TONE GENERATOR
TYPE 4070/01
(Part No. 844070/01)

INSTRUCTION AND MAINTENANCE MANUAL

Supplied for use with
Equipment Serial No.(s)

Made on Order No. 19/5058

Customer's Order No. 3170

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SECTION 1 - INTRODUCTION

This Tone Generator is designed as a low distortion tone source for setting-up levels in the line-up and calibration procedures of an audio system.

Arrangements have been made to reduce the current consumption of the unit when the maximum output is not required.

The mechanical construction of the unit gives maximum accessibility to all components, and the unit may be inserted into either a console installation or a rack mounting frame.

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SECTION 2 - SPECIFICATION

Frequency

900 c/s ±45 c/s

Output Impedance

Less than 50 ohms ±j10 ohms

Output Isolation

Greater than 50 dB

Output Level

0 to +20 dBm into 600 ohm load.
Continuously variable

Distortion

Less than 0·5% at +20 dBm High Current
" " 0·5% " 0 dBm Low Current

Stability

Long Term within less than ±0·5 dB
Short Term within " " ±0·3 dB

Supply Requirements

For +20 dBm Output 16V d.c. 300 mA
" 0 dBm " 16V d.c. 130 mA

Approximate Overall Dimensions

Height 3 inches (7½ cm)
Width 3 inches (7½ cm)
Depth 9¼ inches (23½ cm)

Approximate Weight

2 lb 2 ozs (1 kg)

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SECTION 3 - INSTALLATION AND SETTING-UP

3.1 PREPARATION

Arrangements are made in this unit for the current consumption to be reduced when less than maximum output is required.

The reduction in current consumption is effected by the connections between pins 5 and 13 on the receptacle connector, and the instructions which follow should be observed.

Determine the output level at which the unit will be required to operate, and

(i) if a high output is required pins 5 and 13 should be short circuited, but

(ii) if a low output (i.e. at a level which is less than 0 dBm) is required the pins should be left open circuited, or

(iii) if an intermediate output is required, then a resistor of suitable value and rating should be inserted between the pins.

If the unit is to be used as an addition to an existing installation, fix the receptacle plate (plus any additional screens which may be necessary), and wire the connector in accordance with the instructions contained in the appendix "Unit Mounting and Wiring Techniques".

Where a group of units is to be inserted forced cooling is advisable.

3.2 INSERTION

When ready to insert the unit(s) observe the following:

(a) Always check the B- polarity to ensure that it agrees with the circuit requirements.

(b) Check the B- voltage.

(c) Check that the fuse is secure in its clip.

(d) ALWAYS switch off the power supplies before inserting the unit.

(e) To insert the unit, grasp the handle and press the unit into the frame until the catch in the handle area engages. Apply a gentle pull to ensure the unit is securely in position.

(f) Switch on the B- supply. Check that there is a signal at the output of the unit, and again check the B- voltage which should be 16V ±1V.

(g) If it is necessary to remove the unit: then grasp the handle so as to lift up the small catch, and the unit may then be pulled out.

3.3 CONTROLS

The gain control, which varies the output from zero to maximum, is mounted centrally on the front panel of the unit and is marked 'LEVEL'.

The SET STABILITY control is preset, and is mounted internally. The control is adjusted before the unit leaves the factory and normally does not require further adjustment. If, however, the setting of the control has been altered, or it becomes necessary to replace a component in the oscillator stage or the control circuit, it would be advisable to carry out the setting-up procedure as outlined in the following:

(a) Set the LEVEL control to maximum and connect together pins 5 and 13 on the receptacle socket.

(b) Adjust the SET STABILITY control to give an output level of +21 dBm into a 600 ohm load.

