2968
TETRA Radio Test Set

The 2968 TETRA Radio Test Set for comprehensive mobile and base station testing

- Call processing for simplex and duplex operation
- On-channel TETRA transmitter measurements for manufacturing and installation
- T1 test signal generator supports conformance tests
- Comprehensive TETRA modulation analysis with constellation and phase trajectory analysis
- Uplink test signal for base receiver testing
- Base station control channel simulation to provide effective network simulation

The 2968 is the world's leading TETRA radio test set, addressing the testing needs of TETRA terminals and base stations.

The 2968 TETRA radio test set performs the on-channel transmitter measurements required in a TETRA production environment. Burst and continuous power measurements, vector modulation accuracy and frequency error are supported. Receiver measurements are supported by generation of the T1 test signals. The 2968 is also capable of supporting the main world-wide trunking format (MPT1327), GSM digital cellular and all of the international analog cellular standards (TACS, AMPS & NMT).

Based on the methods specified in the ETSI TETRA specifications, the 2968 has been designed to test all of the key RF, audio and DC parameters of a TETRA radio quickly and easily.

TETRA Functionality

The development of the 2968 has been phased to provide increasing TETRA functionality as the TETRA market moves from manufacture and installation through to maintenance and service.

The 2968 is capable of emulating the environments of the TETRA mobile, base station and direct mode terminal, providing a one instrument test solution for the TETRA air interface. To satisfy the wide range of future applications, the 2968 covers the frequency range of 10 MHz to 1 GHz.

The latest enhancements for the 2968 enable testing of Base Station receivers and Mobile Station call processing functions.

Ongoing development will add further functions to the current 2968 by field upgrades.

TETRA Measurements

The 2968 provides the capability to make a range of essential measurements on an active TETRA transmitter.

Transmitter measurements on mobiles, base stations and direct mode TETRA terminals can be made via the intuitive user interface. Measurements include transmitter power, both burst and continuous, and burst profiles for all major burst types. Modulation accuracy, for both peak and RMS vector error, can also be measured. Constellation and phase trajectory displays provide a graphical indication of vector error. Demodulated data is also available for display and is selectable by burst type.

The 2968's signal generator provides T1 test signals, defined in ETS 300 394-1, for performing receiver and transmitter tests on mobiles which implement a T1 test mode. The 2968 can generate a Main Control CHannel (MCCH) or Traffic CHannel (TCH) to support manufacturer-specific test modes.

For Base Station receiver testing, the 2968 synchronizes to the multiframe timing of the downlink signal generated by a TETRA Base Station, and transmits an uplink T1 type 7 (TCH/7.2) test signal to the Base Station receiver. This new feature provides the signal required to enable the base station to measure its own receiver Bit Error Rate, without the need of a separate signal generator or an external synchronization signal.

For Mobile Station testing the 2968 supports call processing performed by TETRA radios from a variety of manufacturers. The call processing functions include registration, de-registration, individual and group call set-up, mobile-originated and mobile-terminated call set-up, plus audio loopback (talk-back) for simplex and duplex radios. Applications for call processing include production final test, screening prior to installation, and maintenance testing. The general functionality of a radio can be tested quickly and easily before use on a live system.

The enhanced 2968 also includes:-

- Burst timing meter for measurement of Mobile Station timing alignment.
- Slot selection to enable transmitter measurements to be made on a particular time slot.
- Bit Error Rate (BER) meter for measuring Mobile Station receiver performance with a downlink T1 type 1 (TCH/7.2) signal, using T1 Loopback.

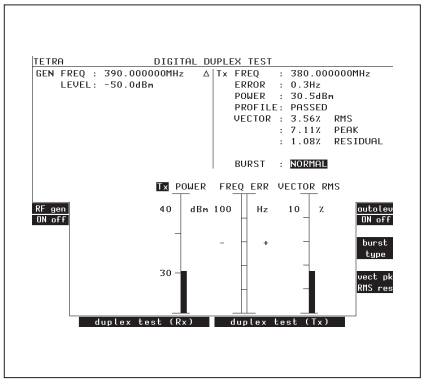
- Enhanced data displays providing decoded logical channel data in addition to demodulated burst data.
- Standard TETRA channel numbering plans for 380, 410, 450 and 870 MHz bands.
- The T1 test signal enables transmitter frequency error to be measured and also exercises the TETRA link control to adjust transmitter power.

