SECTION 1

SAWTOOTH AND LIFT TEST GENERATORS GE4/506, GE4/506A AND GE4/506B

Introduction

The GE4/506 was designed to provide a video test waveform consisting of sawtooth, black level, white level and variable lift when driven by standard pulses corresponding to the 405, 525 or 625 line standards. The unit, which contains its own power supply, has its components assembled on a printed board which is mounted on a plug-in unit. The power and signal connections are made via a multi-way connector.

The GE4/506 and GE4/506A differ only in that the first is constructed on a chassis Type CH1/11A and the second on a chassis Type CH1/12B*. A modification to reduce the change of output-signal amplitude with changes of temperature involves adjusting the earlier models to operate on either the 405-line or the 625-line standard only. The GE4/506B is fitted with an additional switch which enables the unit to be used on either of these two standards.

General Specification

Signal Inputs

Mixed blanking pulses, 2 volts p-p.
Mixed syncs, 2 volts p-p.

Output

A single output of 1-volt p-p composite test signal as determined by the setting of the *W/F Selector* switch; output impedance is 75 ohms. Amplitude is stabilised by use of a thermistor. The waveform and line-standards selection switches are mounted on the front panel.

Composite Test Signals

1. Sawtooth; variable from 0·5 volt to 0·9 volt p-p at the output by means of a front-panel control (Fig. 1.1).
2. Black level; i.e. mixed syncs only.
3. White level; level is pre-set by a control mounted on the printed board.
4. Lift; signal level variable from black level to white level by means of a front-panel control.

Amplitude of sync pulses is variable from 0·2 volt to 0·4 volt p-p by means of a front-panel control.

Change of Standard

On changing line standards the amplitudes of all waveforms should remain constant.

Power Consumption

12 mA at 240 volts 50 c/s a.c.

Power and Signal Connections

Via 15-way plug which mates with 15-way socket on a panel Type PN3A/2.

Size and Weight

Constructed on chassis CH1/11A or CH1/12B
Weight, 2 lb 3 oz.

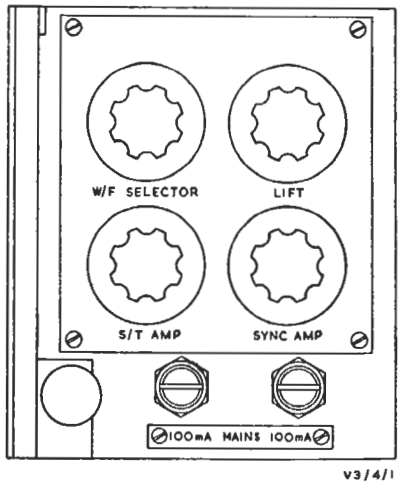


Fig. 1.1. GE4/506: Main Controls

Circuit Description (Fig. 1)

General

The test generator GE4/506, of which the circuit is shown in Fig. 1, uses six transistors and six junction diodes; two of the transistors are used as input and pulse-shaping stages for the blanking and sync input waveforms, two for sawtooth generation and two for waveform-mixing purposes.

The various functions of the test generator, controlled by switch S1, are listed below for the different switch positions:

Position 1	Sawtooth
Position 2	Black
Position 3	White
Position 4	Lift

*Index peg positions 1 and 26.

Sawtooth Generator

The sawtooth is generated by charging the capacitor C3 with a constant current, drawn through npn transistor VT2, and discharging it by means of pnp transistor VT1. Blanking pulses are applied to the base of VT1 which cause it to bottom so that C3 is discharged during the blanking period. When VT1 conducts, its base/emitter current charges C1; when the transistor is cut off, the rectifier MR1 provides a discharge path for this capacitor.

