

# Radio Communications Test Set

## 2955



- ☐ Comprehensive testing facilities for AM/FM/ΦM transceivers to 1000 MHz
- ☐ Single key mode selection for transmitter, receiver and duplex testing
- ☐ Full duplex facility tests radio telephones and cross-band repeaters
- ☐ Comprehensive sequential tones encoder/decoder
- ☐ Menu-driven CRT display with store and recall for standard settings
- ☐ Precision digital readouts and auto-ranging bar charts for rapid testing
- ☐ Built-in self test and operator guide
- ☐ System checking of simplex transceivers in less than 3 seconds
- ☐ Operation from any standard AC supply up to 400 Hz or vehicle supply
- ☐ Digital scope with single shot for peak modulation setting
- ☐ GPIB option for full instrument control

The 2955 Radio Communications Test Set combines all the instruments required for transceiver testing within a single unit. It is designed for bench and mobile field service applications in maintenance workshops. The instrument is lightweight, portable and may be operated from all standard AC supplies, or vehicle supplies.

Comprehensive facilities are provided for testing all types of AM, FM and ΦM mobile radio equipment, including low-power hand portables and mobiles using selective calling, full duplex radio telephones, base station and repeater equipment. Major users include mobile radio manufacturers, providers of mobile radio



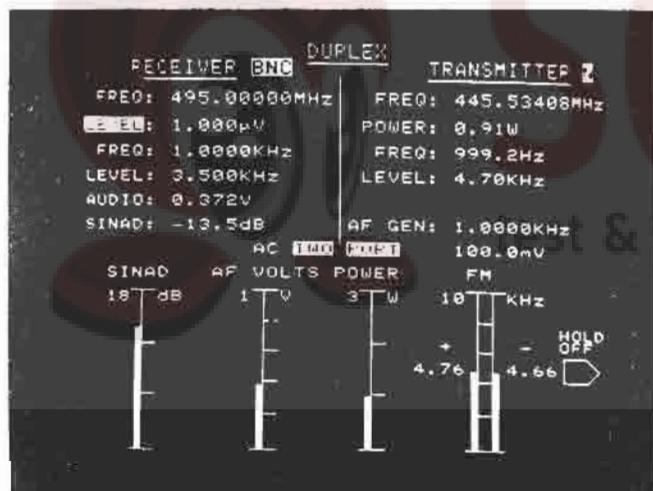
telephone networks, service maintenance workshops, commercial and public service organisations, and the military.

### FULL COMPREHENSIVE TESTING

The Test Set comprises 11 instrument functions for transceiver testing: RF power meter, RF frequency meter, modulation meter, RF signal generator, AF signal generator, AF frequency meter, AF voltmeter, 1 kHz AF distortion meter, S/N and SINAD meter, digital oscilloscope and tones encoder/decoder. This comprehensive instrument also functions well as a low-cost ATE system, or as a set of general-purpose test equipment for production, service or laboratory use.

### Ease of operation

Operation of the test set is by keys, which configure the instrument functions to test either a transmitter and receiver together in full duplex mode, or independently for simplex or semi-duplex operation. A large CRT display provides the operator with all generated and measured information relating to a particular transceiver test, and a direct indication of controls in use. Setting up the instrument for a particular test involves selection of the appropriate colour identified keys in a logical left-to-right sequence. As the operator selects the required keys, the screen indicates the test mode selected and highlights the function accessed in reverse screen video. This informs the operator which frequency or level parameter is then available for control.



### CONTROLS AND INDICATIONS

#### Push button and rotary controls

Setting of specific test channel frequencies, modulating levels and output levels etc. is via a numeric key pad. However, for convenience and speed of operation, three variable controls are provided. Programmable incremental keys for frequency and level allow the operator to define any INC/DECrement size, within the range and resolution of the test set. This facility enables rapid channel changing for checking of multi-channel radios, and simplifies receiver bandwidth and AGC testing. For tests requiring fine adjustments of frequency or level, such as squelch threshold measurements or sub-audible tone deviation settings, a rotary variable

control is available. This gives an analog feel to adjustments and allows the user to obtain fast changes by spinning the knob.

### CRT display

The CRT display in 2955 provides the flexibility for measurements to be presented in digital form for precise unambiguous readings, from which a hard-copy printout can be obtained. It also allows measured information to be presented in analog bar chart form, which is convenient for providing simple peaking indications for transmitter power setting. Comparative measurements between positive and negative peak deviation are available to check modulation symmetry.

### Digital storage scope

In transmitter, receiver and audio test modes, a dedicated key is provided to select the digital storage scope facility. When testing transmitters, the scope's vertical scale is directly calibrated for modulation measurements: a single shot facility allows the user to measure peak-to-peak modulation. This peak hold function is invaluable for setting the modulation limiter circuits in the radio, and for ensuring that maximum permissible deviation is not exceeded.