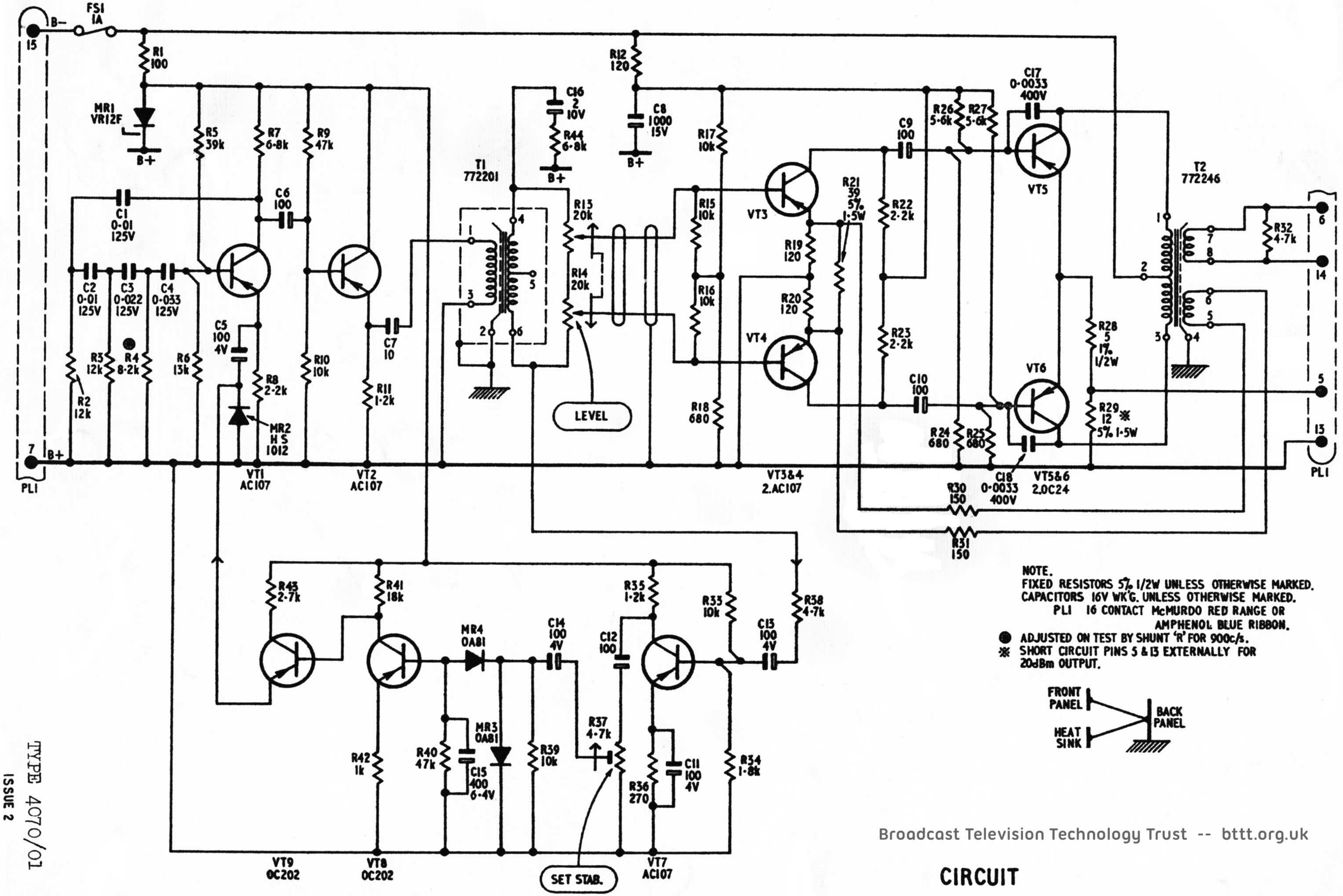
(c) Ensure that the output frequency is 900 c/s ±45 c/s. If the output frequency is not within the specified tolerance then adjust R4 by shunt resistors until the correct frequency is obtained. *

(d) Link the pins 5 and 13 as described in Section 3.1 and

(e) adjust the LEVEL control to give the desired output.

*NOTE: The output frequency may be tested by comparing, on an oscilloscope, the output waveform of the unit with the 900 c/s waveform of a test oscillator of known accuracy.

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NOTE.
FIXED RESISTORS 5% 1/2W UNLESS OTHERWISE MARKED.
CAPACITORS 16V WK'G. UNLESS OTHERWISE MARKED.
PL1 16 CONTACT McMURDO RED RANGE OR AMPHENOL BLUE RIBBON.
● ADJUSTED ON TEST BY SHUNT 'R' FOR 900c/s.
※ SHORT CIRCUIT PINS 5 & 13 EXTERNALLY FOR 20dBm OUTPUT.

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CIRCUIT

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SECTION 4 - TECHNICAL DESCRIPTION

4.1 THE OSCILLATOR SECTION

Basically the oscillator is a phase-shift oscillator which has four phase-shifting elements between the collector and base of a single transistor (VT1). The output from VT1 is resistance-capacitance coupled to the base of a common collector stage (VT2). The B- potentials applied to the two stages are stabilised by the zener diode MR1 and the resistor R1. From the emitter of VT2 the signal passes to T1 (the output section drive transformer) and to the LEVEL control R13 and R14.

A sample of the oscillator output signal is taken from the secondary of T1 and fed into VT7 for oscillator stabilisation, the action being as described in the next sub-section.

4.2 THE STABILITY CONTROL SECTION

To ensure a constant output voltage a form of automatic gain control is employed in the unit.

The common emitter amplifier stage VT7 is followed by R37, the SET STABILITY potentiometer. R37 is preset to adjust the gain of the control circuit. The amplified signal is rectified in a voltage doubling circuit which operates in the following manner:

On positive half-cycles MR3 conducts and C14 is charged proportionately to the value of the signal from R37, on negative half-cycles MR4 conducts and C15 is similarly charged.

The charge across C14 and R37 is in series with respect to C15 and the potential of the d.c. now fed to VT8 is approximately double that rectified from the signal fed via R37. This rectified potential, the amplitude of which is proportional to the amplitude of the output voltage from the oscillator, is then amplified by the d.c. amplifier VT8 and VT9.

The amplified voltage is now applied to a silicon diode (MR2). The diode is connected in series with C5, the by-passing capacitor for R8, which is the emitter resistor of VT1.

The forward impedance characteristic of a silicon diode varies logarithmically and inversely with the linear value of forward bias, advantage of that fact is taken in this stage by causing the silicon diode to vary the decoupling in the emitter circuit of VT1. If, for instance, the output from the oscillator increases, the bias at the control point (the junction of C5 and MR2) becomes less and MR2 causes C5 to become more decoupled, a high degree of negative feedback is then applied to the oscillator circuit with a consequent reduction in output from that stage. When the stage output is decreased a reverse action of the automatic gain control takes place until equilibrium is restored.

