CHAPTER 2

CALIBRATION

INTRODUCTION

1. The instrument is accurately set-up after manufacture and should, under normal operational use, maintain its accuracy over a long period of time. Should it fail to give the expected display during operation or instrument check (Section 1, Chapter 2, paragraph 6) the following procedure should be carried out.

WARNING: This procedure should only be carried out by competent personnel with suitable test equipment after all other causes of error have been eliminated. If the necessary test equipment is not available, the instrument should be returned to the manufacturer.

2. The location of the preset controls that are adjusted during the alignment procedure is shown in Figure 34.

TEST EQUIPMENT

3. (a) Multi-range test meter e.g. Avo Model 8.

(b) An oscilloscope with an accurately calibrated time base, capable of measuring pulse widths to ±3%.

(c) A digital frequency meter measuring up to 1 Mc/s with an accuracy of at least 1 part in 10^6.

OR

(d) A 200 kc/s Droitwich receiver together with an oscilloscope, preferably with one or other of the following features:-

(i) A double beam.

(ii) A Z-MOD input.

PRELIMINARY SETTING-UP

4. (1) Remove the wrap round top and side cover, and the base plate as described in Chapter 1, paragraph 1.

(2) Check that the voltage selector is correctly set for the mains voltage supply. (Section 1, Chapter 2, paragraphs 1. and 2.).

(3) Connect the instrument to the mains supply, and set the Function switch to one of the Frequency positions.

(4) Set the Count switch to the Test position.

(5) Check that the voltage outputs of the power supply on the printed wiring board tags M and L are nominally +12 volts and -12 volts respectively, and that tag E on XK board is -15 volts. All voltages are measured with respect to the 0-volt line which is tag B on all the boards.

1 Mc/s CRYSTAL OSCILLATOR ADJUSTMENT

5. A digital frequency meter with an accuracy of at least 1 part in 10^6 or an oscilloscope together with a frequency standard of better than 1 part in 10^6 stability are essential. A choice of four methods is given, one utilizing a digital frequency meter and three using a frequency standard with different types of oscilloscope. It is assumed that the user will have to resort to the Droitwich transmission of 200 kc/s as a frequency standard. The visual result obtained with the last three methods differs, and in order to check the stability, the oscilloscope trace must be observed for a period of at least 5 seconds, and the particular instructions for each method should be carried out.

NOTE: The adjustment to be described in paragraphs 6. to 10. should not be carried out until the instrument has been switched on for at least 30 minutes in an ambient temperature between 20° and 25°C to allow the oven and crystal temperature to become stabilized.

6. Method 1: A digital frequency meter with an accuracy of at least 1 part in 10^6 is used.

(1) Connect the input terminals of the digital frequency meter to tag C of the XJ board; an earth is available at tag B.

(2) Adjust the variable capacitor CV1 (fig. 32) until the frequency meter indicates exactly 1 Mc/s.

7. Method 2: A double-beam oscilloscope with an external trigger input is used.

(1) Connect the 200 kc/s output from the Droitwich receiver to the Y1 input terminal of the oscilloscope and also to the trigger input.

(2) Select a timebase speed which produces approximately two cycles over the trace length.

(3) Connect the 1 Mc/s oscillator output at tag C of the XJ board to the Y2 terminal of the oscilloscope; an earth point is available at tag B.

(4) Adjust the variable capacitor CV1 (fig. 32) until five cycles of the Y2 trace are stationary with respect to one cycle of the Y1 trace.

(5) Check that the Y2 trace does not drift by more than 1 cycle over a period of at least 5 seconds.

8. Method 3: A single-beam oscilloscope with Z MOD. input is used.

(1) Switch off the oscilloscope timebase.

(2) Connect the 200 kc/s output from the Droitwich receiver to the oscilloscope Y - amplifier input.

(3) Connect the 1 Mc/s oscillator output tag C on the XJ board to the Z MOD. input of the oscilloscope; an earth point is available at tag B.

(4) The c.r.t. display will be a vertical trace superimposed with moving "bright up" spots.

(5) Adjust the variable capacitor CV1 (fig. 32) until the spots are stationary.

(6) Check that a "spot" does not move by more than the distance between two consecutive "spots" over a period of at least 5 seconds.

9. Method 4: A simple single-beam oscilloscope with X and Y amplifiers is used.

(1) Switch off oscilloscope timebase.

(2) Connect the 200 kc/s output of the Droitwich receiver to the oscilloscope X - amplifier input.

(3) Connect the 1 Mc/s oscillator output at tag C on the XJ board to the oscilloscope Y - amplifier; an earth point is available at tag B.

(4) A moving Lissajous figure will be displayed on the oscilloscope c.r.t.

(5) Adjust the variable capacitor CV1 (fig. 32) until the Lissajous figure becomes stationary.

(6) Check that the Lissajous figure does not re-cycle more than once during a period of at least 5 seconds.

SYNCHRONOUS DIVIDERS

10. An oscilloscope with an accurately calibrated timebase capable of measuring pulse widths to ±3% is required for checking and setting-up the synchronous dividers.

(1) Connect the Y input terminals of the oscilloscope to tags J and B (earth) of the XJ unit.

(2) Adjust the variable resistor RV1, on the XJ unit (fig. 34), until the period of the waveform is 10 microseconds (rather than 9 or 11 microseconds).

(3) Further adjust RV1 until the width of the pulse displayed is exactly 1 microsecond at half pulse height.

(4) Transfer the Y input terminals to tags J and B (earth) of the XH unit.

(5) Adjust the variable resistor RV1, on the XH unit (fig. 34), until the period of the waveform is 100 microseconds (rather than 90 or 110 microseconds).

(6) Further adjust RV1 until the width of the pulse displayed is exactly 5.5 microseconds at half pulse height.

(7) Transfer the Y input terminal from tag J to tag K of the XH unit.

(8) Adjust the variable resistor RV2 (fig. 34) until the period of the waveform is 1 millisecond (rather than 0.9 or 1.1 milliseconds).

(9) Further adjust RV2 until the width of the pulse displayed is exactly 70 microseconds at half pulse height.

(10) Transfer the Y input terminal from tag K to tag D on the XH unit.

(11) Adjust the variable resistor RV3 (fig. 34) until the period of the waveform is 10 milliseconds (rather than 9 or 11 milliseconds).

(12) Further adjust RV3 until the width of the pulse displayed is exactly 700 microseconds at half pulse height.

(13) Connect the Y input terminals of the oscilloscope to tags H and J in turn (tag B common earth) of the XJ unit and check that a frequency division ratio of ten occurs between J and H.

(14) Connect the Y input terminals of the oscilloscope to tag J of the XJ unit and tag J of the XH unit in turn (tag B: earth) and check that a frequency division ratio of ten occurs between tag J of the XH unit and tag J of the XJ unit.

(15) Connect the Y input terminals of the oscilloscope to tags J, K and D in turn (tag B common earth) of the XH unit, and check that a frequency division of ten occurs between K and J, D and K respectively.

AMPLIFIER GAIN

11. (1) Apply a 100 kc/s, 3V r.m.s. signal to the input terminals and switch the AC-DC switch to DC.

(2) Set the Function switch to FREQUENCY X10.

(3) Monitor the output at pin F on the XB unit with an oscilloscope.

(4) Adjust RV1 on the XB unit until the 'blips' on the waveform (fig. 19: waveform C) are equi-distant about the mean level.

CHAPTER 3

INITIAL FAULT LOCATION

CONTENTS

CHAPTER 3

INITIAL FAULT LOCATION

INTRODUCTION

1. The initial fault location is confined to the use of an Avo Model 8 or similar 20,000 ohms per volt multi-range instrument.

2. Unless otherwise stated, all voltages are measured with respect to the 0 volt line i.e. tag B on all printed wiring boards.

INSTRUMENT CHECKS

3. The correct functioning of the instrument may be checked by setting the Count switch to the TEST position and the Function switch to the FREQUENCY X10 position. The 1 microsecond clock pulses are fed via the amplifier and shaper circuits to the signal gate etc. The resultant display should be 099999, 100000 or 100001. Switch to FREQUENCY X1 and FREQUENCY X0.1 and the display should be 999999, 000000 or 000001 in each case. Check that the AC-DC switch is in the AC position and that the INT-EXT STANDARD switch at the rear of the unit is in the INT position.

4. The instrument may be further tested by using any combination of gate times and clock units, but under these conditions the amplifier is not tested due to the clock pulses being fed via the ancillary shaper to the signal gate.

FAULT LOCATION CHART

Symptom	Action	Possible cause and remarks
Instrument completely inoperative i.e. no read-out.	(a) Check fuses (b) Check supply voltage to the primary of the mains transformer.	Power section (SA3) of the Count switch faulty or a break in the wiring to the switch or fuses.

Symptom	Action	Possible cause and remarks
	(c) Check the +12 volt supply on the printed wiring board tags (tag M, +ve; tag B, 0V, earth)	Mains transformer faulty, MR1, MR4, MR5, C4, R10 faulty or a short-circuit on the +12V line. Remove red leads of the cableform from tag M of the XK board to determine if the short-circuit is in the power supply or printed boards. If in the printed boards, cut the wire to each tag M in turn to isolate the short-circuit. Note: Do not switch on the instrument when the positive supply is not connected as the Zener diode MR5 will overheat.
	(d) Check the -15V supply at the XK board (tag E -15V; tag B, 0V, earth)	MR2, MR3, C8 faulty or a short-circuit on -15V line. Disconnect tag E on XK board to isolate the short-circuit.
	(e) Check the -12V supply at the printed wiring board tags (tag L, -12V; tag B, 0V, earth).	MR6, R9, C5, C6, VT2 (adjacent to voltage selector) faulty or a short-circuit on -12V line. Remove the leads of the cableform from tag L of the XK board to determine if the short-circuit is in the power supply or printed boards. If in the printed boards, cut the wire to each tag L in turn to isolate the short-circuit. Note: Do not switch on the instrument when the negative supply is not connected as the Zener diode MR6 will overheat.

Symptom	Action	Possible cause and remarks
	(f) Set the Function switch to FREQUENCY X1 and the Count switch to TEST. Monitor with an Avo 8 the input (tag N, XK board) and the output (tags P, of the XF, XG and XE boards) of the bulb supply power amplifier.	The input and output should be a negative level of -12V, falling to 0V for a period of approximately 1 second. If the input is normal but there is no output, VT1 is faulty.

CHAPTER 4

GENERAL FAULT LOCATION

CONTENTS

CHAPTER 4

GENERAL FAULT LOCATION

Introduction

1. This procedure should only be carried out by competent personnel with suitable test equipment. If the necessary test equipment is not available, the instrument should be returned to the manufacturer.

2. Fault location is generally confined to the isolation of the fault to a printed circuit board and the replacement of the board. Before proceeding with this chapter, the Initial Fault Location in Chapter 3 should be carried out.

3. The following procedure whilst not comprehensive is designed to aid the location of a faulty board and comprises a number of external indications of incorrect operation together with a number of tests. It should be noted that the tests should be carried out in the order shown and that each test is valid only if those preceding it (if any) have been performed.

4. Unless otherwise stated, all voltages and waveforms are measured with respect to the 0 volt line i.e. tag B of all printed circuit boards.

Test Equipment

5. (a) Avo Model 8 or similar 20,000 ohms per volt instrument.

   (b) An oscilloscope with an accurately calibrated timebase, capable of measuring pulse widths to ±3%.

FAULT LOCATION CHART

Symptom		Action	Possible cause and remarks
1. Instrument is operative but the display remains at 000000 on TEST in all FREQUENCY positions of the Function switch.	(a)	Set the Function switch to each of the FREQUENCY positions in turn and check that the display is extinguished for 0.1 sec., 1 sec. and 10 sec. respectively.	If the display is extinguished for the required period of time, the timebase (XJ, XH, and XD boards), the 'or' gate, the control flip-flop, the display-time generator and bulb inhibit (XC board) circuits are correct and the fault must be in the amplifier and shaper (XB board), the signal gate (XK board), or the totalizer, decoder and read-out (XE, XG and XF boards). If in any FREQUENCY position of the Function switch the display is not extinguished proceed to test (b).
	(b)	Monitor with an oscilloscope the output on tags H and J of the XJ board; pulses of the 1 μS period appearing at H and 10 μS period at J. Also monitor the output on tags J, K and D on the XH board; pulses of 100μS period appearing at J, 1mS period at K and 10mS period at D.	If pulses are not present at any of the outputs, the XJ or XH boards are faulty. If the pulses are present at each output proceed to test (c).
	(c)	Monitor the input (tag K, XK board) of the 'or' gate for each FREQUENCY position of the Function switch.	If there is no input at tag K, a fault exists in the wiring or the Function switch wafer SB1B.

Symptom	Action	Possible cause and remarks
1. (cont'd)	(d) Monitor the 'or' gate output (tag H, XK unit). Switch to FREQ. X10 and turn the DISPLAY TIME to minimum.	These should be eleven pulses separated by 10mS occurring about every 0.5 sec. If not, there is a fault in the XK unit, the XD-5 unit, switch SB2B, or wiring.
	(e) As in (d) but switched to FREQUENCY X1.	These should be groups of pulses separated by 10mS and lasting for 1 sec; each group separated by about 0.5 sec. If not, there is a fault in the XK unit, the XD-7 unit, switch SB2B or the wiring.
	(f) As in (d) but switched to FREQUENCY X0.1.	These should be groups of pulses with 10mS p.r.f. and lasting for 10 seconds, each group separated by 0.5 sec. If not, there is a fault in the XK unit, the XD-9 unit, switch SB2B or the wiring.
	(g) Monitor the output (tag N, XK board) of the bulb inhibit. The output should be a negative level of -12V rising to 0V for 0.1 sec., 1 sec. and 10 sec. respectively for the X10, X1 and X0.1 FREQUENCY positions of the Function switch.	If there is no output or a constant -12V, a fault exists in the XK board or VT1 on main chassis.
	(h) Monitor the amplified Test input waveform (pin 9 on the Power Control board) and the amplifier output at tag C of the XB board.	If there is no input at pin 9 of the Power Control board, a fault exists in the wiring, switch SA1B, R2 or the AC-DC switch (SE). If there is no output at tag C,

Symptom	Action	Possible cause and remarks
1. (cont'd)		the XB board is faulty.
	(i) Monitor the input to tag F and the output tag G of the signal gate on the XK board. The input should be 1 µS pulses which appear inverted at tag G during the count period only.	If there is no input, the Function switch wafer SA2B, the ancillary shaper on the Power Control board (pins 13 and 14) or the wiring between these points is at fault. If there is no output during the "gate open" period, the XK board is faulty.
	(j) Monitor the inputs (tag H) and outputs (tag J) of XE, XG, and XF boards in turn. Ensure that every ten input pulses provide one output pulse.	No output or an incorrect division ratio indicates a faulty board.
2. Instrument operative but incorrect display obtained on Test.	(a) The display is consistently incorrect or jumps alternately between a correct and incorrect display. Monitor with an oscilloscope the output tags H and J of the XJ board; pulses of 1 µS period should appear at H and 10 µS period at J. Also monitor the output at tags J, K and D on the XH board; pulses of 100 µS period should appear at tag J, 1mS at tag K and 10mS at tag D.	If the outputs are incorrect, re-align the synchronous dividers as described in Sect. 2, Chap. 2, para. 10. If the synchronous dividers fail to re-align on carrying out this procedure, a fault exists in either the XJ or XH board. If the outputs are correct proceed to test (b).
	(b) Set the Function switch to	If the correct division ratio is not obtained, the fault is

Symptom		Action	Possible cause and remarks
2. (cont'd)		FREQUENCY X0.1 and monitor the inputs (tag C) and the outputs (tag D) of the XD boards, and check that for every ten input pulses, one output pulse occurs.	in the XD boards.
	(c)	Carry out test described in paragraphs 1. (h) to 1. (j).	
3. Instrument operative but incorrect display on Test with two display bulbs lit simultaneously in one decade.	(a)	Check the +12V supply (tag M) and +12V reset (tag A) on the appropriate XE, XG or XF board.	If +12V is correct on both supply and reset, the XE, XG or XF board is faulty. N.B. It is permissible for two bulbs to light when the unit is first switched on.
4. Instrument operative with correct display on Test but gives incorrect displays when used on Period measurements.	(a)	With the Function switch in the PERIOD 1 position and a signal applied to the input terminals, monitor the output (tag C) of the XB board and input (tag K, XK board) of the 'or' gate.	If the output of the XB board is correct but there is no input to the 'or' gate, a fault exists in the Function switch wiring.
	(b)	Monitor the inputs at tag C and the outputs at tag D of the XD boards, and check that one output pulse occurs for every ten input pulses.	If the correct division ratio is not obtained from an XD board, a fault exists in the board.

CHAPTER 5

COMPONENTS LIST

Orders for Spare Parts

In order to expedite handling of spare part orders, please quote:-

(1) Type and serial number of equipment.

(2) Circuit reference, description and manufacturer of part required.

(3) Quantity required.

Joint-Service Numbers

(also known as CCA or NATO Stock Numbers)

Commercial and private users will note that the above numbers have been included in this section; these are for assisting Service users in the provision of spare components.

NOTES ON COMPONENT CHANGES AND ADDITIONS

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer

CHAPTER 5

LIST OF COMPONENTS

Sheet 1

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
		MAIN CHASSIS			
Resistors					
R1	47k	carbon	$\frac{1}{4}$W	10	Erie 16
R2	27k	carbon	$\frac{1}{4}$W	10	Erie 16
R3	3.3k	carbon	$\frac{1}{4}$W	10	Erie 16
R4	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R5	4.7k	carbon	$\frac{1}{4}$W	10	Erie 16
R6	4.7k	carbon	$\frac{1}{4}$W	10	Erie 16
R7	1k	carbon	$\frac{1}{4}$W	10	Erie 16
Potentiometers					
RV1	100k	DISPLAY TIME			RACAL ASW23207 (Ganged with switch SH)
Diode					
MR1					Mullard OA47
Capacitors					
C1	.01µF	ceramic	350V	20	Lemco 316K
C2	330pF	ceramic	350V	20	Lemco 310K
C3	330pF	ceramic	350V	20	Lemco 310K
C4	2.2pF	ceramic N750	750V	$\pm\frac{1}{4}$pF	Erie N750A
Transistors					
VT1 & VT2					NEWMARKET NKT404

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Switches					
SA		Count			Racal BSW23219
SB		Function			Racal BSW23220
SC		Battery/Mains			Racal BSW23218
SD		Standard INT/EXT			Plessey S6 D.P.D.T. indexed
SE		A.C./D.C.			Plessey S6 T.P.D.T. indexed
SF		Start			Bulgin MP16 Black
SG		Stop			Bulgin MP16 Black
SH		Display Time			Racal ASW23207 (Ganged with RV1)
SJ		Reset			Painton 501404
Plugs and Sockets					
PL1		EXT. STD.			SELECTRO PR300 RED
SKT1		EXT. STD.			SELECTRO SKT50 RED
PL2		EXT. RESET			SELECTRO PR300 RED
SKT2		EXT. RESET			SELECTRO SKT50 RED
PL3		EARTH			SELECTRO PR300 BLACK
SKT3		EARTH			SELECTRO SKT50 BLACK
PL4		CLOCK OUTPUT			SELECTRO PR300 RED
SKT4		CLOCK OUTPUT			SELECTRO SKT50 RED
SKT5		BATTERY			McMurdo BM7/AU
SK6		Start			Belling Lee L1568 (Red)
SK7		Stop			Belling Lee L1568 (Red)
SK8		Input (line)			Belling Lee L1568 (Red)
SK9		Input (earth)			Belling Lee L1568 (Black)
Miscellaneous					
		Voltage Selector			Racal AD21129
FS1	1A	Fuse			Belling Lee L754
		Fuse Holder			Belling Lee L575
FS2	1A	Fuse			Belling Lee L754
		Fuse Holder			Belling Lee L575
T1		Transformer			Racal BT 23217

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

PRINTED CIRCUIT BOARDS

Oscillator and Synchronous Divider XJ Unit

Resistors

R1	12k	carbon	$\frac{1}{4}$W	10	Erie 16
R2	6.8k	carbon	$\frac{1}{4}$W	10	Erie 16
R3	3.9k	carbon	$\frac{1}{4}$W	10	Erie 16
R4	470 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R5	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R6	22k	carbon	$\frac{1}{4}$W	10	Erie 16
R7	22k	carbon	$\frac{1}{4}$W	10	Erie 16
R8	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R9	3.3k	carbon	$\frac{1}{4}$W	10	Erie 16
R10	470 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R11	33k	carbon	1/10W	10	Erie 15
R12	10k	carbon	1/10W	10	Erie 15
R13	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R14	10k	carbon	1/10W	10	Erie 15
R15	10k	carbon	1/10W	10	Erie 15
R16	3.3k	carbon	1/10W	10	Erie 15
R17	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R18	10k	carbon	1/10W	10	Erie 15
R19	33k	carbon	1/10W	10	Erie 15
R20	10k	carbon	1/10W	10	Erie 15
R21	1k	carbon	1/10W	10	Erie 15
R22	2.2k	carbon	1/10W	10	Erie 15
R23	10 Ω	carbon	1/10W	10	Erie 15
R24	2.2k	carbon	1/10W	10	Erie 15
R25	8.2k	carbon	$\frac{1}{4}$W	5	Painton 72
R26	33k	carbon	1/10W	10	Erie 15
R27	10k	carbon	1/10W	10	Erie 15

Potentiometers

RV1	5k				Reliance WL35 (Printed Circuit version)

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

<u>Oscillator and Synchronous Divider XJ Unit</u> continued......

Capacitors

C1	100pF	ceramic	350V	10	Lemco 310K
C2	0.01μF	dielectric	125V		Tropyfoil F
C3	1000pF	ceramic	350V	10	Lemco 310K
C4	1000pF	ceramic	350V	10	Lemco 310K
C5	330pF	ceramic	350V	10	Lemco 310K
C6	120pF	ceramic	750V	10	Lemco 310N1500
C7	120pF	ceramic	750V	10	Lemco 310N1500
C8	330pF	ceramic	350V	10	Lemco 310K
C9	820pF	polystyrene	125V	10	Salford PF
C10	100μF	electrolytic	16V		Mullard C426AM/E100
C11	0.01μF	dielectric	125V		Tropyfoil F

Transistors

VT1 & VT2	TEXAS 2G 417
VT3 - VT8	Mullard GET 882
VT9	Texas 2N711

Diodes

MR1 & MR2	Texas IS 301
MR3	Mullard OA47
MR4	Mullard OA91
MR5	Mullard OA47
MR6	Mullard OA91
MR7 - MR10	Mullard OA47
MR11	Mullard OA91
MR12	Mullard OA47
MR13	Texas IS 301

<u>Decade Divider XD Unit</u>

Resistors

R1	4.7k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Decade Divider XD Unit - Resistors continued......					
R2	56k	carbon	1/10W	10	Erie 15
R3	10k	carbon	1/10W	10	Erie 15
R4	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R5	56k	carbon	1/10W	10	Erie 15
R6	10k	carbon	1/10W	10	Erie 15
R7	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R8	4.7k	carbon	1/10W	10	Erie 15
R9	4.7k	carbon	1/10W	10	Erie 15
R10	56k	carbon	1/10W	10	Erie 15
R11	10k	carbon	1/10W	10	Erie 15
R12	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R13	56k	carbon	1/10W	10	Erie 15
R14	10k	carbon	1/10W	10	Erie 15
R15	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R16	4.7k	carbon	1/10W	10	Erie 15
R17	4.7k	carbon	1/10W	10	Erie 15
R18	56k	carbon	1/10W	10	Erie 15
R19	10k	carbon	1/10W	10	Erie 15
R20	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R21	56k	carbon	1/10W	10	Erie 15
R22	10k	carbon	1/10W	10	Erie 15
R23	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R24	4.7k	carbon	1/10W	10	Erie 15
R25	3.3k	carbon	1/10W	10	Erie 15
R26	4.7k	carbon	1/10W	10	Erie 15
R27	56k	carbon	1/10W	10	Erie 15
R28	10k	carbon	1/10W	10	Erie 15
R29	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R30	56k	carbon	1/10W	10	Erie 15
R31	10k	carbon	1/10W	10	Erie 15
R32	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R33	4.7k	carbon	1/10W	10	Erie 15
Capacitors					
C1	2200pF	ceramic	350V	10	Lemco FEC 310K
C2	1000pF	ceramic	350V	10	Lemco FEC 310K
C3	1000pF	ceramic	350V	10	Lemco FEC 310K

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Decade Divider XD Unit - Capacitors continued......