### TRANSMITTER TEST

When measuring a transmitter in the frequency range 1.5 MHz to 1000 MHz, the modulation meter automatically tunes to the incoming signal frequency in typically less than 3 seconds, providing the user with analog and digital readouts of all parameters. This avoids the operator having to set up the transmitter frequency.

### On-screen measurements

The 2955 indicates on-screen transmitter frequency, power, modulation frequency, modulation level and transmitter distortion. All measurement scales are auto-ranging, thus preventing the likelihood of accidental damage due to excessive input levels. Best instrument measurement accuracy is assured because manual range selection is avoided. These facilities cut service test time dramatically.

### RF power measurement

RF power measurement range is 0.05 mW to 75 W continuous rating, catering for low-power portables and base station transmitters. High-power transmitters of up to 150 W may be measured for short intervals, typically 2 minutes at room temperature. A thermal sensor warns the operator if the load gets too hot, by flashing a screen message to REMOVE RF INPUT. A short interval later, an additional two-tone audible alarm is given in case the operator's attention has been diverted from the screen. To facilitate a number of maximum power measurements, without having to wait for the power load to cool, a HOLD DISPLAY key is provided. This enables the user to freeze the entire screen display after the readings have been stabilised, allowing all the transmitter measurements and settings to be read off, with the transmitter de-keyed.



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## Hardcopy printout

A hard-copy printout of all the digital information contained in RX, TX, DUPLEX, AF TEST and Directional Power meter screens can be obtained using a GPIB printer with a listen only mode or using the optional 24 column ticket printer.

## RF frequency counter

RF frequency counter resolution is selectable as either 1 Hz or 10 Hz, enabling tests of SSB systems. 2955 provides a two-tone modulating signal which may be applied to an SSB transmitter to check for linearity; the carrier waveform may be observed at the IF output socket on the rear of the instrument. This facility also allows future expansion in 2955 capability to meet the needs of emerging radio telephone networks.

## Simplified simplex testing

Testing simplex radios is simplified by using the RX = TX key. This presets the RF signal generator to the same frequency as the transmitter, saving the operator the task of entering the channel frequency in receive test mode. The INC/DEC keys may be used to offset the generator frequency for channel-to-channel operation or for semi-duplex tests.

## DUPLEX TEST

Full duplex testing of radio telephones is possible using the 2955. All necessary parameters for both the transmitter and receiver can be displayed simultaneously on the CRT screen. The frequency and level of the RF generator and the frequency of the AF generator may be independently controlled from the instrument keypad or varied using the rotary control.

## Independent modulation meter

A unique feature of 2955 is that the modulation meter is independent of the RF signal generator, so there is no restriction to the total frequency offset between transmitter and receiver test. This means that, in addition to measuring standard duplex systems, 2955 can also be used to check cross-band repeaters. Instruments fitted with issue 12 or later software may also be used to check repeater systems using AM and FM equipment.

## RECEIVER TEST

In the receiver test mode, standard default settings of the RF and AF signal generators are provided. The RF signal generator level is set to -100 dBm and the AF signal generator frequency for 1 kHz. Modulation is set to a nominal level 1.5 kHz/1 rad for testing FM/PM receivers and 30% mod level for AM receivers. This facility is provided so that the minimum amount of user interaction is required to perform a simple system check. If the RF signal generator frequency has been preset using the RX = TX key and the radio being tested is simplex, then no further instrument settings are required. For a functioning receiver, audio output will be present from the receiver under test. Dedicated keys allow the user to select either signal-to-noise (S/N), SINAD or distortion test. All readings are displayed numerically on the CRT screen and as auto-ranging bar charts for maximum user convenience.

## High output level accuracy

RF output level accuracy is specified to be within  $\pm 2$  dB over the attenuator range of 0 dBm to -127 dBm, and includes the effects of temperature, making 2955's signal generator one of the most accurate available in a test set for the maintenance user.

## Full modulation control

Comprehensive modulation control is provided by using the INC/DEC keys or rotary control. The generator may be internally or externally modulated to produce AM/FM signals. The external modulation input can be used for dual tone inputs such as DTMF tones, or for FFSK/FSK modulation.

## AUDIO TEST

The audio test function provides access to the audio signal generator, AF voltmeter and digital oscilloscope, for testing and fault-finding uses. The AF input socket has a nominal input impedance of 1 Megohm, making it compatible with standard probes.

## Tones encoder/decoder

The Radio Communications Test Set provides a comprehensive tones encoder/decoder facility for testing selective calling circuits in mobile radio. Four tone standards are available to the user from a screen menu: CCIR, ZVEI, DZVEI, EEA in addition to a fifth USER DEFINE mode. Provision is made to send up to 11 tones in any standard, either as a single burst, tone step or continuous cycles for receiver testing. Frequencies may be shifted from nominal, up to  $\pm 9\%$  in 1% steps for tolerance checking of receiver decoders. In tones decode mode the 2955 compares each tone received with standard frequencies held in memory. If these are within the standard specified limits, the tone number, tone frequency and error percentage are displayed.

