Contents

Chapter 1

General information

1.1 INTRODUCTION

The TF 2361 Sweep Generator is a general-purpose instrument with a wide range of applications. The main unit, described in this manual, generates a sweep voltage which is used to drive a plug-in oscillator; several different plug-in oscillators are available, covering different frequency ranges, and each oscillator is described in a separate manual. The main unit houses the power supplies for the complete instrument, and has front panel controls which enable the sweep voltage to be driven internally or externally, locked to the mains frequency or to a television frame scan, or controlled manually. Other facilities include a blanking generator, a marker adder and an X-drive output for an associated oscilloscope, display unit or chart recorder.

The operational modes are selected by a front panel sweep function switch. This gives a range of internal sweep drive from 0.01 Hz to 100 Hz in four decades, mains lock to mains frequencies from 45 to 400 Hz, TV lock to frame scan on 405, 525 or 625 line composite television signals, external control by signals from d.c. to 20 kHz, a c.w. mode in which the instrument behaves as an ordinary signal generator, and a manual mode in which a control is used to manually sweep over the range of frequencies set up on the plug-in oscillator. The ratio of sweep to flyback can be set at 1:1 or 10:1, and on the internal ranges the instrument can be set to give a single sweep when a 'one shot' switch is operated.

In the mains lock and TV modes, a phase shift control allows the swept frequency to be positioned so that high or low frequencies are applied to any part of the spectrum being examined.

The instrument is contained in a bench mounting case, or it can be rack mounted.

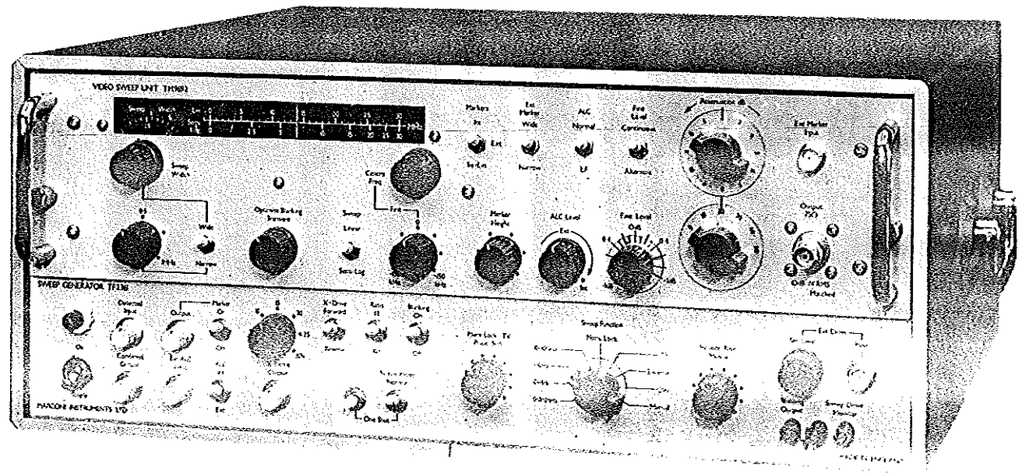


Fig. 1.1 Sweep generator TF 2361, fitted with video oscillator TM 9457

1.2 DATA SUMMARY

Characteristics	Performance	Supplementary information
Internal sweep		
Ranges:	0.01 to 0.1 Hz 0.1 to 1.0 Hz 1.0 to 10 Hz 10 to 100 Hz	
Rate control:	Continuously variable over selected range.	
Sweep ratio:	Ramp : Nominal 10 :1. Triangular : Nominal 1 :1.	
Single sweep:	Provided on all ranges 0.01 to 100 Hz, frequency adjustable by variable rate control.	
Locked sweep		
Mains lock:	Locks to 50, 60 or 400 Hz mains frequencies, according to position of variable rate control; at 400 Hz, lock is to sub-multiple within range 40-65Hz.	
Phase shift:	Adjustable up to 270° phase shift on mains lock and TV field lock only.	
External TV field:	Locks on 405, 525 and 625 line systems. Variable rate control available.	
TV input required:	Composite signal: 1 V p-p (approx. 0.3 V sync pulses). Negative field pulses: 0.3 V to 3 V. Sine wave: 5 V to 10 V p-p.	
Input impedance:		75 Ω nominal.
Waiting time:	Minimum time for stability on mains lock and TV field lock not greater than 500 μs.	
Blanking output		
Amplitude:	Greater than +22 V from 2 kΩ source.	
Rise time:	Less than 4 μs, 10-90%.	
Decay time:	Less than 20 μs, 10-90%.	

Characteristics	Performance	Supplementary information
X-Drive		
Output:	D.C. coupled, reversible.	
Amplitude:	Continuously variable up to at least 30 V p-p into 50 kΩ impedance (2 V p-p into 1 kΩ impedance). Symmetrical about earth.	
A.L.C.		Internal, or external with suitable a.l.c. detector for the sweep unit.
Marker adder		Detected signal added to the marker output to provide combined marker and signal output.
External sweep		
Sensitivity:	Adjustable.	
Minimum input:	4.5 V p-p sine wave drive, symmetrical about earth, for full sweep.	
Maximum input:		50 V p-p sine wave drive, symmetrical about earth.
Bandwidth:	D.C. to 20 kHz.	
Manual sweep		Gives full sweep range of the plug in sweep unit within the limits of the close sweep width.
C.W. output		Provides a c.w. signal at any frequency of the sweep range. Adjustable centre frequency control on sweep unit.
Power requirements		
A.C. mains input:	95 to 130 V or 190 to 264 V, 45 to 65 Hz; 105 to 130 V or 200 to 264 V, 65 to 500 Hz.	
Power consumption:	40 VA with plug in unit.	

Dimensions and weight	Height	Width	Depth	Weight
	178 mm (7 in)	432 mm (17 in)	406 mm (16 in)	9.1 kg (20 lb)

1.3 ACCESSORIES

Description	M.I. code
Accessories supplied	
Kit, comprising :	46883-060
Free Plug type BNC (3 off)	23443-374 / 23443-371
Adapter 2 mm to BNC	43168-015
Mains Lead	43122-017
Optional accessories	
Extension Cable TM 9912 To allow operation of a plug-in unit when removed from the main unit for repair or maintenance.	43127-066
Rack Mounting Kit TM 8270	46883-002
Associated equipment	
Video Sweep Unit TM 9692 25 kHz to 30 MHz.	52362-013
VHF Sweep Unit TM 9693 1 MHz to 300 MHz.	52363-013
UHF Sweep Unit TM 9694 220 MHz to 1000 MHz.	52364-013
VHF/UHF Attenuator TM 9695 For use with TM 9693 and TM 9694.	46845-104

Chapter 2

Operation

2.1 INSTALLATION

The instrument, when contained in a bench cabinet, is ready for immediate operation after the plug-in unit has been fitted in position and the supply voltage adjusted and connected. The supply lead is stowed on cleats at the rear of the case, and a hinged bar under the case permits the instrument to be tilted at an angle convenient for operation of the front panel controls. The operation of the instrument depends on the plug-in unit in use, and all operating procedures for the complete equipment are described in the manual for the plug-in unit.

