

# Wireless

## 2965A 100 kHz to 1 GHz Radio Test Set

**AEROFLEX**  
A passion for performance.



A high performance and comprehensive radio test set that provides fast tests for increased throughput

- Fast and accurate radio testing
- High performance, full span spectrum analyzer
- Tracking generator with variable level and offset tracking
- FFT analyzer for audio and modulation signals
- 500 kHz digital storage oscilloscope
- Variable Frequency SINAD/Distortion
- Accurate broadband power meter from 1 mW to 150 W
- Selective power meter with 2  $\mu$ V sensitivity

*The 2965A Radio Test Set builds on the benchmark performance of its 2955 series predecessors by offering superior speed and ease of use. Its benefits include competitive pricing and performance, well proven ergonomics and broad range of applications and options. It boasts many features that are not found in test sets selling for much higher prices. The design allows high speed of operation and accuracy of measurements, resulting in higher throughput and the application of tighter test limits.*

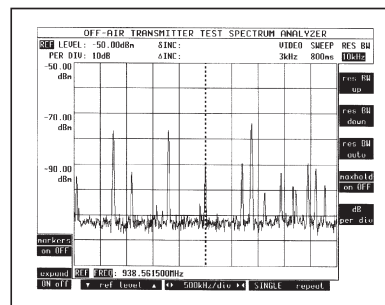
### Standard Features

The 2965A Radio Test Set follows the philosophy of offering a complete package with many of the features as standard. Among the standard features of the 2965A Radio Test Set are full span spectrum analyzer, tracking generator, broadband power meter, 500 kHz oscilloscope and a PC compatible memory card with internal autorun capability.

The 2965A Radio Test Set includes RF and LF high performance spectrum analyzers with features that are normally only found on dedicated high performance spectrum analyzers.

### RF Spectrum Analysis

The RF spectrum analyzer allows fast high resolution analysis of signals applied to either of the RF inputs over a wide dynamic range including off-air signals. Facilities include flexible frequency level settings, steerable markers for absolute or relative measurement of level or frequency and control of the resolution bandwidth.



The update rate is remarkable for this type of product, allowing real-time measurements on off-air signals.

The tracking generator provides a convenient method of alignment

for filters and sub-modules whilst the offset generator facilitates mixer testing.

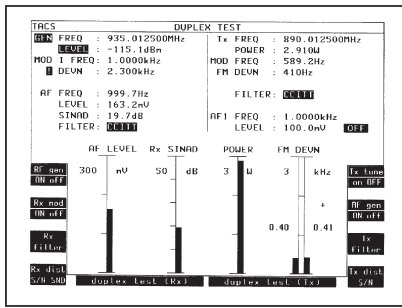
### LF Spectrum Analysis

The FFT analyzer allows analysis of audio signals demodulated from RF or via the audio input. Interference and intermodulation products can be analyzed and distortion observed at a range of frequencies. An automatic sweep facility to 20 kHz complements the manual facilities of the FFT.

### Comprehensive Audio and Modulation Sources

Three LF generators are provided for audio stimulus along with three modulation sources - enabling the most complex signaling to be generated without the need for external oscillators. These sources can be combined to produce a single audio or modulation source to 100 kHz.

Major signaling protocols are included as standard to reduce the need for external encoders and decoders. User definable tones may be stored in non-volatile memory so that non-standard tone systems can easily be emulated.



### Large Bright Display

The 2965A Radio Test Set is designed for intuitive operation. The large, bright, high resolution screen with its 22 associated soft keys has significant benefits for automated as well as manual testing. From switch on, the 2965A Radio Test Set welcomes the user with features that make radio testing simple, fast and accurate.

### Selective Test Modes for Specific Tests

The 2965A Radio Test Set allows a wide range of radio testing.

The DUPLEX mode shows both transmit and receive paths so that any interaction can be observed. If one path needs closer examination, it may be selected without disturbing the other path.

The RF test mode is for testing repeaters, mixers and RF systems including SSB measurements. This mode also gives access to the tracking generator which can be configured to allow RF to IF and IF to RF conversions, doubler and :- 2 analysis. Likewise the AF Test mode provides audio testing when the RF is not required giving access to an audio sweep facility.

### Comprehensive Cellular Testing

Testing of cellular and trunked radio is required at many stages in the life-cycle of a radio. For applications ranging from factory production through to repair and customer assurance, the test requirements vary considerably. Simple checks through to a full performance test of all the important radio parameters are required. The 2965A Radio Test Set meets all these demands and is flexible yet easy to operate.

The 2965A Radio Test Set provides 'cell site simulation'. This generates the signaling protocol that the radio would see from the real network. It is then possible to place and receive calls. This activates the receiver and transmitter, so that normal parametric measurements can be made. The signaling may also be verified, permitting faults and errors to be traced before releasing a phone on to the network.

All system options allow 'system definition' so that future changes and new country variants can be defined by the user. This flexibility ensures that the 2965A Radio Test Set can develop with a rapidly expanding market.

### Built-in Automatic Tests

There are four built-in test programs, ranging from simple call processing to comprehensive performance testing. Each of the tests may be run in a variety of ways to suit individual requirements. The 2965A Radio Test Set can offer a solution for every application using internally run programs.

### Manual Test Mode

A manual testing mode is included, allowing tests to be repeated or varied to identify faults.

### Data Displays

Data displays show the messages being sent to and from the radio under test. Corrupted messages are indicated on the display and the screen can be easily downloaded to a printer whenever the need arises.

### Programming

The control capabilities and Autorun facilities of the 2965A Radio Test Set benefit users who are automating testing in an attempt to reduce failures. Programs can be written in an interpreted form of BASIC by the user and stored inside the instrument. Additional programs can be downloaded via the RS-232 into the user defined area allowing custom programs to be run. Speed is important in all aspects of testing particularly in automatic control. The 2965A Radio Test Set allows multi-tasking for parallel measurements to be made, further enhancing its speed.

