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# Wireless

## 2967 GSM 900/1800/1900 Radio Test Set



**AEROFLEX**  
A passion for performance.

High Performance GSM 900/1800/1900 and analog test solution with digital test incorporating Dual Band functionality. This product can be used in conjunction with PhoneTest software

- Supports GSM 900/1800/1900 (GSM) and Phase 2 GSM measurements
- Available with PhoneTest software suite
- Power and phase profile plots for normal and access bursts to aid diagnostics
- Full range of BER/RBER/FER measurements for receiver testing
- Dual band functionality
- Manual, GO/NO GO and fully programmable testing
- Supports AMPS, TACS, NMT and MPT 1327 trunking
- Full range of analog instrumentation

*The 2967 Radio Test Set supports all the protocols required to perform measurements on GSM 900/1800/1900 MHz systems. In addition, it supports analog cellular standards TACS, AMPS, NMT and the world-wide trunking systems based on MPT 1327.*

*Based on ETSI GSM11.10 recommendations, the 2967 tests all the essential RF, audio and DC parameters quickly and easily in both Service and Production environments.*

*Unlike GSM only radio test sets, the 2967 includes a host of RF instrumentation and analog/digital facilities which are invaluable for performing diagnostics, radio alignment and parametric tests.*

High-speed testing is ensured by use of pre-programmed test sequences, fully user configurable for depth of test, running on a multi-processor test platform. Further speed enhancements are obtained by performing simultaneous TX or RX measurements over a specified number of bursts using remote control commands.

GSM 900 Phase two testing is fully supported in the 2967.

### Extensive GSM Functionality

The 2967 emulates a GSM 900/1800/1900 base station allowing mobiles to be tested in the same way that they operate on a real system without user knowledge of manufacturer specific test modes. Network simulation is especially useful when checking for configuration problems on mobiles. Transmitter tests measure power, peak and RMS phase error, frequency error and timing error, all as specified in GSM11.10. Graphical displays, with fast update rates, show power profile and phase profile against the relevant GSM masks, for both shortened and normal bursts, to aid radio alignment. Receiver testing covers all classes of BER, RBER and FER readings, and automatic sensitivity measurement is also provided.

New system features have been added to test additional terminal facilities, IMSI detach, Cell Barring and Minimum RF level for Access.

The 2967 covers the Phase 2 frequency plan (E-GSM) and supports the lower power levels (PL16-PL19).

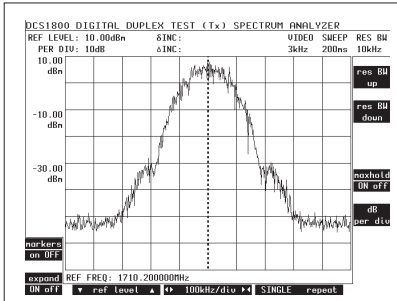
### Dual Band Functionality

Multi-band capability has been added to the test functions of the 2967, allowing full testing of multi-band mobiles in manual test, autorun and remote, including PhoneTest applications. Registration and calls to and from the mobile can be tested in the GSM 900 and 1800/1900 bands with handoff carried out from band to band.

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

## Spectrum Analysis

The inbuilt RF spectrum analyzer allows fast, high resolution analysis of signals applied either directly to the RF ports or off-air via an antenna. It carries many features only usually found on stand-alone analyzers, such as full span, selectable resolution bandwidth filters and two steerable markers.



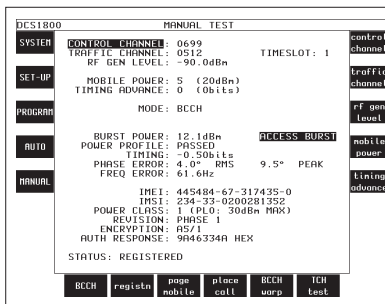
The tracking generator facility (with offset tracking) is provided for RF module characterization. With a useable frequency range of 100 kHz to 1 GHz and 1.3 GHz to 2.2 GHz, the spectrum analyzer supports IQ modulator alignment and the testing of internal local oscillators and IF systems. IQ alignment tests are recommended on most popular GSM terminals.