Rack mounting arrangements

The instrument can be removed from its case and rack mounted using the rack mounting accessory kit available as an optional accessory. The instrument can be withdrawn from its case when the four 2 BA screws at the rear are removed, and the rack mounting brackets can then be fitted on each side of the main chassis. Slides or runners should be used to carry the weight of the instrument.

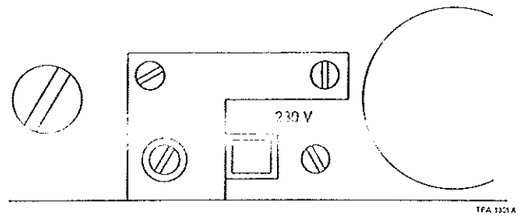


Fig. 2.1 A.C. supply range switch

Supply voltage adjustment

The instrument can be operated from a. c. mains supplies of 95 to 130 V or 190 to 264 V. Selection of the appropriate range is made by a two-position sliding switch at the rear of the case, which can only be moved from one position to another when a locking plate is removed (two 6 BA screws). Reverse the plate and re-secure it to lock the switch in its new position. The two ranges (115 V and 240 V) are engraved on the rear panel, and the range in use is visible through the cut-out section of the locking plate.

Mains lead

Attach a suitable 3-pin plug to the mains lead. The colour code used for the wires is being changed to conform to international standards; either of the following codes may apply to this instrument:

Earth	Green/yellow		Green/yellow
Neutral	Light blue	or	Black
Line	Brown		Blue

In addition the earth wire carries a yellow sleeve bearing a green earth symbol, and the neutral wire carries a sleeve marked N.

Fuses

Check that the rear panel fuses FS1 and FS2 in the a. c. supply are correctly rated for the a. c. supply range in use; 500 mA for the 95 to 130 V range, 250 mA for the 190 to 264 V range.

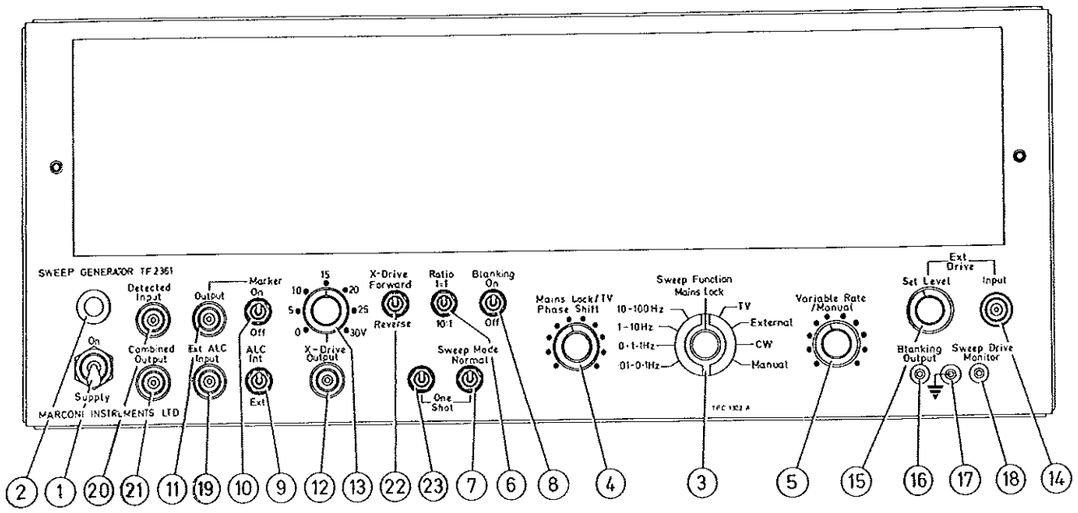


Fig. 2.2 Front panel controls and connectors

2.2 CONTROLS AND CONNECTORS

Front panel

(1) SUPPLY: A.C. mains on/off switch.

(2) SUPPLY INDICATOR LAMP: Lamp will glow when supply is switched ON.

(3) SWEEP FUNCTION: Sets the sweep generator to any one of nine operational modes.

(4) PHASE SHIFT: Varies the phase of the sweep output over a range of at least 270° with respect to the input trigger in mains lock or TV mode.

(5) VARIABLE RATE: Gives continuous variation over selected range on internal sweep modes, and sufficient control in mains lock and TV modes to cover mains frequencies from 45 to 400 Hz and TV systems of 405, 525 or 625 lines. When 3) is set to MANUAL, this control can be used to give manual sweep.

(6) RATIO: Selects a ratio of sweep to flyback at either 1:1 or 10:1. Affects video output, blanking output and X-drive output.

(7) SWEEP MODE: In ONE SHOT position, brings one shot switch 23) into operation.

(8) BLANKING: With blanking on, the video output is turned off during the sweep flyback. This provides a convenient base line for the display.

(9) A.L.C. SWITCH: Switches a.l.c. from internal control to control from external a.l.c. detector via socket 19).

(10) MARKER SWITCH: Switches marker output from plug-in unit to combined output socket 21) and marker output socket.

(11) MARKER OUTPUT: Markers direct from plug-in unit, via switch (10).

(12) X-DRIVE OUTPUT: Provides horizontal sweep for associated oscilloscope or recorder, synchronized with sweep rate.

(13) X-DRIVE LEVEL CONTROL: Sets X-drive output level from 0 to 30 V p-p into 50 kΩ load, or from 0 to 2 V p-p into 1 kΩ load.

(14) EXT DRIVE INPUT: An input signal from d.c. to 20 kHz will sweep the generator when the SWEEP FUNCTION switch is set to EXTERNAL.

(15) EXT DRIVE SET LEVEL: Adjusts sensitivity of EXT DRIVE INPUT.

(16) BLANKING OUTPUT: Same with [illegible] blanking generator (1:1 or 10:1 according to position of RATIO switch) of 22 V for synchronizing or triggering associated equipment. Synchronized with sweep rate.

(17) EARTH SOCKET:

(18) SWEEP DRIVE MONITOR: Monitors the swept output from distorter and drive unit in plug-in.

(19) EXT A.L.C. INPUT: Automatic level control from external a.l.c. detector via A.L.C. switch (9)

(20) DETECTED INPUT: Accepts input from the detector in use so that markers may be added.

(21) COMBINED OUTPUT: Combination of detected input and markers (with MARKER switch ON).

(22) X-DRIVE SWITCH: To suit the polarity requirements of an associated oscilloscope or recorder connected to the X-drive output, the output horizontal sweep waveform may be either positive-going when the switch is set to FORWARD or negative-going when set to REVERSE.

(23) ONE SHOT: Spring-loaded switch, operational with SWEEP MODE in ONE SHOT position, triggers sweep for one cycle when released.

Rear panel

(24) SUPPLY SOCKET: 3 pin a.c. mains supply input connector.

(25) SUPPLY RANGE: 2 way switch with locking device, 95 to 130 V or 190 to 264 V.

(26) MAINS: Supply fuses 500 mA or 250 mA.