### Test Program Generation made easy

GPIB Edit and Runtime Software is a PC based test programming and test executive environment for developers of automatic test applications. It runs under Windows and allows the 2965A Radio Test Set to be programmed using high-level language commands. While providing simple access to its powerful facilities the software offers experienced designers the speed and efficiency benefits of a high-level programming environment. The 2965A Radio Test Set GPIB software driver implements all the control functions. Commands are provided for low level access to the 2965A Radio Test Set as well as the main test modes and measurements. The driver allows remote control of transmitter and receiver testing, off air signaling and general purpose RF and AF testing.

### Size and Weight

Not only does the 2965A Radio Test Set pack the performance you would normally see on a bench full of instruments, it weighs in at under 18 kg (39.5 lb) so it is portable when the need arises.

## Results Storage

Results may be stored in a number of ways. They may be transferred to the PC compatible memory card or sent via the RS-232 or parallel interface to a printer. The memory card meets the PCMCIA 2 standard for standardization of memory card formats.

## Utilities Disk

A collection of PC software utilities is available to aid users in programming the 2965A Radio Test Set.

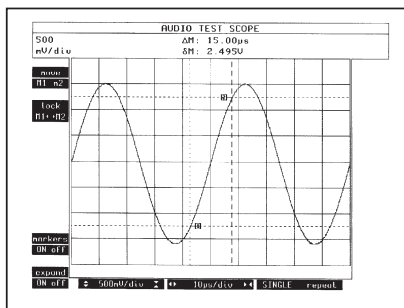
A screen capture facility is available so any screen displayed on the 2965A Radio Test Set can be saved direct to a PC, via the serial port, as a bit map file. These screens can then be imported into documents or retained on a database.

A GPIB command transfer program is also available for use with a suitably equipped PC – this program allows single command transfer, file transfer into internal memory and running of remote control programs.

## APPLICATIONS

### Base Stations

Many base stations are situated with other transmitters meaning that it is very important to control the problems of out of band radiation and intermodulation products. Most are multi-channel and operate in full duplex, which requires the use of combiners, duplexers and filters. The quality spectrum analyzer with tracking generator will greatly facilitate base station testing. The sensitivity of the receiver also allows remote monitoring and field strength measurements to be taken. The 2965A Radio Test Set is light enough and small enough to be easily carried on-site.

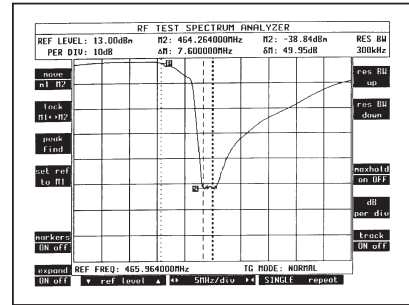


Antenna feeder forward and reverse power, and VSWR measurements can be made using the 2955 Directional Power Head accessories which are compatible with 2965A Radio Test Set.

The software to interface with the Directional Power Head is supplied as standard within the 2965A Radio Test Set.

Comprehensive audio waveform generation and analysis facilities are included for use with modems, speech processors, filters and tone encoders.

The inclusion of a 500 kHz DSO (Digital Storage Oscilloscope) allows audio and demodulated signals to be analyzed, including sequential tones. The multimeter function completes the picture.



## Production

Modern production facilities for mobile radio equipment fall into two classes – fully automated and fully de-skilled. In the case of fully de-skilled processes remote control is of primary importance. The use of IEEE-488.2 commands and syntax, multi-tasking and high speeds make the 2965A Radio Test Set ideal. The ease of use of the Autorun capability, the small footprint and the low capital outlay per work station make it ideally suited to this application.

User calibration allows the instrument to be optimized for the operating environmental conditions, i.e. in an equipment rack or on the bench. Once run, it will not be necessary to re-run the user calibration unless the operating or ambient temperature changes by more than 5°C.

## Quality Assurance

With escalating exports of mobile radio equipment around the world, the need for acceptance testing and quality audits away from the production environment is increasing. It is essential in these situations that the tests be performed with equipment comparable to that used in production. It is often the case, however, that these remote centres are poorly funded and therefore the price/performance of the instrument is a key issue. The 2965A Radio Test Set provides a cost effective solution to meet these needs.

## Research and Development

The 2965A Radio Test Set with its spectrum analyzer and high performance signal generator is ideal for use in research and development laboratories. The 2965A provides a complete solution for laboratory needs yet with flexibility to allow field testing and fault location to be easily achieved.

## Surveillance

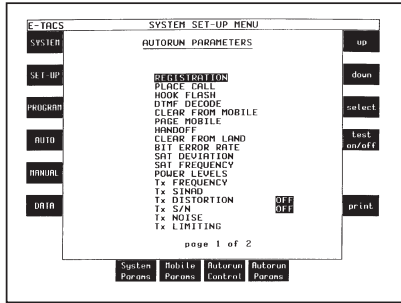
The needs for this market are growing. The basic tools of this trade are a spectrum analyzer and receiver. The 2965A Radio Test Set combines both these requirements.

## Military

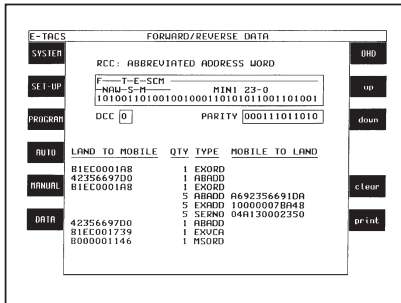
The capabilities of the 2965A Radio Test Set allow a wide range of military AM, FM and SSB radio equipment to be tested, including systems using tone signaling. High power handling capability (up to 150 W) saves the need for external power attenuators when testing vehicle radios.

## Analog Cellular

2965A Radio Test Set has optional software for major analog systems which retain the ease of use and comprehensive test capability of the 2960 series.



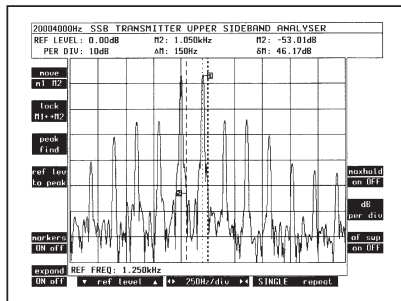
The data display mode allows the sequence of signaling on both the forward and reverse channels to be viewed on the same screen.



