

Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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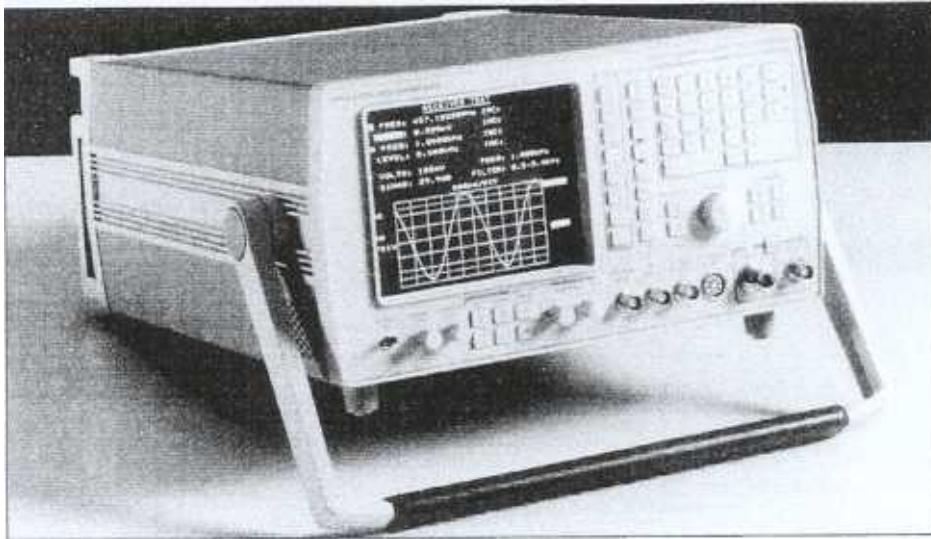
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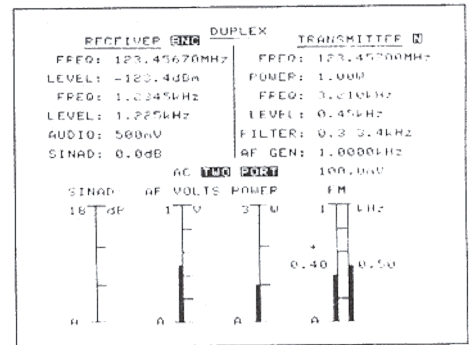


Radio Communications Test Set

2955B



and highlights the function accessed in reverse video. This informs the operator which frequency or level parameter is then available for control.



CONTROLS AND INDICATIONS

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 stepping 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.

Large Clear Display

The CRT display 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 adjustments such as simple peaking indications. Comparative measurements between positive and negative peak deviation are available to check modulation symmetry.

In transmitter, receiver and audio test modes, a digital storage oscilloscope facility is provided. When testing transmitters, the oscilloscope'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 (MODE = Tx TEST)
When measuring a transmitter in the frequency range 1.5 MHz to 1000 MHz, the

- Comprehensive testing facilities for AM/FM/ØM transceivers to 1000 MHz
- Full duplex facility tests radio telephones and cross-band repeaters
- Sensitive receiver for off-air transmitter monitoring with option 001
- Sequential and revertive tones, DTMF and DCS encoders/decoders
- Menu driven CRT display with 26 stores for recall of 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 or RS232 for full instrument control
- High stability OCXO fitted as standard

The 2955B Radio Communications Test Set combines all the instruments required for transceiver testing within a single unit. 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 ØM mobile radio equipment, including low-power hand portables and mobiles using selective calling, full duplex radio telephones, digital pocket pagers, 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.

Comprehensive Measurements

The 2955B comprises 19 instrument functions for transceiver testing: RF power meter, RF frequency meter, modulation meter, RF signal generator, dual AF signal generators, AF frequency meter, AF voltmeter, 1 kHz AF distortion meter, S/N

and SINAD meter, sequential tones encoder/decoder, DTMF encoder/decoder, digitally coded squelch (DCS) encoder/decoder, POCSAG digital pager encoder and digital oscilloscope. 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.

With option 001 the 2955B provides a sensitive, selective input for measurement of signals as low as 1 µV.

Simple Set-up

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 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

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. The screen indicates 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: a range hold is available where automatic ranging is not required. These facilities cut service test time dramatically.