(27) -24 V: Supply fuse 1 A, time-lag.

(28) +24 V: Supply fuse 1 A, time-lag.

(29) +110 V: Supply fuse 160 mA, time-lag.

2.3 OPERATING INSTRUCTIONS

All other operational information, including control functions, switching-on procedure, operation and applications is given in the instruction manual for the plug-in unit.

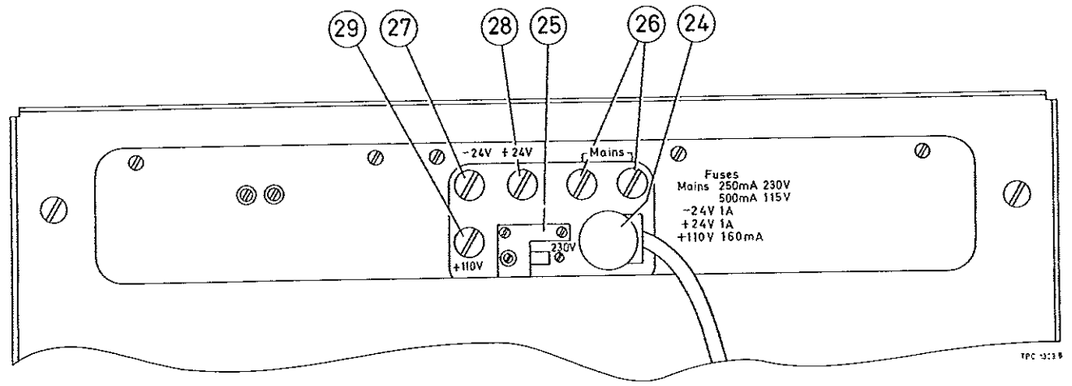


Fig. 2.3 Rear panel controls and connectors

VIDEO

BLANKING

SYNC

0·3V

site TV signal at pin 1

+8·8V

+7·2V

nput to base of VT1

+2V

+1V

tput at VT1 collector

+8·8V

+7·2V

+2V

nput to base of VT2

−23·2V

−24V

−25·3V

Input to base of VT3

−0·4V

−25V

—80μs

Output of VT3 at pin 5

3.3 Operation of TV sync separator

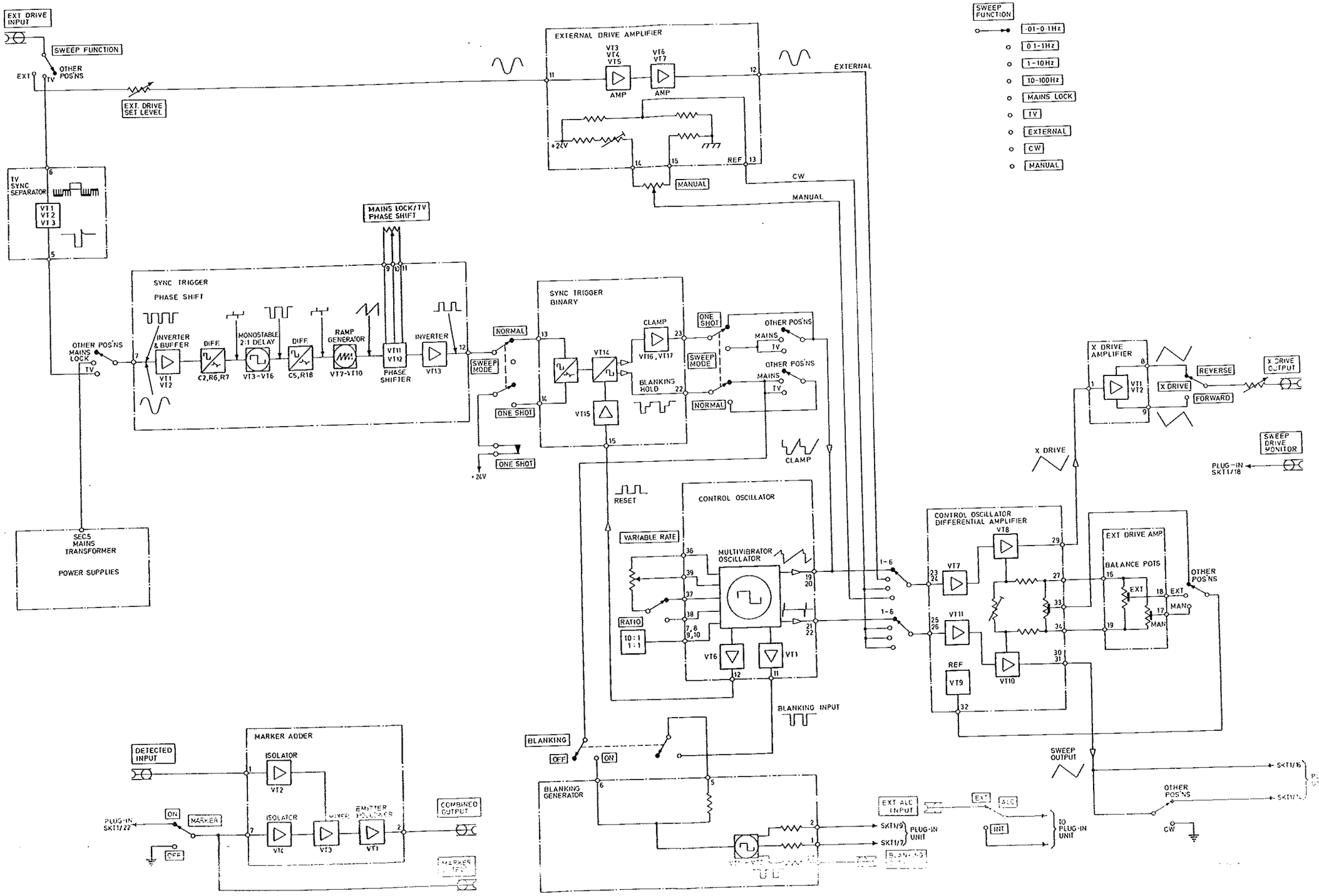


Fig. 3.1 Sweep generator TF 2361, block diagram

Chapter 3

Technical description

3.1 GENERAL

The following technical description should be read in conjunction with the block diagram, Fig. 3.1, and the circuit diagrams included at the end of this manual.

3.2 CONTROL OSCILLATOR

(Circuit diagram, Fig. 7.2)

The control oscillator generates the sweep voltage used to drive the swept oscillator in the plug-in unit. The essential characteristics of the control oscillator are good linearity over a wide range of frequencies and rapid response to changes in frequency.

The oscillator comprises an emitter-coupled multivibrator with constant-current charging circuits; the current is varied to effect frequency control. Range selection of the four internal ranges and the mains lock/TV ranges is made by switching the capacitors C10 to C18 between the emitters of VT3 and VT5. Close coupling between these two transistors is provided in the feedback circuits by the Zener diodes MR5 and MR12 driven by the emitter followers VT1 and VT6.