Operation

Single or dual port duplex test modes of operation are available, configurable for high power or high sensitivity measurements.

The full range of TETRA features is available under manual or remote operation. The high resolution display and 22 associated softkeys enable selection of all the major test modes. The Duplex screen displays both the stimulus to the radio receiver and the response from the transmitter, softkeys allowing selection of the display format for the results. Alternatively the display can be confined to one signal path only, either Rx or Tx.

In Rx test mode the receiver under test can be stimulated using a T1 test signal, control channel or traffic channel whose level and frequency can be varied. The Tx test mode provides measurements of all the major on-channel parameters. Selection of the measurement type such as burst power profile, spectrum analyzer or vector diagram produces the appropriate display whilst maintaining all the other measurement parameters on screen. The measurement displays can be expanded to occupy the full screen when more detailed analysis is required.



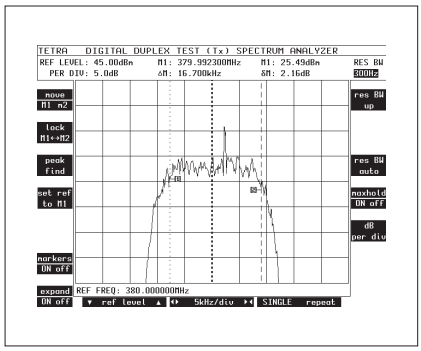
REMOTE Operation

The 2968 provides remote control of all the major functions. Control can be exercised by either GPIB or RS232.

STANDARD FEATURES

The 2968 follows the IFR philosophy of offering a comprehensive package with all the essential features for testing in the radio environment, including:-

- Full span Spectrum Analyzer for signal tracking and alignment.
- Tracking Generator with variable level and offset tracking for gain and loss measurement, including mixer stages.
- Single port and two port Duplex test modes enabling measurement before or after the diplexer/combiner.
- FFT analyzer for audio analysis giving rapid display update with narrow resolution bandwidths.
- Variable frequency SINAD and distortion measurement for customized applications.
- Range of selectable Audio filters for versatile audio characterization.
- Comprehensive audio generators, with up to six sources enabling complex signalling to be generated without additional oscillators.
- Broad band and selective power meters to enable measurement of total transmitted power or power in a specific channel.
- Built-in multimeter, on the bench when you need it.



Spectrum Analysis

The RF spectrum analyzer allows analysis of signals applied either directly to the RF ports or off-air via an antenna.

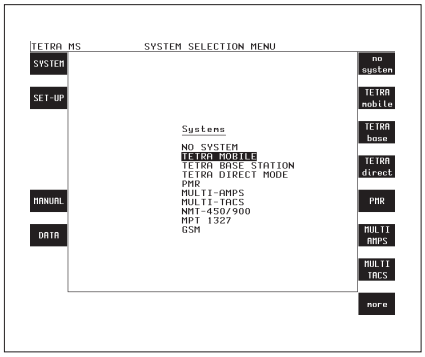
It carries many features usually found only on stand alone analyzers such as full span, selectable resolution bandwidth filters and two steerable markers.

In a TETRA environment the spectrum analyzer max hold facility allows TDMA signals to be displayed. For alignment of IQ mixers, carrier leakage and image rejection can be displayed. For RF module characterisation and radio alignment a tracking generator facility is provided. Additionally the tracking generator can be programmed with a fixed frequency offset to characterize frequency converter stages, and ×2 or ÷2 frequency ranges for doubler or divider stages.

