Instrument Serial No. 766633

TELEQUIPMENT®

FOR SERVICING AND SPARES ENQUIRIES
SEE THE INFORMATION AT START OF SECTION 5.

TELEQUIPMENT is a registered trade mark of TEKTRONIX U.K. LTD.

TEKTRONIX U.K. LTD
313 Chase Road,
Southgate,
London N14 6JJ
ENGLAND.

Telephone:
01-882 6100
Telex: 262004
Cables:
TELEQUIPT LONDON N14

TEKTRONIX INC.,
P.O. Box 500,
Beaverton,
Oregon (97005),
U.S.A.

Telephone:
(503) 644-0161
Telex: 36 0485
Cables:
TEKTRONIX

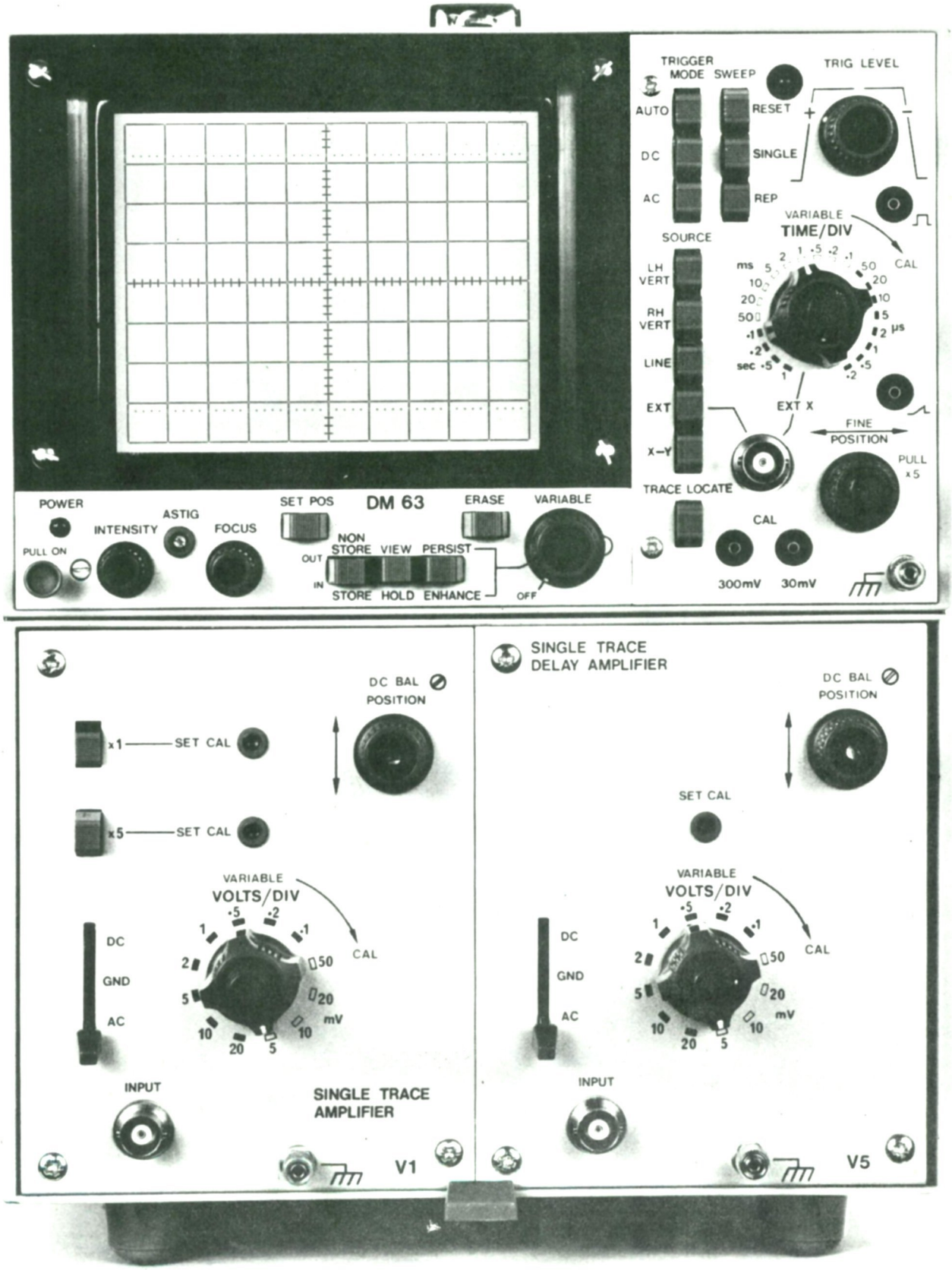
MAIN FRAME UNIT
TYPE DM63

INSTRUCTION MANUAL

Issue 7
August 1979
© Copyright (1975) by
Tektronix U.K. Ltd

070-1736-04

Printed in England by D & H NEWMAN LTD, 29 Harcourt Street, London W1 01-262 6356


TRIGGER
MODE SWEEP
TRIG LEVEL
AUTO
DC
AC
RESET
SINGLE
REP
SOURCE
LH VERT
RH VERT
LINE
EXT
X–Y
VARIABLE
TIME/DIV
CAL
EXT X
FINE
POSITION
PULL
x5
TRACE LOCATE
CAL
300mV
30mV
POWER
PULL ON
INTENSITY
ASTIG
FOCUS
SET POS
DM 63
ERASE
VARIABLE
NON
STORE VIEW PERSIST
OUT
IN
STORE HOLD ENHANCE
OFF
x1
SET CAL
x5
SET CAL
DC BAL
POSITION
VARIABLE
VOLTS/DIV
CAL
DC
GND
AC
mV
INPUT
SINGLE TRACE
AMPLIFIER
V1
SINGLE TRACE
DELAY AMPLIFIER
DC BAL
POSITION
SET CAL
VARIABLE
VOLTS/DIV
CAL
DC
GND
AC
mV
INPUT
V5

INTRODUCTION

The DM63, with two vertical plug-ins, is an all solid state direct-view storage oscilloscope with a single sweep horizontal system. An 8 x 10 divs, split beam, CRT provides a bright and clear dual beam display. The features of the vertical system depend on the type of plug-in used and are given in the appropriate manuals.

The manual covers the mainframe, which houses the following:

Calibrator
Storage Circuit
Sweep Generator and Horizontal Amplifier
Power Supplies
Un-blanking Amplifier
Vertical Amplifier, Output Stage

The design of this instrument is subject to continuous development and improvement, consequently this instrument may incorporate minor changes in detail from the information contained herein, which would, in the main, affect the Components List and Circuit Diagrams. The reader should pay particular attention to the notes at the beginning of Chapter 5.

NOTICE TO OWNER

To obviate the risk of damage during transit and facilitate packaging, the owner is requested to remove the power supply plug and NOT send the following items unless they are suspect, should this instrument be returned to TELEQUIPMENT for servicing:—

Manual
Probes
Power Supply Lead
Plug Assemblies

CONTENTS

CHAPTER		Page
1	SPECIFICATION	
	Cathode Ray Tube (CRT)	1/2
	General	
	Cooling	1/2
	Power Requirements	1/2
	Size	1/2
	Temperature Limits, ambient ...	1/2
	Weight	1/2
	Horizontal Amplifier	
	Ext X Input	1/1
	Sweep	1/1
	Sweep Operating Mode	1/1
	Trigger	1/1
	Outputs, Front Panel	
	Calibrator	1/2
	Gate Out	1/2
	Sweep Out	1/2
	Vertical Amplifier	1/1
	Z Mod	1/2
2	OPERATING INSTRUCTIONS	
	Function of Controls and Connectors	
	Connectors	2/1
	CRT	2/1
	Sweep	2/1
	Trigger	2/1
	Vertical	2/1
	First Time Operation	
	Checks	2/2
	Operation	2/2
	Storage Operation	2/2
3	CIRCUIT DESCRIPTION	
	Calibrator	3/2
	E.H.T.	3/5
	External X	3/2
	Horizontal Amplifier	3/2
	Power Supply	3/4
	Storage Circuit	3/2
	Sweep Generator	3/2
	Trace Locate	3/2
	Trigger Amplifier	
	Internal	3/1
	External	3/2
	Unblanking Amplifier	3/5
	Vertical Amplifier	3/1
	X–Y Mode	3/2
	Table 1 I.C.1. Sweep Control I.C. ...	3/6
	Table 2 I.C.2. Sweep Generator ...	3/6
	Table 3 Relationship of Events in Auto Mode	3/7
	Plate 1 Storage Tube	3/3
	Plate 2 Secondary Emission Characteristic	3/3

CHAPTER		Page
4	MAINTENANCE AND CALIBRATION	
	Calibration Procedure	
	Calibrator Adjustment	4/3
	E.H.T. and Display Adjustments ...	4/1
	Power Supply	4/1
	Storage Circuit PC176	4/3
	Time Base PC158	4/2
	Vertical Amplifier PC175 (Final Stage)	4/2
	Vertical Plug-in	4/2
	Introduction	4/1
	Mechanical	
	Access to Interior	4/1
	CRT Fitting	4/1
	CRT Removal	4/1
5	COMPONENTS LIST	
	Assemblies	5/9
	Electrical	5/2
	Mechanical	5/11
6	CIRCUIT DIAGRAMS AND PC BOARDS	Figure
	Mother Board	1
	Trigger Amplifier and Sweep Generator ...	2
	Time/Div Switch	3
	X-Amplifier and Calibrator	4
	Quintupler EHT, Bright-up & CRT ...	5
	Power Supply	6
	Storage Circuit	7
	Waveforms Derived from Storage CCT ...	8
	PC BOARDS	
	PC158	9
	PC161 and PC163	10
	PC162	11
	PC175	12
	PC176	13

CHAPTER 1
SPECIFICATIONS

1.0 VERTICAL AMPLIFIER

provided by two of the following:—

V1	Single trace
V3	High gain differential
V4	Dual trace
V5	Single trace with signal delay

Reference should be made to the appropriate manual for details.

X – Y Mode	
Operation	Two identical plug-ins
'Y'	L.H. plug-in
'X'	R.H. plug-in
Phase response	$< 1^{\circ}$ up to 100 kHz

2.0 HORIZONTAL AMPLIFIER

2.1 SWEEP OPERATING MODE

Repetitive
Single shot

2.2 TRIGGER

Mode	
Auto	Bright line 10 Hz – 15 MHz
DC	DC – 15 MHz
AC	10 Hz – 15 MHz
Sensitivity	
Internal	< 0.3 division at 1 MHz < 0.7 division at 15 MHz
External	100 mV at 1 MHz 150 mV at 15 MHz
Polarity	
+	From positive signal edge } By Rotation of
–	From negative signal edge } LEVEL CONTROL
Source	
Internal	
L.H. Vert	From L.H. Amplifier
R.H. Vert	From R.H. Amplifier
External	From external source, DC or AC coupled
Line	From supply frequency

2.3 SWEEP

Range	
X1	1s – 200 ns/div
X5	0.2 s – 40 ns/div max.
Variable (time) range	> 2.5 to 1
Accuracy	
X1	± 3%
X5	± 5%

2.4 EXT X input

Sensitivity	
X1	1 V/div ± 25%
X5	0.2 V/div ± 25%
Bandwidth	> 1 MHz, a.c. or d.c. coupled depending on trigger mode selection

3.0 CATHODE RAY TUBE (CRT)

Split beam storage CRT with internal graticule

Display area: 8 x 10 div (each div 0.9 cm approx)

Phosphor standard: P31

Overall accelerating potential: 8 kV approx.

Operating modes

Min. writing speed	Approx. storage time	
	Store	Hold
Stored condition: 0.05 div/μs	4 minutes	50 minutes
Variable persistence	0.2s to 1 minute coverage	
Max. enhancement: 1.0 div/μs	0.5 minute	5 minutes

4.0 FRONT PANEL OUTPUTS

4.1 CALIBRATOR

Amplitude Pk to Pk: 30 mV, 300 mV or 3 mA at 1 kHz when shorted together

Accuracy

- Voltage: ± 1%
- Frequency: ± 20%
- Current: ± 1%

4.2 GATE OUT

Positive pulse at sweep width

Impedance: 3 kΩ approx.

4.3 SWEEP OUT

Amplitude: 10 V

Impedance: 5 kΩ approx.

5.0 Z MOD

Full blanking sensitivity: + 20 V approx.

Input impedance: 10 kΩ and 20 pF approx.

Frequency: DC – 3 MHz approx.

6.0 GENERAL

6.1 POWER REQUIREMENTS

Voltage: 100 – 125 V in 5 V steps; 200 – 250 V in 10 V steps

Frequency: 48 – 400 Hz

Consumption: 80VA to 95VA depending on the vertical plug-in configurations

6.2 SIZE

Height: 290 mm

Width: 215 mm

Depth: 520 mm

6.3 WEIGHT

Complete: 14 kg

Less plug-ins: 12.25 kg

6.4 COOLING

Convection

6.5 TEMPERATURE LIMITS, ambient

Operating: + 5 to 40°C approx.

Non-operating: –25 to 70°C approx.

CHAPTER 2
OPERATING INSTRUCTIONS

2.1 FUNCTION OF CONTROLS AND CONNECTORS

These are situated on the front panel except where otherwise specified. For those controls not covered below, reference should be made to Chapter 2 of the manual for "V" plug-in.

2.1.1 CRT

POWER

PULL ON — power supply ON–OFF switch.

INTENSITY — varies the intensity of the display.

ASTIG — a preset used in conjunction with FOCUS for achieving the best overall definition.

FOCUS — controls the definition of the display.

TRACE LOCATE — when pressed brings the trace onto the screen and free runs the timebase.

NON STORE — permits conventional operation of the CRT. In this mode, the only CRT controls affecting display are INTENSITY, ASTIG and FOCUS.

STORE — when pushed in, the written trace can be stored, all controls being operative.

VIEW — in conjunction with STORE mode, provides storage time up to 5 minutes.

HOLD — the storage time is increased and the information is retained at reduced intensity. All controls in this setting are inoperative unless switched to NON STORE.

PERSIST — in association with the VARIABLE alters the persistence of the CRT. In this setting, all CRT controls function but INTENSITY must be adjusted for the best display.

ENHANCE — when pushed in, and with the clockwise rotation of the VARIABLE, the writing capability of the CRT is improved but the time for which the trace could be stored in the STORE and HOLD modes is reduced.

ERASE — when depressed, clears the stored trace. This control is inoperative in the HOLD mode.

SET POS — while depressed, enables the trace start point to be set using POSITION control so that more than one trace can be stored without overlapping.

TRACE ROTATION — preset situated on the rear panel; used to align the trace in the horizontal axis.

2.1.2 SWEEP

TIME/DIV — controls the speed of the sweep. The sweep rates indicated are only valid if VARIABLE is fully clockwise and X5 is not selected. If X5 is selected and VARIABLE at CAL, the calibrations should be divided by 5 to ascertain the sweep speed.

VARIABLE — provides continuous coverage of sweep speeds in between those selected by TIME/DIV switch.

POSITION — varies the position of the trace in the horizontal axis.

FINE — is a fine horizontal position control.

X5 — when pulled magnifies trace 5 times in the horizontal axis; sweep calibrations must be divided by 5.

REP — pressed, selects repetitive triggering.

SINGLE — assists in viewing or photographing a non-recurrent signal. Upon application of a trigger pulse a single sweep only takes place. Sweep circuit is then disabled until the RESET button is pressed.

X – Y — connects R.H. VERT to 'X' and L.H. VERT to 'Y'.

2.1.3 TRIGGER

TRIG LEVEL — selects the point on the waveform at which the sweep starts.

TRIG MODE
AUTO — provides a horizontal trace in the absence of signal by permitting the timebase to free run until signal is applied. LEVEL range is reduced to approximately 1 division.

AC or DC — relates to the coupling of the trigger circuit. For very low input frequency signals, DC should be selected.

POLARITY
± — selects triggering from the positive or negative-going slope of a waveform.

L.H. VERT)
R.H. VERT) — selects the respective vertical trigger signal.

LINE — provides trigger signal at the power supply frequency.

EXT — enables the sweep to be triggered from an external source.

2.1.4 VERTICAL

refer to respective 'V' Manuals.

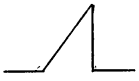
2.1.5 CONNECTORS

INPUT
EXT TRIG
EXT X — share a common input BNC socket located on the front panel. Signals are then applied to the required circuit by selection of either the EXT TRIG button or EXT X on T/B switch.

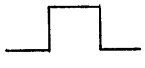
Z MOD — input socket situated on the rear panel is DC coupled via Z mod amp. to the CRT grid. A negative-going signal is necessary to intensify the trace while a positive-going signal will blank it.

OUTPUTS
CAL — output sockets provide a 1 kHz waveform for checking the calibrations of the vertical channels and setting up probes. The two outputs provide 300 mV and 30 mV 1 kHz (approx.) squarewave, when linked a 3 mA peak to peak current passes.

SAWTOOTH — provides a positive-going ramp waveform when the sweep is running. A recurring sawtooth is produced when AUTO is selected. The resistance of an applied load should exceed 10 kΩ.



GATE OUT — provides a fast-edged positive-going rectangular pulse lasting for the duration of the sweep. The resistance of an applied load should exceed 4.7 kΩ.



2.2 FIRST TIME OPERATION

2.2.1 CHECKS

1 Correct plug-ins are plugged in.

2 Rear voltage-selector plug is indicating the local supply voltage or nearest value.

3 Fuse fitted is a 2 A for 100–125 V operation or 1A for 220–250 V.

NOTE: The 3-core supply lead is colour coded as follows:

	Line	Neutral	Earth (Chassis)
or	Brown Black	Blue White	Green/Yellow Green

4 The power supply cord is secured to the instrument with the nuts and screws provided.

2.2.2 OPERATION

Set controls as follows:

1 CRT

INTENSITY	Central
FOCUS	Central
ASTIG	As set
Mode	NON STORE
VIEW-HOLD	VIEW
PERSIST-ENHANCE	PERSIST
VARIABLE	OFF

TIME BASE

POSITION	Central and depressed
SWEEP	REP
TIME/DIV	5 ms
VARIABLE	Fully clockwise
TRIG MODE	AUTO
POLARITY	Rotate to + 
SOURCE	INT

VERTICAL As given in appropriate 'V' manuals.

2 Plug into the supply; pull POWER ON.

3 Allow a few minutes for warm up then press TRACE LOCATE and adjust POSITION controls for a display.

4 Adjust TRACE ROTATION, if necessary, to align trace horizontally.

5 Connect the CAL 30 mV to one INPUT via co-axial lead.

6 Set DC-GND-AC to DC; adjust INTENSITY and FOCUS as required.

7 Check amplitude is 6 divisions.

2.2.3 STORAGE OPERATION

1 Repeat 1 through 7 Para. 2.2.2.

2 Release VIEW-HOLD and PERSIST-ENHANCE buttons to select VIEW and PERSIST. Select SINGLE sweep and STORE mode. Depress ERASE and then RESET button and check that the trace is stored.

NOTE: Adjust INTENSITY if required.

3 Depress VIEW-HOLD button to select HOLD and notice the change in degree of brightness.

4 Select VIEW and set TIME/DIV to 5 µs. Depress ERASE button. Turn INTENSITY fully clockwise. Select ENHANCE, depress RESET and turn VARIABLE clockwise till the trace is visible. Depress ERASE and check that the trace can be restored with the RESET button.

5 Disconnect CAL input. Set VOLTS/DIV to 5 mV and TIME/DIV to 0.1 s. Display sinewave of amplitude 20 mV and Frequency 20 Hz. Select PERSIST and turn VARIABLE to select the required level of persistence.

CHAPTER 3
CIRCUIT DESCRIPTION

3.1 VERTICAL AMPLIFIER

3.1.1 As both channels of the main amplifier are similar in design, only the left hand (LH) channel will be described in detail, the differences in the right hand (RH) channel will be described separately.

3.1.2 The interface, reference Figure 1, with the vertical plug-ins is via two 16 way sockets mounted on the mother board PC175. The sockets are designated SK802 (LH) channel and SK803 (RH) channel. The signal is carried via pins 5 and 13 to the shunt feedback amplifier TR801, TR802. To ensure that the main amplifier always has the same sensitivity, the gain is set by the series elements, R809, R812 and the shunt elements R805 R806. The total gain adjustment is approximately 18%.

3.1.3 The output of the shunt feedback amplifier drives directly into the output stage amplifier TR812, TR813. The collectors are connected to the CRT 'Y' plates. Adjustment of R869 sets the mean plate potential to 50 V. Emitter resistors, R845 R846, are normally earthed in the timebase via SK804/13. H.F. peaking is achieved by the network between the emitters formed by R849, C812.

3.1.4 TR805, TR806 are driven from the output of the shunt feedback stage and form the trigger amplifier. The output from TR805 collector is controlled via the switching diode D805, by the potential existing on SK802 pin 6. D803 is the path by which the trigger signal is fed to the timebase via SK804 pin 11. A second source of trigger signal is also applied to SK804 pin 11, and is derived from SK802 pin 7. If a V1 plug-in is plugged into SK802 the only trigger source available is from TR805, therefore a +24 V control voltage is applied to SK802/6 reverse biasing D805, the signal is therefore allowed to pass via D803 to the timebase socket SK804/11. If, however, the V1 plug-in is exchanged for a V5 plug-in, (this plug-in contains the delay cable), a pre-delay line trigger signal is required via SK802 pin 7. Therefore in this case SK802 pin 6 is connected to potential of −24 V, thereby forward biasing D805 and reverse biasing D803, thus switching off the source of trigger signal from TR805 collector.

3.1.5 SK804/13 and SK804/14 are joined together inside the timebase, via switch S4e/5, S4e/4 (X−Y switch) and then to earth via S3 (TRACE LOCATE). When the TRACE LOCATE button is pressed, the total current of both output stages is limited by R843 thus restricting the available collector swing of both output stages to within the confines of the tube, regardless of the POSITION. The POSITION control may then be set to centre the trace.

3.1.6 When the DM63 is switched to X − Y mode, the LH vertical plug-in is used in the 'Y' axis but the RH plug-in is now used to drive the 'X' axis. However, as the DM63 uses a split beam tube it becomes necessary to shift the RH channel beam off the screen. This is achieved in the following manner. When the X − Y switch S4 is pressed, the emitter resistors R847, R848 become disconnected from earth via SK804/14, hence the collectors of TR814 and TR815 rise to HT. However at the same time, S4 switches SK804/12 to earth, D811 (normally reverse biased by R868) becomes forward biased and the collector voltage of TR815 is lowered due to the potential divider formed by R865, collector load, and R861. Sufficient voltage differential now exists between the 'Y' plates to position the trace off the screen.

3.1.7 Whilst in X − Y mode, the timebase uses the RH trigger signal to drive the 'X' axis. As already explained, it is possible to obtain a trigger signal from two sources, i.e. direct from SK803/7 or from the collector of TR807 via D804, depending upon the type of 'V' plug-in used. Therefore to ensure the same amplitude of signal regardless of 'V' plug-in used, it is very desirable to use one trigger source only i.e. that from TR807. This is achieved in the following manner. The trigger source from TR807 is connected permanently to SK804/10. SK803/7 is connected to SK804/10 via diode D809. SK803/6, the trigger amplifier controlling voltage, is connected to diode D808. TR809 and TR811 form a bistable circuit. Now consider a V1 plug-in plugged into the RH channel, and the oscilloscope working normally, SK803/6 is at +24 V, therefore diode D808 is conducting, and TR811 is 'on' its collector is therefore at approximately −24 V, diode D807 is therefore conducting, D809 being reverse biased. No signal is therefore able to pass D809 to SK804/10. However TR809 is 'off', its collector being at approximately +24 V reverse biases D806, allowing D804 to pass the signal onto SK804/10. Now switching to X − Y mode, the junction of R847 and R848 rises in potential to approximately +17 V and thereby aiding TR811 to stay 'on'. The signal source remains as before i.e. via D804. However, consider a V5 plug-in in the RH channel and working normally. SK803/6 is now at −24 V, reverse biasing diode D808. SK804/14 is at earth therefore TR811 is 'off' its collector being at approx. +24 V reverse biasing D807. However, TR809 is now 'on' its collector being at approx. −24 V forward biasing D806 and switching off this signal source. But SK803/7 can now feed its signal via D809 to SK804/10. Now switching to X − Y, R847 R848 junction rises to +17 V and this is sufficient to turn TR811 'on' and once again D807 is forward biased, shunting the signal from SK803/7 to −24 V and also TR809 is once again 'off', reverse biasing D806 and permitting the signal to pass on to SK804/10 via D804. So, whichever amplifier is in situ, when X − Y is pressed the signal source is via TR807.