4.3 THE OUTPUT SECTION

The output from the oscillator section is fed into the phase splitting transformer T1, and via the LEVEL control R13 and R14 to two stages of class A push-pull arranged in common emitter configuration, the two pairs being VT3 - VT4 and VT5 - VT6, with the output from the latter pair feeding directly into the output transformer T2. The capacitors C17 and C18 reduce the loop gain of those frequencies which are above the audio spectrum.

Negative feedback from the secondary of the output transformer is applied to the emitters of VT3 and VT4.

Provision for altering the bias arrangements of the output stage to suit individual requirements is made. The connections of R29 are brought out to pins 5 and 13, and as described in Section 3, suitable connections can be made across these pins to reduce the current consumption when low signal output is required.

4.4 RATING AND COOLING

All components, including semiconductors, are operated well within their maximum ratings. Extreme ambient temperature conditions have been considered and a wide ambient temperature range is therefore possible. Cooling of the power transistors is assisted by the heat dissipation coefficient of the heat sink, and the unit as a whole is cooled by convection in the surrounding air.

Attention is drawn to the appendix "Maintenance Precautions on Semiconductor Units".

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SECTION 5 - MAINTENANCE AND FAULT FINDING

NOTE: Before commencing any checking, fault finding or other maintenance work, see the appendix 'Maintenance Precautions on Semiconductor Units'.

5.1 ACCESS TO COMPONENTS

To obtain access to components inside the unit:
unscrew the knurled posts at the rear of the unit, and remove the screw at the opposite (front) end of the members that held the knurled posts. Loosen the screws at the base of the unit to prevent binding, and carefully hinge out the sides of the unit on to some flat surface so as not to strain the cableform.

5.2 VOLTAGE AND CURRENT ANALYSIS

(See the warning given at the head of this section).

The location of faults will be facilitated by making checks at the points given in the following analysis table. The figures given are those measured on a typical unit and figures measured on other units may vary slightly from one unit to another. Deviations from the figures given are not necessarily indicative of faults, but if the supply voltage is set to within the specified tolerance any wide divergency should be investigated.

Conditions

All voltage readings on this unit have been taken with respect to the positive rail, under normal working conditions with pins 5 and 13 on PL1 linked, the meter used having a sensitivity of 20,000 ohms per volt and the readings taken on the meter range quoted.

The abbreviations used in the table are:
e = emitter b = base c = collector

Circuit	Location	Meter Range Volts	Measurement Volts
VT1	e	10	2·8
	b	10	2·9
	c	10	3·8
VT2	e	2·5	1·9
	b	2·5	1·8
	c	25	12·5

Circuit	Location	Meter Range Volts	Measurement Volts
VT3	e	2·5	0·5
	b	2·5	0·6
	c	10	6·5
VT4	e	2·5	0·5
	b	2·5	0·6
	c	10	6·5
VT5	e	2·5	1·2
	b	2·5	1·4
	c	25	15·5
VT6	e	2·5	1·2
	b	2·5	1·4
	c	25	15·5
VT7	e	2·5	1·6
	b	2·5	1·7
	c	10	5·9
VT8	e	-	-
	b	-	-
	c	2·5	1·5
VT9	e	2·5	0·8
	b	2·5	1·5
	c	2·5	0·9
I_{B-}			260 mA

5.3 RESISTANCE OF WINDINGS

All values are ±10% tolerance

Transformer T2

Pins	1 - 2	2 ohms
"	2 - 3	2 "
"	5 - 9	25 "
"	9 - 6	25 "
"	7 - 8	10 "

5.3.1 High Permeability Cored Transformers

WARNING

D.C. resistance measuring devices and continuity checking equipment, e.g. Avometers should not be used for checking the resistance or continuity of certain transformer windings. The reason for this and the treatment to be applied if d.c. is accidentally used are dealt with in the Appendix 'De-magnetisation of High Permeability Cores', bound in with this manual.

The transformer(s) to which this warning applies are listed below, together with the inductance of the windings, the voltage and frequency at which it is measured, the r.m.s. demagnetising voltage, and the pins to which this voltage is applied.

Circuit Ref.	Inductance/Voltage/Frequency	Demagnetising Volts	Pins
T1 Primary	≠ 175 H / 0·2 / 50 c/s	33	1 - 3

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PARTS LIST
FOR
TONE GENERATOR
TYPE 4070/01

