Operating **Manual**

H 52017-900K

Vol. 1

10kHz-1024MHz AM/FM SIGNAL GENERATOR 2017

Code No. 52017-900K

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

CONTENTS

HAZARD WARNING SYMBOLS

The following symbols appear on the equipment.

Symbol	***Type of hazard***	***Reference** in manual*
A	Static sensitive device	Page (iv)
A	Incorrect adjustment	Chap. 3, para. 30
	Component containing beryllia	Page (iv)
	AC voltages	Page (iv)

Note.. .

Each page bears the date of the original issue or the code number and date of the latest amendment (Am.1, Am.2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus ► .....◄ to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

Fuses

Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

WARNING : HANDLING HAZARDS

This equipment is formed from metal pressings and although every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.

WARNING : TOXIC HAZARD

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.

Beryllia (beryllium oxide) is used in the construction of the following components in this equipment :

.....Unit AB2 : Transistors TR23 and TR26.....

This material, when in the form of fine dust or vapour and inhaled into the lungs, can cause a respiratory disease. In its solid form, as used here, it can be handled quite safely although it is prudent to avoid handling conditions which promote dust formation by surface abrasion.

Because of this hazard you are advised to be very careful in removing and disposing of these components. Do not put them in the general industrial or domestic waste or despatch them by post. They must be separately and securely packed and clearly identified to show the nature of the hazard and then disposed of in a safe manner by an authorized toxic waste contractor.

WARNING : AC VOLTAGES

⚠ Disconnect mains lead before removing the cover of Unit AP1 for either access or adjustment, for details see Control circuit power supply (AP1) Chap. 4-2 Technical description.

Chapter 1

GENERAL INFORMATION

CONTENTS

FEATURES

1. 2017 is a stable, low noise a.m./f.m. signal generator covering the frequency range 10 kHz to 1024 MHz. Front panel operation is by direct entry of required settings via a keyboard with the alternative of using rotary controls to adjust carrier frequency and output level. Microprocessor control ensures maximum flexibility and allows programming by the General Purpose Interface Bus (GPIB)*. It is therefore equally suitable for use as a manually operated bench mounted instrument or as part of a fully automated test system.

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* *GPIB - Marconi Instruments General Purpose Interface Bus in accordance with IEEE Standard 488-1978 and IEC Publication 625-1.*

Fig. 1 10 kHz to 1024 *MHz AM/FM Signal Generator* 2017

2. Output levels from 0.2 µV to 4 V e.m.f. are available in the c.w. or f.m. modes (up to 2 V e.m.f. in the a.m. mode) and the user is offered a choice of five output level calibrations which are switch selectable on the front panel.

3. Frequency stability in the locked mode is determined by a high quality reference oscillator within the instrument and facilities are provided for the use of an external reference when this is preferred.

4. Comprehensive amplitude and frequency modulation facilities are provided using either an internal modulation oscillator or an external source. High quality pulse modulation and slow sweep facilities are also provided.

5. Memory facilities allow up to ten complete instrument settings to be stored and recalled for later use.

6. The frequency counter display can also be used for the measurement of external signals in the range 10 Hz - 512 MHz.

Tuning

7. In the manual mode the frequency display gives an active indication of the output frequency. Tuning takes place by means of the RANGE selector switch and the rotary **TUNE** and FINE TUNE front panel controls. Depressing the LOCK key reverts the system to a synchronizer whose setting will be the last measured frequency indicated on the display.

8. Accuracy is within ±2 parts in 10^7 over the temperature range of 0 to 40°C. An external frequency standard of 1 MHz may be used where better stability is required or *to* ensure consistency when a number of instruments are used in an area.

output

9. RF levels can be set by means of the keyboard control or varied manually by rotary control if preferred.

Modulation

10. Frequency and amplitude modulation are provided by the internal oscillator giving a choice of two fixed frequencies, 400 Hz and 1 kHz, and a further 3 variable ranges from 20 Hz to 20 kHz which are controlled from the front panel MODULATION OSCILLATOR controls.

PERFORMANCE DATA

Characteristic	*Performance*
Carrier frequency	
16. Range	10 kHz - 1024 MHz in 9 ranges. (1) 10 kHz to 4 MHz (2) 4 MHz to 8 MHz (3) 8 MHz to 16 MHz (4) 16 MHz to 32 MHz (5) 32 MHz to 64 MHz (6) 64 MHz to 128 MHz (7) 128 MHz to 256 MHz (8) 256 MHz to 512 MHz (9) 512 MHz to 1024 MHz
Selection	
Manual :	Frequencies may be selected manually using the 11 turn main tuning control with separate 3 turn fine tune control.
Keyboard :	Keyboard provides for entry of up to 8 significant digits, decimal point and frequency units. A manually tuned frequency may be locked by pressing the **LOCK** key.
Indication	7½ digit, LED seven segment display.
Resolution	10 Hz up to 128 MHz. 100 Hz above 128 MHz.
Accuracy	
Unlocked :	Refer to frequency counter accuracy.
Locked :	Relative to the reference frequency. The output frequency will be within $\pm 1 \times 10^{-7} \pm 1$ Hz of the indicated frequency.

Stability

Locked mode : Refer to the accuracy specification and to the internal reference standard specification. Less than 7 seconds is required for the generator to regain frequency lock after a frequency change is made.

Frequency sweep

17. Sweep rate : Single shot sweep for use with X-Y plotter. Maximum sweep width one carrier frequency range. 30 - 150 seconds for a full range sweep adjustable by a front panel control.

Horizontal output : 1 - 9 V over one frequency range,

RF output

18. Level 0.13 µV to 4 V e.m.f. (-131 to +19 dBm) c.w., f.m. and pulse mode.

0.13 µV to 2 V e.m.f. (-131 to +13 dBm) a.m.

Selection

Manual : Two concentric knob controls : switched coarse attenuator with 6 dB steps and a continuously variable fine attenuator with 8 dB range.

Keyboard : Allows entry of up to 4 significant digits, decimal point, sign and units.

Indication : 3½ digit, LED, seven segment display with illuminated legend showing e.m.f., p.d., dBµV e.m.f., dBµV p.d. and dBm. Units are selected by a front panel switch.

Total level accuracy (for levels, above 1 µV p.d.) ±1 dB up to 512 MHz.
±2 dB up to 1024 MHz.

Output impedance 50 Ω; VSWR <1.15:1 up to 256 MHz,
<1.25:1 up to 512 MHz,
<1.35:1 up to 1024 MHz at r.f. output levels below 0.5 V e.m.f.

RF leakage Less than 1 µV generated in a 50 Ω load by a 2 turn 25 mm loop, 100 mm or more from the case of the generator.

Reverse power protection Protects the generator output system against accidental reverse power from a transmitter of up to 50 W capacity, 10 kHz - 1024 MHz or applied d.c. of up to ±40 V.

Amplitude modulation

19. Carrier frequency range — 10 kHz - 400 MHz, usable to 1024 MHz.

Modulation depth — Up to 99% in 1% steps. 2 digits, LED seven segment display. Entered via the keyboard or remote programming.

Accuracy (At 1 kHz modulation rate) — Better than ±3% depth up to 80% depth.

Envelope distortion (using internal 1 kHz modulation oscillator) — Less than 2% t.h.d. up to 30% depth. Less than 3.5% t.h.d. up to 80% depth.

External modulation

Frequency range : (For carrier frequencies 10 kHz to 512 MHz): — 20 Hz to 125 kHz (d.c. coupled) at maximum deviation and up to 260 kHz at half maximum deviation.

(For carrier frequencies 512 MHz to 1024 MHz): — 20 Hz to 30 kHz (d.c. coupled).

Frequency response: (For carrier frequencies 10 kHz to 512 MHz) — -10.5 dB from 20 Hz to 125 kHz in levelled mode; ±0.3 dB from 20 Hz to 125 kHz in unlevelled mode.

(For carrier frequencies 512 MHz to 1024 MHz) — ±0.5 dB from 20 Hz to 30 kHz in levelled mode; ±0.3 dB from 20 Hz to 30 kHz in unlevelled mode.

