2968 TETRA Radio Test Set

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

- ***TETRA terminal and base station test options***
- ***Trunked Mode and optional Direct Mode***
- ***Simplex and Duplex operation***
- ***Group, Individual, Phone and Emergency call types***
- ***Direct or Hook signalling***
- ***TIPv3 compliant***
- ***ETSI EN 300 394-1 transmitter and receiver measurements***
- ***TETRA Test (TT) registration and TT loopback BER testing***
- ***TI test signal generation and T1 loopback and BER testing***
- ***Auto-test mode for fast terminal testing***
- ***Audio loopback testing for voice or tones***
- ***Multi-standard platform***
- ***Optional TETRALOG protocol analysis***
- ***Full span spectrum analyzer and tracking generator***
- ***Audio FFT analysis***

The IFR 2968 TETRA Radio Test Set is a single box solution for testing TETRA radio terminals and / or base stations and has been designed to offer maximum flexibility to satisfy applications in design, manufacturing and radio maintenance. The test set provides all the necessary signalling to control a TETRA radio and then make measurements of key transmitter and receiver RF and audio parameters. Measurements are performed accurately with speed and ease.

TETRA Measurements

Transmitter measurements performed on terminals and base stations include burst power, power profile, frame alignment (burst timing error), frequency error, modulation accuracy (EVM) and residual carrier. All are performed in accordance with ETSI EN 300 394-1. These parameters are measured for each of the different TETRA burst types and displayed numerically on a summary screen as well as a graphical bar chart. Individual parameters are supported by dedicated graphical displays to aid design engineering or fault diagnosis. Demodulated symbol data for captured bursts can be displayed or output for offline storage or analysis.

The IFR 2968 is able to perform TETRA receiver sensitivity measurements by various means depending upon the capability of the radio under test. TETRA terminals supporting TT loopback can be automatically tested by allowing the 2968 to control test mode registration and RF loopback during which BER, MER and RBER parameters can be measured. Terminals supporting T1 test mode can be tested for BER using T1 loopback; MER and BER may be measured by the terminal under test using the T1 signals generated by the 2968. The T1 signal types supported include TCH/7.2 type 1, TCH/2.4 type 4 and SCH/F type 2. Receiver sensitivity (SINAD, Distortion) may also be tested by recovering and analyzing audio signals from the terminal using the array of standard audio analysis features of the tester. The 2968 provides the necessary RF stimulus modulated with a digitized encoded audio tone, silence or 'talkback' .

For base station testing the 2968 supports synchronization either to the downlink signal generated by the base station or to a synchronization pulse output from the base station. The RF T1 Test signal generated in the test set (TCH/7.2 type 7) stimulates the base station receiver to enable internal BER measurement.

Network Simulation

The IFR 2968 is highly configurable to enable it to emulate a wide variety of different TETRA networks, such that a terminal under test recognizes the

IFR 2968 as the network for which it is configured. Functional tests provide an essential check for terminals before they are deployed into a TETRA network or when returning to active service after repair.

- *The various TETRA RF channel plans are all supported together with user defined or NO PLAN options making the 2968 suitable for use wherever TETRA systems are deployed.*
- *TX slot selection and RF power control modes are made user definable to improve versatility.*
- *Group attachment, detachment and modification functions are supported for up to 40 different groups. Displayed GSSI information makes it simple for users to verify that terminals are correctly configured for the target user.*
- *SDS-TL text messages (up to 120 characters) can be sent or received by the test set using either TETRA or GSM message coding schemes. Sent messages can be time stamped and received messages can be displayed with destination SSI and ESN. When requested the tester provides a message received response to the terminal.*

Call Processing Functions

The 2968 supports all the necessary call processing functions required for terminal testing. These include registration, de-registration to / from a network, mobile originated and mobile terminated call set-up and clear down. Supported call types include individual, group, telephone, emergency and user defined. An audio loopback (talk-back) feature is provided to enable simple end to end testing. In talkback received audio from the terminal microphone is received, time delayed, then re-transmitted to the terminal from the 2968 and output from the terminal loudspeaker.

Auto-test

Pre-defined auto-test sequences are provided to enable fast and simple testing of terminals in repair organizations. Test sequences can be selected to perform comprehensive signalling and RF measurement or protocol only tests to verify functionality only. User defined test sequences can be configured via the front panel in which up to 6 different call setup and clear down scenarios can be specified. This allows terminals supporting different modes of operation to be fully tested. TT loopback can also be incorporated within an automated test program enabling simple and repeatable Go / No Go testing of terminals.