Optional Systems

In addition to TETRA the 2968 may also be equipped with analog trunking, analog cellular and digital cellular systems. This allows the current analog system users to be prepared for the introduction of digital systems. The following systems are available:

- MPT1327/MPT1343 Trunked Radio
- PMR Test for AM/FM/ϕM radios.
- NMT Cellular Radio
- AMPS Cellular Radio (inc. N-AMPS)
- TACS Cellular radio (inc. N-TACS)
- GSM Digital Cellular (900 MHz)



For analog trunking and cellular testing IFR is established as the industry standard. The 2968 provides the fundamental measurements required (e.g. broadband power, FM deviation, SINAD) and a range of advanced facilities, such as the unique 40 kHz FFT analyzer.

Concise easy to read printouts

The 2968 produces printouts at the touch of a key. This enables measurement results to be added to test reports and service notes.

Additionally, for analog systems and GSM, printouts can be stored on PCMCIA2 memory card.

Size and Weight

Not only does the 2968 have the performance you would normally expect to see on a bench full of instruments, it also weighs under 19.5 kg (43 lb), so it is portable too.

Specification

Certain characteristics are shown as typical. These provide additional information for use in applying the instrument but they are unwarranted.

TETRA Signal Generator

FREQUENCY

Range
10 MHz to 1 GHz, usable to 1.15 GHz.

Resolution
1 Hz.

Indication
4 digit display (channel number) in SYSTEMS mode
10 digit display (Hz) in Duplex mode

Setting
SYSTEMS mode: Channel number and frequency plan.
Other modes: Keyboard entry (Hz), 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 -50 dBm
TNC socket: -135 dBm to -30 dBm
Rx Test and two-port Dx modes:
N-Type socket: -135 dBm to -40 dBm
TNC socket: -135 dBm to -20 dBm

Resolution
0.1 dB.

Indication
4 digits plus sign (dBm).

Accuracy
N-Type socket:
±1 dB (TETRA modulation) over the temperature

range 15 to 35°C.
Otherwise
±1.2 dB up to 575 MHz
±1.75 dB up to 1 GHz for levels above –120 dBm.
±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 Ω 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.

RF Carrier Leakage
Less than 0.5 µV PD generated at the carrier frequency in a 50 Ω 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 Ω load.

TETRA Modulation

Frequency Range
10 MHz to 1 GHz, usable to 1.15 GHz.

Modulation Rate
18 k symbols/sec

Modulation Filter
Root Nyquist, α =0.35

Vector Error
<3% RMS.
<6% peak.

Residual Carrier power
<-35 dBc

Data
T1 test signals (in accordance with ETS 300 394-1)
T1 type 1 (TCH/7.2 downlink)
T1 type 2 (SCH/F downlink)
T1 type 4 (TCH/2.4 downlink)
T1 type 7 (TCH/7.2 uplink)

Control Channel (MCCH)
Traffic Channel (TCH)

TETRA Transmitter Measurements

Frequency Range
10 MHz to 1 GHz.

Dynamic Range
0 dBm to +52 dBm.

Burst Types Measured - Base Station Test
NDB - Normal Down Link (cont.) using TS1 or TS2
SB - Synchronization Burst (cont.)
NDB - Normal Down Link (discont.) using TS1 or TS2
SB - Synchronization Burst (discont.)

Burst Types Measured - Direct Mode Mobile Test
DNB - Direct mode Normal Burst using TS1 or TS2
DSB - Direct mode Synchronization Burst
DSB - Direct mode Synchronization Burst (cont.)

Burst Types Measured - Mobile Test
CB - Control Burst (Half Slot discont.)
NUB - Normal Uplink Burst (discont.) TS1 or TS2
NUB - Normal Uplink Burst (cont.) TS1 or TS2

RF RELATIVE FREQUENCY ERROR METER
Mobiles test mode only

Frequency Error Range
±500 Hz.

Burst Types Measured
CB, NUB (discont.), NUB (cont.)

Resolution
10 Hz.

Indication
3 digits and bar chart with peak hold.

Accuracy
±15 Hz.

RF ABSOLUTE FREQUENCY ERROR METER
Base Station and Direct Mode test modes only

Frequency Range
10 MHz to 1 GHz.

Dynamic Range
0 dBm to +52 dBm

Frequency Error Range
±500 Hz.

Resolution
0.1 Hz.

Indication
3 digits and bar chart with peak hold.