Item				Pye Part No.	Manufacturer	Type
6.1 RESISTORS						
5	ohms	±1%	½W	NC05066	Painton	93
12	"	±5%	1½W	PE12059	"	MV1A
39	"	"	"	PE39059	"	"
100	"	"	½W	PE10167	Electrosil	CJ20
120	"	"	"	PE12167	"	"
150	"	"	"	PE15167	"	"
270	"	"	"	PE27167	"	"
680	"	"	"	PE68167	"	"
1k	"	"	"	PE10267	"	"
1·2k	"	"	"	PE12267	"	"
1·8k	"	"	"	PE18267	"	"
2·2k	"	"	"	PE22267	"	"
2·7k	"	"	"	PE27267	"	"
4·7k	"	"	"	PE47267	"	"
5·6k	"	"	"	PE56267	"	"
6·8k	"	"	"	PE68267	"	"
8·2k	"	"	"	PE82267	"	"
10k	"	"	"	PE10367	"	"
12k	"	"	"	PE12367	"	"
13k	"	"	"	PE13367	"	"
18k	"	"	"	PE18367	"	"
39k	"	"	"	PE39367	"	"
47k	"	"	"	PE47367	"	"
4·7k	"	Linear Pot.		811530	Plessey	MH2-LIN
20k+20k		Log Pot.		PL02462	"	ECZ LOG
6.2 CAPACITORS						
0·0033µF		±10%	400V	653616	Mullard	C296AC/A3K3
0·01	"	"	125"	653600	"	C296AA/A10k
0·022	"	"	125"	653602	"	C296AA/A22k
0·033	"	"	"	653603	"	C296AA/A33k
2		"	-10+100 10V	680302	"	C426AN/D2
10		"	-10+50 16"	680307	"	C426AM/E10
100		"	" 4"	680316	"	C426AM/B100
100		"	" 16"	680319	"	C426AM/E100
400		"	" 6·4	PS44000	"	C426AM/C400
1000		"	-20+50 15V	680217	Plessey	CE1302

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Item	Pye Part No.	Manufacturer	Type
6.3 SEMICONDUCTORS			
Transistor	FV05008	Mullard	OC202
"	FV05010	"	OC24
"	FV05068	"	AC107
Diode	FV09005	A.E.I.	VR12F
Zener Diode	FV09047	Mullard	OA81
Diode	721469	Hughes	HS1012
6.4 TRANSFORMERS			
T1 Interstage Transformer	772201	Pye	B8846
T2 Output "	772246	"	B9066
6.5 MISCELLANEOUS			
Plug 16-way	724101	Amphenol	26-159-16
Socket 16-way	724153	"	26-190-16

MAINTENANCE PRECAUTIONS

FOR

SEMICONDUCTOR UNITS

NOTE: Non-observance can lead to destruction of semiconductors.

SECTION 1. GENERAL ELECTRICAL PRECAUTIONS

1.1 CONTINUITY CHECKING

When using any type of meter to check continuity, it is essential to remember that some give a voltage which is sufficient to destroy certain low voltage semiconductors. This is most likely if the polarity of the test voltage is applied incorrectly. Therefore:

(a) Check the polarity of the test meter voltage.
(b) Check the voltage level and see that this is within the rating of the semiconductors.
(c) When checking wiring external to a unit, it is safer to unplug the unit (or units) whenever possible.
When it is required to check resistors, capacitors and other components it must be remembered that if these components are across the whole, or part, of a semiconductor device, the device itself may affect test meter readings. It is necessary in these cases to disconnect one end of the component being checked.
(d) When the potential at the test meter terminals exceeds the semiconductor ratings it will be advisable to disconnect one end of every component which it is necessary to check - but see also 1.2. below.

1.2 SOLDERING

When soldering is undertaken in semiconductor circuits, poor insulation on the iron can give a sufficient level of a.c. leakage to permanently damage semiconductors. It is advisable therefore to make a quick check with a meter between the bit of the iron and the circuit earth. Note: on some units this may not be the chassis. If a potential is present take one of the following steps:

(a) Repair earth on the iron, or get another.
(b) Remove unit's earth by unplugging where possible.
(c) Remove unit's earth by disconnecting temporarily, say at an equipment plug or terminal block.
(d) Fit a switch in the 'live' lead to the iron, and switch off before bit touches the components or wiring.
(e) Use a low voltage iron or one which can be earthed to the equipment (not to the main's earth).

Remember, these precautions also apply when soldering cableform wiring external to the unit.

Never solder with the B+ switched ON. This can lead to disastrous short circuits, e.g. across emitter resistor.

All semiconductors are temperature sensitive, even without the power ON. Therefore;

When soldering use a thermal shunt, e.g. long nosed cool pliers or similar shunt, between the iron and the device.

1.3 VOLTAGE ANALYSIS

When making a voltage analysis be more than normally careful to prevent undesired short circuits by test prods. These can ruin a transistor e.g. if across base and B-, or across emitter resistor. Crocodile clips are a very common cause of accidental short circuits.

1.4 DISCONNECTING SEMICONDUCTOR UNITS

Because high level transients can damage many types of semiconductor always switch off the power supplies before removing the unit or unplugging it. Even if transients are known to be of no importance it is still possible in unplugging to break say a bias line before the B+ and hence give rise to damage.

1.5 TEST POWER SUPPLIES

Where units of an equipment can be unplugged and removed from a rack or console, it is always preferable to use a jumper lead so that the unit may be plugged in to its normal power supply. Check the polarity on the jumper lead (see also 2.5). Where test power supplies must be used observe the following:

(a) Use a power unit with similar characteristics to the one in the equipment e.g. with low ripple, high stabilisation, transient suppression, etc.
(b) Set d.c. supply to nominal ±1V, or better, so that results are meaningful.
(c) Always check polarity before connecting any test supply.
(d) Heavy gauge wire is essential for low impedance B+ supplies, say 23/·0076.

