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THE

SIGNAL GENERATOR

TYPE III

INSTRUCTIONS FOR USE

INTRODUCTION

The introduction of Commercial Television Transmitting Stations in the United Kingdom, operating in the 174–216 Mc/s band, and frequency modulation receivers operating in the 80–100 Mc/s band, has led to a demand for a relatively cheap but reliable Signal Generator for the Servicing Engineer.

Designing a good R.F. Signal Generator to operate at any frequency is not a simple task, and the problem becomes much more complex when the 100 Mc/s point is passed, for at these higher frequencies, components and wiring layouts begin to behave in a predictable but unhelpful manner. The design engineer must endeavour to obtain a sensibly constant and consistent output on all ranges covered by the instrument, but hitherto it has been almost impracticable to acheive this without recourse to relatively expensive compensating circuits and components. Now, however, due to the formulation and introduction of new and novel techniques, "AVO" have built a Signal Generator at a reasonable price, which gives a sufficiently high degree of accuracy and performance to satisfy the majority of Radio Engineers. In designing this instrument, we have not only concentrated on giving the user engineer an instrument which is as electrically perfect as the price allows, but we have, in addition, ensured that (a) the instrument is compact, light and portable, (b) a hard stove-enamelled finish has been employed, which will not collect dust, (c) the controls have been simplified to the maximum degree, (d) all controls have been clearly marked, (e) we have ensured that the instrument is as easy to use as its thousands of predecessors which operate at lower frequencies, (f) the six frequency bands have been chosen in such a manner as to ensure that the most densely packed transmission bands are covered without the range switch having to be operated.

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THE CONTROLS

Five controls are provided, their respective functions being as follows:

The Range Control—A six-position switch marked:

150 Kc/s–500 Kc/s

500 Kc/s–1·6 Mc/s

1·6 Mc/s–5·5 Mc/s

5·5 Mc/s–18 Mc/s

18 Mc/s–70 Mc/s

70 Mc/s–220 Mc/s

The position of this control indicates nominal the band over which the instrument is set to operate. The limits of the six frequency bands are also displayed on the main scale plate adjacent to each particular section of the calibrated scale.

The Set Frequency Control: This control operates the main condenser which is coupled to move in unison with the calibrated frequency dial. Since they are directly coupled, there can be no back-lash between condenser and dial. The figures 0–9 around the top of the control knob form an arbitrary calibration to enable rough interpolations to be made.

The Output Control: This is a four-position switch control marked "OFF", "C.W." (unmodulated R.F.), "MOD" (R.F. modulated at 1,000 c/s), "L.F." (1,000 c/s signal available between L.F. output socket and earth terminal of dummy aerial assembly).

The Attenuator Controls: Two attenuator controls are provided, that on the left-hand side of the instrument operating a potentiometer and an internal dial, calibrated "min. -100, FORCE", whilst the right-hand multiplier operates an internal dial marked "FORCE", mV, x.1mV, x10μV, μV. Both these dials are visible through an illuminated aperture, which also serves to indicate that the instrument is energised. When the two controls are both set to "FORCE", an R.F. output of approximately 250 mV is available via the terminals on the dummy aerial assembly.

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CIRCUIT AND GENERAL CONSTRUCTION

A high slope triode oscillator is used in a modified Colpitts circuit, delivering approximately 250 mV R.F. signal into a new design of attenuator system having a low characteristic impedance. This variable output is available at a screened coaxial socket into which fits a screened output lead and dummy aerial. A 250 mV ("FORCE") signal is also available via this output lead when the two attenuator switches are set to "FORCE".

On entering the attenuator system proper, the 250 mV (FORCE) signal is attenuated to 100 mV, and this signal is available via the R.F. output socket when the left-hand variable attenuator control is set to 100, and the right-hand control to mV. This 100 mV signal can then be further attenuated by the operation of the left-hand variable attenuator control. The three remaining positions of the right-hand step attenuator control are marked X.1mV, X10μV, μV, thus giving the following set of voltage ranges via the attenuator controls :

Min.–100 mV

Min.–10 mV

Min.–1 mV

Min.–100 μV

The calibrations on both the variable (left-hand) and step (right-hand) attenuator control dials have been brought together in a central escutcheon. It is the combined reading of both dials at the hairline in the escutcheon which gives the magnitude of the R.F. signal obtained at the output.