150 W Power Handling

RF power measurement range is 0.05 mW to 75 W continuous rating, catering for low-power portables and base station transmitters. Power readings in dBm or Watts are available. High-power transmitters of up to 150 W may be measured for short intervals. 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 stabilized, allowing all the transmitter measurements and settings to be read, with the transmitter de-keyed. 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 or RS232 printer. The optional 24 column ticket printer fits into the instrument lid for storage.

SSB Testing

RF frequency counter resolution is selectable as either 1 Hz or 10 Hz enabling tests of SSB systems. A two-tone modulating signal may be applied to a 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 capability to meet the needs of emerging radio telephone networks.

Testing simplex radios is simplified by using the Rx = Tx key. This pre-sets 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 (MODE = DUPLEX TEST)

Full duplex testing of radio telephones is possible with all necessary parameters for both the transmitter and receiver displayed simultaneously on the CRT screen. The frequency and level of the RF and AF signal generators may be independently controlled from the instrument key pad or varied using the rotary control.

Any Duplex Offset

A standard feature 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, cross-band repeaters and repeater systems using mixed AM and FM equipment can be tested.

RECEIVER TEST (MODE = Rx 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 to 1 kHz. Modulation can be set to any default value for FM, \emptyset M and AM testing within the default limits. This facility is provided so that the minimum amount of user interaction is required to perform a simple system check after switch on. If the RF signal generator frequency has been pre-set 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.

Noise and Distortion

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.

RF output level accuracy is specified to be within ± 2 dB over the attenuator range of +5 dBm to -127 dBm, and includes the effects of temperature, from 0 to +50°C, making the signal generator one of the most accurate available in a test set for the maintenance user.

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 or \emptyset M signals. The external modulation input can be used for dual tone inputs such as DTMF tones, or for FFSK/FSK modulation.

AUDIO TEST (MODE = Rx TEST)

FUNCTION = AF GEN)

The audio generator function provides access to the 2 audio generators, AF voltmeter and digital oscilloscope. The audio generators provide a choice of sine, square, triangular and saw-tooth waveforms. Tone generation is available providing CCIR, ZVEI, DZVEI, EEA, EIA or USER DEFINED tones, and separately DTMF generation and decoding. The AF input socket has a nominal input impedance of 1 M Ω , making it compatible with standard probes.

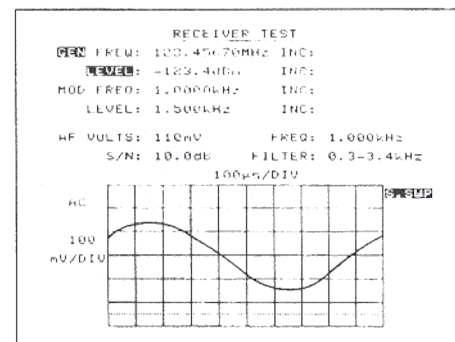
TONES ENCODER/DECODER

The 2955B provides a very comprehensive analog and digital tones encoder/decoder facility for testing selective circuits in mobile radios and digital pagers. Sequential tone standards are available to the user from a screen menu. In addition, a USER DEFINED mode allows 15 different tone frequencies to be defined. Provision is made to send a sequence of up to 33 tones in any standard, either as a single burst, tone step or as continuous cycles for receiver testing. Frequencies may be shifted from nominal up to $\pm 9\%$ in 1% steps for tolerance checking of receiver decoders. Any one of the sequence tones can be extended. Sub audible tones (CTCSS) and two tone operation are also available.

Standard Tones

Decoded tones are compared with standard frequencies held in memory. If each tone is within the standard limits, the tone number, frequency and percentage error is displayed. Sub audible tones are measured directly in the transmitter test mode by the audio frequency counter with the 300 Hz low pass filter selected: this allows measurement even in the presence of modulation. For applications requiring encoding and decoding of complex or non standard tones systems, an EXTERNAL MODULATION input and AF DEMODULATION output are provided.

Revertive tone systems can be tested. Up to 11 tones can be programmed for transmit; with decoding and display of up to 11 revertive tones from the unit under test.



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DTMF messages can be sent and received, and displayed on the screen. Digitally coded squelch (DCS) can be generated with the capability to program the DCS 3 digit code, digital bit rate, modulation level and signal polarity. DCS transmissions can be received, decoded and the waveforms displayed with the correct code highlighted from all possible codes.

Pager Testing

POCSAG digitally coded pagers can be tested with control of the pager frequency, bit rate, deviation and identity code. Transmission of either an alert signal only, a numeric message or an alpha-numeric message is available. A facility to insert errors into the 32 bit address to test the unit's error correction capability is provided.