C4	2200pF	ceramic	350V	10	Lemco FEC 310K
C5	2200pF	ceramic	350V	10	Lemco FEC 310K
C6	1000pF	ceramic	350V	10	Lemco FEC 310K
C7	1000pF	ceramic	350V	10	Lemco FEC 310K
C8	2200pF	ceramic	350V	10	Lemco FEC 310K
C9	2200pF	ceramic	350V	10	Lemco FEC 310K
C10	1000pF	ceramic	350V	10	Lemco FEC 310K
C11	1000pF	ceramic	350V	10	Lemco FEC 310K
C12	2200pF	ceramic	350V	10	Lemco FEC 310K
C13	5000pF	ceramic	350V	10	Lemco FEC 310K
C14	2200pF	ceramic	350V	10	Lemco FEC 310K
C15	1000pF	ceramic	350V	10	Lemco FEC 310K
C16	1000pF	ceramic	350V	10	Lemco FEC 310K
C17	2200pF	ceramic	350V	10	Lemco FEC 310K

Transistors

VT1 - VT8*					Texas 2G1303A Mullard ACY20

*NOTE: Boards should not contain a mixture of equivalents.

Diodes

MR1 - MR10					Mullard OA91 or G.E.C. GEX13

Synchronous Divider XH Unit

Resistors

R1	4.7k	carbon	1/10W	10	Erie 15
R2	33k	carbon	$\frac{1}{4}$W	10	Erie 16
R3	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R4	470Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R5	10Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R6	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R7	3.3k	carbon	$\frac{1}{4}$W	10	Erie 16
R8	8.2k	carbon	$\frac{1}{4}$W	5	Painton 72

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Synchronous Divider XH Unit - Resistors continued......					
R9	4.7k	carbon	1/10W	10	Erie 15
R10	33k	carbon	$\frac{1}{4}$W	10	Erie 16
R11	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R12	470 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R13	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R14	10Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R15	3.3k	carbon	$\frac{1}{4}$W	10	Erie 16
R16	8.2k	carbon	$\frac{1}{4}$W	5	Painton 72
R17	4.7k	carbon	1/10W	10	Erie 15
R18	33k	carbon	$\frac{1}{4}$W	10	Erie 16
R19	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R20	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R21	470 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R22	10Ω	carbon	$\frac{1}{4}$W	10	Erie 16
R23	3.3k	carbon	$\frac{1}{4}$W	10	Erie 16
R24	8.2k	carbon	$\frac{1}{4}$W	5	Painton 72
Potentiometers					
RV1	4.7k				Plessey MP
RV2	4.7k				Plessey MP
RV3	4.7k				Plessey MP
Capacitors					
C1	330pF	ceramic	350V	10	Lemco 310K
C2	.015µF	polyester	125V	5	Mullard C296AA/A15K
C3	1000pF	ceramic	350V	10	Lemco 310K
C4	.15µF	polyester	125V	5	Mullard C296AA/A150K
C5	1000pF	ceramic	350V	10	Lemco 310K
C6	.47µF	polyester	125V	5	Wima Tropyfol M
C7	1.0 µF	polyester	125V	5	Wima Tropyfol M
C8	200µF	electrolytic	12V		Plessey CEV411/6
Transistors					
VT1 - VT9					Mullard GET 882

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Synchronous Divider XH Unit continued......

Diodes

MR1 - MR3					Mullard OA91

Totalizer, Decoder and Display XG Unit

Resistors

R1	4.7k	carbon	1/10W	10	Erie 15
R2	56k	carbon	1/10W	10	Erie 15
R3	10k	carbon	1/10W	10	Erie 15
R4	2.2k	carbon	¼W	10	Erie 16
R5	10k	carbon	1/10W	10	Erie 15
R6	10k	carbon	1/10W	10	Erie 15
R7	56k	carbon	1/10W	10	Erie 15
R8	10k	carbon	1/10W	10	Erie 15
R9	2.2k	carbon	¼W	10	Erie 16
R10	4.7k	carbon	1/10W	10	Erie 15
R11	4.7k	carbon	1/10W	10	Erie 15
R12	56k	carbon	1/10W	10	Erie 15
R13	10k	carbon	1/10W	10	Erie 15
R14	2.2k	carbon	¼W	10	Erie 16
R15	56k	carbon	1/10W	10	Erie 15
R16	10k	carbon	1/10W	10	Erie 15
R17	2.2k	carbon	¼W	10	Erie 16
R18	4.7k	carbon	1/10W	10	Erie 15
R19	4.7k	carbon	1/10W	10	Erie 15
R20	56k	carbon	1/10W	10	Erie 15
R21	10k	carbon	1/10W	10	Erie 15
R22	2.2k	carbon	¼W	10	Erie 16
R23	56k	carbon	1/10W	10	Erie 15
R24	10k	carbon	1/10W	10	Erie 15
R25	2.2k	carbon	¼W	10	Erie 16
R26	4.7k	carbon	1/10W	10	Erie 15
R27	3.3k	carbon	1/10W	10	Erie 15
R28	4.7k	carbon	1/10W	10	Erie 15
R29	56k	carbon	1/10W	10	Erie 15
R30	10k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
<u>Totalizer, Decoder and Display XG Unit</u> - Resistors continued......					
R31	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R32	56k	carbon	1/10W	10	Erie 15
R33	10k	carbon	1/10W	10	Erie 15
R34	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R35	4.7k	carbon	1/10W	10	Erie 15
R36	8.2k	carbon	1/10W	10	Erie 15
R37	8.2k	carbon	1/10W	10	Erie 15
R38	1.8k	carbon	1/10W	10	Erie 15
R39	8.2k	carbon	1/10W	10	Erie 15
R40	8.2k	carbon	1/10W	10	Erie 15
R41	1.8k	carbon	1/10W	10	Erie 15
R42	8.2k	carbon	1/10W	10	Erie 15
R43	8.2k	carbon	1/10W	10	Erie 15
R44	1.8k	carbon	1/10W	10	Erie 15
R45	8.2k	carbon	1/10W	10	Erie 15
R46	8.2k	carbon	1/10W	10	Erie 15
R47	1.8k	carbon	1/10W	10	Erie 15
R48	8.2k	carbon	1/10W	10	Erie 15
R49	8.2k	carbon	1/10W	10	Erie 15
R50	1.8k	carbon	1/10W	10	Erie 15
R51	22 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
Capacitors					
C1	330pF	ceramic	350V	10	Lemco 310K
C2	330pF	ceramic	350V	10	Lemco 310K
C3	330pF	ceramic	350V	10	Lemco 310K
C4	330pF	ceramic	350V	10	Lemco 310K
C5	330pF	ceramic	350V	10	Lemco 310K
C6	330pF	ceramic	350V	10	Lemco 310K
C7	330pF	ceramic	350V	10	Lemco 310K
C8	330pF	ceramic	350V	10	Lemco 310K
C9	220pF	ceramic	350V	10	Lemco 310K
C10	220pF	ceramic	350V	10	Lemco 310K
C11	220pF	ceramic	350V	10	Lemco 310K
C12	220pF	ceramic	350V	10	Lemco 310K
C13	220pF	ceramic	350V	10	Lemco 310K
C14	220pF	ceramic	350V	10	Lemco 310K

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Totalizer, Decoder and Display XG Unit - Capacitors continued......

C15	220pF	ceramic	350V	10	Lemco 310K
C16	220pF	ceramic	350V	10	Lemco 310K
C17	680pF	ceramic	350V	10	Lemco 310K

Transistors

VT1 & VT2 *	Texas 2G1303A Mullard ACY20
VT3 - VT10	Mullard G.E.T.882 or ASY27
VT11 - VT25 *	Texas 2G1303A Mullard ACY20

* NOTE: Boards should not contain a mixture of equivalents.

Diodes

MR1 - MR17	Mullard OA91

Display Bulbs

ILP1 - ILP10	wire ended 12V-0.1A	Thorn L1053

Totalizer, Decoder and Display XF Unit

Resistors

R1	4.7k	carbon	1/10W	10	Erie 15
R2	56k	carbon	1/10W	10	Erie 15
R3	10k	carbon	1/10W	10	Erie 15
R4	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R5	10k	carbon	1/10W	10	Erie 15
R6	10k	carbon	1/10W	10	Erie 15
R7	56k	carbon	1/10W	10	Erie 15
R8	10k	carbon	1/10W	10	Erie 15
R9	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R10	4.7k	carbon	1/10W	10	Erie 15
R11	4.7k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Totalizer, Decoder and Display XF Unit - Resistors continued......

R12	56k	carbon	1/10W	10	Erie 15
R13	10k	carbon	1/10W	10	Erie 15
R14	2.2k	carbon	¼W	10	Erie 16
R15	56k	carbon	1/10W	10	Erie 15
R16	10k	carbon	1/10W	10	Erie 15
R17	2.2k	carbon	¼W	10	Erie 16
R18	4.7k	carbon	1/10W	10	Erie 15
R19	4.7k	carbon	1/10W	10	Erie 15
R20	56k	carbon	1/10W	10	Erie 15
R21	10k	carbon	1/10W	10	Erie 15
R22	2.2k	carbon	¼W	10	Erie 16
R23	56k	carbon	1/10W	10	Erie 15
R24	10k	carbon	1/10W	10	Erie 15
R25	2.2k	carbon	¼W	10	Erie 16
R26	4.7k	carbon	1/10W	10	Erie 15
R27	3.3k	carbon	1/10W	10	Erie 15
R28	4.7k	carbon	1/10W	10	Erie 15
R29	56k	carbon	1/10W	10	Erie 15
R30	10k	carbon	1/10W	10	Erie 15
R31	2.2k	carbon	¼W	10	Erie 16
R32	56k	carbon	1/10W	10	Erie 15
R33	10k	carbon	1/10W	10	Erie 15
R34	2.2k	carbon	¼W	10	Erie 16
R35	4.7k	carbon	1/10W	10	Erie 15
R36	8.2k	carbon	1/10W	10	Erie 15
R37	8.2k	carbon	1/10W	10	Erie 15
R38	1.8k	carbon	1/10W	10	Erie 15
R39	8.2k	carbon	1/10W	10	Erie 15
R40	8.2k	carbon	1/10W	10	Erie 15
R41	1.8k	carbon	1/10W	10	Erie 15
R42	8.2k	carbon	1/10W	10	Erie 15
R43	8.2k	carbon	1/10W	10	Erie 15
R44	1.8k	carbon	1/10W	10	Erie 15
R45	8.2k	carbon	1/10W	10	Erie 15
R46	8.2k	carbon	1/10W	10	Erie 15
R47	1.8k	carbon	1/10W	10	Erie 15
R48	8.2k	carbon	1/10W	10	Erie 15
R49	8.2k	carbon	1/10W	10	Erie 15
R50	1.8k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Totalizer, Decoder and Display XF Unit - Resistors continued......

R51	22 Ω	carbon	¼W	10	Erie 16

Capacitors

C1	2200pF	ceramic	350V	10	Lemco 310K
C2	2200pF	ceramic	350V	10	Lemco 310K
C3	2200pF	ceramic	350V	10	Lemco 310K
C4	2200pF	ceramic	350V	10	Lemco 310K
C5	2200pF	ceramic	350V	10	Lemco 310K
C6	2200pF	ceramic	350V	10	Lemco 310K
C7	2200pF	ceramic	350V	10	Lemco 310K
C8	2200pF	ceramic	350V	10	Lemco 310K
C9	1000pF	ceramic	350V	10	Lemco 310K
C10	1000pF	ceramic	350V	10	Lemco 310K
C11	1000pF	ceramic	350V	10	Lemco 310K
C12	1000pF	ceramic	350V	10	Lemco 310K
C13	1000pF	ceramic	350V	10	Lemco 310K
C14	1000pF	ceramic	350V	10	Lemco 310K
C15	1000pF	ceramic	350V	10	Lemco 310K
C16	1000pF	ceramic	350V	10	Lemco 310K
C17	5000pF	ceramic	350V	10	Lemco 310K

Transistors

VT1 - VT25 *					Texas 2G1303A Mullard ACY20

* NOTE: Boards should not contain a mixture of equivalents.

Diodes

MR1 - MR17					Mullard OA91

Display Bulbs

ILP1 - ILP10		wire ended 12V, 0.1A			Thorn L1053

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Totalizer, Decoder and Display XE Unit

Resistors

R1	33k	carbon	1/10W	10	Erie 15
R2	10k	carbon	1/10W	10	Erie 15
R3	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R4	10k	carbon	1/10W	10	Erie 15
R5	10k	carbon	1/10W	10	Erie 15
R6		DELETED			
R7	8.2k	carbon	1/10W	10	Erie 15
R8	10k	carbon	1/10W	10	Erie 15
R9	10k	carbon	1/10W	10	Erie 15
R10	10k	carbon	1/10W	10	Erie 15
R11	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R12	8.2k	carbon	1/10W	10	Erie 15
R13	1.8k	carbon	1/10W	10	Erie 15
R14	33k	carbon	1/10W	10	Erie 15
R15	10k	carbon	1/10W	10	Erie 15
R16	33k	carbon	1/10W	10	Erie 15
R17	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R18	8.2k	carbon	1/10W	10	Erie 15
R19	33k	carbon	1/10W	10	Erie 15
R20	10k	carbon	1/10W	10	Erie 15
R21	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R22	10k	carbon	1/10W	10	Erie 15
R23	8.2k	carbon	1/10W	10	Erie 15
R24	1.8k	carbon	1/10W	10	Erie 15
R25	10k	carbon	1/10W	10	Erie 15
R26	33k	carbon	1/10W	10	Erie 15
R27	10k	carbon	1/10W	10	Erie 15
R28	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R29	8.2k	carbon	1/10W	10	Erie 15
R30	8.2k	carbon	1/10W	10	Erie 15
R31	1.8k	carbon	1/10W	10	Erie 15
R32	33k	carbon	1/10W	10	Erie 15
R33	10k	carbon	1/10W	10	Erie 15
R34	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R35	10k	carbon	1/10W	10	Erie 15
R36	8.2k	carbon	1/10W	10	Erie 15
R37	8.2k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Totalizer, Decoder and Display XE Unit - Resistors continued......					
R38	1.8k	carbon	1/10W	10	Erie 15
R39	10k	carbon	1/10W	10	Erie 15
R40	33k	carbon	1/10W	10	Erie 15
R41	10k	carbon	1/10W	10	Erie 15
R42	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R43	33k	carbon	1/10W	10	Erie 15
R44	10k	carbon	1/10W	10	Erie 15
R45	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R46	10k	carbon	1/10W	10	Erie 15
R47	8.2k	carbon	1/10W	10	Erie 15
R48	8.2k	carbon	1/10W	10	Erie 15
R49	1.8k	carbon	1/10W	10	Erie 15
R50	10k	carbon	1/10W	10	Erie 15
R51	33k	carbon	1/10W	10	Erie 15
R52	10k	carbon	1/10W	10	Erie 15
R53	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R54	22 Ω	carbon	$\frac{1}{4}$W	10	Erie 16
Capacitors					
C1	120pF	ceramic		10	Lemco 310N1500
C2	330pF	ceramic	350V	10	Lemco 310K
C3	330pF	ceramic	350V	10	Lemco 310K
C4	120pF	ceramic	750V	10	Lemco 310N1500
C5	120pF	ceramic	750V	10	Lemco 310N1500
C6	120pF	ceramic	750V	10	Lemco 310N1500
C7	330pF	ceramic	350V	10	Lemco 310K
C8	330pF	ceramic	350V	10	Lemco 310K
C9	120pF	ceramic	750V	10	Lemco 310N1500
C10	120pF	ceramic	750V	10	Lemco 310N1500
C11	330pF	ceramic	350V	10	Lemco 310K
C12	330pF	ceramic	350V	10	Lemco 310K
C13	120pF	ceramic	750V	10	Lemco 310N1500
C14	120pF	ceramic	750V	10	Lemco 310N1500
C15	330pF	ceramic	350V	10	Lemco 310K
C16	330pF	ceramic	350V	10	Lemco 310K
C17	120pF	ceramic	750V	10	Lemco 310N1500

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Totalizer, Decoder and Display XE Unit continued......

Transistors

VT1	Mullard GET 882
VT2 & VT3 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT4	Mullard GET 882
VT5 - VT7 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT8	Mullard GET 882
VT9 & VT10 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT11	Mullard GET 882
VT12 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT13	Mullard GET 882
VT14 - VT16 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT17	Mullard GET 882
VT18 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT19	Mullard GET 882
VT20 - VT22 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT23	Mullard GET 882
VT24 *	Mullard ACY20/G.E.C.G.E.T.536 or 538
VT25	Mullard GET 882
VT26 *	Mullard ACY20/G.E.C.G.E.T.536 or 538

* NOTE: Boards should not contain a mixture of equivalents.

Diodes

MR1	Mullard OA91
MR2	Mullard OA47
MR3	Mullard OA91
MR4	Mullard OA47
MR5	Mullard OA91
MR6 & MR7	Mullard OA47
MR8 - MR12	Mullard OA91
MR13 - MR15	Mullard OA47
MR16	Mullard OA91
MR17	Mullard OA47
MR18 & MR19	Mullard OA91
MR20 & MR21	Mullard OA47
MR22	Mullard OA91
MR23	Mullard OA47
MR24	Mullard OA91

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Totalizer, Decoder and Display XE Unit - Diodes continued......					
MR25					Mullard OA47
MR26					Mullard OA91
MR27 & MR28					Mullard OA47
MR29					Mullard OA91
MR30 & MR31					Mullard OA47
MR32					Mullard OA91
MR33					Mullard OA47
Display Bulbs					
ILP1 - ILP10		wire ended 12V, 0.1A			Thorn L1053
Amplifier and Shaper XB Unit					
Resistors					
R1	6.8k	carbon	1/10W	10	Erie 15
R2	150Ω	carbon	1/10W	10	Erie 15
R3	4.7k	carbon	1/10W	10	Erie 15
R4	12k	carbon	1/10W	10	Erie 15
R5	3.3k	carbon	1/10W	10	Erie 15
R6	3.9k	carbon	1/10W	10	Erie 15
R7	150Ω	carbon	1/10W	10	Erie 15
R8	330k	carbon	$\frac{1}{4}$W	10	Erie 16
R9	15k	carbon	$\frac{1}{4}$W	10	Erie 16
R10	4.7k	carbon	$\frac{1}{4}$W	10	Erie 16
R11	820Ω	carbon	$\frac{1}{4}$W	5	Erie 108
R12	1.2k	carbon	$\frac{1}{4}$W	5	Erie 108
R13	6.8k	carbon	1/10W	5	Erie N1
R14	820Ω	carbon	$\frac{1}{4}$W	5	Erie 108
R15	15k	carbon	1/10W	5	Erie N1
R16	47Ω	carbon	1/10W	5	Erie N1
R17	2.2k	carbon	1/10W	5	Erie N1
R18	1k	carbon	$\frac{1}{4}$W	5	Erie 108
R19	6.8k	carbon	$\frac{1}{4}$W	5	Erie 16
R20	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R21	5.6k	carbon	1/10W	10	Erie 15

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Amplifier and Shaper XB Unit - Resistors continued......					
R22	10k	carbon	1/10W	10	Erie 15
R23	100k	carbon	1/10W	10	Erie 15
R24	390Ω	carbon	1/10W	10	Erie 15
Potentiometers					
RV1	100 Ω				Reliance WL35 (printed circuit version)
Capacitors					
C1	200 μF	electrolytic	16V		Mullard C426/AM/E200
C2	200 μF	electrolytic	6.4V		Mullard C426/AM/C200
C3	200 μF	electrolytic	16V		Mullard C426/AM/E200
C4	56pF	ceramic	750V	10	Lemco 310N750
C5	220pF	ceramic	350V	10	Lemco 310K
C6	.01 μF	polyester	400V	20	Wima Tropyfol 'M'
C7	10 μF	electrolytic	16V		Mullard C426/AM/E10
Transistors					
VT1 & VT2					Texas 2G401
VT3					Texas 2S 733
VT4 - VT6					Texas 2G403
Diodes					
MR1					Mullard OA47
MR2 & MR3					Mullard OA91
MR4					Texas IS130
MR5					Mullard OA91
MR6					Mullard OA47
MR7					Mullard OAZ247

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Control and Timing XK Unit

Resistors

R1	33k	carbon	1/10W	10	Erie 15
R2	10k	carbon	1/10W	10	Erie 15
R3	33k	carbon	1/10W	10	Erie 15
R4	3.3k	carbon	1/10W	10	Erie 15
R5	820Ω	carbon	1/10W	10	Erie 15
R6	1.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R7	10k	carbon	1/10W	10	Erie 15
R8	10k	carbon	1/10W	10	Erie 15
R9	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R10	10k	carbon	1/10W	10	Erie 15
R11	33k	carbon	1/10W	10	Erie 15
R12	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R13	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16
R14	33k	carbon	1/10W	10	Erie 15
R15	2.2k	carbon	1/10W	10	Erie 15
R16	470 Ω	carbon	1/10W	10	Erie 15
R17	33 Ω	carbon	1/10W	10	Erie 15
R18	10k	carbon	1/10W	10	Erie 15
R19	10k	carbon	1/10W	10	Erie 15
R20	3.3k	carbon	1/10W	10	Erie 15
R21	33k	carbon	1/10W	10	Erie 15
R22	5.6k	carbon	1/10W	10	Erie 15
R23	10k	carbon	1/10W	10	Erie 15
R24	10k	carbon	1/10W	10	Erie 15
R25	100k	carbon	1/10W	10	Erie 15
R26	18k	carbon	1/10W	10	Erie 15
R27	2.2k	carbon	1/10W	10	Erie 15
R28	10k	carbon	1/10W	10	Erie 15
R29	10k	carbon	1/10W	10	Erie 15
R30	1.5k	carbon	$\frac{1}{4}$W	10	Erie 16
R31	4.7k	carbon	1/10W	10	Erie 15
R32	33k	carbon	1/10W	10	Erie 15
R33	22k	carbon	1/10W	10	Erie 15
R34	2.2k	carbon	1/10W	10	Erie 15
R35	100Ω	carbon	1/10W	10	Erie 15
R36	6.8k	carbon	1/10W	10	Erie 15
R37	1k	carbon	$\frac{1}{4}$W	10	Erie 16

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Control and Timing XK Unit - Resistors continued......					
R38	33k	carbon	1/10W	10	Erie 15
R40	100Ω	carbon	1/10W	10	Erie 15
R41	33k	carbon	$\frac{1}{4}$W	10	Erie 16
R42	10k	carbon	$\frac{1}{4}$W	10	Erie 16
Capacitors					
C1	330pF	ceramic	350V	10	Lemco 310K
C2	120pF	ceramic	750V	10	Lemco 310N1500
C3	120pF	ceramic	750V	10	Lemco 310N1500
C4	680pF	ceramic	350V	10	Lemco 310K
C5	220pF	ceramic	350V	10	Lemco 310K
C6	100 μF	electrolytic	16V		Mullard C426/AM/E100
C7	1000pF	ceramic	350V	10	Lemco 310K
C8	.01 μF	polyester	125V	20	Wima Tropyfol M
C9	1.6 μF	electrolytic	64V		Mullard C42AE/H1.6
C10	220pF	ceramic	350V	10	Lemco 310K
C11	.047 μF	polyester	125V	20	Wima Tropyfol M
C12	1000pF	ceramic	350V	10	Lemco 310K
Transistors					
VT1 - VT10					Mullard GET 882
VT11 & VT12					Mullard ACY20
VT13					Texas 25733
VT14					Mullard ACY20
Diodes					
MR1					Mullard OA47
MR2					Mullard OA91
MR3 & MR4					Mullard OA47
MR5 & MR6					Mullard OA91
MR7 & MR8					Mullard OA47
MR9		DELETED			
MR10 - MR16					Mullard OA91
MR17					Mullard OA47
MR18					Mullard OA91
MR19					Mullard OA47

