

# 110 MHz Spectrum Analyzer

## 2370 series



test & measurement instruments

- 100 dB displayed range
- 0.1 dB and 5 Hz resolution
- 30 Hz to 110 MHz frequency range
- Frequency measurement to 1 Hz resolution
- Phase lock tuning
- Digital storage of spectral information
- Split store mode gives dual display
- Built-in tracking generator
- 1.25 GHz range with optional frequency extender

2370 is a comprehensive Spectrum Analyzer covering the frequency range 30 Hz to 110 MHz. Outstanding features of this unique instrument include 100 dB displayed range, resolution of 0.1 dB and 5 Hz, and a very advanced data presentation system employing electronic storage.

Thus the 2370 has important advantages over previous spectrum analyzers for measurements of communications signals including broadcast, f.d.m., p.c.m., s.s.b. and f.s.k.

Swept selective measurements for the frequency response characterization of active and passive networks over wide dynamic ranges are made possible by the inclusion of a tracking generator. A dual display

mode and the 9-digit frequency counter together enhance the precision measurement capability.

Simplicity of operation is achieved by a logic programme which automatically selects the best r.f./i.f. gain ratio, sweep rate and filter bandwidth, eliminating the possibility of measurement error resulting from incorrect setting of the controls.

The standard model of 2370 has input and output impedances of 50  $\Omega$ . An alternative version, 2370/1, is available for 75  $\Omega$  use. In this model the RF input, Tracking Generator output and Calibrator output are all at 75  $\Omega$  impedance; 2370/1 is particularly suitable for measurements on IFs and basebands of f.d.m. systems where the normal impedance is 75  $\Omega$ .

### Data store and display

The detected output from the receiver section of the analyzer is converted to digital form giving a 256 level by 512 ordinate representation which is stored in a MOSFET recirculatory digital store. The stored information is continuously scanned and displayed on a bright 130 × 100 mm television camera monitor tube as a brightness modulated picture on a vertically scanned raster.

Superimposed on this display is an electronically produced graticule which may be shifted vertically or horizontally and scaled horizontally against the internal counter to give an exact frequency calibration.

A bright line cursor coupled to the counter can also be superimposed on the display after any single sweep recording and it can be positioned to enable the frequency of any point on the screen to be measured. In the MANUAL mode this electronic cursor becomes an edit pointer indicating the manual tune position and enabling the display to be selectively updated around two points of interest and the frequency to be measured to a resolution of 1 Hz.

A split-store mode permits the store to be used in two halves, each of 256 ordinates, to superimpose two recorded displays with the facility for updating one store while retaining the other for comparison purposes. One image can be dimmed relative to the other for easy identification.

### Frequency measurement

The 9-digit electronic counter gives readout in MHz with automatic positioning of the decimal point. Three modes of operation are available: in the PAST CENTRE mode the centre frequency is measured and displayed each time the data is renewed. In the BRIGHT LINE mode the counter displays the frequency corresponding to the position of the bright line, and in the DIFF mode the counter displays the difference between these two values. This is useful, for example, in measuring side-band frequencies relative to a carrier.

### X-Y output

X, Y and pen-lift outputs suitable for driving most pen recorders are available at a socket on the rear panel of the display unit.

### Optional accessories and associated equipment

A number of optional accessories are available to increase the usefulness of 2370. Among these are two Zero Loss Probes 2374 series which provide a high input impedance for the Spectrum Analyzer. A camera hood is also available for mounting a camera for photographic recording of the display.

An associated unit, Frequency Extender 2373, can be used to extend the frequency range of 2370 and 2370/1 up to 1.25 GHz, with sweep widths up to the full 50 MHz to 1.25 GHz range of 2373.