During the line period, when VT1 is cut off, capacitor C3 charges via VT2; the waveform and d.c. levels at the collector of VT1 are shown in Fig. 1.2, waveform (a). The waveform developed across C3, which has an amplitude of about 2·4 volts, is applied to the base of VT3; this transistor has a load resistor in both its emitter and its collector circuit.

of the sawtooth waveform can be adjusted by controlling the rate of charging; this is achieved by use of the variable resistor RV1, designated *Sawtooth Amplitude*, to control the magnitude of the constant current. Temperature compensation of the sawtooth amplitude is provided by the thermistor TH1 which varies the current through the potential-divider chain in sympathy with changes of ambient temperature. Switch S2, in combination with the A.O.T. resistors R21 and R24, permit rapid adjustment for change of line standards without disturbing the setting of RV1; for units Type GE4/506A, either R21 and R22 are installed or R23 and R24.

Sync-pulse Mixing Stage

The input mixed-sync waveform is applied to the base of transistor VT6 and the input arrangement is the same as for VT1. The 2-volt input is sufficient to bottom VT1 which therefore acts as a pulse-clipping

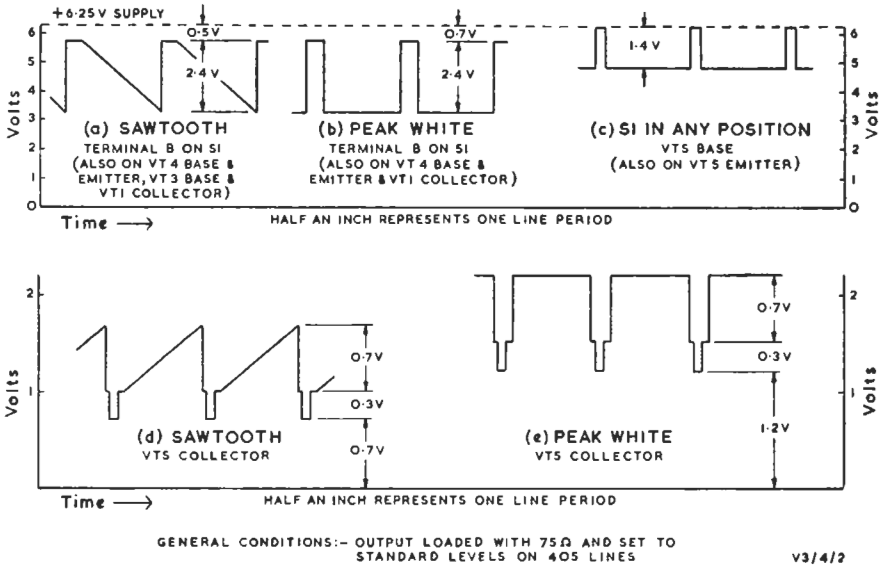


Fig. 1.2. GE4/506: Waveforms

The output waveform, which is developed across the emitter resistor, is taken via switch S1b to the base of the waveform-mixing transistor VT4. A portion of the sawtooth waveform developed in the collector circuit is fed back to the base of the charging resistor VT2 to linearise the sawtooth. This feedback is necessary because some of the constant current from VT2 is used to drive the base of VT3 and so the charging rate of C3 is not linear.

Because the charging time is fixed, the amplitude

amplifier. With VT6 cut off, the base potential of VT5 is determined by the variable resistor RV5, the *Sync Amplitude* control. Transistors VT4 and VT5 have a common-collector load R15 and the output waveform developed across this is the required composite waveform. The relevant waveforms are shown in Fig. 1.2, diagrams (c) and (d).

Generation of Black and White Levels and Lift

These functions correspond to positions 2, 3 and 4

respectively of switch S1. When *Black* is selected, the base of VT4 is disconnected from the sawtooth generator and transferred to the positive supply line; with VT4 permanently cut off, the output waveform consists of sync pulses only.

When *White* is selected, the base of VT4 is driven by positive-going blanking pulses from the collector circuit of VT1; thus VT4 conducts during the active-line periods and is cut off during the blanking periods. White level in the output waveform is determined by the base-input current to VT4 and this is adjusted by means of the pre-set *Set Peak White* control (RV3).