With option 001 fitted, off-air measurements of a transmitter station can be made by the 2955B when Tx MONitor mode is selected. A selective, sensitive receiver with 1 μ V sensitivity covering the range 100 kHz to 1 GHz is available to demodulate an off-air signal. Calibrated signal strength is displayed in μ V, mV, dB μ V or dBm up to a level of 140 mV. Carrier frequency is measured and displayed as an offset from the ideal. Modulation level, frequency and distortion are also displayed, both as readings and as bar charts.

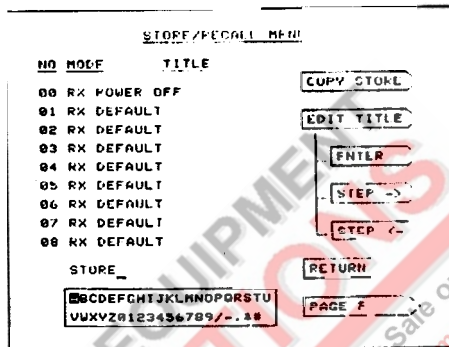
Off-Air Testing

In use the 2955B is connected to a suitable antenna or the telescopic antenna supplied. The readings are then presented in a similar way to the normal transmitter test screen. The increment keys may be used to alter the carrier frequency, such as for channel steps, and the variable control is available for fine tuning. The audio generators are available for exciting the transmitter, typically over a land line to a remote base station. Other applications include the use of a probe (see 52388-900D) for fault finding and aligning receiver circuits such as mixers, IF amplifiers and filters. Being high impedance, the loading on the circuit in question can be minimized.

The demodulated signal can be monitored on the built-in loudspeaker and on the storage oscilloscope display. If desired an external loudspeaker or a headset can also be used. To cater for different modulation types, two receiver bandwidths are available, 12 kHz for narrowband speech and 180 kHz for data and broadcast signals. The normal transmitter tones decoding facilities are available to permit tests on remote base station calling tones.

Using the microphone interface accessory and microphone (54432-013E and 54412-020Y) it is possible to use the 2955B in a 'talk-through' mode as a low power transceiver for testing mobile equipment whilst in service. This allows instructions to be given to the radio operator and for comments to be returned. In this way large fleets can be quickly tested, with minimum disruption to users.

The sensitive receiver allows channel and frequency scanning. It is possible to store up to 11 spot frequencies or a channel plan of up to 9999 channels in memory. The 2955B may then be asked to scan until a signal large enough to lift the squelch is found. This is particularly useful where a base station is monitored.



26 non-volatile stores are provided, each capable of retaining indefinitely a complete front panel set-up, with instant recall whenever required. Each store may be allocated an alphanumeric title of up to 20 characters to remember its contents. One additional storage location (00) 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.

Full instrument control is provided via the GPIB or RS232 interfaces, and adds further versatility for automatic testing, and computer-assisted manual testing. A write-to-screen capability enables the CRT to be used 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.

Instrument lifetime is a significant factor in cost-of-ownership, and the 2955B 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-RF connector, a relay opens the signal path thus protecting the instrument.

Simple Servicing

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 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, an attenuator block, a receiver module (option 001) and a power load. These are easily removed for replacement or further test.

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.

A 3 year unconditional warranty is provided in many territories.

Accessories are available to provide comprehensive cellular radio test facilities for NMT, AMPS and TACS. MPT 1327 (Band III) and similar trunked radio system test facilities are also available.

Other accessories are described later in this document.

RF SIGNAL GENERATOR

FREQUENCY

Range
0.4 MHz to 1000 MHz (usable to 1060 MHz).

Resolution
50 Hz up to 530 MHz. 100 Hz up to 1000 MHz.

Indication
9 digit display.

Accuracy
As internal standard.

OUTPUT LEVEL

Range
Rx Mode:
-135 dBm to -15 dBm (0.04 μ V to 40 mV),
N-type socket selected. -15 dBm to 5 dBm
(0.4 μ V to 400 mV), BNC socket selected.
One Port Duplex Mode:
-140 dBm to -21.5 dBm, (0.0224 μ V to 18.85 mV).
Two Port Duplex Mode:
-115 dBm to -15 dBm (0.04 μ V to 40 mV).

Resolution
0.1 dB.