## Check base station to mobile access

The first tone in a five-tone sequence, or the third tone in a seven-tone sequence can be extended to 700 ms for checking base station to mobile access.

## Sub-audible tones

Sub-audible tones (CTCSS) and two-tone (one frequency fixed) are also available. Sub-audible tone frequencies are measured directly in the transmitter test mode by the audio frequency counter with the 300 Hz low-pass filter selected. For applications requiring encoding and decoding of complex or non-standard tones system, an EXTERNAL MODULATION input and AF DEMODULATED output are provided.

## NON-VOLATILE MEMORY

2955 is provided with 37 non-volatile stores, each capable of retaining indefinitely a complete front panel set-up, with instant recall whenever required. One additional storage location provides power fail back-up so that the last group of front panel settings is restored after an AC power or battery supply failure. A facility is provided to lock the stores to prevent accidental erasure.

## PROGRAMMABLE OPERATION

The 2955's GPIB option provides full instrument control and adds further versatility for automatic testing, and



computer-assisted manual testing. A write-to-screen capability enables the CRT to be used as a VDU for operator instructions and for simple straight line graphics. Specification tests can be carried out using the upper half of the screen, whilst the lower half is used for drawing limit bar charts and writing text.

#### LOW COST-OF-OWNERSHIP

Instrument lifetime is a significant factor in cost-of-ownership, and the 2955 includes a number of features to reduce calibration costs, reduce down-time and help eliminate expensive repairs. Visual and audible warnings are given when excess power is dissipated in the power load, and if a transmitter with an output power of up to 50 W is accidentally connected to the BNC signal generator output. A relay then opens the signal path if the input power exceeds 1.0 W thus protecting the instrument.

#### Ease of repair

A built-in self test facility identifies faulty sections either to major module level or group of components, so reducing the mean time to repair. Instrument down-time is further reduced by 2955's modular construction, which simplifies the service of faulty modules. The Test Set has only six PCBs plugging into a mother board, a plug-in RF tray, attenuator block and power load. These are easily removed for replacement or further test.

#### Stored calibration factors

Routine calibration needs have been kept to a minimum, and calibration factors stored in non-volatile memory may be accessed with a secure access code from the front panel key buttons, or via the GPIB, permitting rapid recalibration.

#### VERSIONS AND ACCESSORIES

Versions of the 2955 are available which provide comprehensive cellular radio test facilities for the 450/900 MHz Nordic Mobile Telephone (NMT) systems, Advanced Mobile Phone Service (AMPS), the Total Access Communication System (TACS), the French Radiocom 2000 system and the UK Band III trunked mobile radio system. French and Spanish language versions are also available with complete front panel and software translations. A further version of 2955 is available fitted with a GPIB interface for automatic testing applications. An export licence-free version of 2955 is also available.

#### POWER HEADS

Accessories available for use with 2955 include two directional power heads, covering the frequency ranges 1-50 MHz and 25-1000 MHz, a sophisticated battery pack with built-in fast charge circuit, a 600 ohm balanced input/output interface, CCITT and CMESS filters, 24 column ticket printer, GPIB interface, IF injector probes, 20 dB AF attenuator and rugged transit case.

#### RF SIGNAL GENERATOR

##### FREQUENCY

<b>Range</b>	0.4 MHz to 1000 MHz. 0.4 MHz to 520 MHz (302D version).
<b>Resolution</b>	50 Hz up to 530 MHz. 100 Hz up to 1000 MHz.
<b>Indication</b>	8 digit display.
<b>Setting</b>	Via keyboard entry. Step change variation by INC/DEC keys and rotary control.
<b>Accuracy</b>	As internal standard.

##### OUTPUT LEVEL

<b>Range</b>	Rx Mode: -140 dBm to -20 dBm (0.0224 $\mu$ V to 22.4 mV). N-type socket selected. -120 to 0 dBm (0.224 $\mu$ V to 224 mV), BNC socket selected. One Port Duplex Mode: -140 dBm to -80 dBm (0.0224 $\mu$ V to 0.0224 mV). Two Port Duplex Mode: -120 dBm to -40 dBm (0.224 $\mu$ V to 2.24 mV).
<b>Resolution</b>	0.1 dB.
<b>Indication</b>	4 digits with units dBm/ $\mu$ V PD/EMF selection.
<b>Setting</b>	Via keyboard entry. Step change variation by INC/DEC keys and rotary control.
<b>Accuracy</b>	$\pm 2$ dB for levels above -127 dBm.