When *Lift* is selected the conditions are unchanged except that the base of VT4 is returned to the slider of RV4, thus providing control of the signal level during the active-line period. Lift can be adjusted from white level to blanking level.

Performance

Output Rise and Fall Times

Sync pulses	less than 0·25 μsec
White level and lift	less than 0·4 μsec
Sawtooth (fall time)	less than 0·5 μsec
Sawtooth Linearity	better than 1 per cent
Output Impedance	75 ohms ±2 per cent up to 5 Mc/s
Stability	less than 0·1 dB change of output level for 3 dB change in level of input pulses.
Mains Variation	less than 0·1 dB change of output level for ±7·5 per cent change of mains voltage.
Temperature Stability	
White level	less than 0·01 dB per degree C.
Sawtooth	less that 0·2 dB per degree C.
Input Impedance	not less than 3 kilohms for both signals.

Because the maximum operating temperature is 60 degrees C, it is important that the test generator is not mounted above valve-operated equipment.

Maintenance Notes

The test generator should not be serviced while it is in its PN3/17 housing but should be withdrawn and plugged into a PN3A/2 fixed at a test position on a bench.

When work is to be done to the unit on the bench with the base plate removed, it should be remembered that although the greater part of the unit has only 6 volts on it, mains do appear on the transformer primary tags.

In the event of a transistor failure, care should be taken to use thermal shunts on the replacement transistor when it is being soldered into position.

The method of replacing components depends to a large extent on the way they are assembled to the board initially; they may either have their leads pushed through the holes, soldered and cut off flush, or they may be bent over at right angles on to the copper pad and then soldered. In the former case it is quite easy to remove components without damage to the printed wiring, but in the latter case it is preferable to cut away the component leaving its leads as soldering points for the new component.

It has been found in practice that a small iron of the order of 10 watts, such as the Litosold, is ideal for work on printed boards and components can easily be replaced without damage to the board.

Test Schedule

Apparatus Required

Avometer Model 8
Tektronix Oscilloscope Type 515 or 545
Panel Connector Block Type PN3A/2 made up for use with GE4/506
Test Waveform Generator or supplies of mixed syncs and mixed blanking pulses with 2-volt p-p amplitude.
Two terminations, Musa, 75 ohms.
One termination, F. & E., 75 ohms.

Test Procedure

1. Check that the mains tapping on T1 is correct and that correct-value fuses are installed; switch on.
   Note:—Mains voltage appears on the printed-board pins numbered 1 and 2 and also on the transformer terminals.
2. With the *W/F Selector* on *Bk.* (black), check that the following voltages are within the limits given, using the Avometer Model 8:

Test Point	*Meter Range*	*Voltage Limits*
T1 Secondary	25 V a.c.	13·0–16·0
Across C7A	25 V d.c.	16·0–19·0
Across C7B	10 V d.c.	5·9–6·6

3. Apply mixed synchronising and mixed blanking pulses to the inputs of the generator, terminating the inputs and output in 75 ohms. View the output waveform on a Tektronix oscilloscope Type 515 or 545.
4. Switch *W/F Selector* to *Wh.* (white) and check that the *Set Pk. Wh.* control, RV3 on the printed board, will vary the white level over the range 0·6 volt to 0·8 volt at least. Set the control to give 0·7 volt.
5. Switch *W/F Selector* to *S/T* (sawtooth) and check that the *S/T Amp.* control will reduce the sawtooth amplitude to 0·3 volt (0·5 volt on 405 lines). Turn the *S/T Amp.* control fully clockwise and check that the sawtooth amplitude has reached at least 0·9 volt after 50 μsec from its start without limiting; ignore the limiting after 50 μsec. This is a sufficient check that the sawtooth amplitude will be within specification when driven by pulses on any line standard. Set the *S/T Amp.* control to give 0·7 volt of sawtooth. Adjust *S/T Linearity*, RV2 on the printed board, to give a linear sawtooth by judgement of eye on the oscilloscope. Readjust *S/T Amp.* to 0·7 volt of sawtooth if necessary.
6. Check that the *Sync Amp.* control varies the amplitude of the synchronising pulses on the output over the range 0·2–0·4 volt at least. Set the *Sync Amp.* control to give 0·3 volt of syncs.
7. Switch *W/F Selector* to each position to check proper functioning. *Bk.* should give synchronising pulses only and on *Lift* check that the *Lift* control varies the level of signal from black to white level (0·7 volt).
8. Measure the rise and fall times of the blanking edges on white and sawtooth signals and also of the sync edges and check they are within the limits below.