1.6 TEST EQUIPMENT

It should be remembered that items of test equipment often contain capacitors which may be charged as a result of some previous test. This charge may be sufficient to damage semiconductors in the item under test. Therefore:

(a) Always connect test equipment earth wires first to the unit under test, then touch the other connecting lead to earth before connecting it into the unit to be tested.
(b) Observe this kind of precaution with capacitors, whether these are used for test purpose or as replacements, i.e. check that they are discharged.

Signal Generators, especially l.f.types, quite frequently give voltages which far exceed the semiconductor rating. Therefore:

Before connecting this class of instrument into a semiconductor circuit the output should be turned down to minimum and care taken that the output is not subsequently turned up above a safe level.

1.7 SEMICONDUCTOR POWER UNITS

Special components are usual in these units; all are low voltage items. Some are intolerant of overloads. Therefore in all maintenance and servicing operations ensure that incorrect conditions are not introduced e.g. if the mains transformer or its taps have to be changed the connections should be carefully checked to ensure that excess voltage is not applied.

1.8 HIGH VALUE CAPACITORS

High capacity condensers are common on all semiconductor units. Since semiconductor devices are intolerant of large transients, be careful not to charge or discharge high value capacitors through them, e.g. by short circuits when power has been recently applied, or by replacing a capacitor when the B+ is on.

Never discharge the many thousand µF condensers by short circuits in the unit.

1.9 EARTHING

On no account should the earthing system of multi-unit audio installations, video installations, or any others be altered. On transistorised equipment this is more than normally important due to the use of low impedance supplies and the risk of introducing hum and other forms of interference into low signal circuits. The unit circuit earth is not necessarily connected to the mains earth or chassis. Any added B+(earth) wiring should always be in very heavy cable (See 1.5 d.)

This prohibition applies equally to paths for lamp, relay and other similar circuit supplies which are kept separate from signal paths. In this case high ripple (or plain a.c.) voltage may be fed into the signal earth. The resulting earth currents can then be picked up in low level signal circuits and amplified.

1.10 TRANSISTOR TESTING

It is always advisable to use a test item designed specifically for testing semiconductors, since any other item may give misleading results, and may also damage the semiconductor device.

SECTION 2. MECHANICAL PRECAUTIONS

2.1 PAINT

The black paint covering on certain semiconductors is there to stop light from reaching the junction which is sensitive to electromagnetic radiation including regions centred on the frequency of visible light. In fitting and handling, this paint must not be damaged.

2.2 SEMICONDUCTOR LEADS

When replacing, or disconnecting for test, the lead should not be bent closer than 1·5mm with respect to the body since any bending closer than this may damage the seal.

2.3 POWER SEMICONDUCTORS

When replacing power semiconductors the mica insulating washers (if used) must not be damaged; nor may any other material be substituted since this will affect adversely the transfer of heat from the case to the heat sink.

A smear of silicone grease on the washer serves to prevent sticking and also to make a more intimate heat bond to the sink. No other type of grease should be used.

Fixings on power semiconductors should be well tightened since this again affects heat transfer.

With some devices the metal case may be connected to an internal electrode. In these cases care must be taken not to allow the case to touch the chassis, other components, or any nearby tags.

2.4 HEAT SINKS

On no account should the black matt finish be removed from heat sinks (or fins) since this can affect the power handling capacity by an amount varying up to as much as 30% depending on the type of component.

On many small semiconductors a clip is used to increase the power dissipation. Make sure, therefore, that when a device is replaced the same size of clip is used and that this makes close contact with the case.

2.5 FORCED COOLING

Where forced cooling is provided this must not be obstructed since this can affect the power handling capacity by as much as 200% or higher.

When servicing on a test bench, or on jumper leads, the equipment air supply should be simulated or damage may result.

SECTION 3 - STORAGE

3.1 R.F.RADIATION

When units or components are stored this should not be near any high-power r.f. radiation e.g. from transmitters, test installations, etc. Radiation of this type is harmful, especially in the 'S' and 'X-Band'.

3.2 RADIO-ACTIVE EFFECTS

Semiconductors are affected adversely by various radio-active radiations e.g. X-rays, gamma rays and neutrons. Keep them away from any quantity of radio-active valves e.g. T.R.cells and some gas tubes since these contain radio-active materials.

3.3 TEMPERATURE

Although temperature ranges for semiconductors are continually increasing it is still good practice to keep all stocks away from hot radiators etc. and equally, not to permit stocks to accidentally reach very low temperature conditions.

3.4 MAGNETS

Semiconductors should not be stored close to very strong magnets. There is no permanent effect on the semi-conductor material, but part of the device, i.e. the case, may become permanently magnetised and the field from this will then change the performance of the semi-conductor.

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UNIT MOUNTING AND WIRING TECHNIQUES

1. GENERAL

Plug-in units are housed in special frames which can accept different sizes of units (in mixed sizes) and can also provide individual unit screening facilities.

2. FIXING THE FRAME

Some frames are supplied permanently fixed into consoles, others are loose items for bolting into racks. When fixing the frame into any rack observe the following:

(a) Use the fibre washers (supplied with the fixing screws) so as to protect the paint on the front member of the frame.

(b) Do not obstruct the ventilation holes in the top and bottom plates of the frame.

(c) Units generating large amounts of heat should not be positioned immediately beneath the frame.