#### SPECTRAL PURITY

<b>Residual FM</b>	Less than 30 Hz up to 520 MHz, typ. 15 Hz, less than 60 Hz up to 1000 MHz, typ. 30 Hz. Measured in 300 Hz to 3.4 kHz bandwidth.
<b>Residual AM</b>	< 0.5%, 0.3-3.4 kHz B.W.
<b>Harmonics</b>	Less than -20 dBc up to 1.5 MHz, -25 dBc up to 250 MHz, -20 dBc up to 1000 MHz.
<b>Sub-harmonics</b>	None up to 530 MHz, less than -25 dB to 1000 MHz.
<b>Spurious signals</b>	For carrier frequencies up to 88 MHz: Less than -45 dB up to 110 MHz, less than -35 dB above 110 MHz. For carrier frequencies up to 1000 MHz: Less than -60 dB.
<b>Signal/noise at 20 kHz</b>	Less than -106 dBc/Hz to 500 MHz, less than 100 dBc/Hz to 1000 MHz.
<b>RF leakage</b>	Less than 0.5 $\mu$ V p.d. generated in a 50 $\Omega$ load by a 2-turn 25 mm loop as near as 25 mm to the case of the instrument with the output set to less than -20 dBm and the output terminated in a 50 $\Omega$ sealed load.
<b>Protection</b>	50 W reverse power trip, automatically resets on removal of power input (BNC socket). Visual alarm warning (REMOVE RF INPUT) and audible alarm provided for added protection.
<b>OUTPUT IMPEDANCE</b>	50 $\Omega$ nominal.
<b>VSWR</b>	Less than 1.2 to 500 MHz, less than 1.35 to 1000 MHz (N-type). Less than 2.2 to 1000 MHz (BNC).



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## MODULATION

### AMPLITUDE MODULATION INTERNAL

<b>CW range</b>	1.5 to 400 MHz, usable to 400 kHz.
<b>Mod. depth range</b>	0 to 70%, usable to 85%.
<b>Mod. frequency range</b>	50 Hz to 15 kHz.
<b>Resolution</b>	1%.
<b>Indication</b>	2 digits.
<b>Setting</b>	Via keyboard entry. Step change variation by INC/DEC keys and rotary control.
<b>Accuracy</b>	$\pm 7\%$ of reading $\pm 1$ digit at 1 kHz. $\pm 10\%$ of reading $\pm 1$ digit, 50 Hz to 5 kHz up to 60% AM. $\pm 15\%$ of reading $\pm 1$ digit, 50 Hz to 5 kHz up to 80% AM.

### EXTERNAL

<b>As internal plus:</b>	
<b>Input impedance</b>	1 M $\Omega$ in parallel with approximately 40 pF.
<b>Sensitivity</b>	1.5 V p-p for 30% AM at 1 kHz $\pm 15\%$ reading $\pm 1\%$ AM.
<b>AM distortion</b>	Less than 2% at 1 kHz with 30% AM (300 Hz to 3.4 kHz bandwidth).

### FREQUENCY MODULATION INTERNAL

<b>CW range</b>	0.4 to 1000 MHz.
<b>Modulation range</b>	0 to 25 kHz.
<b>Mod. frequency range</b>	50 Hz to 15 kHz.
<b>Resolution</b>	25 Hz (< 6.25 kHz dev.) 100 Hz (< 25 kHz dev.).
<b>Indication</b>	4 digits.
<b>Setting</b>	Via keyboard entry. Step change variation by INC/DEC keys and rotary control.
<b>Accuracy</b>	$\pm 7\%$ $\pm 10$ Hz (at 1 kHz). $\pm 10\%$ (50 Hz to 15 kHz).

### EXTERNAL

<b>As internal plus:</b>	
<b>Input impedance</b>	1 M $\Omega$ in parallel with approximately 40 pF.
<b>Modulation range</b>	0 to 30 kHz.
<b>Mod. frequency range</b>	1 Hz to 50 kHz.
<b>Sensitivity</b>	1 V peak to peak for 5 kHz deviation; $\pm 10\%$ at 1 kHz.
<b>FM distortion</b>	Less than 1% at 1 kHz with 5 kHz deviation (300 Hz to 3.4 kHz bandwidth).

### PHASE MODULATION INTERNAL

<b>CW range</b>	0.4 to 1000 MHz.
<b>Modulation range</b>	0 to 10 rads.
<b>Mod. frequency range</b>	300 Hz to 3.4 kHz.
<b>Resolution</b>	0.02/0.03 rads, up to 6.3 rads.
<b>Indication</b>	3 digits.
<b>Setting</b>	Via keyboard entry. Step change variation by INC/DEC keys and rotary control.
<b>Accuracy</b>	$\pm 8\%$ at 1 kHz, $\pm 11\%$ from 300 Hz to 3.4 kHz.