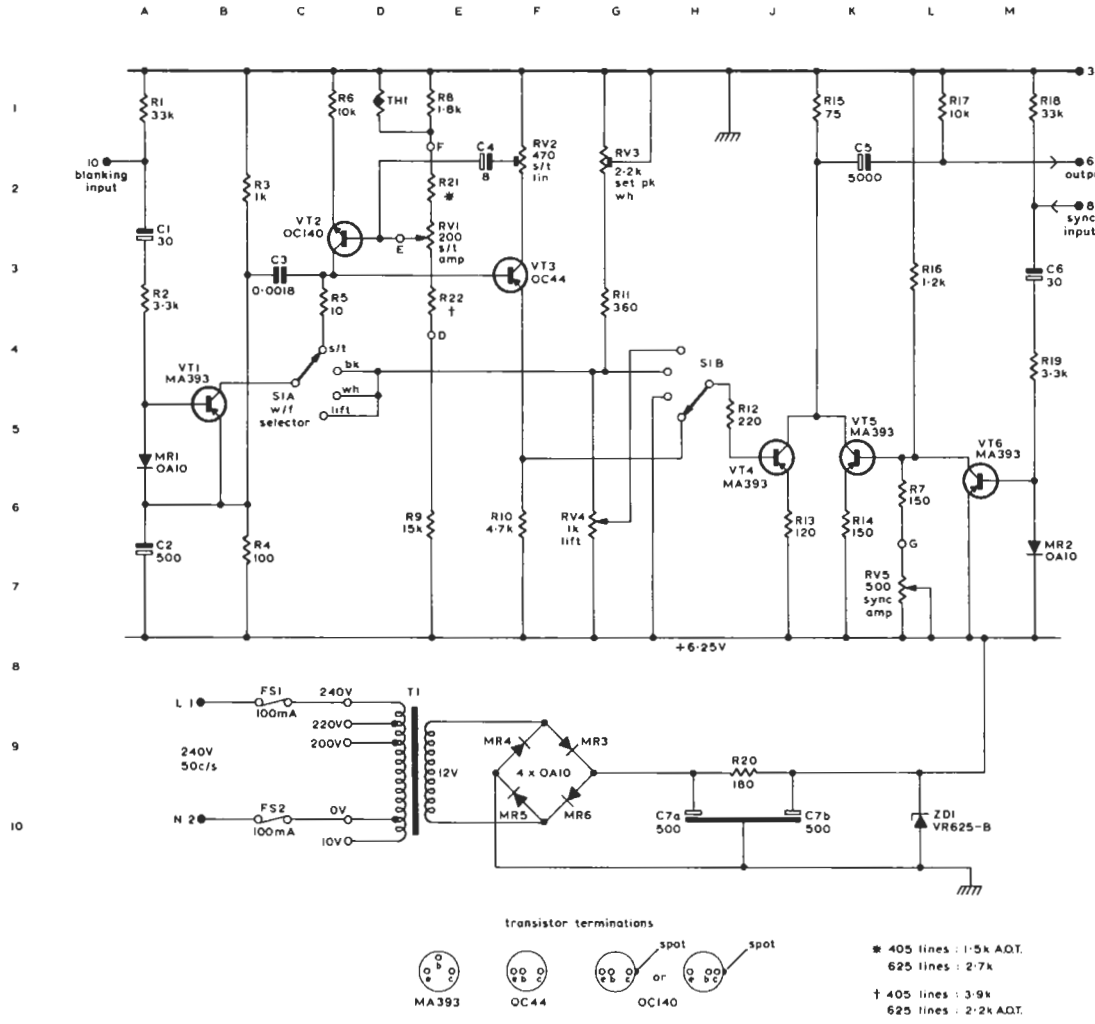
   Blanking rise and fall: <0·4 μsec
   Sawtooth fall: <0·5 μsec
   Sync rise and fall: <0·25 μsec