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer

Power Supply Unit

Resistors

R1	10k	carbon	1/10W	10	Erie 15
R2	100k	carbon	1/10W	10	Erie 15
R3	22k	carbon	1/10W	10	Erie 15
R4	22k	carbon	1/10W	10	Erie 15
R5	10k	carbon	1/10W	10	Erie 15
R6	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R7	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R8		DELETED			
R9	120 Ω	wirewound	1.5W	5	Painton MV1A
R10	39 Ω	wirewound	1.5W	5	Painton MV1A
R11	33k	carbon	1/10W	10	Erie 15
R12	1k	carbon	$\frac{1}{4}$W	10	Erie 16
R13	2.2k	carbon	$\frac{1}{4}$W	10	Erie 16

Capacitors

C1	120pF	ceramic	750V	10	Lemco 310N1500
C2	0.47μF	polyester	125V	5	Wima Tropyfol M
C3	120pF	ceramic	750V	10	Lemco 310N1500
C4	1000 μF	electrolytic	25V		Plessey CE 12051
C5	100 μF	electrolytic	16V		Mullard C426/AM/E100
C6	100 μF	electrolytic	16V		Mullard C425/AM/E100
C7	470pF	ceramic	350V	10	Lemco 310K
C8	5000 μF	electrolytic	18V		Plessey CE 1711/1
C9	15pF	silver mica	300V	±1pF	Johnson Matthey C12S

Capacitor variable

CV1	4-60pF				Mullard C010AA160E

Transistors

VT1 - VT3					Mullard GET 882

Cct. Ref.	Value	Description	Rat.	Tol. %	Manufacturer
Power Supply Unit continued......					
Diodes					
MR1					Texas 18131
MR2 & MR3					Texas IS020
MR4					Texas IS131
MR5 & MR6		Zener			International MZ12TS
Miscellaneous					
		Crystal Oven			Snelgrove Type SO-12
XL		Quartz Crystal			Racal BD23041
		International Octal valveholder			McMurdo Type XE/U

CHAPTER 6

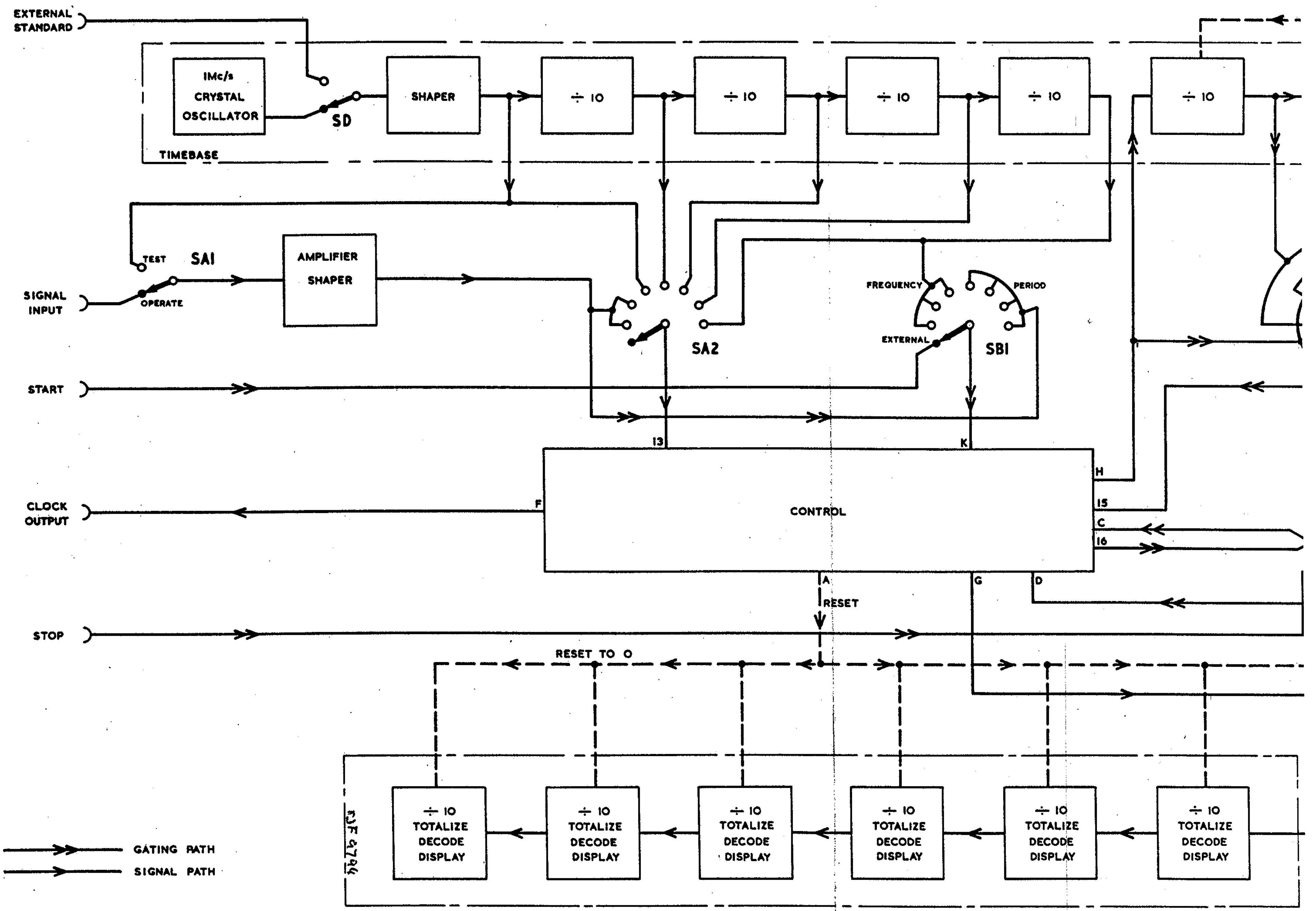
RECOMMENDED MAINTENANCE

SPARES

CHAPTER 6

RECOMMENDED MAINTENANCE SPARES

Item	Description	Part No.	Qty.
1	Fuse 1 Amp.	L.754	6
2	Lamp 12V	L.1063	12
3	1 Mc/s Crystal	BD.23041	1
4	Crystal Oven	ASW.23040	1
5	1.2 Mc/s AC/DC Amplifier	XB	1
6	Periodic Divider	XD	1
7	Totalizer, Decoder and Display	XE	1
8	Totalizer, Decoder and Display	XF	1
9	Totalizer, Decoder and Display	XG	1
10	Synchronous Divider	XH	1
11	Oscillator and Synchronous Divider	XJ	1
12	Control Board	XK	1
13	Power Supply Board	PU	1



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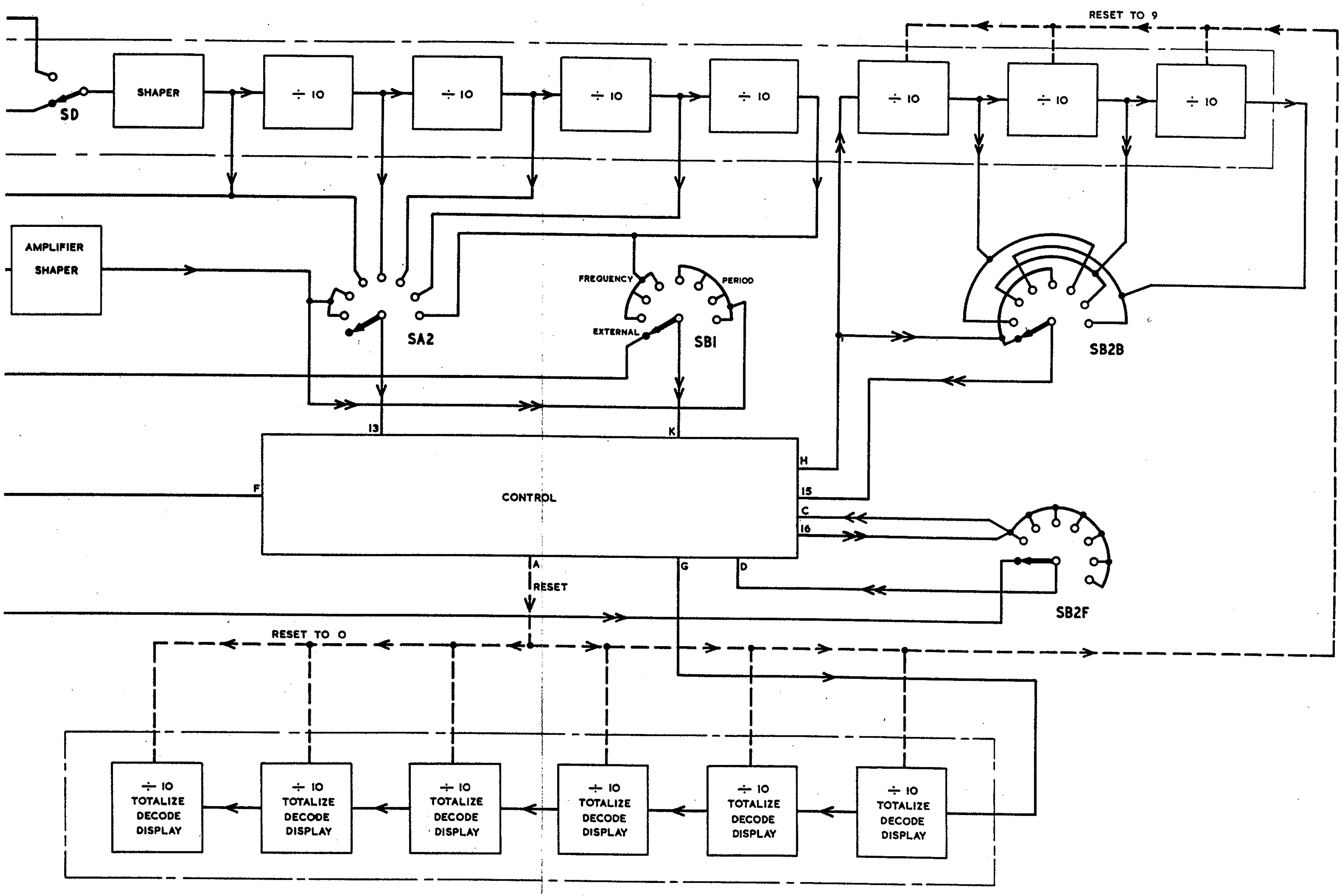
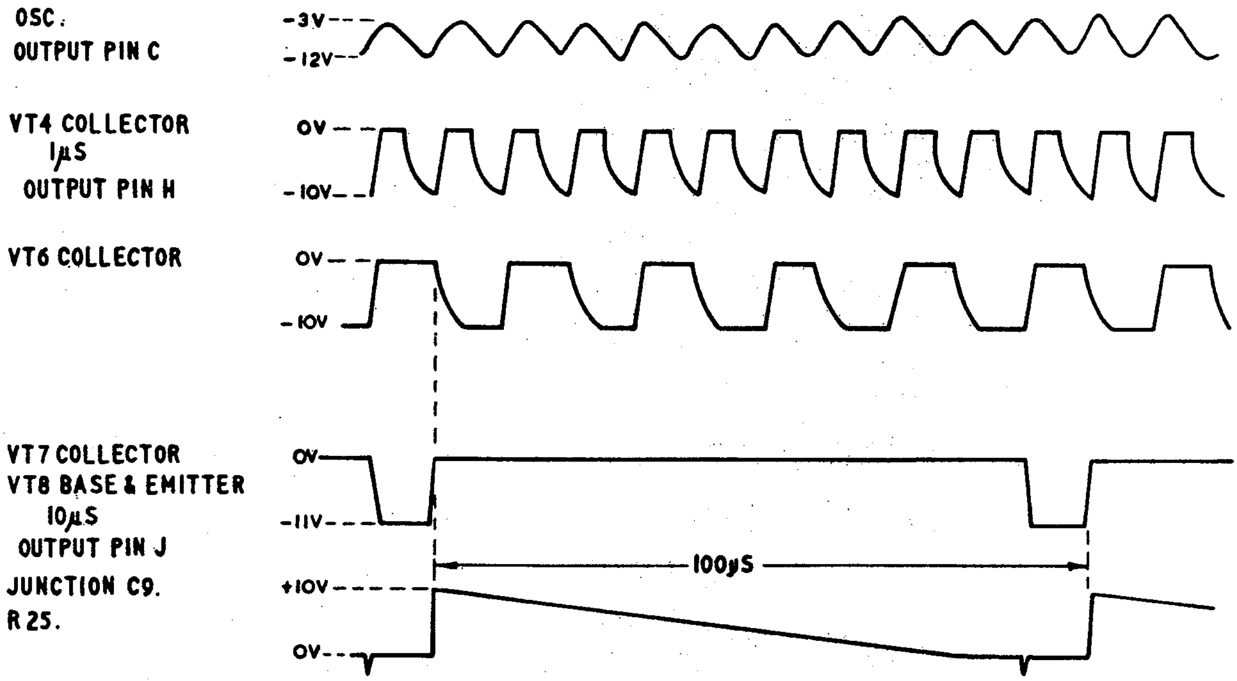
Simplified Block Diagram SA.535

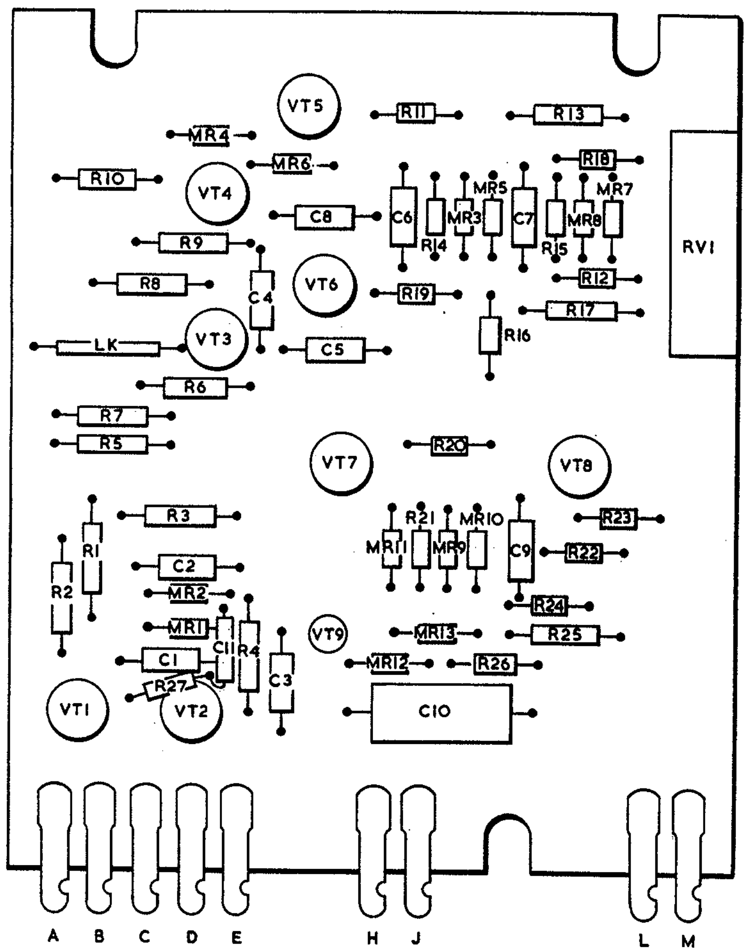


Simplified Block Diagram SA.535

Fig.1



102/2/2 Waveforms : XJ Unit Fig.2.



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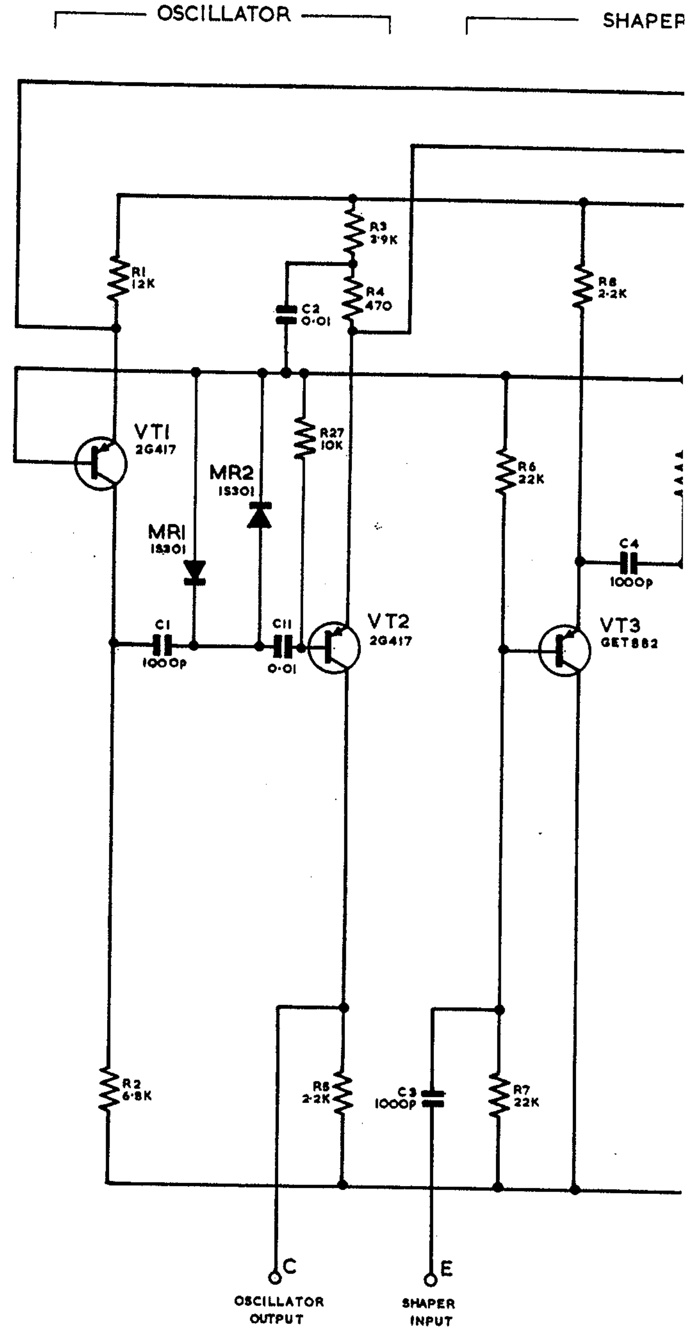
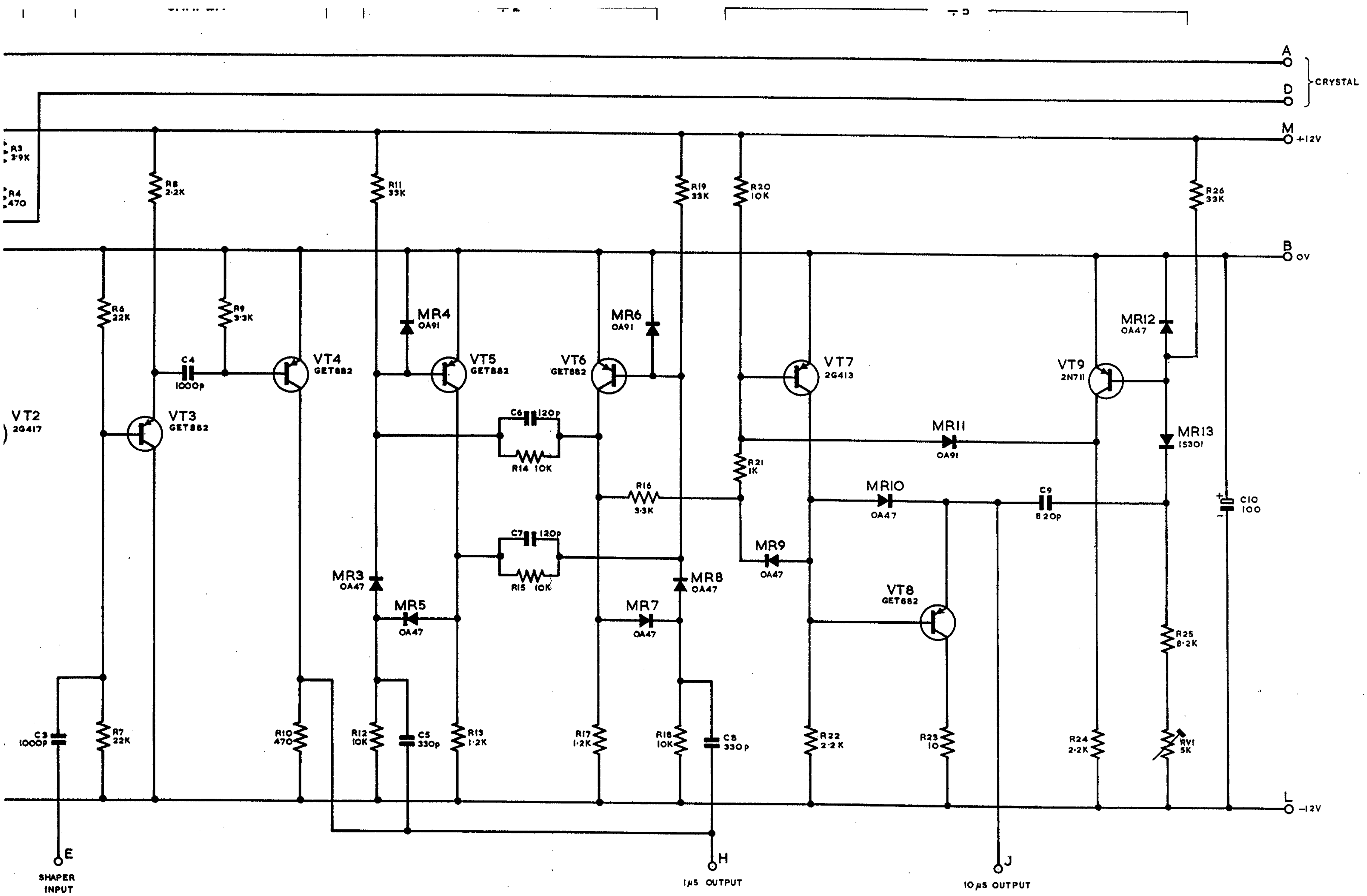
Layout : XJ Unit