Input level : — 0.5 V - 1.5 V r.m.s. into 600 Ω to set reference level, indicated by an illuminated legend in the levelled mode only.

1 V r.m.s. into 600 Ω to set reference level in unlevelled mode.

Frequency modulation

20. Deviation — Entered via the keyboard or remote programming. 3 digits, LED, 7 segment display.

RF range	*Maximum deviation*
1	40 kHz
2	40 kHz
3	80 kHz
4	160 kHz
5	320 kHz
6	640 kHz
7	1.28 MHz
8	2.56 MHz
9	200 kHz

Accuracy — -14% of deviation selected +50 Hz.

Distortion — Using the internal 1 kHz fixed modulation oscillator, less than 2% t.h.d. at maximum deviation on each r.f. range.

External modulation

Frequency range (For carrier frequencies 10 kHz to 512 MHz): — 20 Hz to 125 kHz (d.c. coupled) at maximum deviation and up to 260 kHz at half maximum deviation.

(For carrier frequencies 512 MHz to 1024 MHz): — 20 Hz to 30 kHz (d.c. coupled).

	Frequency response :	20.5 dB over specified frequency range in levelled mode. 20.3 dB over specified frequency range in unlevelled mode.
	Input level :	0.5 V - 1.5 V r.m.s. into 600 Ω to set reference level, indicated by an illuminated legend in the levelled mode only. 1 V r.m.s. into 600 Ω to set reference level in unlevelled mode.

Internal modulation oscillator

21.	Frequency	20 Hz to 20 kHz, continuously variable in 3 decade ranges. Also 2 fixed frequencies, switch selected, of 400 Hz and 1 kHz.
	Accuracy	±5% for fixed frequencies.

Pulse modulation

22.	Carrier frequency range	4 MHz to 1024 MHz.
	Pulse/carrier rise time	Less than 25 ns for carriers above 25 MHz.
	Pulse duration	100 ns *to* infinity.
	Carrier suppression	Better than 70 dB up to 80 MHz, 46 dB up to 512 MHz.
	Additional carrier level error	±2 dB.
	Input characteristic	Positive-going modulation up to +1 V input. Saturation level +1.1 V. Maximum input +5 V. Input impedance 50 Ω. Effective bandwidth d.c. to 15 MHz reduced below 25 MHz carrier.

Frequency counter (external mode)

23.	Frequency range	10 Hz to 520 MHz.
	Resolution	1 Hz from 10 Hz to 10 MHz, 10 Hz from 1 MHz to 100 MHz, 100 Hz from 10 MHz to 520 MHz.
	Sensitivity	100 mV p.d. into 50 Ω, 1 MHz to 520 MHz. 200 mV p.d. into 1 MΩ, 10 Hz to 10 MHz.
	Accuracy	±1 digit + reference standard error.

Internal reference standard

24. Temperature stability — Better than ±2 in 10^7 over the operating temperature range 0 to 40°C.

Warm up time — Within 0.5 p.p.m. of final frequency within 5 min. from switch on at ambient 20°C.

Spurious signals

25. Carrier harmonics (c.w., a.m. and f.m.) — Better than -27 dBc. Typically better than -40 dBc.

Carrier sub-harmonics — For carrier frequencies up to 512 MHz no carrier sub-harmonics are generated. -60 dBc above 512 MHz.

Non-harmonic components — For carrier frequencies between 4 MHz and 1024 MHz no non-harmonically related signals are generated. -50 dBc below 4 MHz.

FM on c.w. (CCITT telephone psophometric weighting) — Less than 3 Hz equivalent deviation up to 512 MHz and 6 Hz up to 1024 MHz. Reduces by approximately 6 dB per octave as the carrier frequency is reduced (down to 4 MHz).

AM on c.w. (-3 dB bandwidth 20 Hz to 20 kHz) — Less than -70 dBc. Equivalent to less than 0.06% modulation depth.

Single sideband phase noise (at, 20 kHz offset) — Better than -135 dBc/Hz at 20 kHz offset from carrier at 470 MHz. For typical performance at other offsets and carrier frequencies see Fig. 2, Sideband noise curves.

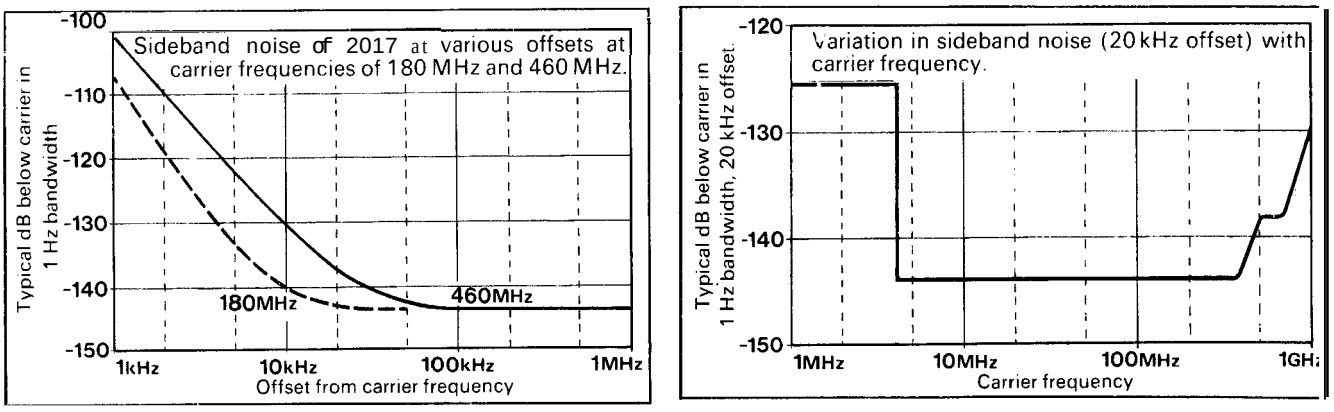


Fig. 2 Sideband noise curves

Auxiliary facilities

26. Remote operation — All major front panel functions may be remotely controlled via the GPIB (see Chap. 1, p.1*).

Subsets : Complies with the following subsets as defined in IEEE 488-1978 : SH1,AH1,T5, TE0,L4,LE0,SR1,RL1,PP0,DC1,DT0,C0,E1.

outputs

Modulation oscillator : Front panel socket providing approximately 1 V r.m.s. into 600 Ω.

Frequency standard : Rear panel socket may be used as internal standard output or external standard input as selected by adjacent switch. 1 MHz, t.t.l. compatible.

Inputs

External frequency standard : Switch selected input accepting at least 4 V p-p at 1 MHz. Input impedance approximately 1 kΩ.

Power requirements

27. AC supply voltage — 105 V to 120 V ±10% or 210 V to 240 V ±10%.

Frequency — 45 to 65 Hz.

Consumption — 140 VA maximum.

Safety regulations

28. This instrument complies with Publication IEC 348.

Radio frequency interference

29. This instrument conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.

Limit range of operation

30. Temperature — 0 to 55°C.

Conditions of storage and transport

31.	Temperature	$-40^{\circ}C$ to $+70^{\circ}C$.
	Humidity	Up to 90% relative humidity.
	Altitude	Up to 2500 m (pressurized freight at 27 kPa differential i.e. 3.9 lbf/in^2).

Dimensions and weight (approximately)

		With handles & feet	Without handles & feet
32.	Height :	195 mm (7.7 in)	178 mm (7 in).
	Width :	453 mm (17.8 in)	419 mm (16.5 in).
	Depth :	543 mm (21.4 in)	491 mm (19.3 in).
	Weight :	29 kg (63 lb).	

ACCESSORIES

33. Supplied accessories

	Code no.
AC supply lead	43123-076Y
Operating manual H 52017-900K (Vol. 1)	46881-388D

Optional accessories

When ordering, address the order to our Service Division and specify the type and serial number of the instrument as given on the label on the rear panel. If this has been superseded by a model number label, quote the model number instead.

