SECTION 2

PICTURE LINE-UP TEST GENERATORS GE4/508 AND GE4/508A

Introduction

The picture line-up generating equipment (*p.l.u.g.e.*) GE4/508 or GE4/508A provides a video signal intended to facilitate correct and uniform adjustment of the brightness and contrast on picture monitors. The GE4/508 is designed for use with 405-line monitors, whereas the GE4/508A is for 625-line and 525-line operation.

The generator output produces a display comprising two narrow vertical bars spaced apart on the left-hand side of a monitor screen and a broad vertical bar on the right as shown by Fig. 2.1. The rest of the picture consists of a dark background. The first narrow bar is slightly darker, and the second slightly lighter, than the background. The broad bar is normally fully white over its top half and grey over its lower half.

When a monitor is being adjusted the brightness control must be set so that the blacker narrow bar is indistinguishable from the background but the whiter one can just be seen; the brightness is too high if both narrow bars are visible, but too low if neither can be seen. When the brightness has been correctly set, the contrast control must then be adjusted to produce the desired brilliance in the white area of the broad bar. Finally, the grey section of the broad bar can be used to check the contrast law of the monitor.

The generator output waveform during lines when the broad bar is white and the waveform when the broad bar is grey are shown superimposed in Fig. 2.2, and also subsequently in Waveform 1. The background obtained when the signal is displayed on a monitor is produced by the platform in the waveform. The two narrow bars are generated by the small-amplitude pulses, called the *black* and *white* pulses, below and above the platform. The broad bar is produced by the wide pulse of large amplitude above the platform; the grey area of the broad bar is obtained from the lower amplitude of this pulse during the second half of each field. Line and field sync pulses are also included in the output. The outline of the output waveform in a field period is shown by Waveform 2.

The pulses producing the narrow bars are borne on a platform to compensate for the effect of the brilliance of the broad bar on the eyes. The presence of the light from the broad bar would cause a user to lose the darker narrow bar before the monitor brightness was adjusted down to its correct level if the narrow bars did not sit on the background produced by the platform. Superimposing the narrow bars on the background produced by the platform results in a satisfactory

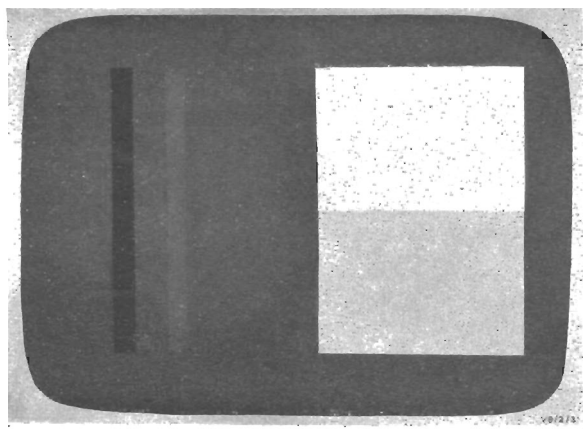


Fig. 2.1. Picture Produced by a GE4/508 on a Monitor Adjusted so that the Darker Narrow Bar is Distinguishable

A GE4/508A produces a similar picture on 625 lines, but on 525 lines all the bars extend lower

setting being obtained when the brightness is adjusted so that the blacker narrow bar disappears; that is, a setting is obtained that subsequently causes black areas to appear subjectively black in a dark picture. The level of the platform has been determined empirically to provide this compensation under the conditions of ambient light normally employed.

The GE4/508 and GE4/508A differ only in the circuits timing the introduction and duration of various parts of the waveform in each line. There is no difference in the field timing circuits, and whereas the vertical bars occupy approximately the middle three-quarters of the picture height on

405-line and 625-line monitors, the bars tend to reach the bottom of the screen in 525-line operation, where the field period is shorter.

Printed wiring is largely used in both versions of the generator. Transistors and semiconductor diodes are employed throughout.

General Data

The following particulars apply to both the GE4/508 and the GE4/508A except where separate data for each type are given.

Output Signal

One output of 1 volt peak-to-peak composite video test signal into 75 ohms. The waveform of the signal is as shown in Fig. 2.2.

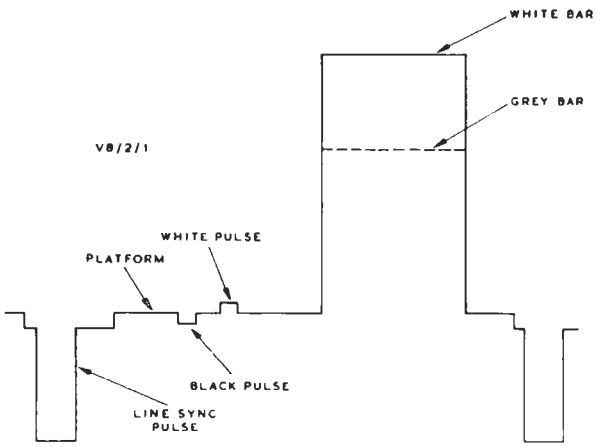


Fig. 2.2 GE4/508 and GE4/508A: Output Waveform in Line Periods

Input Signals

1. 2 volts peak-to-peak mixed sync pulses. Not more than −5 volts d.c. nor any positive d.c. voltage must be superimposed.
2. 2 volts peak-to-peak mixed blanking pulses. Not more than ±5 volts d.c. must be superimposed.