## Advanced GSM Measurements

The 2967 performs advanced GSM measurements for detailed fault diagnosis in production and advanced service centre environments. For radios that refuse to register or go into conversation, the 2967's capability to analyze the access (RACH) bursts is invaluable. All transmitter measurements are automatically triggered on these bursts to help the user isolate problems.

An advanced Mobile Tuning Range Test Capability (Warping) is also available. With this facility (Option 22) the BCCH (Broadcast Control Channel) frequency and data rate can be varied in controlled steps, enabling mobiles with poor reference oscillators to be identified in Manual and Automatic modes of operation.

For complete versatility, the 2967 can be used to transmit or receive at any frequency within the 10 MHz to 1 GHz band, 1.709 to 1.991 GHz Rx and 1.709 to 1.991 GHz Tx frequencies and radios can be tested in test modes, without signaling and synchronization.



## Display of Mobile Reports

The 2967 reports equipment and subscriber details during registration and call placement. The IMSI and IMEI are displayed, as are power-class, revision (Phase 1 or Phase 2), and encryption capability (A5/1 or A5/2), frequency and short message service capabilities.

The 2967 produces print outs at the touch of a key, providing the terminal information and test results in a concise form. 'Brief Test', for example, gives a three channel summary in a single page. The pass/fail count is given at the bottom of the page so good radios can be verified quickly and bad ones can be identified.

The 2967 print-outs also include the instrument serial number as well as time/date stamping, and can also be annotated with the Company name and User name for quality control. Printouts can be stored to a standard PCMCIA2 memory card.

## Manual and Automatic Operation

The 2967 User Interface offers ready access to many sophisticated functions. The instrument extends the original test set interface established by the 2955 into the world of digital communications.

The large bright, high resolution screen and the 22 associated soft-keys on the front panel have significant benefits in terms of user comfort, and hence efficiency in Manual test modes.

For automatic testing, the 2967 includes four built-in test programs ranging from simple call processing to comprehensive performance testing. These test programs are easy to configure – individual tests can be turned on and off, limits changed and averaging periods optimized. For complete flexibility, the 2967 can be programmed through MI-BASIC.

## PhoneTest

The 2967 can be enhanced by using PhoneTest, which is a PC based solution running on Windows 95/98 or Windows NT, for GSM 900/1800/1900 testing. PhoneTest brings a new dimension to Radio Test Set applications by introducing more than just the ability to test digital cellular handsets. The PhoneTest suite of programs comprises four component parts, a control driver package, PhoneTest-Repair, PhoneTest-Manager and PhoneTest-Exchange, providing a complete service workshop logistics solution.

## Proven Analog Cellular Testing

For analog cellular testing IFR is established as the de facto industry standard. The 2967 provides the fundamental measurements required (e.g. broadband power, FM deviation, SINAD) and a range of advanced diagnostic facilities, such as the unique 40 kHz FFT analyzer and 500 kHz oscilloscope.

TACS, AMPS and NMT come as options which support most country variants.

## Test Program Generation Made Easy

The internal MI-BASIC controller allows users to write programs using the internal automatic test routines and the standard instrument functions and measurements. Conventional BASIC functions are supported such as mathematical operations, branching and looping.

Programs can be written using a standard PC text editor and downloaded, via RS-232, to the test set. The program then remains in the instrument even after switch off. A program loaded into the instrument can be copied onto a memory card and then transferred quickly and easily to another unit.

## APPLICATIONS

### Production

For the production environment the 2967 can be controlled fully over GPIB or RS-232. These interfaces come as standard. Versatility is paramount; all of the internal test sequences can be modified easily by the user – particular tests can be selected/deselected, parameters and limits can be adjusted to suit.