Service manual H 52017-900K (Vol. 2)	46881-389T
Rack mounting kit	46883-482E
Maintenance kit	54711-032H
Comprising :	
Extender cable 14 way (Ribbon cable)	43129-591M
Extender cable 16 way (Ribbon cable)	43129-592C
Extender lead (AS3) } Edge-connector type	43129-618W
Extender lead (AS4) } Edge-connector type	43129-619D
Extender lead (AS5) } Edge-connector type	43129-620S
RF connector assy. (Maintains logic box r.f. connection when in servicing position)	43129-625X
GPIB lead assy.	43129-189U
Marconi Instruments GPIB manual H 54811-010P	46881-365R
RF connecting cable TM 4969/3; 50 Ω, 1.5 m (5 ft) BNC	43126-012S
GPIB IEEE/IEC connector adapter	46883-408K

Chapter 2

INSTALLATION

CONTENTS

UNPACKING AND REPACKING

1. Retain the container, packing material and the packing instruction note (if included) in case it is necessary to reship the instrument.

2. If the instrument is to be returned for servicing attach a label indicating the service required, type or model number (on rear label), serial number and your return address, Pack the instrument in accordance with the general instructions below or with the more detailed information in the packing instruction note.

(1) Place a pad in the bottom of the container.

(2) Place pads in the front and rear ends of the container with the plywood load spreader(s) facing inwards.

(3) Put the polythene cover over the instrument and place it in the container with the front handles and rear projections (where applicable) against the plywood load spreaders.

(4) Place pads in the two sides of the container with cushioning facing inwards.

(5) Place the top pad in position.

(6) Wrap the container in waterproof paper and secure with adhesive tape.

(7) Mark the package FRAGILE to encourage careful handling.

Note..

If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader; if the rear panel has guard plates or other projections a rear load spreader is also advisable.

MOUNTING ARRANGEMENTS

3. Excessive temperatures may affect the instrument's performance; therefore, completely remove the plastic cover, if one is supplied over the case, and avoid standing the instrument on or close to other equipment that is hot.

CONNECTING TO SUPPLY

4. Before connecting the instrument to the a.c. supply check the position of the voltage selector on the rear panel. The instrument is normally despatched with the selector set to 230 V. For supplies in the range 95 to 130 V remove upper instrument cover, remove the handle trim strips as indicated in para. 7(b) then raise the logic processor as described in para. 7 (5), (6) and (7). Remove API transparent perspex covering plate. This is affixed by two nylon screws. Change the edge connector socket **SKAK** with the alternative clipped into the rear panel fixing and marked 230 V. Secure the socket not in use marked 115 V into the rear panel fixing so that selected range is indicated in the window. Refit API cover plate, logic processor, connectors and finally outside cover and trim strips.

5. The free a.c. supply cable is fitted at one end with a female plug which mates with the a.c. ,connector at the rear of the instrument. When fitting a supply plug ensure that conductors are connected as follows.

Earth - Green/Yellow
Neutral - Blue
Live - Brown

When attaching the mains lead to a non-soldered plug it is recommended that the tinned ends of the lead are first cut off owing to the danger of cold flow resulting in intermittent connections.

SAFETY TESTING

6. Where safety tests on the mains input circuit are required, the following procedures can be applied. These comply with BS 4743 and IEC Publication 348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that mains input circuit components and wiring (including earthing) are safe.

(1) Earth lead continuity test from any part of the metal frame to the bared end of the flexible lead for the earth pin of the user's mains plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds.

Test limit : not greater than 0.5 Ω.

(2) 500 V d.c. insulation test from the mains circuit to earth.

Test limit : not less than 2 MΩ.

RACK MOUNTING

7. A rack mounting kit is supplied if required as an optional accessory. When rack mounted, extra support is required at the rear of the instrument, fitting instructions are as follows:-

(1) Remove instrument outer covers. Both top and bottom covers are easily removed by withdrawing two fastening screws for each cover, these are secured to the rear panel.

(2) Detach and discard the front and rear feet on the bottom cover.

(3) Remove the trim strips from the side of both front carrying handles, each of these are held by two countersunk screws, see Fig. 1 below.

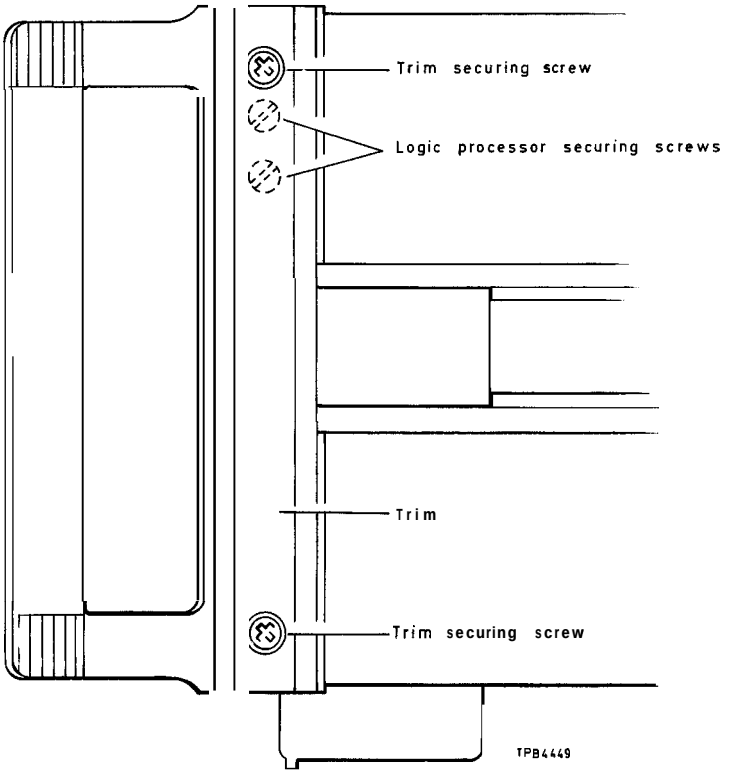


Fig. 1 Logic processor unit ***front*** *securing screws*

(4) Temporarily remove the right-hand, side handle and side rail as follows:-

(a) Remove (stone coloured) end cap cover by sliding up (or down) from its mating end cap plate.

(b) Prise off handle end cap by inserting blade at outer end of moulding.

(c) Remove handle held by a single screw at each end.

(d) Slide out the infill trim strip to uncover the side rail fixings.

(e) Remove the side rail secured by three screws.

(5) Remove the two front logic processor securing screws from the right-hand front carrying handle, see Fig. 1, and similarly the corresponding screws on the left-hand side carrying handle.

(6) Detach the air duct from the rear of the logic processor unit shown in Fig. 2 below,

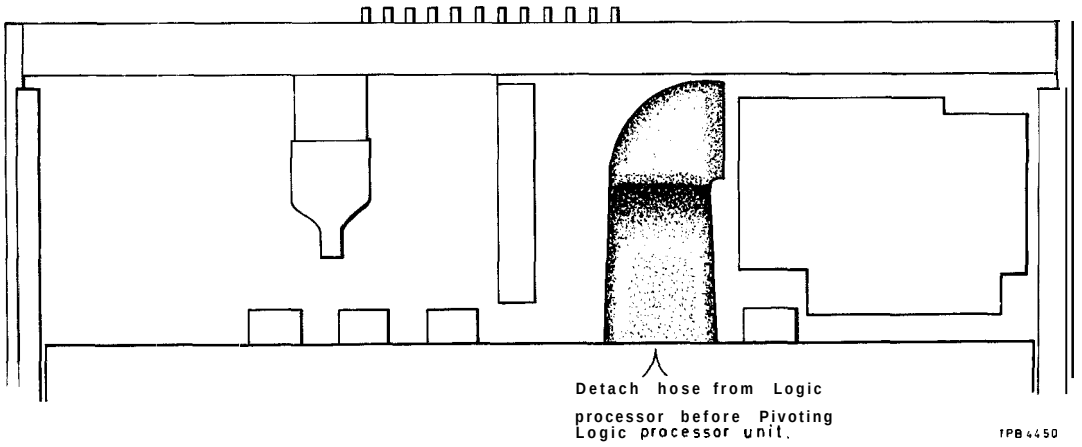


Fig. 2 Removal of air duet

(7) Before any attempt is made to pivot the logic processor unit it is essential that the four conhex plugs PLAU, PLAV, PLAW and PLDE are first disconnected. To ensure that this is not neglected a safety feature has been incorporated. A slide key plate is fitted in such a position that its tab protrudes through a keyhole in the side frame. This prevents the raising of the unit inadvertently. When the conhex plugs have been disconnected the slide key plate can be moved sideways to release the tab from the side frame. The logic processor unit should then be pivoted into one of three positions and fixed using one of the two front securing screws as shown in Fig. 3 below.

