Sequential tones: Encodes CCIR, ZVEI, DZVEI, EEA or EIA and user-defined frequencies.
User can send up to 33 tones in any standard continuously, by tone step or in a burst. A facility allows for tones to be extended.

Duplex testing

Setting: Press DUPLEX TEST key to select this test mode.

Modulation meter: Independent modulation meter and RF signal generator allows any frequency offset for duplex radio or cross-band repeater testing.

Sequential tones: Decodes and encodes CCIR, ZVEI, DZVEI, EEA or EIA and user-defined menu.
User can send up to 33 tones in any standard continuously, by tone step or in a burst. A facility allows for tones to be extended.

PERFORMANCE DATA

RF signal generator

Output impedance

50 Ω nominal.

VSWR:
N socket; <1.2:1 to 500 MHz.
<1.35:1 to 1000 MHz.
BNC socket; <2.2:1 to 1000 MHz.

Frequency

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

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

Indication: 8 digit display.

Setting: Keyboard entry; step change variation by increment/decrement keys and rotary control.

Accuracy: As internal standard.

Output level

Range

N socket:	−135 to −15 dBm (0.04 µV to 40 mV).
BNC socket:	−115 to +5 dBm (0.4 µV to 400 mV).
One-port duplex:	−140 to −21.5 dBm (0.0224 µV to 18.85 mV).
Two-port duplex:	−115 to −15 dBm (0.4 µV to 40 mV).

Resolution:	0.1 dB.
Indication:	4 digits (dBm/μV, PD/EMF and dBμV).
Accuracy:	±1.8 dB for levels above –127 dBm over temperature range 18 to 28°C. ±2 dB for levels above –127 dBm over full temperature range.

Spectral purity

FM on CW:	<23 Hz up to 520 MHz. <45 Hz up to 1000 MHz. (0.3 to 3.4 kHz weighted RMS). Typically 8 Hz up to 250 MHz, 15 Hz up to 500 MHz, 30 Hz up to 1000 MHz.
Harmonics:	Harmonics specified in band 0.4 to 1000 MHz only. <–20 dBc up to 1.5 MHz. <–25 dBc 1.5 MHz to 250 MHz. <–20 dBc 250 MHz to 1000 MHz.
Sub–harmonics:	None up to 520 MHz, <–25 dBc up to 1000 MHz.
Spurious signals:	Carrier up to 88 MHz– <–45 dBc below 110 MHz. <–25 dBc above 110 MHz. Carrier up to 1000 MHz <–60 dBc.
S/N at 20 kHz:	<–106 dB/Hz to 500 MHz. <–100 dB/Hz to 1000 MHz.
RF carrier leakage:	<0.2 μV 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 –20 dBm and the output terminated in a 50 Ω sealed load.

Protection:	N socket; Reverse power overload is indicated by a visual warning (REMOVE RF INPUT) and an audible alarm. BNC socket; A trip circuit operates at approximately 1.0 W. Reverse power protection up to 50 W, automatically resets on removal of power input. Tripping is indicated by visual warning (REMOVE RF INPUT) and an audible alarm.
CW on/off key:	Switches RF output on and off.

Modulation generator

Amplitude modulation

CW range:	1.5 to 400 MHz. Usable from 400 kHz to 500 MHz.
Modulation range:	0 to 99%.
Frequency range:	20 Hz to 20 kHz.
Resolution:	1%.
Indication:	2 digits.
Setting:	Keyboard entry; step change variation by increment/decrement keys and rotary control.
Accuracy:	±7% of setting ±1 digit at 1 kHz up to 85% AM. ±10% of setting ±1 digit from 50 Hz to 5 kHz only and 0 to 70% AM only. ±15% of setting ±1 digit from 50 Hz to 15 kHz and 0 to 85% AM.

AM external input

Input impedance:	1 MΩ in parallel with 40 pF approximately.
CW range:	1.5 to 400 MHz.
Modulation depth range:	0 to 99%.
Frequency range:	20 Hz to 20 kHz.
Sensitivity:	50 Hz to 5 kHz, up to 70% AM; 1.5 V p-p for 30% AM ±10% ±1% AM 50 Hz to 15 kHz, up to 85% AM; 1.5 V p-p for 30% AM ±15% ±1% AM.
AM distortion:	<2% distortion at 1 kHz with 30% AM in a 0.3 to 3.4 kHz bandwidth.