Variation of frequency over any selected range is provided by the front panel variable rate control which changes the base voltages on VT2 and VT4. Minimum current at the lower end of the frequency range is preset by RV3 in the internal modes; in mains lock and TV modes, the minimum current is established by R8. The variable rate control gives overlap on the four internal sweep ranges, and gives sufficient control on the mains lock and TV ranges to cover mains frequencies from 45 to 400 Hz and TV systems of 405, 525 and 625 lines.

The multivibrator circuit generates two complex waveforms at the emitters of VT3 and VT5 respectively (see Fig. 3.2); the ramp portion of the VT3 waveform establishes the sweep voltage, while the ramp portion of the VT5 waveform establishes the flyback voltage. The ratio of sweep to flyback can be set at 10:1 or 1:1 by operation of the front panel ratio switch 10Sa, which changes the ratio of the collector current shared by VT12 and VT13.

VT1 provides a square wave output for operation of the blanking generator, and VT6 provides a squarewave output for resetting the binary VT15 in the sync trigger circuit.

Parasitic oscillation is prevented, in the external, c.w. and manual modes of operation, by R20 and R21, while R22, C9 and MR13 establish correct starting conditions. MR14 ensures that the correct starting conditions are not lost in the event of failure of the +24 V line.

The sweep and flyback outputs from the control oscillator pass through the sweep function switch in positions 1 to 6 (that is, the four internal ranges, mains lock and TV) before going to the differential amplifier. In the other three positions (external, c.w. and manual) the control oscillator is inoperative. During mains lock and TV operation, the control oscillator is locked to the mains or TV frame frequency by a trigger signal from the sync trigger circuit.

3.3 DIFFERENTIAL AMPLIFIER

(Circuit diagram, Fig. 7.2)

The differential amplifier forms part of the control oscillator sub-unit, and combines the sweep and flyback signals from the control oscillator to form a single sweep output suitable for driving the plug-in unit. This output is held within precise current limits by preset gain and balance potentiometers so that no changes take place when different plug-in units are employed. The differential amplifier also supplies a current drive to the X-drive amplifier.

In the external, c.w and manual modes of operation the differential amplifier receives its inputs from the external drive amplifier sub-unit.

The emitter followers VT7 and VT11 are used as input buffers, and the current output from VT10 is set to sweep from 0.45 mA to 4.55 mA by RV1 (mean current value) and RV2 (current swing); this output is the current drive to the swept oscillator in the plug-in unit. The current output from VT8 is at a higher level, and supplies the input to the X-drive amplifier. These output waveforms are also shown in Fig. 3.2.

In the external and manual modes of operation RV1 (mean current value) is replaced by separate