Accuracy
±15 Hz + frequency standard accuracy.

TETRA RF POWER METER

Power Measurement
Average power during one burst
Measured at the symbol points
Measured through TETRA filter
(Root Nyquist α = 0.35)
Averaged over n bursts
(selectable between n =1 to n = 250)

Indication Units
dBm.

Resolution
0.1 dB.

Indication
3 digits and bar chart with peak hold

Accuracy
±0.6 dB for temperatures in the range 15 to 35°C
See also under Environmental - User Calibration.

TETRA MODULATION ANALYZER

Modulation Error Range
20% RMS Vector error
40% peak Vector error
20% Residual Carrier

Resolution
0.25%

Indication
4 digits and bar chart with peak hold.
Vector Error profile.

Accuracy
±0.5% at 10% error

Graphical Displays

RF POWER PROFILE

Vertical Scale
10 dB/div or 3 dB/div

Burst Type (Selectable)
BS, MS and DM-MS (Discontinuous only).

Power Measurement
Measured through TETRA filter
Referenced (0 dB) to average power

Power Profile Dynamic Range:
50 dB.

Indication
Power profile against TETRA template

Display
Complete Burst
Ramp Up/Ramp Down.

Time Spans
300 symbol periods for NUB, DNB, DSB, NDB, SB.
150 symbol periods for CB
Ramp Up/Ramp Down 2×25 symbol periods

Accuracy
±0.6 dB at symbol points for levels greater than -10 dB.

CONSTELLATION DIAGRAM
Amplitude and phase at the symbol point
Measured over all symbols of the burst
($SN_0 \sim SN_{max}$)
Measured through TETRA filter

Display Features
Normal/Expanded

Display Mode
Single/Continuous
Refresh/Persistence/Accumulate

PHASE TRAJECTORY DIAGRAM
Amplitude and phase continuously
Measured over all symbols of the burst
($SN_0 \sim SN_{max}$)
Measured through TETRA filter

Display Features
Normal/Expanded

Display Mode
Single/Continuous
Refresh/Accumulate

RF Analog Signal Generator

Frequency Range
100 kHz to 1 GHz, usable 90 kHz to 1.15 GHz

Resolution
1 Hz.

Indication
4 digit display (channel number) in SYSTEMS mode
10 digit display (Hz) in Duplex mode

Setting
SYSTEMS mode: Channel number and frequency plan.
Other modes: Keyboard entry (Hz), delta increment/decrement function and rotary variable control.

Accuracy
As frequency standard.

OUTPUT LEVEL

Range
One-port Dx modes:
N-Type socket: -135 dBm -40 dBm.
TNC socket: -115 dBm -20 dBm.
Rx Test and two-port Dx modes:
N-Type socket: -135 dBm -10 dBm
(-20 dBm with AM).
TNC socket: -115 dBm +10 dBm
(0 dBm with AM).

Resolution
0.1 dB.

Indication
4 digits plus sign (dBm, dB µV, µV, mV PD/EMF).

Accuracy
N-Type socket:
±1.2 dB up to 575 MHz
±1.75 dB up to 1 GHz for levels above -120 dBm.
±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 Ω 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)
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 µV PD generated at the carrier frequency in a 50 Ω 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 Ω load.

AMPLITUDE MODULATION – INTERNAL

Frequency Range
100 kHz to 400 MHz, usable 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 [1] (up to 85% AM)
±4% of setting ±1 digit for modulation frequency 1 kHz.
±6% of setting ±1 digit for modulation frequencies from 30 Hz to 10 kHz.
±8% of setting ±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 MΩ in parallel with 100 pF.

Frequency Range
As internal AM.

Modulation Frequency Range
As internal AM with AC or DC coupling.

Accuracy
As internal ±2%.

Input Sensitivity
1 Vrms for indicated modulation depth.

FREQUENCY MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, usable 90 kHz to 1.15 GHz.

Indication
4 digits.