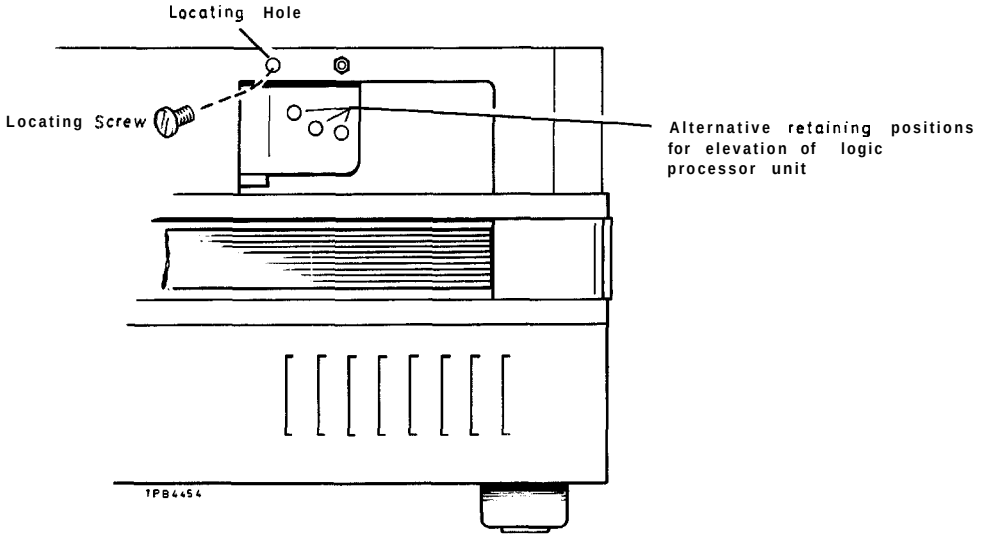


Fig. 3 Alternative fixing positions for logic processor unit

(8) Remove the hexagon securing nut from the 'RF OUTPUT connector and push the 50 Ω connector (socket SKDJ) back out from the front panel mounting. Re-route the co-axial connector to pass through the notch in the forward outer corner of the GPIB board AG1 and install the socket SKDJ into the alternative rear panel position, transferring the blind grommet from the rear to the front panel hole.

(9) Restore the logic processor unit to its stowage position, reconnecting the conhex plugs and slide plate. Refit the side rail and side handle.

(10) Fit rack brackets into the front handle trim recesses using the M4 x 16 mm long screws,

(11) Replace top and bottom covers and fit unit into the rack; support at the rear should also be given e.g. a shelf located within the rack or cubicle.

Chapter 3

OPERATION

CONTENTS

PRINCIPLES OF CONTROL

1. Operation of the generator is achieved by both keyboard and individual front panel controls. The primary functions can be set either by entering values via the keyboard or by conventional manual controls.

2. Remote operation can be carried out from a control unit or computer. If an illegal operating condition is selected, either by local or remote control, a limit or out of lock condition will be indicated on the front panel display.

3. The supply switch is illuminated when ON to give a clear indication that the instrument is switched on.

CONTROLS AND CONNECTORS

4. Coaxial connectors. The RF OUTPUT connector is an 'N' type whilst the remainder are BNC. Holes are provided on the rear panel to accommodate connectors when rack mounted.

Front panel

5. (1) SUPPLY switch : Applies the a.c. supply voltage in both manual and remote control operation.

(2) LOCAL : Reselects manual control after remote control lock-out.

(3) REM : Indicates that the instrument is under **REMOTE** control.

(4) ADDR : Diagnostic indication to the GPIB programmer that the 2017 has been addressed by the GPIB controller. This does not prevent local control if the REMOTE **lamp** is off.

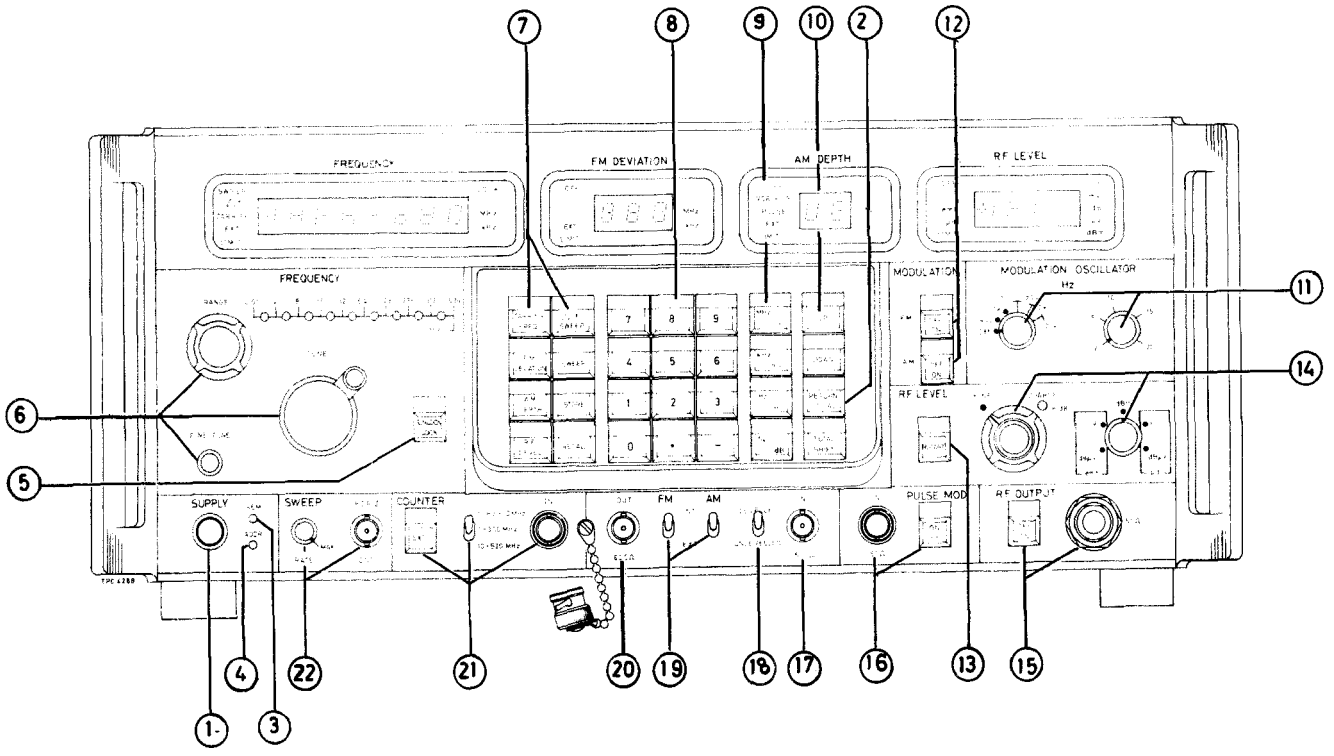


*Fig. 1 Front **pane2** controls*

(5) LOCK/UNLOCK : During manual tuning of the carrier frequency, locks to the last measured FREQUENCY display when depressed.

Note... When using the external counter facility the 2017 output frequency is unlocked.

(6) MANUAL TUNE : Manual rotary controls used in the Local mode of operation as an alternative to keyboard control when selecting a carrier frequency.

(7) FUNCTION : Keyboard control of primary and secondary functions of the 2017. Primary function keys are coloured orange.

(8) DATA : Numerical keyboard, selects value of the primary function.

(9) UNITS : Selects the units of the primary function.

(10) Δf/SWEEP ACTION KEYS : Increments the carrier frequency and initiates the sweep cycle.

(11) MODULATION OSCILLATOR : Provides manual selection of fixed 400 Hz and 1 kHz oscillators and variable 20 Hz to 20 kHz controls.