Fig.3

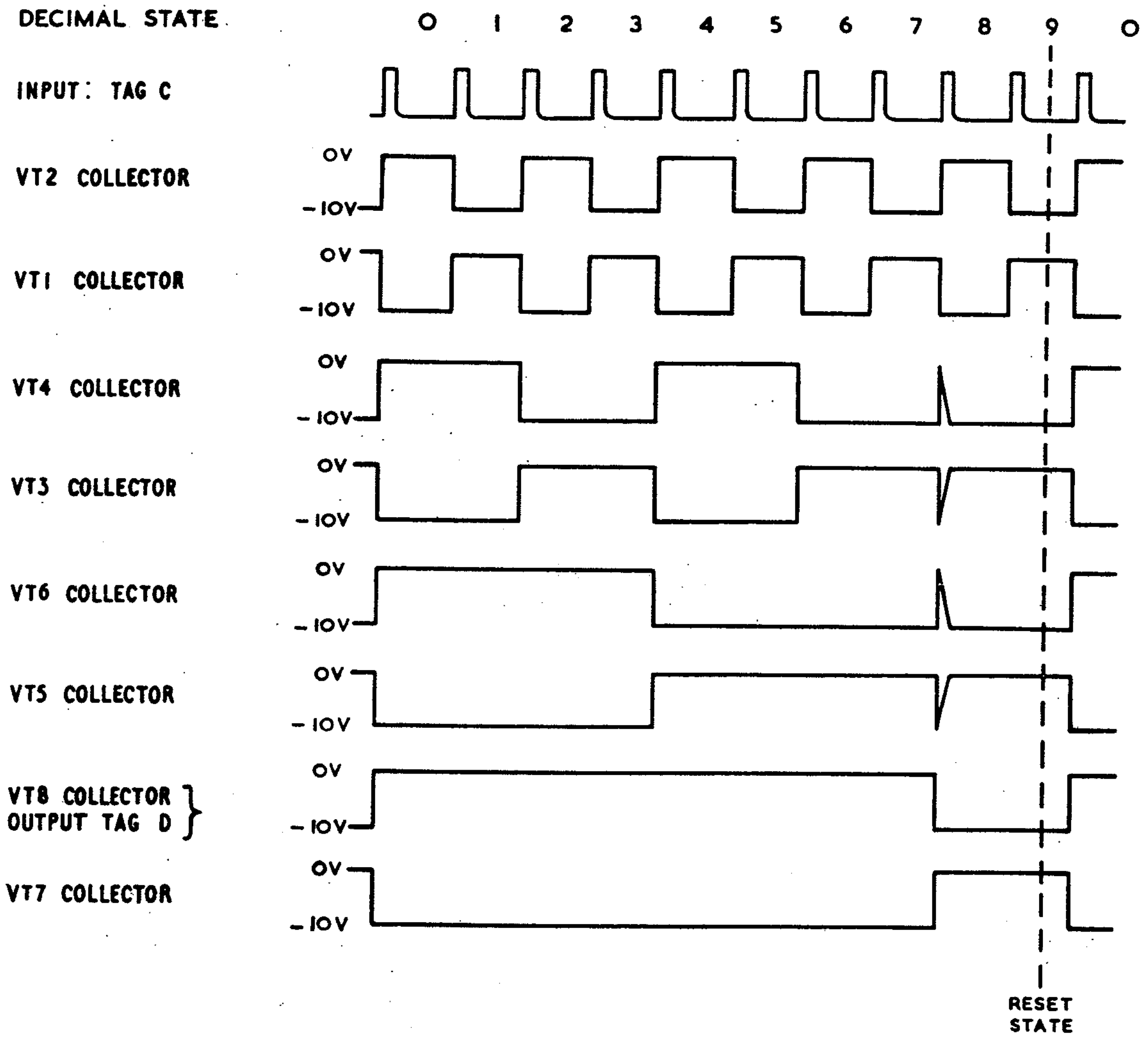


102/2

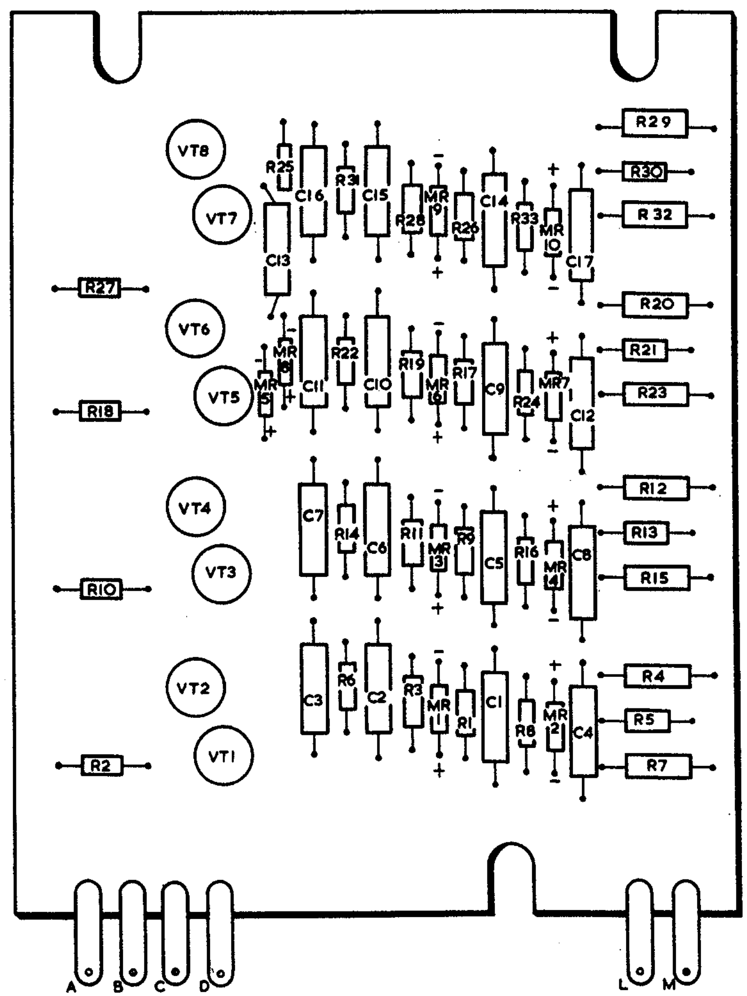


Circuit : Oscillator and Divider Type XJ

Fig. 4

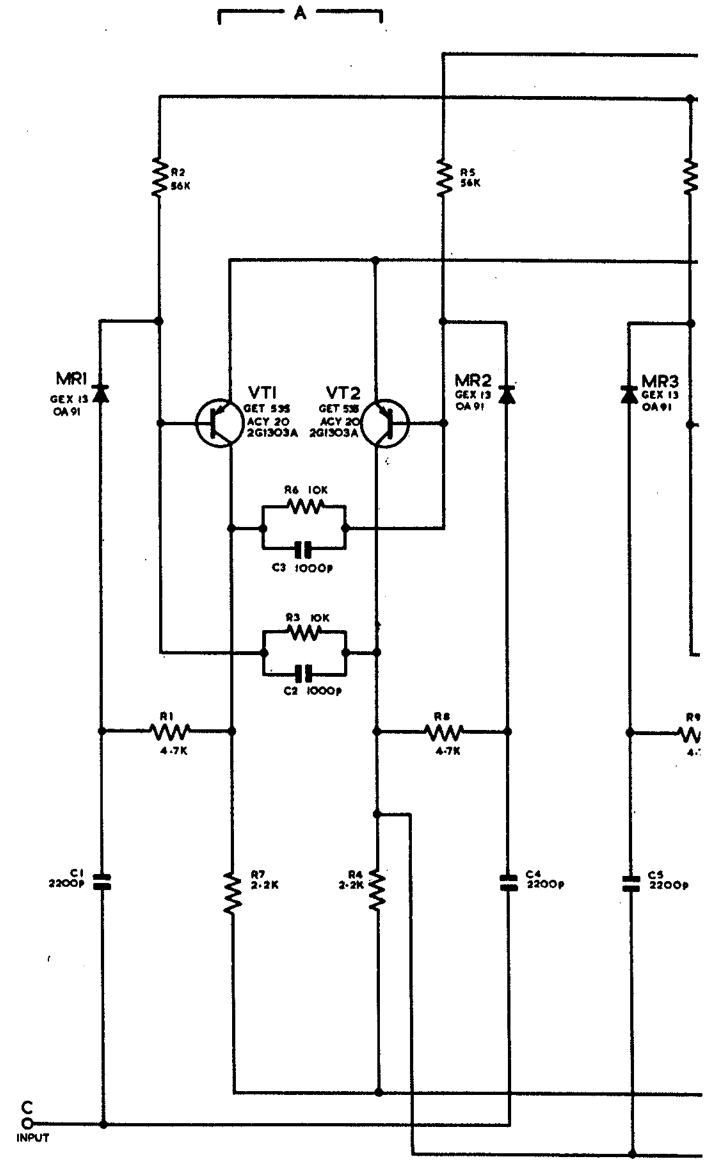


102/1/2 Waveforms: XD Unit — S A.535 Fig. 5

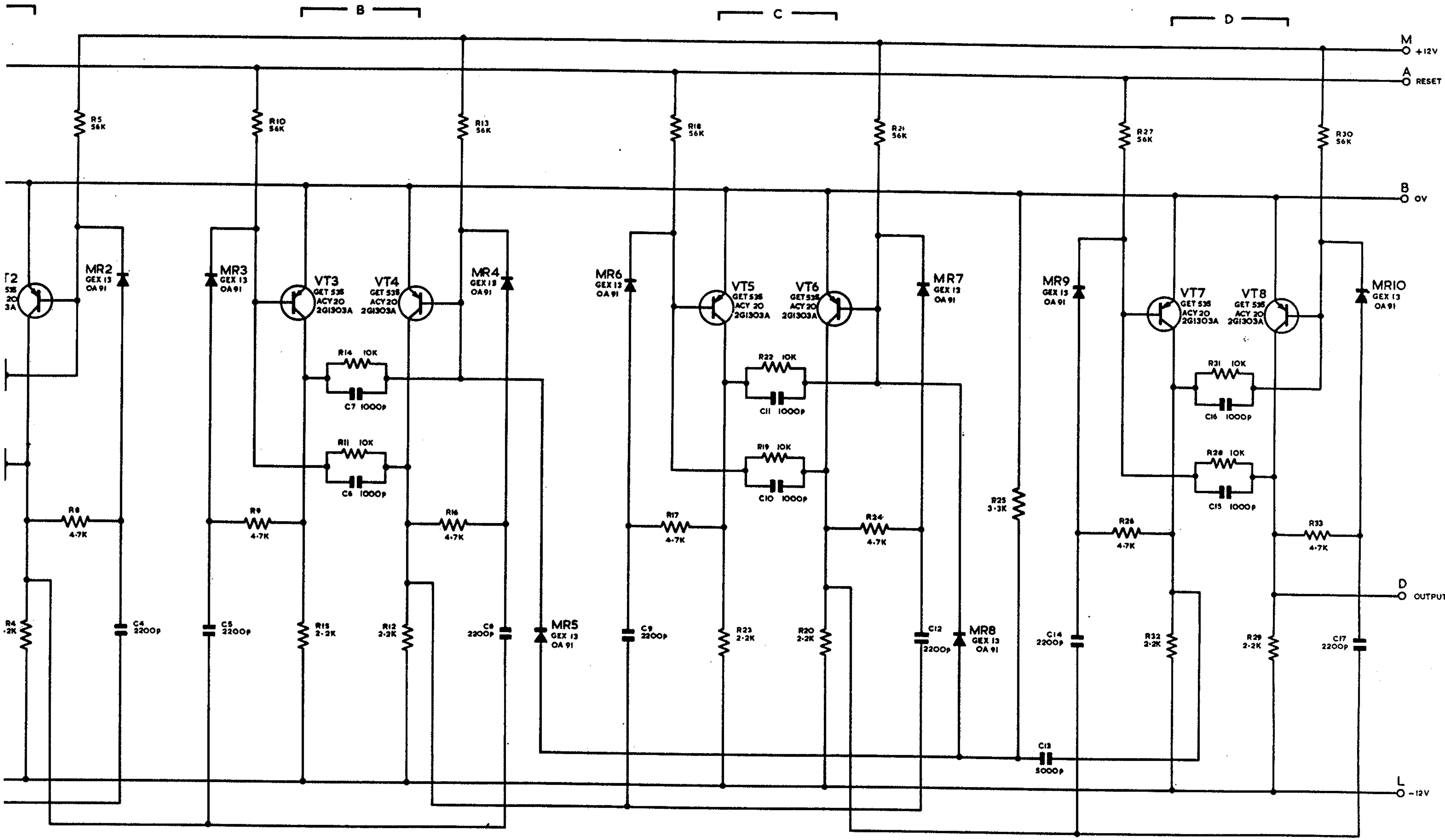


102/1/1

Layout: X D Unit—SA.535 Fig.6

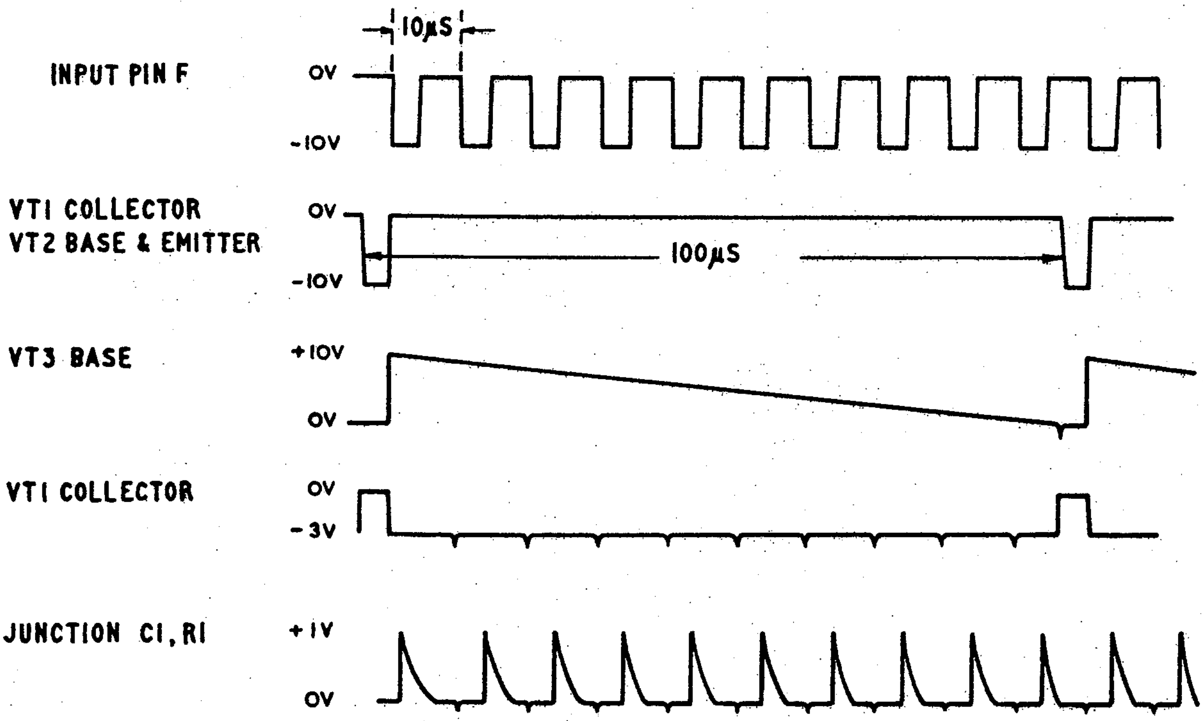


102/1



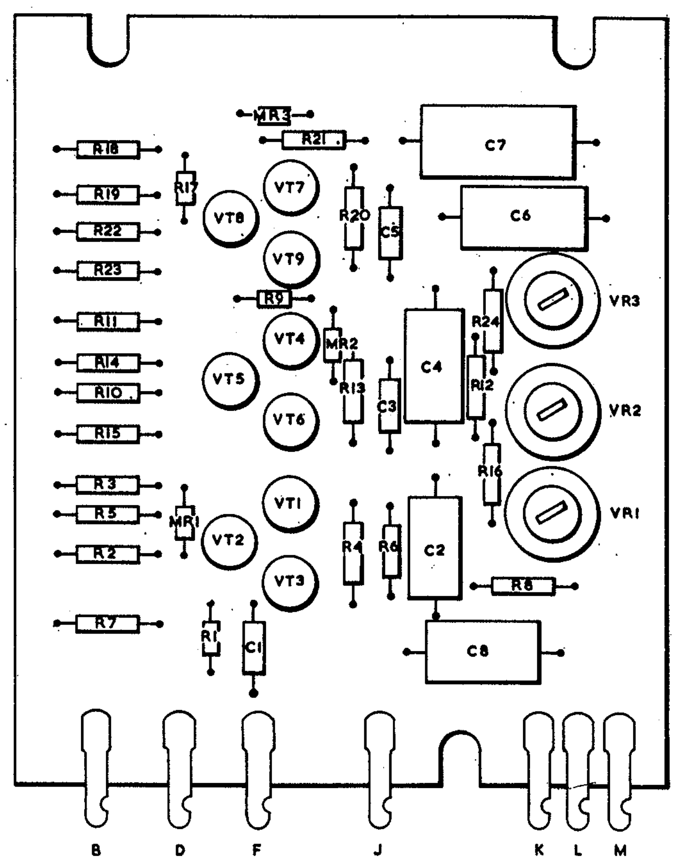
Circuit : Decade Divider Type X D

Fig.7



N.B. TYPICAL WAVEFORMS FOR THE FIRST DIVIDED ONLY ARE SHOWN. THE WAVEFORMS FOR THE REMAINING TWO DIVIDERS FOLLOW A SIMILAR PATTERN

102/5/2 Waveforms : X H Unit — S A.535 Fig.8



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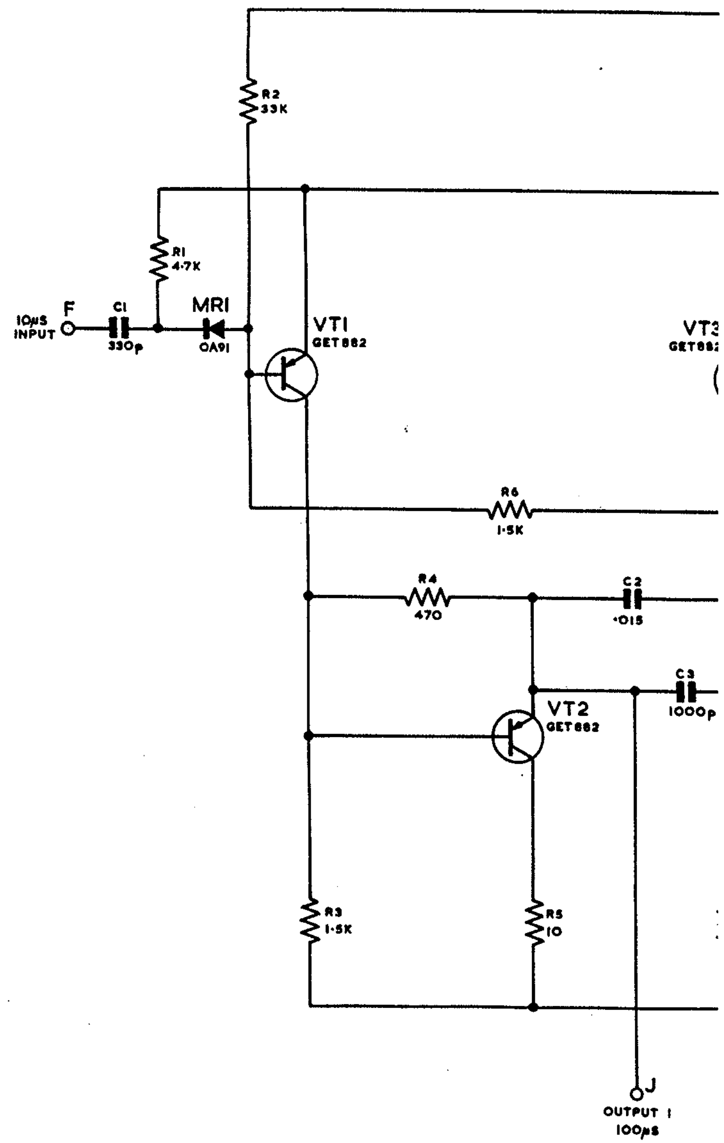
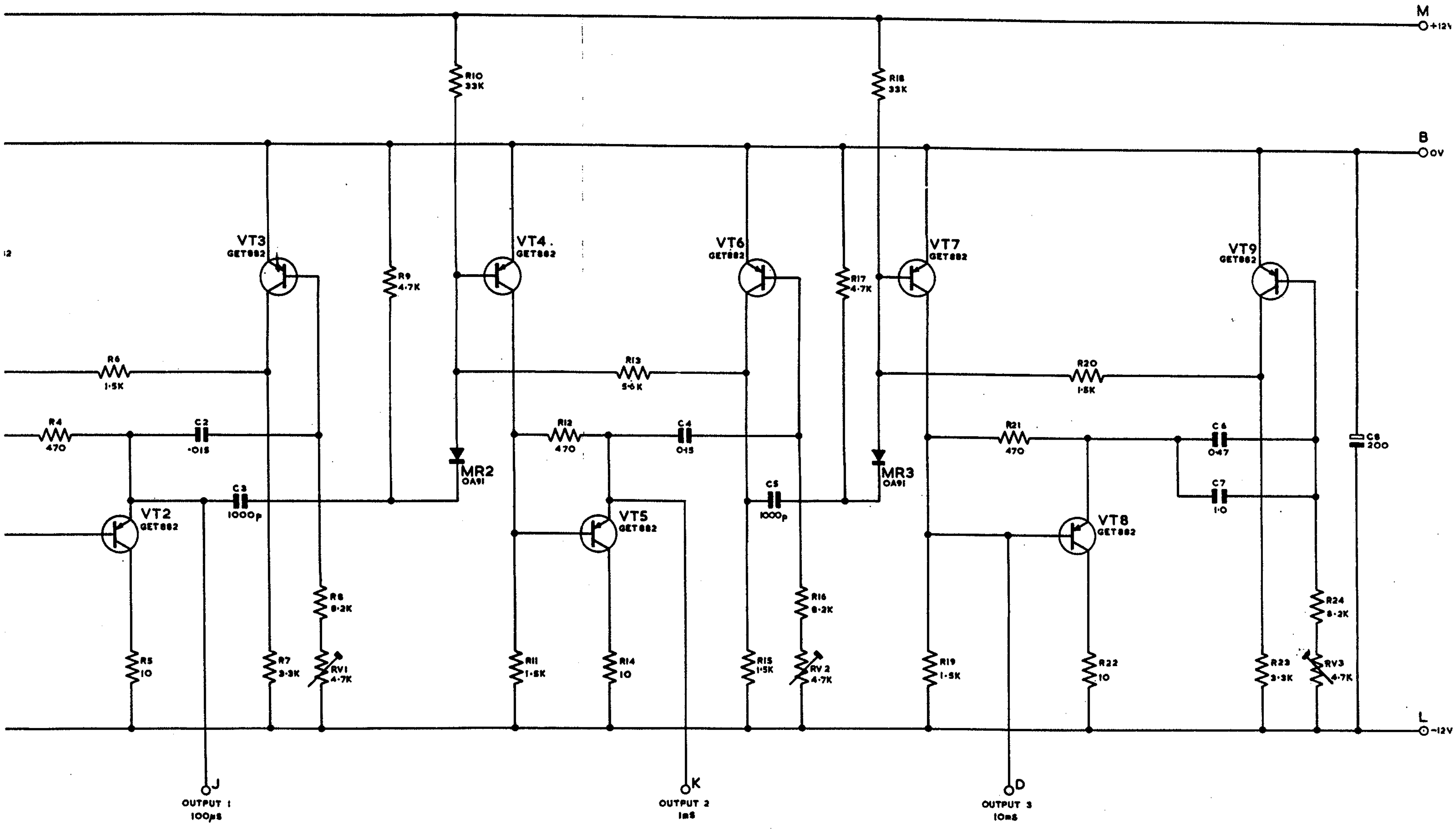
Layout: XH Unit-S A.535