A GSM upgrade path is available for the 2965A Radio Test Set allowing effective testing of digital GSM systems.

### SSB Option

The SSB option allows the demodulation of SSB transmissions with CW, upper and lower sideband analysis capabilities. The displayed frequency is always the carrier frequency, calculated from the mode (e.g. CW, upper SB and lower SB) and the audio generator frequency. Analysis capabilities include carrier and alternate sideband suppression to 50 dBc and audio analysis via the FFT. Two fully variable audio generators are available to perform two tone measurements.



## SPECIFICATION

### GENERAL DESCRIPTION

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted. (Applies to version 7.00 and above)

### RF SIGNAL GENERATOR

#### FREQUENCY

##### Range

100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

##### Resolution

1 Hz

##### Indication

10 digit display

##### Setting

Keyboard entry, delta increment/decrement function and rotary variable control

##### Accuracy

As frequency standard

#### OUTPUT LEVEL

##### Range

One-port Dx:

N-Type socket:  $-135$  dBm to  $-40$  dBm

TNC socket:  $-115$  dBm to  $-20$  dBm

Rx Test and two port Dx modes:

N-Type socket:  $-135$  dBm to  $-7$  dBm ( $-17$  dBm with AM)

TNC socket:  $-115$  dBm to  $+13$  dBm ( $+3$  dBm with AM)

##### Resolution

0.1 dB

##### Indication

4 digits plus sign (dBm, dB $\mu$ V,  $\mu$ V, mV PD/EMF)

##### Accuracy

N-Type socket:

$\pm 1$  dB up to 575 MHz,

$\pm 1.5$  dB up to 1 GHz for levels above  $-120$  dBm

$\pm 1.2$  dB 575 MHz to 1 GHz over the temperature range 15 to 35°C.

##### Carrier On/Off

Keyboard operation, reduces signal generator output to less than  $-120$  dBm

##### Reverse Power Protection

N-Type socket: With instrument switched on 150 W. Overload indicated by visual and audible warnings.

TNC socket: Protection up to 10 W. Reset available on removal of RF power. Excess power indicated by visual and audible warnings.

##### Output Impedance

50  $\Omega$  nominal

##### VSWR

N-Type socket: better than 1.2 up to 500 MHz; better than 1.3 up to 1 GHz (typically 1.2).

TNC socket: typically 1.3 at 900 MHz.

## SPECTRAL PURITY

### Residual FM (CCITT weighted)

15 to 35°C

Less than 6 Hz RMS up to 575 MHz

Less than 12 Hz RMS up to 1 GHz

Residual AM (CCITT weighted)

Less than 0.05% RMS

### Harmonics

Better than -30 dBc for levels up to +7 dBm (TNC)

Better than -30 dBc for levels up to -13 dBm (N-Type)

### Spurious Signals

Better than -45 dBc for carrier frequencies from 100 kHz to 36 MHz;

Better than -50 dBc for carrier frequencies above 36 MHz

### SSB Phase Noise (20 kHz offset)

Better than -114 dBc/Hz up to 575 MHz;

Better than -108 dBc/Hz up to 1 GHz.

### RF Carrier Leakage

Less than 0.5  $\mu$ V PD generated at the carrier frequency in a 50  $\Omega$  load by a 2 turn loop 25 mm or more from the case with output level set to below -60 dBm and terminated in a sealed 50  $\Omega$  load.

## AMPLITUDE MODULATION – INTERNAL

### Frequency Range

100 kHz to 400 MHz, useable to 1.15 GHz

### AM Depth Range

0 to 99%

### Resolution

0.1%

### Indication

3 digits

### Setting

Keyboard entry, delta increment/decrement function and rotary variable control

### Accuracy<sup>(1)</sup> (up to 85% AM)

$\pm 4\%$  of setting  $\pm 1$  digit for modulation frequency 1 kHz

$\pm 6\%$  of setting  $\pm 1$  digit for modulation frequencies from 30 Hz to 10 kHz

$\pm 8\%$  of setting  $\pm 1$  digit for modulation frequencies from 10 kHz to 20 kHz

### Distortion

Less than 1% at 1 kHz for modulation depths up to 30%, CCITT weighted

Less than 2% for modulation frequencies from 100 Hz to 20 kHz and depths up to 85%

### Modulation Frequency

Range: 20 Hz to 15 kHz for carrier frequencies up to 36 MHz; 20 Hz to 20 kHz for carrier frequencies up to 400 MHz.

Resolution: 0.1 Hz below 10 kHz; 1 Hz below 20 kHz.

## AMPLITUDE MODULATION – EXTERNAL

### Input impedance

Nominally 1 M $\Omega$  in parallel with 100 pF

## Frequency Range

As internal AM

### Modulation Frequency Range

As internal AM with AC or DC coupling

### Accuracy

As internal  $\pm 2\%$

### Input Sensitivity

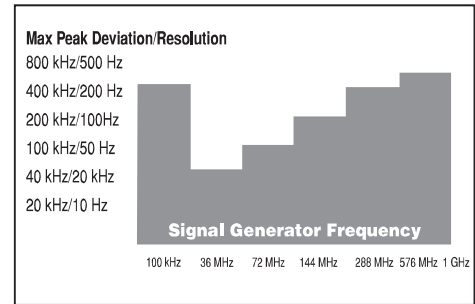
1 V RMS for indicated modulation depth

## FREQUENCY MODULATION – INTERNAL

### Frequency Range

100 kHz to 1 GHz, useable 90 kHz to 1.15 GHz

### Maximum Deviation



### Indication

4 digits

### Setting

Keyboard entry, delta increment/decrement function and rotary variable control.

### Accuracy<sup>(1)</sup>

$\pm 3\% \pm 1$  digit at 1 kHz over the range 15 to 35°C (0.1% per °C outside this range)

Typically  $\pm 3\% \pm 1$  digit for modulation frequencies from 20 Hz to 5 kHz

Typically  $\pm 7\% \pm 1$  digit for modulation frequencies from 5 kHz to 20 kHz

Typically  $\pm 10\% \pm 1$  digit for modulation frequencies from 20 kHz to 75 kHz

### Distortion<sup>(1)</sup>

Less than 0.5% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 kHz to 800 kHz).