(12) FM/AM MODULATION ON/OFF : Selects either AM, FM or both simultaneously. Depressing AM twice invokes the VOR/ILS facility, (this is available only in the 2017-301S version of the instrument).

(13) ROTARY : Enables manual (rotary) control of the r.f. level by means of the COARSE and FINE controls (14).

(14) RF LEVEL : Rotary control of r.f. level in coarse dB steps with 6 dB of continuously variable control. Displayed output can be selected in volts e.m.f., volts p.d., dB relative to 1 μV e.m.f., dB relative to 1 μV p.d. and dBm.

(15) RF OUTPUT : 50 Ω, N type output socket, output controlled by ON/OFF key mounted alongside the socket. Indication of r.f. level is shown on the RF LEVEL display.

(16) PULSE MOD : Input socket and ON/OFF key provided for pulse modulation inputs in the carrier frequency range 4 MHz to 512 MHz.

(17) MOD INPUT, IN 600 Ω : Accepts external modulating signals from 20 Hz to 50 kHz a.m. and 20 Hz to 125 kHz f.m.

(18) LEVELLED/UNLEVELLED : Enables the levelling circuits to be switched off to allow modulation by external non-sinusoidal or multiple tone signals, or where it is desired *to* vary the modulation according to the level applied.

(19) FM/AM INT., EXT : In the internal mode (INT), levelling is provided regardless of the switch selection. In the external mode (EXT), levelling takes place with inputs from 0.5 V to 1.5 V when the LEVELLING switch is ON.

(20) MOD OUTPUT, OUT 600 Ω : Provides an output of 1 V e.m.f. into 600 Ω source at the frequency of the internal modulation oscillator.

(21) COUNTER : These controls provide an external facility for measuring the frequency of signals in the range 10 Hz to 500 MHz. When the EXT push button is depressed the IN socket is coupled to the 2017 frequency display. A three position switch allows a resolution of 1 Hz for frequencies between 10 Hz and 10 MHz, 10 Hz for frequencies between 1 MHz and 100 MHz and 100 Hz for frequencies between 10 MHz and 520 MHz.

(22) SWEEP : HORIZ OUT, BNC socket provides a single shot carrier frequency sweep, output amplitude between 0 - 10 V. The sweep is capable of covering the full width of the selected r.f. carrier range.

RATE control can be adjusted to give sweep times of between 30 and 150 seconds.

Rear panel

6. (1) AC 45-65 Hz plug : Accepts a.c. supply input cable code no. 43129-071D. The earth pin is internally connected to chassis.

(2) RF OUT, 50 Ω : Internal connection to this alternative RF OUTPUT socket can be made when the instrument is rack mounted by transferring the front panel RF OUT, 50 Ω output socket (15) to the rear and by re-routing the existing connector. Fitting instructions are included within the kit.

(3) GPIB : Accepts the 24 way IEEE GPIB connector.

(4) ADDRESS : These (rear panel) switches provide choice of one of 31 single character addresses. The talk only switch, TON, enables the 2017 to be used as a simple GPIB system without a controller.

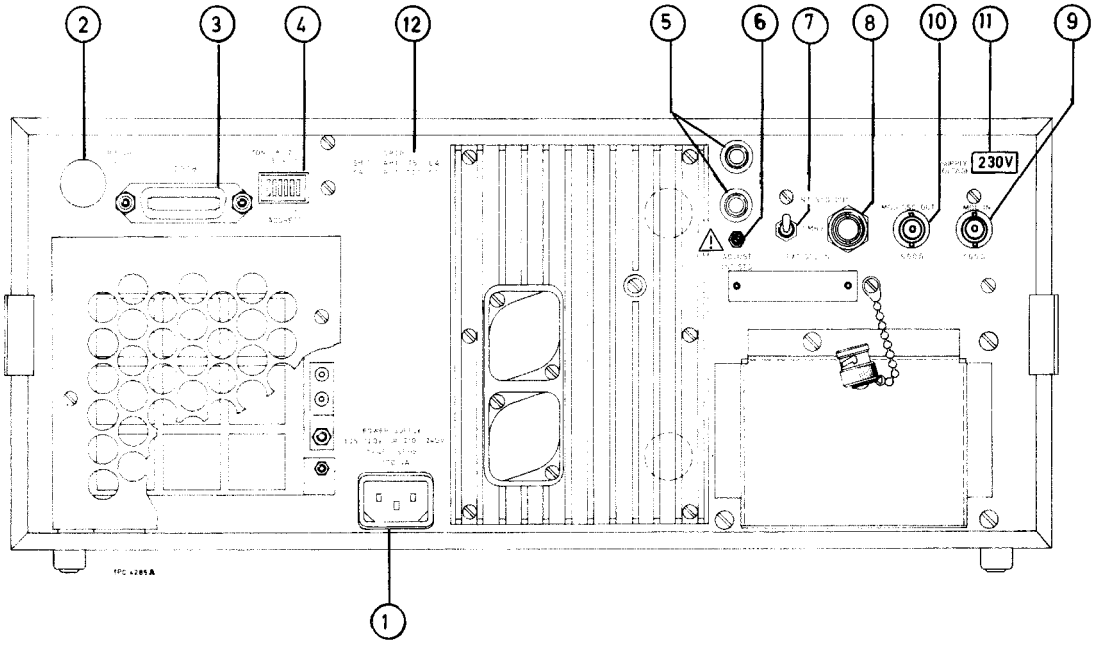


Fig. 2 Rear panel controls

(5) SUPPLY FUSES : 2.5 A-T (time lag), one each in both live and neutral lines of the input supply.

(6) ADJUST INT STD : ⚠ Adjusted to set internal 10 MHz standard against an external primary standard. Refer to para. 30 before making any adjustments.

(7) INT/EXT STANDARD : Set to accept either an external standard or to use the internal standard.

(8) INT STD OUT/EXT STD IN : The socket provides, in conjunction with the INT/EXT STD switch, two functions :

(1) INT : Gives a convenient output of the 1 MHz internal standard for measurement purposes.

(2) EXT : Provides a connection for an external 4 V p-p t.t.l. standard frequency signal.

(9) MOD IN 600 Ω
(10) MOD OSC OUT 600 Ω } : Alternative connections to these sockets, instead of the corresponding front panel ones, can be made when the instrument is rack mounted,

(11) SUPPLY VOLTAGE : Provides a visible indication of the supply voltage in use. Two sockets are provided for internal connection, one for each of the two voltage ranges 115 V and 230 V. The socket (SKAK) not in circuit should be secured to the rear panel window. This gives an indication of the voltage range of the plug actually fitted to the instrument's supply tapping point.

(12) GPIB FUNCTIONS : Details of GPIB functions are described in para. 40 onwards.

PREPARATION FOR USE

Switching on

7. With the instrument connected to a suitable a.c. supply proceed as follows.

(1) Switch ON and check that the SUPPLY switch is lit and the fan is operating.

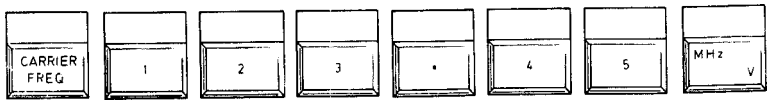
(2) Check that the instrument has taken up the LOCAL operating mode condition, that is CARRIER FREQ tuned to 400 MHz, no FM or AM MODULATION and minimum RF LEVEL setting.

(3) Check that the rear STANDARD INT/EXT switch is set to INT, unless an external standard is being used as described in para. 22.

(4) When using the internal reference standard, allow a warm-up period of 5 minutes.

OPERATING PROCEDURES

Setting carrier frequency (keyboard)



8. Press the CARRIER FREQ primary function key, enter the desired value via the data keys and terminate the instruction by depressing the required units key e.g. 123.45 MHz. The FREQUENCY display will indicate this on the $7\frac{1}{2}$ digit readout.

9. A LOCK indication also on the display confirms that the selection has been made and that the synchronizer within the 2017 is locked on. Should a request outside the operating range 10 kHz to 1024 MHz be made a LIMIT indication will flash continually and the 2017 will tune to the upper or lower limit nearest to the frequency requested.