Careful attention to screening and the use of the patented attenuator design have virtually eliminated unwanted signals in the attenuator system; thus, with both attenuator controls set to minimum, the output signal is negligible even at the highest frequencies. For similar reasons, the sub-division accuracy is well maintained over the whole frequency range.

The design of the coils and oscillatory circuit is such that the instrument gives a substantially consistent output at all frequencies. The R.F. signal is modulated at a nominal frequency of 1,000 c/s and a depth of approximately 30 per cent., series anode modulation being employed.

A low frequency oscillator employing a high slope triode with a heavy negative feed-back ensures a modulation wave form of high purity, whilst steps have been taken to ensure that unwanted frequency modulation has been kept to a minimum. Switching has been provided to enable the R.F. output signal to be obtained either modulated or un-modulated (C.W.) whilst the L.F. modulation signal is available between the L.F. socket provided, and the earth terminal on the dummy aerial. The dummy aerial is so designed as to be suitable for use over the major part of the frequency band covered by the instrument, and is housed in a very light and compact screening box at the end of the main output cable. A terminal is provided on this assembly so that the dummy aerial can be by-passed, and the signal obtained directly from the cable. At the higher television frequencies it may be preferable to employ a simple resistance matching network and this should be connected across the terminals Direct and E.

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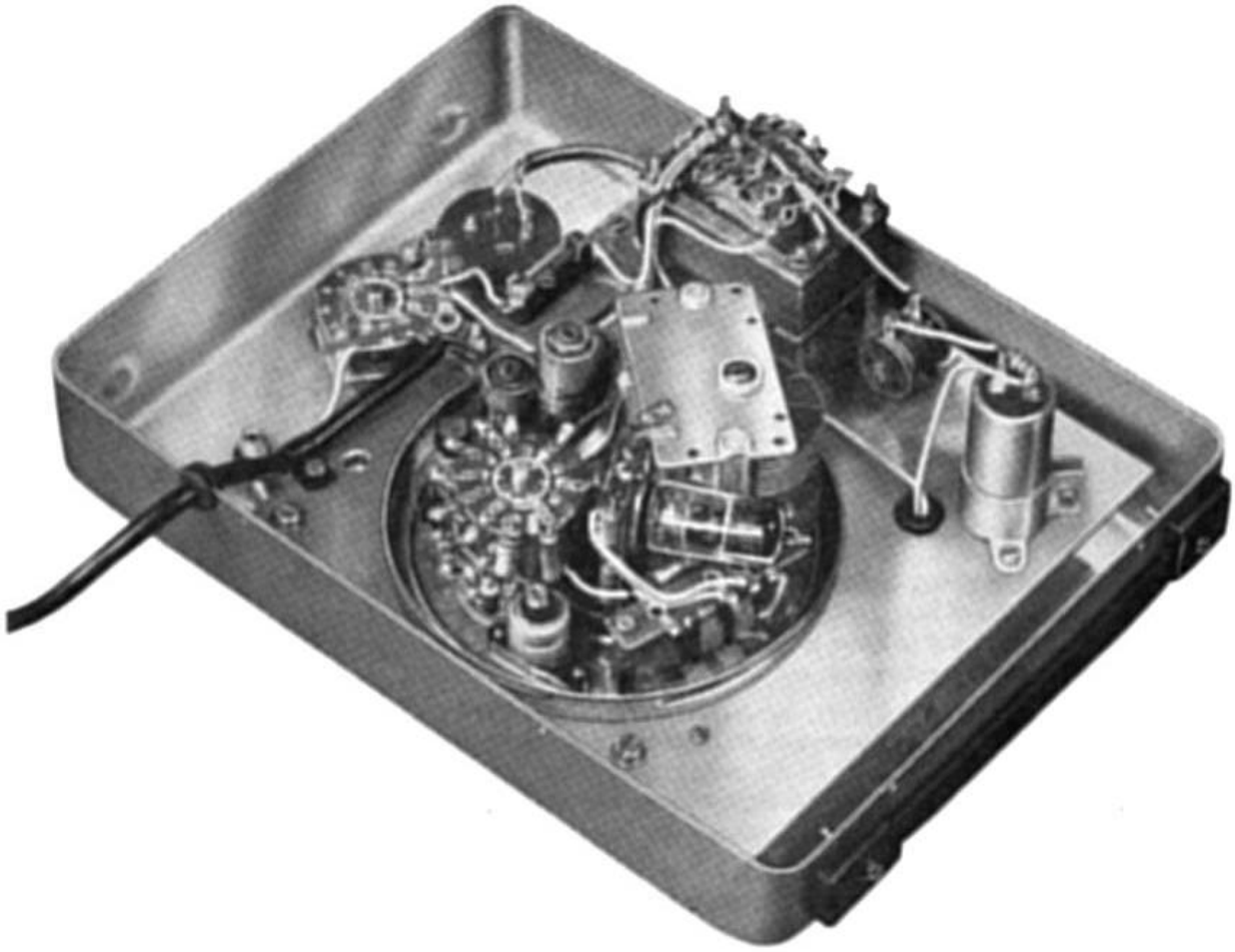