FREQUENCY  
MEASUREMENT

<b>Range</b>	30 Hz to 110 MHz.
<b>Tuning</b>	Four REFERENCE FREQUENCY controls provide frequency cover of 0 to 110 MHz, $\pm 1$ MHz, $\pm 70$ kHz and $\pm 1$ kHz respectively.
<b>Reference</b>	The reference frequency for scan width expansion can be selected by front panel push-button to be either the centre or the left hand side of the display.
<b>Frequency reading</b>	By calibrated electronic graticule and 9-digit electronic counter. The counter resolution is automatically switched to suit the combination of filter/scan width selected.
<b>Resolution</b>	1 Hz using the MANUAL MODE, 5 Hz filter and 200 Hz scan width.

AMPLITUDE  
MEASUREMENT

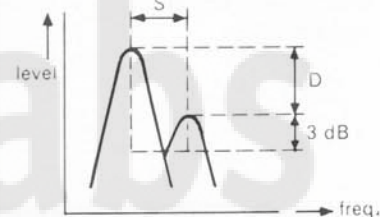
<b>Vertical scale range</b>	There are two logarithmic and one linear vertical scales. +30 to -159 dBm using 10 dB/div scale. +30 to -109 dBm using 1 dB/div scale. (1 div = approx. 1 cm).
<b>Vertical scale display</b>	Log: 10 dB/div for a 100 dB full screen display. 1 dB/div for a 10 dB full screen display. Linear: 300 mV/div to 300 nV/div in a 1, 3, 10 sequence on a 10 division display.
<b>Vertical scale range accuracy</b>	10 dB steps: $\pm 0.3$ dB/10 dB; cumulative error less than $\pm 1.5$ dB. 1 dB steps: $\pm 0.1$ dB/1 dB; cumulative error less than $\pm 0.3$ dB.
<b>Vertical scale display accuracy</b>	Log: 10 dB/div $\pm 1$ dB (0 to -80 dB), $\pm 1.5$ dB (-80 to -100 dB). 1 dB/div $\pm 0.1$ dB. Quantization error $\pm 0.25\%$ of full scale for 5 Hz to 5 kHz filter bandwidths. Volts/div linearity: $\pm 1.5\%$ of full-scale range.
<b>Frequency response (relative to 10 MHz level)</b>	$\pm 1$ dB from 100 Hz to 110 MHz. -3 dB at less than 30 Hz.
<b>Bandwidth/scan width switching accuracy</b>	Maximum error when switching between bandwidths and Hz/div settings (15 to 25°C): Log: $\pm 1$ dB $\pm 1\%$ f.s.d. Linear: $\pm 10\%$ .
<b>Overall accuracy</b>	Accuracy when set against internal calibrator $\pm 0.3$ dB at 10 MHz.
<b>Amplitude stability</b>	$\pm 0.1$ dB per °C.
<b>Maximum input level</b>	+25 dBm continuous (4 V r.m.s. for 2370, 4.7 V r.m.s. for 2370/1). +30 dBm for 5 min (7.1 V r.m.s. for 2370, 8.6 V r.m.s. for 2370/1).
<b>Input impedance</b>	2370: 50 $\Omega$ . 2370/1: 75 $\Omega$ . (BNC socket).
<b>Input v.s.w.r.</b>	Less than 1:2.1.

SWEEP AND FILTER  
CHARACTERISTICS

<b>Sweep modes</b>	AUTO: Analyzer sweep free runs. MANUAL: Tuning point indicated by position of electronic BRIGHT LINE cursor. In this mode the instrument may be used as a selective level measuring set, 1.5 Hz bandwidth video filter for noise averaging being automatically selected. SINGLE: A single sweep may be initiated by the START control. START: Initiates a new sweep on either AUTO or SINGLE.
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## Frequency scan width