Setting carrier frequency (manual)

10. Depress the LOCK/UNLOCK key to take manual control of the frequency tuning. Select the frequency range required on the RANGE selector, 1 of 9 l.e.d's will illuminate to indicate the selected range. Tune to the wanted frequency using the rotary controls TUNE and FINE TUNE observing the FREQUENCY display. When the required frequency is reached again depress the LOCK/UNLOCK key, this will lock the system to the last measured frequency indicated on the display.

Carrier frequency Δf incremental control

11. (1) 

To increment the carrier frequency depress the keys indicated, this will shift the carrier upward in frequency by 100 kHz.

(2) 

To increment 100 kHz step down, depress the down key. Each subsequent depression of the Up or Down keys further increments the carrier frequency by 100 kHz.

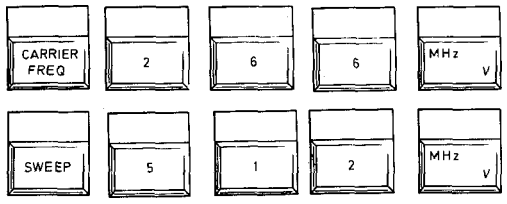
(3) 

Return to the original carrier frequency can be made at any time by depressing the RETURN/LOCAL key.

(4) 

Indication of the total shift of carrier frequency increments at any time may be obtained by depressing the TOTAL SHIFT key. This must be held down to register the reading on the display; when released the display reverts to the carrier frequency indication.

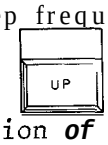
Carrier frequency sweep control

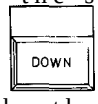


Start freq (1)

Sweep freq (2)

12. To operate the sweep control, connect between HORIZ-OUT BNC socket and the input of an X-Y plotter or similar. Output from the socket will be from 0-10 V. Initially depress the CARRIER FREQ primary function key and enter the start frequency (1). Depress the SWEEP key and enter the end of sweep frequency (2). Do not select however a start frequency lower than the previous ranges upper limit.

13. 

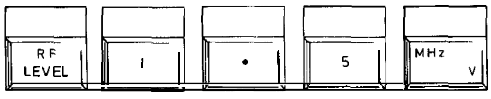
Activate the sweep cycle by depressing the Up key. On completion of the sweep a return to the start frequency can be made in two ways, either slowly by depressing the 

key or rapidly by the 

key.

14. Sweep time can be adjusted by the variable 25-120 seconds RATE front panel control. Each successive selection of the SWEEP function will give a one shot sweep.

Setting r.f. output (keyboard)



15. To set an r.f. output level using the keyboard control proceed as follows:-

(1) Select the 5 position front panel RE LEVEL switch to the calibration unit required, either dBμV e.m.f., V e.m.f., dBm, V p.d. or dBμV p.d.

(2) Depress the keyboard function and data keys as shown above to give an output of 1.5 V. The display indicates the value in terms of the units selected in step (1). Output voltages from 4 V e.m.f. down to 0.1 μV e.m.f. are available in the c.w. and f.m. modes of operation (2 V e.m.f. in the a.m. mode).

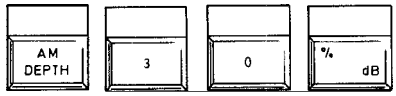
(3) If an unacceptable demand is made a **LIMIT** indication will flash and the r.f. level will be fixed at the upper or lower limit nearest to the level requested.

(4) The r.f. output can be further controlled by the ON/OFF key alongside the r.f. output socket.

Setting r.f. output (manual)

16. To take control of the r.f. level depress the ROTARY key. Select the display units required. Display units, range, limit indication and ON/OFF functions all operate as described in para. 15. Set the COARSE and **FINE** controls to achieve the required r.f. level indication.

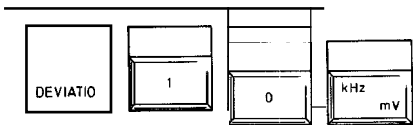
Setting internal a.m.



17. To set the internal a.m. enter the primary function and data as shown above. The depth selected is variable from 0 to 99% in 1% increments. Set the MODULATION OSCILLATOR frequency control to the required frequency, either 400 Hz or 1 kHz fixed frequencies, or one of 3 variable ranges from 20 Hz to 20 kHz.

18. Switch the AM INT/EXT two way switch to INT. This will provide a modulation oscillator output at the OUT 600 Ω BNC socket, at a level of 1 V e.m.f. from a 600 Ω source, for use with external auxiliary equipment.

19. Further OFF/ON control of the a.m. can be made with the AM MODULATION OFF/ON key.



21. Switch the FM INT/EXT *two* way switch to INT. This will provide a further output of the modulation oscillator at the OUT 600 Ω BNC socket for use with external auxiliary equipment.

22. Further OFF/ON control of the f.m. can be made with the FM MODULATION OFF/ON key.

Use of external modulation

23. An external modulating source must be capable of providing a signal between 0.5 V and 1.5 V across 600 Ω within the range 20 Hz - 50 kHz for a.m. and 20 Hz to 125 kHz for f.m. (or up to 260 kHz at half maximum deviation).

24. Connect the modulating signal to the BNC socket on the front panel (or on the rear panel if the instrument has been modified for this purpose). Switch the AM or FM INT/EXT switch to EXT and the LEVELLED/UNLEVELLED switch to LEVELLED for normal operation or UNLEVELLED if modulation by non-sinusoidal or multiple tone signals are required. Finally switch the MODULATION OFF/ON AM or FM OFF as required.

Use of mixed a.m. and f.m.

25. AM and f.m. can be applied simultaneously in any of the following combinations:-

(i) both from the internal modulation oscillator,

(ii) both from the same external modulating source,

(iii) one internal and the other external.

In each case follow the appropriate individual procedures given in paras. 17-22.

Use of Store and Recall facility

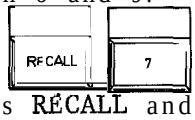
26. Up to ten complete sets of data can be retained and recalled from memory at any time by the following procedure:-

(1) Check that r.f. carrier frequency, f.m. deviation and/or a.m. depth, and r.f. level are all indicating the values required. Delete from the display any unwanted data.

(2) 

Depress the STORE key followed by any numeral between 0 and 9, this stores the complete set of data showing on the display at that time.

(3) The 2017 may then be further programmed with another set of data and the STORE key further depressed followed by any numeral between 0 and 9.

27. 

To regain any of the ten sets of data stored, simply depress RECALL and the relevant numeral 0 to 9 as required.

Use of external frequency standard

28. The 2017 may be controlled from an external frequency standard, in place of the internal one, for system synchronizing purposes or where an exceptional degree of accuracy or stability is required. The standard signal should be 1 MHz at 4 V p-p into 1 kΩ.

29. To use this facility set the STD INT/EXT switch on the rear panel to EXT and connect the signal to the 1 MHz INT STD OUT/EXT STD IN socket also situated on the rear panel. Allow a few seconds for the internal locking circuit to stabilize.

Adjustment of internal frequency standard

30. The ADJUST INT STD preset on the rear panel enables the internal standard to be set against a primary external standard. The output is available for this purpose at the INT STD OUT/EXT STD IN BNC socket with the STD INT/EXT switch set to INT.

CAUTION ⚠

Incorrect adjustment of this preset will impair the frequency accuracy of the 2017.

OUTPUT IMPEDANCE AND LEVEL STANDARDS

31. The performance specification for the instrument assumes operation into 50 Ω external loads, but often it is desirable to work into other mismatched loads. This is in general possible although an uncertainty of performance may be introduced. Mismatching can produce standing waves which at low carrier frequencies can be ignored but at higher frequencies could be significant. The effects of a mismatch can be minimized by introducing a 20 dB pad between the generator and the load if the additional loss can be tolerated,

32. A further optional accessory, the 6 dB 50/75 Ω Matching Pad TM 5573/3, can be used where external loads of 75 Ω are employed. These give accurate matching of the source impedance to the characteristic impedance of the output connecting cable for operating carrier frequencies up to 500 MHz.

33. In the 2017 there are five different units of measurement available to the user in respect of the r.f. level. These are selected by a 5 position RF LEVEL switch and the level is indicated on the RF LEVEL display, both are situated on the front panel.