### EXTERNAL

<b>As internal plus:</b>	
<b>Input impedance</b>	1 M $\Omega$ in parallel with approximately 40 pF.
<b>Sensitivity</b>	1 V p-p for 5 rads.
<b>PM distortion</b>	Less than 2% at 1 kHz with 5 rads (measured in a 300 Hz to 3.4 kHz bandwidth).

## AUDIO GENERATOR, 1 kHz OSCILLATOR

### OUTPUT IMPEDANCE

Less than 5  $\Omega$  nominal.

### FREQUENCY

<b>Range</b>	50 Hz to 15 kHz (Usable 20 Hz to 20 kHz).
<b>Resolution</b>	0.1 Hz (20 Hz to 3.25 kHz). 1 Hz (3.25 kHz to 20 kHz).
<b>Indication</b>	5 digits.
<b>Setting</b>	Via keyboard, and with rotary control for step change variation.
<b>Accuracy</b>	$\pm 0.01$ Hz from 50 Hz to 3.25 kHz, $\pm 0.1$ Hz from 3.25 kHz to 15 kHz.
<b>Distortion</b>	Less than 2%.
<b>Spurious signals</b>	Less than -26 dBc (at 9370 $\pm$ 20 Hz only).
<b>Residual noise</b>	Less than 0.2 mV RMS in a psophometric bandwidth.
<b>DC offset</b>	Less than 100 mV DC.

### FIXED FREQUENCY

<b>Distortion</b>	Less than 1%.
<b>Residual noise</b>	Less than 0.4 mV RMS in a psophometric bandwidth.
<b>DC offset</b>	Less than 100 mV DC.
<b>Accuracy</b>	As internal standard.

### TWO TONE SETTING

Two tones are available, 1 kHz and the AF Generator setting frequency, both at the same level.

### OUTPUT LEVEL (e.m.f.)

<b>Range</b>	1 mV to 2.55 V (to 5 kHz). 1 mV to 2 V (to 15 kHz).
<b>Accuracy</b>	$\pm 5\%$ $\pm 1$ digit.
<b>Setting</b>	1 mV steps (1 mV to 255 mV), 2.5 mV steps (255 to 635 mV), 10 mV steps (640 mV to 2.55 V).

## RF FREQUENCY METER

### FREQUENCY

<b>Range</b>	1.5 MHz to 1000 MHz.
<b>Resolution</b>	1 Hz or 10 Hz to 200 MHz, 10 Hz from 200 MHz to 1000 MHz.
<b>Typ. acquisition</b>	Up to 200 MHz, 100 ms, with 10 Hz resolution; 1 s with 1 Hz resolution. Up to 1000 MHz, 400 ms, 10 Hz resolution only.

### INPUT

<b>Sensitivity</b>	Input to type-N socket: 5 mW (0.5V), Tx mode selected. 20 mW (1V), one/two port duplex. 0.05 mW (50 mV) BNC input typ.
<b>Accuracy</b>	As internal standard $\pm 1$ digit.

## RF POWER METER

### INPUT

<b>Impedance</b>	As RF counter section.
<b>VSWR</b>	As RF counter section.
<b>Reading Ranges:</b>	N socket; TX mode 50 mW to 150 W, usable down to 5 mW. One-port duplex 100 mW to 150 W, usable down to 20 mW. Two-port duplex 50 mW down to 5 mW. BNC socket; 0.05 mW to 1.0 W.
<b>Continuous rating:</b>	75 W at 0 to 50°C.



<b>Maximum Input</b>	N socket; 150 W (TX mode or one-port duplex) or 100 W (two-port duplex) for limited period, typically 2 minutes at 25°C. End of usable working period indicated by visual warning (REMOVE RF INPUT) and audible alarm. BNC socket; 1.2 W. Trip circuit operates at approximately 1.0 W. Overload protection up to 50 W. Tripping indicated by visual warning (REMOVE RF INPUT) and audible alarm.
<b>Frequency range</b>	1.5 to 1000 MHz.
<b>Resolution</b>	1% of indicated bar chart range.
<b>Indication</b>	2 or 3 digits and analog display.
<b>Setting</b>	Automatic ranging on scales 0 to 30, 0 to 100, 0 to 300 mW, 0 to 1, 0 to 3, 0 to 10, 0 to 30, 0 to 100, 0 to 300 W.
<b>Acquisition time:</b>	<3 s with 10 Hz resolution.
<b>Accuracy</b>	±10% ±1 digit up to 500 MHz. ±15% ±1 digit up to 960 MHz. ±20% ±1 digit up to 1000 MHz. ±1.25 dB ±1 digit >5mW over the ranges 825 to 845 MHz and 890 to 905 MHz from +15°C to +25°C. (There may be a difference between a TX mode reading and a duplex mode reading. The difference is normal and within the above limits.)