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

Accuracy [1]
±3% ±1 digit at 1 kHz over the range 15-35°C (0.1% per °C outside this range).
Typically ±3% ±1 digit for modulation frequencies from 20 Hz to 5 kHz.
Typically ±7% ±1 digit for modulation frequencies from 5 kHz to 20 kHz.
Typically ±10% ±1 digit for modulation frequencies from 20 kHz to 75 kHz.

Distortion [1]
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 (6)
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 MΩ 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 ±2% for frequencies up to 20 kHz.

PHASE MODULATION – INTERNAL

Frequency Range
100 kHz to 1 GHz, usable to 1.15 GHz.

Indication
4 digits.

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

Accuracy
±5% ±1 digit for modulation frequencies from 250 Hz to 3.4 kHz, over the range 15-35°C (0.1% per °C outside this range).

Distortion [1]
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 MΩ 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 ±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, ΦM.

Audio Voltmeter

Input Impedance
Nominally 1 MΩ in parallel with 100 pF.

Frequency Range
DC and 20 Hz to 500 kHz.
AC only 20 Hz to 500 kHz.
Polarised DC less than 10 Hz.

Level Ranges
0-10, 0-30, 0-100, 0-300 mV, 0-1, 0-3, 0-10, 0-30 V RMS reading (autoranging or fixed).

Level Indication
4 digits and barchart with peak hold.

Level Accuracy (DC Coupled) [3] [5]
±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) [3]
±2% of reading ±1 mV, ± resolution 150 Hz to 20 kHz.
±4% of reading ±1 mV, ± resolution 100 Hz to 100 kHz.

Residual Noise
100 µV 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 ±1 digit ± resolution.

Sensitivity
On barchart 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 barchart with peak hold.

Accuracy (bandpass filter selected)
±0.5 dB ± 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 100%.

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
±5% of reading ± 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.

Accuracy
±0.5 dB ± 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 µs minimum.

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

Voltage Accuracy
±5% of full scale.

Timebase
5 µs/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

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
±0.3 dB 100 Hz to 15 kHz; typically ±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 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 (±0.1 dB less than 150 Hz, ±0.2 dB, 150-200 Hz relative to 100 Hz).
300 Hz to 3.4 kHz Bandpass (±0.4 dB, 400-2100 Hz relative to 1 kHz).
5 kHz Lowpass (±0.3 dB at <3 kHz relative to 1 kHz).
20 kHz Lowpass ±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.

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 ±2 Hz ± 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
±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 µW 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 [5]
100 kHz to 500 MHz:
±7.5% (0.3 dB), 0.1 W to 50 W (N-Type).
±10% (0.4 dB), 20 mW to 150 W (N-Type).
±12% (0.5 dB), 200 µW to 50 mW (TNC).
500 MHz to 1 GHz:
±12% (0.5 dB), 20 mW to 150 W (N-Type).
±15% (0.6 dB), 200 µW to 50 mW (TNC).
100 kHz to 1 GHz:
±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°C 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.

Dynamic Range (Manually 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 + barchart with peak hold.

Accuracy [5]
Typically ±2.5 dB N-Type & TNC.
See also under Environmental - User Calibration.

RF Spectrum Analyzer

Frequency Range:
100 kHz to 1 GHz, usable 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 [5]
Typically ±2.5 dB.
See also under Environmental-User Calibration.

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

Phase Noise
Typically -70 dBc / Hz at ±100 Hz from signal
Typically -75 dBc / Hz at ±1 kHz from signal
Typically -75 dBc / Hz at ±10 kHz from signal
Typically -85 dBc / Hz at ±20 kHz from signal
Typically -100 dBc / Hz at ±100 kHz from signal

Sweep Speeds
Optimum sweep speed selected according to span and resolution bandwidth.

Modes
Single sweep and continuous.

Graticule
10 horizontal by 8 vertical divisions.

Display Features
Normal/Expanded.

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, IF's, fundamental and 2nd harmonic analysis (up, down, ×2, ÷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 µV 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 accessory 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 Ω. 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 bar chart with peak hold.

Accuracy (up to 85% AM) [1] [5]
±3% of reading, ±1% AM, 250 Hz to 5 kHz.
Typically ±5% of reading, ±1% AM, 50 Hz to 15 kHz.