3.1.8 The RH channel trigger amplifier contains in its emitter circuit a DC TRIG BAL potentiometer. It is used to ensure that the start of a dc triggered trace is the same for RH channel as for LH channel.

3.2 TRIGGER AMPLIFIER

3.2.1 INTERNAL TRIGGER

Part of the signal to be displayed is "picked-off' from the appropriate vertical amplifier and fed via the 16 way socket, SK804, to diode D11 or D12, reference Figure 2. Selecting S4a or S4b causes the correct diode to conduct and passes the trigger signal on to the trigger pre-amplifier stage TR2. Switches S1b and S1c select DC and AC TRIG, respectively, while S4c allows triggering at supply frequency. Level and polarity controls are achieved with a centre-tapped dual ganged potentiometer, R38 and R61. Operating the pot between its fully anti-clockwise end and the centre tap selects the positive slope region of the displayed waveform while the range between the centre tap and the clockwise end selects the negative slope. The AUTO mode is selected with S1a, part of whose action is to reduce the triggerable range of the display to within 1 division on the screen.

The output of the trigger pre-amplifier TR2 is DC coupled via current limiting circuitry and a frequency compensation network, which improves the H.F. response at 5 MHz, to provide an analogue signal at pin 4 of I.C.1 the Sweep Control I.C. TR7 functions as a slope selector switch converting the positive or negative voltage at the wiper of R61 into corresponding logic levels for application to pin 5 of I.C.1.

3.2.2 EXTERNAL TRIGGER

The signal from an external triggering source is connected to the BNC socket on the timebase unit front panel. This is then coupled via emitter follower, TR1, to the base of TR2 through diodes D3, D7, which are turned on when S4d is selected.

When DC Trig Mode switch is selected the trigger signal is DC coupled all the way to the base of TR2 as both C1 and C11 are by-passed.

The circuit has an input impedance of approximately 100 k and is protected from voltage overloads by C2, R4.

3.3 SWEEP GENERATOR

3.3.1 The sweep generator, reference Figure 2, is basically a very high gain Miller integrator and a voltage comparator contained within a 10 pin integrated circuit in a T05 package, I.C.2. Interlinked with this unit is the "control" integrated circuit, I.C.1, in a 16 pin D.I.L. package.

The "control" I.C. is driven with positive logic, the convention used being, positive = logic '1', ground = logic '0'.

The operation of the two interlinked integrated circuits is best understood by referring to Tables 1, 2 and 3.

3.3.2 The 10 V sawtooth output produced at pin 8 of I.C.2 is converted into a current via R74 and fed to the base of TR101 in the X amplifier. Trimmer C22 in parallel with R74 is a sweep linearity control, while trimmer C19 is an adjustment for setting the timing on the fastest settings of the Time/Div switch. A measure of variable Hold-off is incorporated, when the trig level control is operated, by feeding back a portion of the volts via R37 to pin 11 of I.C.1 TR4 supplies a regulated +5 V to supply I.C.1.

3.4 HORIZONTAL AMPLIFIER

The input to the horizontal amplifier, reference Figure 4 is at the base of TR101 where the sweep is mixed with fine and coarse shift levels. The junction of R12/C5 and C7/R25, where the signal currents from External X and X – Y respectively are taken, is also connected to the base of TR101. The differential output from the collectors of TR102, TR103, drives the 'X' plates of the C.R.T. The amplifier incorporates a catching network D101/R104, to prevent TR102 from saturating. The X5 gain switch is incorporated in the emitters of the output pair.

R110, across the collectors of TR102 and TR103 is fitted for the DM63, storage version. This effectively reduces the gain of the stage by approximately 10% as the storage C.R.T. is that much more sensitive.

3.5 EXTERNAL X

When switched to this mode, (with the Time/Div switch) all functions of the timebase unit are overridden except the X – Y facility and Trace Locate button. The external driving voltage is applied to the BNC socket on the T.B. unit front panel and after passing through emitter follower TR1 passes to the horizontal amplifier via D1 and D4 reference Figure 2.

'Bright-up' is achieved by holding pin 15 of I.C.1 at about + 0.8V when R14 is connected to the –24 V line. At the same time pin 10 of I.C.1 rises to logic '1' to "lockout" the sweep.

3.6 X–Y MODE

In this mode all functions of the timebase unit are overridden except Trace Locate. Its function is such that a calibrated 'Y' co-ordinate (in the vertical direction) is available using the LH channel of the oscilloscope and also a calibrated 'X' co-ordinate (in the horizontal direction) via the RH channel. The 'Y' signal passes through the LH plug-in via the vertical amplifier on the mother board to the 'Y' plates of the CRT. The 'X' signal passes through the RH plug-in via SK804 on the mother board to D12 in the timebase unit. When S4e is selected, D12 conducts and the 'X' signal is passed to the base of TR101 in the horizontal amplifier via R29/R25/C7. S4e also disables the coarse shift control and unbalances the RH channel output amplifier. Bright-up is accomplished by taking pin 15 of I.C.1 to logic '1' when R6 is connected to the –24 V line. Pin 10 of I.C.1 also rises to logic '1' and the sweep is locked out.

3.7 TRACE LOCATE

When S3 is depressed and held, the currents of the horizontal amplifier and both vertical output amplifiers are reduced by about 50% restricting the display to within the screen area of the CRT. Also pin 2 of I.C.1 rises to logic '1' enabling the timebase to "free run". Trace Locate functions for all modes of operation of the oscilloscope.

3.8 CALIBRATOR

This (reference Figure 4) is a simple multivibrator running at about 1 kHz. Accuracy depends on resistors R124, R125, R128 and the –24 V line. Potentiometer R127 takes up the tolerance of R128. When SK101 and SK102 are shorted, 3 mA passes through the short circuit.

3.9 STORAGE CIRCUIT – Fig.7

3.9.1 The storage circuit is mounted on a printed circuit board, PC176, and situated underneath the CRT. All connections to it are achieved via a connector situated at the rear of PC176.

3.9.2 PRINCIPLES OF STORAGE OPERATION

The essential components of a typical storage tube are shown in Plate 1. The writing beam is the same as the electron beam of a conventional cathode ray tube, but in addition to exciting the screen phosphor directly, it deposits a charge pattern on the storage surface. Low velocity flood beam electrons continuously approach the entire surface area of the storage mesh but are transmitted only where a charge has been deposited by the writing beam. Flood electrons which are transmitted are then accelerated by the screen voltage, and produce a visible, continuous image corresponding to the trace of the writing beam.

3.9.3 THE STORAGE MESH

The storage tube relies for its operation on the characteristics of the storage mesh, particularly the high leakage resistance and secondary emission characteristics of the storage surface. The backing electrode is a fine metal mesh. On one side of this mesh, facing the electron guns, is a thin layer of a high quality dielectric material. The resistivity of this dielectric is very high, so that adjacent positive and negative charges on the storage surface are effectively isolated.

The storage mesh behaves as a control grid to the flood beam. The maximum brightness of any area on the screen depends on the screen and flood gun voltages but intermediate brightness values result from modulation of the flood beam by local storage

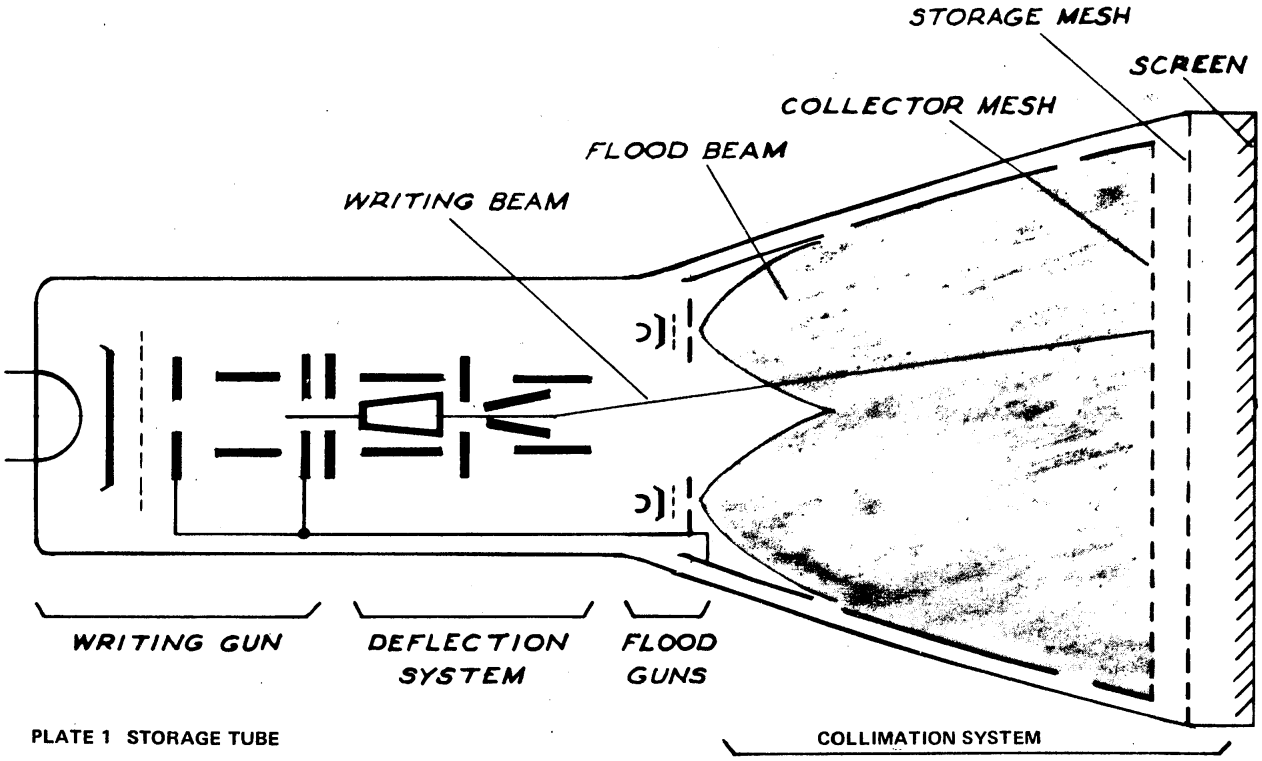


PLATE 1 STORAGE TUBE

surface potentials. Electrons which land with energies between the first and second cross-over potentials as shown in Plate 2 result in the emission of secondary electrons in greater numbers than those arriving. The secondary electrons are attracted to the collector mesh, leaving a net positive charge on the storage surface. Electrons landing with energies below the first cross-over potential (i.e. the flood beam) generate less secondary electrons and produce a net negative charge.

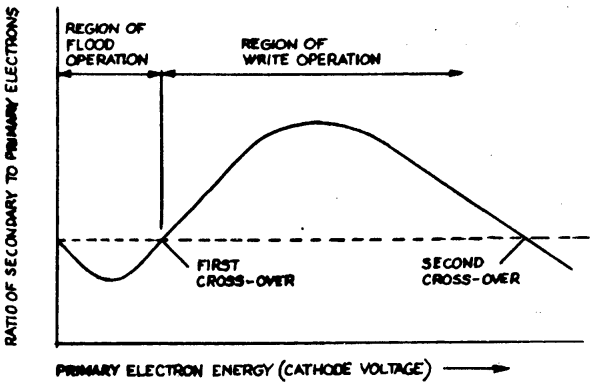


PLATE 2 SECONDARY EMISSION CHARACTERISTIC

During operation, the potential on any part of the storage surface is determined by the following four factors.

a) **Flood beam charging**
An area which becomes positive with respect to the flood gun cathode will attract flood beam electrons; provided the initial positive voltage is below the first cross-over potential the flood beam will charge it negatively, back to zero (cathode potential).

b) **Writing beam operation**
The cathode of the writing gun is typically 1350 V negative, so that an area scanned by the writing beam is bombarded by electrons with an energy above the first cross-over potential and driven positive. The amount of positive charge deposited depends on the current density of the writing beam and the speed with which it scans the storage surface (writing speed). The charge increments from successive low-current scans of the same point are integrated until the surface potential is limited by flood beam charging.

c) **Backing electrode voltage**
The storage surface, dielectric layer and backing electrode form a capacitance, so that changes in the backing electrode voltage are capacitively coupled to the whole of the storage surface. The steady-state operating voltage of the backing electrode is 0.3 Volts.

d) **Positive ion charging**
Since the storage mesh is negative with respect to its surroundings, it will attract positive ions produced by collision of electrons with residual gas molecules within the tube. Only those ions produced between the collector mesh and the screen can reach the storage surface, the collector mesh repelling ions formed in the gun end of the tube.

This positive ion current is present whenever the electron beams are operating and tends to drive the whole storage surface slowly positive.

When studying the action of the storage mesh, it is important to remember that the ion and electron currents described above are not landing on a conducting electrode, as in most types of electron tube, but on an insulator surface where the local potential depends on the relative magnitudes and energies of the currents landing. The backing electrode, in addition to providing structural support for the dielectric layer, is used to shift the range of storage surface potential by capacitive coupling.

3.9.4 BACKING ELECTRODE DC

For non store operation, the backing electrode (BE) of the CRT is held at −50 V. This is achieved via CON13 and S1004. For store operation BE potential is retained at approximately 0.3 Volts. TR1012 and TR1014 form a summing amplifier.

3.9.5 ERASE SEQUENCE

To erase the stored information from the CRT a pulse of shape and duration shown in Fig. 8—F is required at the BE. This erase pulse is made up from the following time periods.

a) For a period of approximately 100 ms the potential of the backing electrode is raised from its initial value to 105 volts.

then

b) For a period of approximately 200 ms the backing electrode is returned to its original value.

then

c) For a period of approximately 300 ms the backing electrode is raised from its initial value to a maximum of 12 volts.

Condition (a) is provided by the 100 ms monostable TR1001 and TR1002, whose time constant is controlled by C1003 and R1003. TR1001 is normally on and TR1002 is off. At initiation of the erase sequence S1001 is pressed, this allows C1001 to charge up. Release of S1001 shorts C1001 and provides a -ve going pulse at TR1001 base. Usual monostable action takes place and provides the pulse shown in Fig. 8—A, at the collector of TR1002. This pulse is fed to the summing amplifier, TR1012, TR1014, whose gain is determined by the feedback resistor R1038 and the series summing resistor, in this case being R1025. Hence the input (—24 V) to the summing amplifier is amplified by a factor of 5.5 giving approximately 138 V inverted output. As the HT line is only +105 V, this provides the upper limit of the pulse amplitude.

Condition (b) is provided by TR1003 and its associated timing elements C1004 and R1009, these produce the 200 ms time period. At rest TR1003 is normally on hence its base sits at approximately —22.8 volts. C1004 is therefore discharged. At the initiation of erase sequence, TR1001 turns off, its collector rising to earth, C1004 is therefore charged up to approximately 24 volts. At the termination of the 100 ms period, TR1001 turns on again and its collector is pulled down to —23 volts. The base of TR1003 is also pulled down by 20 volts and now sits at approximately —44 volts (see Fig. 8—C). Instantly C1004 starts to discharge towards +105 volts via R1009. The collector of TR1003 provides a +ve going pulse of 200 ms duration shown in Fig. 8—D.

Condition (c) is achieved by TR1004 and TR1005 the 300 ms monostable, its time constant being controlled by C1006 and R1014. TR1004 is normally on and TR1005 is normally off and initiation of the monostable is controlled by the —ve going edge of the waveform at TR1003. R1017 is the collector load and is used to adjust the amplitude of the 300 ms pulse before it is applied to the summing amplifier. Once again the gain at the summing amplifier is determined by the feedback resistor R1038 and the series resistor, in this case being R1033. The resulting gain is approximately 0.5. Therefore the pulse at TR1005 collector, as shown in Fig. 8—E is inverted at TR1014 collector and is adjusted by R1017 from BE-DC to approximately +12 volts. Therefore the complete waveform as shown in Fig. 8—F is produced at TR1014 collector.

3.9.6 VARIABLE PERSISTENCE

TR1011 and TR1013 form a multivibrator operating at a frequency of approximately 500 Hz, the frequency determining elements being C1015, R1037 and C1017, R1039. The waveform at both collectors is shown in Fig.8—G. The —ve going edge of the waveform is differentiated by C1014 R1035, and coupled via C1012 to the base of TR1009.

TR1006 and TR1009 form the variable persistence monostable. TR1009 collector is returned to earth via TR1008 and S1006, therefore TR1008 and TR1009 are conducting and TR1006 is off. With S1002 in persist mode, R1028 is connected as a variable resistance, with one side earthed and is in series with R1031. R1028, R1031 and C1008 form the timing elements of the monostable. Negative pulses from C1012 keep the monostable running at approximately 500 Hz and the pulse width is then made to vary between 2 μs and 220 μs by use of the variable control. The waveform at TR1006 collector, Fig. 8—H, is fed via the same path as the 300 ms generator, R1017 being a common load resistor. So that the setting of R1017 is the same for the erase pulse as for the variable persistence pulse. If during the variable persistence mode it is required to erase the information on the CRT (for instance variable persistence is set to a very long period) this may still be done manually by pressing the erase button. However, it is desirable that during the 200 ms period of the erase sequence, the variable persistence pulses should be eliminated. This is achieved in the following way. The base of TR1008 is returned to the collector of TR1003, which is normally on and the collector is at —23 volts. TR1008 is thus on. During the 200 ms period TR1003 is turned off, its collector is returned to earth for the 200 ms period thereby turning TR1008 off during the same period. The waveform of Fig. 8—J is therefore seen at the output of the summing amplifier.

3.9.7 HOLD

For all storage operations the flood beam current is set to 700 μA by the adjustment of R1056. As flood gun cathode FK is at earth the negative voltage derived by R1056 is applied to flood gun grid Fg1 via diodes D1021, D1022 and Con 5. To achieve the hold condition, the mean flood beam current must be reduced. This is achieved by pulsing the flood gun grid Fg1 negative with respect to the d.c. potential normally on the grid. TR1015, TR1016 form a monostable, the time constant being derived from C1021 and R1044. When switched to hold condition, TR1015 collector is connected to +24 V and negative pulses, differentiated from TR1013 collector, are coupled via C1019 and trigger the monostable at approximately 500 Hz. A portion of the collector waveform is used to switch TR1017 which acts as an inverter and buffer amplifier. The collector waveform of TR1017 shown in Fig. 8—K is a.c. coupled via C1023 and then d.c. restored by D1022, to the d.c. potential originally set on R1056 (see Fig. 8—L). The ratio of pulse width to repetition pulse duration i.e. 2 ms to 170 μs is approximately 12 : 1. Therefore the mean flood beam current is approximately 700/12 = 65 μA.

3.9.8 ENHANCE

Enhance mode is a condition in which the storage writing rate be increased at the expense of storage time. This condition is simply acquired by raising the potential at backing electrode and reducing the erase pulse amplitude. When S1002 is depressed, R1020 is switched in and R1028 becomes a potentiometer connected between the collector of TR1007 and earth. The base of TR1007 is returned to the +105 volt line via R1024, and is therefore turned on. The wiper of the variable is now taken to the series summing resistor R1034. The output of the summing amplifier can now be set to a potential greater than the original BE-DC by turning the VARIABLE clockwise (the amount being set by R1019). When it is required to erase the enhance stored information, it is desirable to first remove the enhanced voltage. This is achieved in the following manner. As the erase switch is depressed, the base of TR1007 is connected to —24 volts so that C1007 is charged to —24 volts via R1022, thus turning TR1007 off, and allowing the variable wiper to rise to earth i.e. backing electrode original potential. On releasing S1001, the erase sequence is initiated and also allows TR1007 base to rise towards +105 volts, however at approximately +1.2 volts, TR1007 turns on again and pulls the variable wiper down to the enhanced condition. The time constant C1007, R1024 is arranged to be longer than the total erase sequence.

3.9.9 SET POSITION

When in store mode and set pos is depressed the intensity of the beam is set by R1012, such that there is minimal flooding of the storage surface. For non store and normal store conditions the intensity functions normally. When in hold the intensity is turned off completely so that no information can be written on to the CRT thus over writing on any stored information.

3.10 POWER SUPPLY

The —105 V, +24 V and —24 V lines, reference Figure 6, are all self regulating and protected from short circuits, they are connected to the remainder of the instrument via two plugs and sockets.

3.10.1 +24 V

Diodes D405, D406, D407 and D408 form a full wave bridge rectifying circuit whose reservoir capacitor is C405. The output of this line is dependent on −24 V line setting, the sampling chain resistors R424 and R426 provide bias to the control loop of TR408, TR406 and TR405. TR402, R407 R425 and R413 form a current limiting and foldback network to protect the output under overload conditions.

3.10.2 −24 V

This is used as a reference voltage for the other two lines and when set accurately will bias the +105 V and +24 V lines to their correct output voltages. Diodes D409, D411 and D413 form a full wave bridge rectifying circuit. TR411 and TR407 are a long tailed pair and in conjunction with TR409 and TR413 stabilise the circuit.

Current foldback and limiting is provided by TR403, R433, R420 and R405.

3.10.3 +105 V

Diodes D401, D402, D403 and D404 provide full wave bridge rectification. If a short circuit occurs on this line the instrument must be switched off and on again before the line returns to its normal voltage. Transistors TR414, TR412, TR415 and TR416 stabilise the output and TR401 and TR404 provide short circuit protection in the form of a bistable. D410 is forward biased if the +24V line has collapsed. If fault conditions do not prevail the a.c. fed through D410 resets the bistable.

3.11 E.H.T.

The E.H.T. (reference Figure 5) is derived from a class C oscillator operating at approximately 28 kHz. The oscillator amplifying transistor TR303 uses transformer T301 as its load and main frequency determining component. R301 sets the cathode potential which is regulated by a feedback loop including a high gain amplifier formed by TR301 and TR302. The grid is set to the correct tube cut-off potential by adjusting R315. The output voltage is limited at switch on by thermistor TH301 whilst C304 inhibits E.H.T. feedback into the unregulated +30 V line. Diodes D303 and D304 provide half wave rectification from T301 for the cathode and grid supplies. The PDA is derived from a five stage multiplier (quintupler) whose input is taken from the same tapping on T301 as that used for the cathode supply. Tube focusing is achieved by adjusting R327 which is on the front panel.

3.12 UNBLANKING AMPLIFIER

This amplifier is a current in voltage out stage. A 2 mA change of input current produces an anti-phase 30 V output. The internal unblanking and external Z MOD signals are fed into TR351 emitter in current form at each potential. This current is transferred to the base of TR352 where it is mixed with the intensity control current. TR352 and TR353 form a stage whose gain is determined by R358.

TABLE 1

I.C.1. Sweep Control I.C.