## MODULATION METER

<b>Manual-tune</b>	Provides frequency offset indication from carrier. 3 Digits and decimal point indicate most significant positive or negative error.
<b>Auto-tune</b>	Provides: Measurement and simultaneous display of RF frequency, power, modulation frequency and level, and 1 kHz demod. distortion.
<b>Acquisition</b>	Less than 3 seconds at 10 Hz resolution.
<b>INPUT</b>	
<b>Frequency range</b>	As RF Frequency Meter.
<b>Sensitivity</b>	As RF Frequency Meter.
<b>AF filters</b>	The following filters are available: Band-pass — 300 Hz to 3.4 kHz. Low-pass — 300 Hz. Low-pass — 15 kHz.
<b>AMPLITUDE MODULATION</b>	
<b>CW range</b>	1.5 MHz to 400 MHz.
<b>Modulation range</b>	0 to 90% up to 100 MHz. 0 to 80% up to 400 MHz, in auto-tune mode. 0 to 100% up to 400 MHz in manual-tune mode. Automatic ranging (bar chart), 0 to 10, 0 to 30, 0 to 100% depth.
<b>Mod. frequency range</b>	50 Hz to 10 kHz (typically 10 Hz to 15 kHz).
<b>Resolution</b>	1% AM.
<b>Indication</b>	2 digits and +/— peak analog display.
<b>Accuracy</b>	±6% ±1 digit at 1 kHz, ±8.5% ±1 digit from 50 Hz to 10 kHz.
<b>Demod. distortion</b>	Less than 5% below 21 MHz and less than 2% above. Measured with 300 Hz to 3.4 kHz filter and 30% AM at 1 kHz modulation frequency.
<b>Residual AM</b>	<1% at frequency meter sensitivities +6 dB.
<b>FREQUENCY MODULATION</b>	
<b>Modulation range</b>	0 to 25 kHz. Automatic ranging (bar chart), 0 to 1, 0 to 3, 0 to 10, 0 to 30 kHz.
<b>Mod. frequency range</b>	50 Hz to 10 kHz (typically 10 Hz to 15 kHz).

<b>Resolution</b>	20 Hz to 5 kHz deviation, 1% up to 25 kHz deviation.
<b>Indication</b>	3 digits and +/— peak analog display.
<b>Accuracy</b>	±6% ±1 digit at 1 kHz, ±8.5% over range 50 Hz to 10 kHz.
<b>Demod. distortion</b>	Less than 2% at 5 kHz deviation and 1 kHz modulation frequency in a 300 Hz to 3.4 kHz bandwidth.
<b>Residual FM</b>	Less than 30 Hz RMS up to 500 MHz, typ. 15 Hz. Less than 60 Hz RMS up to 1000 MHz, typ. 30 Hz. For inputs above 20 mW/0.2 mW (N/BNC), measured in a 300 Hz to 3.4 kHz bandwidth.

## PHASE MODULATION

<b>Modulation range</b>	0 to 10 radians. Automatic ranging (bar chart), 0 to 1, 0 to 3 and 0 to 10 radians.
<b>Mod. frequency range</b>	300 Hz to 3.4 kHz. Phase de-modulation is obtained using 750 µs de-emphasis.
<b>Resolution</b>	1% or 0.01 radians.
<b>Indication</b>	3 digits and +/— peak analog display.
<b>Accuracy</b>	±6% ±1 digit at 1 kHz. ±8.5% ±1 digit from 0.3 to 3.4 kHz. WRT 750 µs de-emphasis.
<b>Demod. distortion</b>	Less than 2% at 5 rads. modulated by 1 kHz measured in 300 Hz to 3.4 kHz bandwidth

## SINAD METER / S/N METER

<b>Frequency</b>	1 kHz.
<b>Range</b>	0 to 18, 0 to 50 dB (SINAD). 0 to 30, 0 to 100 dB (S/N).
<b>Resolution</b>	0.1 dB.
<b>Indication</b>	3 digits plus analog display.
<b>Accuracy</b>	±1 dB.
<b>Sensitivity</b>	50 mV (100 mV for 40 dB SINAD/S/N).

## DISTORTION METER

<b>Frequency</b>	1 kHz.
<b>Range</b>	0 to 10%, 0 to 30% distortion.
<b>Resolution</b>	0.1% distortion.
<b>Indication</b>	3 digits plus analog display.
<b>Accuracy</b>	±5% of reading ±0.5% distortion.
<b>Sensitivity</b>	50 mV (100 mV for 1% distortion).