34. When switched to either of the two e.m.f. switch positions dBμV or V the output indicated on the display will be in terms of the e.m.f. available at the open circuit RF OUTPUT 50 Ω socket. dBμV indicates a level of dB relative to a reference level of 1 μV.

35. In the p.d. positions V or dBμV the display indicates the voltage that will appear across a closed (or matched) external 50 Ω load.

36. The centre switch position dBm indicates a level of dB relative to a reference level of 1 mW.

REVERSE POWER PROTECTION

37. When using the 2017 for testing transceivers it is conceivable that the transmitter could be accidentally switched on. To prevent possible damage to the attenuator circuits in the generator a reverse power protection unit (RPPU) operates isolating the output,

38. An indication that this has taken place is given by the front panel RF OFF annunciator flashing continually. If the cause of the overload is removed the 2017 RPPU can be instantly reset by depressing the RF ON/OFF key whereby the RF OFF annunciator will turn off. If the overload inadvertently remains on, pressing the RF ON/OFF key to reset will cause the RF OFF annunciator to change from a flashing indication to a steady on state. After a delay of 4 seconds the annunciator will again begin flashing until another attempt to reset is made and a steady on indication is again resumed for a further 4 second period. In the remote control condition an SRQ instruction is asserted to indicate that the RF trip has acted. Reset can be obtained by sending the Carrier On instruction (C1). This circuit will protect the output attenuator against unwanted reverse power levels up to 50 watts. Relay operate time for typical overload conditions is 50 μs or less.

39. Should the instrument be operated with the maximum RF LEVEL output voltage selected and no terminating load on the RF OUTPUT socket, it is possible for the RPPU to trip. If this does occur, depressing the LOCK/UNLOCK key will enable the RPPU to be reset.

40. Also when the 2017 is switched OFF, the output socket is automatically disconnected from the output attenuator - a further safety feature.

GENERAL PURPOSE INTERFACE BUS (GPIB) FUNCTIONS

41. The GPIB provides the facility for interconnection of the 2017 to a remote controller. The essential purpose of the GPIB functions are described below. Further information if required, can be obtained from the separate GPIB manual, offered as an optional accessory.

SH1 : Source handshake (complete capability)

42. The source handshake sequences the transmission of each data byte from the 2017 over the bus data lines. The sequence is initiated when the function becomes active, and the purpose of the function is to synchronize the rate at which bytes become available to the rate at which accepting devices on the bus can receive the data.

AH1 : Acceptor handshake (complete capability)

43. The acceptor handshake sequences the reading of each 2017 data byte from the bus data lines. The data byte received may be an interface message from the controller or (part of) a device dependent message from the talker.

T5 : Talker function (complete capability)

44. The talker provides the 2017 with the ability to send device dependent messages over the bus to other devices. The generator has data that can be transmitted to the controller, and therefore needs the talker function. The ability of any device to talk only exists when it has been addressed as a talker.

L4 : Listener function (no listen only function)

45. The listener function provides a device with the ability to receive device dependent messages over the bus. The capability only exists where the device is addressed to listen via the bus by the controller.

SR1 : Service request function (complete capability)

46. The service request function gives the 2017 the capability to asynchronously inform the controller of its need for attention.

RL1 : Remote/local function (complete capability)

47. The remote/local function gives the 2017 the ability to switch between either the local front panel controls or device dependent messages over the bus.

DC1 : Device clear function (complete capability)

48. Device clear is a general reset to the 2017 and may be given to all devices in the system simultaneously (DCL), or only to addressed devices (SDC).

E1 : Open collector drivers

49. The GPIB drivers fitted to 2017 have open collector, rather than tristate, outputs.

GPIB programming codes

50. Functions

CF	Carrier frequency
DV	FM deviation
ED	AM depth
LV	RF level
DF	Delta-frequency
SW	Sweep (stop) frequency
EDED	AM depth in VOR/ILS mode (52017-301S version only)
FH	Carrier frequency with range hold

Delta-frequency mode

UP	Delta-F Up
DN	Delta-F Down
RT	Return to last CF or LK frequency

Sweep mode

UP	Sweep up slowly (controlled by front panel RATE adjustment)
DN	Sweep down slowly (controlled by front panel RATE adjustment)
UPUP	Sweep up rapidly
DNDN	Sweep down rapidly
RT	Return to CF frequency rapidly

Units

MZ	Megahertz	VL	Volt
KZ	Kilohertz	MV	Millivolt
HZ	Hertz	UV	Microvolt
PC	Percentage (used with ED and EDED only)	DB	Decibel
UØ	dB rel. 1 µvolt e.m.f.		
U1	Voltage e.m.f.		
U2	dB rel. 1 milliwatt		
U3	Voltage p.d.		
U4	dB rel. 1 µvolt p.d.		

Stores

ST	Store instrument settings (followed by a number 0-9).
RC	Recall instrument settings (followed by a number 0-9).

Note. If an empty store is recalled, nothing happens.

Mode

M1	Modulation osc. on	MØ	Modulation osc. off
D1	FM on	DØ	FM off
E1	AM on	EØ	AM off
P1	Pulse mod on	PØ	Pulse mod off
C1	Carrier on (and RPP reset - see below)	CØ	Carrier off

LK	Lock RF oscillator
UL	Unlock RF oscillator (Frequency rotary controls active).
XC	Count external frequency (unlocks oscillator).
RY	RF level rotary controls active (LV inactivates these controls).
W1	Wait on (2017 waits for tuning to finish before allowing further bytes to proceed on the bus).
WØ	Wait off (2017 continues to accept bus data while tuning).

Note..

M1 mode can be invoked providing the instrument's front panel MODULATION OSCILLATOR is first selected to either of the two fixed frequencies, 400 Hz or 1 kHz or the variable 20 Hz to 20 kHz control.

Talk

TF — Primes 2017 to talk counter frequency when unlocked and next addressed to talk (default mode).

TL — Primes 2017 to talk r.f. level (millivolts or dB) when in RY mode and next addressed to talk. (TL must be sent each time before a level can be sent, otherwise 2017 defaults to TF mode.)

Reverse power protection

When tripped by an overload applied to the RF OUTPUT socket, the GPIB SRQ line is asserted, and the status byte (obtainable by the controller conducting a serial poll) will contain the value 97 (decimal).

C1 sent over the bus will attempt a reset of the RPPU which if successful, will cause the status byte to clear to 0. If unsuccessful the status byte will have the value 33.

Clear and switch on

SDC and DCL clear 2017 to the following state:-

400 MHz carrier frequency locked.
Minimum output level, carrier on.
No FM, AM, VOR/ILS or PULSE modulation.
WØ mode.
TF mode.

Notes,

(1) The instrument stores are not changed. Switch on clears the 2017 to the same states as SDC or DCL but also clears the stores. If an 'empty' store is recalled nothing happens. The only SRQ produced is for 'RPPU triggered', status byte available. Status byte normally Ø or 97 if RPPU is tripped.

(2) The GPIB address set by the rear panel address switch is displayed in the frequency display window for a few seconds duration after switch on. The address is displayed in binary form and presents a useful confirmation of the switch settings.