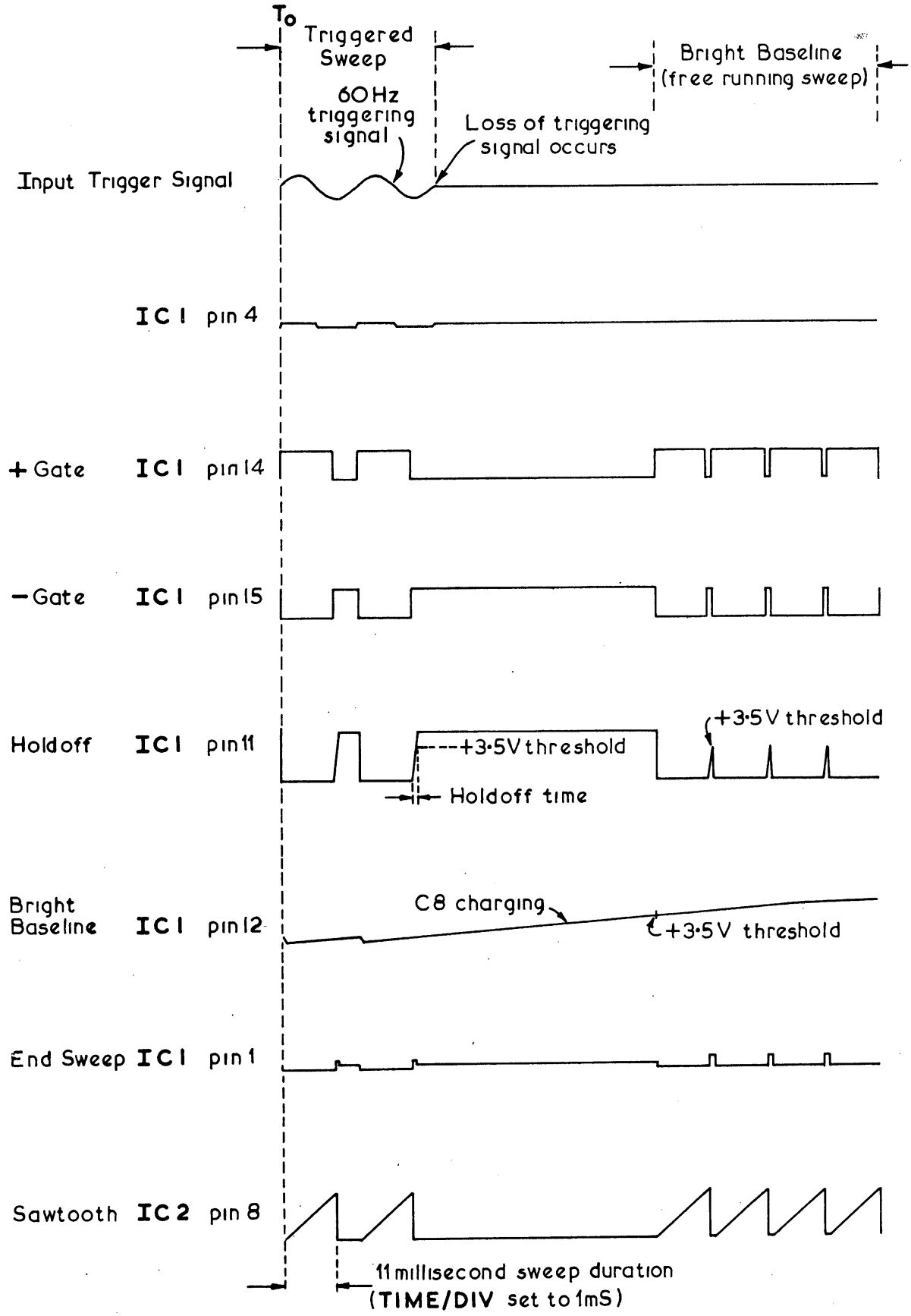
Pin No.	Function	Operation
1	END SWEEP	A logic '1' input causes logic '0' at pin 14 to end sweep (see pin 14).
2	FREE RUN	A logic '1' input causes logic '1' at pin 14 which if maintained, enables the sweep to free run at its "natural" selected frequency. Used to free run timebase when "Trace Locate" button is pushed.
3	INDEPENDENT GROUND	Connected to pin 8.
4	TRIGGER INPUT	Analogue input current from trigger pre-amp produces a train of "internal" pulses, in conjunction with a logic level at pin 5.
5	SLOPE SELECTOR	A logic '1' input allows a positive analogue signal at pin 4 to produce "internal" pulses. Logic '0' allows negative going analogue at pin 4 to produce "internal" pulses.
6	SINGLE SHOT CONTROL	A logic '1' input enables a repetitive sweep to continue. Logic '0' input allows a single sweep to be produced.
7	RESET	A logic '1' arms the timebase to receive a trigger signal and produces a single sweep. When Reset button is released pin returns to logic '0'.
8	SUBSTRATE	Connected to ground.
9	READY LAMP OUTPUT	A logic '0' output is produced when Single Shot button is pushed. This state allows ready state indicator, light emitting diode, to come on.
10	LOCKOUT	A logic '1' input disables the sweep, i.e., it cannot be started. A logic '0' allows normal operation.
11	HOLD-OFF TIMING	On receipt of an internal pulse, (generated at the end of the sweep), the timing components are connected allowing the pin to rise to threshold voltage of 3.5 V. A new sweep can commence upon receipt of next trigger pulse or if pin 12 is above its upper threshold voltage (see pin 12).
12	BRIGHT BASE LINE TIMING	Pin is allowed to rise to its threshold of 3.5 V when AUTO switch is selected. This then produces a logic '1' at pin 14 to start sweep and free run at "natural" selected frequency. If trigger signal is present or has a repetition rate $>$15 Hz, threshold voltage is never reached, pin goes to logic '0' and timebase is "triggered" in normal manner.
13	BRIGHT BASE LINE CONTROL	A logic '1' input keeps pin 12 at ground and disables B.B.L. operation. A logic '0' allows B.B.L. to function.
14	+ GATE OUTPUT	A logic '1' output is applied to pin 1 of I.C.2 to start the sweep and is maintained for duration of sweep. Logic '0' output to pin 1 of I.C.2 ends ramp and is maintained for whole of retrace period.
15	– GATE OUTPUT	Logic output is exactly 180° out of phase with pin 14. Output used as the bright up pulse.
16	POWER SUPPLY	Taken to +5 V line.

TABLE 2

I.C.2. Sweep Generator

Pin No.	Function	Operation
1	SWEEP GATE IN	Logic '1' input starts sweep and results in sawtooth output at pin 8.
2	OSCILLATION SUPPRESSOR	C17 and R65 connected to ground reduce gain of integrator and prevent internal oscillation.
3	GROUND	Connected to ground.
4	END SWEEP PULSE	Logic '1' output produced when ramp reaches its allowed maximum amplitude. Applied to pin 1 of I.C.1.
5	DELAYED GATE	Not used.
6	DELAY CONTROL IN	Maintained at +9.8 V and applied to one side of a voltage comparator inside i.e. the amplitude of the ramp is established at the other side.
7	POWER SUPPLY	Held at approximately +15.8 V by Zener diode, D24.
8	SAWTOOTH OUTPUT	Ramp output of approximately 10 V amplitude starting from 0 V, when logic '1' applied to pin 1.
9	TIMING CURRENT IN	Junction of timing capacitors and resistors taken to pin.
10	SUBSTRATE	Taken to –24 V line via R69, sits at approximately –6.7 V.

TABLE 3. RELATIONSHIP OF EVENTS IN AUTO MODE



CHAPTER 4
MAINTENANCE AND CALIBRATION

4.1 INTRODUCTION

4.1.1 The solid-state design of the instrument makes frequent adjustment of the internal components unnecessary. The appropriate part of the calibration procedure should be performed whenever the instrument fails to meet its specification or whenever a defective component is replaced. However, if R428 is adjusted to set the –24 V line, the full calibration procedure should be carried out.

4.1.2 For calibration procedure of VERTICAL plug-ins, see appropriate Vertical plug-in MANUAL.

4.1.3 For calibration, the tools and equipment required are:

Low-capacitance trimming tool (for preset controls)
Small screwdriver (for preset potentiometers)
Two Vertical plug-ins
Vertical Calibration Unit 067-0672-00
D.C. Voltmeter ± 0.5% accurate for measuring power supply voltages
D.C. Voltmeter of input impedance greater than 25 MΩ and ±0.5% accuracy for measuring cathode potential (–1.35 kV)
Squarewave Generator providing outputs of 25 mV and 250 mV at 1 kHz accuracy ± 1%
Squarewave Generator providing 1 MHz rise time ⩽3 ns
Sinewave Generator providing 500 Hz to 50 kHz
Constant Amplitude Sinewave Generator providing 50 kHz to 20 MHz for measuring bandwidth
Time-mark Generator providing markers of 1 ms and 1 μs.

4.2 MECHANICAL

4.2.1 ACCESS TO INTERIOR

The instrument has two vertical plug-ins, a timebase unit, a power supply unit and a EHT unit. The two cabinet covers of the instrument are removed as follows:

1 Disconnect the power lead.
2 Turn four buttons, two on each side cover, to release.
3 Lift the two side covers.

To remove the vertical plug-in(s):

Depress the plug-in retaining clip on the front and withdraw the plug-in(s).

To remove the sweep unit:

1 Unplug the two output leads from the CRT top pins.
2 Loosen one screw at the rear securing the unit.
3 Withdraw the unit.

To gain access to the preset controls inside the EHT box:

Remove the L-cover (one screw).

Power supply unit can be withdrawn from the rear of the instrument by removing the two retaining screws.

4.2.2 CRT REMOVAL

1 Remove the side covers as detailed above.
2 Remove the bush from the moulding to expose the PDA plug and socket. Earth plug and socket with a screwdriver and remove plug from the socket.
3 Remove the rear cover (two screws).
4 Disconnect the CRT base connector.
5 Unplug the neck pin connectors.
6 Unsolder the trace rotation coil connections.
7 Remove the vertical plug-in units and sweep unit as detailed in para 4.2.1.
8 Disconnect the CRT flying leads (three) from PC175 noting position of the connections.
9 Disconnect the VARIABLE coupling.
10 Remove INTENSITY, FOCUS and PULL-ON knobs.
11 Remove CRT front panel and sub panel (two screws).
12 Remove two screws holding PC176 assembly to the main frame.
13 Disengage PC176 from SK805 and remove the PC176 assembly.
14 Remove CRT front clamp screws (two) on the top.
15 Slacken the top screw of the clamp holding the mumetal screen.
16 Remove bezel (four screws) and the filter.
17 Remove two screws holding CRT clamp to the main frame.
18 Remove the CRT, screen and clamp from the instrument by moving these toward the rear to clear the front panel, then lowering the front end of CRT towards the centre of the instrument allows the CRT rear to be moved outwards. Withdraw the CRT assembly.
19 Remove location moulding (two screws).
20 Withdraw the CRT from the screen.

4.2.3 CRT FITTING

Reverse the order detailed above in 4.2.2. When fitting location moulding, it must be ascertained that the CRT front end is held against the front casting.

4.3 CALIBRATION PROCEDURE

4.3.1 POWER SUPPLY

Adjustment of –24 V line or replacement of any of the transistors TR407, TR409, TR411 and TR413 would necessitate carrying out the entire calibration procedure as detailed in this chapter.

A voltmeter of better than 0.5% accuracy should be used for measuring the power supply voltages.

1.0 **Check line voltages.**
1.1 Remove cabinet covers.
1.2 Set meter range to cover –24 V DC.
1.3 Connect meter between earth and –24 V output (junction of R429 and C415).
1.4 Adjust R428 PC162 for –24 V.
1.5 Set meter range to cover +105 V DC.
1.6 Connect meter between earth and +105 V output (junction of R432 and C416).
1.7 Check voltage is within ± 2% of +105 V i.e. +107.1 V, +102.9 V.
1.8 Set meter range to cover +24 V DC.
1.9 Connect meter between earth and +24 V output (junction of R424 and C414).
1.10 Check voltage is within ± 2% of +24 V i.e. +24.48 V, +23.52 V.

4.3.2 E.H.T. and DISPLAY ADJUSTMENTS

A voltmeter of input impedance greater than 25 MΩ and accuracy better than 0.5% should be used for measuring the cathode potential.
CAUTION: HIGH VOLTAGE

1.0 **Check cathode potential (R301 PC163).**
1.1 Remove cabinet covers, EHT cover and rear cover plate.
1.2 Set meter range to cover –1.35 kV DC.
1.3 Connect meter between earth and pin 7 on tube base.
1.4 Adjust R301 for –1.35 kV.

2.0 **Check grid cut-off (R317 PC163).**
2.1 Remove cabinet covers and EHT cover.
2.2 Check INTENSITY range.
2.3 Set TIME/DIV to EXT X.
2.4 Turn INTENSITY fully anti-clockwise.
2.5 Adjust R317 for extinction of spot.
2.6 Set TIME/DIV to 10 ms.
2.7 Check INTENSITY range.

3.0 **Set differential intensity (R332 PC163).**
3.1 Display two traces and position these 2 to 3 mm apart about the central graticule line.
3.2 Turn INTENSITY such that one of the two traces is just visible.
3.3 Adjust R332 to equalise intensity of the two traces.
3.4 Turn INTENSITY control anticlockwise and check that both the traces disappear at the same time. Repeat 3.2 and 3.3 if necessary.

4.0 **Set geometry (R1055 PC176).**
4.1 Obtain a trace and bring it onto the graticule centre using POSITION.
4.2 Adjust TRACE ROTATE so that the trace is exactly parallel to the graticule horizontal line.
4.3 Reposition the trace on the top graticule line and adjust R1055 to correct the trace distortion.
4.4 Bring the trace, using POSITION, onto the bottom graticule line. Examine the trace. If any distortion is visible, correct it by resetting R1055. Re-check 4.3.

4.3.3 VERTICAL AMPLIFIER PC175 (Final Stage)

Switch off the instrument. Remove left-hand V plug-in and replace with vertical calibration unit 067-0672-00. Switch on the instrument.

1.0 **Set LH Y place potential (R869).**
1.1 Switch calibration unit to CALIBRATE.
1.2 Connect voltmeter of at least 1% accuracy between TR812 and TR813 collectors.
1.3 Adjust POSITION to achieve 0 V between collectors.
1.4 Connect voltmeter from one collector to earth.
1.5 Adjust R869 to obtain a reading of 51 V.
1.6 Repeat Ops 1.2 to 1.5.
1.7 Disconnect voltmeter.

2.0 **Set LH channel gain (R805).**
2.1 Connect 1 kHz squarewave of 250 mV amplitude to INPUT.
2.2 Set TIME/DIV to 1 ms.
2.3 Adjust R805 for precisely 5 divisions.

3.0 **Set LH channel pulse response (R849 and C812).**
3.1 Connect 200 mV 1 MHz $\leqslant$ 3 ns rise time squarewave to INPUT.
3.2 Set TIME/DIV to 0.2 μs.
3.3 Adjust R849 and C812 for best pulse response.

4.0 **Check LH channel bandwidth.**
4.1 Connect 50 kHz sinewave to INPUT.
4.2 Adjust generator to give 5 div trace.
4.3 Set TIME/DIV to 1 ms.
4.4 Switch generator to 18 MHz.
4.5 Check amplitude $>$ 3.5 divisions.

5.0 **Set RH Y plate potential (R871).**
Note: Place vertical calibration unit 067-0672-00 jnto right-hand channel.
5.1 Switch vertical calibration unit to CALIBRATE.
5.2 Connect voltmeter of at least 1% accuracy between TR814 and TR815 collectors.
5.3 Adjust POSITION to achieve 0 V between collectors.
5.4 Connect voltmeter from one collector to earth.
5.5 Adjust R871 to obtain a reading of 51 V.
5.6 Repeat Ops. 5.2 to 5.5.
5.7 Disconnect voltmeter.

6.0 **Set RH channel gain (R807).**
6.1 Connect 250 mV 1 kHz squarewave to INPUT.
6.2 Set TIME/DIV to 1 ms.
6.3 Adjust R807 for precisely 5 divisions.

7.0 **Set RH channel pulse response (R851 and C813).**
7.1 Connect 200 mV 1 MHz $\leqslant$ 3 ns rise time squarewave to INPUT.
7.2 Set TIME/DIV to 0.2 μs.
7.3 Adjust R851 and C813 for best pulse response.

8.0 **Check RH channel bandwidth.**
8.1 Connect 50 kHz sinewave to INPUT.
8.2 Adjust generator to give 5 div trace.
8.3 Set TIME/DIV to 1 ms.
8.4 Switch generator to 18 MHz.
8.5 Check amplitude $>$ 3.5 divisions.
Note: Replace vertical calibration unit with normal 'V' plug-in.

4.3.4 VERTICAL PLUG-IN

See appropriate MANUAL.

4.3.5 TIME BASE PC158

1.0 **Set trigger.**
1.1 Select AUTO Trigger Mode and LH VERT Source buttons.
1.2 Set TIME/DIV switch to 1 ms.
1.3 Ensure that the main frame contains two calibrated V1, vertical plug-ins. Centralise traces of both channels.
1.4 Apply a 500 Hz sinewave to LH channel input socket and adjust its amplitude to display 0.5 division on the screen.
1.5 Adjust R57 so that the display "free runs" when the TRIG LEVEL control is at either extremity of its front panel + and — slope regions.
1.6 Select AC Trigger Mode button.
1.7 Increase amplitude of display to 8 divisions on the screen.
1.8 Check that by operating the TRIG LEVEL control the displayed waveform can be made to start at any point on its + or — slope.
1.9 Set start point of display on centre graticule line.
1.10 Select DC Trigger Mode button.
1.11 Adjust R32 for $<$ 0.4 division change in position of the start point of the display when the Trigger Mode is switched between AC and DC on both + and — slopes.
1.12 Select DC Trigger Mode button. Apply the same signal also to RH channel input socket and ensure that both displayed waveforms are superimposed.
1.13 Adjust R841 on rear of Mother Board PC175 for no change in start point of display when switching between LH VERT and RH VERT Source buttons.
1.14 Disconnect the signal from both input sockets.

2.0 **Set timing.**
2.1 Set TIME/DIV switch to 1 ms, VARIABLE to CAL and horizontal gain to x1. Select LH VERT Source button.
2.2 Apply 1 ms markers to LH channel input socket and adjust to a suitable amplitude on the screen.
2.3 Adjust R114 for 1 marker per division.
2.4 Pull gain switch for x5 and adjust R108 for 1 marker per 5 divisions.
2.5 Alter input signal to 1 μs markers.
2.6 Set TIME/DIV switch to 1 μs.
2.7 Push gain switch for x1.
2.8 Adjust C19 for 1 marker per division.
2.9 Set TIME/DIV switch to 0.2 μs.
2.10 Pull gain switch for x5.
2.11 Remove marker input signal and apply a 15 MHz sinewave.
2.12 Adjust C22 for best linearity at the start of the trace.

3.0 **Set external trig.**
3.1 Remove signal from inputs and connect LH channel input socket to Ext X socket on timebase front panel.
3.2 Push AUTO and DC Trigger buttons together and select EXT Source button.
3.3 Set LH channel VOLTS/DIV switch to 0.1 V and select x1 gain.
3.4 Set LH channel DC-GND-AC switch to GND, and centre the trace.
3.5 Set DC-GND-AC to DC and adjust R2 to return trace to centre of screen.
3.6 Repeat 3.4 and 3.5 until there is no more movement of trace.
3.7 Disconnect LH channel input and EXT X sockets op. 3.1.

4.0 **Set X—Y gain.**
4.1 Select RH VERT Source button on time base front panel.
4.2 Set RH channel DC-GND-AC switch to DC and LH channel DC-GND-AC switch to GND.
4.3 Set RH channel VOLTS/DIV switch to 5 mV.

4.4 Apply a 25 mV 1 kHz squarewave to RH channel input socket and ensure that the squarewave is 5 divisions high on the screen.
4.5 Select X–Y Source button.
4.6 Adjust R25 for 2 spots, 5 divisions apart in the horizontal direction on the screen.

4.3.6 STORAGE CIRCUIT PC176

1.0 **Set Fg 1 (R1056).**
1.1 Ensure NON STORE-STORE, VIEW-HOLD and PERSIST-ENHANCE buttons are OUT and VARIABLE is OFF.
1.2 Switch off the instrument; remove left-hand vertical plug-in and set all the presets on PC176 to midrange excepting R1055.
1.3 Unsolder the wire connected to CRT base pin 9.
1.4 Connect meter, set to 1 mA d.c., positive to CRT base pin 9 and negative to earth.
1.5 Switch on the instrument and allow 5 minute warm up time.
1.6 Adjust R1056 to give a meter reading of 700 μA.
1.7 Switch off the instrument, disconnect the meter, reconnect the wire to pin 9 and switch the instrument on.

2.0 **Set collimation (R1047).**
2.1 Select STORE, AUTO, REP, RH VERT and set TIME/DIV to 1 ms.
2.2 Turn INTENSITY to maximum and slowly cover the whole screen with the trace using vertical POSITION control.
2.3 Depress SINGLE sweep button and adjust R1047 to obtain the most uniform background illumination.
2.4 Depress ERASE to clear the screen and select LINE trigger.

3.0 Set erase amplitude (R1017)
3.1 Set TIME/DIV to 20 us, INTENSITY fully clockwise, VARIABLE to CAL and FOCUS as required.
3.2 Turn R1017 fully clockwise and depress ERASE to clear the screen.
3.3 Depress RESET and notice that no trace can be stored.
3.4 Turn R1017 slightly anti-clockwise. Depress ERASE and then RESET. Observe if there is a stored trace. If there is no stored trace, turn R1017 slightly more anti-clockwise and repeat till the trace is just stored and is unbroken on any part of the screen.
3.5 Set TIME/DIV to 1 μs, VARIABLE (ENHANCE) fully clockwise and switch to ENHANCE.
3.6 Turn R1019 fully anti-clockwise, press ERASE, wait 3 seconds then RESET. Turn R1019 partially clockwise till the trace appears as an unbroken line on the screen. Press ERASE and RESET to check setting.

4.0 Set preset intensity (R1012).
4.1 Set TIME/DIV to 1 ms and VARIABLE to CAL. Select PERSIST and turn VARIABLE fully anticlockwise (OFF).
4.2 Depress ERASE to clear the screen.
4.3 Keeping SET POS depressed, adjust R1012 so that the spot is of low enough intensity and is not likely to flood the screen rapidly but can be seen to move, on turning the vertical POSITION control.

5.0 Set compensation (C1016).
5.1 Connect oscilloscope to SK805/13.
5.2 Turn VARIABLE PERSIST fully clockwise.
5.3 Adjust C1016 so that the displayed pulse has a flat top.
5.4 Replace the left-hand vertical plug-in.

4.3.7 CALIBRATOR ADJUSTMENT

Normally, no further amplitude adjustments are required to the calibrator outputs. In the event of its failure requiring resistor replacement then the amplitude should be checked and if required R127 should be adjusted.

CHAPTER 5
COMPONENTS LIST

Values of resistors are stated in ohms or multiples of ohms; ratings at 70°C are in watts or sub-multiples of watts. Values of capacitors are stated in sub-multiples of farads; ratings at 70°C are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternatives may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument type
2. Instrument serial number
3. Component circuit reference
4. Component part number
5. Component value

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this chapter and their location in the circuitry and printed circuit boards in Chapter 6.

Circuit Reference		Circuit	Fig.	P.C. Board No.
From	To			
1	100	Trigger and Sweep Generator	2	158
101	140	X–Amplifier and Calibrator	4	158
151	170	Time/Div Switch	3	–
301	350	E.H.T. Control – CRT	5	163
351	370	Bright-Up	5	161
401	450	Power Supply	6	162
801	880	Mother Board	1	175
1000	1060	Storage circuit	7	176

ABBREVIATIONS

BM	Button mico	CMP	Cermet preset	PS	Polystyrene
C	Carbon	E	Electrolytic	Se	Selenium
CP	Carbon preset	Ge	Germanium	Si	Silicon
CV	Carbon variable	MF	Metal film	SM	Silver mica
CER	Ceramic	MO	Metal oxide	WW	Wire-wound
CT	Ceramic trimmer	PE	Polyester	WWP	Wire-wound preset
CM	Cermet thick film	PP	Polypropylene	WWV	Wire-wound variable

TEKTRONIX UK LIMITED

36 - 38 Coldharbour Lane, Harpenden, Hertfordshire, England

Telephone: Harpenden 63141 Telex: 25559

All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service.