INTERNAL CONSTRUCTION OF THE "AVO" SIGNAL GENERATOR TYPE III.
(Internal R.F. screening has been removed)

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The power supply for the instrument is derived from 50/60 A.C. mains, it is adequately smoothed, and an R.F. filtering circuit has been included to ensure that the minimum output signal is not spoilt due to R.F. leakage into the mains.

The whole instrument is housed in an attractively finished metal screening box which, in addition to the separate internal R.F. circuit metal housing, still further serves to reduce stray radiation, whilst the controls are pleasingly grouped on the top panel of the instrument.

FREQUENCY RANGES

The complete frequency range of the instrument is 150 Kc/s–220 Mc/s, covered in 6 bands with a total calibrated scale length of approximately 36 inches.

Band 1. 150 Kc/s–500 Kc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 5 Kc/s.
This band covers the long wave broadcasts and the commonly used intermediate frequencies for broadcast receivers.

Band 2. 500 Kc/s–1·6 Mc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 10 Kc/s.
The frequencies covered constitute the normal broadcast medium wave band.

Band 3. 1·6 Mc/s–5·6 Mc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 50 Kc/s.
This band covers certain intermediate frequencies used in America, some broadcast frequencies, shipping and aircraft signals.

Band 4. 5·6 Mc/s–18 Mc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 100 Kc/s.
This band encompasses some television I.F. frequencies, the main short wave and amateur bands.

Band 5. 18 Mc/s 65 Mc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 0·5 Mc/s.
This band encompasses the shorter wave broadcast signals, television frequency transmission frequencies, some television I.F. frequencies, Police, and certain inter-communication broadcast frequencies. The whole of band I is covered by this range.

Band 6. 65Mc/s 220 Mc/s.

Calibrated sub-divisions at mid-scale are marked at intervals of 1 Mc/s.
This band covers a number of communication frequencies and television transmitting bands. The whole of bands II and III are covered by this range.

Frequency bands covered by the instrument have been chosen in such a manner as to ensure that the most densely packed transmission bands are covered without the range switch having to be operated.

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OPERATION OF THE INSTRUMENT

The instrument is suitable for operation on 50–60 c/s 100-120V, 200–260V mains. When using the instrument for the first time, remove four screws around the bottom of the instrument and lift off the rear cover. By means of the chart on the inner screening casing, it will then be possible to check, and if necessary adjust the mains setting on the transformer. The case should now be re-assembled and the fixing screws firmly re-positioned.

The mains connection lead of the instrument has three cores, black, red and green (or yellow). The black and red lead should be connected to neutral and line respectively, and the green (or yellow) lead connected to earth.

The instrument may now be switched on by turning the output control switch away from its "OFF" position, and it will be noted that the two dials in the escutcheon at the centre of the instrument panel become illuminated. Allow the instrument a few moments to warm up, then set the controls for the desired test.

The circuitry of the instrument has already been described, and its working clearly explained, but there are one or two important points which should be noted.

The force output of 250 mV is obtainable by placing both attenuator controls in their "FORCE" position and the output control to either C.W. or MOD, as desired. The signal is obtainable between the earth terminal and either of the remaining terminals on the dummy aerial. (Impedances: Direct terminal 80Ω, on variable output; approximately 200Ω on force. Dummy aerial terminal 400Ω approximately at 1 Mc/s.