Less than 1% for modulation frequencies from 50 Hz to 20 kHz (for deviation 1 kHz to 800 kHz).

### Modulation Frequency Range<sup>(6)</sup>

20 Hz to 20 kHz Mod generators 1, 2, 3 or

20 Hz to 100 kHz Mod generator 4

### Resolution

0.1 Hz

## FREQUENCY MODULATION – EXTERNAL

### Input Impedance

Nominally 1 M $\Omega$  in parallel with 100 pF

## Frequency Range

As internal FM

## Modulation Frequency Range

DC to 100 kHz (DC coupled)  
10 Hz to 100 kHz (AC coupled)

## Input Sensitivity

2.828 V pk-pk for indicated deviation

## Accuracy

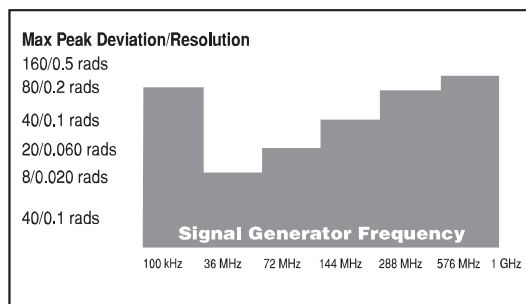
As internal  $\pm 2\%$  for frequencies up to 20 kHz

## PHASE MODULATION – INTERNAL

### Frequency Range

100 kHz to 1 GHz, useable to 1.15 GHz

### Maximum Deviation



## Indication

4 digits

## Setting

Keyboard entry, delta increment/decrement function and rotary variable control

## Accuracy

$\pm 5\%$   $\pm 1$  digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15 to 35°C (0.1% per °C outside this range)

## Distortion <sup>(4)</sup>

Less than 1% for modulation frequencies from 250 Hz to 5 kHz (for deviation 1 rad to 160 rads)

## Modulation Frequency

Range: 250 Hz to 5 kHz

## Resolution

0.1 Hz

## PHASE MODULATION – EXTERNAL

### Input Impedance

Nominally 1 M $\Omega$  in parallel with 100 pF

### Frequency Range

As internal phase modulation

### Modulation Frequency Range

250 Hz to 5 kHz

### Input Sensitivity

2.828 V pk-pk for indicated deviation

## Accuracy

As internal  $\pm 2\%$

## INTERNAL MODULATION AND AUDIO SOURCES

Up to 6 tone sources can be assigned as 3 modulation generators and 3 audio tone generators

## Modulation Modes

Internal generators may be assigned to AM, FM,  $\Phi$ M

## AUDIO VOLTMETER

### Input Impedance

Nominally 1 M $\Omega$  in parallel with 100 pF

### Frequency Range

DC and 20 Hz to 500 kHz  
AC only 20 Hz to 500 kHz  
Polarized DC less than 10 Hz

### Level Ranges

0 to 10, 0 to 30, 0 to 100, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 V RMS reading (autoranging or fixed)

### Level Indication

4 digits and bargraph with peak hold

### Level Accuracy (DC Coupled)<sup>(3) (5)</sup>

$\pm 2\%$  of reading  $\pm 1$  mV  $\pm$  resolution, DC and 100 Hz to 20 kHz  
 $\pm 4\%$  of reading  $\pm 1$  mV  $\pm$  resolution, 40 Hz to 100 kHz

### Level Accuracy (AC Coupled)<sup>(3)</sup>

$\pm 2\%$  of reading  $\pm 1$  mV,  $\pm$  resolution 150 Hz to 20 kHz  
 $\pm 4\%$  of reading  $\pm 1$  mV,  $\pm$  resolution 100 Hz to 100 kHz

### Residual Noise

100  $\mu$ V RMS CCITT weighted

## AUDIO FREQUENCY METER

### Range

10 Hz to 500 kHz

### Resolution

0.1 Hz from 10 Hz to 5 kHz  
1 Hz from 5 kHz to 50 kHz  
10 Hz from 50 kHz to 500 kHz

### Indication

6 digits

### Accuracy

As frequency standard  $\pm 1$  digit  $\pm$  resolution

### Sensitivity

On bargraph greater than 25% FSD (DC coupled)

## AUDIO SINAD METER

### Frequency

1 kHz default. User selectable up to 20 kHz

### SINAD Range

5 to 50 dB

### **Resolution**

0.1 dB for readings less than 20 dB  
0.2 dB for readings less than 25 dB

### **Indication**

3 digits and bargraph with peak hold

### **Accuracy (bandpass filter selected)**

$\pm 0.5$  dB  $\pm$  resolution

### **Sensitivity**

100 mV for 46 dB SINAD

## **AUDIO DISTORTION METER**

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### **Frequency**

1 kHz default. User selectable up to 20 kHz

### **Distortion Range**

0 to 100%

### **Resolution**

0.1% distortion for readings greater than 1%  
0.2% distortion for readings less than 1%

### **Indication**

3 digits and bargraph with peak hold.

### **Accuracy**

$\pm 5\%$  of reading  $\pm$  resolution (bandpass filter selected)

### **Sensitivity**

100 mV for 0.5% distortion

## **AUDIO S/N METER**

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### **S/N Range**

0 to 100 dB

### **Resolution**

0.1 dB for readings less than 50 dB  
0.2 dB for readings less than 70 dB

### **Indication**

3 digits and bargraph with peak hold

### **Accuracy**

$\pm 0.5$  dB  $\pm$  resolution

### **Sensitivity**

2 V for 60 dB, 200 mV for 40 dB

## **AUDIO OSCILLOSCOPE**

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### **Operating Modes**

Single or Repetitive sweep

### **Frequency Range**

DC to 500 kHz  
10 Hz to 500 kHz (AC coupled)