CIR REF	PART NUMBER	VALUE F	DESCRIPTION TYPE	TOL %	RATING Volts	Eff. Ser.No.
C1	285-0915-00	100 n	PE	20	100	
C2	281-0710-00	10 n	CER		250	
C3	285-0854-00	100 p	PS	2	350	
C4	285-0854-00	100 p	PS	2	350	
C5	285-0854-00	100 p	PS	2	350	729451
C6	281-0734-00	100 n	CER		30	
C7	285-0869-00	47 p	PS	2 p	350	
C8	290-0623-00	4.7 μ	E		25	
C9	285-0873-00	200 p	PS	5	350	
C11	281-0729-00	1.5 μ	PE	20	63	
C12	285-0854-00	100 p	PS	2 p	350	
C13	281-0710-00	10 n	CER		250	
C14	281-0734-00	100 n	CER		30	
C15	285-0838-00	75 p	PS	2	350	729451
C16	281-0734-00	100 n	CER		30	
C17	285-0873-00	200 p	PS	5	350	
C18	281-0833-00	20 p	CER	±5	400	
C19	281-0155-00	2-22 p	PP		500	
C20	281-0734-00	100 n	CER		30	
C21	281-0734-00	100 n	CER		30	
C22	281-0154-00	2-12 p	PP		500	
C24	281-0734-00	100 n	CER		30	
C25	281-0734-00	100 n	CER		30	
C26	281-0734-00	100 n	CER		30	
C27	281-0710-00	10 n	CER		250	
C100	281-0734-00	100 n	CER		30	
C101	285-0872-00	180 p	PS	2	350	
C102	281-0710-00	10 n	CER		250	
C103	281-0842-00	39 p	CER	±5	400	
C104	285-1015-00	4.7 n	PE		160	
C105	285-0800-00	10 n	PE	20	250	
C106	290-0556-00	22 μ	E		25	
C151	285-1033-00	220 n	PE	20	160	
C152	285-1070-00	3.3 n	PS	10	400	
C153	285-0941-00	80 p	PS	1	350	
C154	285-1146-00	10 n	PE	1	63 v	703901
C155	285-0943-00	1 μ	PE	1	160	
C156	281-0734-00	100 n	CER		30	
C300	281-0710-00	10 n	CER		250	
C301	285-0759-00	2.2 n	PS	5	125	
C302	281-0680-00	470 p	CER	20	1.5 k	
C303	281-0680-00	470 p	CER	20	1.5 k	
C304	290-0623-00	4.7 μ	E		25	
C305	290-0495-00	47 μ	E		40	
C306	285-0799-00	33 n	PE	20	250	
C307	281-0677-00	10 n	CER		2 k	
C308	281-0682-00	20 n	CER	20	2 k	
C309	285-1015-00	4.7 n	PE	20	160	
C311	281-0779-00	2.2 n	CER		2 k	
C312	281-0682-00	20 n	CER	20	2 k	
C313	281-0710-00	10 n	CER		250	
C314	281-0710-00	10 n	CER		250	
C315	281-0677-00	10 n	CER		2 k	
C316	285-1046-00	100 n	PE	20	160	
C352	285-0796-00	100 n	PE	20	250	
C353	281-0710-00	10 n	CER		250	
C401	285-0793-00	10 n	PE	20	630	
C402	285-0793-00	10 n	PE	20	630	
C403	285-0793-00	10 n	PE	20	630	
C404	290-0547-00	330 μ	E		160	
C405	290-0624-00	2.2 m	E		40	
C406	290-0624-00	2.2 m	E		40	
C407	285-1058-00	10 n	PE	20	400	
C408	290-0494-00	47 μ	E		25	
C409	285-0915-00	100 n	PE	20	100	
C410	285-0854-00	100 p	PS	2	350	606751
C411	290-0635-00	4.7 μ	E		63	
C412	285-0870-00	120 p	PS	2	350	
C413	285-0796-00	100 n	PE	20	250	
C414	290-0556-00	22 μ	E		25	
C415	290-0556-00	22 μ	E	+ 100	25	
C416	290-0895-00	4.7 μ	E	– 10	160	
C417	290-0556-00	22 μ	E	+ 50	25	
C418	281-0734-00	100 n	CER	– 25	30	703901
C801	281-0710-00	10 n	CER		250	
C802	281-0710-00	10 n	CER		250	
C803	281-0710-00	10 n	CER		250	
C804	281-0710-00	10 n	CER		250	
C805	281-0710-00	10 n	CER		250	
C807	285-0800-00	10 n	PE	20	250	
C808	285-0800-00	10 n	PE	20	250	
C809	285-0920-00	56 p	PS	2	350	
C811	285-0920-00	56 p	PS	2	350	
C812	281-0157-00	5.5-65.5 p	PP		500	
C813	281-0191-00	10-60 p	CT	30	250	
C814	285-0845-00	68p	PS	2 p	350	739701
C815	285-0845-00	68p	PS	2 p	350	739701
C816	281-0830-00	15 p	CER	5	400	
C817	281-0830-00	15 p	CER	5	400	
C818	290-0377-00	1 m	E		16	
C819	281-0710-00	10 n	CER		250	
C821	290-0344-00	1.6 m	E		10	
C822	285-0920-00	56 p	PS	2	350	
C823	285-0920-00	56 p	PS	2	350	
C824	281-0710-00	10 n	CER		250	
C825	281-0710-00	10 n	CER		250	
C1001	281-0710-00	10 n	CER		250	
C1002	285-1063-00	390 p	PS		160	606057
C1003	290-0690-00	1 μ	E		63	

CIR REF	PART NUMBER	VALUE F	DESCRIPTION TYPE	TOL %	RATING Volts	Eff. Ser.No.
C1004	290-0635-00	4.7 µ	E		63	
C1005	281-0734-00	100 n	CER		30	
C1006	290-0635-00	4.7 µ	E		63	
C1007	285-1014-00	1 µ	PE	20	63	
C1008	285-1053-00	3.3 n	PS	5	160	
C1009	281-0800-00	3p9	CER	0.25p	400	703951
C1011	285-0888-00	220 n	PE	5	250	
C1013	285-0867-00	20 p	PS	1 p	350	606057
C1014	285-0873-00	200 p	PS	5	350	
C1015	285-0912-00	10 n	PE	5	630	
C1016	281-0156-00	1.4-6.4 p	PP		500	
C1017	285-0912-00	10 n	PE	5	630	
C1018	285-0854-00	100 p	PS	2 p	350	
C1021	285-0850-00	1 n	PS	5	125	
C1022	285-0796-00	100 n	PE	20	250	
C1023	281-0734-00	100 n	CER		30	
C1024	285-0796-00	100 n	PE	20	250	
C1025	281-0734-00	100 n	CER		30	
C1026	285-0796-00	100 n	PE	20	250	

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D1	152-0062-01	75 V	1N914	Si		50 mA	
D2	152-0062-01	75 V	1N914	Si		50 mA	
D3	152-0062-01	75 V	1N914	Si		50 mA	
D4	152-0062-01	75 V	1N914	Si		50 mA	
D5	152-0062-01	75 V	1N914	Si		50 mA	
D6	152-0062-01	75 V	1N914	Si		50 mA	
D7	152-0062-01	75 V	1N914	Si		50 mA	
D8	152-0062-01	75 V	1N914	Si		50 mA	
D9	152-0062-01	75 V	1N914	Si		50 mA	
D11	152-0062-01	75 V	1N914	Si		50 mA	
D12	152-0062-01	75 V	1N914	Si		50 mA	
D13	152-0575-00		L.E.D.	Si			
D14	152-0062-01	75 V	1N914	Si		50 mA	
D15	152-0472-00	5.6 V	Zener	Si			
D16	152-0062-01	75 V	1N914	Si		50 mA	
D17	152-0062-01	75 V	1N914	Si		50 mA	
D18	152-0062-01	75 V	1N914	Si		50 mA	
D19	152-0062-01	75 V	1N914	Si		50 mA	
D21	152-0062-01	75 V	1N914	Si		50 mA	
D22	152-0472-00	5.6 V	Zener	Si			
D23	152-0469-00		Rectifier	Si			
D24	152-0416-00	8.2 V	Zener	Si			
D101	152-0062-01	75 V	1N914	Si		50 mA	
D102	152-0062-01	75 V	1N914	Si		50 mA	
D103	152-0062-01	75 V	1N914	Si		50 mA	
D104	152-0062-01	75 V	1N914	Si		50 mA	
D105	152-0473-00	6.8 V	Zener	Si		330 mW	
D300	152-0062-01	75 V	1N914	Si		50 mA	606851
D301	152-0062-01	75 V	1N914	Si		50 mA	
D303	152-0567-00	3 kV	SCM30	Si			
D304	152-0567-00	3 kV	SCM30	Si			
D305	152-0388-00	130 V	Zener	Si		330 mW	
D351	152-0062-01	75 V	1N914	Si		50 mA	
D352	152-0062-01	75 V	1N914	Si		50 mA	
D353	152-0062-01	75 V	1N914	Si		50 mA	607201

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D401	152-0341-00	450 V	DDO56	Si		500 mA	
D402	152-0341-00	450 V	DDO56	Si		500 mA	
D403	152-0341-00	450 V	DDO56	Si		500 mA	
D404	152-0341-00	450 V	DDO56	Si		500 mA	
D405	152-0339-00	50 V	1N4001	Si		500 mA	
D406	152-0339-00	50 V	1N4001	Si		500 mA	
D407	152-0339-00	50 V	1N4001	Si		500 mA	
D408	152-0339-00	50 V	1N4001	Si		500 mA	
D409	152-0339-00	50 V	1N4001	Si		500 mA	
D410	152-0062-01	75 V	1N914/1N4148	Si		75 mA	607201
D411	152-0339-00	50 V	1N4001	Si		500 mA	
D412	152-0339-00	50 V	1N4001	Si		500 mA	
D413	152-0339-00	50 V	1N4001	Si		500 mA	
D414	152-0348-00	6.2 V	Zener	Si	5	330 mW	
D415	152-0062-01	75 V	1N914	Si		50 mA	
D416	152-0062-01	75 V	1N914	Si		50 mA	
D417	152-0468-00	150 V	BAX16	Si		200 mA	
D418	152-0062-01	75 V	1N914/1N4148	Si		75 mA	
D801	152-0062-01	75 V	1N914	Si		50 mA	
D802	152-0062-01	75 V	1N914	Si		50 mA	
D803	152-0062-01	75 V	1N914	Si		50 mA	
D804	152-0062-01	75 V	1N914	Si		50 mA	
D805	152-0062-01	75 V	1N914	Si		50 mA	
D806	152-0062-01	75 V	1N914	Si		50 mA	
D807	152-0062-01	75 V	1N914	Si		50 mA	
D808	152-0062-01	75 V	1N914	Si		50 mA	
D809	152-0062-01	75 V	1N914	Si		50 mA	
D811	152-0062-01	75 V	1N914	Si		50 mA	
D812	152-0339-00	50 V	1N4001	Si		500 mA	
D813	152-0339-00	50 V	1N4001	Si		500 mA	
D814	152-0339-00	50 V	1N4001	Si		500 mA	
D815	152-0339-00	50 V	1N4001	Si		500 mA	
D1001	152-0062-01	75 V	1N914	Si		50 mA	
D1003	152-0062-01	75 V	1N914	Si		50 mA	
D1004	152-0062-01	75 V	1N914	Si		50 mA	
D1005	152-0062-01	75 V	1N914	Si		50 mA	
D1006	152-0062-01	75 V	1N914	Si		50 mA	
D1007	152-0062-01	75 V	1N914	Si		50 mA	
D1008	152-0062-01	75 V	1N914	Si		50 mA	
D1009	152-0062-01	75 V	1N914	Si		50 mA	
D1011	152-0062-01	75 V	1N914	Si		50 mA	
D1012	152-0062-01	75 V	1N914	Si		50 mA	
D1013	152-0062-01	75 V	1N914	Si		50 mA	
D1014	152-0062-01	75 V	1N914	Si		50 mA	
D1015	152-0062-01	75 V	1N914	Si		50 mA	
D1016	152-0062-01	75 V	1N914	Si		50 mA	
D1017	152-0062-01	75 V	1N914	Si		50 mA	
D1018	152-0062-01	75 V	1N914	Si		50 mA	
D1019	152-0062-01	75 V	1N914	Si		50 mA	
D1020	152-0062-01	75 V	1N914	Si		50 mA	607201
D1021	152-0062-01	75 V	1N914	Si		50 mA	
D1022	152-0062-01	75 V	1N914	Si		50 mA	

CIR REF	PART NUMBER	VALUE	DESCRIPTION	Eff. Ser.No.
FS401	159-0069-00	2 A	1.25" lg. 100-125 V	
FS401	159-0073-00	1 A	1.25" lg. 200-250 V	
IC1	155-0056-00		Inter: Circuit Tek	
IC2	155-0028-00		Inter: Circuit Tek	739501
L101	108-0482-00	160 µH	Inductor Fixed	
L302	108-0753-00		Trace Rotate	
LP401	150-0074-00	6.5 V	Lamp 0.15 A	
PL301	134-0145-00		EHT Unit	
PL401	134-0135-00		Mains Power	
PL402	134-0102-00		Voltage Selector Plug	

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R1	317-0224-01	220 k	C	5	125 m	
R2	311-0756-00	47 k	CP	20	250 m	
R3	317-0224-01	220 k	C	5	125 m	
R4	317-0103-01	10 k	C	5	125 m	
R5	317-0682-01	6.8 k	C	5	125 m	
R6	317-0682-01	6.8 k	C	5	125 m	
R7	317-0471-01	470	C	5	125 m	
R8	317-0432-01	4.3 k	C	5	125 m	
R9	317-0622-01	6.2 k	C	5	125 m	
R10	317-0471-01	470	C	5	125 m	
R11	317-0392-01	3.9 k	C	5	125 m	
R12	317-0432-01	4.3 k	C	5	125 m	
R13	317-0822-01	8.2 k	C	5	125 m	
R14	317-0622-01	6.2 k	C	5	125 m	606751
R15	317-0183-01	18 k	C	5	125 m	
R16	317-0473-01	47 k	C	5	125 m	
R17	317-0273-01	27 k	C	5	125 m	
R18	317-0273-01	27 k	C	5	125 m	
R19	317-0471-01	470	C	5	125 m	
R20	317-0561-01	560	C	5	125 m	
R21	317-0223-01	22 k	C	5	125 m	
R22	317-0273-01	27 k	C	5	125 m	
R23	317-0561-01	560	C	5	125 m	
R24	317-0562-01	5.6 k	C	5	125 m	
R25	311-0802-00	4.7 k	CP	20	250 m	
R26	317-0123-01	12 k	C	5	125 m	
R27	317-0273-01	27 k	C	5	125 m	
R28	317-0222-01	2.2 k	C	5	125 m	
R29	317-0682-01	6.8 k	C	5	125 m	
R30	317-0102-01	1 k	C	5	125 m	
R31	317-0472-01	4.7 k	C	5	125 m	
R32	311-0798-00	2.2 k	CP	20	250 m	
R33	317-0153-01	15 k	C	5	125 m	
R34	317-0472-01	4.7 k	C	5	125 m	
R35	317-0472-01	4.7 k	C	5	125 m	
R36	317-0682-01	6.8 k	C	5	125 m	
R37	317-0125-01	1.2 M	C	5	125 m	
R38	317-0102-01	1 k	C	5	125 m	
R39	317-0221-01	220	C	5	125 m	
R40	317-0331-01	330	C	5	125 m	
*R41	311-1540-00	22 k	CV	20	250 m	

*R41 & R61 ganged

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R42	317-0104-01	100 k	C	5	125 m	
R43	317-0822-01	8.2 k	C	5	125 m	
R44	317-0622-01	6.2 k	C	5	125 m	
R45	317-0202-01	2 k.	CF	5	125 m	729451
R46	317-0103-01	10 k	C	5	125 m	
R47	317-0472-01	4.7 k	C	5	125 m	
R48	317-0472-01	4.7 k	C	5	125 m	
R49	317-0911-01	910	C	5	125 m	
R50	317-0101-01	100	C	5	125 m	
R51	317-0822-01	8.2 k	C	5	125 m	
R52	317-0105-01	1 M	C	5	125 m	
R53	317-0100-01	10	C	5	125 m	
R54	317-0752-01	7.5 k	C	5	125 m	
R55	317-0471-01	470	C	5	125 m	
R56	317-0123-01	12 k	C	5	125 m	
R57	311-0798-00	2.2 k	CP	20	250 m	
R58	317-0680-01	68	C	5	125 m	
R59	317-0123-01	12 k	C	5	125 m	
R60	317-0222-01	2.2 k	C	5	125 m	
*R61	311-1540-00	22 k	CV	20	250 m	
R62	317-0223-01	22 k	C	5	125 m	
R63	317-0562-01	5.6 k	C	5	125 m	
R64	317-0332-01	3.3 k	C	5	125 m	
R65	317-0121-01	120	C	5	125 m	
R66	317-0223-01	22 k	C	5	125 m	
R67	317-0561-01	560	C	5	125 m	
R68	321-0328-48	25.5 k	MF	1	125 m	606751
R69	317-0122-01	1.2 k	C	5	125 m	
R73	321-1313-48	18 k	MF	1	125 m	
R74	317-0103-01	10 k	C	5	125 m	
R76	317-0272-01	2.7 k	C	5	125 m	
R77	317-0472-01	4.7 k	C	5	125 m	
R78	317-0101-01	100	C	5	125 m	
R100	321-0850-48	27 k	MF	1	125 m	
R101	317-0223-01	220 k	C	5	125 m	
R102	317-0103-01	10 k	C	5	125 m	
R103	301-0223-01	22 k	C	5	500 m	
R104	317-0681-01	680	C	5	125 m	
**R105	311-2056-00	22k/100 k	CV	20	250 m	750401
R106	307-0424-00	4.3 k	MO	5	3	
R107	301-0302-01	3 k	C	5	500 m	
R108	311-0712-00	100	CP	20	250 m	
R109	311-2056-00	22k/100 k	CV	20	250 m	750401
R111	315-0333-02	33 k	C	5	250 m	
R112	317-0561-01	560	C	5	125 m	
R113	317-0101-01	100	C	5	125 m	
R114	311-0995-00	680	CP	20	250 m	
R115	317-0823-01	82 k	C	5	125 m	
R116	307-0424-00	4.3 k	MO	5	3	
R117	301-0302-01	3 k	C	5	500 m	
R119	301-0223-01	22 k	C	5	500 m	
R121	315-0222-01	2.2 k	C	5	250 m	
R122	317-0154-01	150 k	C	5	125 m	
R123	317-0822-01	8.2 k	C	5	125 m	
R124	325-0123-00	10.1	MF	0.5	125 m	
R125	321-0093-42	90.9	MF	0.5	125 m	
R126	317-0103-01	10 k	C	5	125 m	
R127	311-0717-00	220	CP	20	250 m	

**With S101

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R128	321-0280-48	8.06 k	MF	1	125 m	
R129	317-0683-01	68 k	C	5	125 m	
R151	321-1606-48	72 k	MF	1	125 m	
R152	321-1392-48	120 k	MF	1	125 m	
R153	321-1421-48	240 k	MF	1	125 m	
R154	321-1604-48	720 k	MF	1	125 m	
R155	325-0157-00	1.2 M	MF	1	250 m	
R156	325-0158-00	2.4 M	MF	1	250 m	
R157	324-0619-40	7.2 M	MF	1	1	
R158	321-1229-48	2.4 k	MF	1	125 m	
R159	321-1605-48	48 k	MF	1	125 m	
R161	324-1584-40	12 M	MF	1	1	
R162	317-0100-01	10	C	5	125 m	
R163	311-1547-00	5 k	CV	20	250 m	
R164	317-0101-01	100	C	5	125 m	
R165	317-0391-01	390	C	5	125 m	
R301	311-0850-00	15 k	CP	20	250 m	
R302	315-0153-01	15 k	C	5	250 m	
R304	307-0628-00	15 M	CM	5	500 m	729651
R306	307-0537-00	1.1 M	CM	5	500 m	729651
R308	317-0103-01	10 k	C	5	125 m	
R310	317-0221-01	220	C	5	125 m	
R311	317-0124-01	120 k	C	5	125 m	
R312	317-0331-01	330	C	5	125 m	
R313	317-0102-01	1 k	C	5	125 m	
R314	307-0184-00	15 k	MO	5	1.5	
R315	307-0647-00	40 R	Thermistor	±15R	25°C	739601
R316	317-0184-01	180 k	C	5	125 m	
R317	311-2027-00	2.2 M	CMP	20	1 W	729651
R318	317-0273-01	27 k	C	5	125 m	
R319	307-0628-00	15 M	CM	5	500 m	729651
R320	307-0647-00	40 R	Thermistor	±15R	25°C	739601
R322	307-0627-00	12 M	CM	5	500 m	729651
R323	317-0103-01	10 k	C	5	125 m	
R324	315-0684-01	680 k	C	5	250 m	
R325	301-0395-01	3.9 M	C	5	500 m	
R326	301-0395-01	3.9 M	C	5	500 m	
R327	311-1347-01	2.5 M	CP	20	250 m	
R328	311-1544-00	5 k	CP	20	250 m	
R329	317-0333-01	33 k	C	5	125 m	
R330	317-0332-01	3k3	C	5	125 m	607001
R331	317-0273-01	27 k	C	5	125 m	
R332	311-0765-00	100 k	CP	20	250 m	
R333	311-1543-00	100 k	C	20	250 m	
R334	317-0104-01	100 k	C	5	125 m	
R335	317-0394-01	390 k	C	5	125 m	
R351	311-1543-00	100 k	C	20	250 m	
R352	317-0473-01	36 k	C	5	125 m	704051

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R353	317-0223-01	22 k	C	5	125 m	
R354	317-0680-01	68	C	5	125 m	
R355	317-0103-01	10 k	C	5	125 m	
R356	317-0363-01	39 k	C	5	125 m	704051
R357	317-0103-01	10 k	C	5	125 m	
R358	317-0333-01	33 k	C	5	125 m	704051
R359	317-0562-01	5.6 k	C	5	125 m	
R361	317-0821-01	820	C	5	125 m	
R362	317-0562-01	5.6 k	C	5	125 m	
R363	317-0100-01	10	C	5	125 m	
R364	317-0101-01	100	C	5	125 m	607201
R402	315-0683-02	68 k	C	5	250 m	
R403	315-0562-02	5.6 k	C	5	250 m	
R404	317-0223-01	22 k	C	5	125 m	
R405	308-0725-00	2.7	WW	10	1	
R406	308-0726-00	1.5	WW	10	1	606345
R407	308-0726-00	1.5	WW	10	1	
R408	317-0474-01	470 k	C	5	125 m	606751
R409	317-0100-01	10	C	5	125 m	
R410	317-0152-01	1 k5	C	5	125 m	607201
R411	317-0332-01	3.3 k	C	5	125 m	
R412	317-0334-01	330 k	C	5	125 m	
R413	317-0472-01	4.7 k	C	5	125 m	
R414	315-0472-02	4.7 k	C	5	250 m	
R415	307-0144-00	10 k	MO	5	1.5	
R416	317-0562-01	5.6 k	C	5	125 m	
R417	317-0103-01	10 k	C	5	125 m	
R418	317-0822-01	8.2 k	C	5	125 m	
R419	315-0183-01	18 k	C	5	250 m	
R420	317-0101-01	100	C	5	125 m	
R421	317-0104-01	100 k	C	5	125 m	
R422	317-0683-01	68 k	C	5	125 m	
R423	317-0103-01	10 k	C	5	125 m	
R424	321-0296-48	11.8 k	MF	1	125 m	
R425	317-0101-01	100	C	5	125 m	
R426	321-0298-48	12.4 k	MF	1	125 m	
R427	321-0871-48	6.8 k	MF	1	125 m	
R428	311-1419-00	1.5 k	WW	10	1	
R429	321-1313-48	18 k	MF	1	125 m	
R430	317-0225-01	2 M2	CF	5	125 m	
R431	315-0473-02	47 k	C	5	250 m	
R432	321-0351-48	44.2 k	MF	1	125 m	
R433	317-0472-01	4.7 k	C	5	125 m	
R434	321-0289-48	10 k	MF	1	125 m	
R435	307-0427-00	2.2	C	5	125 m	
R801	317-0182-01	1.8 k	C	5	125 m	
R802	317-0182-01	1.8 k	C	5	125 m	
R803	317-0182-01	1.8 k	C	5	125 m	
R804	317-0182-01	1.8 k	C	5	125 m	
R805	311-1449-00	4.7 k	CP	20	75 m	
R806	317-0271-01	270	C	5	125 m	
R807	311-1449-00	4.7 k	CP	20	75 m	
R808	317-0271-01	270	C	5	125 m	
R809	317-0820-01	82	C	5	125 m	
R811	317-0621-01	620	C	5	125 m	
R812	317-0820-01	82	C	5	125 m	
R813	317-0820-01	82	C	5	125 m	
R814	317-0621-01	620	C	5	125 m	

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R815	317-0820-01	82	C	5	125 m	
R816	317-0561-01	560	C	5	125 m	
R817	317-0101-01	100	C	5	125 m	
R818	317-0101-01	100	C	5	125 m	
R819	317-0561-01	560	C	5	125 m	
R821	317-0561-01	560	C	5	125 m	
R822	317-0101-01	100	C	5	125 m	
R823	317-0101-01	100	C	5	125 m	
R824	317-0561-01	560	C	5	125 m	
R825	317-0391-01	390	C	5	125 m	
R826	317-0391-01	390	C	5	125 m	
R827	317-0391-01	390	C	5	125 m	
R828	317-0391-01	390	C	5	125 m	
R832	317-0821-01	820	C	5	125 m	
R833	317-0821-01	820	C	5	125 m	
R834	317-0182-01	1.8 k	C	5	125 m	
R835	317-0182-01	1.8 k	C	5	125 m	
R836	317-0152-01	1.5 k	C	5	125 m	
R837	317-0152-01	1.5 k	C	5	125 m	
R838	317-0103-01	10 k	C	5	125 m	
R839	317-0152-01	1.5 k	C	5	125 m	
R841	311-1447-00	470	CP	20	75 m	
R842	317-0184-01	180 k	C	5	125 m	
R843	302-0271-01	270	C	10	500 m	
R844	317-0823-01	82 k	C	5	125 m	
R845	303-0561-00	560	C	5	1	
R846	303-0561-00	560	C	5	1	
R847	303-0561-00	560	C	5	1	
R848	303-0561-00	560	C	5	1	
R849	311-1446-00	220	CP	20	75 m	
R851	311-1446-00	220	CP	20	75 m	
R852	317-0103-01	10 k	C	5	125 m	
R853	317-0223-01	22 k	C	5	125 m	
R854	317-0391-01	390	C	5	125 m	
R855	317-0223-01	22 k	C	5	125 m	
R856	317-0432-01	4.3 k	C	5	125 m	
R857	317-0432-01	4.3 k	C	5	125 m	
R858	317-0560-01	56	C	5	125 m	
R859	317-0560-01	56	C	5	125 m	
R861	307-0284-00	540	MO	5	3.25	
R862	307-0420-00	1 k	MO	5	5	
R863	307-0420-00	1 k	MO	5	5	
R864	307-0420-00	1 k	MO	5	5	
R865	307-0420-00	1 k	MO	5	5	
R866	307-0318-00	330	MO	5	1.5	
R867	307-0318-00	330	MO	5	1.5	
R868	317-0104-01	100 k	C	5	125 m	
R869	311-1472-00	100	C	20	500 m	
R871	311-1472-00	100	C	20	500 m	
R872	317-0820-01	82	C	5	125 m	
R873	317-0820-01	82	C	5	125 m	
R874	317-0123-01	12 k	C	5	125 m	704051
R1001	301-0685-02	6.8 M	C	5	500 m	
R1002	317-0105-01	1 M	C	5	125 m	
R1003	317-0124-01	120 k	C	5	125 m	
R1004	317-0103-01	10 k	C	5	125 m	
R1005	317-0472-01	4.7 k	C	5	125 m	