3. FIXING THE SCREENS

The types of screening plates available can fit into the frame so as to divide it vertically and horizontally as required, i.e. to give a mixture of compartment sizes. Fit these as follows:

(a) Insert vertical screens first by dropping the lugs into the slots provided in the frame and then by slightly bowing the screen allow the other lugs to spring into the opposite slots.

(b) Insert the horizontal screens in the same manner but with the lugs entering the slots in the vertical screens.

4. RECEPTACLE PLATE ASSEMBLY

When units are supplied to fit into the frame a back plate (appropriate to the size of the compartment) is supplied loose. This is complete with fixings and with the unit mating connector already in position. When fitting the plate observe the following:

(a) Ensure that the plate is mounted so as to give the correct pin alignment of the mating connector.

(b) Do not tighten the mating connector fixings; "floating" is deliberate to ensure easy alignment of the unit connector and the mating component.

5. WIRING CONNECTORS

WARNING If the particular unit being installed contains semi-conductors it should not be plugged in during the soldering operation. Similarly other units already in the equipment should be

unplugged if these contain semiconductors, but see the section entitled "Maintenance Precautions on Semiconductor Units".

When soldering new leads ensure attention to the following:

(a) Use stranded wire for all connections. Stiff wire will cancel the floating action of the connector and will be liable to fracture.

(b) Do not tightly stretch the leads, but leave just sufficient slack to reconnect if the lead should be accidentally broken away.

(c) Do not permit solder to run back along the conductor strands; this spoils the insulant and creates a danger of breakage at some later date.

(d) Programme leads (input and output) should be insulated, screened twin. Expose no more than approximately $\frac{1}{2}$ inch of lead from the screening braid in order to avoid unwanted pick-up. The screening on the output leads should not be finished in a pigtail; trim and cover with a sleeve. The screening on the output signal leads should be earthed at the remote end of the audio cable, NOT to a mains earth.

(e) The screening pigtail of the input leads must go to the signal earth (normally B+ or the B+ busbar). Keep it short and sleeve it to prevent short circuits.

(f) Leads from B+ and B- should not be of smaller gauge than 14/.0076, preferably with thick wall insulation. The heavy gauge is needed in this application because of the low impedance of the power supply. This impedance must not be increased otherwise the stability of the power supply may suffer. For leads longer than 1 yard (1 m) the use of 23/.0076 is strongly advised.

6. DUMMY UNITS AND PANELS

If a frame is being installed then it should be remembered that different sizes of dummy units and back panels are available to fill vacant compartments in the frame. Where forced cooling is present in a rack (or console) these dummy units with their back panels serve not only to ensure a good presentation but also to ensure that the path of the cooling air stream is not diverted in a wasteful manner. On semi-conductor equipments this is of more than normal importance.

7. PARTS LIST

Rack Mounting Frame (19" rack)	749087
Vertical Screen	435629
Horizontal Screen	435630

APPENDIX

DE-MAGNETISATION OF HIGH PERMEABILITY CORES

1. GENERAL

The long term effects arising from the physical maltreatment of Mumetal and other high permeability materials are widely known. Effects which arise as a result of high d.c. current when applied in associated windings either continuously or in surges are not so well known. Increasing use of high permeability materials in transformers, record/playback heads, and other wound assemblies, coupled with the steady increase in remanence figures as new materials become available, make the need for care in one-time simple checking operations more than ever necessary. Fortunately, the precaution to be taken normally only applies when some fault has developed, and it is necessary to check such things as continuity and / or resistance in part of a circuit that includes transformers which have not been designed to carry d.c. current.

2. PRECAUTIONS

It is sometimes forgotten that simple d.c. operated instruments, such as Avometers when used on their resistance ranges for continuity or resistance checks can give quite high ampere-turn figures in the windings which they are used to check. In small modern transformers (and similar components) any such developed field strength has a small, compact mass of core material on which to act. When this small mass is composed of material with characteristics such as high permeability, fairly high remanence, and rather low magnetising force, the effect of the field can be quite marked. The effect shows itself in the overall component as a change of inductance. This will in turn affect the frequency response. The duration of the effect will depend upon a variety of factors but the really important point to remember is that in many cases only if corrective treatment is applied can the effect be cancelled. Therefore a simple rule should be observed that if:

(a) the unit's transformers are small,

(b) the circuit diagram shows that no d.c. flows in the windings,

then no d.c. operated device should be used for checking either continuity or resistance in the purely a.c. items. On such components as physically small output transformers it is normally sufficient to ensure that any d.c. current from test equipment does not exceed the current normally carried by the component.

3. CORRECTIVE TREATMENT

Since accidents are always possible a simple guide to demagnetising is set out in this section. It must be emphasised that since it is often impossible to gauge the extent of the damage caused by electrical maltreatment of wound components no guarantee of correction is implied by the provision of this information.

3.1 SUPPLIES

Normally any 50 c/s or 60 c/s supply is satisfactory. The r.m.s. demagnetising voltage is given in the maintenance section of unit manuals. Current rating of the supply is unlikely to present any problem. For most small input transformers in Audio units a range of a few hundred milliamps is sufficient. For large items a quick calculation based on the a.c. voltage plus the inductance quoted will provide the answer.