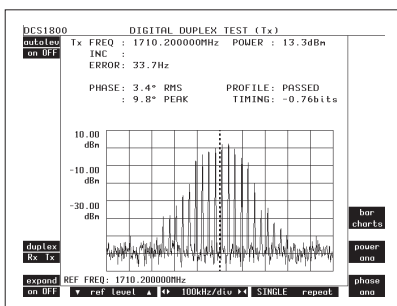
For GSM 900/1800/1900, commands are available to perform and read back the results of either all the TX tests or all the RX tests simultaneously giving a significant time saving.

For more involved testing the unit is fully programmable via the internal MI-BASIC interpreter, allowing the user to write custom test programs. Via this programming language the user has access to all of the internal tests and more: RS-232 read/write can be used to control a radio in test modes and read or write calibration data; four logic controls on the rear of the instrument can be used to drive mechanical actuators. Programs downloaded into the instrument can be copied onto the memory card then quickly and easily transferred to other units.

### Alignment

Most modern cellular phones, whether analog or digital, contain few if any mechanical trimmers – most calibration, or ‘phasing’, is carried out electrically via the keypad or a local PC.

For calibration, the 2967 shows all of the fundamental measurements on the screen at the same time. Rapid update rates simplify alignment. Calibrating the radio for power, frequency and modulation accuracy is straight-forward using the instrument’s bar charts and graphical displays.



MI-BASIC provides full access to the RS-232 port and all measurement functions, making the standard instrument suitable for closed-loop alignment applications.

### Service

In the field, many faults are simple connector, antenna or battery problems. These can often be identified visually. To locate more complex faults, e.g. unable to register, those that result from component or solder joint failure, sophisticated test tools are required. The 2967 TCH mode allows phones to be tested in test modes. Under Manual mode the instrument behaves as a signal generator and, at the same time, a ‘free-running’ receiver. No synchronization between the uplink and downlink is required.

Standard features, not available on GSM specific test sets, such as the spectrum analyzer, oscilloscope, multimeter and the unique FFT

audio analyzer aid rapid fault diagnosis.

### Go/No Go Testing

Go/No Go testing is essential to maintain quality in production, distribution and service. In this application, test speed and ease-of-use are key; the 2967 delivers on both counts.

## SPECIFICATION

### GENERAL INFORMATION

*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

#### DIGITAL SIGNAL GENERATOR

##### FREQUENCY

###### Range

800 MHz to 1 GHz

1709 MHz to 1991 MHz

###### Resolution

1 Hz to 1 GHz

2 Hz to 1991 MHz

###### 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 modes:

N-Type socket: -135 dBm to -45 dBm

TNC socket: -135 dBm to -25 dBm

Two-port Dx modes:

N-Type socket: -135 dBm to -35 dBm

TNC socket: -135 dBm to -15 dBm

###### Resolution

0.1 dB

###### Indication

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

###### Accuracy

N-Type socket single port duplex

$\pm 1.5$  dB

$\pm 1.0$  dB over the temperature range 15 to 35°C

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**Sub Harmonics**

1709 to 1991 MHz &lt;-40 dBc

**GMSK MODULATION – INTERNAL****Frequency Range**

800 MHz to 1 GHz, useable to 1.15 GHz

1.805 to 1.88 GHz (GSM 1800)

1.930 to 1.99 GHz (GSM 1900)