CIR REF	PART NUMBER	VALUE Ohms	DESCRIPTION TYPE	TOL %	RATING W	Eff. Ser.No.
R1006	317-0153-01	15 k	C	5	125 m	
R1007	317-0103-01	10 k	C	5	125 m	
R1008	317-0103-01	10 k	C	5	125 m	
R1009	317-0224-01	220 k	C	5	125 m	
R1011	317-0223-01	22 k	C	5	125 m	
R1012	311-0750-00	22 k	CP	20	250 m	
R1013	317-0473-01	47 k	C	5	125 m	607501
R1014	317-0244-01	240 k	C	5	125 m	604501
R1015	317-0223-01	22 k	C	5	125 m	
R1016	317-0223-01	22 k	C	5	125 m	
R1017	311-0735-00	10 k	CP	20	250 m	606501
R1019	311-0735-00	10 k	CP	20	250 m	
R1020	317-0332-01	3 k3	CF	5	125 m	750501
R1022	317-0103-01	10 k	C	5	125 m	
R1023	317-0224-01	220 k	C	5	125 m	
R1024	301-0395-01	13.9 M	C	5	500 m	606501
R1025	317-0184-01	180 k	C	5	125 m	
R1026	317-0472-01	4.7 k	C	5	125 m	
* R1028	311-1676-01	100 k	CV	20	60 m	739601
R1029	317-0223-01	22 k	C	5	125 m	
R1030	317-0224-01	220 k	CF	5	125 m	729451
R1031	317-0471-01	470	C	5	125 m	607051
R1032	317-0273-01	27 k	C	5	125 m	
R1033	317-0225-01	2.2 M	C	5	125 m	
R1034	317-0105-01	1 M	C	5	125 m	
R1035	317-0223-01	22 k	C	5	125 m	
R1036	317-0223-01	22 k	C	5	125 m	
R1037	317-0154-01	150 k	C	5	125 m	
R1038	317-0105-01	1 M	C	5	125 m	
R1039	317-0154-01	150 k	C	5	125 m	
R1041	317-0223-01	22 k	C	5	125 m	
R1042	307-0136-00	18 k	MO	5	1.5	
R1043	317-0563-01	56 k	C	5	125 m	
R1044	317-0244-01	240 k	C	5	125 m	
R1045	317-0473-01	47 k	C	5	125 m	
R1046	317-0682-01	6.8 k	C	5	125 m	
R1047	311-0750-00	22 k	CP	20	250 m	
R1048	317-0153-01	15 k	C	5	125 m	
R1049	317-0102-01	1 k	C	5	125 m	606152
R1051	317-0473-01	47 k	C	5	125 m	
R1052	317-0473-01	47 k	C	5	125 m	
R1053	317-0393-01	39 k	C	5	125 m	
R1054	317-0273-01	27 k	C	5	125 m	
R1055	311-0765-00	100 k	CP	20	250 m	
R1056	311-0735-00	10 k	CP	20	250 m	
R1057	317-0123-01	12 k	C	5	125 m	
R1058	317-0393-01	39 k	C	5	125 m	606673
R1059	317-0513-01	51 k	CF	5	125 m.	739662

CIR REF	PART NUMBER	DESCRIPTION	Eff. Ser.No.
S1	260-1566-00	Push button Trig Mode	
S2	260-1567-00	Push button Sweep	
S3	260-1565-00	Push button Trace Locate	
S4	260-1563-00	Push button Trig Source	
S101	311-2056-00	Push-Pull x 5 (with R105)	750401
S151	260-1562-00	Rot. 22 Pos. T/DIV	

*With S1006

CIR REF	PART NUMBER	DESCRIPTION	TYPE	Eff. Ser.No.
S401	260-1586-00	Toggle ON/OFF		
S1001	260-1565-00	Push button Erase		
S1002	260-1649-01	Push button Non store/Store		750301
S1003	260-1649-01	Push button View/Hold		750301
S1004	260-1649-01	Push button Persist/Enhance		750301
S1005	260-1565-00	Push button Set Pos		
S1006	311-1676-01	(with R1028)		739601
SK1	131-0650-01	Ext. X & Trig.		
SK2	131-1268-00	Gate out		
SK3	131-1268-00	Sweep out		
SK101	131-1268-00	Cal. 30 mV		
SK102	131-1268-00	Cal. 300 mV		
SK301	136-0302-00	CRT Base		
SK351	131-0650-01	Ext. Z Mod.		
SK401	136-0293-00	Valve PC mtg.		
SK402	136-0315-00	Voltage Selector Panel		
SK801	131-1444-00	Edge Conn. 8 way		
SK802	131-2257-00	Edge Conn. 16 way		750401
SK803	131-2257-00	Edge Conn. 16 way		750401
SK804	131-1443-00	Edge Conn. 16 way		
T301	120-0861-00	E.H.T.		
T401	120-0862-00	Power		
TR1	151-0445-00	ZTX214	Si PNP	
TR2	151-0317-00	BC109 C	Si NPN	729451
TR3	151-0317-00	BC109C	Si NPN	
TR4	151-0317-00	BC109C	Si NPN	
TR101	151-0127-02	BSX20	Si NPN	
TR102	151-0525-00	SPS 5286	Si NPN	606201
TR103	151-0525-00	SPS 5286	Si NPN	606201
TR104	151-0326-00	BC107	Si NPN	
TR105	151-0326-00	BC107	Si NPN	

CIR REF	PART NUMBER	DESCRIPTION		TYPE	Eff. Ser.No.
TR301	151-0317-00	BC109C	Si	NPN	
TR302	151-0317-00	BC109C	Si	NPN	
TR303	151-0400-00	2N5191	Si	NPN	
TR351	151-0326-00	BC107	Si	NPN	
TR352	151-0320-01	MPS6518	Si	PNP	
TR353	151-0242-00	2N3904	Si	NPN	
TR401	151-0257-01	BF 305	Si	NPN	750501
TR402	151-0326-00	BC107	Si	NPN	
TR403	151-0326-00	BC107	Si	NPN	
TR404	151-0317-00	BC109C	Si	NPN	750501
TR405	151-0400-00	2N5191	Si	NPN	
TR406	151-0490-00	FRB750	Si	NPN	
TR407	151-0317-00	BC109C	Si	NPN	
TR408	151-0326-00	BC107	Si	NPN	
TR409	151-0490-00	FRB750	Si	NPN	
TR411	151-0317-00	BC109C	Si	NPN	
TR412	151-0525-00	SPS 5286	Si	NPN	606201
TR413	151-0400-00	2N5191	Si	NPN	
TR414	151-0320-01	MPS6518	Si	PNP	
TR415	151-0257-01	BF305	Si	NPN	
TR416	151-0311-00	MJE340	Si	NPN	
TR801	151-0127-03	BSX20	Si	NPN	750301
TR802	151-0127-03	BSX20	Si	NPN	750301
TR803	151-0127-03	BSX20	Si	NPN	750301
TR804	151-0127-03	BSX20	Si	NPN	750301
TR805	151-0320-01	MPS6518	Si	PNP	
TR806	151-0320-01	MPS6518	Si	PNP	
TR807	151-0320-01	MPS6518	Si	PNP	
TR808	151-0320-01	MPS6518	Si	PNP	
TR809	151-0326-00	BC107	Si	NPN	
TR811	151-0326-00	BC107	Si	NPN	
TR812	151-0692-00	BD419	Si	NPN	739701
TR813	151-0692-00	BD419	Si	NPN	739701
TR814	151-0692-00	BD419	Si	NPN	739701
TR815	151-0692-00	BD419	Si	NPN	739701
TR1001	151-0326-00	BC107	Si	NPN	
TR1002	151-0326-00	BC107	Si	NPN	
TR1003	151-0326-00	BC107	Si	NPN	
TR1004	151-0326-00	BC107	Si	NPN	
TR1005	151-0326-00	BC107	Si	NPN	
TR1006	151-0326-00	BC107	Si	NPN	
TR1007	151-0326-00	BC107	Si	NPN	
TR1008	151-0244-00	2N3702	Si	PNP	
TR1009	151-0326-00	BC107	Si	NPN	
TR1011	151-0326-00	BC107	Si	NPN	
TR1012	151-0445-00	ZTX 214C	Si	PNP	606501
TR1013	151-0326-00	BC107	Si	NPN	
TR1014	151-0257-03	FRB749	Si	NPN	
TR1015	151-0257-03	FRB749	Si	NPN	
TR1016	151-0257-03	FRB749	Si	NPN	
TR1017	151-0404-00	TO203	Si	PNP	
V301	154-0704-00	CRT English Electric Type E720B			

ASSEMBLIES

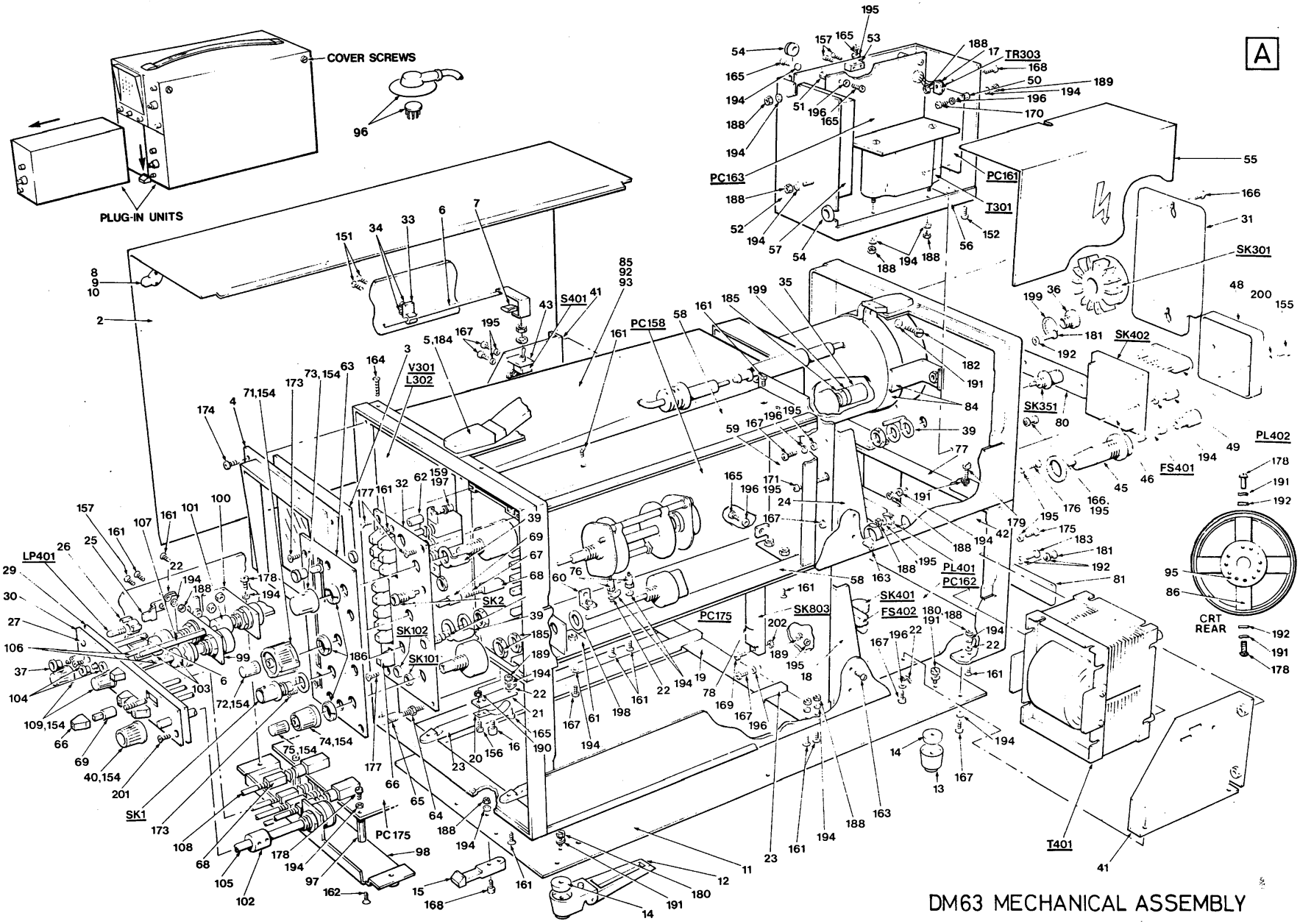
ASSEMBLY	PART NUMBER	INCLUDES	Eff. Ser.No.
Display Unit Module	640-0502-00	Pt.Nos. 426-1069-00, 644-0046-00, 626-0449-00, 670-3053-00 and 670-3357-00. Cir.ref. LP401, R327, R328, R333, R351, R1028 and SK351.	
EHT Unit	670-3053-00	Pt.No. 650-0021-00. Cir.ref. PC161, PC163, D303, D304 and T301.	
Quintupler	650-0021-00	Sealed Unit.	
PC161 Wired	670-3039-01	Cir. ref. C352, C353, D351, D352, R352 to R359, R361 to R363 and TR351 to TR353.	
PC163 Wired EHT	670-3041-07	Cir.ref. C300 to C309, C311 to C314, D300, D301, L301, R301 to R319, R322 to R326, R329, R330, R332, R335, TH301 and TR301 to TR303.	739601
Shield CRT	626-0449-00	Pt.Nos. 337-2001-00, 354-0420-00.	
PC176 Wired Storage CCT	670-3357-01	Cir.ref. C1001 to C1009, C1011 to C1019, C1021 to C1026, D1001 to D1009, D1011 to D1019, D1021, D1022, R1001 to R1009, R1011 to R1019, R1020 to R1027, R1029, R1031 to R1039, R1041 to R1049, R1051 to R1059, S1001 to S1006, TR1001 to TR1009, TR1011 to TR1017.	739662
Timebase Unit	644-0046-00	Pt.No. 262-0972-00 Cir.ref. PC158, D13, R41, R61, R105, R109, S2, SK1, SK2, SK3, SK101 and SK102.	
PC158 Wired Trig & Sweep Gen. "X" Amp and Cal.	670-3036-01	Cir.ref. C2 to C9, C11 to C20, C22 to C26, C100 to C106, D1 to D9, D11, D12, D14 to D17, D19, D21 to D23, D101 to D105, R1 to R37, R39, R40, R42 to R49, R51 to R58, R62 to R69, R71, R73, R74, R76, R100 to R104, R106, R107, R111 to R114, R116, R117, R119, R121 to R129, S1, S3, S4, TR1 to TR4, TR101 to TR105.	
Switch T/Div	262-0972-00	Cir.ref. C151 to C156, R151 to R159, R161 to R163 and S151.	
Power Unit	620-0237-00	Pt.Nos. 426-1070-00 and 620-0238-00.	
Power Supply	620-0238-00	Pt.No. 136-0315-00. Cir.ref. PC162, FS401, S401 and T401.	
PC162 Wired	670-3040-01	Cir.ref. C401 to C409, C411 to C417, D401 to D409, D411 to D417, FS402, R402 to R417, R419 to R429, R431 to R435, SK401, TR401 to TR409, TR411 to TR416.	739601
PC175 Wired Mother Board	670-3356-03	Cir.ref. C801 to C805, C807 to C809, C811 to C819, C821 to C825, D801 to D809, D811 to D815, R801 to R809, R811 to R819, R821 to R828, R832 to R839, R841 to R849, R851 to R859, R861 to R869, R871 to R873, SK801 to SK804.	750401

MECHANICAL PARTS LIST

(Items refer to View)

Item	Description	Part No.	Starting Ser.No.
2	Cabinet side	390-0277-00	
3	Filter Blue	378-0819-02	
	Filter Amber	378-0819-03	
4	Bezel	200-1579-01	
5	Handle Assembly	367-0168-00	
6	Switch Coupling Assy	640-0030-00	
7	Clip	344-0261-00	
8	Clip ¼ turn fastener	343-0631-00	
9	Pin ¼ turn fastener	214-2443-00	
10	Spring pin	214-2444-00	
11	Base	432-0082-01	
12	Foot (raising member) Grey	348-0463-01	
13	Foot Grey	348-0168-00	
14	Packing Washer – foot	210-1075-01	
15	Clip	344-0245-00	
16	Guide Button	351-0335-00	
17	Mica Washer	210-1164-00	
18	Bracket – Mother Board R.H.	407-1085-01	
	Bracket – Mother Board L.H.	407-1085-00	
19	Guide – Mother Board	351-0336-00	
20	Contact – Earthing	131-1259-00	
21	Spring Plate	386-2407-00	
22	6BA Solder Tag	210-0297-00	
23	Guide	351-0286-03	
24	Bracket – Mother Board	407-1384-00	
25	Bracket – Lamp	407-1381-00	
26	Bulb Holder	136-0311-00	
27	Insert	378-0597-00	
29	Front Sub Panel	386-2880-00	
30	Front Panel	333-1869-01	
31	Rear Cover	200-1578-01	
32	Sub Panel	386-2697-00	
33	Bearing	401-0165-00	
34	Spacer	361-0575-00	
35	Spacer (3/8" Whit x 11mm)	385-0209-00	
36	Bush (3/8" Whit x 6.5mm id)	358-0425-00	
37	Knob, Push-Pull	366-1404-00	
39	Solder Tag 3/8" id	210-0275-00	
40	Knob Assy	366-1239-02	
41	Bracket – PCB L.H.	407-1380-00	
	Bracket – PCB R.H.	407-1380-01	
42	Rear Plate	386-2699-00	
43	Bracket – Switch	407-1385-00	
45	Fuse Holder	352-0499-00	
48	Cover	200-2208-01	
49	6BA Spacer	129-0706-00	
50	Spacer (6BA x 5mm)	385-0215-00	
51	Spacer (6BA x 3/8")	361-0198-00	
52	Box – EHT	202-0198-00	
53	Block	391-0100-01	
54	Grommet ¼" id	348-0160-00	
55	Cover – EHT	200-1374-00	
56	Base – EHT	432-0090-00	
57	Quintupler	650-0021-00	
58	Bar	381-0346-01	
59	Bracket – PCB	407-1382-00	
60	Bracket – PCB	407-1383-00	
61	Bracket – POT	407-1386-00	
62	Spacer (6BA / 8BA)	385-0206-00	
63	Front Panel	333-1788-01	
64	Post – Terminal	129-0374-00	
65	Nut – Terminal	220-0647-00	
66	Push Button	366-1403-00	
67	Rod Extension (4BA x 25mm)	384-1141-02	
68	Coupling Switch Extension	376-0132-00	
69	Coupling Switch Extension	376-0136-00	
71	Knob Assy	366-1387-00	
72	Knob Assy	366-1266-01	
73	Knob Assy	366-1239-02	
74	Knob Assy	366-1254-00	
75	Knob Assy	366-1255-00	
76	Stand Off Insulator	342-0156-00	
77	Spacer – Chassis	361-0479-00	
78	Polarising Key	131-1364-00	
80	Nameplate	334-1933-02	
81	Market Ident Warning	334-2968-00	

Item	Description	Part No.	Starting Ser. No.
84	Clamp – CRT (Rear)	343-0456-01	
85	CRT Shield	337-2001-00	
86	CRT Rear Location	354-0420-01	
92	Rubber Packing ¼" x ¼"	252-0608-00	
93	Copper Strip 1.0" x 0.005"	258-0456-00	
96	PDA Connector Assembly	200-0964-00	
97	Spacer 6BA Threaded	385-0196-00	
98	Bracket – PCB	407-1486-00	
99	Bracket – POT	406-1000-00	
100	Bracket – POT	406-1001-00	
101	Coupling 1/4" – 1/8"	376-0137-02	
102	Coupling 1/4" – 1/4"	376-0155-00	
103	Flexible Coupling 1/4" – 1/8"	376-0126-00	
104	Panel Bush	358-0460-00	
105	Rod Extension (¼" x 65mm)	384-0497-05	
106	Rod Extension (1/8" x 45mm)	384-1142-17	
107	Rod Extension (1/8" x 77mm)	384-1142-16	
108	Rod Extension	384-1141-06	
109	Knob Assembly	366-1266-00	
151	Screw Self Tapping No.2 CSK/Hd x 3/8"	213-0356-00	
152	Screw Self Tapping No.2 Pan Hd x 3/16	213-0357-00	
154	Socket Set Screw M3 x 3mm	213-0248-00	
155	Screw M2 x 4mm Pan Hd	213-0802-00	
156	Screw 8BA x 3/8" CHHD	213-0460-00	
157	Screw 8BAX ¼" CHHD	213-0697-00	
159	Screw 8BA x 3/16" CHHD	213-0458-00	
161	Screw 6BA x ¼" CSK Hd	213-0391-00	
162	Screw 6BA x 5/16" CSK Hd	213-0404-00	
163	Screw 6BA x 3/8 CSK Hd	213-0400-00	
164	Screw 6BA x ¾" CSK Hd	213-0405-00	
165	Screw 6BA x 3/16" PAN Hd	213-0392-00	
166	Screw 6BA x ¼" PAN Hd	213-0643-00	
167	Screw 6BA x ¼" PAN Hd	213-0393-00	
168	Screw 6BA x 5/16" PAN Hd	213-0394-00	
169	Screw 6BA x 3/8" PAN Hd	213-0406-00	
170	Screw 6BA x 7/16" PAN Hd	213-0469-00	
171	Screw 6BA x 1½" PAN Hd	213-0862-00	
173	Screw 6BA x ¼" INST Hd	213-0644-00	
174	Screw 6BA x ¼" MUSH Hd	213-0466-00	
175	Screw 6BA x 5/16" MUSH Hd	213-0650-00	
176	Screw 6BA x 3/16" PAN Hd	213-0455-00	
177	Screw 4BA x 5/16" CSK Hd	213-0387-00	
178	Screw 4BA x ¼" PAN Hd	213-0388-00	
179	Screw 4BA x 3/8" PAN Hd	213-0398-00	
180	Screw 4BA x 3/8" HEX Hd	213-0471-00	
181	Screw 4BA x 3/8" MUSH Hd	213-0583-00	
182	Screw 4BA x ½" HEX Hd	213-0389-00	
183	Screw 4BA x ¾" MUSH Hd	213-0601-00	
184	Screw 2BA x 7/16" CSK Hd	213-0509-00	
185	Nut 3/8" x 32 TPI	220-0750-00	
186	Nut Slotted Ring Chrome	220-0527-00	
187	Nut Full 4BA	220-0714-00	
188	Nut Full 6BA	220-0716-00	
189	Nut Half 6BA	220-0717-00	
190	Nut Full 8BA	220-0718-00	
191	Washer 4BA Int Shakeproof	210-1215-00	
192	Washer 4BA Std Plain	210-1206-00	
194	Washer 6BA Int Shakeproof	210-1210-00	
195	Washer 6BA Std Plain	210-1209-00	
196	Washer 6BA Crinkle	210-1208-00	
197	Washer 8BA Shakeproof	210-1214-00	
198	Washer 3/8" id Plain	210-3051-00	
199	Washer 3/8" id ½" od Lock Pl	210-1079-00	
200	Washer 2mm id Std	210-1290-00	
201	Screw 6BA x 3/8" CSK Hd	213-0652-00	
202	Washer 3mm x 1.6mm Thk	210-1268-00	