Fig.9

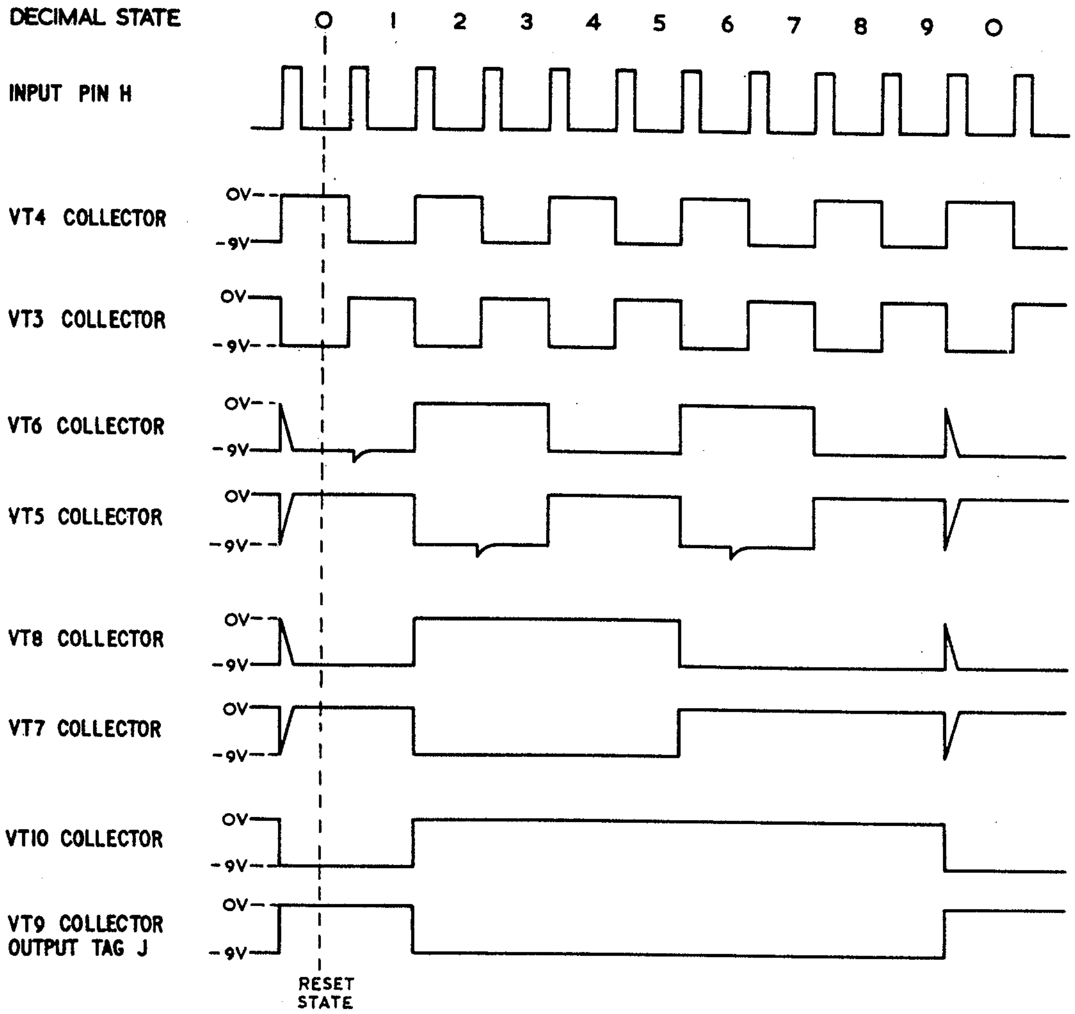


102/5

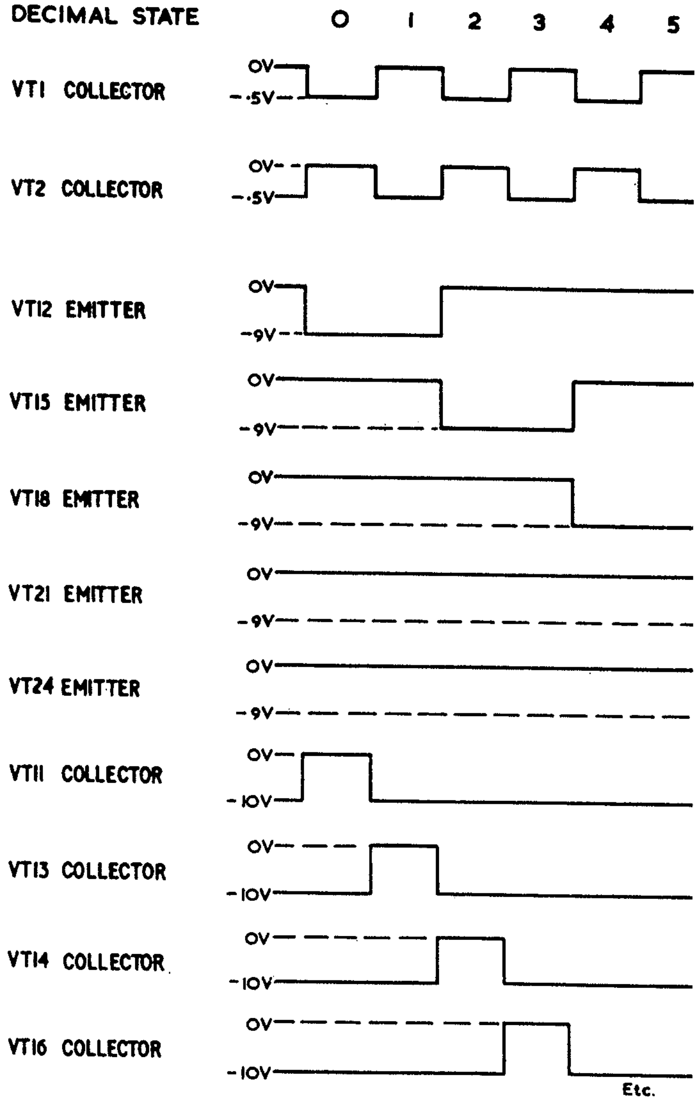


Circuit: Synchronous Divider Type XH

Fig. 10



TOTALIZER



DECODER

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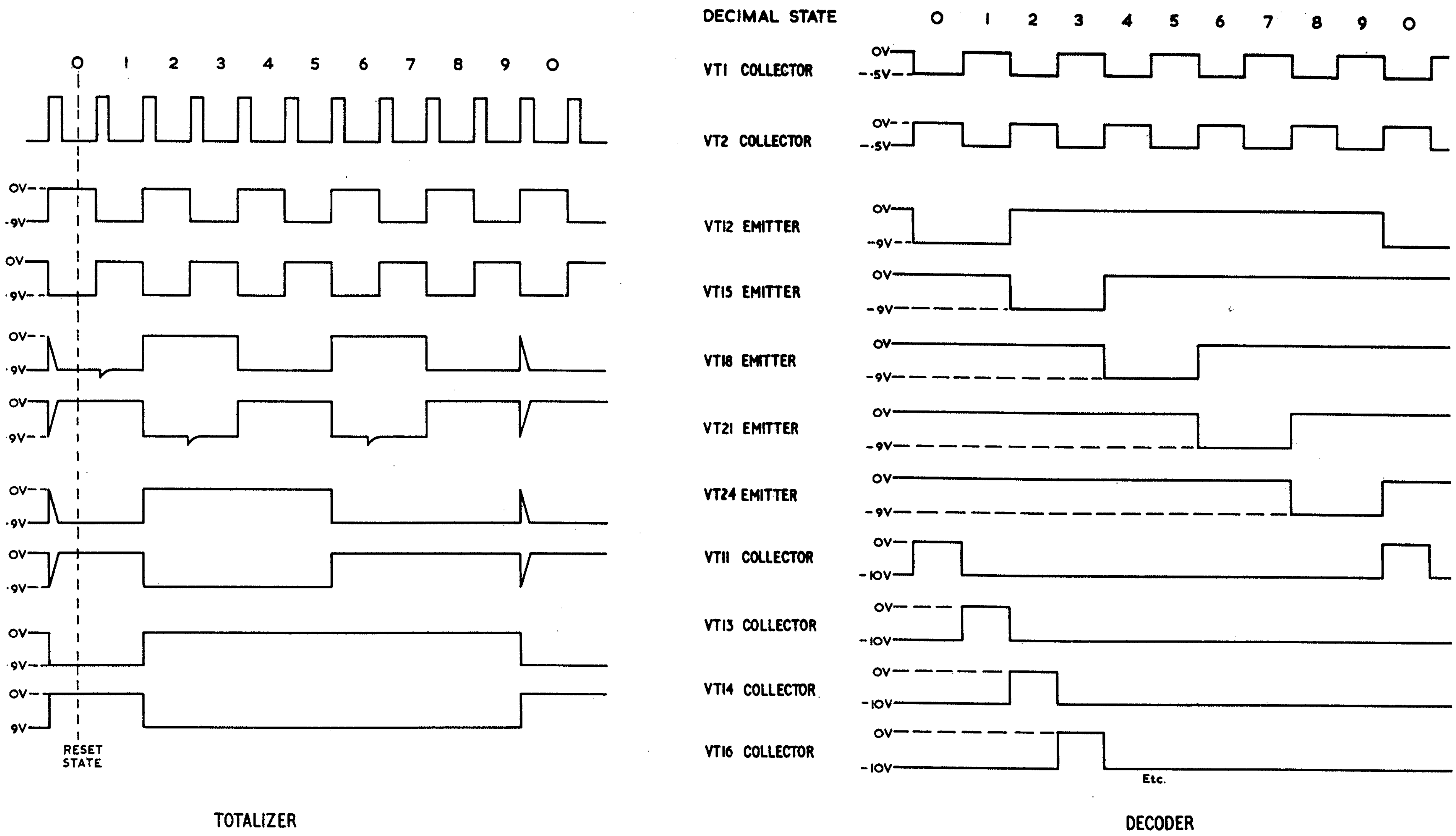
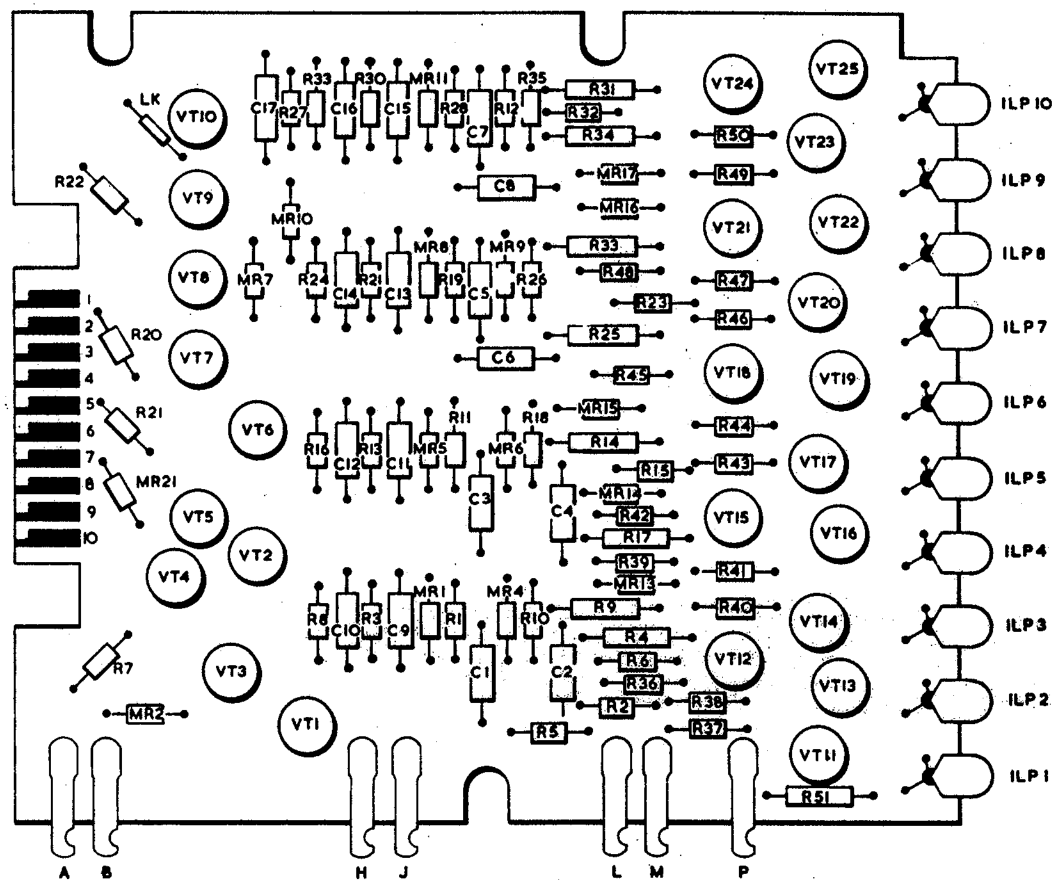
Waveforms : XG and XF Units — SA.535



Waveforms : XG and XF Units — SA.535

Fig. 11.



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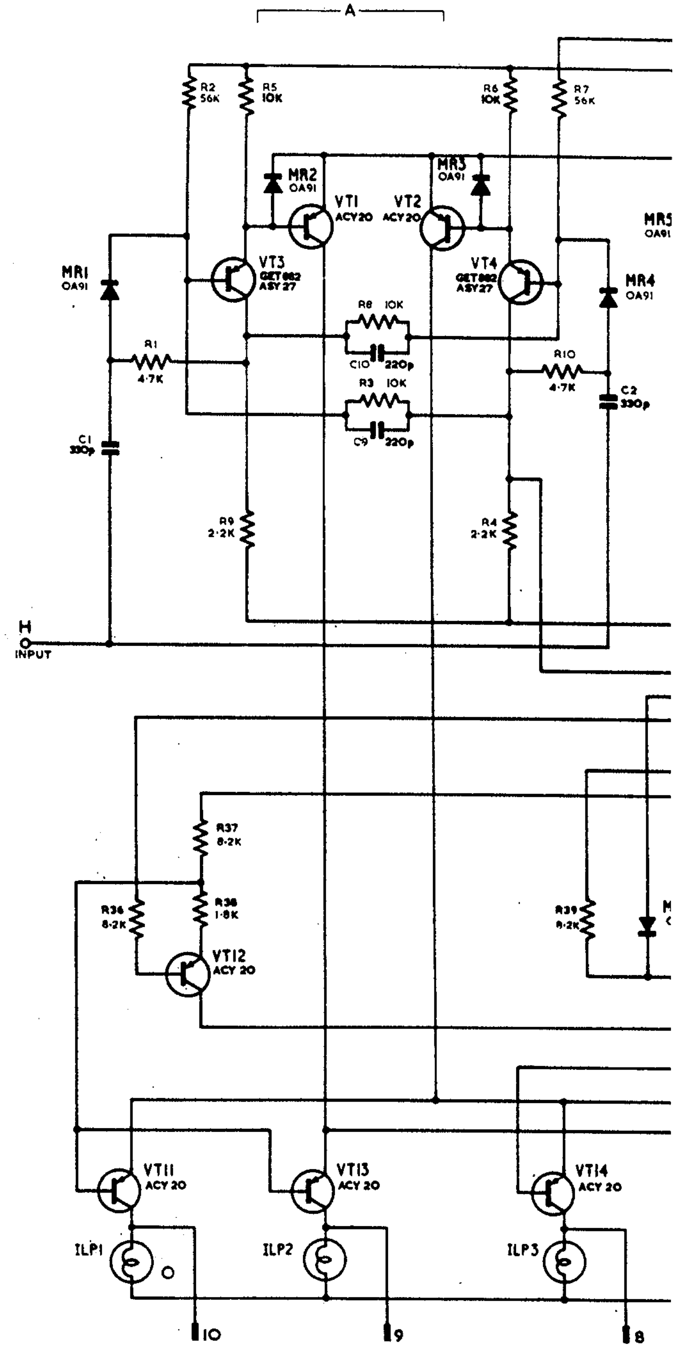
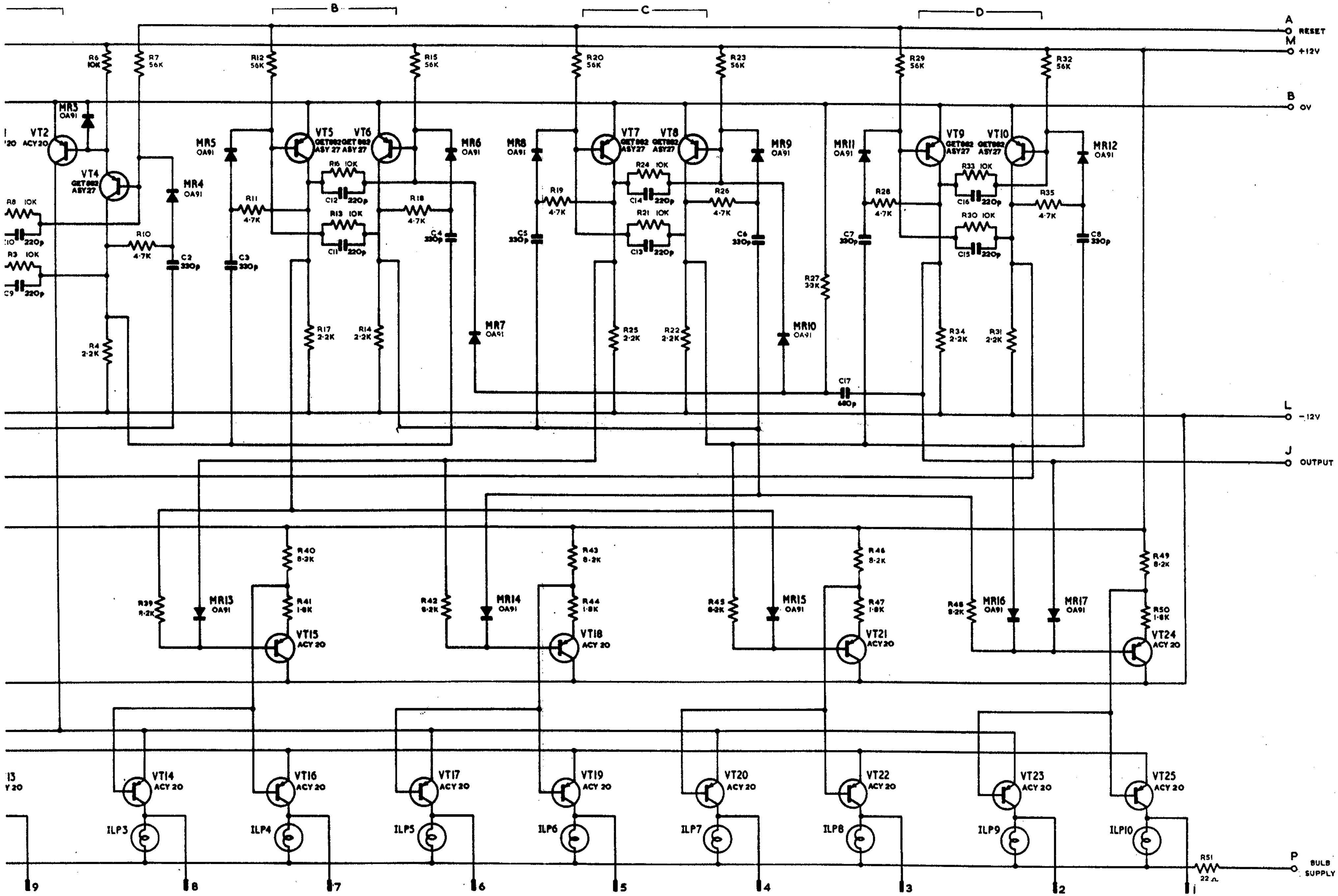
Layout : XG Unit—SA 535

Fig 12

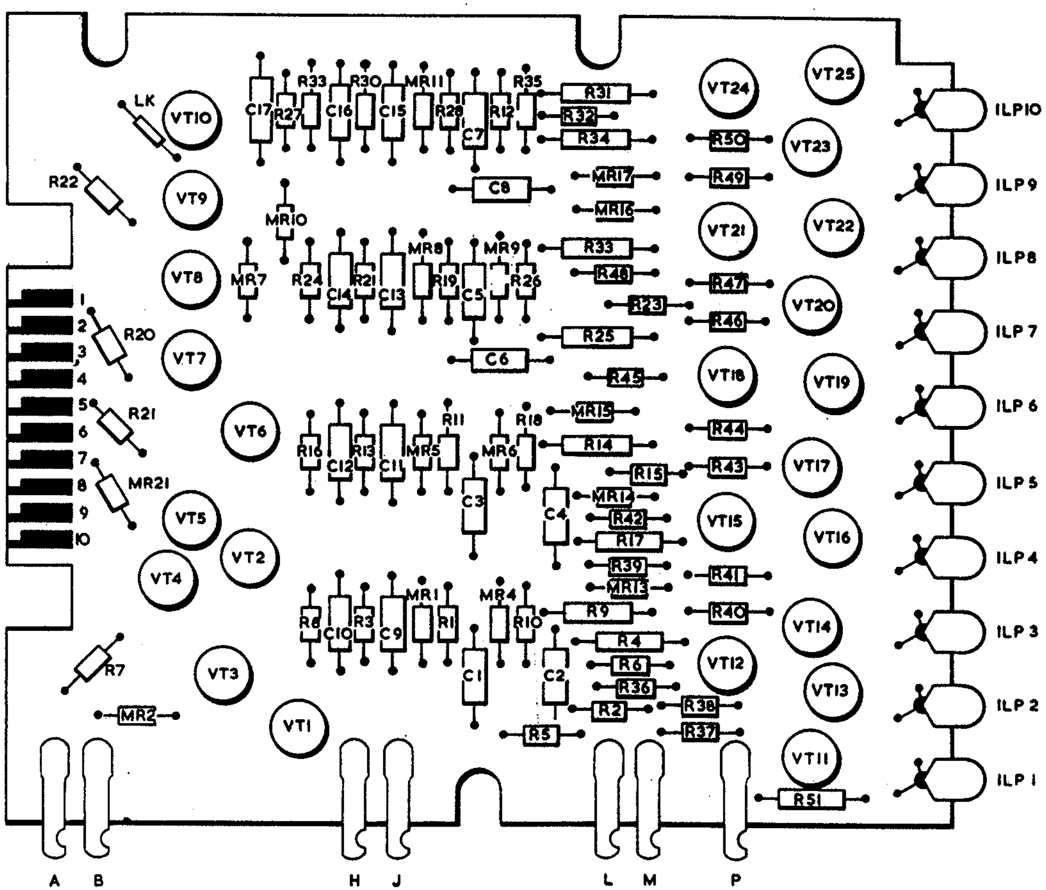


102/3



Circuit: Totalizer Type XG—S A.535

Fig. 13



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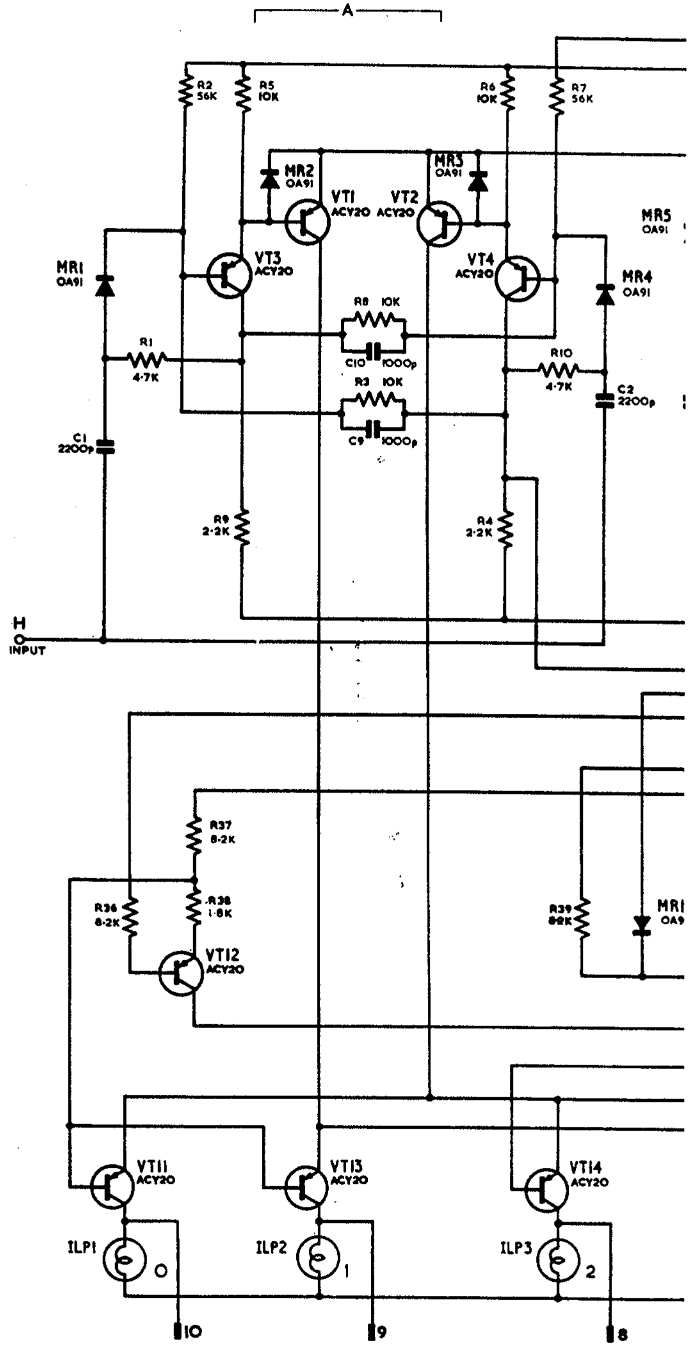
Layout: XF Unit—S A.535