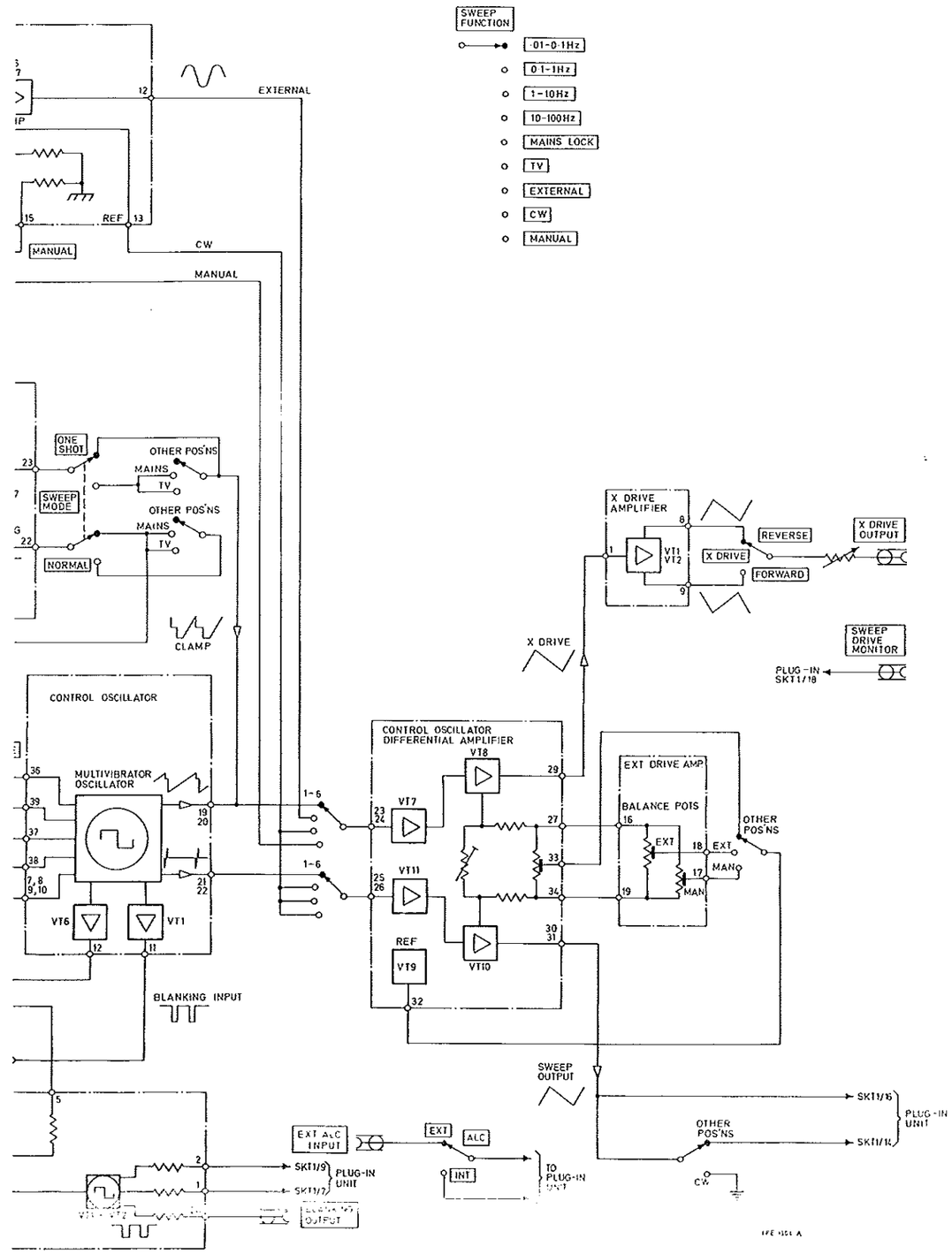


Fig. 3.1 Sweep generator TF 2361, block diagram

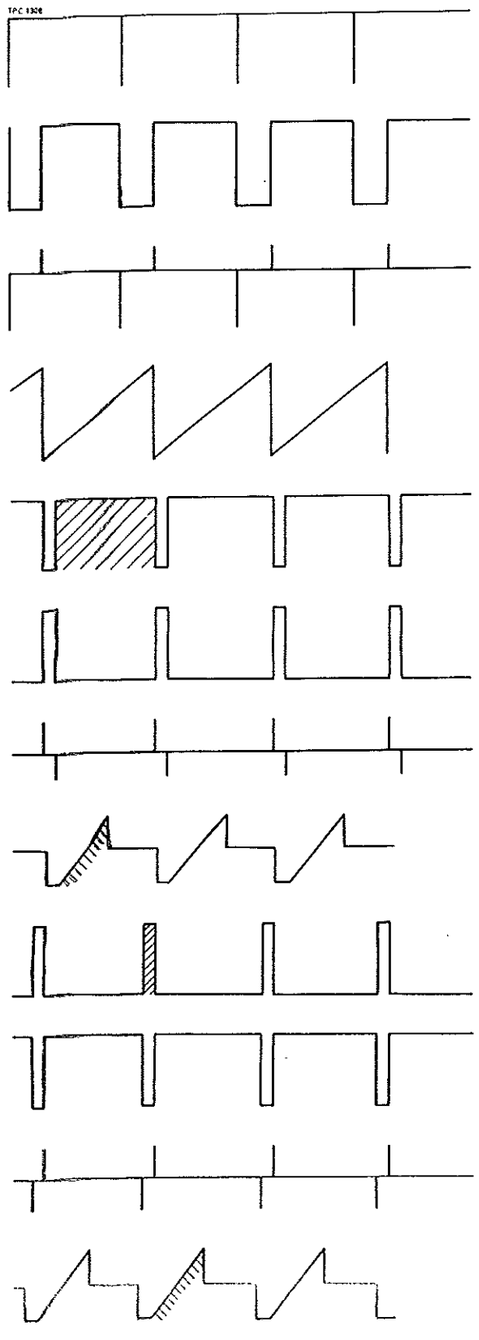


Fig. 3.5 Sync trigger and phase shift waveforms relative to control oscillator output (ratio 1:1)

Fig. 3.4

preset balance potentiometers in the external drive amplifier sub-assembly. VT9 supplies a constant current reference to each of these three potentiometers.

With the sweep function switch set to c.w., the output of the control oscillator is earthed, and the frequency output of the instrument is under the control of the centre frequency control on the plug-in. To keep the differential amplifier properly loaded in this non-operational state, a constant voltage is applied to both differential amplifier inputs from a potential divider on the external drive amplifier sub-unit.

With the sweep function switch set to manual, one side of the differential amplifier is fed from the reference supply in the external drive amplifier (the same as that used for c.w. operation) while the other side of the differential amplifier is supplied from the slider of the manual section of the variable rate/manual control. Preset balance and gain controls in the external drive amplifier determine the operating limits of the differential amplifier in the control oscillator. The control then provides full manual sweep over the range of frequencies set up on the plug-in.

3.4 TV SYNC SEPARATOR

(Circuit diagram, Fig. 7.3)

A composite television signal can be connected to the external drive input socket, and in the TV mode the signal is switched to the TV sync separator where the frame synchronizing pulses are separated and used to produce a negative-going output pulse.

The circuit action is illustrated by the waveforms in Fig. 3.3. C1 and R2 differentiate the input so that VT1 starts to conduct when the negative-going frame pulses appear; R5 and C2 integrate the output of VT1 so that VT2 conducts when the frame pulses have built up; and C3 and R8 differentiate the output of VT2 for application to the amplifier VT3. VT3 produces 25 V negative-going output pulses of 80 μs duration at TV frame frequency.

3.5 PHASE SHIFT

(Circuit diagram, Fig. 7.3)

The phase shift circuit forms part of the sync trigger sub-unit, and enables the sweep to be shifted by up to 270° with respect to the trailing edge of the incoming mains lock or TV signal. In this way, any part of the waveform being examined can be swept by the high or low frequency ends of the sweep.

The input to VT1 is either a -24 V pulse waveform from the TV sync separator, or a 24 V p-p sine wave from the mains transformer, according to the position of the sweep function switch (TV or mains lock). The signal is inverted and shaped by VT1, passed through a buffer stage VT2, and then differentiated by C2 and R7 (see waveforms Fig. 3.4). The circuit comprising VT3, 4, 5 and 6 introduces a 2:1 delay by producing a square wave having a 2:1 mark:space ratio for every input pulse. VT3 and VT4 form a monostable pair, with VT4 normally biased on until an input pulse via MR2 causes a change of state. VT6 has a reference voltage applied to its base, and supplies a constant current to the charging circuit via C3 and R14. The precise 2:1 delay is introduced when the mean voltage on the base of VT5 balances that on the base of VT6, the voltage on the base of VT5 being derived from the square wave at the collector of VT4. The delayed output is taken from the collector of VT3, and is maintained at the constant 2:1 mark:space ratio over the frequency range 30 to 600 Hz. Since the oscillator operates from 40 to 70 Hz (according to the position of the variable rate control) in mains lock and TV modes, a 400 Hz mains input would trigger the oscillator once for every 10 pulses with a 40 Hz setting, or every 6 pulses with a 70 Hz setting.

The 2:1 square wave is differentiated by C5 and R18 and applied to the ramp generator circuit comprising VT7, 8, 9 and 10. When VT7 conducts during the short period of an incoming positive pulse, C6 is discharged, and then charges up with the constant current supply from VT8 during the interval between positive input pulses. The voltage on the base of VT8 is stabilized by the circuit VT10, R23, R24, C7 and MR5, so that the ramp generated is held at constant amplitude regardless of frequency.

The ramp output is taken from the emitter of VT9 via a preset level control and applied to the phase shift circuit of VT11 and VT12. The output of VT12 is an approximate square wave having a width determined by the setting of the front panel phase shift control; the width can be varied from nearly the full width of the ramp to the last 15% of the ramp. In angular terms, if the ramp represents 360°, the phase shift output pulse can be set to start anywhere between approximately 45° and 315°, giving 270° of phase shift. The start point is determined by the voltage applied to the base of VT12, which accepts the ramp waveform via VT11, and the output pulse is then inverted and shaped by VT13 before being passed to the binary circuit. The circuit action is illustrated by the waveforms in Fig. 3.5, which shows their relationship to the control oscillator output waveform.

3.6 BINARY
(Circuit diagram, Fig. 7.2)

The binary circuit forms part of the sync trigger sub-unit, and receives an input from the phase shift circuit (mains lock and TV) or from the one shot spring-loaded switch. Selection of either function is made by the front panel sweep mode normal - one shot switch. For one shot operation a trigger pulse is produced when the one shot switch is released.

The function of the binary circuit is to produce a clamp output to synchronize the sweep oscillator with the mains lock, TV or one shot signals, and a blanking hold output to inhibit the blanking generator during the flyback and clamping period.

The normal state of the binary is with VT15 biased off by MR12 and R41, so that VT14 is conducting and VT16 - VT17 holds the clamp output at the normal starting level of the oscillator sweep. When a negative-going spike is applied from the differentiating circuit C9 and R34, VT14 is cut off and VT15 starts to conduct; this releases the clamp and the oscillator sweep can commence to rise (see waveforms Fig. 3.6). At the same instant the blanking hold output is inhibited and the blanking generator produces a square pulse lasting for the duration of the sweep. On completion of the charging cycle, when the sweep oscillator changes state, the blanking pulse terminates and a positive-going reset pulse is received from the control oscillator. At the end of the flyback period this reset pulse terminates and resets the binary to its normal state. The phasing of the binary waveforms with respect to the control oscillator output is illustrated in Fig. 3.7.

