable over 10 divisions  
External Trigger (Rear): TTL Level

#### Trigger Delay

$\pm$ One sweep time

### DISPLAY

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#### Type

6.4 in. TFT Color LCD

#### Digital Resolution

640 H x 480 V active display area

### MARKERS

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#### Number

Up to 9 colored Markers available with 9 Delta Markers

#### Modes

Normal, Delta, Peak Search, Peak Track, 1/Delta, Marker Track, Marker to Center, Marker to Reference  
All Markers to peak

#### Marker

Marker track  
Marker to center  
Marker to reference  
Marker to peak

### MEMORY

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#### Trace storage

Up to 1,000 stored traces stored internally

#### Setup Storage

Up to 2,000 operational states stored internally

#### External

3.5 in. FDD for bulk storage

#### Display Traces

2 max.

## INPUTS

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### RF Input

Type "N" 50 Ohm female connector

### Input VSWR

<1.5:1 from 150 kHz to 3 GHz with 10 dB attenuation

### Maximum Input

+30 dBm with 30 dB attenuation, 50 Vdc

### LO Emissions

≤70 dBm with 10 dB attenuation

## OUTPUTS

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### IF Output

10.7 MHz nominal

### Video Output

0 to 5 Vdc, VGA output

### Printer Drivers

PCL5 compatible via standard 25-pin female D-Sub Parallel Printer

### Probe Power

+15 V, -12 V and Ground

## FREQUENCY STANDARD (NORMAL STABILITY - SEE ALSO OPTION 03)

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### Frequency

10 MHz

### Output Level

+5 dBm nominal

### Temperature Stability

±2 ppm/°C 0°C to 40°C

### Ageing Rate

±1 ppm/year

### Connector

BNC female

### External Input

-5 dBm to +15 dBm

## INTERFACES

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### GPIB

Conforms to IEEE 488.1 – 1987, 488.2 – 1992

### Subsets

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, C0, LE0, TE0

### RS-232C

Full Duplex

### Baud Rate

110 bps, 300 bps, 600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps

### Parity Check

Odd, Even or None

### Data Length

7 or 8 bit selectable

### Stop Bits

1 or 2 bit

### Protocol

None, Xon-Xoff, RTS-CTS, DTR-DSR

## ENVIRONMENTAL

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### Operating

0 to 40°C

### Storage

-20 to +70°C

### Temperature & Humidity

Meets MIL-T-28800E for Type 2, Class 5, non-condensing (85 % operating, 90 % storage)

### Vibration/Shock

Meets MIL-T-28800E for Type 2, Class 5

### Altitude

Operational up to 3,000 m (19,842 ft.), non-operational to 12,200 m (40,026 ft.)

## PRODUCT SAFETY

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Conforms to EN61010-1 for Class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an Installation Category II.

## ELECTROMAGNETIC COMPATABILITY

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Complies with the limits specified in the following standards: EN 55011: Class A and EN 50082-1

## GENERAL CHARACTERISTICS

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### DIMENSIONS

350 mm (13.78 in.) W, 185 mm (7.28 in.) H, 381 mm (15 in.) D including handle

### Weight

9.4 kg (20.7 lbs.)

### Warm-up Time

15 minutes for specified accuracy

## POWER REQUIREMENTS

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### Voltage

100 to 240 Vac ±10%

### Frequency

50 to 60 Hz

### Power Consumption

90 W max. w/o options fitted

## HARDWARE OPTIONS

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### TRACKING GENERATOR

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#### Frequency Range

100 kHz to 3 GHz

#### Output Level

0 to -70 dBm

#### Output Level Resolution

0.1 dB step

#### Absolute Level Accuracy

$\leq \pm 1.0$  dB at 0 dB

#### Frequency Flatness

$\leq 2.0$  dB at -10 dBm

#### Signal Purity

Harmonics  $\leq 15$  dBc  
Non-harmonics  $\leq 25$  dBc  
Sub-harmonics  $\leq 25$  dBc

#### Leakage

$\leq 90$  dBm

### HIGH STABILITY TIMEBASE (OPTION 03)

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#### Temperature Stability

$\pm 0.2$  ppm/ $^{\circ}$ C  $0^{\circ}$ C to  $40^{\circ}$ C

#### Ageing Rate

$\pm 0.1$  ppm/yr.