Frequency modulation

CW range:	0.4 to 1000 MHz.
Deviation range:	0 to 25 kHz.
Modulation frequency range:	20 Hz to 20 kHz.
Resolution:	25 Hz (<6.25 kHz deviation). 100 Hz (<25 kHz deviation).
Indication:	4 digits.
Setting:	Keyboard entry. Step change variation by increment/decrement keys and rotary control.
Accuracy:	±7% ±10 Hz (at 1 kHz), ±10% (50 Hz to 15 kHz).

FM external input

Input impedance:	1 MΩ in parallel with 40 pF approximately.
CW range:	0.4 to 1000 MHz.
Deviation range:	0 to 30 kHz deviation.
Modulation frequency range:	1 Hz to 50 kHz.
Sensitivity:	1 V p–p for 5 kHz deviation ±10%.
FM distortion:	<1% distortion at 1 kHz with 5 kHz deviation in a 0.3 to 3.4 kHz bandwidth.

Phase modulation

CW range:	0.4 to 1000 MHz.
Deviation range:	0 to 10 rad.
Modulation frequency range:	0.3 to 3.4 kHz.
Resolution:	0.025 rad steps ≤0.3 rad, 0.1 rad steps >0.3 rad.
Indication:	3 digits.
Setting:	Keyboard entry. Step change variation by increment/decrement keys and rotary control.
Accuracy:	±8% at 1 kHz, ±11% from 0.3 to 3.4 kHz.

ΦM external input

Input impedance:	1 MΩ in parallel with 40 pF approximately.
CW range:	0.4 to 1000 MHz.
Deviation range:	0 to 10 rad.
Frequency range:	0.3 to 3.4 kHz.
Sensitivity:	1.0 V p–p for 5 rad at ±12% at 1 kHz.
ΦM distortion:	<2% at 1 kHz with 5 rads, measured in a 0.3 to 3.4 kHz bandwidth.

AF generators

Two tone:	Two tones are available, separately controllable for frequency, shape and level.
Output impedance:	<5 Ω.

Frequency

Range:	50 Hz to 15 kHz. Usable 10 Hz to 20 kHz.
Resolution:	0.1 Hz from 10 Hz to 3.25 kHz. 1 Hz from 3.25 to 20 kHz.
Indication:	5 digits.
Setting:	Keyboard entry. Step change variation by increment/decrement keys and rotary control.
Accuracy:	±0.01 Hz from 10 to 100 Hz. ±0.1 Hz from 100 Hz to 20 kHz.

Shape:

Sine, square, triangle and saw-tooth.

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 saw-tooth).
Accuracy:	±5% ±1 step, 50 Hz to 15 kHz.
Setting:	0.1 mV steps (0.1 to 409.0 mV), 1 mV steps (409 mV to 4.095 V).

Signal purity (sine only)

Distortion:	<0.5% at 1 kHz, <1% from 50 Hz to 15 kHz.
Residual noise:	<0.1 mV RMS in CCITT psophometric bandwidth.
DC offset:	<10 mV DC.

RF frequency meter

Frequency

Range:	1.5 to 1000 MHz (usable to 1060 MHz).
Resolution:	1 Hz or 10 Hz up to 200 MHz, 10 Hz only from 200 to 1000 MHz.
Accuracy:	As internal standard ±1 digit.

Input

Impedance:	50 Ω nominal.
VSWR:	N socket; <1.2:1 to 500 MHz, <1.35:1 to 1000 MHz. BNC socket; <2.2:1 to 1000 MHz.

Sensitivity: N socket; 5 mW, transmitter test mode selected. In one-port duplex mode, sensitivity reduces to 20 mW.
BNC socket; 50 mV usable.

Update rate: 100 ms for frequencies up to 200 MHz with 10 Hz resolution selected,
400 ms for frequencies up to 1000 MHz, 10 Hz resolution only.

RF power meter

Input

Impedance: As RF frequency meter.

VSWR: As RF frequency meter.

Ranges: N socket; Transmitter test mode
50 mW to 150 W.
Usable down to 5 mW.
One-port duplex mode
100 mW to 150 W.
Usable down to 20 mW.
Two-port duplex mode
50 mW to 100 W.
Usable down to 5 mW.
BNC socket; 0.05 mW to 1.0 W.

Continuous rating: 75 W at 0 to 50°C.