GPIB connector contact assignments

51. The contact assignment of the GPIB cable connector and the device connector is as shown in Fig. 3.

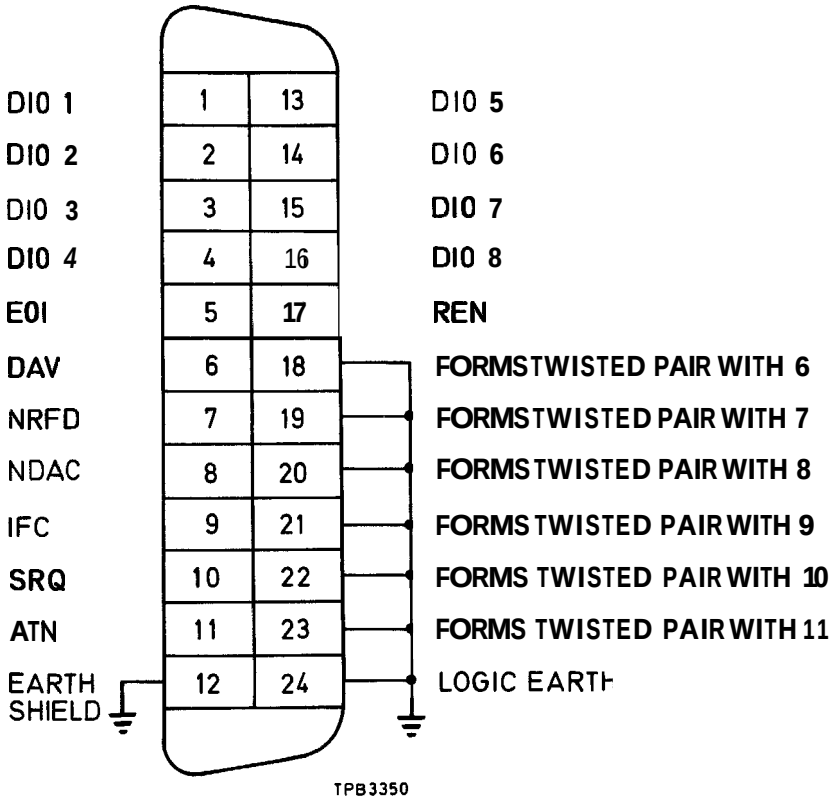


Fig. 3 GPIB connector contact assignments

Chapter 4-1

BRIEF TECHNICAL DESCRIPTION

CONTENTS

INTRODUCTION

1. The following summary is an outline circuit description of the instrument and is intended to be read in conjunction with the block diagram. Detailed descriptions of each stage are given in Chap. 4-2 Service manual.

CIRCUIT SUMMARY

Frequency generation

2. The 2017 utilizes one fore-shortened coaxial line low noise oscillator covering the range 256 to 512 MHz from which all other carrier frequencies are derived.

3. 4 MHz to 512 MHz. The low noise master oscillator covers a frequency range of 256 MHz to 512 MHz. Frequencies from 4 MHz to 256 MHz are obtained by dividing down the master oscillator range with six successive divide by two networks.

4. 512 MHz to 1024 MHz. The master oscillator frequency is utilized to phase lock one of two voltage controlled oscillators which together cover the range 512 MHz to 1024 MHz. This enables the low noise properties of the master oscillator to be transferred to this frequency range.

5. 10 kHz to 4 MHz. The lowest frequency range derived by division of the master oscillator frequency is 4 to 8 MHz. This is mixed with a 31.5 MHz crystal oscillator to produce a signal frequency in the range 35.5 to 39.5 MHz. Unwanted mixer products are then removed by a surface acoustic wave (SAW) band-pass filter. The signal is then further mixed with the output of a 35.5 MHz LC oscillator to produce an output in the range 10 kHz to 4 MHz. The crystal oscillator and the LC oscillator are phase locked to maintain an exact 4 MHz frequency difference.

Counter/synchronizer

6. The carrier frequency is indicated by a frequency counter in the unlocked mode. Greater stability can then be achieved by the locking process. This is a synchronized mode of operation, selecting the displayed output frequency and locking this to a high stability internal reference oscillator. Control of the master oscillator motor drive is also via the counter/synchronizer circuits providing the frequency selection and sweep facility.

Modulation processing

7. The a.m. and f.m. drive to the modulators may be derived from either an internal oscillator or an external source. On selection of AM or PULSE MOD the signal is passed through a double balanced mixer type modulator. When FM is selected the modulation is achieved by a varactor located in the master oscillator tuned circuit.

Output processing

8. Two output amplifiers are utilized, both incorporating automatic level control. The first covers the frequency range 10 kHz to 4 MHz and the second 4 MHz to 1024 MHz. The amplifier outputs are fed to a 6 dB step attenuator assembly to enable output levels of between 0.2 μV e.m.f. and 4 V e.m.f. in c.w. and f.m. modes, (2 V e.m.f. for a.m.) to be selected. Attenuator pads are actuated electro-mechanically according to the instructions received from the generator control circuitry.

9. The final stage of the 2017 is a reverse power protection unit.

Microprocessor control

10. An advanced microprocessor based controller allows convenient keyboard or GPIB control of 2017 functions.

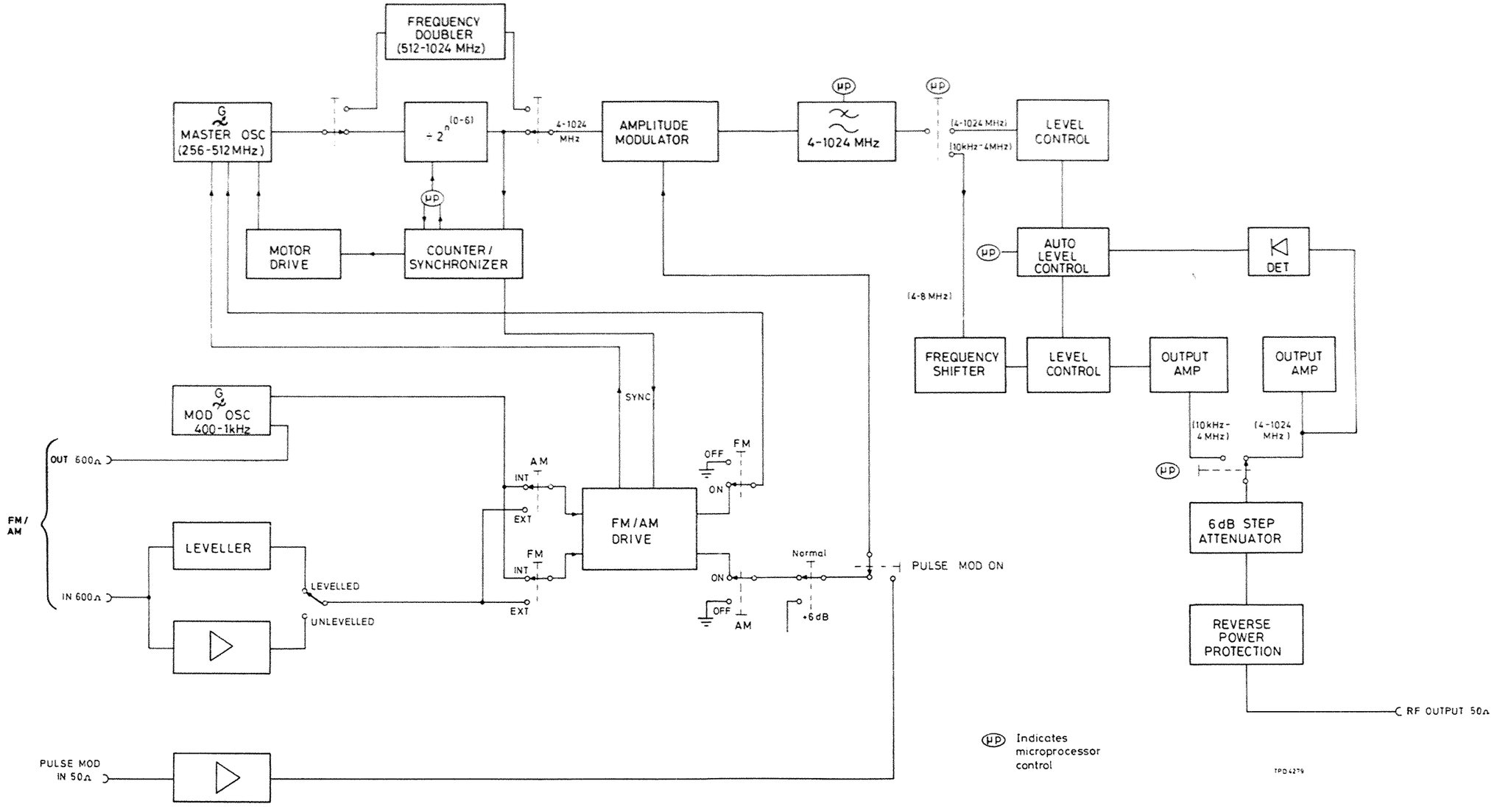


Fig. 1 2017 simplified block diagram