<b>Frequency scan width</b>	200 Hz to 100 MHz, 18 calibrated ranges 10 MHz/div to 20 Hz/div in a 1, 2, 5 sequence and in two bands: kHz/div and MHz/div. In the kHz/div position the 0 to 110 MHz and $\pm 1$ MHz REFERENCE FREQUENCY controls are phase locked in frequency increments of 1 MHz and 100 kHz respectively.
<b>Scan width accuracy</b>	$\pm 10\%$ of full-scale $\pm 20$ Hz against electronic graticule. May be set to within $\pm 1\%$ $\pm 20$ Hz using internal counter.
<b>Sweep speed</b>	Automatically selected to match the scan width and filter bandwidth chosen. 100 ms to 100 seconds in 1, 2, 5 sequence. $\times 5$ speed up over the optimum is available by press button operation. A fixed 100 s sweep can be selected for use with an X-Y recorder.
<b>Filter bandwidth</b>	5 Hz, 50 Hz, 500 Hz, 5 kHz and 50 kHz at the -3 dB point. Up to three (NARROW, NORMAL and WIDE) are automatically selected from the above five to match the selected scan width.
<b>Bandwidth accuracy</b>	$\pm 20\%$ of stated 3 dB bandwidth.
<b>Bandwidth selectivity</b>	Better than 10:1 from 60 dB to 3 dB.
<b>Resolution</b>	Using the 5 Hz filter, signals 100 Hz away from a response at 0 dB can be measured to -70 dB.
<b>Skirt resolution</b>	(The frequency separation of two responses which merge with a 3dB notch.)



D dB is the level difference and S Hz frequency separation for a 3 dB notch between the signals.

Typical skirt resolution for close-in signals:

D (dB)	S (Hz)
> 10 dB	8 Hz
> 20 dB	10 Hz
> 30 dB	12 Hz

## Frequency stability

100 Hz per 10 min after 2 hours warm up and with the RANGE switch in kHz/div position.

## Temperature drift

100 Hz per °C with RANGE switch in kHz/div position.

## COUNTER

The nine digit counter enables frequency measurement to be made on any part of the spectral display. Modes of operation:  
PAST CENTRE: Displays the centre frequency of the last sweep.  
BRIGHT LINE: Displays the frequency corresponding to the position of the electronic cursor.  
DIFF: Displays the frequency difference between the above two measurements.

Frequency measurement  
accuracy

Using the counter, after 60 minutes warm up and using the internal frequency standard:  
AUTO SWEEP:  $\pm 20$  Hz  $\pm 1\%$  of scan width  $\pm$  counter accuracy.  
MANUAL:  $\pm 2$  Hz  $\pm$  counter accuracy.  
Counter accuracy:  
 $\pm 1$  count  
 $\pm 2 \times 10^{-7}$  (accuracy of setting internal standard)  
 $\pm 1 \times 10^{-6}$  per year (ageing rate)  
 $\pm 2 \times 10^{-6}$  (maximum error due to temperature variation).

<b>DISPLAY</b>	<p>A digital storage system giving infinite persistence with 100 ms minimum data renewal time provides the following STORE/DISPLAY modes.</p> <p>HIGH DEFN: Full capacity of electronic store (500 × 200 elements) is used to display the spectrum.</p> <p>DISPLAY 'A': Half capacity of electronic store (250 × 200 elements) is used to display the spectrum.</p> <p>DISPLAY 'B': Remaining half capacity of electronic store (250 × 200 elements) is used to display the spectrum.</p> <p>REFRESH 'A': In this mode DISPLAY 'A' is continuously refreshed as in HIGH DEFN; DISPLAY 'B' is permanently stored.</p> <p>REFRESH 'B': In this mode, DISPLAY 'B' is continuously refreshed as in HIGH DEFN; DISPLAY 'A' is permanently stored.</p> <p>READ IN B/U: Display 'Bright-up' indicates the data renewal point on the display.</p> <p>PEAK MEMORY: The peak signal level of a spectrum (whose level may be changing) is stored and displayed.</p>
<b>Display tube</b>	Television camera viewfinder tube with 100 × 130 mm viewing area.
<b>Intensity 'A'</b>	Controls brightness of the HIGH DEFN and 'A' DISPLAY.
<b>Intensity 'B'</b>	Controls brightness of the 'B' DISPLAY.
<b>Vertical gain</b>	This control allows for pre-set adjustment of the display amplitude.
<b>Vertical shift</b>	This control allows for pre-set adjustment of the vertical display position.
<b>ELECTRONIC GRATICULE</b>	Generates nominal 1 cm vertical and horizontal lines sub-divided horizontally to 2 mm.
<b>Vertical shift</b>	Positions the graticule over greater than 1 major division.
<b>Horizontal shift</b>	Positions the graticule over greater than 1.5 major divisions.
<b>Horizontal gain</b>	Expands the graticule. Cover greater than ± 15%. Indicator lamps show when the above controls are being operated in the uncalibrated position.
<b>Intensity</b>	Controls background brightness of the graticule.
<b>SPECTRAL PURITY</b>	
<b>Intermodulation capability (measured on manual sweep)</b>	Better than -70 dB (two tone test) with signals at -40 dBm at input mixer and 500 Hz apart.
<b>Residual responses</b>	30 Hz to 20 kHz: less than -90 dBm. 20 kHz to 110 MHz: less than -100 dBm.
<b>Spurious responses</b>	Better than 70 dB below a single signal at a level of -40 dBm at input mixer.
<b>Average noise level (between 100 kHz and 110 MHz measured on manual sweep)</b>	Less than -120 dBm with Counter On and less than -130 dBm with Counter Off measured with 50 Hz filter.
<b>TRACKING GENERATOR</b>	Enables the transfer characteristics of any network to be measured over a dynamic range of up to 120 dB.