**Bt**

0.3

**Phase Error (in useful part of burst)**

&lt;1° RMS

&lt;4° peak

**BER METER****Types**

BER Class I

BER Class II

RBER Class Ib

RBER Class II

FER

**Range**

0 to 99%

**Resolution**

0.001%

**Indication**

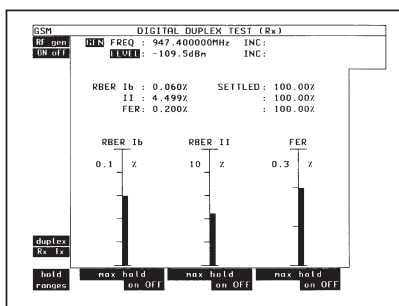
4 digits and bar chart with peak hold

**Features**

Adjustable Sample Size

Duration Indication

% Settled Indication

**RF POWER METER (BURST)****Frequency Range**

800 MHz to 1 GHz

1.709 GHz to 1.991 GHz

**Dynamic Range**

0 dBm to +47 dBm

**Power Profile Dynamic Range**

44 dB

**Power Reading**

Average power over useful part of burst

**Burst Type**

Normal/Access

**Indication Units**

dBm

**Resolution**

0.1 dB

**Indication**

3 digits and bar chart with peak hold

Power profile against GSM11.10 template

Normal/Access bursts

Full burst

Useful Part

Ramps

**Accuracy**

±0.6 dB for temperatures in the range 15 to 35°C

See also under Environmental/User Calibration

**GMSK MODULATION****Frequency Range**

800 MHz to 1 GHz

1709 MHz to 1991 MHz

**Phase Error Range**

10° RMS

±30° peak

**Burst Type**

Normal/Access

**Resolution**

0.1°

**Indication**

3 digits and bar chart with peak hold

Phase profile

**Accuracy**

Better than 0.3° RMS at 5°

Better than 4° peak

**BURST TIMING METER****Burst Type**

Normal/Access

**Range**

-128 to +127 bits

**Resolution**

0.01 bits

**Indication**

5 digits

**Accuracy** $\pm 0.1$  bits**GENERAL FEATURES (SYSTEMS)****Test Modes**

Manual Test/Auto Test

**Auto Test Programs**

Call Processing Only  
 Call and RF Testing  
 Brief Testing  
 Comprehensive Testing  
 User Defined Test  
 Digital Parametric Auto Test Routines  
 Tx Timing  
 Tx Power Level  
 Tx Power Profile  
 Tx Frequency Error  
 Tx RMS Phase Error  
 Tx Peak Phase Error  
 Rx BER Class I  
 Rx BER Class II  
 Rx RBER Class Ib  
 Rx RBER Class II  
 Rx Frame Erasure  
 Rx Sensitivity  
 Rx RSSI Report  
 Dual band handoff

**ANALOG 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 modes:

N-Type socket:  $-135$  dBm to  $-40$  dBmTNC socket:  $-115$  dBm to  $-20$  dBm

Rx Test and two-port Dx modes:

N-Type socket:  $-135$  dBm to  $-10$  dBm ( $-20$  dBm with AM)TNC socket:  $-115$  dBm to  $+10$  dBm (0 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:

 $\pm 1.2$  dB up to 575 MHz for levels above  $-120$  dBm $\pm 1.75$  dB up to 1 GHz for levels above  $-120$  dBm $\pm 1.3$  dB up 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 warning.

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),

better than 1.4 up to 1991 MHz (typically 1.3)

TNC socket: typically 1.3 at 900 MHz, typically  $<1.5$  at 1991 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

Less than 24 Hz RMS up to 1991 MHz

**Residual AM (CCITT weighted)**

Less than 0.05% RMS

**Harmonics**Better than  $-30$  dBc for levels up to  $+4$  dBm (TNC)Better than  $-30$  dBc for levels up to  $-16$  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 36 MHz to 1 GHz.**SSB Phase Noise (20 kHz offset)**Better than  $-114$  dBc/Hz up to 575 MHzBetter than  $-108$  dBc/Hz up to 1 GHz.Better than  $-102$  dBc/Hz up to 1991 MHz**RF Carrier Leakage**Less than 0.5  $\mu$ V PD generated at the carrier frequency, up to 1 GHz, across a 50  $\Omega$  load by a 2-turn 25 mm loop, 25 mm from the surface of the instrument with the output level at  $<-60$  dBm and terminated in a 50  $\Omega$  sealed load.For the very latest specifications visit [www.aeroflex.com](http://www.aeroflex.com)