   It is unlikely that edges will be slower than specified provided the input pulses are within specification, with the possible exception of the sawtooth fall time. If this is slower than 0·5 μsec the remedy is to change VT1. If an overshoot appears on the sawtooth fall the remedy is either to change VT1 or increase R5 to about 18 ohms.
9. Inspect the output waveform for frame tilt. With *W/F Selector* at *Wh.*, increase the sensitivity of the oscilloscope Y amplifier to 0·05 volt/cm and switch to d.c. Adjust the *Vertical Position* to observe black level and measure the peak-to-peak frame tilt on a slow horizontal sweep. (If the *Vertical Position* control is unable to cover this range, a slight adjustment of the *D.C. Bal.* control should bring the black level into the calibrated range of the c.r.t.) The frame tilt should not exceed 10 mV peak-to-peak.
10. Check the hum present on the output as follows. With the set-up as in paragraph 9, adjust the *Vertical Position* control on the oscilloscope to observe the white level. Hum on the output appears mainly as modulation of white level but frame tilt is also present. However, total excursion of the white level due to frame tilt and hum together should not exceed 15 mV with the frame in any phase relative to the hum.
11. Replace the back plate.

K.H.G. 3/66

COMPONENT TABLE: FIG. 1

Comp.	Loc.	Type	Tolerance per cent
C1	A3	U.C.C. SM65/S	
C2	A7	Plessey CE 1279/431	
C3	C3	T.C.C. SM2N	5
C4	E2	U.C.C. SM42S	
C5	K2	Plessey CE 1202/424	
C6	M3	U.C.C. SM65/S	
C7	J10	Plessey CE 7042	
R1	A1	Erie 109 ¼W	2
R2	A3	Erie 109 ¼W	2
R3	B2	Erie 109 ¼W	2
R4	B7	Erie 109 ¼W	2
R5	C3	Erie 109 ¼W	2
R6	C1	Erie 109 ¼W	2
R7	L6	Erie 109 ¼W	2
R8	E1	Erie 109 ¼W	2
R9	E6	Erie 109 ¼W	2
R10	F6	Erie 109 ¼W	2
R11	G3	Erie 109 ¼W	2
R12	J5	Erie 109 ¼W	2
R13	J6	Erie 109 ¼W	2
R14	K6	Erie 109 ¼W	2
R15	K1	Erie 109 ¼W	2
R16	L3	Erie 109 ¼W	2
R17	L1	Erie 109 ¼W	2
R18	M1	Erie 109 ¼W	2
R19	M4	Erie 109 ¼W	2
R20	J9	Painton MV1A 1½W	5
R21	E2	Erie 109 ¼W	A.O.T. (405)
R22	E3	Erie 109 ¼W	A.O.T. (625)
RV1	E3	Plessey M (CP161101 series)	20
RV2	F2	Plessey 404/1/02854/002	
RV3	G2	Plessey 404/1/02854/016	
RV4	G6	Plessey CP161101/207	20
RV5	L7	Plessey CP161101/206	20