Fig.14



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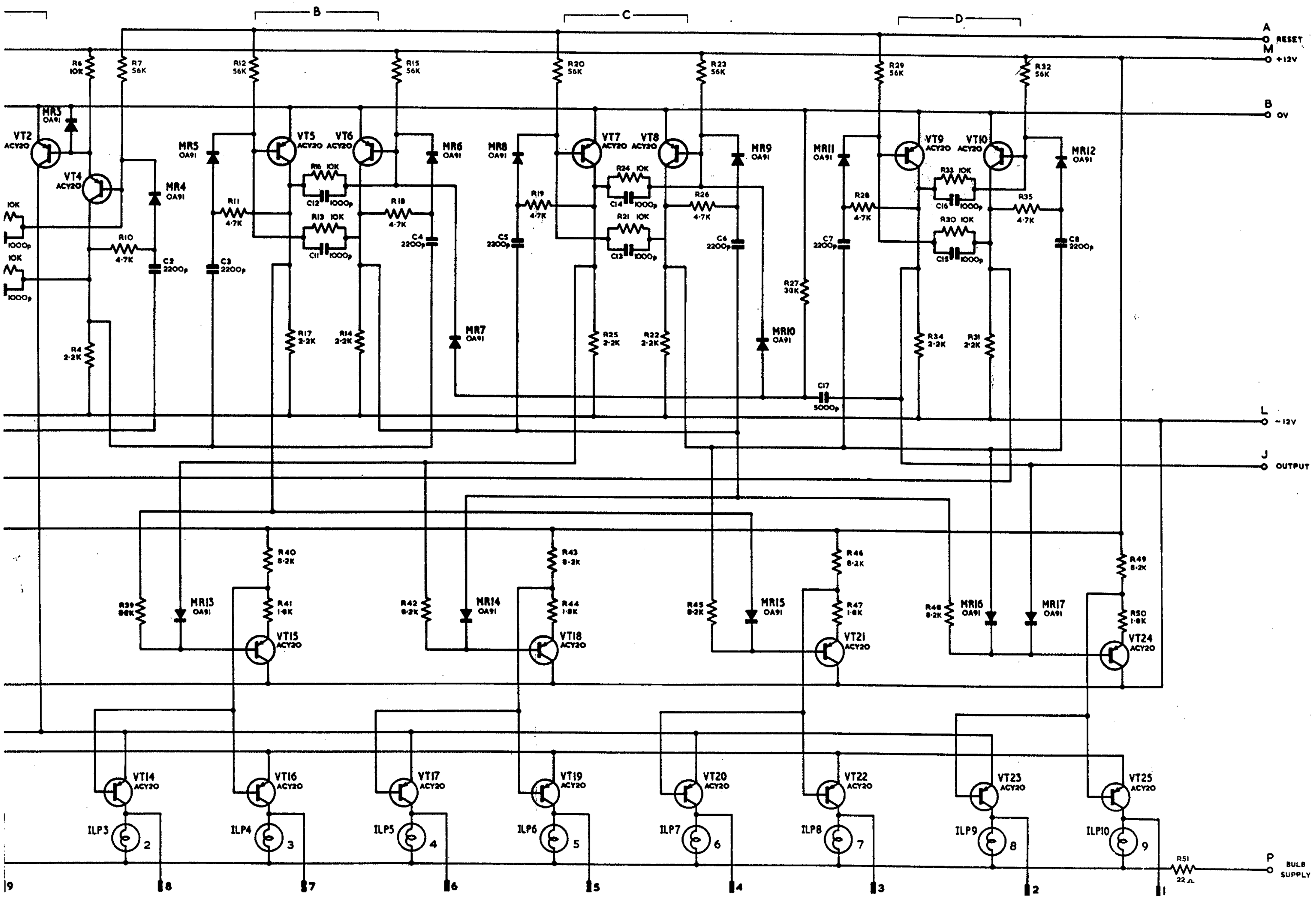
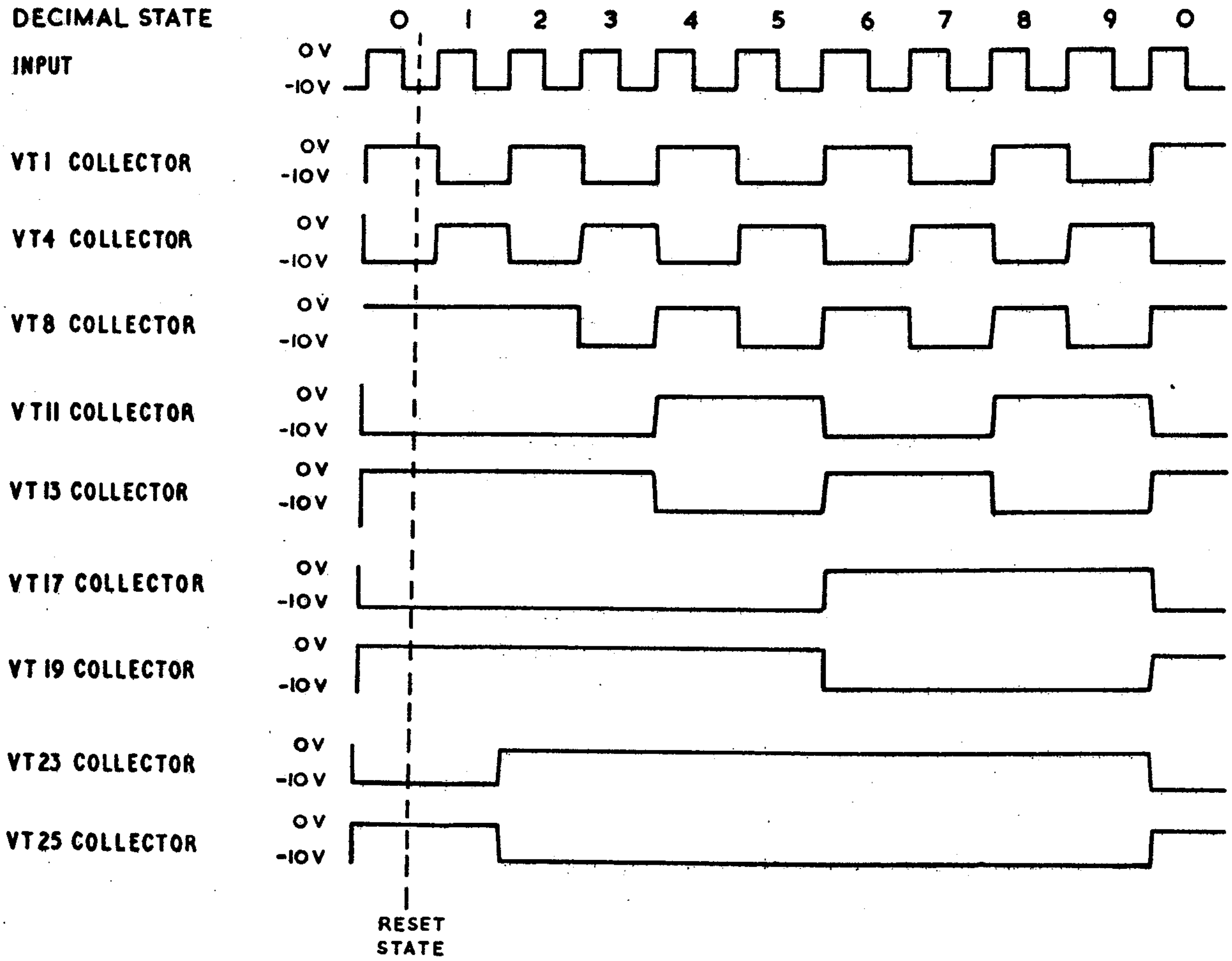


Circuit: Totalizer Type XF—S A.535

Fig. 15



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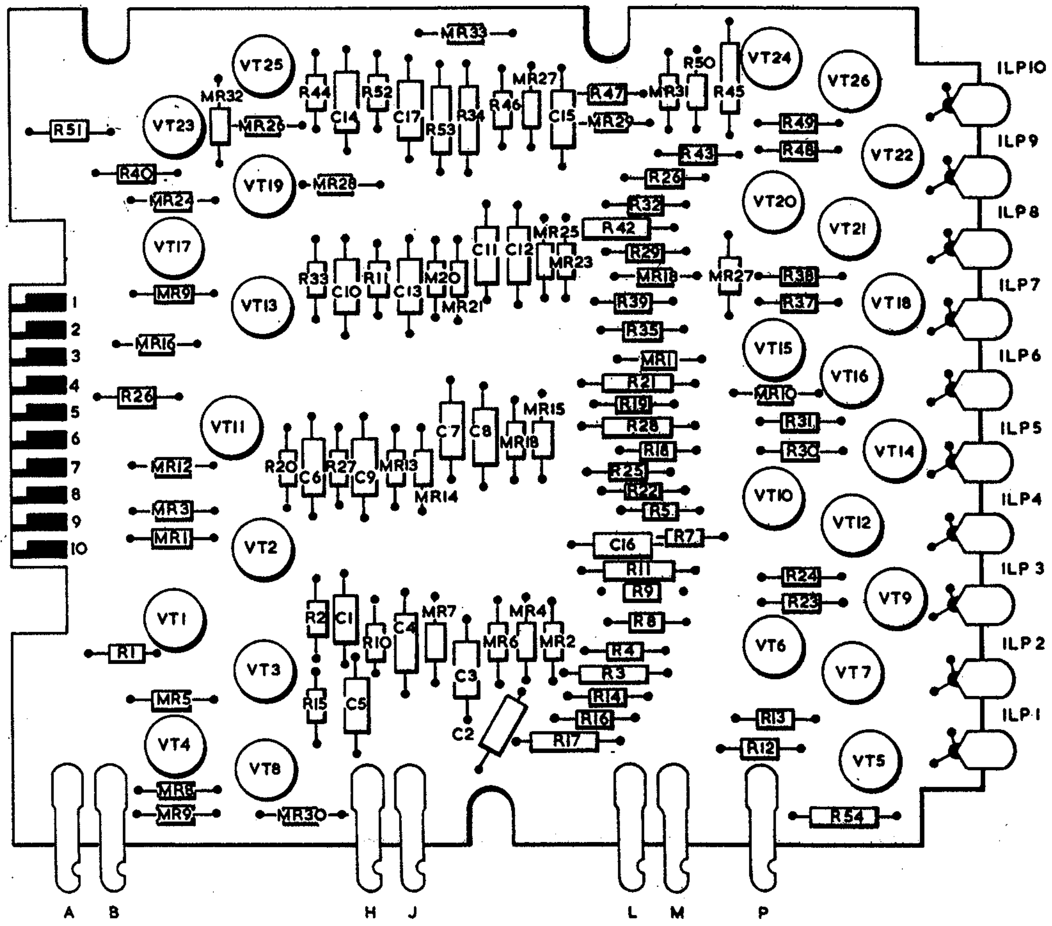
Waveforms : XE Unit — SA.535 **Fig.16**



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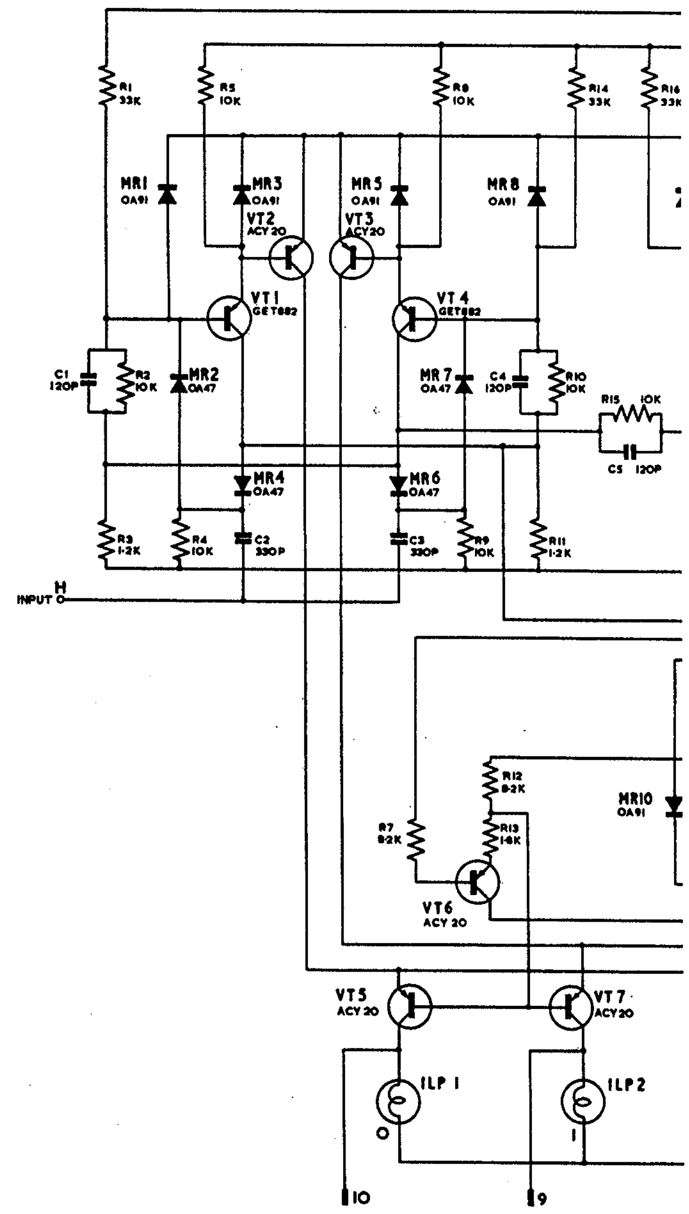
Layout: XE Unit—SA.535

Fig.17



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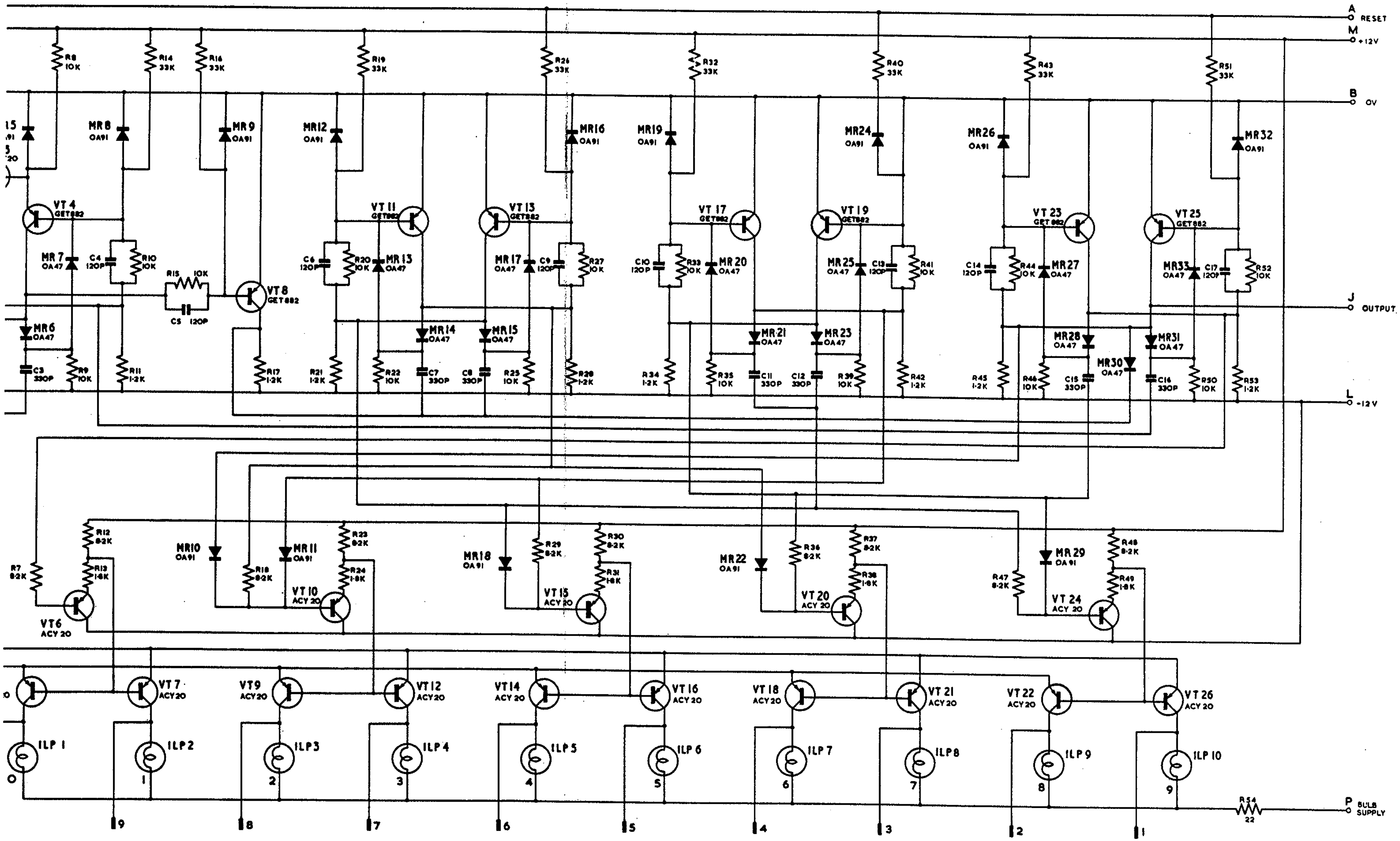
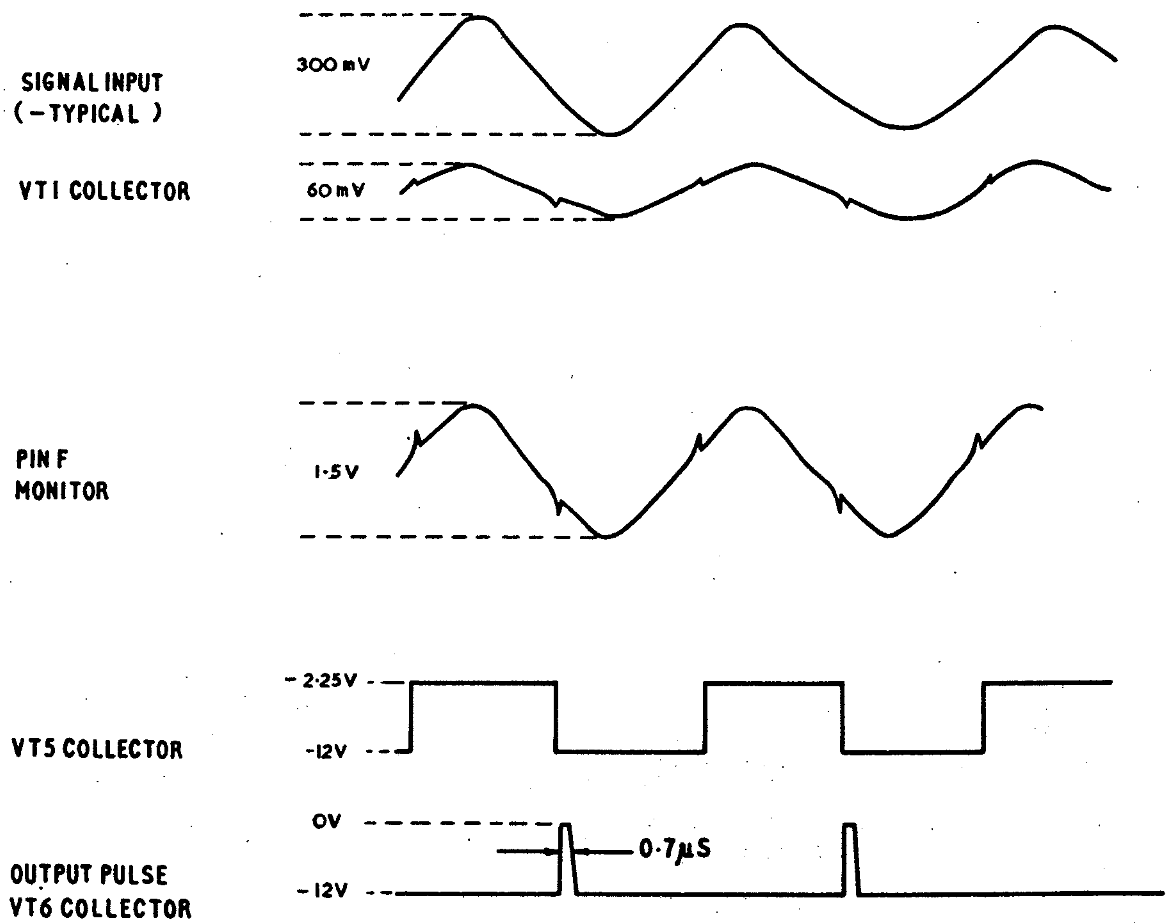


Circuit : Totalizer Unit Type XE-S A.535

Fig. 18



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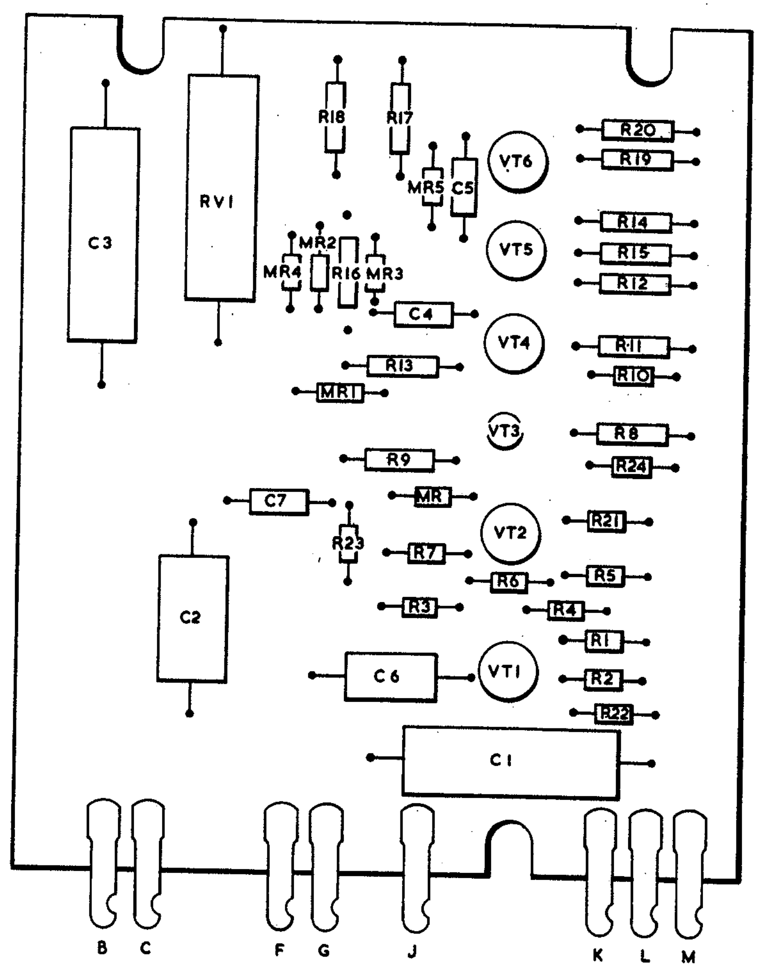
Waveforms : XB Unit — SA.535

Fig.19



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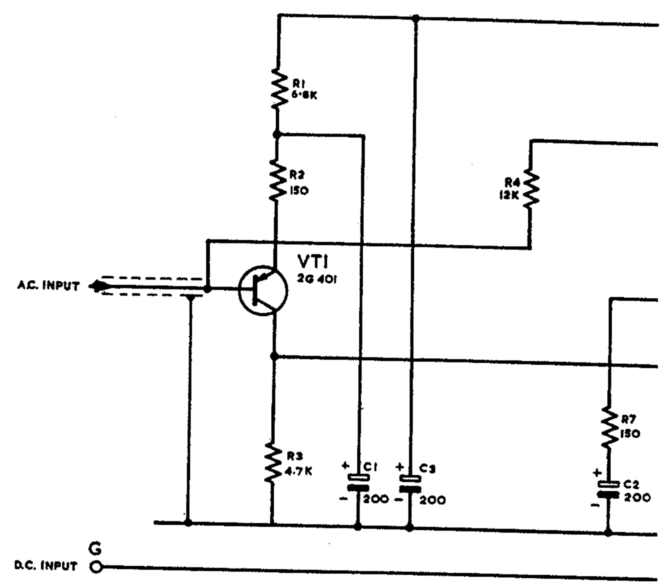
Layout: XB Unit–SA 535

Fig.20

A.C. PRE-AMPLIFIER.



