

**A breakthrough in high performance spectrum analysis, combining cost effectiveness and portability in a new lightweight instrument**



- **9 kHz to 2.7 GHz fully synthesized frequency range**
- **8.2 kg (18 lb): Lightweight, rugged and portable**
- **Split screen operation**
- **Low phase noise**
- **300 Hz minimum resolution bandwidth**
- **Wide input range +26 to -105 dBm**
- **AC/DC/Battery operation**
- **AM/FM demodulation**
- **Full range Tracking Generator Option**
- **EMC measurement capability**
- **GPIB as standard**
- **EasySpan software**

The 2398 Spectrum Analyzer is another in the series of quality spectrum analyzers from IFR. It provides exceptional performance in a lightweight, portable unit.

#### Frequency Accuracy

With a fully synthesized local oscillator system, the 2398 produces highly accurate frequency measurements. The standard 1 Hz frequency counter gives high resolution measurements of any signal above -70 dBm.

#### Lightweight

Weighing only 8.2 kg (18 lb), the 2398 is one of the lightest spectrum analyzers available. This allows measurements to be made in the lab or in the field on a variety of wireless test, troubleshooting or installation applications.

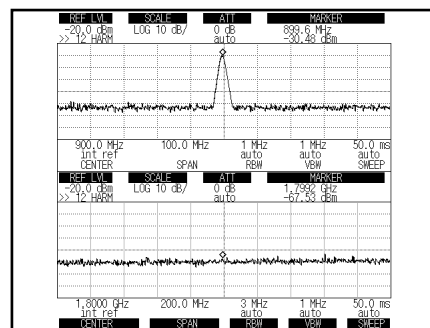
#### Battery and DC capabilities

An optional AC/DC power supply or external battery allows the analyzer to be used in remote locations. DC operation is possible from anywhere between +13 v to +21 v DC.

#### Split Screen Operation

The integral "window" or "split screen" feature allows the analyzer to view a signal in the upper zone and an entirely different signal and setup in the lower zone.

This special capability allows interfering signals to be tracked, an application that is becoming more prevalent in cellular CDMA and TDMA systems.

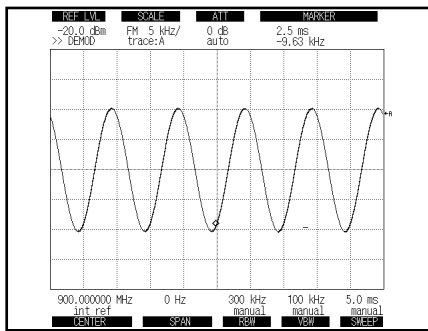


#### Outstanding Spectral Purity

The 2398 offers phase noise of -90 dBc/Hz at 10 kHz offset for determining the spectral purity of modules or systems.

#### Standard AM / FM Receiver

A standard AM and FM demodulator allows full testing and troubleshooting of a wide range of wireless radio systems and repeaters. An internal speaker and a headphone connector are provided.



### Wide Signal Measurement Range

The 2398 provides an input signal range from +26 dBm to -105 dBm. This, combined with the AC coupled RF input, allows direct testing of RF amplifiers.

With the increased deployment of cellular technologies, the 2398 gives a broad range of tools for finding the source of interfering signals in modern wireless systems.

### Versatile Interfaces

The RS-232 interface and a parallel printer port are fitted as standard. The IEEE-488 (GPIB) port offers the additional capability of fully automated testing and data tracking. Hard copies of screen displays can be easily printed.

### PCMCIA Memory

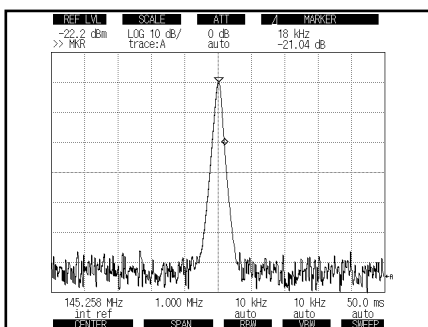
The unit can simultaneously store 20 traces and 10 setups in the internal memory at any one time. It also has an optional PCMCIA memory card slot for mass storage of traces and setups.

### Enhanced Measurement Capabilities

The 2398 has user selectable internal measurement features that perform such measurements as occupied bandwidth, channel power, adjacent channel power and X dB down.

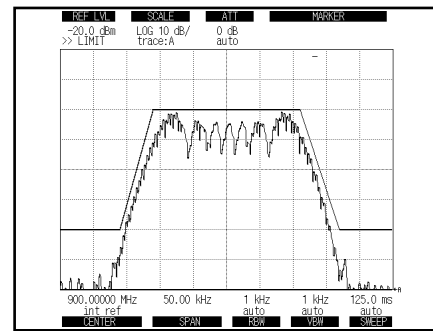
### Versatile Markers

A full range of marker capabilities such as peak function, delta, marker noise and marker zoom are provided. When combined with the accuracy of the 2398, they allow for faster and more comprehensive measurements of the signals displayed.