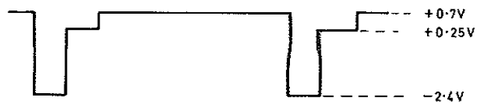
3.7 BLANKING GENERATOR
(Circuit diagram, Fig. 7.2)

The blanking generator forms part of the external drive sub-unit, and produces a 24 V positive-going square pulse during the period of each forward sweep, for switching the oscillators and a.l.c. circuit in the sweep unit. The mark to space ratio of the blanking waveform will be 1:1 or 10:1 according to the position of the ratio switch. The blanking signal is also brought out to a front panel socket for use with associated equipment.

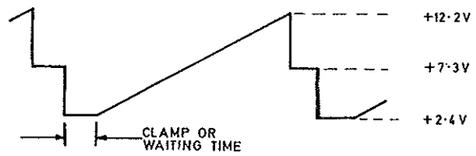
Input from phase shift circuit pin 13

Input to VT14 base

Output of VT14 collector

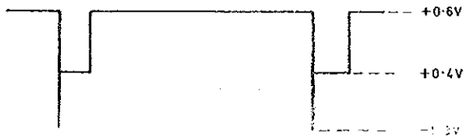


Blanking hold output at pin 22



Clamp output at pin 23 (control oscillator output tag 20)

Reset input at pin 15



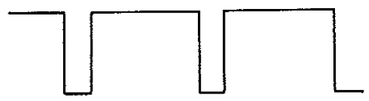
Reset input at VT15 base

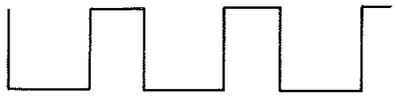
Fig. 3.6 Operation of binary circuit in mains lock or TV mode (ratio 10: 1)

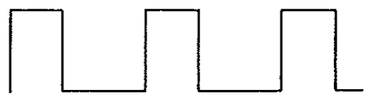

Binary input (phase shift fully counter-clockwise)

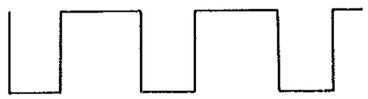

Differentiated input to binary VT14

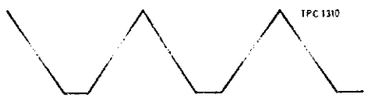

Control oscillator output tag 20


Blanking hold from binary VT14


Blanking output from blanking generator pin 1


Reset input to binary VT15


Blanking drive from control oscillator pin 11

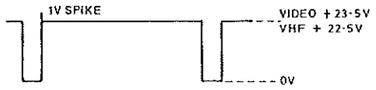


X-drive output 1:1 (forward)

Fig. 3.7 Binary waveforms related to control oscillator output (ratio 1: 1)

Input from control oscillator at pin 5

Blanking hold input from binary at pin 6



Blanking hold output to plug-in at pin 1

Fig. 3.8 Operation of blanking generator (ratio 10: 1)

VT1 receives a square wave input from VT1 in the control oscillator, which is mixed on VT1 base with the blanking hold signal from the binary circuit (see waveforms Fig. 3.8). The three outputs from the collector of the amplifier VT2 have limiting resistors to protect VT2 from overload.

3.8 EXTERNAL DRIVE AMPLIFIER
(Circuit diagram, Fig. 7.3)

With the sweep function switch set to external, the sweep can be driven from an external source connected to the front panel external drive socket.

The external drive is connected to the base of VT3 via a front panel set level control. VT3 and VT5 form part of a differential amplifier current fed by VT4. VT6 and VT7 are emitter follower output stages which pass the drive to both inputs of the differential amplifier in the control oscillator sub-unit via contacts of the function switch in the external position. The amplifier input and output waveforms are shown in Fig. 3.9.

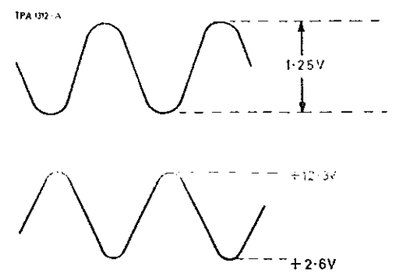


Fig. 3.9 Operation of external drive amplifier (ratio 10: 1)

3.9 X-DRIVE AMPLIFIER

(Circuit diagram, Fig. 7.2)

The X-drive amplifier receives a sweep input (1:1 or 10:1) from the differential amplifier, and converts this from a current drive to a voltage drive for use with an oscilloscope or recorder. The output is taken to a front panel socket via a forward-reverse changeover switch and a set level control.

The current drive is applied to the base of VT1, which gives a collector output of 15 V peak (see waveforms Fig. 3.10). Negative feedback from the collector to the base via R1, and emitter feedback via R4, establish constant gain conditions. The signal is fed to VT2 base and emitter (via R7 and R4-R5 respectively) to give overall stability. RV1 and RV2 are preset controls to set the level of VT1 and VT2 collectors with respect to earth potential.

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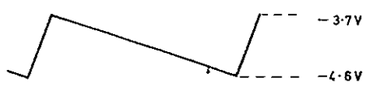

Input from differentiated amplifier at pin 1

Output from pin 8 (reverse)

Output from pin 9 (forward)

Fig. 3.10 Operation of X-drive amplifier (ratio 10:1)

3.10 MARKER ADDER

(Circuit diagram, Fig. 7.3)

The marker adder circuit enables the markers generated in the plug-in to be superimposed on the detected output from the equipment under test.

A high degree of isolation between the two incoming signals is provided by the 1 MΩ input impedance for the detected signal input using a field effect transistor VT2, which also gives good r.f. smoothing. The two signals are mixed on the collector of VT3, and a low impedance output is taken from the emitter of VT1 to the front panel combined output socket.

3.11 POWER SUPPLIES

(Circuit diagram, Fig. 7.4)

A single mains transformer serves the +24 V, -24 V and +110 V stabilized d.c. power supplies (see block diagram Fig. 3.11). The transformer has five secondaries, as follows:

Secondary 1: 30 V at 500 mA, +24 V supply
Secondary 2: 30 V at 500 mA, -24 V supply
Secondary 3: 129 V at 75 mA, +110 V supply
Secondary 4: 11.8 V at 15 mA, 16 V auxiliary supply
Secondary 5: 9 V at no load, mains lock signal

The first four supplies are rectified by silicon diode bridge rectifier circuits with capacitive filters before being applied to the three d.c. stabilizers. The +24 V stabilized supply is used as the reference for the -24 V and +110 V stabilizers.

For the +24 V stabilizer, a sample of the +24 V output is taken from the chain MR1, MR2 and R7 and applied to the differential emitter-coupled amplifier VT4 and VT5, any changes from the correct level being amplified and passed to a second differential amplifier VT2 and VT3. A change at the collector of VT3 then alters the base potential of the series regulator VT6 so as to restore the output to its correct level. The required output level is established by the setting of the preset control RV1. VT1 gives overload protection by starting to conduct when the voltage developed across R1 rises beyond a safe limit, thus disabling the control circuit and preventing damage to VT6.