Indication
4 digits with units μ V, mV, dBm, dB μ V.
PD/EMF selection as appropriate.

Accuracy
 ± 1.8 dB for levels above -127 dBm, from +18 to +28°C.
 ± 2 dB from 0 to 50°C.

SPECTRAL PURITY**Residual FM**

Less than 13 Hz rms up to 520 MHz, typically 10 Hz;
less than 26 Hz up to 1000 MHz, typically 20 Hz.
(300 Hz to 3.4 kHz bandwidth).

Residual AM

Less than 0.5% (300 Hz to 3.4 kHz bandwidth).

Harmonics

Less than -20 dBc up to 1.5 MHz,
-25 dBc up to 250 MHz,
-20 dBc up to 1000 MHz.

Sub-harmonics

None up to 530 MHz, less than -25 dBc to 1000 MHz.

Spurious signals

For carrier frequencies up to 88 MHz:
Better than -45 dBc up to 110 MHz, less than -35 dBc
above 110 MHz.
For carrier frequencies up to 960 MHz:
Less than -60 dBc.

SSB phase noise at 20 kHz offset

Less than -110 dBc/Hz up to 500 MHz, less than
-104 dBc/Hz to 1000 MHz.

RF leakage

Less than 0.2 μ V PD generated in a 50 Ω 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 -40 dBm and
the output terminated in a 50 Ω sealed load.

Protection

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.

OUTPUT IMPEDANCE

50 Ω nominal.

VSWR

Less than 1.2 to 500 MHz, less than 1.3 to
1000 MHz (N-type), less than 2.2 to 1000 MHz (BNC).

MODULATION**INTERNAL AMPLITUDE MODULATION****CW range**

1.5 to 400 MHz, usable from 400 kHz to 500 MHz.

Modulation depth range

0 to 99%.

Resolution

1%.

Modulation frequency range

20 Hz to 20 kHz.

Accuracy

$\pm 7\%$ of setting ± 1 digit at 1 kHz up to 85% AM.
 $\pm 10\%$ of setting ± 1 digit, 50 Hz to 5 kHz up to 70% AM.
 $\pm 15\%$ of setting ± 1 digit, 50 Hz to 15 kHz up to
85% AM.

AM distortion

Less than 2% distortion at 1 kHz with 30% AM (300 Hz
to 3.4 kHz bandwidth).

FREQUENCY MODULATION INTERNAL**CW range**

0.4 to 1000 MHz (usable to 1060 MHz).

Modulation deviation range

0 to 25 kHz.

Resolution

25 Hz (< 6.25 kHz dev.).
100 Hz (< 25 kHz dev.).

Modulation frequency range

20 Hz to 20 kHz.

Accuracy

$\pm 7\%$ ± 10 Hz at 1 kHz.
 $\pm 10\%$ from 50 Hz to 15 kHz.

FM distortion

Less than 1% distortion at 1 kHz with 5 kHz deviation
(300 Hz to 3.4 kHz bandwidth).

PHASE MODULATION INTERNAL**CW range**

0.4 to 1000 MHz.

Modulation range

0 to 10 rads.

Resolution

0.025 rads, up to 6.3 rads.
0.1 rads, above 6.3 rads.

Modulation frequency range

300 Hz to 3.4 kHz.

Accuracy

$\pm 8\%$ at 1 kHz, $\pm 11\%$ from 300 Hz to 3.4 kHz.

 \emptyset M distortion

Less than 2% at 1 kHz with 5 rads
(300 Hz to 3.4 kHz bandwidth).

EXTERNAL

As internal plus:

Input impedance

1 M Ω in parallel with approximately 40 pF.

AM Sensitivity

1 V p-p for 30% AM at 1 kHz $\pm 15\%$ reading $\pm 1\%$ AM.

FM Sensitivity

1 V p-p for 5 kHz deviation: $\pm 10\%$ at 1 kHz.

Modulation deviation range

0 to 30 kHz.

Modulation frequency range

1 Hz to 50 kHz.

 \emptyset M Sensitivity

1 V p-p for 5 rads.
 $\pm 12\%$ at 1 kHz.

DUAL AUDIO GENERATOR**OUTPUT IMPEDANCE**

Less than 5 Ω nominal.

WAVEFORM SHAPE

Sine, square, triangle, saw-tooth.