### **Glitch Catching**

1  $\mu$ s minimum

### **Voltage Ranges**

2 mV/div to 20 V/div in a 1, 2, 5 sequence

### **Voltage Accuracy**

$\pm 5\%$  of full scale

### **Timebase**

5  $\mu$ s/div to 10 s/div in a 1, 2, 5 sequence

### **Timebase Accuracy**

As frequency standard

### **Trigger Mode**

Auto trigger

### **Marker Indication**

Level: M1-M2, M2-M1  
Time: M1-M2, M2-M1

### **Graticule**

10 Horizontal by 8 Vertical divisions  
Can be magnified to full screen

## **AUDIO FFT ANALYZER**

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### **Span Widths**

50 Hz to 50 kHz in a 5, 10, 25 sequence.  
Above 40 kHz signals are attenuated by 80 dB/octave

### **Graticule**

10 Horizontal by 8 Vertical divisions  
Can be magnified to full screen

### **Level Reference (top of screen)**

10 mV to 20 V, in a 1, 2, 5 sequence

### **Level Accuracy**

$\pm 0.3$  dB 100 Hz to 15 kHz; typically  $\pm 1$  dB 40 Hz to 40 kHz

### **Vertical Scaling**

1, 2, 5, 10 dB/div

### **Dynamic Range**

60 dB

### **Max Hold Facility**

### **Audio Sweep facility**

DC to 20 kHz

### **Marker Indication**

Level: M1, M2, M1-M2  
Frequency: M1, M2, M1-M2

## **AUDIO BARCHARTS**

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Displays: AF voltage, SINAD, Distortion, S/N.

Vertical Resolution: 1% of full scale

Ranging: Autoranging, range hold or manual selection (up/down), 1, 3, 10 sequence with hysteresis

With peak hold facility

## **AUDIO AND MODULATION FILTERS**

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300 Hz Lowpass ( $\pm 0.1$  dB less than 150 Hz,  $\pm 0.2$  dB, 150-200 Hz relative to 100 Hz).

300 Hz to 3.4 kHz Bandpass ( $\pm 0.4$  dB, 400 to 2100 Hz relative to 1 kHz).

5 kHz Lowpass ( $\pm 0.3$  dB at  $< 3$  kHz relative to 1 kHz)

20 kHz Lowpass  $\pm 0.3$  dB at  $< 12$  kHz, typically  $-0.9$  dB at  $< 15$  kHz and  $-3$  dB at 20 kHz relative to 1 kHz

CCITT Psophometric

C-MESSAGE

See also under Environmental/User Calibration

## MULTIMETER

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### Input Terminals

3 x 4 mm, 'Volt/Ohm', 'Current' and 'Common'

### Maximum Input Voltage

300 V (CAT II) with respect to instrument chassis

Accuracy specifications apply with a maximum common mode voltage of 25 V

## VOLTMETER

### Voltage Range

0 to 300 V, 0 to 30 V, 0 to 3 V, 0 to 300 mV, Terminals, 'Volt/Ohm' and 'Common', maximum crest factor 3:1 at range full scale

### Frequency Range

Polarized DC or 40 Hz to 1 kHz

### Input Impedance

Nominally 6 M $\Omega$  in parallel with 100 pF

### Resolution

0.1% of FSD

### Accuracy <sup>(5)</sup>

DC:  $\pm 3\%$  of reading  $\pm 2$  mV  $\pm 1$  digit

AC + DC:  $\pm 3\%$  of reading  $\pm 3$  mV  $\pm 1$  digit

See also under Environmental/User Calibration

### Indication

3 digits and bargraph with peak hold

## AMMETER

### Current Range

0 to 1 A and 0 to 10 A

### Frequency Range

Polarized DC or 40 Hz to 1 kHz

### Resolution

1 mA below 1 A; 10 mA below 10 A

### Accuracy

DC:  $\pm 5\%$  of reading  $\pm 50$  mA  $\pm 1$  digit

AC + DC:  $\pm 5\%$  of reading  $\pm 150$  mA  $\pm 1$  digit

### Indication

3 digits and bargraph with peak hold

## RESISTANCE METER

### Resistance Ranges

100  $\Omega$ , 1 k $\Omega$ , 10 k $\Omega$ , 100 k $\Omega$ , 1 M $\Omega$

### Resolution

1  $\Omega$  below 1 k $\Omega$  or 3 digits

### Accuracy <sup>(5)</sup>

$\pm 5\%$  of reading  $\pm 1$   $\Omega$   $\pm 1$  digit

Continuity Test continuous tone if reading is less than 10  $\Omega$

### Indication

4 digits and bar chart with peak hold

## RF FREQUENCY METER

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### Range

100 kHz to 1 GHz

### Resolution

1 Hz or 10 Hz selectable

### Indication

Up to 10 digits

### Accuracy

As Frequency Standard  $\pm 2$  Hz  $\pm$  resolution

### Dynamic Range (Auto tuned)

As RF Power Meter (broadband)

### Frequency Range (Auto tuned)

10 MHz to 999.9 MHz

### Sensitivity

Manual tuned:  $-100$  dBm (TNC) dependent on receiver bandwidth in off air test mode

### Offset Frequency Range

$\pm 1$  MHz dependent on receiver bandwidth

## RF POWER METER (BROADBAND)

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### Frequency Range

100 kHz to 1 GHz

### Dynamic Range (Auto tuned)

10 mW to 150 W (N-Type), 100  $\mu$ W to 0.5 W (TNC)

### Power Reading

True mean power

### Indication Units

Watts

### Resolution

Better than 1%

### Indication

3 digits and bargraph with peak hold

### Accuracy <sup>(5)</sup>

100 kHz to 500 MHz:

$\pm 7.5\%$  (0.3 dB), 0.1 W to 50 W (N-Type).

$\pm 10\%$  (0.4 dB), 20 mW to 150 W (N-Type).

$\pm 12\%$  (0.5 dB), 200  $\mu$ W to 50 mW (TNC).

500 MHz to 1 GHz:

$\pm 12\%$  (0.5 dB), 20 mW to 150 W (N-Type).

$\pm 15\%$  (0.6 dB), 200  $\mu$ W to 50 mW (TNC).