### Limits Capability

The 2398 gives a comprehensive limits capability that allows for the setup of a Pass/Fail line on the screen. When a signal exceeds this limit line, FAIL will be displayed on the screen.



### EMC Measurements

There is an optional Quasi-Peak Detector with a 9 kHz and 120 kHz filter. With today's growing demand for EMC compliance, it is necessary to design and test to the new standards and guidelines. The 2398 is ideal for field as well as design lab pre-compliance testing.

### Autoset

Autoset is a one-button solution that allows for the instant viewing of an unknown signal. The 2398 will search for the highest signal level and tune the center frequency to that signal. Then the span and resolution bandwidth are set to an optimal state for the best view of the signal.

### EasySpan

2398 functionality can be extended by using the IFR EasySpan software application for Windows. This software enables trace data to be transferred to a PC for storage, processing and analysis. EasySpan allows 2398 to be operated remotely via an RS-232 modem and includes a soft front panel instrument control facility ideal for interference monitoring radio networks. EasySpan also enables GPS position and time information to be added to trace data. Coupled with the instruments small size, low weight and DC operation this allows radio mapping measurements to be made with ease.

## SPECIFICATION

### FREQUENCY

#### Tuning Range

9 kHz to 2.7 GHz

#### Tuning Resolution

1 Hz

#### Frequency Span Width

100 Hz/div to 270 MHz/div in 1, 2, 5 step selections (auto selected) plus ZERO Span, and FULL Span (9 kHz to 2.7 GHz). Manual selection of start, stop, and span.

#### Span Accuracy

±3% of the indicated span width

#### Readout Accuracy

±Span accuracy + frequency standard accuracy + 50% of RBW

## Stability

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

## Noise Sidebands

-90 dBc/Hz @ 10 kHz offset measured at 2.7 GHz

## FREQUENCY COUNTER

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### Resolution

1 Hz, 10 Hz, 100 Hz and 1 kHz

### Accuracy

$\pm$  (Reference frequency error x marker frequency + counter resolution  $\pm$  1 count)

### Sensitivity

<-70 dBm

## AMPLITUDE

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### Measurement Range

+26 to -105 dBm

### Displayed Average Noise Level

-105 dBm (1 MHz to 2.7 GHz, Resolution bandwidth of 300 Hz, 10 Hz video filter)

### 1 dB Gain Compression

-10 dBm minimum (0 dB attenuation,  $\geq$ 10 MHz CF)

### Displayed Range

80 dB in 10 dB/div log scale  
40 dB in 5 dB/div log scale  
16 dB in 2 dB/div log scale  
8 dB in 1 dB/div log scale  
8 divisions with linear amplitude scale

## AMPLITUDE UNITS

### Log Scale Mode

dBm, dBmV, dB $\mu$ V, V, W

### Linear Scale Mode

dBm, dBmV, dB $\mu$ V, V, W

### Display Linearity

5 or 10 dB/div,  $\pm$ 0.15 dB/dB,  $\leq$  $\pm$ 1.5 dB over 8 divisions  
1 or 2 dB/div,  $\pm$ 0.5 dB over 8 divisions.  
Linear,  $\pm$ 10% of Reference Level over 8 divisions

### Frequency Response

$\pm$ 1.5 dB ( $\geq$ 10 MHz CF)

## ATTENUATOR

### Range

0 to 50 dB in 10 dB steps, selected manually or automatically coupled to reference level

### Accuracy

$\pm$ 0.5 dB/step up to 1 dB maximum

## REFERENCE LEVEL

### Accuracy

$\pm$ 1.5 dB

### Range

-110 dBm to +30 dBm with 300 Hz filter using 1 dB/division scale

### Resolution

0.1 dB Steps

### Residual Response

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

### Harmonic Distortion

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

### Intermodulation Distortion

$\leq$ 70 dBc (-30 dBm input, 0 dB attenuation 3rd order,  $\geq$ 100 MHz CF)

### Other Input Related Spurious

$\leq$ 60 dBc (-30 dBm input)

## RESOLUTION BANDWIDTHS

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### Selections

300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz,  
300 kHz, 1 MHz and 3 MHz