## AF LEVEL METER

<b>Features</b>	AC + DC, or AC measurements.
<b>Input impedance</b>	1 MΩ in parallel with approximately 40 pF.
<b>Frequency range</b>	50 Hz to 20 kHz (or DC), usable to 50 kHz.
<b>Level range</b>	0 to 100 mV, 0 to 300 mV, 0 to 1, 0 to 3, 0 to 10, 0 to 30 and 0 to 100 V.
<b>Resolution</b>	1 mV or 1% dependent on range.
<b>Indication</b>	3 digits plus analog display.
<b>Accuracy</b>	±3% ±3 mV ±1 digit.
<b>Frequency response</b>	Switchable: band-pass 0.3 to 3.4 kHz, low-pass 300 Hz or 50 kHz.

## AF FREQUENCY METER

<b>Range</b>	20 Hz to 20 kHz.
<b>Resolution</b>	0.1 Hz/1 Hz.
<b>Indication</b>	3, 4 or 5 digits.
<b>Accuracy</b>	As internal standard ±1 digit ±0.1 Hz or 0.02% (whichever is greater).
<b>Sensitivity</b>	50 mV.



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## INTERNAL FREQUENCY STANDARDS

<b>OCXO</b>	Oven controlled crystal oscillator, nominal frequency 10 MHz.
<b>Temperature coefficient</b>	Less than $\pm 5$ parts in $10^6$ from 0 to 50°C. Less than 4 parts in $10^6$ /deg C from 50 to 70°C.
<b>Ageing rate</b>	Less than $\pm 1$ part in $10^7$ / month, $\pm 1$ part in $10^6$ / year after 1 month's continuous use.
<b>Short-term stability</b>	Less than $\pm 1$ part in $10^9$ , RMS frequency error over a 1 s period.
<b>Retrace error</b>	Less than $\pm 2$ parts in $10^7$ over 24 hours, at constant temperature and after 25 minutes warm-up.

## EXTERNAL FREQUENCY STANDARD INPUT

<b>Frequency</b>	1 MHz.
<b>Level</b>	100 mV to 3 V RMS
<b>Impedance</b>	10 k $\Omega$ in parallel with 100 pF approximately.

## DIGITAL STORAGE OSCILLOSCOPE

<b>Features</b>	Single or repetitive sweep, available in TX, RX and Audio Test modes, calibrated for AM, FM and $\Phi$ M.
<b>Frequency range</b>	DC to 50 kHz (from 3 Hz on AC).
<b>Voltage range</b>	10 mV/div to 20 V/div in a 1-2-5 sequence.
<b>Accuracy</b>	$\pm 5\%$ .
<b>FM ranges</b>	$\pm 30$ , 15, 6, 1-5 kHz deviation at $> 10\%$ accuracy.
<b><math>\Phi</math>M ranges</b>	$\pm 15$ , 7-5, 3, 1-5 rad at $\pm 10\%$ accuracy.
<b>AM ranges</b>	20, 10, 5%/div. at $\pm 10\%$ accuracy.
<b>Sweep rates</b>	100 $\mu$ s/div. to 5 s/div. in 1-2-5 sequence, accuracy locked to internal standard.
<b>Trigger</b>	Repetitive or single-shot storage.

## SELCALL ENCODER/DECODER

<b>Functions</b>	Encodes 11 tones, decodes up to 12 tones in a CCIR, ZVEI, DZVEI, EEA, EIA or USER DEFINED tone sequence.
<b>Tone encoder facilities</b>	Send continuous, burst, single step, extend tone, either (1st of 5, 3rd of 7, 5th of 9) null, repeat or frequency shift up to $\pm 9\%$ in 1% steps.
<b>Tone decoder facilities</b>	Displays tone number, frequency and percentage error. Screen indicates null tones (using CRT) and annotates out of limit frequencies with * for ease of identification.
<b>User define</b>	Allows definition for encode or decode of up to 15 tones between 20 Hz and 20 kHz with durations for all tones of between 10 ms and 999 ms. Up to a max. of 11 tones may be sent at any one time. Frequencies are retained in non-volatile memory.
<b>Decoder</b>	Decodes tones 25 ms-1-25s 0-3-3-4 kHz B.W.

## ADDITIONAL FEATURES

### IF OUTPUT SOCKET

<b>Frequency</b>	110 kHz nominal.
<b>Level</b>	Minimum 180 mV.
<b>Impedance</b>	50 $\Omega$ , minimum load 5k $\Omega$ .
<b>Bandwidth</b>	50 kHz to 350 kHz.

### DEMODULATION OUTPUT SOCKET

<b>Level</b>	400 mV peak to peak for $\pm 1$ kHz deviation $\pm 10\%$ .
<b>Impedance</b>	10k $\Omega$ nominal.
<b>Bandwidth</b>	Either 300-3-4 kHz, 15 kHz LP or 300 Hz LP set via front panel filter switch.

### ACCESSORY SOCKET

Pins 1, 3, 5, 6 designated for future options.  
Pin 2, +12 V, at least 100 mA.  
Pin 7, AF output, 1 W into 8 $\Omega$ .  
Pin 1, Pulse output available under GPIB control, approx. 600 ns.