100 kHz to 1 GHz:

$\pm 7.5\%$  (0.3 dB), 0.1 W to 50 W (N-Type)  $+10\%$  (0.4 dB).  
1 mW to 50 mW (TNC) for ambient temperatures in the range 15 to 35°C.

See also under Environmental/User Calibration

#### Maximum Safe Continuous Rating

N-Type: 50 W  
TNC: 0.5 W; overload protected to 10 W

#### Intermittent Rating

N-Type: 150 W for limited periods, typically two minutes at 20°C.  
Typical off to on ratio is 6:1. Overload indicated by audible and visual warning

### RF POWER METER (SELECTIVE)

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#### Frequency Range

100 kHz to 1 GHz

#### IF Bandwidth

300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

#### Dynamic Range (Manual tuned)

0 dBm to +50 dBm (110 kHz IF bandwidth)  
(N-Type -90 dBm to +20 dBm (110 kHz IF bandwidth) (TNC)

#### Power Reading

Average

#### Indication Units

dBm

#### Resolution

0.1 dB

#### Indication

3 digits + bargraph with peak hold

#### Accuracy <sup>(5)</sup>

Typically  $\pm 2.5$  dB N-Type & TNC  
See also under Environmental/User Calibration

### RF SPECTRUM ANALYZER

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#### Frequency

Range: 100 kHz to 1 GHz, useable from 30 kHz to 1.05 GHz

#### Spans

500 Hz/div to 100 MHz/div, in a 1, 2, 5 sequence

#### Resolution Bandwidth

300 Hz to 300 kHz in a 1, 3, 10 sequence and 3 MHz (automatically selected according to span and manually selectable).

Video bandwidth – fixed at 3 kHz

#### Filter Shape

Nominally 3 dB/60 dB, 1:11 (300 Hz to 30 kHz bandwidth)

#### Reference Level (top of screen)

-100 dBm to +70 dBm

#### On Screen Dynamic Range

80 dB

#### Vertical Resolution

0.5 dB on 10 dB/div, 0.05 dB on 1 dB/div

#### Level Accuracy <sup>(5)</sup>

Typically  $\pm 2.5$  dB

See also under Environmental/User Calibration

#### Intermodulation Distortion

Less than 80 dB for 2 signals on screen at reference level

#### Sweep Speeds

Optimum sweep speed selected according to span and resolution bandwidth

#### Modes

Single sweep and continuous

#### Graticule

10 horizontal by 8 vertical divisions

#### Expanded Mode

Can be made to occupy full screen for high definition

#### Markers

M1 and M2

#### Indication

Level: M1, M2, M1-M2  
Frequency: M1, M2, M1-M2

### TRACKING GENERATOR

Available in RF TEST mode

#### Frequency Range

100 kHz to 1 GHz

#### Level Range

-135 dBm to +13 dBm

#### Offset Tracking

Allows testing of mixers, IFs, fundamental and 2nd harmonic analysis (up, down, x2,  $\div 2$ )

### MODULATION ANALYZER

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#### Dynamic Range (Auto tuned)

As RF Power Meter (Broadband)

#### Sensitivity (Manual tuned)

N-Type -30 dBm (110 kHz IF bandwidth)  
TNC -50 dBm (110 kHz IF bandwidth)  
TNC (off-air test mode) -101 dBm (2  $\mu$ V 10 dB SINAD in 30 kHz IF bandwidth and CCITT weighting)

#### Demodulation

Accuracy maintained on signals greater than -60 dBm

#### Receiver Bandwidths

300 Hz to 30 kHz in a 1, 3, 10 sequence and 110 kHz, 280 kHz and 3 MHz

#### Demodulation Filters

As audio analyzer plus 5 kHz lowpass (+0.3 dB at less than 3.4 kHz relative to 1 kHz)

#### Audio Output

Available in to an internal loudspeaker, demodulated output or acces-

sory socket for external loudspeaker or headphones.

### Switching Speed

Nominally less than 1 ms channel to channel up to 50 MHz apart, settling to within 1 kHz of final frequency

### Demodulated Output

Nominal output impedance less than 10  $\Omega$ . Output voltage is range dependent (2 V peak at top of range).

### Squelch

A manual squelch control is provided with a variable threshold

## AMPLITUDE MODULATION

### Frequency Range

100 kHz to 1 GHz

### Modulation Frequency Range

20 Hz to 20 kHz

### AM Depth Range

0 to 99.9%

### Resolution

0.1% AM

### Indication

3 digits and bargraph with peak hold

### Accuracy (up to 85% AM)<sup>(1) (5)</sup>

$\pm 3\%$  of reading,  $\pm 1\%$  AM, 250 Hz to 5 kHz.  
Typically  $\pm 5\%$  of reading,  $\pm 1\%$  AM, 50 Hz to 15 kHz.

### Demodulation Distortion<sup>(1)</sup>

Less than 1% at 1 kHz, CCITT weighted

### Residual AM

Less than 0.1% AM, CCITT weighted

## FREQUENCY MODULATION

### Frequency Range

1 MHz to 1 GHz

### Modulation Frequency Range

20 Hz to 20 kHz

### Deviation Range

0 to 100 kHz

### Resolution

10 Hz below 10 kHz deviation; 100 Hz below 100 kHz deviation

### Indication

3 digits and bargraph with peak hold

### Accuracy<sup>(1) (3) (5)</sup>

$\pm 3\% \pm$  resolution for modulation frequency of 1 kHz  
 $\pm 5\% \pm$  resolution for modulation frequencies from 100 Hz to 15 kHz

### Demodulation Distortion<sup>(1)</sup>

Less than 0.5% at 1 kHz, CCITT weighted

### Residual FM

Less than 25 Hz RMS CCITT weighted

## PHASE MODULATION

### Frequency Range

1 MHz to 1 GHz

### Modulation Frequency Range

250 Hz to 5 kHz

### Deviation Range

0 to 20 rads

### Resolution

0.01 rads

### Indication

3 digits and bargraph with peak hold

### Accuracy<sup>(1) (3) (5)</sup>

$\pm 5\% \pm$  resolution

### Demodulation Distortion<sup>(1)</sup>

Less than 0.5% at 1 kHz, CCITT weighted

## AUDIO GENERATORS

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See section on modulation generators for interaction of audio and modulation generators.