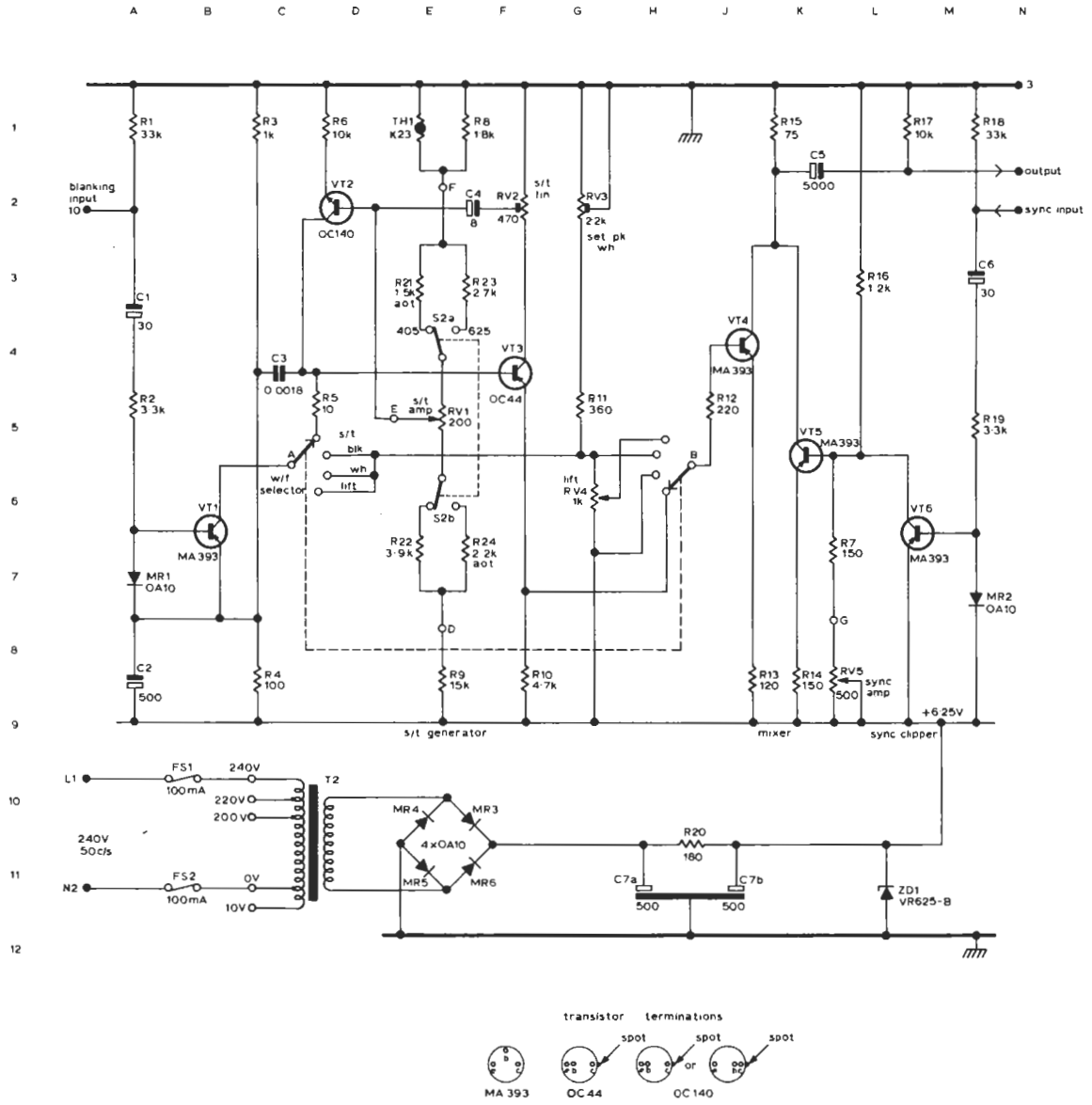


Comp	Loc	Type	Tolerance per cent	Comp	Loc	Type	Tolerance per cent
C1	A3	UCC SM65/S		R13	J6	Erie 109 0·25W	2
C2	A7	Plessey CE1279/431		R14	K6	Erie 109 0·25W	2
C3	C3	TCC SM2N	5	R15	K1	Erie 109 0·25W	2
C4	E2	UCC SM42S		R16	L3	Erie 109 0·25W	2
C5	K2	Plessey CE1202/424		R17	L1	Erie 109 0·25W	2
C6	M3	UCC SM65/S		R18	M1	Erie 109 0·25W	2
C7	J10	Plessey CE7042		R19	M4	Erie 109 0·25W	2
				R20	J9	Painton MV1A 1·5W	5
R1	A1	Erie 109 0·25W	2	R21	E2	Erie 109 0·25W	A.O.T.
R2	A3	Erie 109 0·25W	2	R22	E3	Erie 109 0·25W	A.O.T.
R3	B2	Erie 109 0·25W	2				
R4	B7	Erie 109 0·25W	2	RV1	E3	Plessey M (CP16110 series)	20
R5	C3	Erie 109 0·25W	2	RV2	F2	Plessey 404/1/02854/002	
R6	C1	Erie 109 0·25W	2	RV3	G2	Plessey 404/1/02854/016	
R7	L6	Erie 109 0·25W	2	RV4	G6	Plessey CP/61101/207	20
R8	E1	Erie 109 0·25W	2	RV5	L7	Plessey CP/61101/206	20
R9	E6	Erie 109 0·25W	2				
R10	F6	Erie 109 0·25W	2	T1	D9	M 259	
R11	G3	Erie 109 0·25W	2				
R12	J5	Erie 109 0·25W	2	THI	D1	STC K23	