Maximum input: N socket; Transmitter test mode, 150 W.
One-port duplex mode, 150 W.
Two-port duplex mode, 100 W.
For limited period, typically 2 minutes at 25°C. End of usable working period is indicated by a visual warning (REMOVE RF INPUT) and an audible alarm.

BNC socket; 1.2 W.
Trip circuit operates at approximately 1.0 W. Overload protection up to 50 W. Tripping is indicated by a visual warning (REMOVE RF INPUT) and an audible alarm.

Frequency range: 1.5 to 1000 MHz.

Resolution: 1% of indicated bar chart range.

Indication: 2 or 3 digits and analogue display.

Setting: 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.

Accuracy: ±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 ≥ 5 mW over the ranges 825 to 905 MHz from +15 to +25°C.
(There may be a difference between a transmitter test mode reading and a duplex test mode reading. The difference is normal and within the above limits.)

Modulation meter

Input

Manual tune: Provides frequency offset indication from carrier, 3 digits and decimal point.
Indicates most significant positive or negative error.

Auto tune: Provides measurement and simultaneous display of RF frequency, RF power, modulation frequency and level.

Sensitivity: N socket; Transmitter test mode
5 mW (0.5 V).
One-port duplex mode
20 mW (1 V).
BNC socket; 0.05 mW (50 mV).

Acquisition time: <3 s with 10 Hz resolution selected.

AF filters available: Band-pass – 0.3 to 3.4 kHz.
Low-pass – 0.3 or 15 kHz.

External filter route: Demodulated signal from the rear panel socket to the external filter and returned to the AF input socket.

Amplitude modulation

CW range: 1.5 to 400 MHz.

Modulation depth range: 0 to 90% below 100 MHz.
0 to 80% from 100 to 400 MHz.
Usable to 100% when manually tuned.
Automatic ranging (bar chart), 0 to 10, 0 to 30, 0 to 100% depth.

Modulation frequency range: 10 Hz to 15 kHz.

Resolution: 1% AM.

Indication: 2 digits and analogue display.

Accuracy:	±5% of reading ±1 digit at 1 kHz. ±8.5% of reading ±1 digit from 50 Hz to 10 kHz.
Demodulation distortion:	At 30% AM and 1 kHz modulation frequency, 0.3 to 3.4 kHz bandwidth; <2% at 21 MHz carrier and above, <5% up to 21 MHz carrier.
Residual AM:	<1% for inputs in a 0.3 to 3.4 kHz bandwidth above 10 mW (N socket) or 0.1 mW (BNC socket).

Frequency modulation

CW range:	1.5 to 1000 MHz.
Deviation range:	0 to 25 kHz. Automatic ranging (bar chart), 0 to 1, 0 to 3, 0 to 10, 0 to 30 kHz.
Modulation frequency range:	10 Hz to 15 kHz.
Resolution:	10 Hz up to 2.5 kHz deviation. 1% up to 25 kHz deviation.
Indication:	3 digits and analogue display.
Accuracy:	±5% ±1 digit at 1 kHz. ±7.5% ±1 digit over range 50 Hz to 10 kHz.
Demodulation distortion:	<1.5% distortion at 5 kHz deviation and 1 kHz modulation frequency in a 0.3 to 3.4 kHz bandwidth.
Residual FM:	<23 Hz (typically 15 Hz) RMS up to 500 MHz, <45 Hz (typically 30 Hz) RMS up to 1000 MHz for inputs in a 0.3 to 3.4 kHz bandwidth above 20 mW (N socket) or 0.2 mW (BNC socket).

Phase modulation

CW range:	1.5 to 1000 MHz.
Deviation range:	0 to 10 rad. Automatic ranging (bar chart), 0 to 1, 0 to 3, 0 to 10 rad.
Modulation frequency range:	0.3 to 3.4 kHz. Phase demodulation obtained using 750 µs de-emphasis.
Resolution:	1% or 0.01 rad.
Indication:	3 digits and analogue display.
Accuracy:	±5% ±1 digit at 1 kHz, ±7.5% ±1 digit from 0.3 to 3.4 kHz with respect to 750 µs de-emphasis.

Distortion and noise meter

Distortion

Frequency:	1 kHz.
Range:	0 to 10%, 0 to 30% distortion.
Resolution:	0.1% distortion.
Indication:	3 digits and analogue display.
Accuracy:	±5% of reading ±0.5% distortion.
Sensitivity:	50 mV (100 mV for 1% distortion).