## FREQUENCY

### Range<sup>(6)</sup>

1 Hz to 20 kHz AF Gens 1, 2 & 3 or  
1 Hz to 100 kHz AF Gen 4

### Setting

Keyboard entry, delta increment/decrement function and rotary control

### Indication

6 digits

### Resolution

0.1 Hz

### Accuracy

As frequency standard

## LEVEL

### Range

0.1 mV to 5 V RMS (maximum AF output 7 V peak, all generators combined)

### Setting

Keyboard entry, delta increment/decrement function and rotary control

### Indication

4 digits

### Resolution

0.1 mV

### Accuracy

$\pm 3\% \pm 1$  digit, 250 Hz to 5 kHz  
 $\pm 5\% \pm 1$  digit, 10 Hz to 20 kHz  
 $\pm 10\% \pm 1$  digit, 20 kHz to 75 kHz

### Output Impedance

Nominally 5  $\Omega$

## Protection

Maximum applied voltage 50 V

## SIGNAL PURITY

### Distortion<sup>(2)</sup>

Less than 0.5% at 1 kHz measured in a 30 kHz bandwidth  
Less than 1% from 20 Hz to 20 kHz measured in an 80 kHz bandwidth  
Typically 0.1% for levels greater than 100 mV

### Residual Noise

Less than 50  $\mu$ V RMS (CCITT weighted)

### DC Offset

Less than 10 mV

## SIGNALING ENCODER/DECODER

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### Sequential tones functions

Encodes and decodes up to 40 tones.  
CCIR, ZVEI, DZVEI, EEA, EIA or user defined.  
Any of the tones may be extended.  
Continuous, burst and single step modes available.

### User defined tones

Up to three frequency plans may be defined and stored within the 2965 for sequential tones.

Any of the standard tone frequency plans may be copied to user defined and modified.

Tone length 10 ms to 1 s.

Extended tone length 100 ms to 10 s.

### CTCSS tones mode

Standard tone frequencies may be selected from a menu

### DTMF Encoder/Decode

Generation and decode of DTMF tones, displaying Hi/Lo frequencies, frequency error, timing information and twist.

### DCS Encode/Decode

Generation and decoding of digitally coded squelch

### POCSAG generator

Generation of POCSAG code CCIR No.1

Rec 584. Bit rates from 400 to 9600 bit/s

## AUDIO MONITOR

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Audio and demodulation signals and audio signals may be monitored via the internal loudspeaker or via the accessory socket output or BNC socket on the rear panel

## SSB OPTION

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### SSB Tx

Frequency, range and meter accuracy – as RF frequency  
Power, level and power meter accuracy – as Broadband  
Detection Range – 100  $\mu$ V to 150 W  
AF Demod range – 10 Hz to 5 kHz  
Demod distortion – <2% @ 1 kHz, CCITT weighted

Carrier and Alternate s/band suppression – Better than –50 dBc  
Sideband/CW Analyzer – max 5 kHz full span fre

quency range  
– as RF spectrum analyzer  
Audio Generator – two – as audio generator  
Sideband Selection – LSB, USB, CW

### SSB Rx

Sideband Generator – as RF Gen (AM mode)  
Offset measurement – to 0.1 Hz resolution  
SINAD – as SINAD meter  
Distortion – as Distortion meter

Note: No audio is available in SSB option

## GENERAL FEATURES

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### INTERFACES

#### Keyboard and Display

Logical color coded keyboard with bright high resolution CRT

#### GPIB

Full control of all major instrument functions via the GPIB interface  
Flexibility is further enhanced by IFR's implementation of IEEE-488.2.

#### Capability

Complies with the following subsets as defined in IEEE-488.1-1978:-  
SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C1, E1.

#### Serial

Serial interface is provided for connection of RS-232 for instrument remote control. 9 Way socket. Control language is based on IEEE P1174.

#### Parallel Printer

Connector 25 way female D-Type. Provision made for graphics screen dump. A selection of printer drivers are included.

#### Accessory Socket

Allows the connection of various optional accessories.  
With suitable adapters is compatible with most 2955 series accessories.

#### Memory Card

Meets PCMCIA2/JEIDA – 4 standard. The memory card facility allows the storage of results and set ups.

#### Video Output

Color, compatible with most VGA monitors.  
15 way Sub Miniature D Type.

## FREQUENCY STANDARD

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### Internal Frequency Standard Output

#### Frequency

10 MHz

#### Level

Nominally 2 V pk-pk

#### Output Impedance

Nominally 50  $\Omega$

#### Temperature Stability

Better than 5 in 10<sup>8</sup>, 5 to 50°C

#### Ageing Rate

Better than 1 in 10<sup>7</sup> per year, after 1 month continuous use

## Warm Up Time

Less than 10 minutes to within 2 in 10<sup>7</sup> at 20°C

## External Frequency Standard Input

### Frequencies

1, 2, 5 and 10 MHz

### Level

From 1 V pk-pk to 5 V pk-pk

### Input Impedance

Nominally 1 MΩ in parallel with 40 pF

## POWER REQUIREMENTS

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### AC supply

#### Voltage

100 - 240 V~ (Limit 88 - 264 V~)

#### Supply frequency

50 - 60 Hz (Limit 45 - 66 Hz)

#### Power

Nominally 135 W, 260 W maximum, for future options

### CALIBRATION INTERVAL

2 years

### ELECTROMAGNETIC COMPATIBILITY

Conforms with the protection requirements of the EEC Council Directive 89/336/EEC. Conforms with the limits specified in the following standards:

IEC/EN61326-1 : 1997, RF Emission Class B, Immunity Table 1, Performance Criteria B

### SAFETY

Conforms with the requirements of EEC Council Directive 73/23/EEC (as amended) and the product safety standard IEC / EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for Class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 2 supply.

## ENVIRONMENTAL

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### Rated Range Of Use

0 to 50°C and up to 95% relative humidity at 40°C.

### User Calibration

User calibrations are provided to maintain high accuracy for any ambient temperature (e.g. in ATE racks or in field measurements). Having allowed the instrument to stabilize, running the user calibrations optimizes the performance at that temperature.