TIP V3 Compatibility

Call processing functions are performed in accordance with the TETRA MoU TETRA Interoperability Profile version 3. This ensures that the IFR 2968 is able to test all similarly conforming TETRA terminals.

Direct Mode Operation (DMO) option 32

DMO functionality includes signalling verification as well as transmitter measurement capability. The 2968 displays the mobile's ITSI as well as other call setup parameters such as call type and encryption status in much the same way as for normal Mobile Test trunked mode operation (option 30).

Operation

The IFR 2968 can be manually operated or incorporated into an automated test system and controlled via RS-232 or GPIB. Manual control is via front panel hard and soft-keys used in conjunction with a monochrome CRT. A VGA compatible monitor may be connected in which case display information is presented in color. RF input/output ports to the test set are selectable as either single port or dual port duplex. The two RF inputs provide the flexibility to connect the 2968 directly to high power signal sources up to 150 W or to low level signals during off air analysis. Single port operation is ideal for terminal testing whereas dual port configuration is ideal for base station testing where the TX and RX ports are independent.

TETRALOG (Refer to separate data sheet 46891/117 for detail)

As an optional accessory to the 2968, a software application can be provided for use in conjunction with a PC operating in Windows™. This application captures and displays decoded protocol messages that are exchanged between the radio test set and the TETRA terminal to aid the testing of the terminal protocol during development or interoperability testing. These messages can be displayed with varying degrees of detail from LMAC (layer 2.1) to CMCE and MM (layer 3.2).

Standard Features

The basic 2968 platform is provided with a comprehensive range of standard features including.

- *Fully featured full span spectrum analyzer and variable level offset tracking generator for signal measurement, alignment, filter / amplifier and mixer response measurements.*
- *FFT analyzer for fast and high resolution audio measurements.*
- *Variable frequency SINAD and distortion measurement for customized applications.*
- *Wide range of audio filters for versatile audio characterization.*
- *Comprehensive audio generator with up to 6 sources enabling complex signalling.*
- *Broad band and selective power meters to enable measurement of total transmitted power or channel power.*
- *Built in multi-meter.*

Options

The 2968 may be configured with any combination of available system options. All supported standards can co-exist on the same platform. This makes the 2968 ideal for repair workshops where mixed product is supported.

In addition to the various TETRA terminal and base station radio options, MPT1327/1343 trunking, GSM, TACS, AMPS, NMT and SSB system options are also available.

GSM (900 MHz) Option 21

This option, compatible with GSM Phase 2, allows control and measurement of GSM 900 MHz mobile terminals. The option is designed to enable radio alignment and test during radio repair.

For more information on other system options refer to product specification literature 2965, 2967 available from www.ifrsys.com

Support

The 2968 is supplied with a standard 2 year warranty with an optional extension to 3 years and a recommended calibration interval of 2 years.

Upgrade of functionality is through software download which can be performed in the field by IFR support personnel or at any of IFR's approved service centers.

The 2968 is supported by a component level service manual which is backed up by factory run training courses arranged on demand. On-site service training or user training can be supplied by arrangement.

Specification

General Information

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, useable 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 or direct entry in MHz

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 <-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

Modulation Type

π/4 DQPSK

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)

TETRA Receiver measurements

BER Testing

T1 type 1 (TCH/7.2) BER
TCH/S Class 0 BER
TCH/S Class 1 BER
TCH/S Class 2 BER
TCH/S Class 0 RBER
TCH/S Class 1 RBER
TCH/S MER
Traffic Channel (TCH/S): *Talkback*
Silence
1 kHz test tone
0.153 PRBS

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 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 a TETRA filter (Root Nyquist $\alpha = 0.35$) averaged over n bursts (selectable between $n = 1$ to $n = 250$)

Indication Units

dBm / Watts

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

BURST TIMING ERROR

Range

±510 symbols

Resolution

0.01 symbols

Indication

5 digits

Accuracy

±0.05 symbols

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

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 ($SN_0 \sim SN_{max}$) through TETRA filter

Display Features

Normal/Expanded

Display Mode

Single/Continuous

Refresh/Accumulate

VECTOR ANALYSIS DISPLAYS

Vector error, magnitude error and phase error displays
Amplitude error and Phase error Continuous
measured over all symbols of the burst ($SN_0 \sim SN_{max}$) through TETRA filter

Display Features

Normal/Expanded

Display Mode

Single/Continuous

RF Analog Signal Generator
As TETRA generator except for:

Frequency Range

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

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)

Indication

4 digits plus sign (dBm, dBμV, μV, μV PD/EMF)

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

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 (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

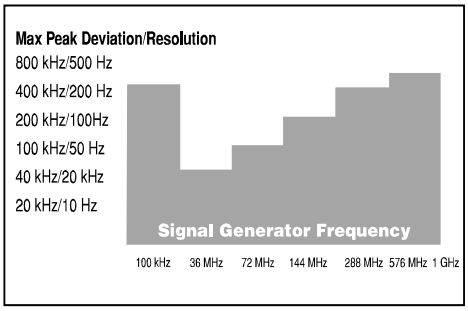
1 VRMS for indicated modulation depth

FREQUENCY MODULATION – INTERNAL

Frequency Range

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

Maximum Deviation



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 to 35°C (0.1% per °C outside this range)

±3% ±1 digit (typ) for mod frequencies from 20 Hz to 5 kHz

±7% ±1 digit (typ) for mod frequencies from 5 kHz to 20 kHz

±10% ±1 digit (typ) for mod 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

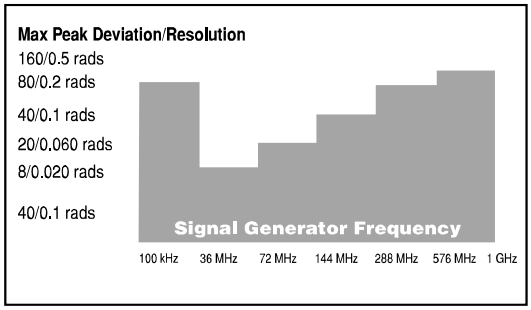
Input Impedance

Nominally 1 MΩ in parallel with 100 pF

Frequency Range

As internal FM

Maximum Deviation



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, useable 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 to 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
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 (auto-ranging 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: Auto-ranging, 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.

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 MΩ in parallel with 100 pF

Resolution

0.1% of FSD

Accuracy [5]

DC: ±3% of reading ±2 mV ±1 digit
AC + DC: ±3% of reading ±3 mV ± 1 digit

See also under Environmental/User Calibration.

Indication

3 digits and barchart 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: ±5% of reading ±50 mA ±1 digit
AC + DC: ±5% of reading ±150 mA ±1 digit

Indication

3 digits and barchart with peak hold

RESISTANCE METER

Resistance Ranges

100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ

Resolution

1 Ω below 1 kΩ or 3 digits

Accuracy [5]

±5% of reading ±1 Ω ±1 digit
Continuity Test continuous tone if reading is less than 10 Ω

Indication

4 digits and bar chart with peak hold

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]

±2.5 dB N-Type & TNC (typical)
See also under Environmental - User Calibration.

RF Spectrum Analyzer

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 [5]

±2.5 dB (typical)
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
-75 dBc / Hz at ±1 kHz from signal
-75 dBc / Hz at ±10 kHz from signal
-85 dBc / Hz at ±20 kHz from signal
-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, IFs, 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 mod frequency of 1 kHz
±5% ± resolution for mod 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

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 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.

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'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 test results and set-ups.

Video Output

Color, 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 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

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 and Standard IEC/EN 61010-1 : 1993
Complies with IEC1010-1, BS EN61010-1 (1993) +A2 (1995). CAT II 300 V 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 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 (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
Auto-net	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

TETRA Options

OPTION 30 TETRA MOBILE OPTION

OPTION 31 TETRA BASE STATION OPTION

OPTION 32 TETRA DIRECT MODE OPTION

General Features (Systems)

Channel Plans:

TETRA 380 (0 Hz or 12.5 kHz offset)
TETRA 410 (0 Hz, -6.25 kHz or 12.5 kHz offset)
TETRA 450 (0 Hz or 12.5 kHz offset)
TETRA 800 (0 Hz or 12.5 kHz offset)
TETRA 870 (0 Hz or 12.5 kHz offset)
USER DEFINED TETRA
No plan

Test Modes

Manual Test/Auto Test

Manual Test Signalling Functions (TETRA Mobile)

Registration (Location Update, all types)
SSI, ITSI

Test Mode Registration
TEI, Power Class, Reciever Class

De-Registration

Individual call (private call)

Mobile Originated (MO) and Mobile Terminated (MT)
Simplex and Duplex
Hook Signalling and Direct Setup
Calling Party SSI (MT)
Called Party SSI (MO)
Priority
Modification by Called Party (MT)
Rejection by Called Party (MT)
Transmit Request and Transmission ceased
Cleardown from Mobile or from Test Set