Less than 1.0  $\mu$ V PD generated at the carrier frequency, from 1 GHz to 2 GHz, across a 50  $\Omega$  load by a 2-turn 25 mm loop, 25 mm from the surface of the instrument with the output level at <-60 dBm and terminated in a 50  $\Omega$  sealed 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>(4)</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 VRMS for indicated modulation depth

#### **FREQUENCY MODULATION – INTERNAL**

##### **Frequency Range**

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

##### **Indication**

4 digits

##### **Setting**

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

##### **Accuracy<sup>(4)</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>(4)</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

##### **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 and Resolution**

0-10, 0-30, 0-100 mV,	resolution 0.1 mV
0-300 mV,	resolution 0.3 mV
0-1 V	resolution 1 mV
0-3 V	resolution 3 mV
0-10 V	resolution 10 mV
0-30 V	resolution 30 mV

All RMS reading, autoranging or fixed

**Level Indication**

4 digits and bargraph with peak hold

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

+2% of reading +1 mV + resolution, DC and 100 Hz to 20 kHz.

+4% of reading +1 mV + 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****Frequency**

1 kHz default. User selectable up to 20 kHz

**Distortion Range**

0 to 30%

**Resolution**

0.1% distortion for readings greater than 1%

0.2% distortion for readings less than 1%

**Indication**

3 digits and bar chart with peak hold

**Accuracy**

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

**Sensitivity**

100 mV for 0.5% distortion

**AUDIO S/N METER****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 bar chart with peak hold

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**Accuracy**

$\pm 0.5$  dB  $\pm$  resolution

**Sensitivity**

2 V for 60 dB, 200 mV for 40 dB

**AUDIO OSCILLOSCOPE****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,  $\delta$ M

Time: M1, M2,  $\Delta$ M

**Graticule**

10 Horizontal by 8 Vertical divisions, can be magnified to full screen

**AUDIO FFT ANALYZER****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,  $\delta$ M

Frequency: M1, M2,  $\Delta$ M

**AUDIO BAR CHARTS**

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**

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****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>Ⓞ</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 bar chart 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 bar chart 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 ERROR METER****Frequency Range**

800 MHz to 1 GHz

1.709 GHz to 1.991 GHz

**Frequency Error Range**

$\pm 5$  kHz

**Burst Type**

Normal/Access

**Resolution**

0.1 Hz.

**Indication**

3 digits and bar chart with peak hold

**Accuracy**

$\pm 30$  Hz

**RF FREQUENCY METER****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)****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 barchart 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)  
 $\pm 10\%$  (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 2 minutes at 20°C. Typical off to on ratio is 6:1. Overload indicated by audible and visual warning

**RF POWER METER (SELECTIVE)****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

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**Dynamic Range (Manually tune)**

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 and TNC

See also under Environmental/User Calibration

**RF SPECTRUM ANALYZER****Frequency**

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

1.71 GHz to 1.991 GHz, useable from 1.3 GHz to 2.2 GHz

**Spans**

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

1 MHz/div max, 1.7 GHz to 1.99 GHz

50 kHz/div max 1.3 GHz to 2.2 GHz

**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, auto selection 100 Hz, 1 kHz and 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

**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,  $\delta M$

Frequency: M1, M2,  $\Delta M$

**TRACKING GENERATOR**

Available in RF TEST mode

**Frequency Range**

100 kHz to 1 GHz

**Level Range**

-135 dBm to +10 dBm

**Offset Tracking**

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

**MODULATION ANALYZER****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 ( $\pm 0.3$  dB at less than 3.4 kHz relative to 1 kHz)

**Audio Output**

Available in to an internal loudspeaker, demodulated output or accessory socket for external loudspeaker or headphones.

**Demodulated Output**

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

**Switching Speed**

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

**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 bar chart with peak hold.

**Accuracy (up to 85% AM)<sup>(4)(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>(4)</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

20 Hz to 100 kHz when Option 08 fitted

**Deviation Range**

0 to 100 kHz

**Resolution**

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

**Indication**

3 digits and bar chart with peak hold.