### Accuracy

$\pm$ 20%

### Selectivity

300 Hz to 3 MHz <15:1 60 dB/3 dB ratio  
9 kHz & 120 kHz (QuasiPeak) <15:1 60 dB/6 dB ratio

### Switching Error

$\pm$ 1.0 dB

### Video Bandwidth Selection

10 Hz to 1 MHz in 1-3-10 steps plus Full BW

## SWEEP

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### Rate (full screen)

50 ms to 1000 sec (in 1-2-5 sequence)  
5 ms to 20 sec (in zero span)

### Sweep Rate Accuracy

$\pm$ 10% of Full Scale  $\geq$ 100 ms

### Trigger Source

Internal, External (rear), Line

### Trigger Modes

Free Run, Video, Single Sweep, Line

### Coupling

DC

### External Trigger Bandwidth

5 Hz HPF or 100 kHz LPF

### Trigger Level

Internal: Adjustable over 8 divisions  
Ext Rear: TTL Level (nominal)

### Trigger Delay

± one sweep time

## DISPLAY

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### Type

(7.4 in) Monochrome LCD.

### Digital Resolution

640 H x 480 V active display area

### Marker Modes

2 Markers, Delta, 1/Delta, Peak Search, Marker Track, Marker to Center, Marker to Reference and Marker Noise

## MEMORY

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### Displayed Traces

2

### Trace Storage (Internal)

20 stored traces including user defined traces and test limits

### Setup Storage (Internal)

10 operational states

### PCMCIA Card

Allows bulk storage of traces and setups

## INPUTS

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### RF INPUT

#### Connector

Type N Female, 50 Ω nominal.

#### Impedance

VSWR < 1.7:1. (≥10 dB Attenuation)

#### Maximum Input Level

20 Vdc, +26 dBm (≥30 dB Attenuation)

#### LO Emissions

≤70 dBm with 0 dB Attenuation

## OUTPUTS

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### Reference

10 MHz @ +5 dBm (rear panel)

### Video

0 to 5 Vdc (rear panel)

### IF out (rear panel)

10.7 MHz equivalent to RF input level

## FREQUENCY REFERENCE

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### Temperature Stability

±2 ppm/°c

### Ageing

±1 ppm/yr

## EXTERNAL REFERENCE INPUT/OUTPUT

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### Connector

Type BNC female

### Input Level

-5 dBm to +15 dBm

### Output Level

+5 dBm

## RS-232 INTERFACE

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### Type

Null Modem (Duplex Virtual Hardware Handshake)

### Baud Rate

600 bps, 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19.2 kbps

### Parity Check

Odd, Even or None

### Data Bits per Word

7 or 8

### Stop Bits per Word

1 or 2

## IEEE-488 (GPIB) INTERFACE

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Conforms to IEEE-Standard 488-1987.

Implemented Subsets

SH1, AH1, T6, L4, SR1, RL1, DC1, CO, PPO, LEO, TEO

## PRINTER INTERFACE

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### Drivers

PCL3 compatible

### Connection

Standard 25 Pin female D-Sub Parallel Printer

## ENVIRONMENTAL

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### Operating

0 to 40°C

### Storage

-20 to 70°C

### Temperature and Humidity

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

### Vibration/Shock

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

### Altitude

Operation up to 3000 m (9843 ft)

Non-operational up to 12200 m (40,000 ft)

## ELECTROMAGNETIC COMPATABILITY

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

## SAFETY

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Conforms with EN 61010-1 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 1 or 2 supply.

## GENERAL CHARACTERISTICS

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### Dimensions

350 mm (13.75 in) W, 185 mm (7.15 in) H, 381 mm (14.75 in) D

### Weight

8.2 kg (18.0 lb)

### Warm-up Time

15 minutes for specified accuracy

## POWER REQUIREMENT

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### Source Voltage and Frequency

100 to 220 VAC, 50-60 Hz

### Power Consumption

100 W Maximum

## OPTIONS

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## AC/DC POWER SUPPLY

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### Source Voltage and Frequency

100 to 220 VAC, 50-60 Hz

### Power Consumption

100 W Maximum

### DC Voltage

13 to 21 VDC (6A nominal @ 13 v)

### External Battery

14.4 VDC, 7 AH

### Operation Time

1 hour

## TRACKING GENERATOR

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### Frequency Range

100 kHz to 2.7 GHz

### Output Level Range

0 dBm to -70 dBm

### Output Level Resolution

0.1 dB step

### Output Flatness

±1.0 dB @ 10 dB attenuation

## Harmonics and Sub-Harmonics

<-20 dBc

## Non-Harmonics

<-30 dBc

## QUASI-PEAK

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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±20%	1 ±20%
Discharge Time (ms)	160 ±20%	550 ±20%
Display Time (ms)	160 ±20%	100 ±20%

## PCMCIA CARD SLOT

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Takes PCMCIA Type 1 cards.