The -24 V stabilizing circuit is identical, except that the reference potential for the overload protection circuit and differential amplifier is obtained from a separate winding on the mains transformer, through an associated rectifier circuit.

The 110 V stabilizer comprises a high gain d.c. amplifier which forms a feedback loop with an r.f. oscillator, the rectified r.f. output being used to control a series regulator transistor. Reference for the stabilizer is provided by the +24 V stabilized line. Basically a Hartley circuit, the oscillator output is taken from a transformer secondary, rectified and smoothed and applied between the emitter and base of the series regulator transistor. An increase in load current causes an initial drop in output voltage due to the secondary source impedance. This drop is detected by the balanced pair VT2 and VT3 and amplifier VT1 which produces an increased supply voltage to the oscillator, thereby raising its output level. This in turn is seen as an increase in its secondary voltage and hence its rectified output.

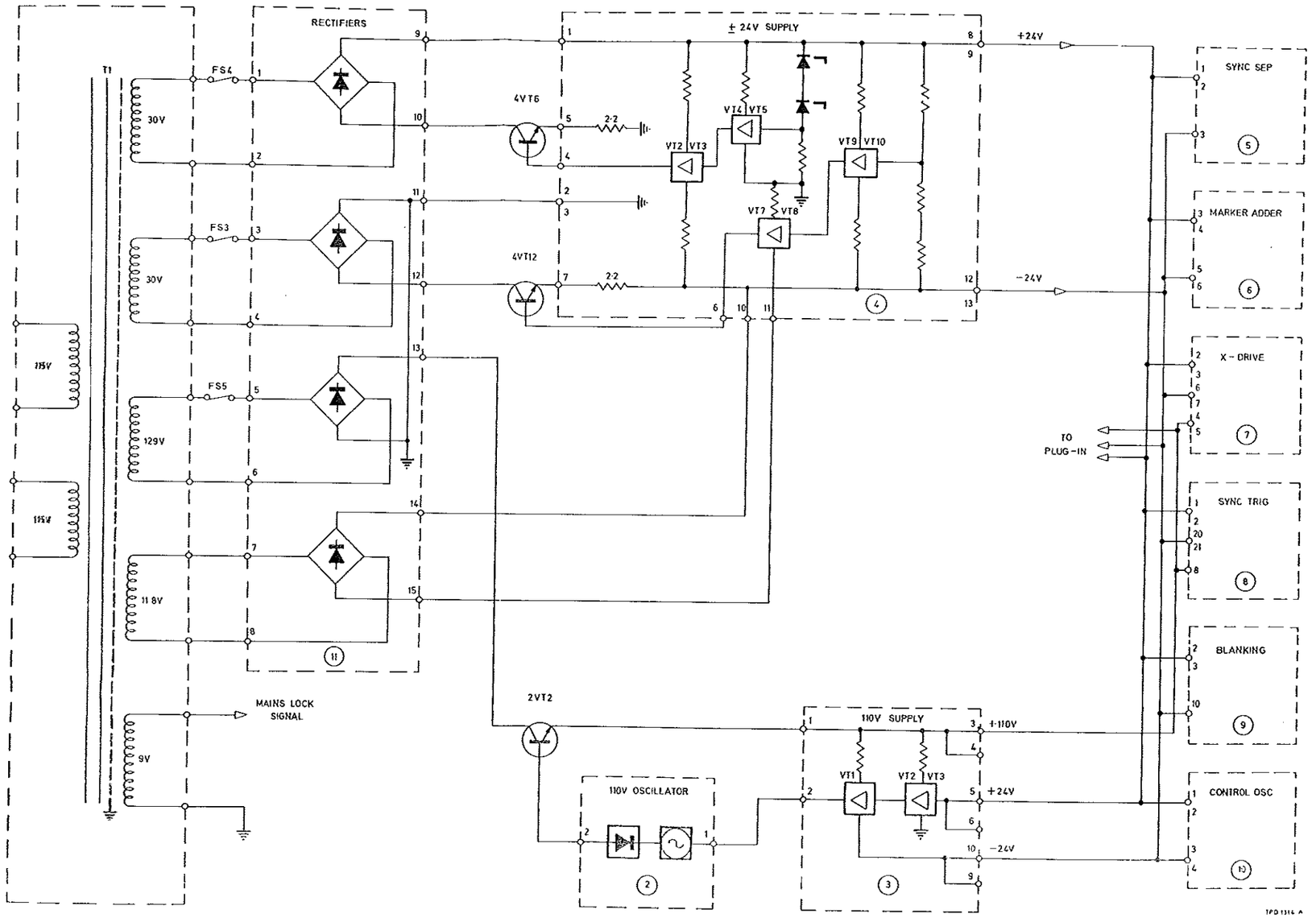

Fig. 3.11 Power supplies block diagram

Chapter 4

Maintenance

4.1 INTRODUCTION

This chapter contains information for keeping the equipment in good working order and for checking its performance.

4.2 TEST EQUIPMENT REQUIRED

This section provides a list of the test equipment that will be required to carry out the performance checks detailed in this chapter.

a) Dummy load, see Fig. 4.1.

b) Oscilloscope, such as M.I. TF 2201 or M.I. TF 2210 or Tektronix 547 with type W plug-in.

c) R C oscillator, such as M.I. TF 1101.

d) Resistor, 50 kΩ $\frac{1}{4}$ W.

e) Resistor, 1 kΩ $\frac{1}{4}$ W.

f) Mains transformer, variable.

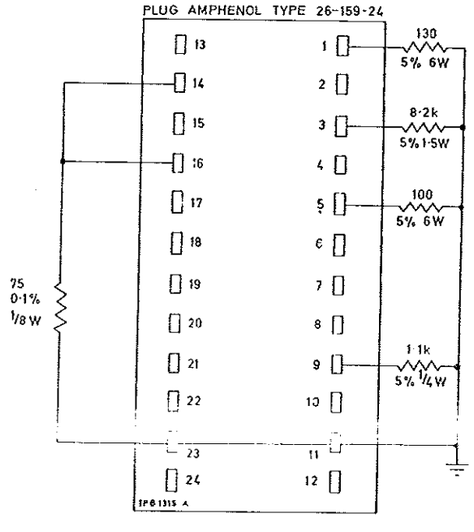

Fig. 4.1 Dummy load

4.3 INITIAL CONDITIONS

Before commencing the performance checks, construct the dummy load according to Fig. 4.1. Remove the plug-in oscillator from the main unit, and connect the dummy load to the 24-way socket on the main unit. The performance checks should not be carried out with the plug-in oscillator in position, because faulty performance in the plug-in can be reflected back into the main unit.

Set the front panel controls on the main unit to the following positions:

SUPPLY SWITCH OFF.

SWEEP FUNCTION switch at 10 - 100 Hz.

VARIABLE RATE fully clockwise.

PHASE SHIFT control fully counter-clockwise.