S/N

Range:	0 to 30 dB, 0 to 100 dB.
Resolution:	0.1 dB.
Indication:	3 digits and analogue display.
Accuracy:	±1 dB.
Sensitivity:	50 mV (100 mV for 40 dB S/N).

SINAD

Frequency:	1 kHz.
Range:	0 to 18 dB, 0 to 50 dB.
Resolution:	0.1 dB.
Indication:	3 digits and analogue display.
Accuracy:	±1 dB.
Sensitivity:	50 mV (100 mV for 40 dB SINAD).

AF frequency meter

General

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

AF voltmeter

General

Input impedance:	1 MΩ in parallel with 40 pF approximately.
Frequency range:	20 Hz to 50 kHz (or DC).
Level range:	0 to 100, 0 to 300 mV; 0 to 1, 0 to 3, 0 to 10, 0 to 30, 0 to 100 V.
Resolution:	1 mV or 1% (dependent on range).
Indication:	3 digits and analogue display.
Accuracy:	±3% of reading ±3 mV, ±1 digit (50 Hz to 20 kHz or DC).
Frequency response:	Switchable; band-pass 0.3 to 3.4 kHz, low-pass 300 Hz or 50 kHz.

Internal frequency standard

Oven-controlled crystal oscillator

Nominal frequency:	10 MHz.
Temperature coefficient:	<±5 parts in 10^8 from 5 to 55°C, <±5 parts in 10^9 from 55 to 70°C.
Ageing rate:	<±5 parts in 10^8 per month, ±5 parts in 10^7 per year after 1 month's continuous use.
Warm-up time:	Output frequency is within 2 parts in 10^7 of the final frequency within 10 minutes of being switched on.
Short-term stability:	<±1 part in 10^{10} RMS frequency error over a 1 s period.
Retrace error:	<2 parts in 10^7 over 24 hours, at constant temperature and after 30 minutes warm-up.

Digital storage oscilloscope

General

Single or repetitive sweep. Available in transmitter test, receiver test and audio test modes (2955A and 2955R) and in transmitter monitor mode (2955R only).
Calibrated for AM, FM and ΦM.
For viewing demodulated audio (plus external input option).

Frequency range: DC to 50 kHz. From 3 Hz on AC.

Voltage range: 10 mV/div to 20 V/div in 1–2–5 sequence.

Accuracy: ±5%.

FM ranges: ±30, 15, 6, 1.5 kHz deviation at ±10% accuracy.

AM ranges: 30, 15, 5%/div at ±10% accuracy.

ΦM ranges: ±15, 7.5, 3, 1.5 rad at ±10% accuracy.

Sweep rates: 100 µs/div to 5 s/div in 1–2–5 sequence. Accuracy locked to internal standard.

Trigger: Repetitive or single shot storage.

Selcall (sequential tones) encoder and decoder

General

Encodes up to 33 and decodes up to 33 tones in a CCIR, ZVEI, DZVEI, EEA, EIA or user-defined tone sequence.

Tone encoding facilities: Sends continuous, burst, single step, extend any tone, null, repeat or frequency shift up to ±9% in 1% steps.

Tone decoding facilities: Displays tone number, frequency and percentage error. Screen indicates null tones (using CRT) and annotates out-of-limit frequencies.

User-defined tones: Allows definition for encoding or decoding of up to 15 tones. Frequency ranges are 20 Hz to 20 kHz (encode) and 300 Hz to 3.4 kz (decode) with duration ranges of 10 to 999 ms (encode) and 20 ms to 1.2 s (decode). Up to a maximum of 33 tones can be sent at any one time. The frequencies are retained in a non-volatile memory.

Capability in audio test mode: The tones encode and decode facility is available using AF generator output and the AF input BNC sockets.

Revertive tones:	Available in receiver test mode. Set of tones is sent and the instrument awaits a response from the unit under test.

Additional features

IF output socket

Frequency:	110 kHz nominal.
Level:	180 mV minimum.
Impedance:	50 Ω, minimum load 5 kΩ.
Bandwidth:	50 kHz to 350 kHz.

Demodulation output socket

Level:	400 mV p-p for ±1 kHz deviation ±10%.
Impedance:	10 kΩ nominal.
Bandwidth:	0.3 to 3.4 kHz band-pass, 300 Hz low-pass or 15 kHz low-pass selected by front panel filter switch.

Accessory socket:

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

DTMF encoder and decoder:

Provides DTMF encoding and decoding under a tones menu. Tone duration and inter-tone gaps can be set at 10 to 999 ms in 1 ms steps.