FREQUENCY**Range**

10 Hz to 20 kHz.

Resolution

0.1 Hz (10 Hz to 3.25 kHz),
1 Hz (3.25 kHz to 20 kHz).

Accuracy

± 0.01 Hz from 10 Hz to 100 Hz.
 ± 0.1 Hz from 100 Hz to 20 kHz.

Distortion

Less than 0.5% at 1 kHz (sine), less than 1% from
50 Hz to 15 kHz (sine).

Residual noise

Less than 0.1 mV RMS in a psophometric bandwidth.

DC offset

Less than 10 mV DC.

OUTPUT LEVEL (EMF)**Range**

0.1 mV to 4.095 V RMS (sine and square).
0.1 mV to 4.095 V peak (triangle and sawtooth).

Accuracy

$\pm 5\%$ ± 1 digit, 50 Hz to 15 kHz.

Setting

0.1 mV steps (0.1 mV to 409.5 mV).
1 mV steps (409.5 mV to 4.095 V).

RF RECEIVER (Option 001)**FREQUENCY****Range**

100 kHz to 1000 MHz (usable to 1060 MHz).

Sensitivity

2 μ V for 10 dB SINAD in 12 kHz bandwidth from 1 MHz
to 1000 MHz for 3.5 kHz deviation in psophometric
bandwidth (typically 1 μ V).

Linearity Response

Typically ± 3 dB level accuracy at 100 MHz with
reference to -60 dBm, over range -87 dBm to -24 dBm
(10 μ V to 14 mV) BNC; -67 dBm to -4 dBm (100 μ V to
140 mV) N type.

Level Response

Typically ± 3 dB from 10 MHz to 1000 MHz.

Image Response

0 dB at ± 42.8 MHz of RF input.

Squelch

A manual squelch control is provided with a variable
threshold.

RF FREQUENCY METER**FREQUENCY****Range**

1.5 MHz to 1000 MHz (usable to 1060 MHz).

Resolution

1 Hz or 10 Hz to 200 MHz, 10 Hz from 200 MHz to
1000 MHz.

Typical acquisition

Up to 200 MHz, 100 ms, with 10 Hz resolution;
1 s with 1 Hz resolution.
Up to 1000 MHz, 400 ms.

INPUT**Sensitivity**

N type socket; 5 mW (0.5 V), Tx mode selected.
20 mW (1 V), one/two port duplex.
BNC input; 0.05 mW (50 mV); 1 μ V with option 001
fitted.

Accuracy

As internal standard ± 1 digit.

RF POWER METER**INPUT****Range**

0.05 mW to 150 W.

Input to type-N socket:

50 mW to 75 W continuous, Tx Mode selected.
100 mW to 75 W continuous in single port duplex mode
(150 W max. for typically 2 minutes at 25°C
continuous).

End of safe working is indicated by screen warning
"REMOVE RF INPUT" and audible alarm.

Input to BNC socket:

Usable 0.05 mW to 25 mW.

Measurement Units

Watts or dBm.

Frequency range

As RF Frequency Meter.

Resolution

1% full-scale.

Indication

2/3 digits and analog display.

Setting

Automatic ranging on scales with full scale values 30,
100, 300 mW, 1, 3, 10, 30, 100 W and 300 W.

Accuracy

$\pm 10\%$ ± 1 digit up to 500 MHz,
 $\pm 15\%$ ± 1 digit up to 960 MHz,
 $\pm 20\%$ ± 1 digit up to 1000 MHz,
 $\pm 25\%$ typical BNC socket.

VSWR

Less than 1.2 to 500 MHz,
less than 1.35 to 1000 MHz (N-type).
Less than 2.2 to 1000 MHz (BNC).

MODULATION METER**Manual tune**

Provides frequency offset indication from carrier.
3 Digits and decimal point indicate most significant
positive or negative error.

Auto-tune

Provides measurement and simultaneous display of RF
frequency, power, modulation frequency and level, and
1 kHz demodulation distortion.

Acquisition

Less than 3 seconds at 10 Hz resolution.

INPUT**Frequency range**

As RF Frequency Meter.

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Sensitivity
As RF Frequency Meter.

AF filters
The following filters are available:
Bandpass – 300 Hz to 3.4 kHz,
Low pass – 300 Hz,
Low pass – 15 kHz.

AMPLITUDE MODULATION

CW range
1.5 MHz to 400 MHz.