RATIO switch at 1:1.

SWEEP MODE switch at NORMAL.

BLANKING ON.

A. L. C. switch at INTERNAL.

MARKER switch OFF.

X-DRIVE LEVEL control fully counter-clockwise.

EXTERNAL DRIVE SET LEVEL control fully counter-clockwise.

X-DRIVE switch at FORWARD.

4.4 PERFORMANCE CHECKS

4.4.1 Internal sweep

Test equipment: a and b

(1) Connect the vertical input of the oscilloscope to the X-DRIVE OUTPUT socket, and switch the supply on.

(2) Set the X-DRIVE switch to suit the oscilloscope time base, and adjust the X-DRIVE LEVEL control so that the displayed waveform occupies the fully vertical displacement of the graticule.

(3) Set the SWEEP FUNCTION switch to 0.01 - 0.1 Hz, and the VARIABLE RATE control fully counter-clockwise. Check that the time taken for the spot to complete one cycle up and down the graticule is greater than 100 seconds.

(4) Set the VARIABLE RATE control fully clockwise, and check that the time taken for the spot to complete one cycle is less than 10 seconds.

(5) Set the SWEEP FUNCTION switch to 0.1 - 0.1 Hz and the VARIABLE RATE control fully counter-clockwise. Check that the time taken for the spot to complete one cycle is greater than 10 seconds.

(6) Set the VARIABLE RATE control fully clockwise and the oscilloscope time base to 500 ms/cm. Check that one cycle of the displayed waveform occurs in less than 1 second.

(7) Set the SWEEP FUNCTION switch to 1 - 10 Hz and the VARIABLE RATE control fully counter-clockwise. Check that the sweep time is greater than 1 second.

(8) Set the VARIABLE RATE control fully clockwise and check that the sweep time is less than 100 ms.

(9) Set the SWEEP FUNCTION switch to 10 - 100 Hz and the VARIABLE RATE control fully counter-clockwise. Check that the sweep time is more than 100 ms.

(10) Set the VARIABLE RATE control fully clockwise and check that the sweep time is less than 10 ms.

4.4.2 Mains lock and TV

Test equipment: a and b

(1) Set the oscilloscope to mains trigger with time base set at 1 ms/cm. Set the SWEEP FUNCTION switch to MAINS LOCK, and adjust the VARIABLE RATE control to give a waiting time (see Fig. 4.2) of 500 μs.

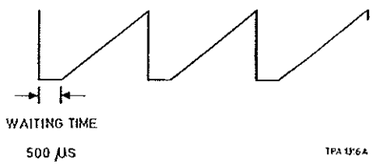

Fig. 4.2 Mains lock waiting time

(2) Set the oscilloscope time base to 5 ms/cm, and adjust the PHASE SHIFT control from fully clockwise to fully counter-clockwise. Check that this gives at least 270° of phase shift.

(3) To check the TV input, connect a composite TV signal to the EXTERNAL DRIVE socket, set the SWEEP FUNCTION switch to TV and repeat checks (1) and (2) above.

4.4.3 External and CW

Test equipment: a, b and c

(1) Set the oscilloscope to internal trigger, connect the a.f. signal generator to the EXTERNAL DRIVE socket, set the SWEEP FUNCTION switch to EXTERNAL, and set the r-c oscillator (maximum output 4.5 V p-p) to 20 Hz.

(2) Check that the waveform displayed on the oscilloscope is an undistorted replica of the input sine wave, capable of being adjusted to 30 V p-p by the EXTERNAL DRIVE SET LEVEL control. Repeat this check with the r-c oscillator set at 1 kHz, 5 kHz, 10 kHz and 20 kHz. Disconnect the oscillator.

(3) The c.w. mode only operates in conjunction with a sweep unit, and the check for it is covered in the handbook for the sweep unit.

4.4.4 Manual

Test equipment: a and b

(1) Set the oscilloscope time base to 5 ms/cm, and the SWEEP FUNCTION switch to MANUAL.

(2) A straight line trace will be displayed; check that the VARIABLE RATE control moves this line up and down the full displacement of the graticule.

4.4.5 One shot operation

Test equipment: a and b

(1) Set the SWEEP MODE switch to ONE SHOT, the SWEEP FUNCTION switch to 0.01 - 0.1 Hz, and the VARIABLE RATE control fully counter-clockwise.

(2) Wait for the trace to settle, then press the ONE SHOT switch and release it. Check that the trace rises and returns for one cycle only.

(3) Repeat with the VARIABLE RATE control fully clockwise.

(4) Repeat for the other three internal ranges of the SWEEP FUNCTION switch, with the VARIABLE RATE control fully counter-clockwise and fully clockwise. After the checks, return the SWEEP MODE switch to the NORMAL position.

4.4.6 Blanking and sweep ratio

Test equipment: a and b

(1) Transfer the oscilloscope to the BLANKING OUTPUT socket with the time base set to 2 ms/cm, set the SWEEP FUNCTION switch to 10 - 100 Hz, set the RATIO switch to 1:1, and adjust the VARIABLE RATE control fully clockwise.

(2) Check that the amplitude of the displayed waveform is greater than 22 V.

(3) Set the RATIO switch to 1:1 or 10:1 according to the requirements of the oscilloscope in use, adjust the oscilloscope to display one pulse of the waveform and check the pulse rise and decay time. The rise time should be less than 4 μs over the 10-90% portion of the waveform, and the decay time less than 20 μs over this portion.

(4) Adjust the oscilloscope to check the sweep ratios. On 1:1 the ratio should be between 0.9:1 and 1.1:1, and on 10:1 it should be between 9:1 and 13:1.

4.4.7 X-drive

Test equipment: a, b, d and e

(1) Connect the oscilloscope vertical input to the X-DRIVE OUTPUT socket, via a T-junction adaptor. Set the RATIO switch at 1:1, the SWEEP FUNCTION switch at 10 - 100 Hz, and the VARIABLE RATE and X-DRIVE LEVEL controls fully clockwise.

(2) Check that the displayed waveform is symmetrical about earth, and has an amplitude of at least 30 V with a 50 kΩ load resistor across the T-junction, and at least 2 V with a 1 kΩ load resistor across the T-junction.

4.4.8 Amplitude of sweep drive

Test equipment: a and b

(1) Connect the oscilloscope across the 75 Ω resistor on the dummy load (pins 23 and 14-16).

(2) Check that the p-p amplitude of the displayed waveform is 308 mV. This is an approximate test, because the accuracy of the sweep waveform level is outside the limits of an oscilloscope. Testing to full specification entails taking the instrument out of its case, and if this is necessary refer to the procedure given in Chap. 5.

4.4.9 Power supply stabilizers

Test equipment: a, b and f

(1) Connect the Variac, set to 115 V or 230 V output according to the range in use, between the a.c. supply and the a.c. input socket. Connect the oscilloscope to the X-DRIVE OUTPUT, and display the internal 100 Hz sweep waveform at a level of 30 V.

(2) Vary the a.c. mains input by ±10% on the Variac, and check that there is no perceptible variation in the level of the displayed waveform.