Whatever the source of a.c. voltage the waveform should be reasonably sinusoidal and free from harmonics and spikes. It should be remembered that highly inductive voltage regulators often provide a very poor waveform. Quality of the waveform is important since this will have a very considerable effect on the efficiency of the treatment.

3.2 METHOD

The procedure to be followed is set out below.

(a) Connect in series across the a.c. source a limiting resistor, and the full winding of a potentiometer of about 1000 ohms.

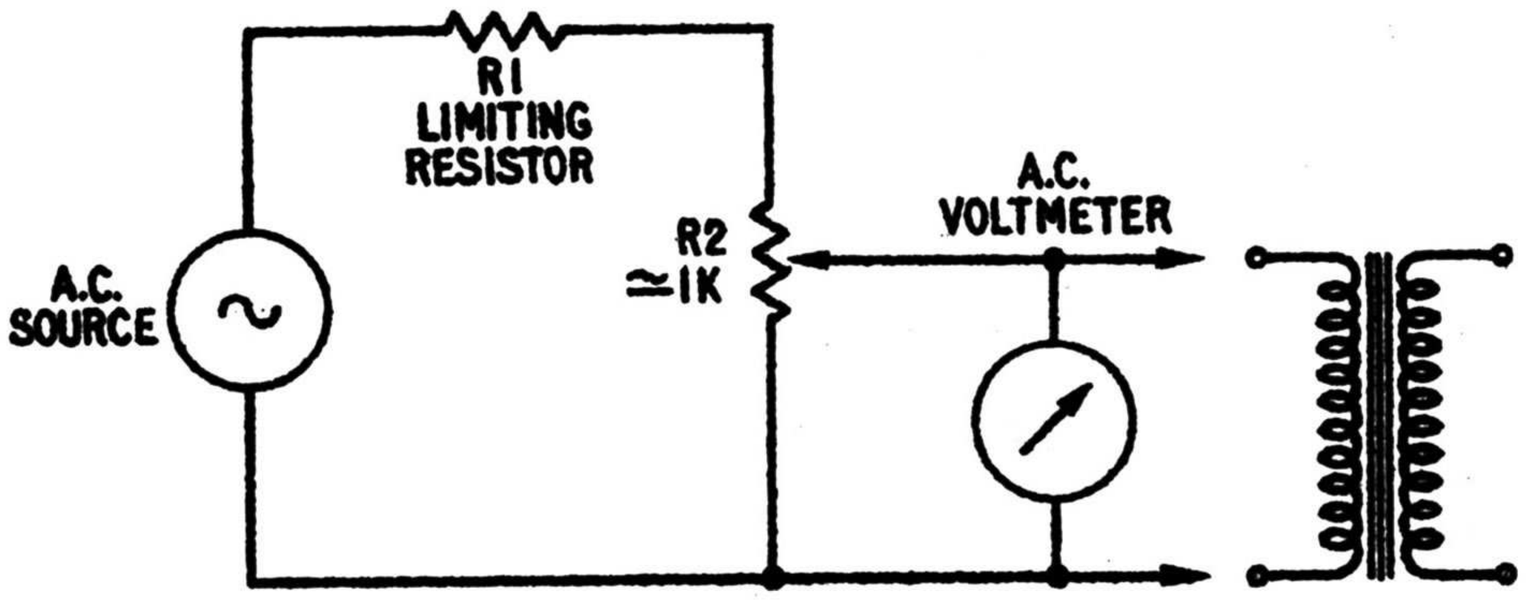


FIGURE 1

(b) Connect the component to be treated and an a.c. voltmeter across the slider of the potentiometer and its contact which is returned to the a.c. supply. Set the potentiometer to give zero volts to the component. (See Figure 1)

NOTE: If Avometers (or similar instruments) are used with a poor waveform the calibration will be in error and allowance must be made in accordance with the handbook supplied by the meter manufacturer.

(c) Switch on the a.c. supply and adjust the potentiometer to give the maximum r.m.s. voltage as shown in the unit manual.

NOTE: The limiting resistor in Figure 1 should be of such a value that if the slider of R1 should accidently be taken to the fullest extent of its travel, the voltage applied to the transformer will be only slightly in excess of the maximum specified.

(d) The voltage should now be gradually reduced to zero in about one minute, but note that the method of doing so is very important. As a rough guide it should be reduced so that a plot of voltage against time would give the well known exponential curve as of a condenser discharging through a fixed resistor. The point to remember is that the longest time is to be spent at the lowest voltages.

(e) If the waveform of the supply contains harmonics (or other departures from a true sine wave) the procedure may have to be repeated a few times.

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TREATMENT FOR ELECTRIC SHOCK

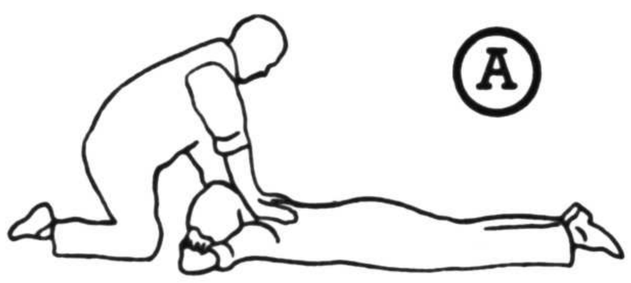
Human beings are rarely killed outright by electric shock and can, in most cases, be saved by immediate commencement of artificial respiration. Electric shock affects the nerves controlling the breathing and the action of the heart and unless prompt aid is given the victim may become unconscious and die. ALWAYS SEND FOR BUT NEVER WAIT FOR A DOCTOR.