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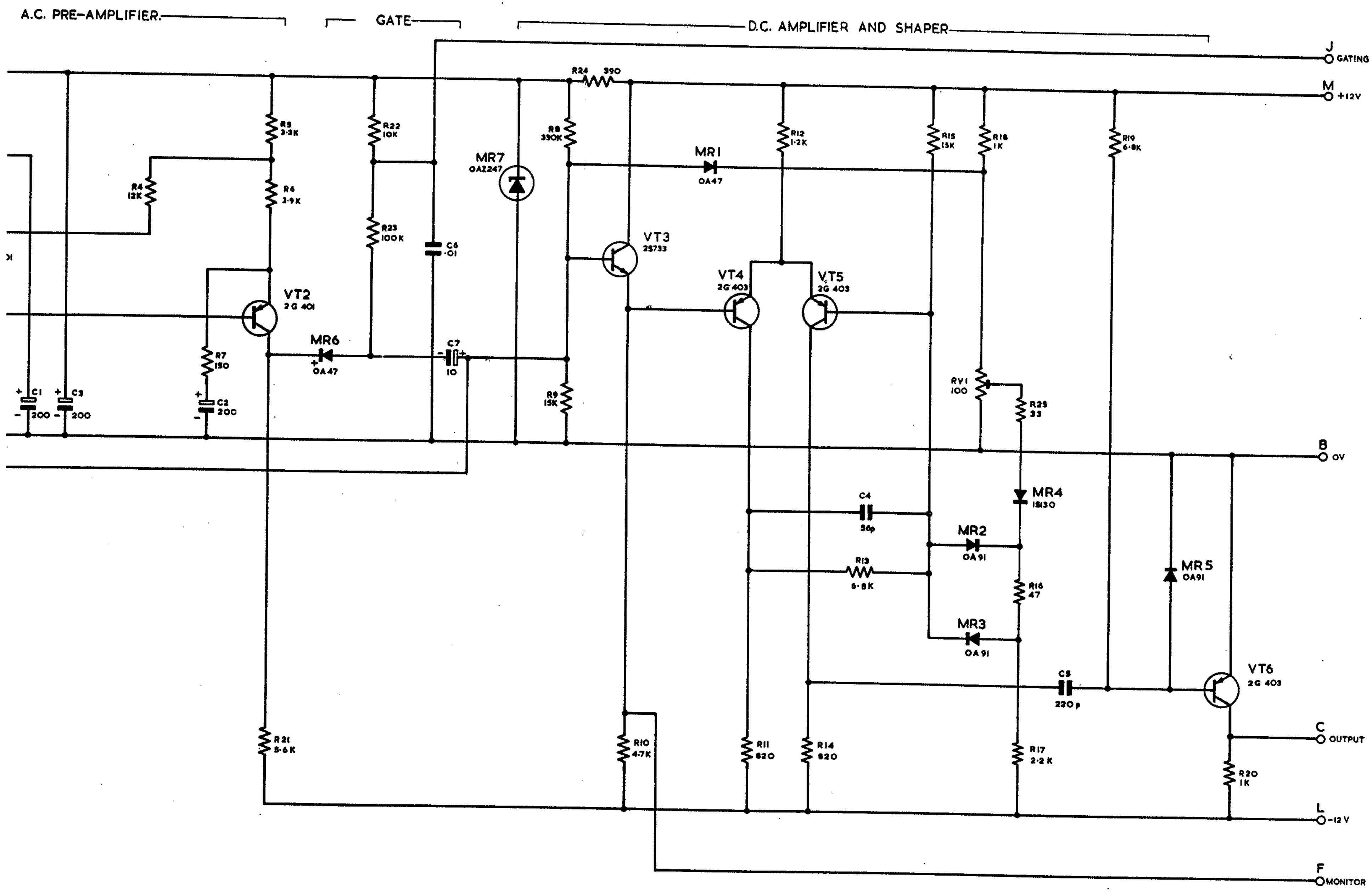
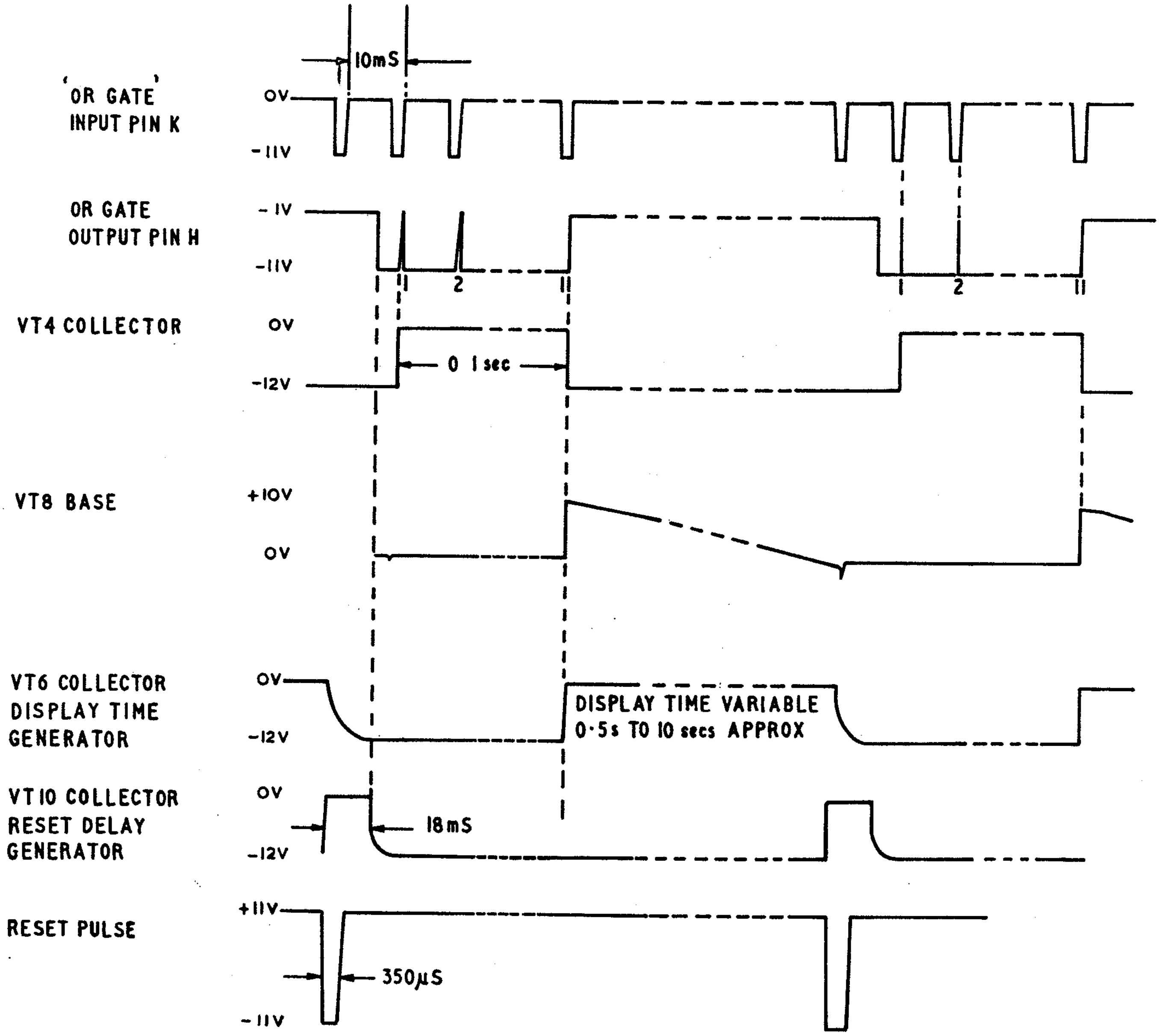


Circuit: 1·2 Mc/s A.C./D.C. Amplifier Type X B

Fig. 21



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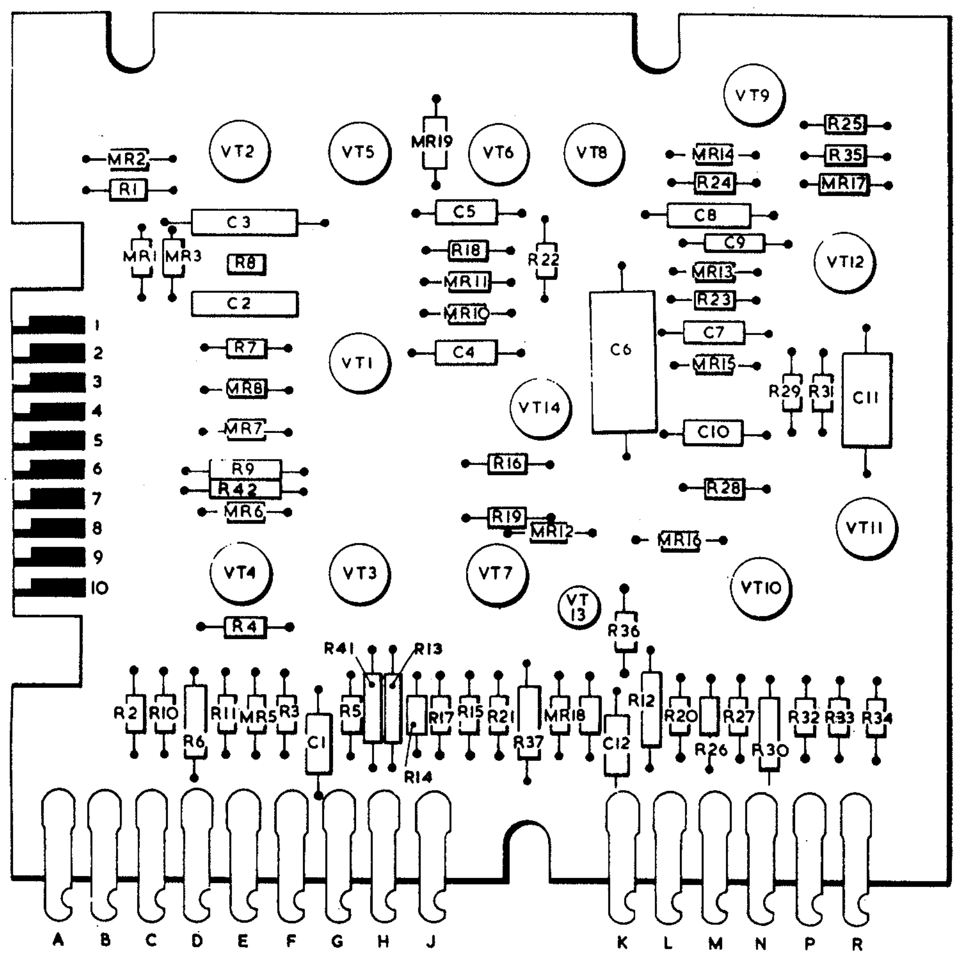
Waveforms : X K Unit — S A.535

Fig. 22



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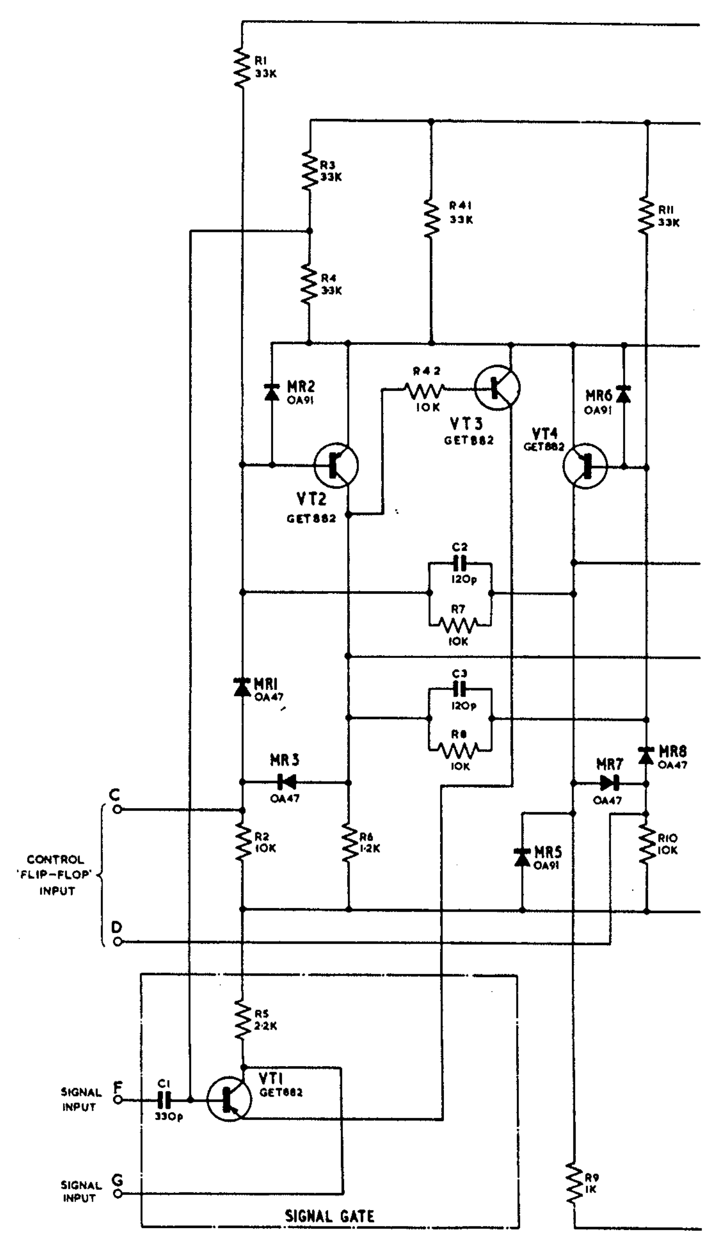
Layout : X K Unit

Fig.23



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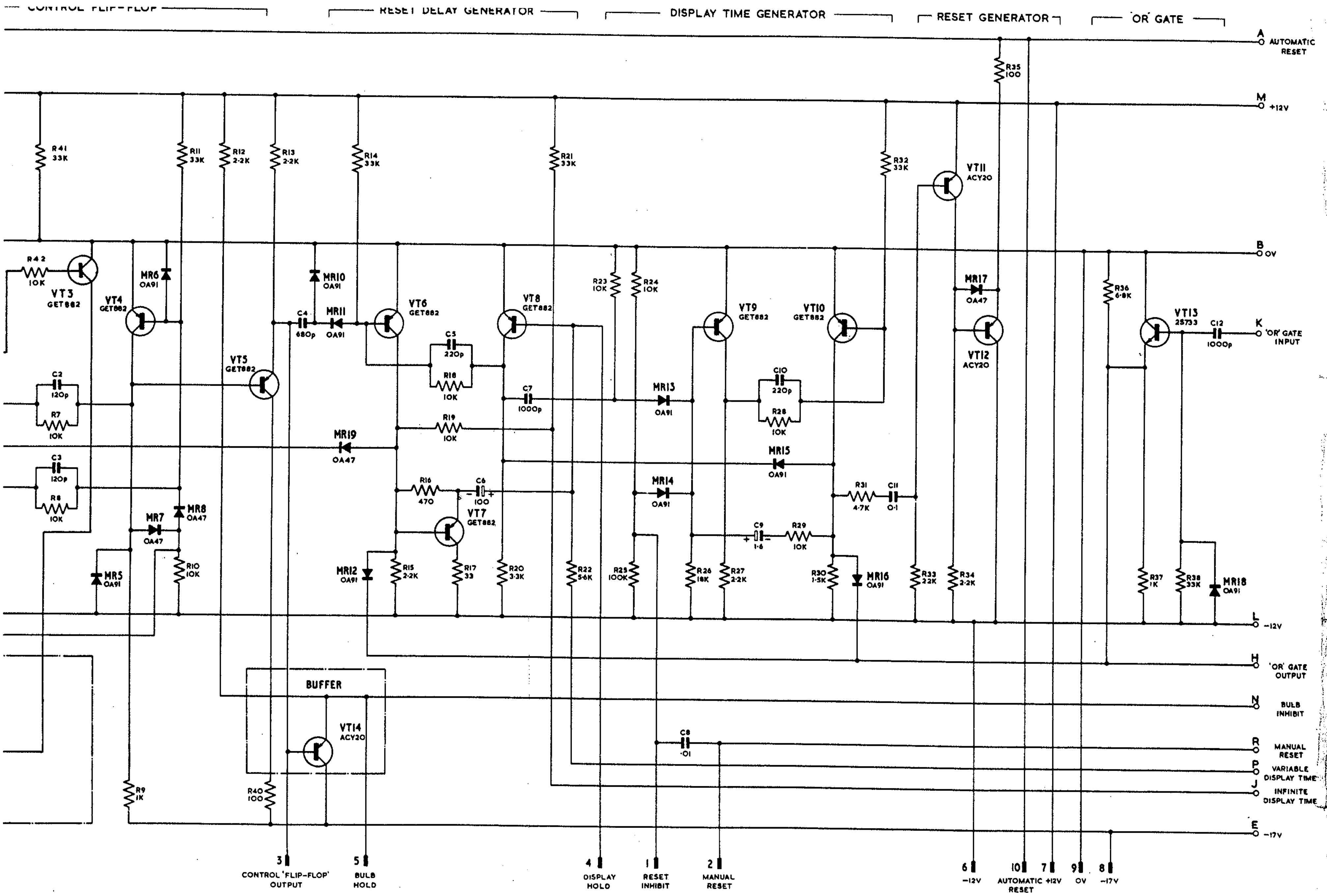
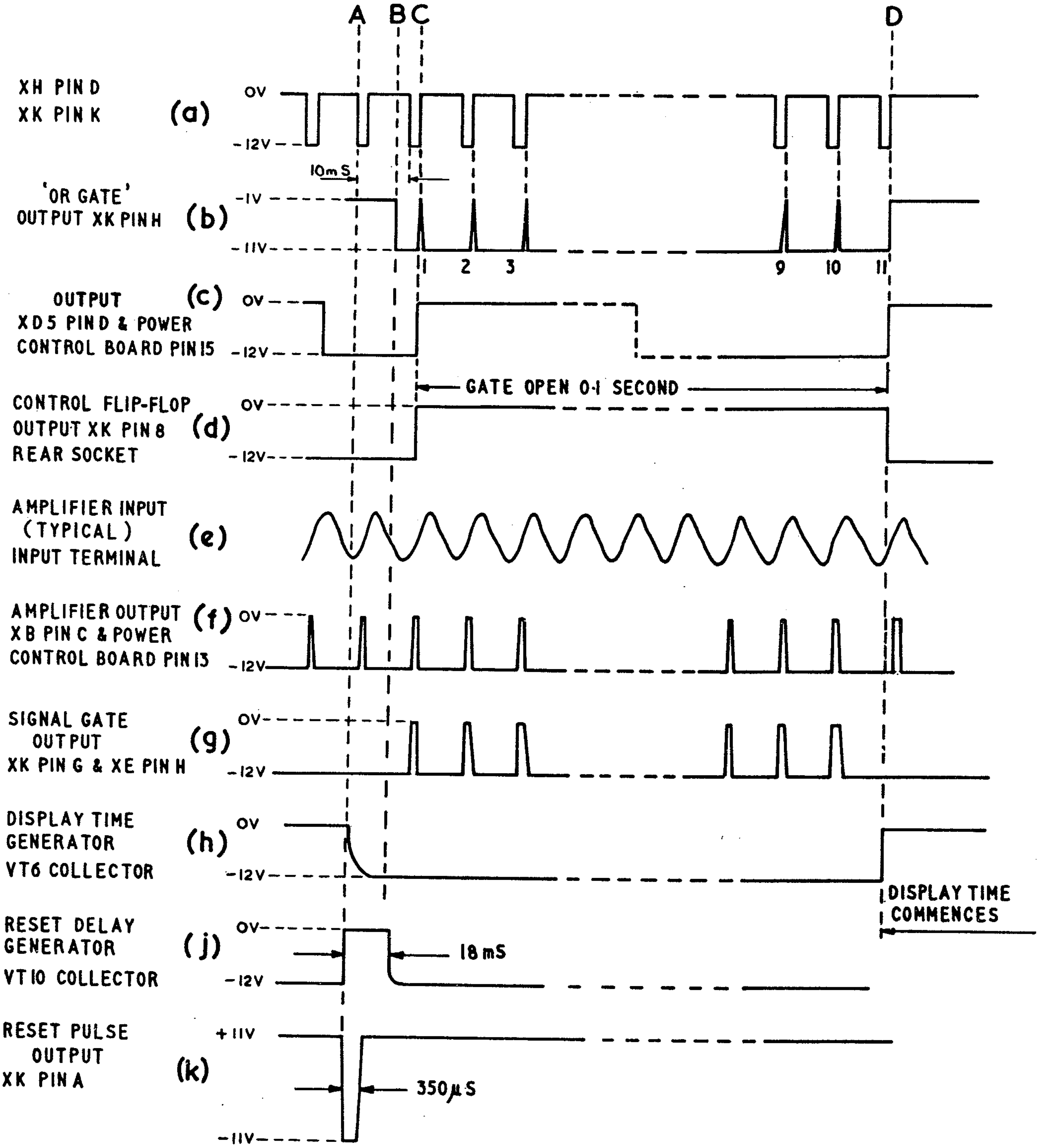


Control and Timing Circuit Type XK

Fig. 24



INSTRUMENT SWITCHED TO FREQUENCY X 10

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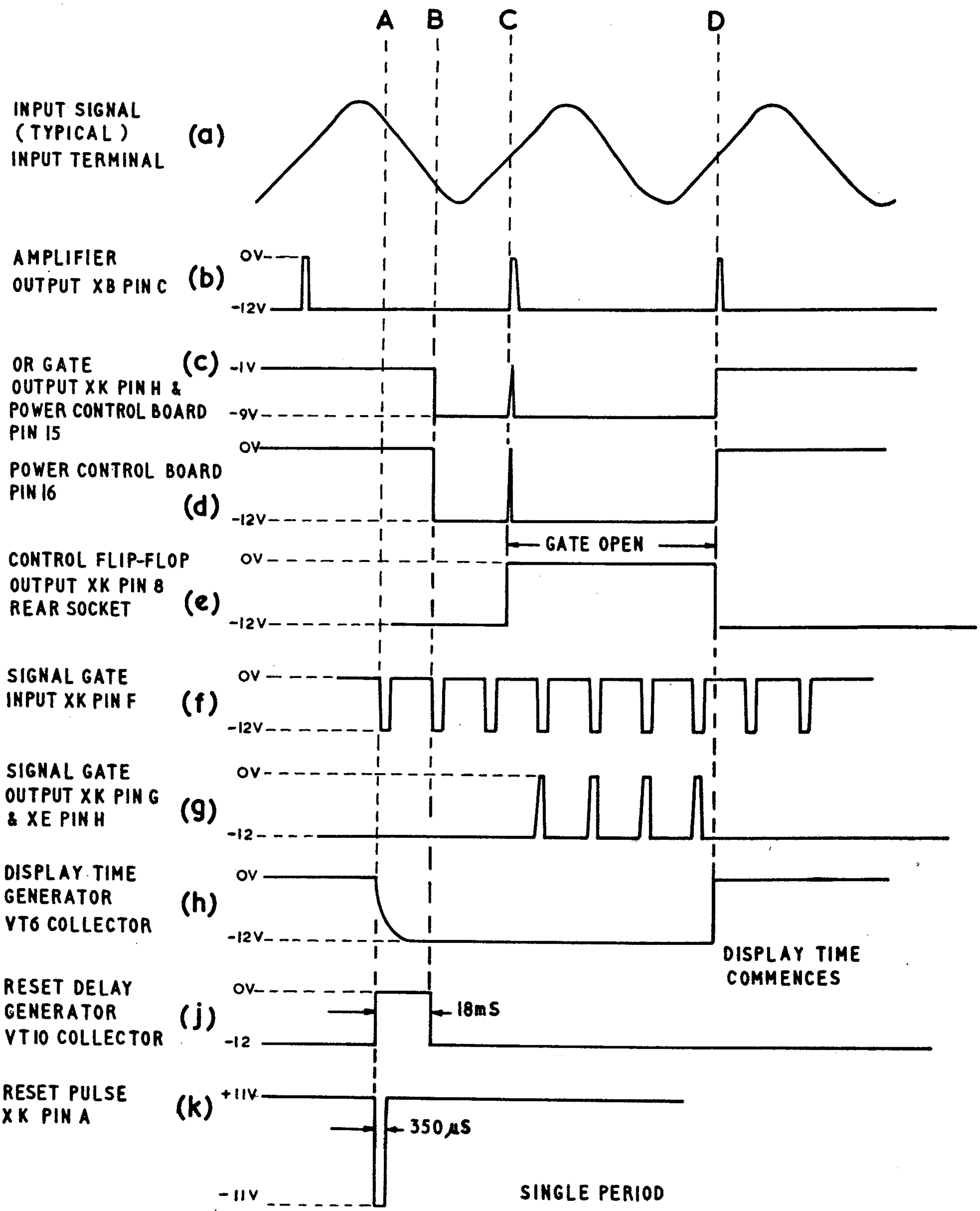
Waveforms Frequency Measurement — S A.535 Fig.25