Steps must always be taken to ensure that the direct R.F. output terminal is not connected to a live point in a receiver, for if this is done the attenuator net-work may be burnt out or severely damaged. If it is essential to make connections to points at a potential above earth, then a suitable condenser of correct rating must be connected between the direct terminal and the circuit under test. It is also desirable to take these precautions when using the dummy aerial output terminal if the signal is to be injected into a high voltage circuit. Failure to do this may cause the breakdown of capacitors C14 and C15, thus damaging the attenuator.

Special precautions must be taken when servicing an A.C./D.C. set. Ensure that the mains plug connected to the set under test is inserted in such a manner that the chassis is earthy. To check, a meter set at a sufficiently high range should be connected between chassis and earth (or neutral). If the mains voltage is shown on the meter, reverse the supply to the set.

ACCURACY AND DISCRIMINATION

Except at the extremeties of the scale, the instrument maintains an R.F. calibration accuracy of ± 1 per cent. This performance has been achieved and maintained even at frequencies greater than 200 Mc/s, by the use of a stable oscillator circuit, long calibration scale, and smooth dial adjustment.

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THE RADIO FREQUENCY SIGNAL AMPLITUDE, LEAKAGE AND RADIATION

The output attenuator is directly calibrated in millivolts over a range of 100dB, and careful attention to the oscillatory circuit has resulted in the input to the attenuator net-work being maintained with a high degree of consistency over the whole of the very wide range of the instrument. A novel and patented design of attenuator has been introduced, which successfully combats leakage and transfer capacities normally found with resistive attenuators at the very high frequencies involved. These points, combined with the employment of adequate double screening, result in the remarkably close adherence of the output to the attenuator calibration, even at the higher television frequencies, combined with a very low leakage figure.

MODULATION

The internal sine wave modulation provided has a normal modulation depth of 30 per cent. at a nominal frequency of 1,000 c/s. This L.F. signal is available between the L.F. output socket, and the earth terminal on the dummy aerial when the output control is turned to its position "L.F."

THE DUMMY AERIAL

A completely screened and insulated dummy aerial and cable are provided, fitted with a separate terminal connection, which enables the dummy aerial to be by-passed.

REPLACEMENT OF THE VALVE AND FUSE

Access to the inside of the instrument can be readily obtained by removing the four screws round the bottom of the instrument, and lifting off the back cover. The Belling-Lee 1A fuse shown in the circuit diagram will at once be visible and, if blown, should be replaced (steps should always be taken to ascertain why the fuse has blown before it is replaced.)

The rectifier, electrolytic condenser, switches and transformer can now readily be examined, but the R.F. screening can must be unscrewed in an anti-clockwise direction before access can be obtained to the R.F. compartment proper. Care must, however, be taken to ensure that the variable condenser is fully meshed (turn set frequency control fully anti-clockwise) before the screening can is removed or replaced. It will be noted from the circuit diagram that this instrument only employs one valve, a 12 AT7, which comprises two triodes in one envelope and this can be removed, together with other components, once the R.F. compartment has been opened.