Demodulation Distortion [1]
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 bar chart with peak hold.

Accuracy (1) (3) (5)
±3% ± resolution for modulation frequency of 1 kHz.
±5% ± resolution for modulation frequencies from 100 Hz to 15 kHz.

Demodulation Distortion (1)
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 (1) (3) (5)
±5% ± resolution.

Demodulation Distortion (1)
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 (6)
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
±3% ±1 digit, 250 Hz to 5 kHz.
±5% ±1 digit, 10 Hz to 20 kHz.
±10% ±1 digit, 20 kHz to 75 kHz.

Output Impedance
Nominally 5 Ω.

Protection
Maximum applied voltage 50 V.

SIGNAL PURITY

Distortion (2)
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 µV RMS (CCITT weighted).

DC Offset
Less than 10 mV.

Signalling 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 2968 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 meter accuracy	– as Broadband power
Detection Range	– 100 µV 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 colour 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
Connector 25 way female D-Type. Provides 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 analog system test results and set-ups.

Video Output
Colour, compatible with most VGA monitors. 15 way Sub Miniature D Type.

Frequency Standard

Internal Frequency Standard Output

Frequency
10 MHz

Level
Nominally 2 V pk-pk.

Output Impedance
Nominally 50 Ω.

Temperature Stability
Better than 5 in 10^8, 5°C to 50°C.

Ageing Rate
Better than 1 in 10^7 per year, after 1 month continuous use.

Warm Up Time
Less than 10 minutes to within 2 in 10^7 at 20°C.

External Frequency Standard Input

Frequencies
1, 2, 5 and 10 MHz.

Level
Greater than 2 V pk-pk.

Input Impedance
Nominally 1 MΩ in parallel with 40 pF.

Power Requirements

AC supply

Voltage
88 V to 132 V and 188 V to 265 V.

Supply frequency
45 Hz to 65 Hz.

Power
Nominally 135 W, 260 W maximum, for future options.

Electromagnetic Compatibility

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

EN55011 Class B	CISPR 11
EN50082-1	IEC 801-2, 3, 4
EN60555-2	IEC 555-2

Safety

Complies with IEC1010-1, BS EN61010-1 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

Environmental

Rated Range Of Use
0°C 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%

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Storage and Transport

Temperature
-40°C to +70°C.

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

Internal Test Software

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.

OPTION 21 GSM (900 MHz) DIGITAL CELLULAR SOFTWARE
GSM Phase 1 and 2

General Features (Systems)

Test Modes
Manual Test/Auto Test.

Note: Autotest not available for TETRA

Auto Test Programs (Analog and GSM)
Call Processing Only
Call and RF Testing
Brief Testing
Comprehensive Testing
User Defined Test.

Digital Parametric Auto Test Routines (GSM)
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

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

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.

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

Including handle, feet and covers.

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

Weight
Less than 19.5 kg (42.9 lb)

Versions and Accessories

When ordering please quote the full oredering number information

Ordering Numbers	*Versions*
2968	TETRA Radio Test Set
	Options
Option 01	French Language Version.
Option 02	Spanish Language Version.
Option 03	German Language Version.
Option 08	WideBand FM
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	MPT1327/MPT1343 Trunked Radio option.
Option 14	PMRTEST for AM/FM/φm radios.
Option 21	GSM (900 MHz) Digital Cellular
Option 22	Mobile Tuning Range Test
	Contact sales office 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).
54112-158	Hard Transit Case.
54112-157	Soft Carrying Case.
54212-001	GSM Phase 2 Plug-In TEST SIM
54212-002	GSM Phase 2 Full Size TEST SIM
54127-310	Rack Mounting Kit.
59000-189	Memory Card (128 K).
54411-052	600 Ω interface and 20 dB AF attenuator (Note 1).
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.
B27033	Edit & Runtime Software, Single User, Dongled.
B27071	GPIB Software Driver.
	Note 1 – requires 46884-645 Accessory socket adapter.
	Service Support
W2	Two year warranty.
W3	Three year warranty.

Contact your local representative for availability of these and other service plans.

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

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