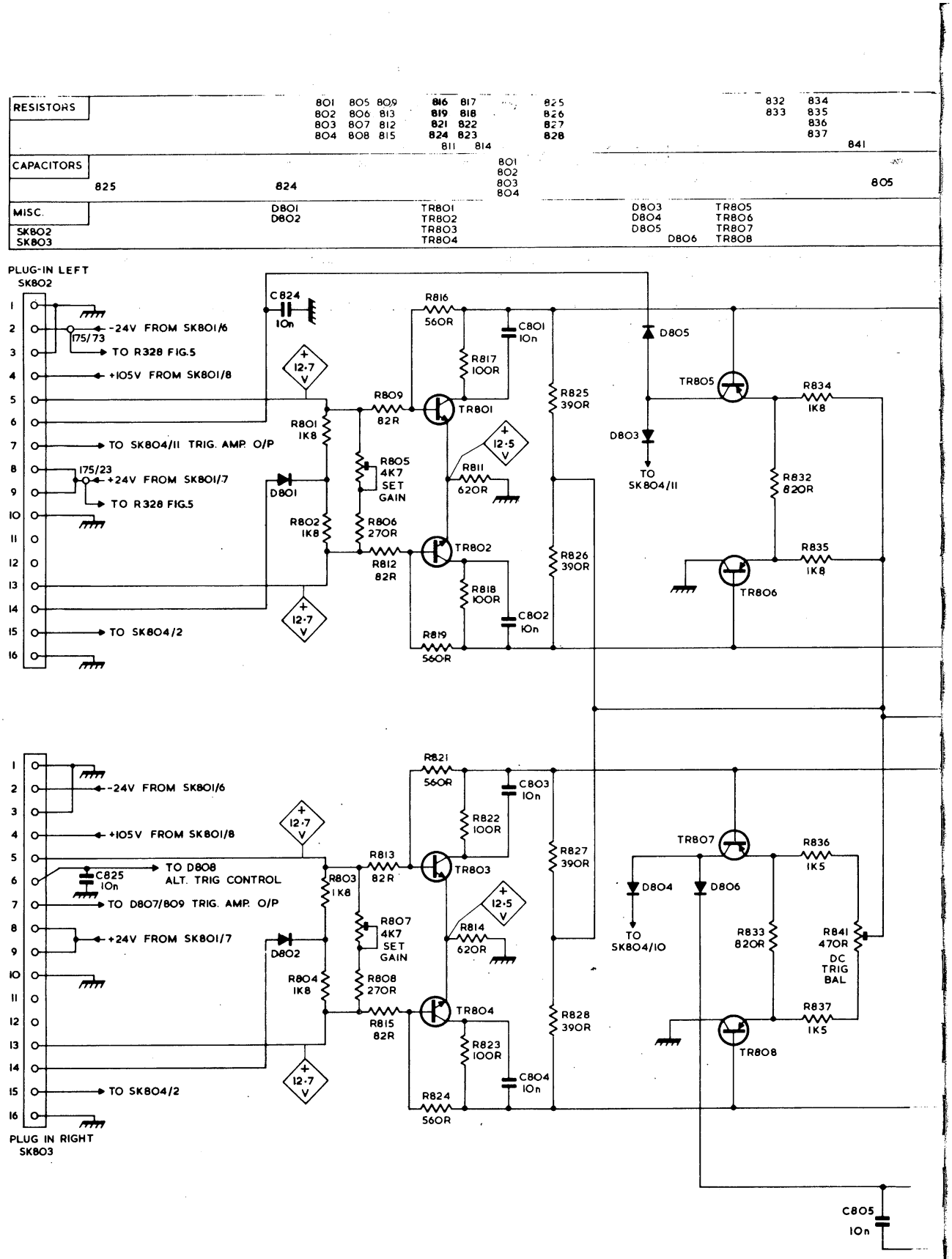
DM63 MECHANICAL ASSEMBLY

CHAPTER 6

CIRCUIT DIAGRAMS AND PC BOARDS

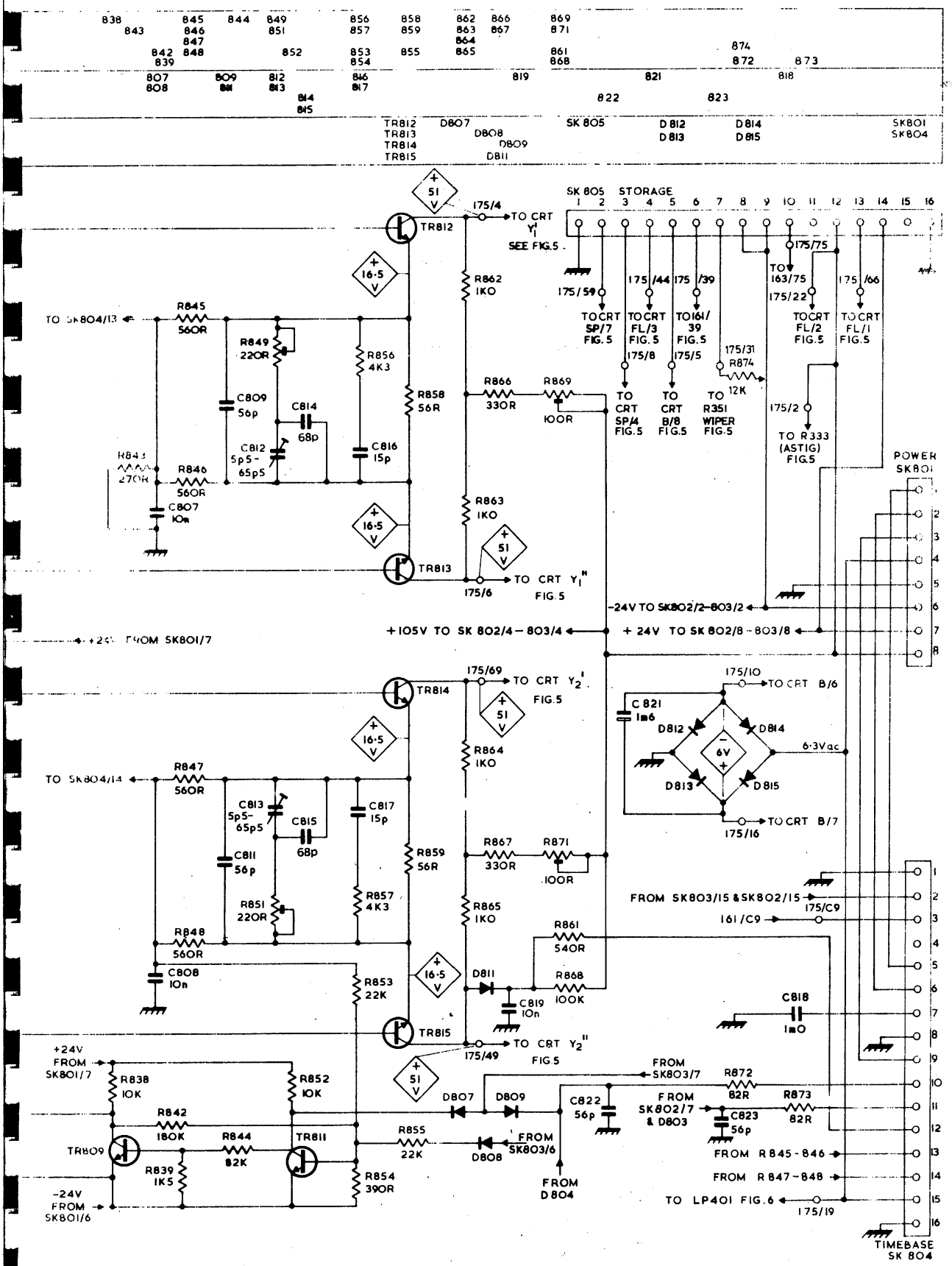
To minimize the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Chapter 5.1, to locate a component in the circuit diagrams, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.



NOTES

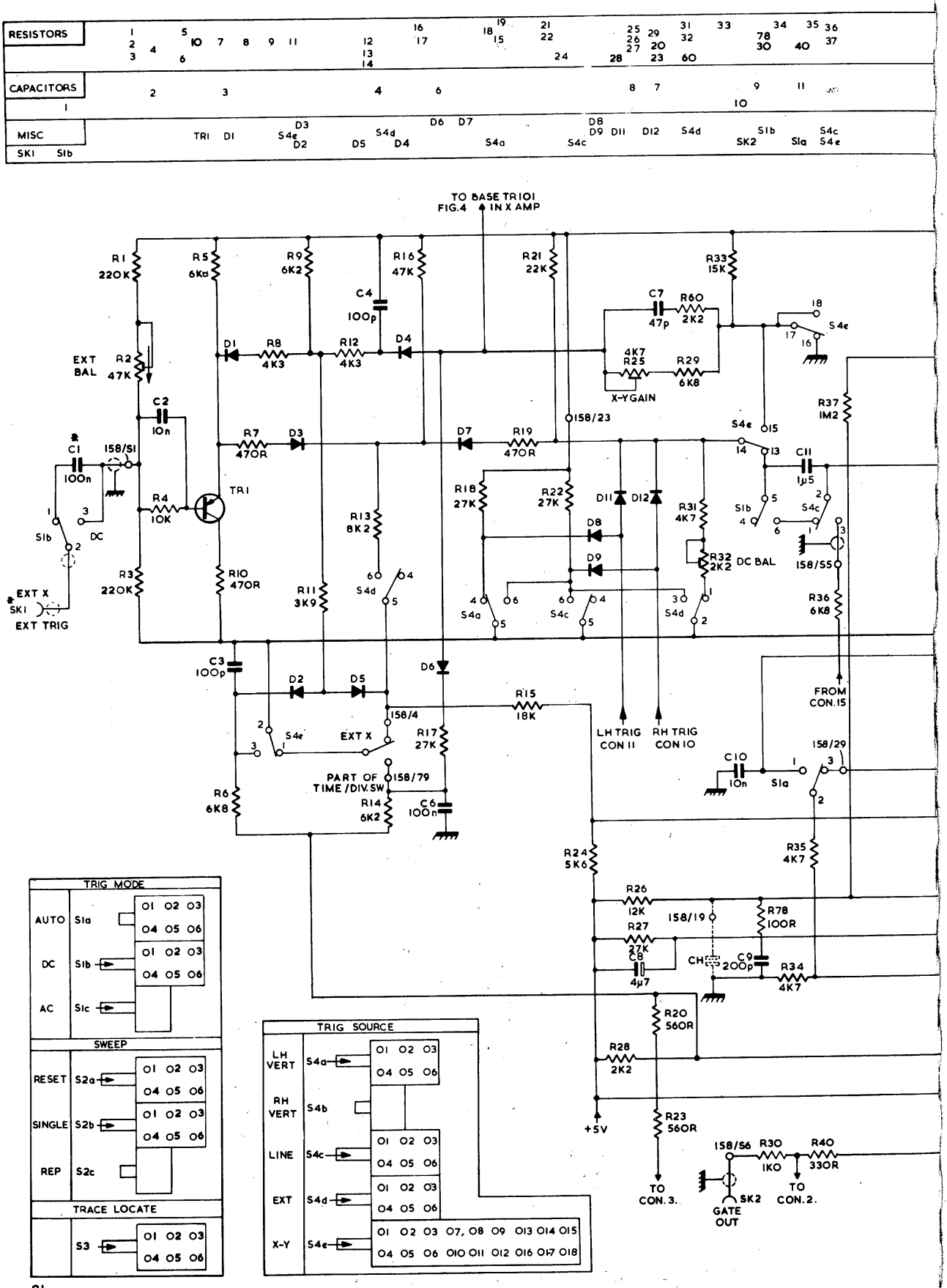
1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD
2. 175/73 DENOTES P.C. BOARD/EYELET OR TERMINAL No. CONNECTION



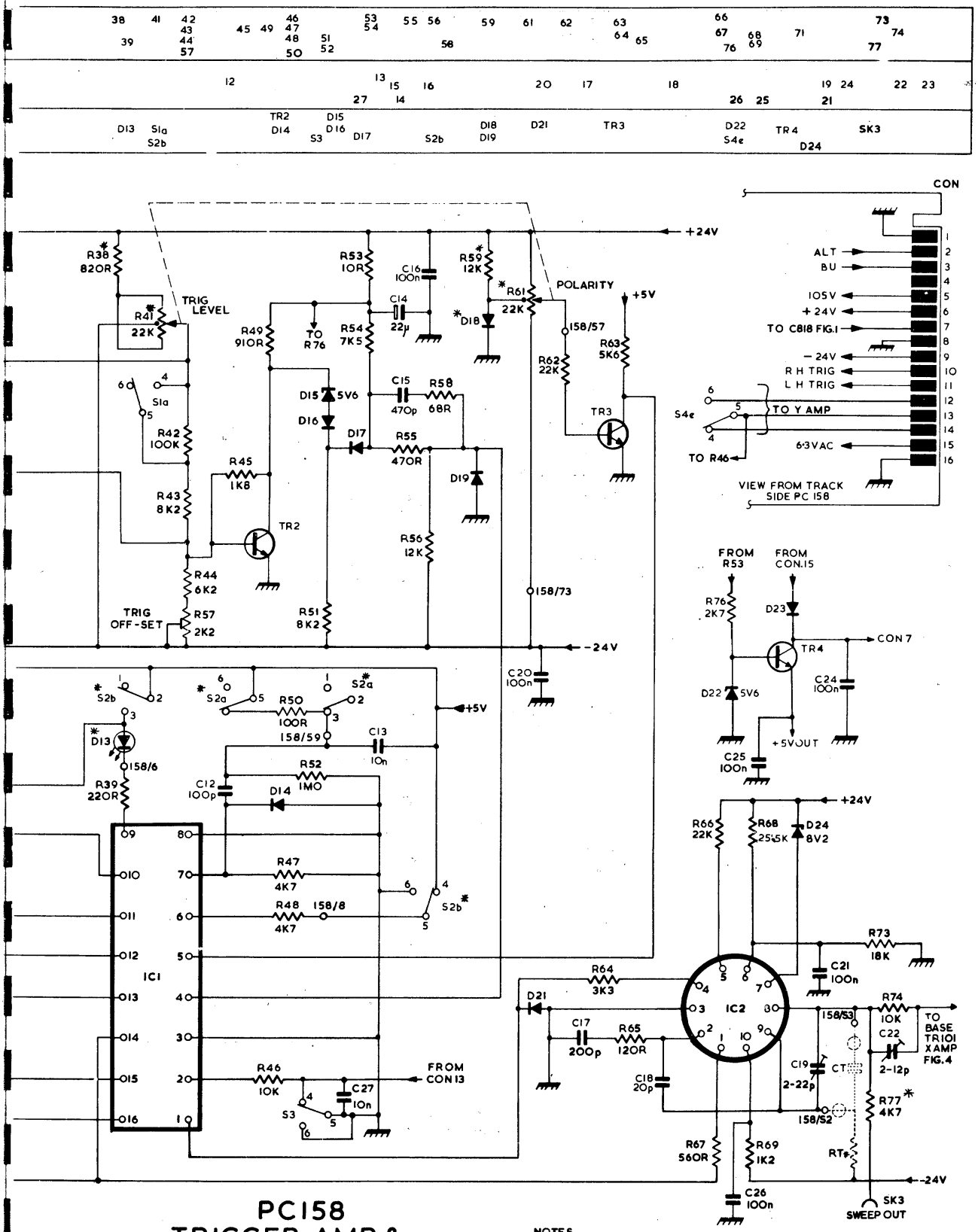
MOTHER BOARD – P.C.175 — DM63

FIG. 1

IR
5/79

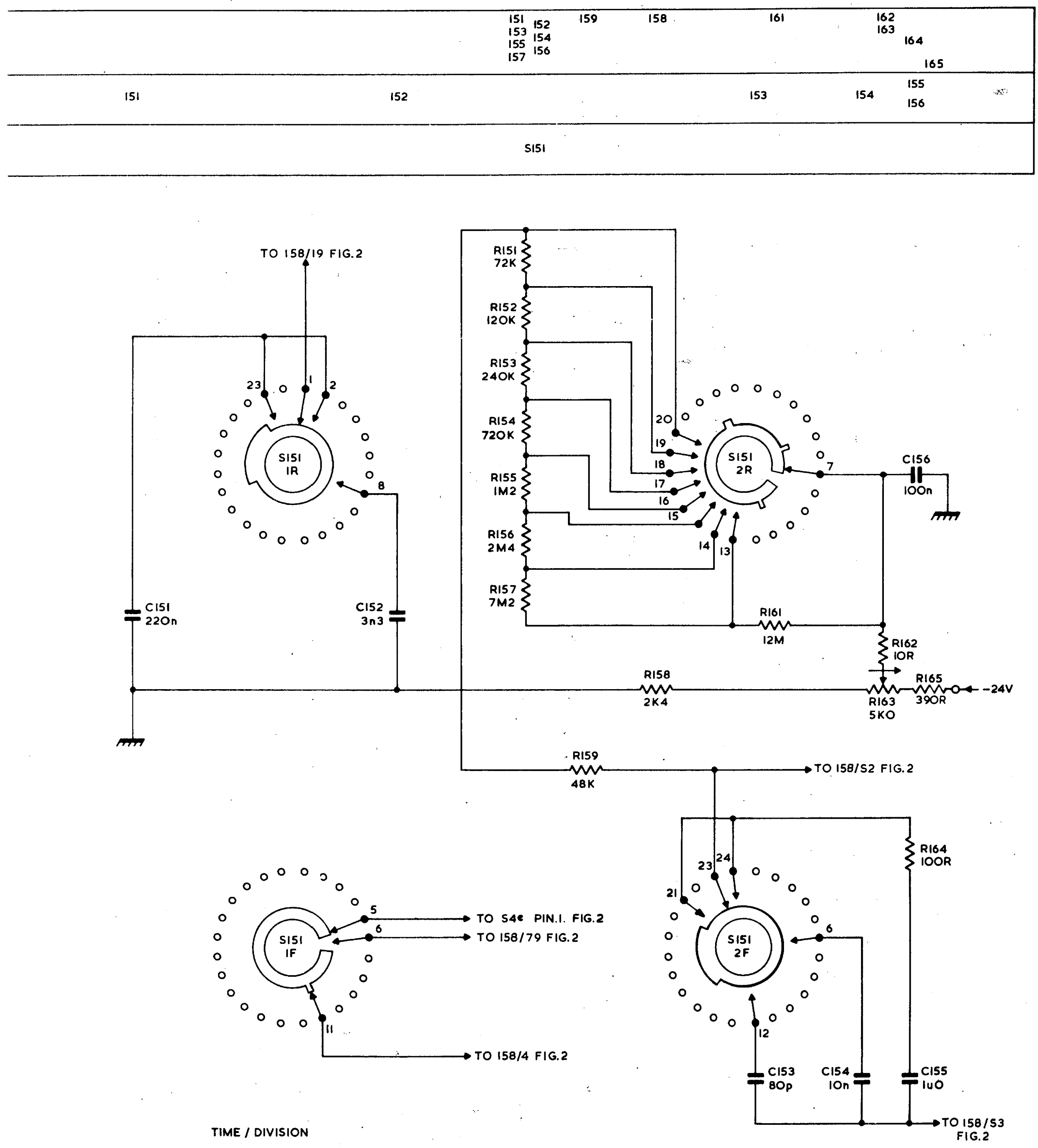

RESISTORS
CAPACITORS
MISC
SK1 S1b
TRI D1 S4e D2 D3 D5 S4d D4 D6 D7 S4a S4c D8 D9 D11 D12 S4d SK2 S1b S1a S4c S4e
TO BASE TRIOI FIG.4 IN X AMP
R1 220K
R5 6K8
R9 6K2
C4 100p
R16 47K
R21 22K
R33 15K
C7 47p
R60 2K2
S4e
EXT BAL
R2 47K
D1
R8 4K3
R12 4K3
D4
4K7 R25
X-Y GAIN
R29 6K8
C2 10n
158/23
R37 1M2
C1 100n
158/51
R7 470R
D3
D7
R19 470R
S4e
C11 1µ5
TR1
R18 27K
R22 27K
D11
D12
R31 4K7
S1b
S4c
R4 10K
R13 8K2
D8
D9
R32 2K2 DC BAL
158/55
S1b
DC
EXT X SK1
EXT TRIG
R3 220K
R10 470R
R11 3K9
S4d
S4a
S4c
S4d
R36 6K8
C3 100p
D2
D5
D6
R15 18K
FROM CON.15
158/4
S4e
EXT X
R17 27K
LH TRIG CON 11
RH TRIG CON 10
C10 10n
158/29
S1a
PART OF TIME/DIV.SW
158/79
R14 6K2
C6 100n
R6 6K8
R24 5K6
R35 4K7
R26 12K
158/19
R78 100R
R27 27K
C8 4µ7
CH
C9 200p
R34 4K7
R20 560R
R28 2K2
+5V
R23 560R
158/56
R30 1K0
R40 330R
TO CON.3.
SK2
TO CON.2.
GATE OUT
TRIG MODE
AUTO S1a
DC S1b
AC S1c
SWEEP
RESET S2a
SINGLE S2b
REP S2c
TRACE LOCATE
S3
TRIG SOURCE
LH VERT S4a
RH VERT S4b
LINE S4c
EXT S4d
X-Y S4e
01 02 03 04 05 06
07, 08 09 013 014 015 010 011 012 016 017 018

2L



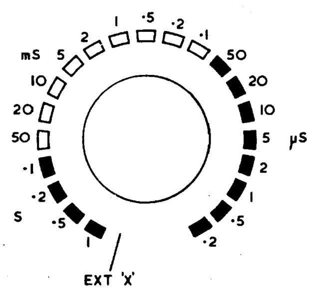
PC158 TRIGGER AMP & SWEEP GENERATOR DM63 FIG.2

NOTES.
1. * INDICATES COMPONENTS NOT MOUNTED ON PC BOARD
2. 158/29 INDICATES PC BOARD/EYELET OR TERMINAL No CONNECTION



NOTES
1. SWITCH IS SHOWN IN FULLY ANTICLOCKWISE POSITION.
2. NUMBER OF POSITIONS 22.

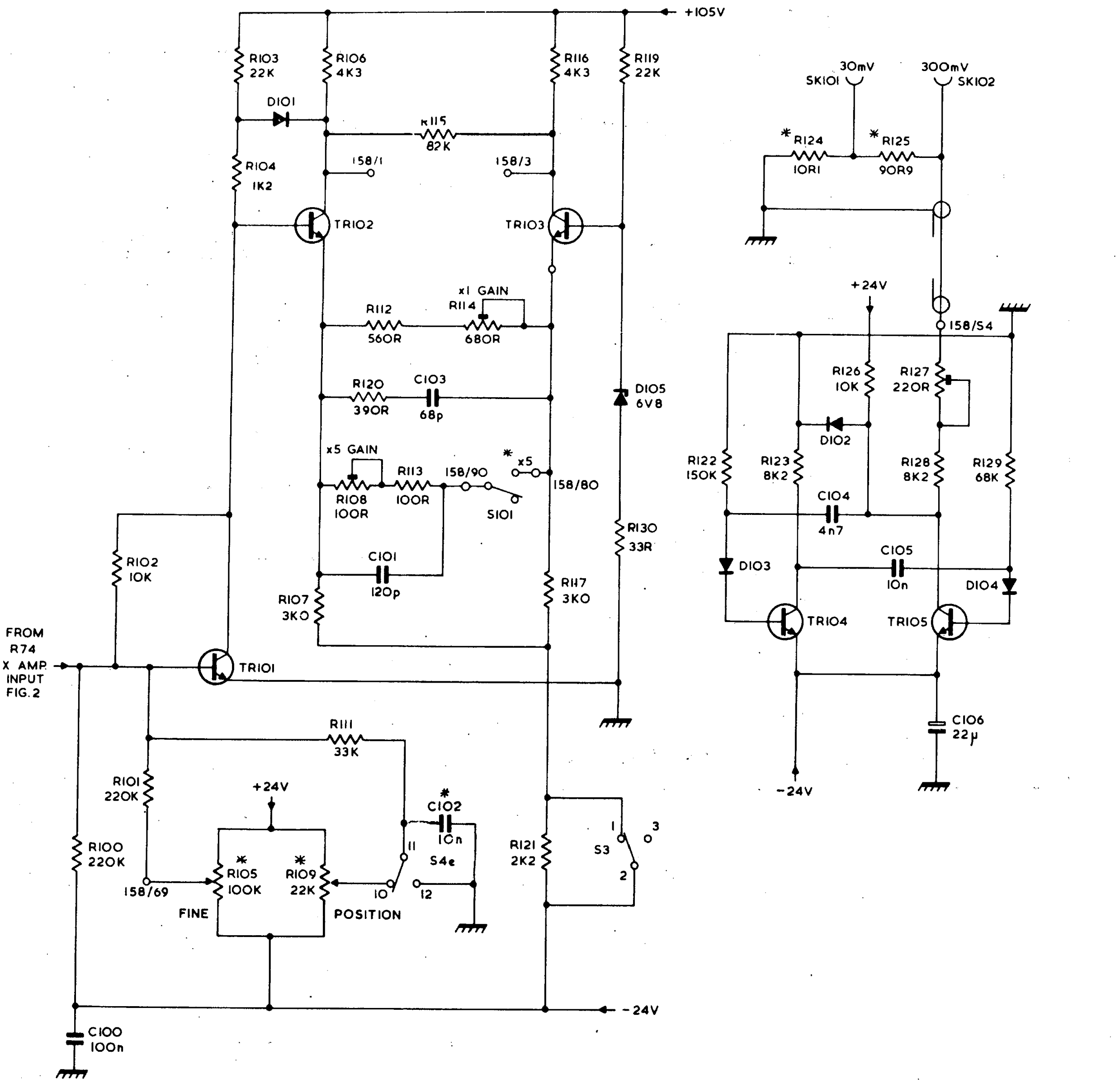
TIME / DIVISION



FRONT PANEL MARKING

TIME / DIV. SWITCH DM63
FIG. 3.