Group Attachment

Selected Group
No Group
Multiple Groups (up to 40 with Class of Usage)
Command Registration with Group Report

Group Call

Mobile Originated (MO) and Mobile Terminated (MT)
Priority
Calling Party SSI (MT)
Called GSSI (MO)
Transmit Request and Transmission ceased
Cleardown from Mobile or from Test Set
Automatic cleardown on hang timer expiry

Phone Call

Mobile Originated (MO) and Mobile Terminated (MT)
Priority
Calling Party SSI (MT) / Called Party SSI (MO)
Calling Party ESN (MT) / Called Party ESN (MO)
CLIP/CLIR
DTMF Overdial
Cleardown from Mobile or from Test Set

Emergency Call

Group/Individual
Simplex/Duplex
Hook Signalling/Direct Setup
Calling Party SSI (MT) / Called Party SSI (MO)
Clear from Mobile or Test Set

User Defined Call (MT)

Group/Individual
Simplex/Duplex
Hook Signalling/Direct Setup
Priority
Calling Party SSI
Calling Party ESN
CLIP/CLIR

Cell-Reselection [7]

Undeclared
Unannounced
Announced Type 3
Announced Type 2
Call Restoration
Neighbor Cell Broadcast

Short Data Service

Mobile Originated and Mobile Terminated
SDS Types 1,2,3,4
SDS-TL Text Messages 7-bit & 8-bit coding Time stamp
SDS-TL Short Reports
SDS-TL User Applications (hex data)
Status (Acknowledged)
Destination SSI & ESN (MO)

Call Control (simplex calls)

Message Trunking
Transmission Trunking
Transmision by 2968:
Timed
Contiuous
No transmission

Power Control

Open Loop
Closed Loop

RF Loopback Control

TT Loopback (BER)
TT Loopback (RBER/MER)
T1 Loopback (BER)

Manual Test Signalling Function

(TETRA DIRECT MODE)

Group Call

Mobile Originated (MO)
Priority
Calling Party ITSI
Called GSSI
Power Class
Power Control Flag
Clear from Mobile

Auto-Test Programs

	TETRA MS	***GSM***	***Analog***
Call Processing Only	√	√	√
Call and RF Testing	–	√	√
Brief Testing	–	√	√
Comprehensive Testing	√	√	√
User Defined Test	√	√	√

Digital Parametric Auto-Test Routines

	TETRA MS	***GSM***
Tx Timing	√	√
Tx Power Level	√	√
Tx Power Profile	√	√
Tx Frequency	√	√
Tx RMS Vector/Phase Error	√	√
Tx Peak Vector/Phase Error	√	√
Tx Residual carrier	√	–
Rx BER Class 0/1/2	√	–
Rx RBER Class 0/1	√	–
Rx BER Class I/II	–	√
Rx RBER Class Ib/II	–	√
Rx Frame/Message 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
Test Mode registration (TETRA)
Place Call
Clear From Mobile- TETRA has six configurable call setup and cleardown tests -MO/MT/GROUP/PRIVATE/PHONE
Page/Call Mobile-Handoff (Not TETRA)
Clear From Land
Speech Quality
Hook Flash (Not GSM/TETRA)
DTMF Decode (Not GSM/TETRA)
Data Performance (Not GSM/TETRA)

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 19.5 kg (42.9 lb)

Versions and Accessories

When ordering please quote the full ordering number information.

Ordering Numbers

Versions

2968	TETRA Radio Test Set Must be ordered with Option 30, 31 or 32

TETRA Options

Option 30	TETRA Mobile Option
Option 31	TETRA Base Station Option
Option 32	TETRA Direct Mode Option

SYSTEM Options

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 AM/FM/ΦM radios
Option 21	GSM (900 MHz) Digital Cellular
Option 22	Mobile Tuning Range Test

Language Options

Option 01	French Language Version
Option 02	Spanish Language Version
Option 03	German Language Version

Note:

Default language selection is English.

TETRA system Options 30, 31 and 32 are available in English only.

General Options

W3	3 year warranty

Supplied with

AC supply lead

Operating and programming manuals

Multimeter test lead kit

TETRA Applications

81514	TETRALOG MS Protocol Analyzer
	Refer to datasheet 46891/117 (requires Option 30)

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 meter)
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

Note 1 – requires 46884-645 Accessory socket adapter

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.

(7) Cell re-selection functions require two test sets and a power splitter.

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