A change in temperature of 5°C from the calibration temperature affects readings as below. These figures are provided as a guide to typical performance.

Typical variations are as follows for a 5°C change in temperature.

Power Meter:	Broadband	2%
	Selective	0.5 dB
Spectrum Analyzer Level		0.5 dB
Audio Analyzer & Modulation Filters	Audio Voltage	0.4%
	Demod depth & deviation	0.4%
	Multimeter:	Voltage

Current

0.5%

## Storage and Transport

### Temperature

-40 to +70°C

### Altitude

Up to 2500 m (pressurized freight at 27 kPa differential)

## INTERNAL TEST SOFTWARE

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### OPTION 10 NMT CELLULAR SOFTWARE

NMT450	NMT900	Benelux
NMTF	Austria	Spain
Malaysia	Indonesia	Saudi 1
Saudi 2	Thailand	Oman
Tunisia	Hungary	Poland
Russia	Czech	Bulgaria
Slovenia	Turkey	

USER DEFINED NMT

### OPTION 11 AMPS CELLULAR SOFTWARE

E-AMPS N-AMPS

USER DEFINED AMPS

### OPTION 12 TACS CELLULAR SOFTWARE

E-TACS	TACS-2	C-TACS I
C-TACS II	J-TACS	N-TACS
USER DEFINED TACS		

### OPTION 13 MPT1327 TRUNKING SOFTWARE

Band III	JRC	UK Water
Hong Kong	Autonet	AMT
Madeira	NL-TRAXYS	NZ MPT1327
PH-INDO		

USER DEFINED MPT

### OPTION 14 PMRTEST SOFTWARE

USER DEFINED PMR for FM radios

## GENERAL FEATURES (SYSTEMS)

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### Test Modes

Auto Test/Manual Test

### Auto Test Programs

Call Processing Only  
Call and RF Testing  
Brief Testing  
Comprehensive Testing  
User Defined Test

### Parametric Auto Test Routines

AF Frequency	AF Level
FM Deviation	Mod Frequency
Rx Distortion	Rx Expansion
Rx Sensitivity	Rx SINAD
Rx S/N	Tx Compression
Tx Distortion	Tx Frequency
Tx Level	Tx Power Level
Tx Limiting	Tx Mod Level
Tx Noise	Tx SINAD
Tx S/N	SAT Deviation
SAT Frequency	ST Duration
ST Frequency	ST Deviation
Data Deviation	DSAT Deviation

## Signaling Auto Test Routines

Registration/Roaming Update  
Place Call  
Clear From Mobile  
Page Mobile  
Handoff  
Clear From Land  
Hook Flash  
DTMF Decode  
Data Performance  
PTT On  
PTT Off

## Auto Test Pause Modes

Pause Manual Only  
Pause On Failure  
Pause Always

## DIMENSIONS AND WEIGHT

Excluding handle, feet and covers.

Height	Width	Depth
177 mm	370 mm	540 mm
(6.9 in)	(14.5 in)	(21.2 in)

Including handle, feet and covers.

Height	Width	Depth
203 mm	420 mm	600 mm
(7.9 in)	(16.5 in)	(23.6 in)

## Weight

Less than 18 kg (39.5 lb)

## NOTES

- <sup>(1)</sup> At low modulation levels the residual AM/FM may become significant.
- <sup>(2)</sup> At low audio levels the residual noise may become significant.
- <sup>(3)</sup> Audio and Modulation filter passband errors not included.
- <sup>(4)</sup> Typical performance figures are non-warranted.
- <sup>(5)</sup> Refer to USER CALIBRATION section.
- <sup>(6)</sup> Either 3 modulation plus 3 audio generators up to 20 kHz or 1 modulation or 1 audio generator to 100 kHz.

## VERSIONS AND ACCESSORIES

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When ordering please quote the full ordering number information.

## Ordering Numbers

### Version

2965A Radio Test Set

### Options

Option 01 French Language Version  
Option 02 Spanish Language Version  
Option 03 German Language Version  
Option 09 SSB receiver option  
Option 10 NMT Cellular Radio option\*  
Option 11 AMPS Cellular Radio option (including N-AMPS)\*  
Option 12 TACS Cellular Radio option (including N-TACS)\*  
Option 13 MPT 1327/MPT 1343 Trunked Radio option\*  
Option 14 PMRTEST for FM

\* Specify which analog cellular option (options 10 to 14) is required at time of ordering

Contact your local sales outlet for details of availability of options

## Supplied with

AC Supply lead  
Operating Manual  
Multimeter Lead Kit (Two 4 mm leads to test points)

## Accessories

54421/001 BNC Telescopic antenna  
54431/023 20 dB AF attenuator (BNC)  
54112/157 Soft Carrying Case  
54127/310 Rack Mounting Kit  
59000/189 Memory Card (128 k)  
54411/052 Impedance Matching Unit (requires 46884/645 Accessory socket adapter)  
46884/645 Accessory socket adapter (for use with 2955 accessories)  
46884/646 Accessory Socket 'Y' adapter  
46884/560 Parallel Printer Interface Cable  
46884/649 Serial port to PC Cable 25 way  
46884/650 Serial port to PC Cable 9 way  
43129/189 GPIB Cable  
43130/596 Coaxial cable N-Type(m) to TNC(m) (double screened)

- 54311/095 Coaxial cable N-Type(m) to N-Type(m) (1 metre)
- 54311/071 TNC(m) to BNC(f) adapter
- 54311/092 N-Type(m) to BNC(f) adapter
- 52388/900 1 GHz Active Probe
- 54441/012 Power supply for probe 52388/900
- 46880/080 Service manual
- Option 21 GSM Hardware and Software Upgrade Note that this option is only available as a retrospective upgrade. To order a complete Radio Test Set, with GSM capability, see 2966A.

### **Service Support**

The 2965A is now supplied with a two year warranty as standard

W3 Third year warranty

Contact your local sales outlet for availability of these and other service plans

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For the very latest specifications visit [www.aeroflex.com](http://www.aeroflex.com)

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