### SPECIAL KEY FUNCTIONS

<b>RX = TX FREQ</b>	Presets the RF signal generator frequency for receiver test mode to that shown in TX mode.
<b>Hold Display</b>	Freezes instrument settings and readings, facilitating high RF power measurements and hard copy printout of TX, RX, Duplex or AF test screens.
<b>INC/DEC</b>	Available in TX, RX, Duplex and AF test modes for defining frequency or level increments of the AF and RF signal generators. Any step size setting within the range and resolution of the test set is permissible.
<b>Store/Recall</b>	37 non-volatile stores (01 to 37) are provided, each capable of retaining all front panel settings for up to 10 years. An additional store (00) is provided to retain the last test set-up, in the event of a power fall.
<b>Help key</b>	Provides access to SELF TEST, stores lock, RF counter resolution, default settings for SINAD or S/N and USER instruction guide for TX, RX, Duplex and Audio Test modes.
<b>Audible output</b>	For listening to demod output and received audio.
<b>Two tone modulation</b>	In transmit mode, two tones available under tones menu, generates 1 kHz fixed + AF synthesizer. In receiver mode, external modulation inputs add to internal modulation.

## GENERAL

### POWER REQUIREMENTS

<b>Rated supply voltage</b>	105-120 V AC, 210-240 V AC, all $\pm 10\%$ .
<b>Supply frequency range</b>	45 Hz-440 Hz.
<b>Maximum consumption</b>	100 VA.
<b>DC supply voltage</b>	11-32 V DC.
<b>DC supply consumption</b>	Less than 60 W.

### GPIB INTERFACE

<b>Capabilities</b>	A GPIB interface is fitted as an option. All functions except the supply switch are remotely programmable. Complies with the following subsets as defined in IEEE 488-1978 and IEC Publication 625-1: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1.
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### RADIO FREQUENCY INTERFERENCE

Conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.

### SAFETY

Complies with IEC 348.

### RATED RANGE OF USE

0 to 50°C.

### LIMIT RANGE OF OPERATION

0 to 55°C.

# CONDITIONS OF STORAGE AND TRANSPORT

Temperature	-40 to +70°C.
Humidity	Up to 90% humidity.
Altitude	Up to 2500 m (pressurized freight at 27 kPa differential, i.e. 3.9 lbf/in <sup>2</sup> ).

## DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
197 mm	389 mm	584 mm	15.5 kg
7.75 in	15.3 in	23.0 in	34 lb

Includes dimensions of handle, feet and front cover.

## VERSIONS AND ACCESSORIES

When ordering please quote eight digit code numbers

Ordering numbers	Descriptions
52955-900A	Radio Communications Test Set with OCXO.
52955-301W	Radio Communications Test Set with GPIB Interface Fitted.
52955-302D	Radio Communications Test Set Export Licence-free Version.
52955-307C	Radio Communications Test Set French Language Version.
52955-312B	Radio Communications Test Set Spanish Version.
	<b>Supplied accessories</b> AC Supply Lead. Operating Manual. Front Cover (Stowage). DC Supply Lead.
54415-005E	<b>Optional accessories</b> Mobile Radio Test System Adapter (must be ordered with at least one of the following options).
46884-101J	NMT (Option 10), covers NMT450, NMT900 and NMT county variants.
46884-102F	Amps (option 20), covers US AMPS including expanded spectrum.
46884-103G	TACS (option 30), covers UK TACS including all E TACS channels.
46884-104V	RC2000 (option 40), covers the French Radio cover 2000 system both UHF & VHF.
46884-105S	Band III (option 50), covers the UK Band III and similar trunked mobile radio systems.
54421-003J	Directional Power Head 25 MHz-1000 MHz.
54421-002L	Directional Power Head 1 MHz-50 MHz.
54462-023W	Battery Pack with built-in D.C. Input Fast Charger.
54211-001D	Printer 24 Column with Paper & Ribbon.
46883-877P	Printer Paper & Ribbon Kit.
54411-052M	600 Ω Balanced Interface with 20 dB AF Attenuator.
54499-042L	CCITT filter.
54499-043S	CMESS filter.
54433-002Y	GPIB Interface Module.
43129-189U	GPIB Lead used with 24 Column Printer.
54451-163Y	IF Injector Probe 470 kHz.
54451-164N	IF Injector Probe 10.7 MHz.
54451-165L	IF Injector Probe 455 kHz.
54127-304C	Rack Mounting Kit (19").
54421-001N	BNC Telescopic Antenna.
54431-023A	20 dB AF Attenuator.
54150-022P	Viewing Hood.
46662-192W	Transit Case.
46881-504C	Service Manual.

(Contact Marconi Instruments for further options)