Provides bulk storage of traces, setups and screen dumps.

## HIGH STABILITY REF OSCILLATOR

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### Temperature Stability

±0.1 ppm/°c

### Ageing

±0.1 ppm/yr

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## **VERSIONS AND ACCESSORIES**

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2398	9 kHz to 2.7 GHz Basic Spectrum Analyzer with IEEE-488 (GPIB)
2398-1	2398 with High Stability Time Base (0.1 ppm), Quasi-Peak Detector and Filters, PCMCIA Card
	Slot
2398-2	2398-1 with Tracking Generator
2398-3	2398-1 with DC Power Supply
2398-4	2398-1 with Tracking Generator, DC Power Supply
2398-5	2398 with PCMCIA
2398-6	2398 with Tracking Generator, PCMCIA
2398-7	2398 with DC power supply, PCMCIA
2398-8	2398 with Quasi-Peak Detector and Filters
2398-9	2398 with Tracking Generator and Quasi-Peak Detector and Filters
2398-10	2398 with Quasi-Peak Detector and Filters, DC power supply

### **Supplied with**

AC2618	Soft Carry Bag
AC2619	Operation Manual Programming Manual AC Supply Lead RS-232 Cable

### **Accessories**

AC0100	Near field probe set
AC1009W	EasySpan© Waveform Transfer Software
AC2388	1 GHz Active Probe supplied with accessory power supply
AC2600	Maintenance Manual
80009	Battery Pack
AC2604	PCMCIA Type I SRAM Card (2 MB)
AC2620	Additional DC power cord for AC2568
AC2621	Rack Mount kit
AC2653	Heavy Duty Ship Case
AC4105	Return Loss bridge (5 MHz to 1.3 GHz)
AC4103	Return Loss bridge (5 MHz to 2 GHz)
AC4250	75 $\Omega$ BNC to 50 $\Omega$ type N adapter
AC5008	N-type DC Block
AC7800	75 $\Omega$ type F to 50 $\Omega$ type N adapter
AC8700	UHF Antenna

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IFR - "Working together to create solutions for the world of communications."

IFR is a world leader in developing leading edge test and measurement equipment. The priority at IFR is to understand your communications test needs and respond to them. IFR has the flexibility and expertise to create just the right test solution for you. We understand that just as you are the expert in designing wireless products, we are expert in wireless test.

Combining the quality of our test products with their reliability, excellent price/performance ratio and minimal requirements for maintenance, every IFR test system represents an outstanding lifetime value.

IFR - "Working together with our customers to be flexible and innovative in providing effective test solutions for the rapid design, manufacture and maintenance of communications systems."

The added value IFR includes with each and every test set we sell will make you more productive. We offer a two-year standard warranty on all products and we will continue to support your product for five years beyond its final production. Our outstanding Customer Service Department offers calibration, out-of warranty repairs and consulting. Our Sales and Training Departments offer clear and concise product information with realistic performance specifications, technology training and application training. Our experienced engineers will help you develop application software and through continuous improvement programs, upgrades are always available.

IFR will continue to build upon our technology resources with an aggressive commitment that will enable you to excel in some of the world's most dynamic, high growth markets.

#### **CHINA**

Tel: [+86] (10) 6467 2823

Fax: [+86] (10) 6467 2821

#### **EUROPE NORTH**

Tel: [+44] (0) 1438 742200

Fax: [+44] (0) 1438 727601

#### **EUROPE SOUTH**

Tel: [+44] (0) 1438 742200

Fax: [+44] (0) 1438 727601

#### **FRANCE**

Tel: [+33] 1 60 79 96 00

Fax: [+33] 1 60 77 69 22

#### **GERMANY**

Tel: [+49] (8131) 29260

Fax: [+49] (8131) 2926130

#### **HONG KONG**

Tel: [+852] 2832 7988

Fax: [+852] 2834 5364

#### **LATIN AMERICA**

Tel: [+1] (972) 899 5150

Fax: [+1] (972) 899 5154

#### **SCANDINAVIA**

Tel: [+45] 9614 0045

Fax: [+45] 9614 0047

#### **SPAIN**

Tel: [+34] (91) 640 11 34

Fax: [+34] (91) 640 06 40

#### **UNITED KINGDOM**

Tel: [+44] (0) 1438 742200

Toll Free: [+44] (0800) 282 388 (UK only)

Fax: [+44] (0) 1438 727601

#### **USA**

Tel: [+1] (316) 522 4981

Toll Free: [+1] (800) 835 2352 (US only)

Fax: [+1] (316) 522 1360

email **[info@ifrsys.com](mailto:info@ifrsys.com)**

web **[www.ifrsys.com](http://www.ifrsys.com)**

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