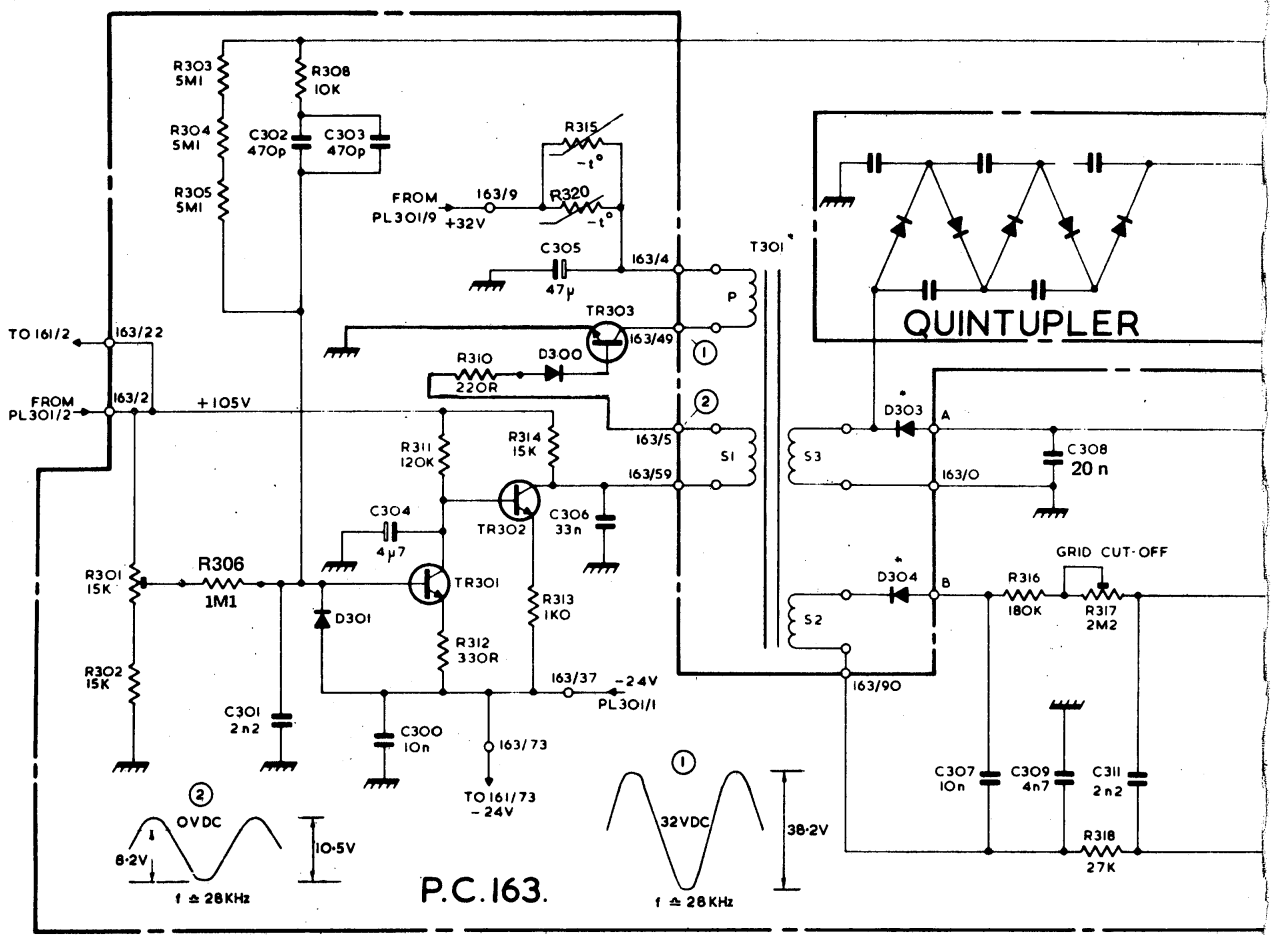
RESISTORS	100 101 102 103 104 105 106 107 108 109 111 112 120 113 115 114 116 117 121 119 130 122 123 124 126 125 127 128 129
CAPACITORS	100 101 103 102 104 105 106
MISC	TR101 D101 TR102 S4e S101 TR103 D105 S3 D103 TR104 D102 SK101 TR105 SK102 D104

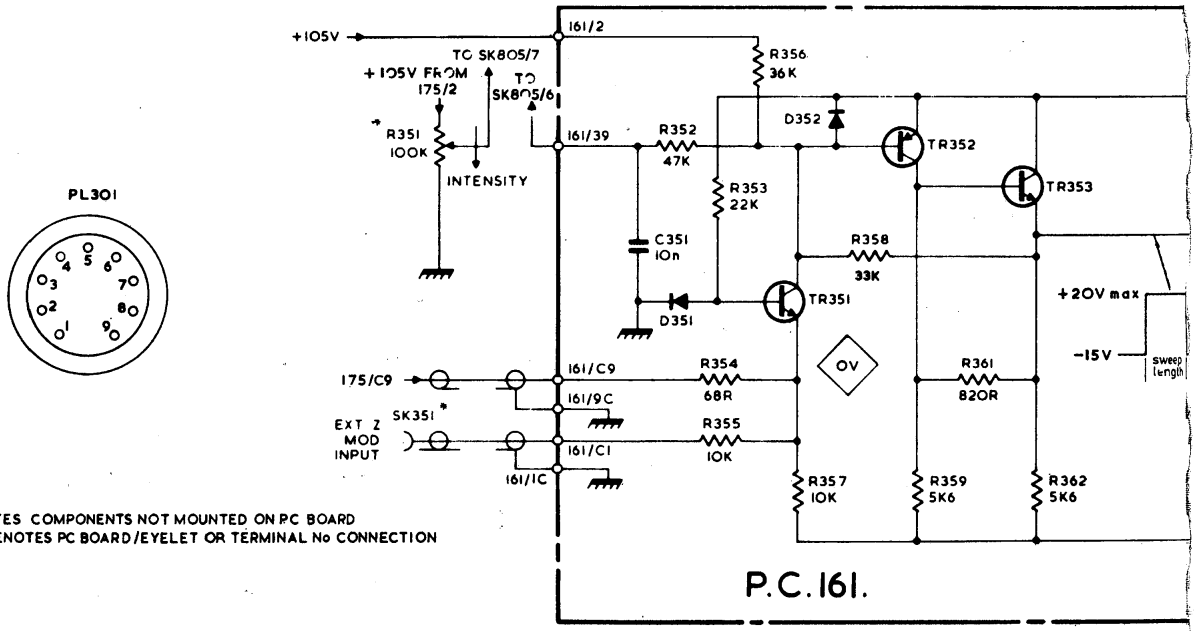


NOTES
1. ✱ DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
2. 158/90 DENOTES P.C. BOARD EYELET OR TERMINAL No. CONNECTION.

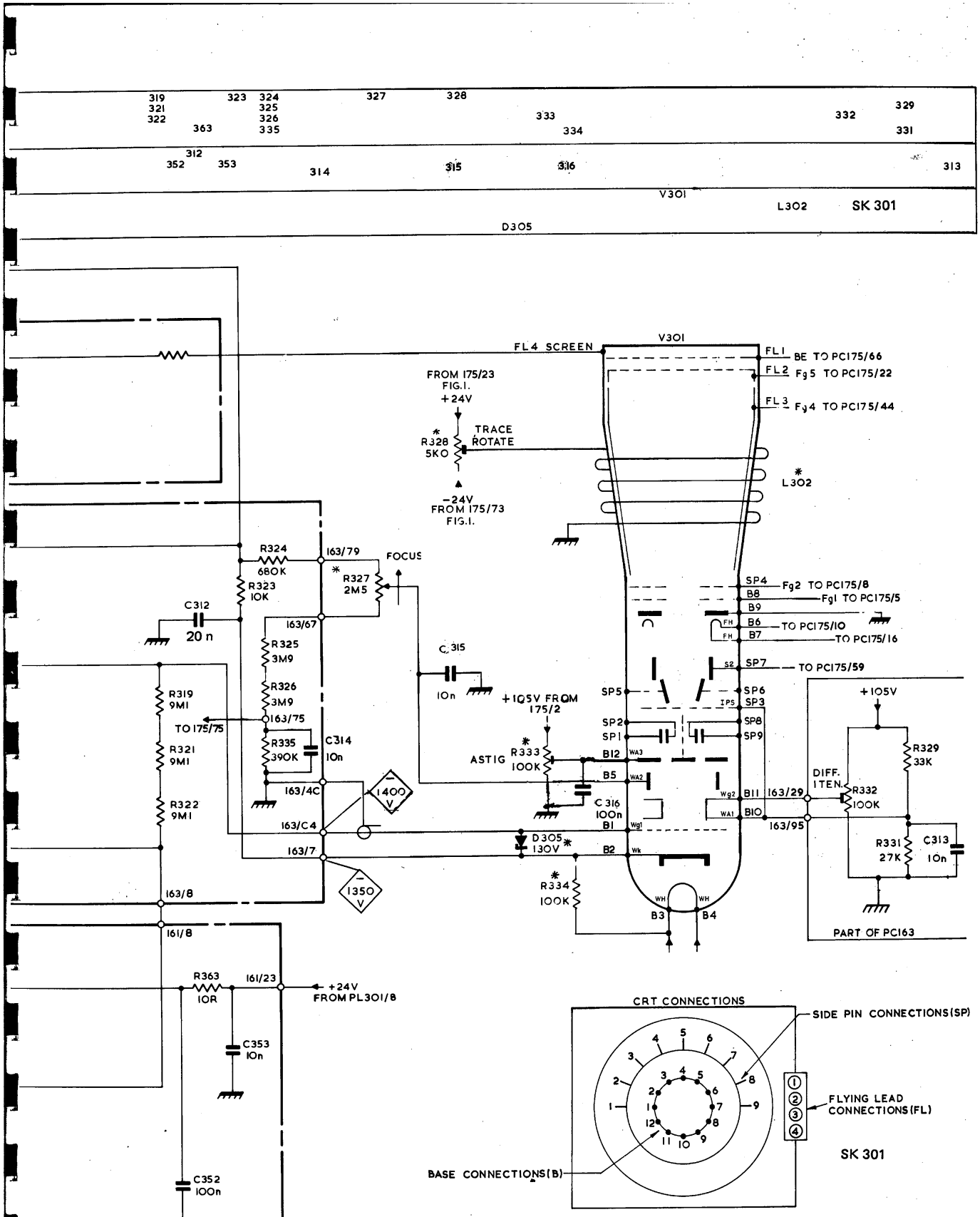
X AMPLIFIER — P.C.158 — CALIBRATOR DM63
FIG. 4

RESISTORS	301 302 303 304 305 306 308 311 312 313 314 315 320 310 351 352 353 354 355 356 357 358 316 359 317 318 361 362
CAPACITORS	301 302 303 304 300 305 306 351 307 308 309 311
MISC.	D301 TR301 TR302 TR303 D300 SK351 T301 D351 D303 D304 TR351 D352 TR352 TR353





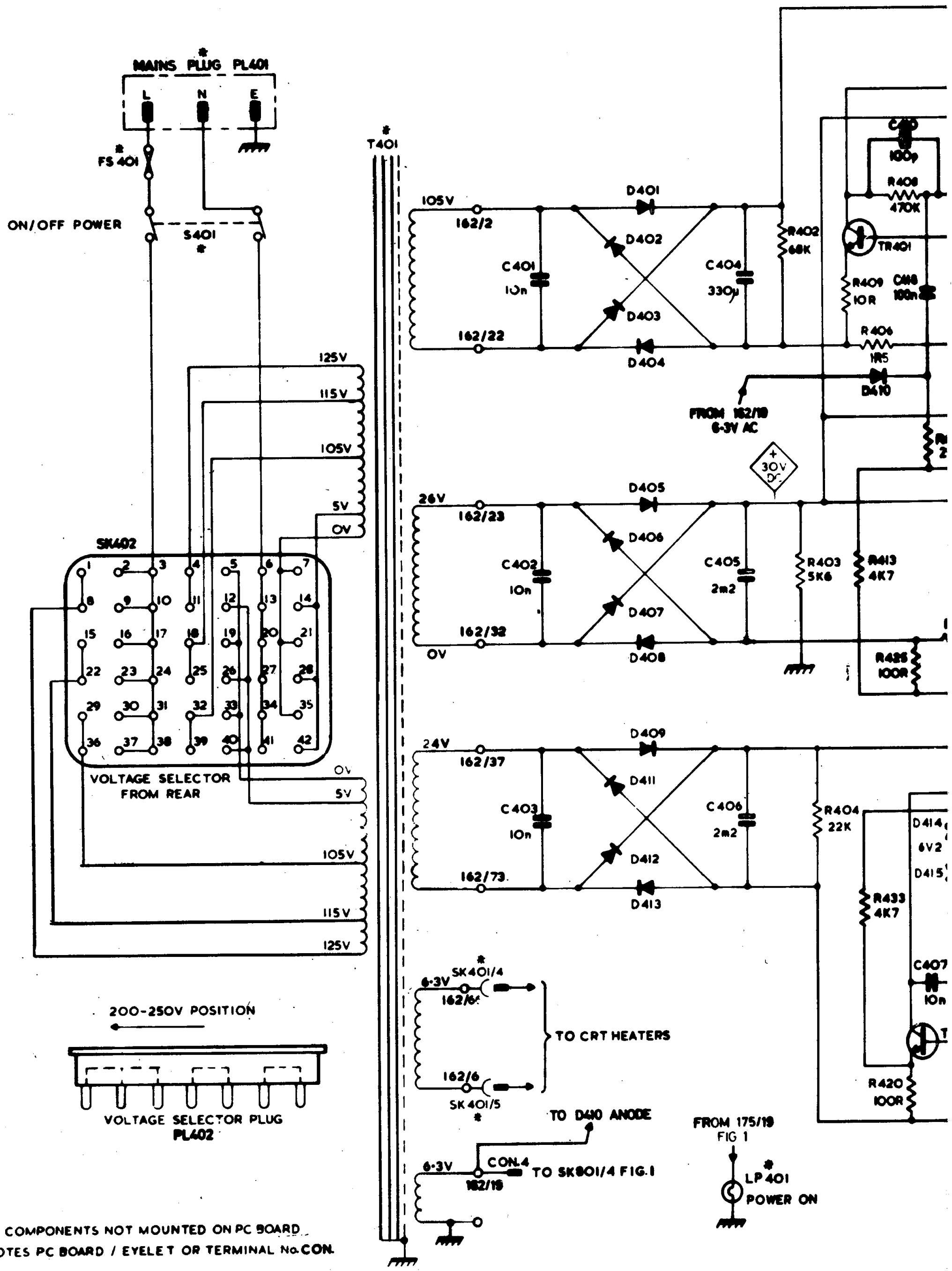
NOTES.
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD
2. 163/2 DENOTES PC BOARD/EYELET OR TERMINAL No CONNECTION



QUINTUPLER EHT - PC163
BRIGHT UP - PC161 & CRT DM63
FIG. 5

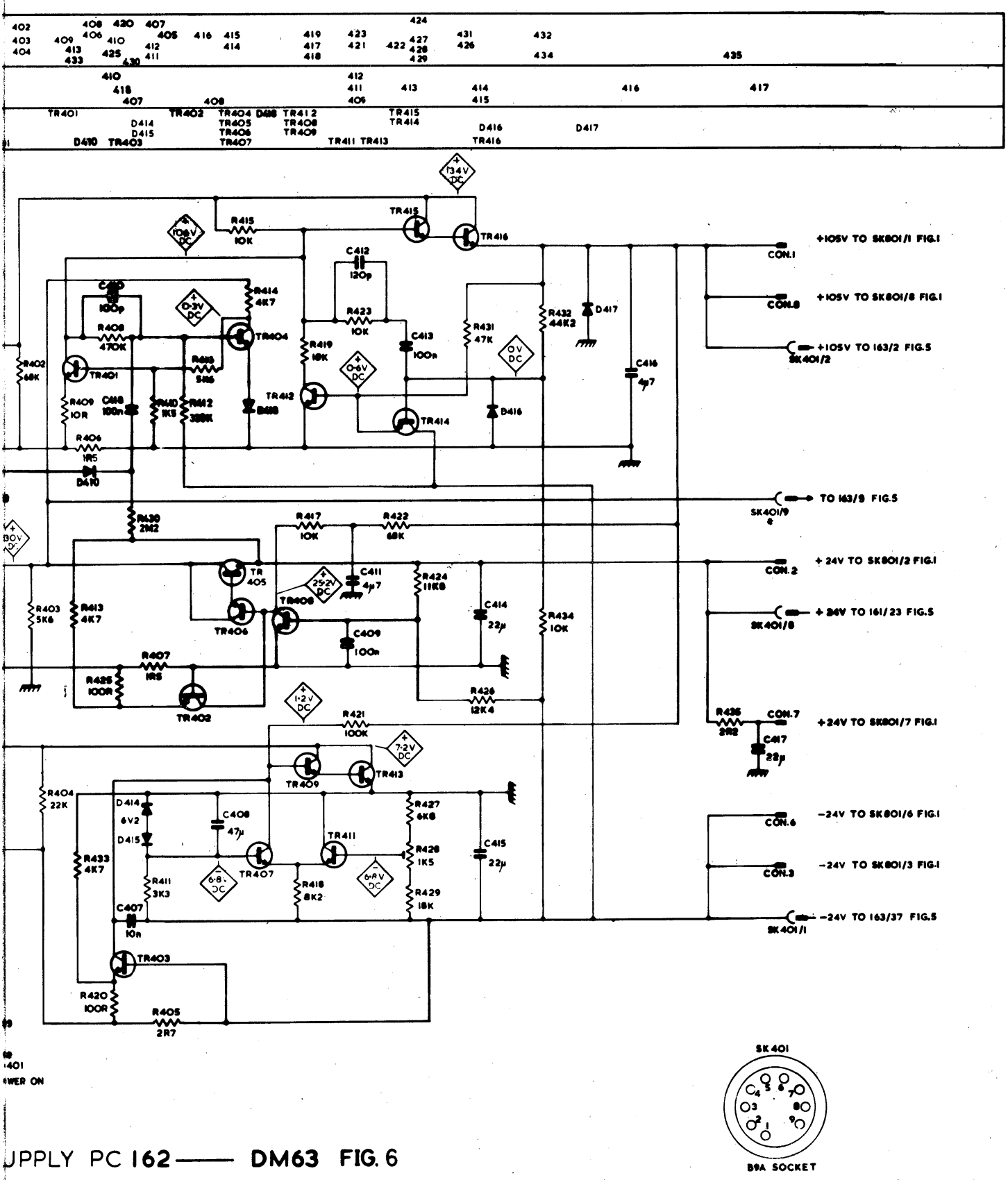
5R
8/79

RESISTORS				402 403 404	409 413 433	408 406 410 425 430	420
CAPACITORS			401 402 403	404 405 406		410 418 407	
MISC.	SK402 FS401 S401 PL402 PL401	T401	D401 D405 D409 D402 D406 D411 D403 D407 D412 D404 D408 D413	LP401	TR401	D410 TR403	D41 D41

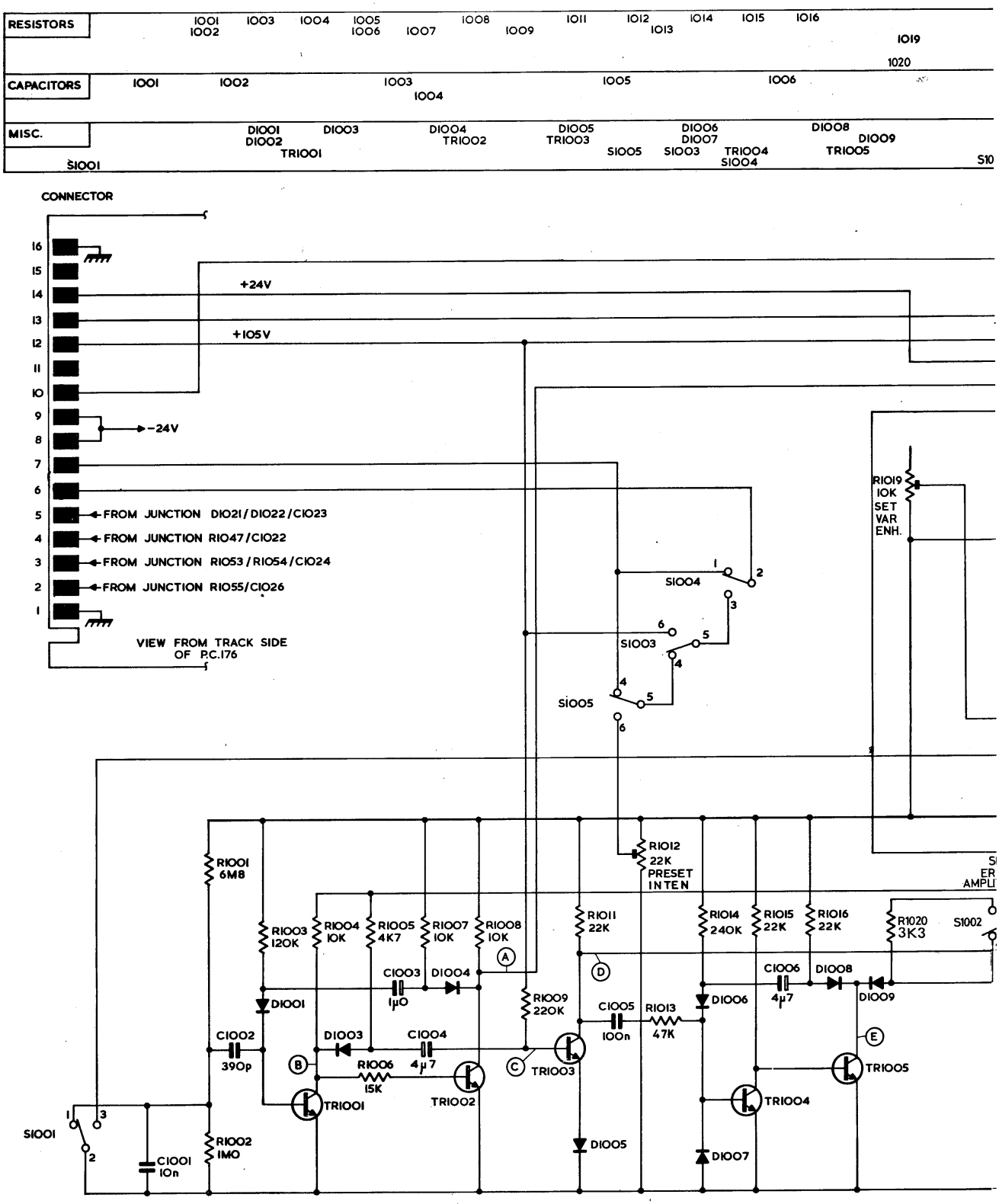


NOTES.
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD.
2. 162/2 DENOTES PC BOARD / EYELET OR TERMINAL No. CON.