Modulation range
Manual tune mode: 0 to 100% up to 400 MHz.
Auto-tune mode: 0 to 90% up to 100 MHz.
0 to 80% up to 400 MHz.
Auto ranging (bar chart), 0 to 10, 0 to 30, 0 to 100% depth.

Accuracy
 $\pm 5\% \pm 1$ digit at 1 kHz, $\pm 8.5\% \pm 1$ digit from 50 Hz to 10 kHz.

Resolution
1% AM.

Modulation frequency range
10 Hz to 15 kHz.

Demodulation distortion
Less than 2% above 21 MHz; Less than 5% below 21 MHz; measured in a 300 Hz to 3.4 kHz filter and 30% AM at 1 kHz.

Residual AM
Less than 1% in a 300 Hz to 3.4 kHz bandwidth for inputs above 10 mW/0.1 mW (N-Type/BNC).

FREQUENCY MODULATION

Modulation range
0 to 25 kHz.
Automatic ranging (bar chart), 0 to 1, 0 to 3, 0 to 10, 0 to 30 kHz.

Resolution
10 Hz up to 2.5 kHz deviation.
1% up to 25 kHz deviation.

Accuracy
 $\pm 5\% \pm 1$ digit at 1 kHz, $\pm 7.5\%$ over range 50 Hz to 10 kHz.

Modulation frequency range
10 Hz to 15 kHz.

Demodulation distortion
Less than 1.5% at 5 kHz deviation and 1 kHz modulation frequency in a 300 Hz to 3.4 kHz bandwidth.

Residual FM
Less than 15 Hz RMS up to 500 MHz, typically 12 Hz.
Less than 30 Hz RMS up to 1000 MHz, typically 24 Hz.
For inputs above 20 mW/0.2 mW (N-Type/BNC), (300 Hz to 3.4 kHz bandwidth).

PHASE MODULATION

Modulation range
0 to 10 radians. Automatic ranging (bar chart), 0 to 1, 0 to 3 and 0 to 10 radians.

Resolution
1% or 0.01 radians.

Accuracy
 $\pm 5\% \pm 1$ digit at 1 kHz.
 $\pm 7.5\% \pm 1$ digit from 0.3 to 3.4 kHz with respect to 750 μ s de-emphasis.

Modulation frequency range
300 Hz to 3.4 kHz. Phase de-modulation is obtained using 750 μ s de-emphasis.

Demodulation distortion
Less than 2% at 5 rads. Modulated by 1 kHz measured in 300 Hz to 3.4 kHz bandwidth.

SINAD METER/S/N METER

Frequency
1 kHz.

Range
0 to 18 dB, 0 to 50 dB (SINAD).
0 to 30, 0 to 100 dB (S/N).

Resolution
0.1 dB.

Accuracy
 ± 1 dB.

Sensitivity
50 mV (100 mV for 40 dB SINAD/S/N).

DISTORTION METER

Frequency
1 kHz.

Range
0 to 10%, 0 to 30% distortion.

Resolution
0.1% distortion.

Accuracy
 $\pm 5\%$ of reading $\pm 0.5\%$ distortion.

Sensitivity
50 mV (100 mV for 1% distortion).

AF LEVEL METER

Features
AC + DC, or AC measurements.

Input impedance
1 M Ω in parallel with approximately 40 pF.

Frequency range
20 Hz to 50 kHz (or DC).

Level range
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.

Resolution
1 mV on 1% dependent on range.

Accuracy
 $\pm 3\% \pm 3$ mV ± 1 digit (50 Hz to 20 kHz or DC).

Frequency response
Switchable: bandpass 0.3 to 3.4 kHz, low pass 300 Hz or 50 kHz, external filter.

AF FREQUENCY METER

Range
20 Hz to 20 kHz.

Resolution
0.1 Hz/1 Hz.

Accuracy
As internal standard ± 1 digit ± 0.1 Hz or 0.02% (whichever is greater).

Sensitivity
50 mV.

INTERNAL FREQUENCY STANDARD

OXC
Oven controlled crystal oscillator, nominal frequency 10 MHz.

Temperature coefficient
Less than ± 5 parts in 10^6 from 0 to 50°C;
Less than ± 4 parts in 10^6 /°C from 50 to 70°C.

Ageing rate
Less than ± 5 parts in 10^6 /month, ± 2 parts in 10^7 /year after 1 month's continuous use.

Short-term stability
Less than ± 1 part in 10^6 , RMS frequency error over a 1 s period.