**Accuracy<sup>(4)(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. $\pm 10\% \pm$  resolution for modulation frequency 15 kHz to 100 kHz opt 08 only.**Demodulation Distortion<sup>(4)</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 bar chart with peak hold.

**Accuracy<sup>(4)(3)(5)</sup>** $\pm 5\% \pm$  resolution, 2 to 20 rads**Demodulation Distortion<sup>(4)</sup>**

Less than 0.5% at 1 kHz, CCITT weighted.

**AUDIO GENERATORS**

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 and 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

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**Residual Noise**

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

**DC Offset**

Less than 10 mV

**SIGNALING ENCODER/DECODER****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 2967 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**

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

**SSB OPTION****SSB Tx**

Frequency, range and meter accuracy	– as RF frequency
Power, level and accuracy	– as Broadband power meter
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 frequency range
Spectrum Analyzer	– 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****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 Ltd's implementation of IEEE-488.2.

**Capability**

Complies with the following subsets as defined in IEEE-488.1-1978:- SH1, AH1, T6, 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.

**Parallel**

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, set ups and MI-BASIC programs.

**Video Output**

Color, compatible with most VGA monitors.

15 way Sub Miniature D Type.

**FREQUENCY STANDARD****Internal Frequency Standard Output****Frequencies**

10 MHz and 13 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, 10 and 13 MHz

**Level**

Greater than 2 V pk-pk, less than 5 Vpk-pk

**Input Impedance**

Nominally 100 Ω

**POWER REQUIREMENTS****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****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:	Burst	0.5 dB
	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	0.5%
Current	0.5%

**Storage and Transport****Temperature**

-40 to +70°C

**Altitude**

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

**INTERNAL TEST SOFTWARE****OPTION 10 NMT CELLULAR SOFTWARE**

<b>NMT450</b>	<b>NMT900</b>
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 MPT 1327 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

**Analog 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

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**Signalling Auto Test Routines**

Registration / Roaming Update  
 Place Call  
 Clear From Mobile  
 Page Mobile  
 Handoff  
 Clear From Land  
 Speech Quality  
 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.

<b>Height</b>	<b>Width</b>	<b>Depth</b>
177 mm	370 mm	540 mm
(6.9 in)	(14.5 in)	(21.2 in)

Including handle, feet and covers.

<b>Height</b>	<b>Width</b>	<b>Depth</b>
203 mm	420 mm	600 mm
(7.9 in)	(16.5 in)	(23.6 in)

**Weight**

Less than 20.5 kg (45.1 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

When ordering please quote the full ordering number information.

### Ordering Numbers

#### Versions

2967 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 radios.  
 Option 16 GSM 1800  
 Option 17 GSM 1900  
 Option 22 Mobile Tuning Range Test

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)

#### PhoneTest Options

81506 PhoneTest for 2967  
 81510 PhoneTest Bundle includes  
 81506/81507/81508/81509  
 81507 PhoneTest-Repair  
 81508 PhoneTest-Manager  
 81509 PhoneTest-Exchange  
 81504 PhoneTest and enabled options, site licence software  
 upgrade  
 81505 PhoneLib

### Accessories

54421/001 BNC Telescopic antenna  
 54431/023 20 dB AF attenuator (BNC)  
 54112/158 Hard Transit Case  
 54112/157 Soft Carrying Case  
 54127/310 Rack Mounting Kit  
 59000/189 Memory Card (128 K)  
 54411/052 600  $\Omega$  interface and 20dB AF attenuator (requires  
 46884/645 Accessory socket adapter)  
 46884/645 Accessory socket adapter (for use with 2955 acces-  
 sories)  
 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)  
 54212/001 GSM Phase 2 Plug-In TEST SIM  
 54212/002 GSM Phase 2 Full Size TEST SIM  
 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

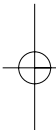
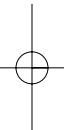
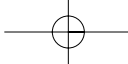
#### Service Support

The 2967 is now supplied with a 2 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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Part No. 46891/021, Issue 13, 03/04





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