POWER SUPPLY PC I

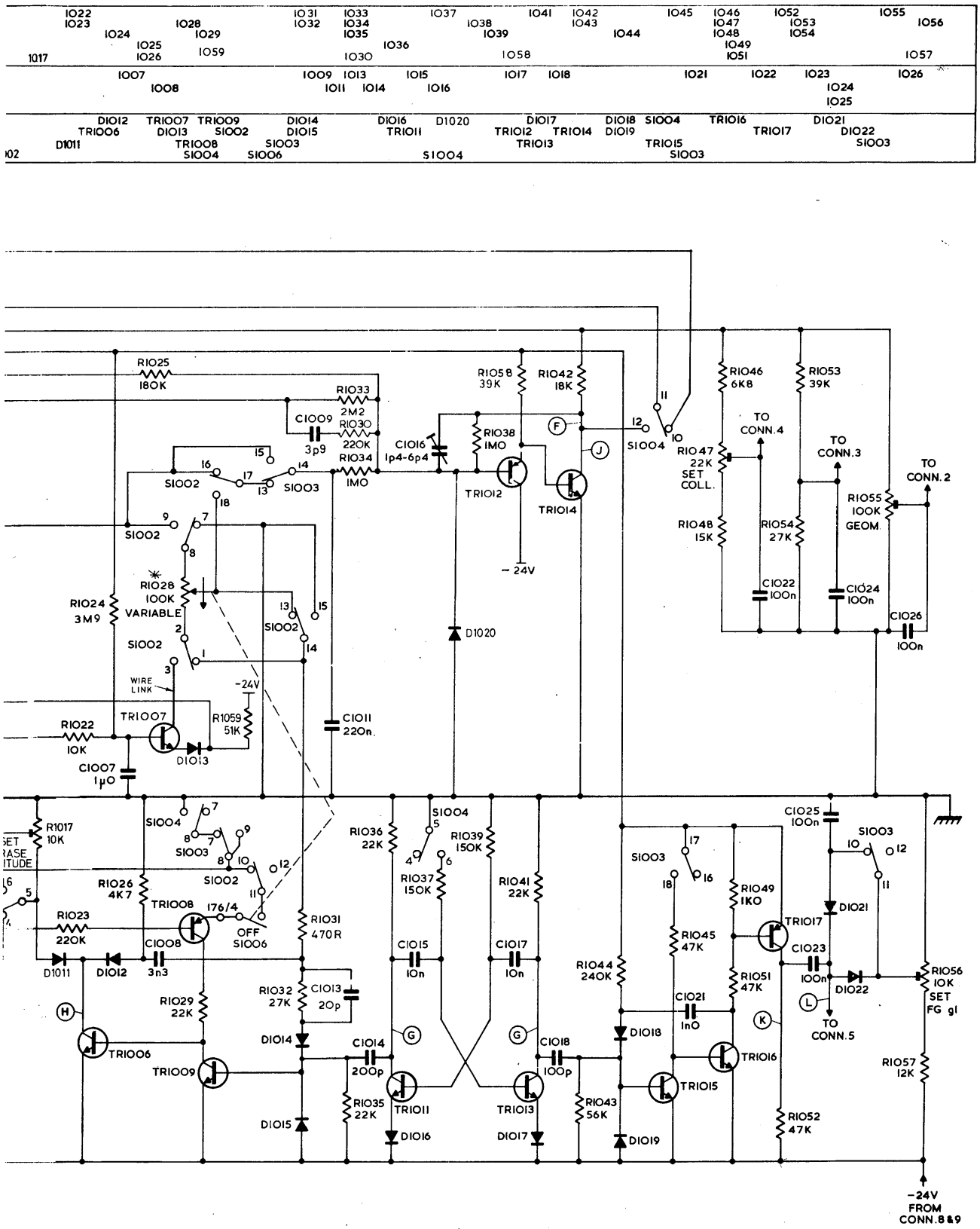


UPPLY PC 162 —— DM63 FIG. 6



NOTES.

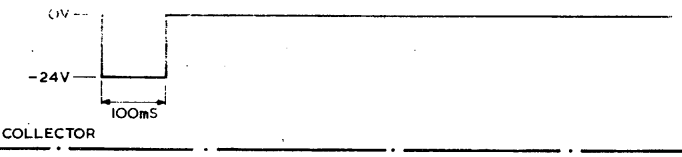
1. 176/4 DENOTES P.C. BOARD EYELET OR TERMINAL No. CONNECTION.
2. ✳ DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD.
3. SKETCH OF SWITCHES IS SHOWN LOOKING FROM COMPONENT SIDE OF P.C.176.

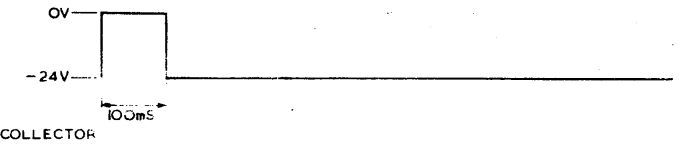


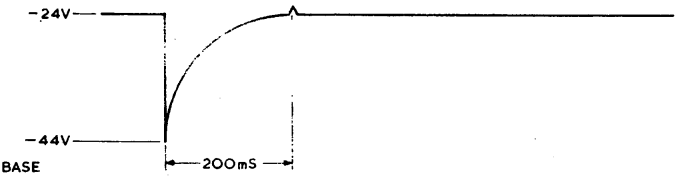
STORAGE CIRCUIT — P.C.176 DM63

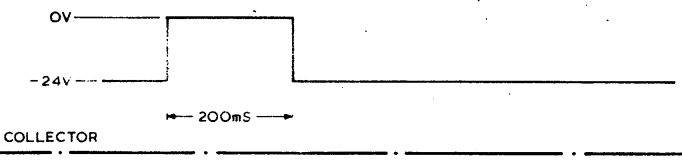
FIG. 7

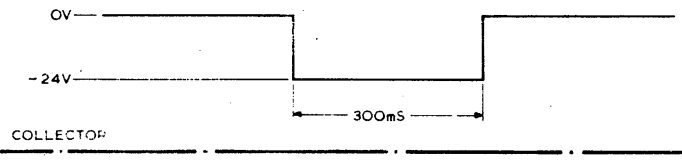
Rev 5/79

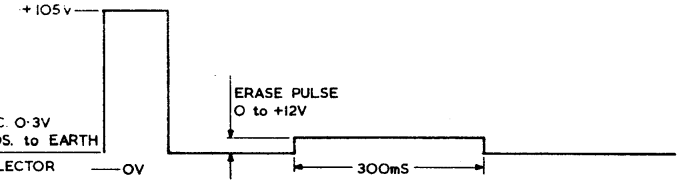


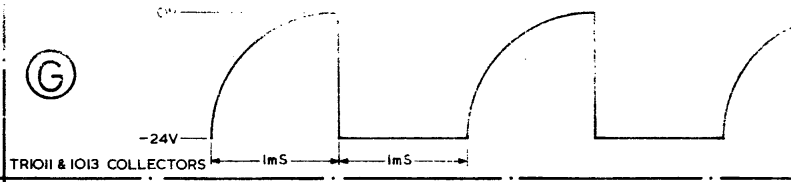


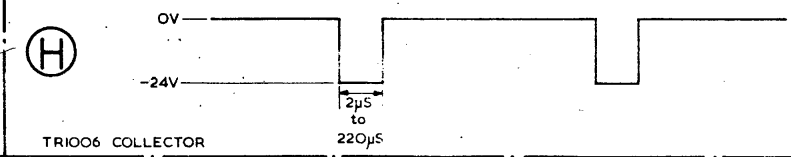


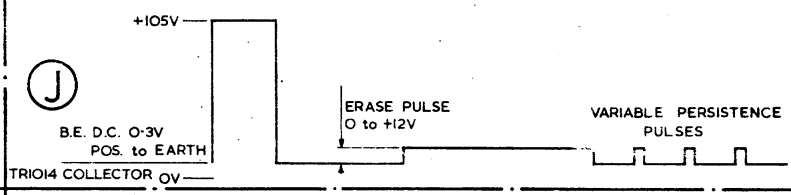


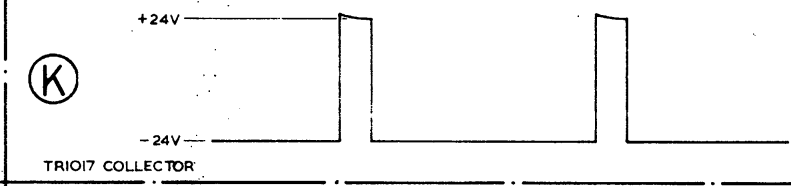


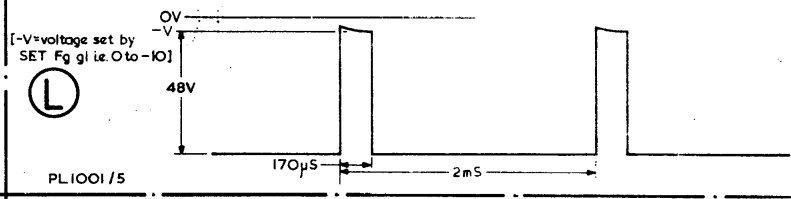








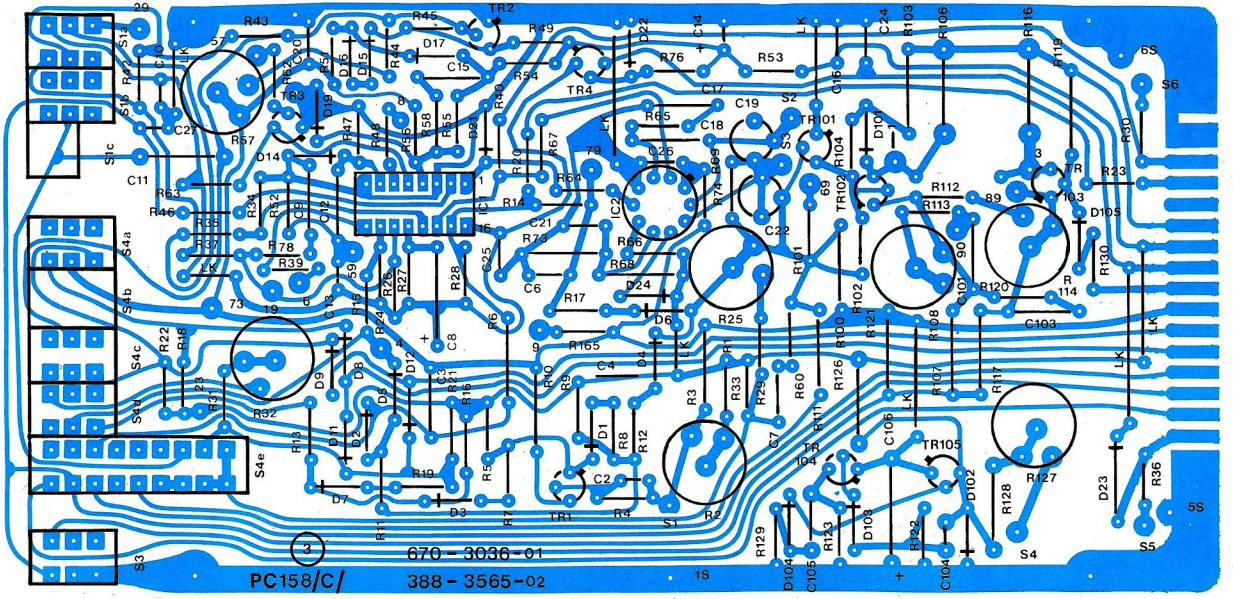




A to F ERASE SEQUENCE ONLY.
G to J VARIABLE PERSISTENCE ON ERASE.
K and L HOLD.
NOTE. ALL MEASUREMENTS ARE APPROXIMATE.

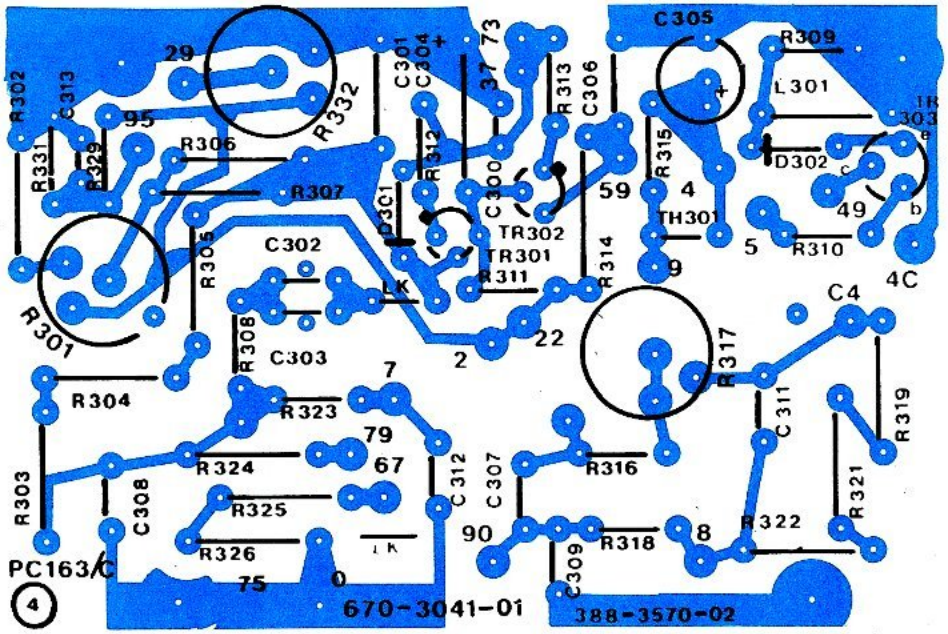
WAVEFORMS DERIVED FROM STORAG

FIG. 8

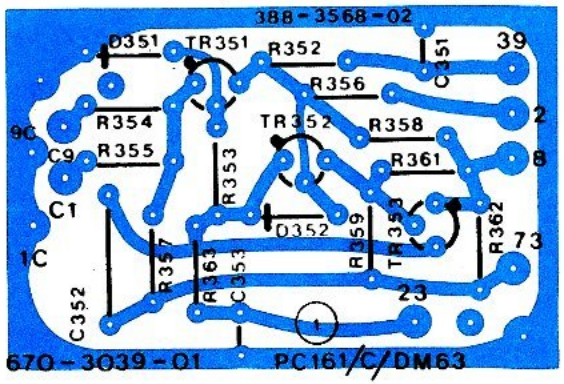


PRINTED CIRCUIT BOARD P.C.158

FIG. 9



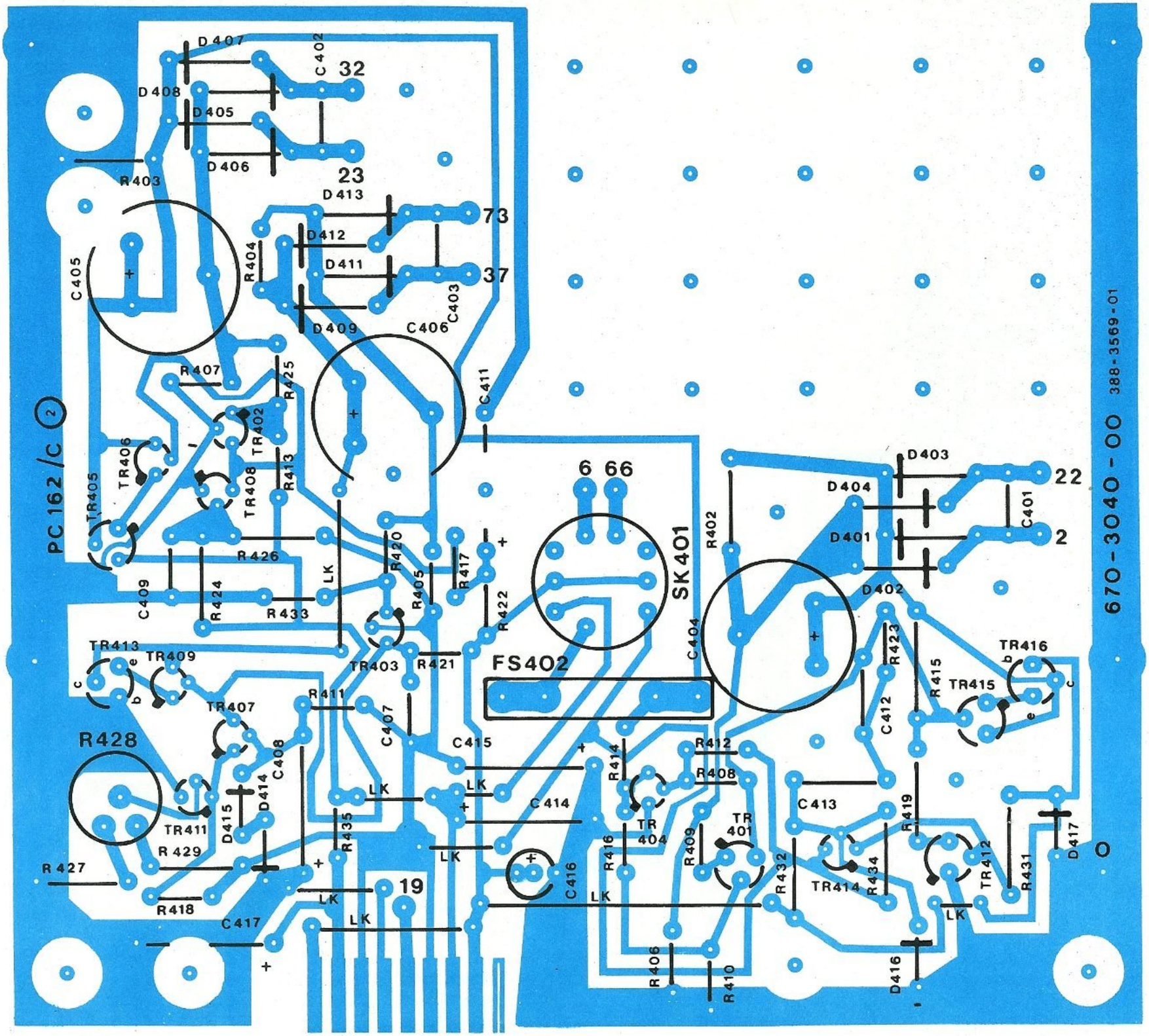
P.C. 163



P.C. 161

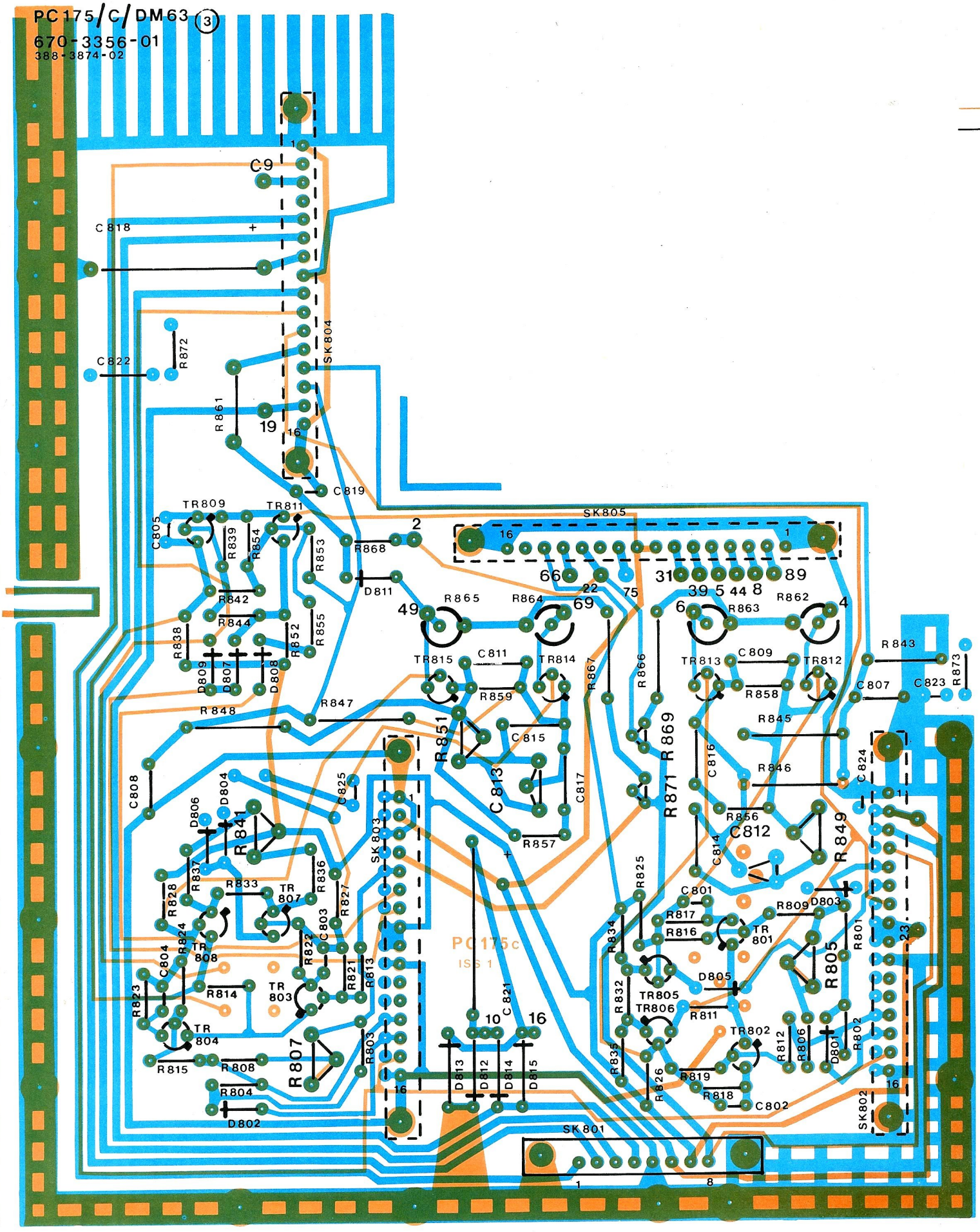
PRINTED CIRCUIT BOARDS

FIG.10



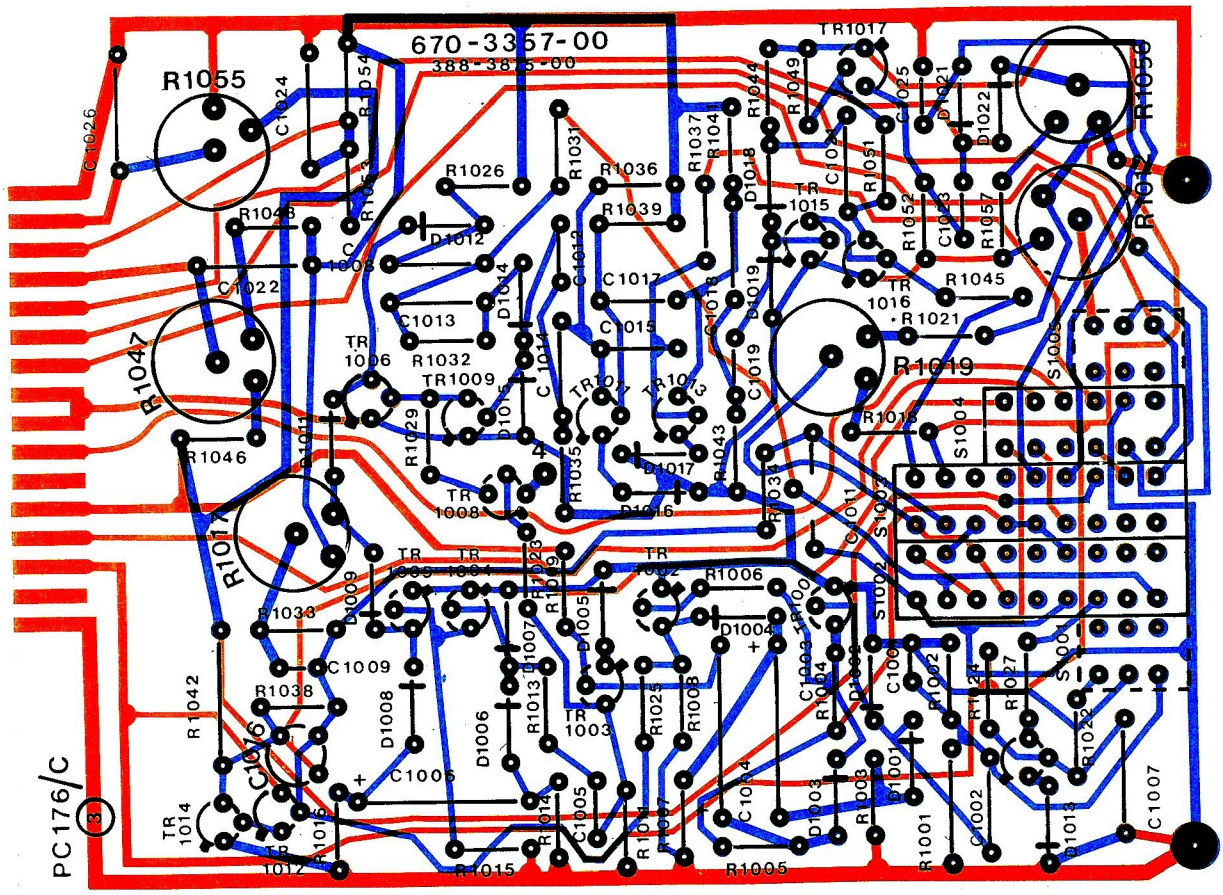
PRINTED CIRCUIT BOARD P.C. 162

FIG. 11



PRINTED CIRCUIT BOARD P.C. 175

FIG. 12



PRINTED CIRCUIT BOARD P.C.176

FIG. 13