Retrace error
Less than ± 2 parts in 10^7 over 24 hours, at constant temperature and after 25 minutes warm-up.

EXTERNAL FREQUENCY STANDARD INPUT

Frequency
1 MHz.

Level
100 mV to 3 V RMS.

Impedance
Nominally 10 k Ω in parallel with 100 pF.

DIGITAL STORAGE OSCILLOSCOPE

Features
Single or repetitive sweep, available in Tx, Rx and Audio Test modes (Tx MON with option 001), calibrated for AM, FM and \emptyset M.

Frequency range
DC to 50 kHz (from 3 Hz on AC).

Voltage range
10 mV/div to 20 V/div in a 1-2-5 sequence.

Accuracy
 $\pm 5\%$.

FM ranges
 $\pm 30, 15, 6, 3, 1.5$ kHz deviation at $\pm 10\%$ accuracy.

\emptyset M ranges
 $\pm 15, 7.5, 3, 1.5$ rad at $\pm 10\%$ accuracy.

AM ranges
20, 10, 5%/div. at $\pm 10\%$ accuracy.

Sweep rates
100 μ s/div to 5 s/div in 1-2-5 sequence, accuracy locked to internal standard.

Trigger
Repetitive or single-shot storage.

SELCALL ENCODER/DECODER

Functions
Encodes 33 tones, decodes up to 33 tones in a CCIR, ZVEI, DZVEI, EEA, EIA or USER DEFINED tone sequence.

Tone encoder facilities
Send continuous, burst, single step, extend any tone, null, repeat or frequency shift up to $\pm 9\%$ in 1% steps.

Tone decoder facilities
Displays tone number, frequency and percentage error. Screen indicates null tones (using CRT) and annotates out of limit frequencies for ease of identification.

User defined
Allows definition of up to 15 tones.
Frequency range 300 Hz to 3.4 kHz, duration 20 ms to 1.2 s (decode); 20 Hz to 20 kHz, duration 10 ms to 999 ms (encode). Frequencies are stored in non-volatile memory. A copy function allows any of the tone standards to be copied then modified in the user defined memory.

Tones in audio mode
Tones encode and decode facility available using AFGEN output and AF input BNC sockets.

Revertive tones
Available in Receive Test Mode, tones are sent to the radio and the 2955B awaits a response.

DTMF ENCODER/DECODER

Provides DTMF encoder and decoder under Tones menu. Tone duration and intertone gaps may be varied from 10 to 999 ms in 1 ms steps.

PAGER TESTER

Encoding of POCSAG code CCIR No. 1 Rec. 584. Bit rate 400-1500 bits/s, deviation 0-25 kHz. Allows entry of Radio Identity Code (RIC), 4 addresses, 2 preset numeric messages, 4 alphanumeric messages and insertion of bit errors. A data Invert facility is provided.

DCS ENCODER

Digitally Coded Squeech encoder, allows entry of Bit rate 100-200 bits/s, deviation 0-25 kHz. Polarity, normal or inverted, RIC 3 digit code.

DCS DECODER

Displays bit rate, deviation, polarity and all possible codes.

ADDITIONAL FEATURES

DEMODULATION OUTPUT SOCKET

Level
400 mV p-p for ± 1 kHz deviation $\pm 10\%$.

Impedance
10 k Ω nominal.

Bandwidth
Either 300-3.4 kHz, 15 kHz or 300 Hz LP.

EXTERNAL MODULATION

In Rx MOD, the 2955B can be configured to measure the modulation at the EXT MOD INPUT. Adjustment will provide the desired modulation level.

ACCESSORY SOCKET

Pins 3, 4, 5, 6 accessory control.
Pin 2, +12 V, 100 mA max.
Pin 7, AF output, 1 W into 8 Ω.
Pin 1, pulse output available under GPIB control, approximately 600 ns.

SPECIAL KEY FUNCTIONS

Rx = Tx FREQ

Presets the RF signal generator frequency to the measured frequency in Tx mode and Duplex mode.

Hold Display

Freezes instrument settings and readings, facilitating high RF power measurements and hard copy printout of Tx, Rx, Duplex, Tx monitor or AF test screens.

INC/DEC

Available in Tx, Rx, Duplex, Tx monitor 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.

Store/Recall

26 non-volatile stores (01 to 26) are provided, each capable of retaining all front panel settings for up to 10 years. Alphanumeric titles are available for all store locations.