Pager testing:

Encoding of POCSAG code CCIR No.1 Rec. 584.
Bit rate 400 to 1500 bit/s.
Deviation setting 0 to 25 kHz.
Allows entry of the following:-
- Radio identity code (RIC),
- 4 addresses,
- 2 preset numeric messages,
- 4 alphanumeric messages,
- Insertion of bit errors.

A data invert facility is provided.

DCS encoding:

Digitally coded squelch.
Allows entry of the following:-
- Bit rate 100 to 200 bit/s,
- Deviation setting 0 to 25 kHz,
- Polarity normal or inverted,
- 3-digit code.

DCS decoding:

Measures bit rate and deviation. All possible codes and polarity are displayed.

External modulation measurement: Accessed by means of a receiver modulation setup menu. The instrument can be configured to measure the modulation generated by a signal connected to the external modulation input socket. By adjusting the applied signal level, the required modulation level can be set.

Special key functions

RX=TX FREQ: Presets the RF signal generator frequency for receiver test mode to that shown in the transmission test mode.

HOLD DISPLAY: Freezes instrument settings and readings, facilitating high RF power measurements and hard copy printout of transmitter, receiver, duplex or audio test displays.

INCREMENT: Available in transmitter, receiver, duplex and audio test modes for defining frequency and level increments and decrements of the AF and RF signal generators. The step size can be any setting within the range and resolution of the test set.

STORE and RECALL: 26 non-volatile stores, 01 to 26, are provided. Each is 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 failure.

ON OFF (with SET MOD, AF GEN LEVEL or RF GEN LEVEL): Turn relevant functions on and off.

Hold range on bar chart: Each displayed bar chart can be held (i.e. no autoranging) by the use of the oscilloscope keys.

HELP key: Provides access to self test, stores lock, RF frequency meter resolution, default settings for SINAD or S/N, external attenuator offset, variable default deviation, 2955 or 2955A emulation, default AF filter, RX/TX modulation type lock, European or USA tones standard selection and user instruction guide for transmitter, receiver, duplex and audio test modes.

Miscellaneous

Audible output:	For listening to demodulated output and received audio.
Two tone modulation:	In transmitter test mode, two tones are available under a tones menu. In receiver test mode, external modulation inputs add to the internal modulation.
Transmitter distortion:	In duplex test mode, transmitter distortion measurement is possible.
Transmitter S/N and SINAD:	In transmitter test mode, S/N and SINAD measurement is possible.
Transmitter audio response:	Relative modulation level measurements in transmitter test mode are possible. (Units are .)
Remote control:	All functions except the supply switch and analogue controls are remotely programmable through the GPIB interface unit.
GPIB:	Complies with the following subsets as defined in IEEE 488.1978 – SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, E1.

Off-air receiver (2955R only)

General

Frequency range:	400 kHz to 1060 MHz.
Sensitivity:	1 µV for 10 dB SINAD in 12 kHz bandwidth typical, from 1 MHz to 1000 MHz for 3.5 kHz deviation.
Linearity response:	Typically ±6 dB level accuracy at 100 MHz with reference to –60 dBm over the range –87 to –24 dBm (10 µV to 14 mV) at the BNC socket or –67 to –4 dBm (100 µV to 140 mV) at the N socket.
Indicated signal strength range:	1 µV to 30 mV into BNC socket. 10 µV to 300 mV into N socket.
Image response:	0 dB at ±42.8 MHz of RF input.
Damage level in Tx monitor mode:	>1 W into BNC socket. >75 W into N socket.
Squelch:	A squelch control is provided so that the squelch threshold level can be adjusted.

General

Power requirements

Rated supply voltage:	105 to 120 V AC ±10%. 210 to 240 V AC ±10%.
Supply frequency range:	45 to 440 Hz.
Maximum consumption:	100 VA.
DC supply voltage:	11 to 32 V DC.
DC supply consumption:	<60 W.

Radio frequency interference: Conforms with the requirements of EEC Directive 76/889 as to limits of RF interference.

Conforms with VDE (Verband Deutscher Electrotechniker) requirements Vfg 1046/1984 Class B.
(See self-certificates in Appendix 1 at the end of this manual.)

Safety: Complies with IEC 348.

Environmental

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:	175 mm (6.9 in).
Width:	345 mm (13.6 in).
Depth:	460 mm (18.1 in).
Weight:	15.5 kg (34 lb).