<b>Frequency</b>	Tracks the input tune frequency within ± 2 Hz.
<b>Amplitude</b>	-10 dBm ± 2 dB at 10 MHz.
<b>Frequency response (relative to 10 MHz level)</b>	± 1 dB from 100 Hz to 100 MHz. -3 dB at less than 20 Hz and greater than 110 MHz.
<b>Output impedance</b>	2370: 50 Ω. 2370/1: 75 Ω. (BNC socket).
<b>Output v.s.w.r.</b>	Less than 1.2:1.
<b>CALIBRATOR</b>	
<b>Frequency</b>	10 MHz ± 20 Hz.
<b>Amplitude</b>	-10 dBm ± 0.3 dB.
<b>Output impedance</b>	2370: 50 Ω nominal. 2370/1: 75 Ω nominal. (BNC socket).
<b>EXTERNAL STANDARD INPUT</b>	Rear BNC socket permits internal 10 MHz standard to be locked to external 1 MHz standard. Green light next to socket glows when adequate signal is applied at the correct frequency to achieve satisfactory lock.
<b>Input impedance</b>	Approx. 10 k Ω shunted by 100 pF.
<b>Signal level required</b>	0.25 V to 1.0 V r.m.s.
<b>Frequency</b>	1 MHz.
<b>Accuracy required</b>	Better than 1 in 10 <sup>7</sup> .
<b>DETECTED OUTPUT</b>	Rear panel BNC socket provides demodulated output.
<b>Output impedance</b>	Approx. 600 Ω.
<b>Frequency response</b>	-3 dB at less than 30 Hz to greater than 20 kHz using 50 kHz filter relative to the level at 1 kHz.
<b>Maximum output level</b>	0 dBm ± 3 dB into 600 Ω load for 100% a.m. signal. Maximum undistorted output level occurs if the unmodulated carrier is set to the top of the screen on 1 dB/div or 40 dB down from the top of the screen on 10 dB/div.
<b>X-Y RECORDER OUTPUTS</b>	From 15-way Amphenol socket (type 17-10150), on rear panel of display unit. Enables 2370 to be used with X-Y recorder.
<b>X output</b>	A ramp of typically 0.8 V/div, 10 V maximum amplitude from source impedance of 1 kΩ. 100 s sweep time.
<b>Y output</b>	A detected signal of 0.2 V/div, with typically 2 V corresponding to display at top of screen, from output impedance of 1 kΩ.
<b>Pen-lift output</b>	A pair of contacts are closed during the sweep and opened by an internal relay during the flyback period. Enables the pen to be lifted when used with X-Y recorders with automatic pen lift.
<b>PROBE SUPPLY</b>	Supply available at front panel socket to power Zero Loss Probes 2374 and 2374/1.
<b>POWER REQUIREMENTS</b>	
<b>AC supply</b>	200 to 250 V or 100 to 130 V at any frequency between 45 and 440 Hz. <i>Regulation:</i> ± 10% on the nominal supply voltage. Approximately 130 W (170 VA).