### QUASI-PEAK DETECTOR (OPTION 04)

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#### Quasi-Peak detector and EMC filters

RBW	9 kHz Band B	120 kHz Band C
Frequency Range	150 kHz to 30 MHz	30 MHz to 1 GHz
Charge Time (ms)	1 $\pm 20\%$	1 $\pm 20\%$
Discharge Time (ms)	160 $\pm 20\%$	550 $\pm 20\%$
Display Time (ms)	160 $\pm 20\%$	100 $\pm 20\%$

### DIGITAL RESOLUTION BANDWIDTH FILTERS (OPTION 05)

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#### Bandwidths

100 Hz, 30 Hz, 10 Hz

#### Bandwidth accuracy

$\pm 20\%$

#### Selectivity (-60 dB/-3 dB)

$< 5:1$

#### Maximum span

1 MHz

#### Sweep times for 10 kHz span

RBW	100 Hz	$< 0.9$ sec.
	30 Hz	$< 3$ sec.
	10 Hz	$< 4.5$ sec.

Displayed Average Noise Levels (DANL) between 1 MHz and 2.4 GHz reduces DANL by typically 5 dB from the values in the 300 Hz resolution bandwidth filter.

## AC/DC POWER SUPPLY (OPTION 6)

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#### DC Voltage

1.2VDC to 21VDC

#### External Battery

14.4VDC @ 7AH

#### Operation Time

1 Hour

### INTERNAL LOW NOISE PRE-AMPLIFIER (OPTION 07)

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#### Internally fitted option

DANL	Improves DANL by approximately 12 dB above 50 MHz	
Frequency Range	50 kHz to 50 MHz	-115 dBm typical
DANL	50 MHz to 1.8 GHz	-127 dBm typical
	1.8 GHz to 3 GHz	-126 dBm typical
Gain	Compensated internally	
Selection	User selected	

## SOFTWARE OPTIONS

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### OPTION 11 - DISTANCE TO FAULT (DTF)

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#### DISTANCE TO FAULT SPECIFICATIONS

##### DTF Measurement

##### Measurement Range

Up to 99 km (324,720 ft.) depending on cable loss

##### Units

Meters or Feet

##### Minimum Resolution

For two equal amplitude discontinuities using maximum span:

$13.24 \times V_r$  cm

Where  $V_r$  is the relative velocity factor for the cable.

##### Maximum Measurement Update Rate

20 ms for 500 points

##### Dynamic Range

$> 60$  dB

##### Distance Accuracy

0.78 m for a single fault

##### Transmission Line Database

Data for common cables supplied as standard

##### VSWR or Return Loss Measurement

##### Calibration

Open circuit or Short circuit

##### Linearity

As spectrum analyzer:  $< 0.15$  dB/dB,  $< 1.5$  dB over 10 divisions

##### Accuracy

Linearity + directivity + test port mismatch

For Bridge 59999/170 at frequencies  $> 50$  MHz:

Accuracy  $< 0.01 + 0.032\rho^2 + \text{linearity}$

Where  $\rho$  is reflection coefficient of system under test.

## ACCESSORY OPTIONS TO MAKE THE MEASUREMENTS

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The user can choose from a range of accessories to suit the test regime required.

In order for the DTF option to operate, the 2399B must be fitted with the optional tracking generator (2399B/1) and the DTF software, option 011.

### Hardware Configurations

#### 1. VSWR (Return Loss) only

Comprises:

RF Bridge (5 MHz to 3 GHz)	59999/170
RF cable, 0.5 m [type N (male) to type N (male)]	54351/022
Adapter type N (male) to type N (male)	54311/175

#### 2. DTF only

Comprises:

Power Divider (type N)	54311/187
RF cable, 0.5 m [type N (male) to type N (male)]	54351/022
Calibration Load (50 Ohm)	54421/023

#### 3. VSWR (return loss) and DTF

Comprises:

RF Bridge (5 MHz to 3 GHz)	59999/170
RF cable, 0.5 m [type N (male) to type N (male)]	54351/022
Adapter type N (male) to type N (male)	54311/175
Power Divider (type N)	54311/187
Calibration Load (50 Ohm)	54421/023

### OPTION 12 - MARKER LABEL EDIT

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This software option allows the user to change the marker label from the normal numeric format to a user defined 4 digit alpha-numeric label.

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## VERSIONS, OPTIONS AND ACCESSORIES

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### Versions

2399B/0	9 kHz to 3 GHz basic spectrum analyzer
2399B/1	2399B/0 with tracking generator

### Options

03	High stability timebase
04	Quasi-peak detectors and filters
05	Digital resolution bandwidth filters
06	AC/DC power supply
07	Internal pre-amplifier
11	Distance to fault (DTF) software
12	Marker label edit software

### Supplied Accessories

	Front cover
	Operation manual
	Programming manual
	AC supply lead
	RS-232 cable
	2 x 250 V, 3.15 A fuses
80010	Soft carry case

### Optional Accessories

	Maintenance manual
AC2621	Rack mount kit
59999/170	Return loss bridge 5 MHz to 3 GHz, type N (f)
AC4250	50 $\Omega$ N to 75 $\Omega$ BNC
AC5008	DC block N type
AC8700	UHF antenna
80010	Soft carry case

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

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