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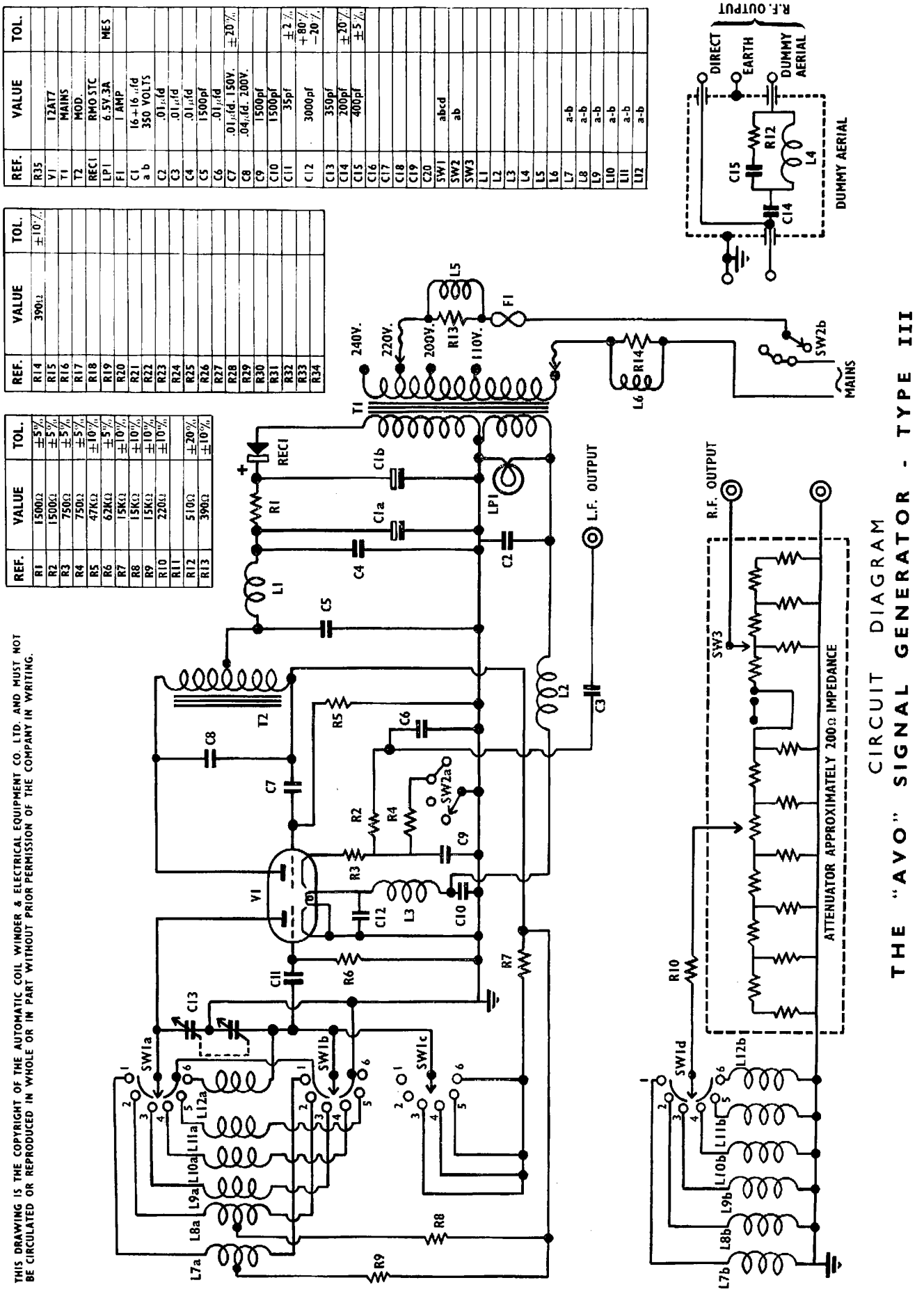

REF.	VALUE	TOL.
R1	1500Ω	±5%
R2	1500Ω	±5%
R3	750Ω	±5%
R4	750Ω	±5%
R5	47KΩ	±10%
R6	62KΩ	±5%
R7	15KΩ	±10%
R8	15KΩ	±10%
R9	15KΩ	±10%
R10	220Ω	±10%
R11		
R12	510Ω	±20%
R13	390Ω	±10%

REF.	VALUE	TOL.
R14	390Ω	±10%
R15		
R16		
R17		
R18		
R19		
R20		
R21		
R22		
R23		
R24		
R25		
R26		
R27		
R28		
R29		
R30		
R31		
R32		
R33		
R34		

REF.	VALUE	TOL.
R35		
V1	12AT7	
T1	MAINS	
T2	MOD.	
REC1	RMO STC	MES
LP1	6.5V.3A	
F1	1 AMP	
C1 a b	16+16 μfd 350 VOLTS	
C2	.01 μfd	
C3	.01 μfd	
C4	.01 μfd	
C5	1500pf	
C6	.01 μfd	±20%
C7	.01 μfd. 150V.	±20%
C8	.04 μfd. 200V.	
C9	1500pf	
C10	1500pf	
C11	35pf	±2 %
C12	3000pf	+80% −20%
C13	350pf	±20%
C14	200pf	±20%
C15	400pf	±5%
C16		
C17		
C18		
C19		
C20		
SW1	abcd	
SW2	ab	
SW3		
L1		
L2		
L3		
L4		
L5		
L6		
L7	a-b	
L8	a-b	
L9	a-b	
L10	a-b	
L11	a-b	
L12	a-b	

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