<b>RADIO FREQUENCY INTERFERENCE</b>	Conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.			
<b>SAFETY</b>	Complies with IEC 348.			
<b>LIMIT RANGE OF OPERATION</b>				
<b>Temperature</b>	0 to 50°C.			
<b>CONDITIONS OF STORAGE AND TRANSPORT</b>				
<b>Temperature</b>	-40°C to +70°C.			
<b>Humidity</b>	Up to 90% relative humidity.			
<b>Altitude</b>	Up to 2500 m (pressurised freight at 27 kPa differential, i.e. 3.9 lb/in <sup>2</sup> ).			
<b>DIMENSIONS AND WEIGHT</b>	Height	Width	Depth	Weight
<b>Display unit</b>	172 mm 6.75 in	440 mm 17.3 in	516 mm 20.3 in	20 kg 44 lb
<b>RF unit</b>	156 mm 6.13 in	453 mm 17.8 in	516 mm 20.8 in	19.5 kg 43 lb

**VERSIONS AND ACCESSORIES**

When ordering please quote eight digit code numbers

Ordering numbers	Versions
52370-015F 52370-399X	2370 Standard version. 2370. Version with modified specification.
52370-901E	2370/1. Version with 75 Ω input, Tracking Generator output and Calibrator Output. Specification is otherwise as for 2370.
52370-398P	2370/1. Version with modified specification.
52370-301T	2370, NATO version. Differs from standard model only by accessories supplied. (NATO Cat. No. 6625-99-529-1124).
	<b>Supplied Accessories</b> Extender Board 44827-235W, for use when servicing printed boards. Board Extractor 41700-048A. Connector Assembly, (umbilical), 170 mm (6.7 in) long, 2-off, 43169-005C. Protective Cover (2-off) 41690-087N. Fuse Kit 46883-219V comprising: Fuse, quick acting, 250 mA, 23411-004E. Fuse, quick acting, 3.15 A, 23411-008L. Fuse, time-lag, 2.0 A, 23411-060M. Fuse, (2 off) time-lag, 4.0 A, 23411-063B. Stay Assembly 34900-209W (for use in servicing). Plug, Amphenol type 17-20150-0, for connection to X-Y recorder output socket. AC Supply Lead 43123-076Y. Operating Manual (2370) 46881-241U. Operating Manual (2370/1) 46881-404B. Operating Manual (2370 modified version) 46881-501P. Operating Manual (2370/1 modified version) 46881-528D.
52374-900C 52374-901R 43281-007C 54127-211H 46883-267B	<b>Optional Accessories</b> Zero Loss Probe 2374. Zero Loss Probe 2374/1. RF Fuse Unit 9884. Rack Mounting Kit. Camera Hood. For use with Polaroid CR9 or Shackman Models 77 and 7000 cameras for photographic recording of display.
54112-111K 54431-021B 43169-010B	Carrying Case. (Two required to carry the two halves of 2370). 20 W, 20 dB, 50 Ω Attenuator. Connector Assembly (umbilical). 752 mm (30 in) long. For use during maintenance to enable 2370 to be operated while separated into two halves. (Two required).
43126-012S 54351-011F	RF Connecting Cable 4969/3, 50 Ω BNC, 1520 mm (60 in) long. RF Connecting Cable 4969/3, 75 Ω BNC, 1830 mm (72 in) long.
46881-240E 46881-257X 46881-502X	Service Manual for 2370. Service Manual for 2370/1. Service Manual for 2370 modified version.
46881-529T	Service Manual for 2370/1 modified version.
43168-061X	BNC to Phone Jack Adapter.
52373-900F	<b>Associated Equipment</b> Frequency Extender 2373.