Recall 00

An additional store (00) is provided to retain the last test set-up, in the event of a power fail.

Help

Provides access to SELF TEST, stores lock, RF meter resolution, SINAD or S/N default values, external attenuator offset, variable default deviation, 2955/NORMAL emulation, default AF filter, Rx/Tx modulation type lock, USA/Europe tone standard selection, and user help for Tx, Rx, Duplex and AF test modes.

Hold range

The displayed bar chart can be held, ie no autoranging, by use of the oscilloscope pushbuttons.

Audible output

For listening to demodulated output and received audio.

Two tone modulation

In transmit mode, two tones are available under tones menu. In receiver mode, external modulation inputs add to internal modulation.

GENERAL

POWER REQUIREMENTS

Rated supply voltage

105-120 V AC, 210-240 V AC, all ±10%.

Supply frequency range

45 Hz-440 Hz.

Maximum consumption

100 VA (with all options fitted).

DC supply voltage

11-32 V DC.

DC supply consumption

Less than 70 W (with all options fitted).

GPIB INTERFACE

All functions except the supply switch are remotely programmable.

Capabilities

Complies with the following subsets as defined in IEEE 488-1978 and IEC Publication 625-1: SH1, AH1, T5, L4, SR1, RL1, PP0, DT1, E1.

RADIO FREQUENCY INTERFERENCE

Conforms with the requirements of EEC Directive 76/889 as to limits of RF interference. Complies with VDE 0871, limit value Class B, as specified in General Licence Vfg 1046/1984.

SAFETY

Complies with IEC 348.
Approved to UL 1244.

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/in²).

DIMENSIONS AND WEIGHT

Height	Width	Depth
175 mm	345 mm	460 mm
6.9 in	13.6 in	18.1 in

Weight

15.5 kg (34lb)
16.8 kg (37lb) with all options fitted.

VERSIONS AND ACCESSORIES

When ordering please quote eight digit code numbers.

Ordering Numbers	2955B	Versions				
Option 001	Option 002	Option 003	Option 004	Option 005	Option 006	Radio Communication Test Set with GPIB interface. Sensitive receiver. GPIB interface removed. RS-232 fitted in place of GPIB interface. French Version. Spanish Version. DC Kit & Front Stowage Cover.
		Supplied with	AC Supply Lead. Operating Manual. Introductory Guide. DC Supply Lead (with option 006). BNC Telescopic Antenna (with option 001). Operating Summary Card.			
54415-015G		Selected Accessories	Cellular and Trunking Adapters Multi-cellular and trunking adapter, converts a 2955B with GPIB to 2960B to allow Cellular & Trunking. NMT Cellular Software* AMPS Cellular Software* TACS Cellular Software* Band III (MPT 1327) Trunked* Radio Software			
46884-101J	46884-102F	46884-103G	46884-105S	54415-020S		Multi-cellular and trunking adapter including D-AMPS, converts a 2955B with GPIB to 2960D to allow Analog Cellular and Trunking + D-AMPS. NMT Cellular Software* TACS Cellular Software* Band III (MPT 1327) Trunked Radio Software* * Fits into one of the above adapters; at least one must be selected at time of ordering.
		46884-581G	46884-583S	46884-585D	54415-018W	Analog Amps Adapter - converts a 2955B with GPIB to 2957B to allow Analog AMPS Cellular.
					54415-019D	Digital Amps Adapter - converts a 2955B with GPIB to 2957D to allow Analog and Digital AMPS Cellular.
					54421-003J	General Accessories RF Directional Power Head 25 MHz-1000 MHz.
					54421-002L	RF Directional Power Head 1 MHz-50 MHz.
					54462-023W	Battery Pack with built-in DC input fast charger.
					54211-001D	Printer 24 Column with Paper & Ribbon.
					46883-877P	Printer Ribbon & Paper Kit.
					54433-002Y	GPIB Interface.
					54433-004L	RS-232 Interface.
					44991-129S	PMRTEST Software
					54411-052M	600 Ω Balanced Interface with 20 dB Attenuator.
					54499-042L	CCITT Psophometric Filter.
					54499-043J	CMESS Psophometric Filter.
					41690-605Y	Front Stowage Cover.
					46662-192W	Hard Transit Case for 2955, 2957 and 2960 series.
					54412-157G	Soft Carrying Case for 2955 series.
					46882-114B	Service Manual.

For further details of accessories please refer to the 2955 Series Accessories data sheet.