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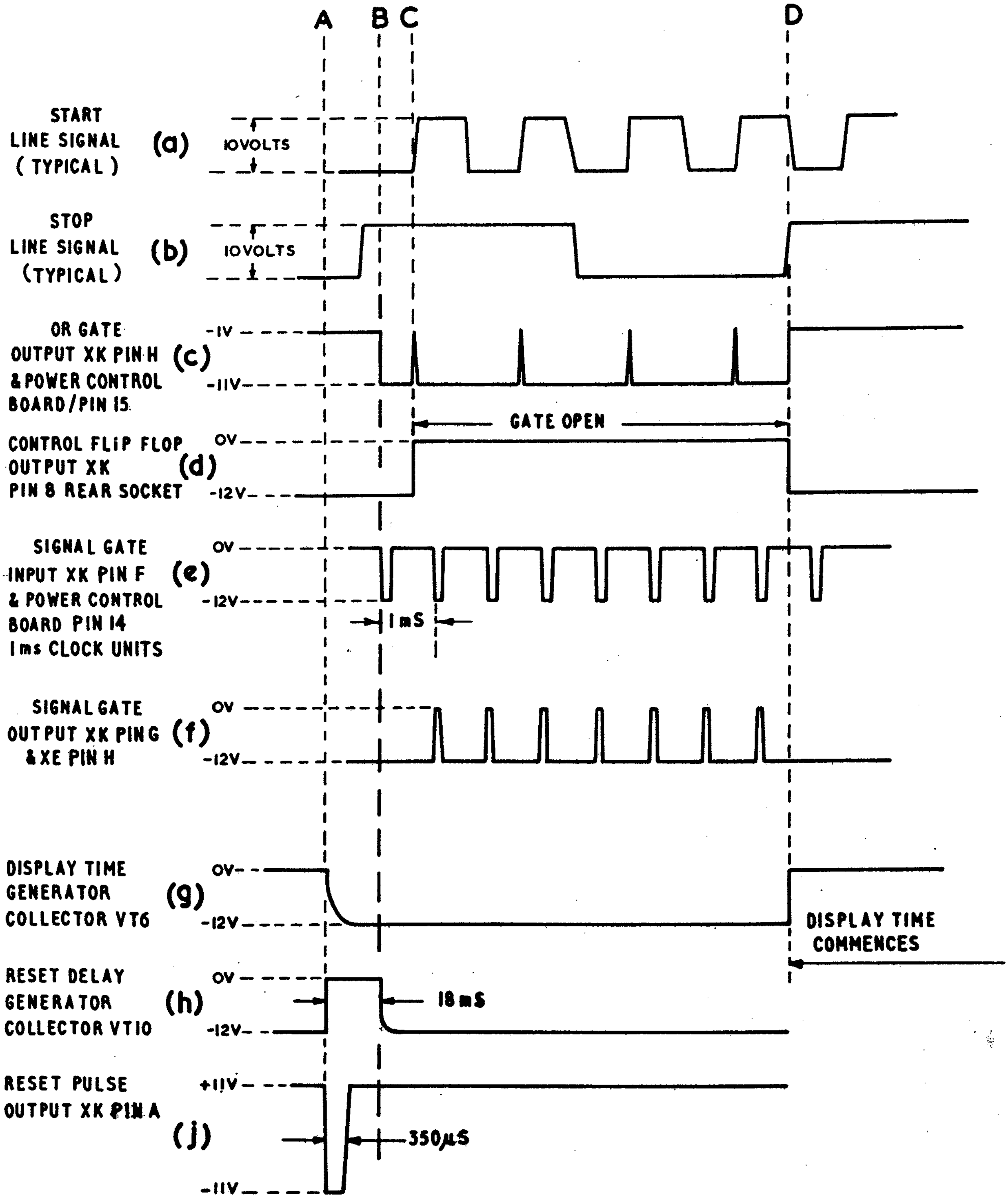
Waveforms : Period Measurement - S A.535 **Fig.26**



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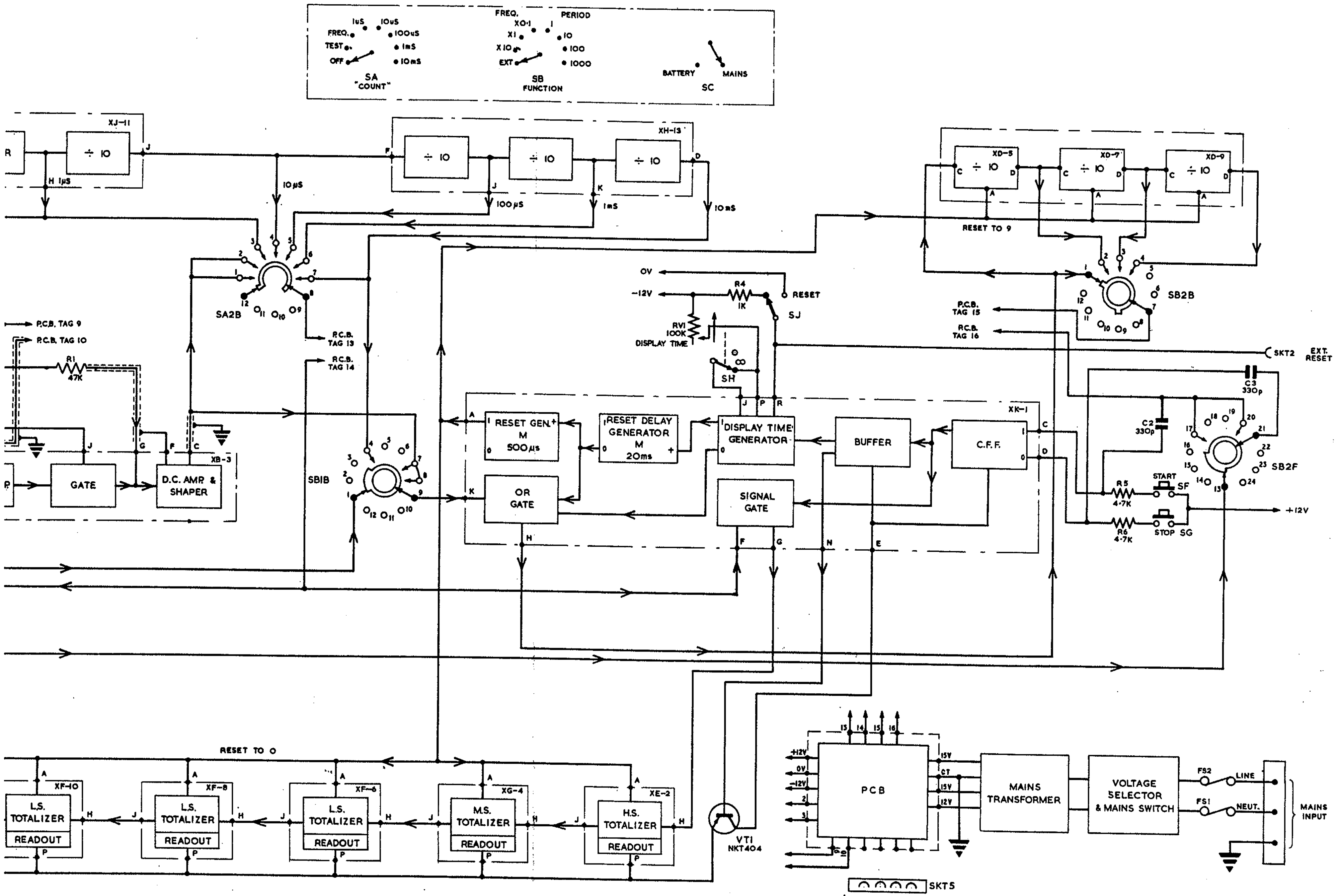
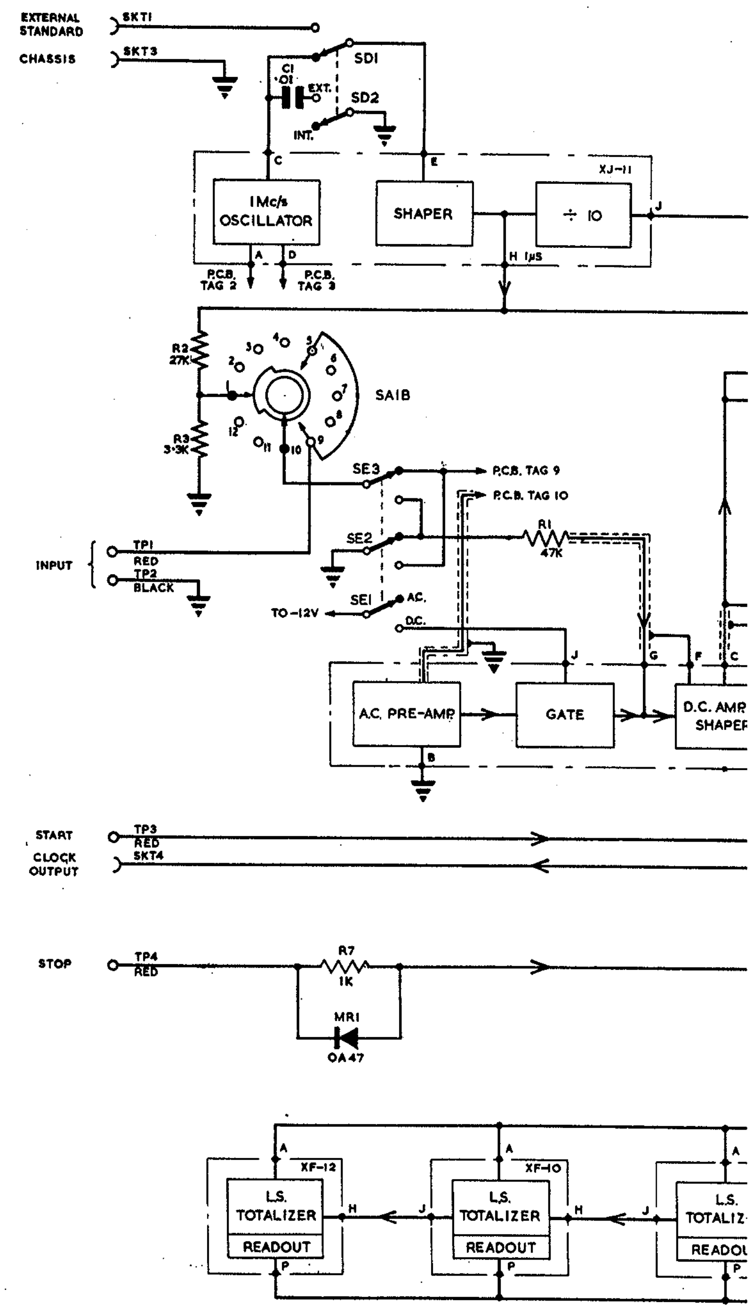
Waveforms : External Operation — S A.535 Fig.27



Detailed Block Diagram SA.535

Fig. 28



EXTERNAL STANDARD
SKT1
CHASSIS
SKT3
SD1
SD2
C1 ·01
EXT.
INT.
XJ-11
C
E
J
1Mc/s OSCILLATOR
SHAPER
÷ 10
A
D
H 1µS
P.C.B. TAG 2
P.C.B. TAG 3
R2 27K
R3 3·3K
SA1B
SE3
SE2
SE1
P.C.B. TAG 9
P.C.B. TAG 10
R1 47K
INPUT
TP1 RED
TP2 BLACK
TO -12V
A.C.
D.C.
A.C. PRE-AMP
GATE
D.C. AMP SHAPER
B
G
F
START
TP3 RED
CLOCK OUTPUT
SKT4
STOP
TP4 RED
R7 1K
MR1 OA47
XF-12
XF-10
L.S. TOTALIZER
READOUT
H
P

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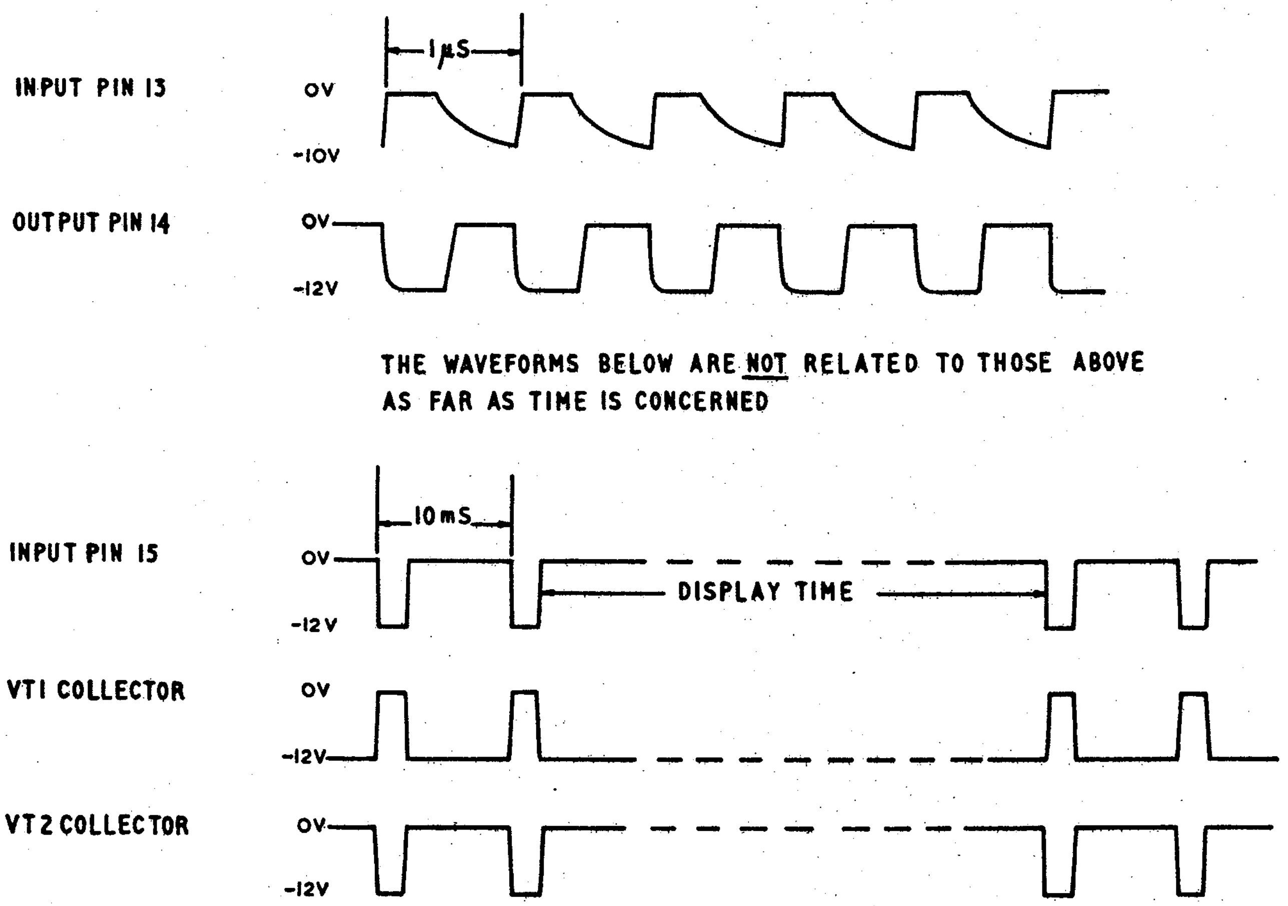
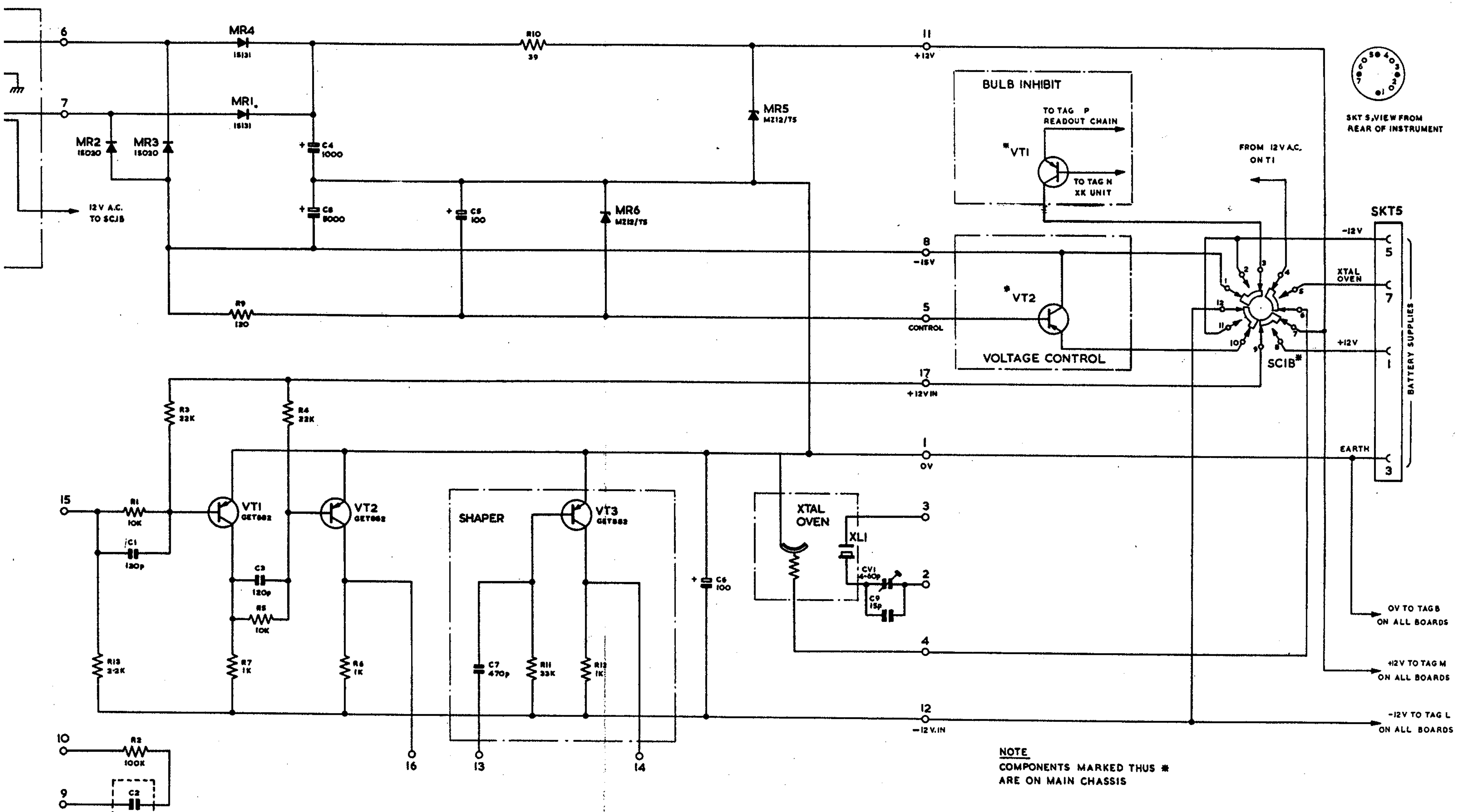


NB. THESE WAVEFORMS ARE TYPICALLY IDEALISED WITH THE INSTRUMENT OPERATING IN ITS 'TEST' POSITION & FREQUENCY X 10

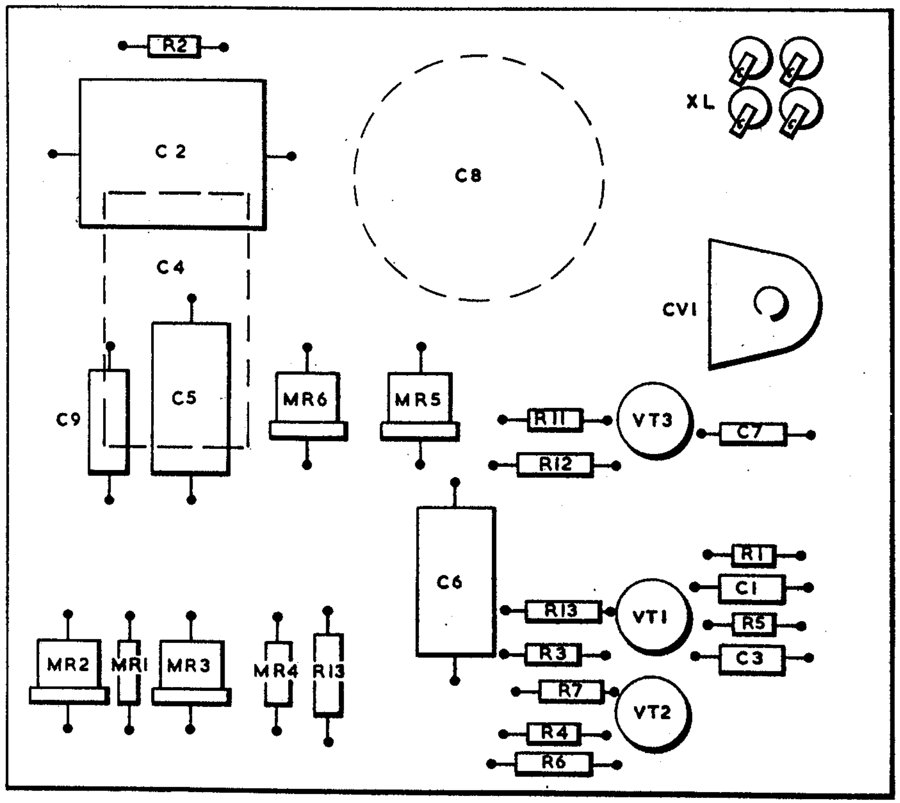
Waveforms : Power Control Board — S A.535

Fig.29



Circuit : Power Control - SA.535

Fig.31



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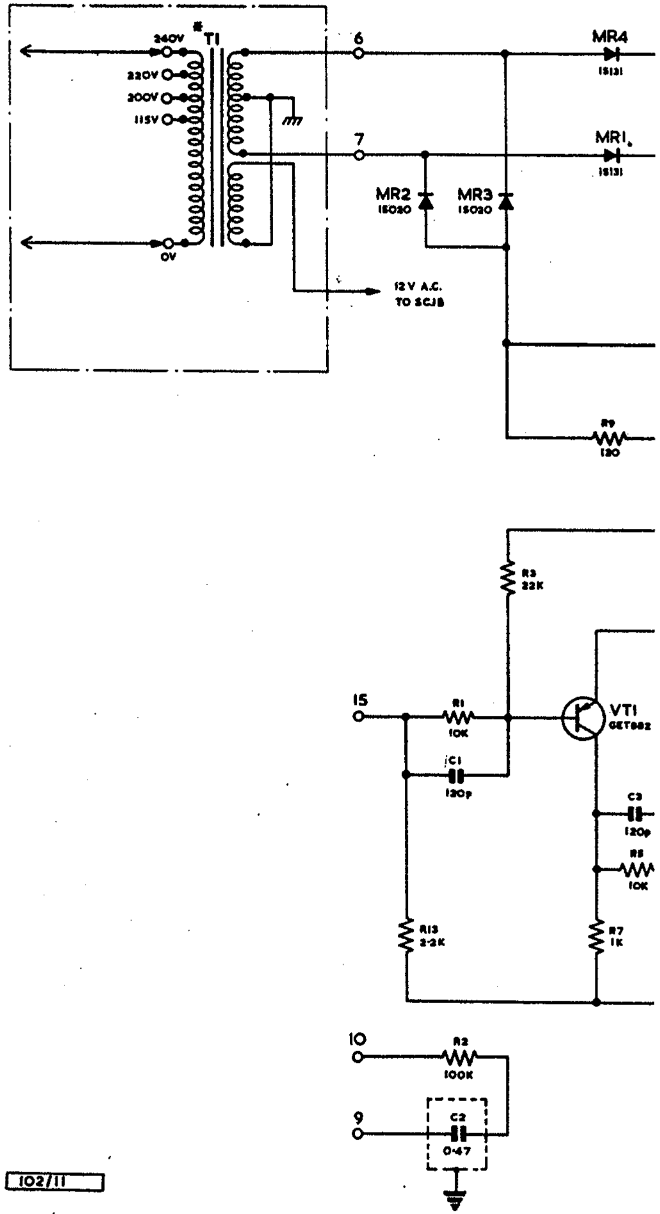
Layout: Power Control Board - S A.535

Fig.30



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