SAWTOOTH AND LIFT TEST GENERATORS GE4/506 AND GE4/506A : CIRCUIT

COMPONENT TABLE: FIG. 1A

Comp.	Loc.	Type	Tolerance per cent
C1	A3	U.C.C. SM 65 S	
C2	A8	Plessey CE 1279/431	
C3	C4	T.C.C. SM2N	5
C4	F2	U.C.C. SM42S	
C5	K2	Plessey CE 1202/424	
C6	M3	U.C.C. SM65/S	
C7	J11	Plessey CE 7042	
R1	A1	Erie 109 ¼W	2
R2	A5	Erie 109 ¼W	2
R3	C1	Erie 109 ¼W	2
R4	C8	Erie 109 ¼W	2
R5	C5	Erie 109 ¼W	0·5 ohm
R6	D1	Erie 109 ¼W	2
R7	K6	Erie 109 ¼W	2
R8	E1	Erie 109 ¼W	2
R9	E8	Erie 109 ¼W	2
R10	F8	Erie 109 ¼W	2
R11	G5	Erie 109 ¼W	2
R12	J5	Erie 109 ¼W	2
R13	K8	Erie 109 ¼W	2
R14	K8	Erie 109 ¼W	2
R15	K1	Erie 109 ¼W	2
R16	L3	Erie 109 ¼W	2
R17	L1	Erie 109 ¼W	2
R18	M1	Erie 109 ¼W	2
R19	M5	Erie 109 ¼W	2
R20	J10	Painton MV1A 1½W	5
R21	E3	Erie N6A ⅛W	A.O.T.
R22	E7	Erie N6A ⅛W	2
R23	F3	Erie N6A ⅛W	2
R24	F7	Erie N6A ⅛W	A.O.T.
RV1	E5	Plessey M (CP161101 series)	20
RV2	F2	Plessey 404/1/02854/002	
RV3	G2	Plessey 404/1/02854/016	
RV4	G6	Plessey CP161101/207	20
RV5	L8	Plessey CP161101/206	20



SAWTOOTH AND LIFT TEST GENERATOR GE4/506B : CIRCUIT