Before touching the injured person, make sure that he is not in contact with a live conductor. If he is, break the circuit by opening the power switch - DO NOT TOUCH THE VICTIM WITH YOUR BARE HANDS. If it is not possible to switch off the current, use a piece of dry insulating material, such as wood, bakelite or rubber, to knock or push aside the conductor. Alternatively, pull the victim free using a leather belt or braces, protecting yourself still further by standing on a folded newspaper or a dry mackintosh.

HOLGER NIELSON METHOD OF ARTIFICIAL RESPIRATION

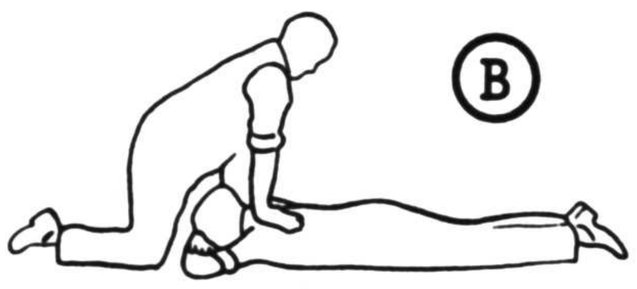
(1) Immediately the patient is released from electrical contact loosen his collar and any tight clothing as quickly as possible.

(2) Remove false teeth and sweets etc. from the patient's mouth and make sure that the tongue is free by giving two or three firm slaps with the flat of the hand between the shoulder blades.



(3) Lay the patient face downwards with the forehead resting on the fore arms so that the mouth and nose are kept clear of the ground (A).

(4) Kneel on one knee a little in front of and to the side of the patient's head so that the left foot is at the side of the patient's elbow. (A). The arms should slope forward so that the hands lie close together on the patient's shoulders with the wrists over the top of the shoulder blades. This is the starting position.



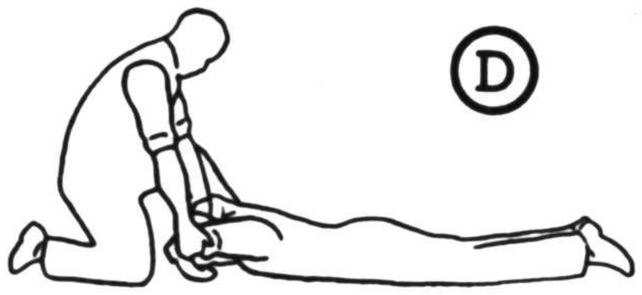
(i) Rock forward on outstretched arms until the arms are vertical above the patient's body (B). The pressure should be light and without force; the movement should take approximately 2 seconds.

(ii) Release the pressure by allowing the hands to slide quickly down the patient's arms to the elbows taking approximately $\frac{1}{2}$ a second (C). Then raise his arms and shoulders slightly, at the same time moving your body backwards (D), taking approximately 2 seconds.



(iii) Lower the patient's arms until they touch the ground (E), and return your hands to the original position on his shoulders and resume the position as before. Take approximately $\frac{1}{2}$ a second for this movement.

(5) Repeat the movements described in (i), (ii) and (iii) so that the complete cycle takes approximately six seconds. That is, about nine complete respirations per minute.



(6) Whilst artificial respiration is continued have someone else:-

(a) Loosen patient's clothing and keep him warm.

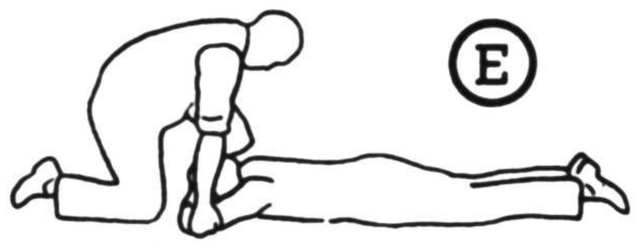
(b) Send for a doctor.

(c) Watch so that they can take over if prolonged treatment is necessary.

(7) Keep going for at least four hours even if there is no sign of recovery.

(8) Do not move the patient until he is breathing normally without assistance. There should be no hurry to move him after he has recovered.

(9) Do not give the patient oxygen or other stimulants unless ordered to by a doctor. When fully recovered the patient may be allowed to drink cold water with, if available, one teaspoonful of Sal Volatile to a glass. He may also be permitted to sniff smelling salts.



TREATMENT FOR BURNS

If as a result of electric shock the patient is suffering from burns, the following treatment should be given without hindrance to artificial respiration:-

(1) Remove the clothing near the affected part to enable the burn/s to be treated, taking care not to break any blisters that may have formed.

(2) Saturate the burn/s using a warm solution made up of one desertspoonful of bi-carbonate of soda and a pint of warm water. If bi-carbonate of soda is not available, use a teaspoonful of salt.

(3) Cover the burns with lint soaked in the above solution and apply a bandage taking care not to burst any blisters that may have formed.

(4) If a solution as above is not available cover the burns with a sterile dressing to exclude the air.