Line Standards

GE4/508: 405.
GE4/508A: 625 or 525.

Output Impedance

75 ohms ±2 per cent up to 5 Mc/s.

Input Impedances

Mixed sync pulses: 8 kilohms.
Mixed blanking pulses: greater than 3·3 kilohms.

Output Pulse Amplitudes

Platform level: 0·02 volt ±10 per cent above black level.
Black pulse: 0·02 volt ±10 per cent below platform level.
White pulse: 0·02 volt ±10 per cent above platform level.
Grey bar: 0·47 volt ±10 per cent above platform level.
White bar: 0·7 volt above black level.
Sync pulse: 0·3 volt below black level.

Output Pulse Durations and Timings

Duration of black and white pulses: GE4/508, 3 to 5 µsec; GE4/508A, 2 to 4 µsec.

Separation between black and white pulses: GE4/508, 5 to 7 µsec; GE4/508A, 3 to 5 µsec.

The time from the leading edge of the line sync pulse to the black pulse, the time from the leading edge of the black pulse to the white and grey bar, and the duration of the white and grey bar, are adjusted by pre-set controls to be 30 µsec in the GE4/508 signal and 20 µsec in the GE4/508A signal.

Output Rise and Decay Times

Sync pulses: less than 0·25 µsec.
White bar: less than 0·5 µsec.

Hum on Output

Less than 0·01 volt peak-to-peak.

Output Variation With Mains Voltage

Less than 0·05 dB for ±7·5 per cent change in voltage.

Operating Temperature

0 to 40 degrees C.

Output Variation With Temperature

Less than 0·01 dB per degree C.

Mains Voltage

200 to 250 volts, 50 c/s.

Mains Input

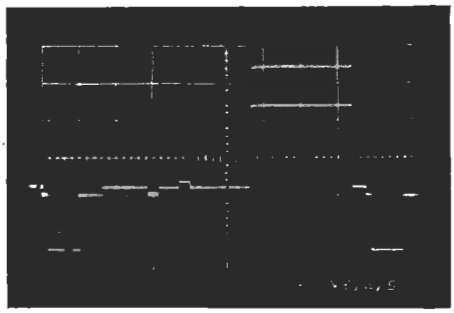
30 mA at 240 volts, 50 c/s.

Weight

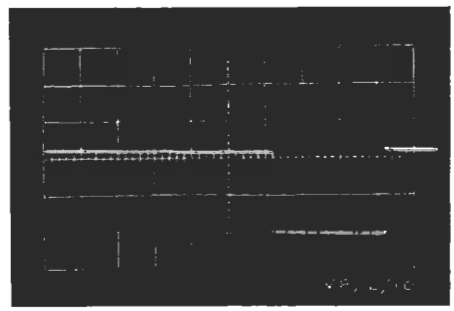
3 lb 5 oz.

Size

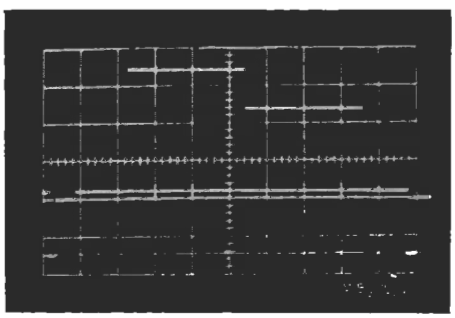
Constructed on a CH1/12D chassis.



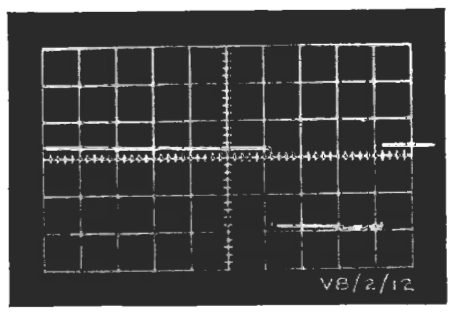
Waveform 1: Output
Vertical scale: 0·2 volt per square
Horizontal scale: 11μsec per square



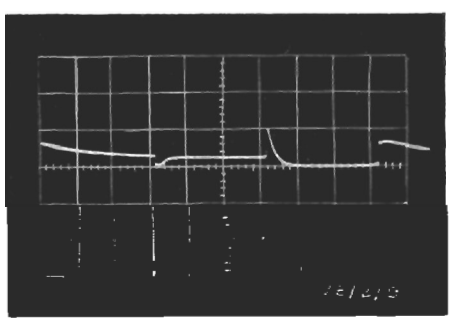
Waveform 4: VT38 Collector
Vertical scale: 2 volts per square
Horizontal scale: 10 μsec per square



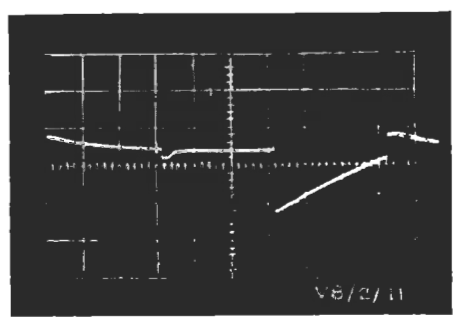
Waveform 2: Output
Vertical scale: 0·2 volt per square
Horizontal scale: 2 msec per square



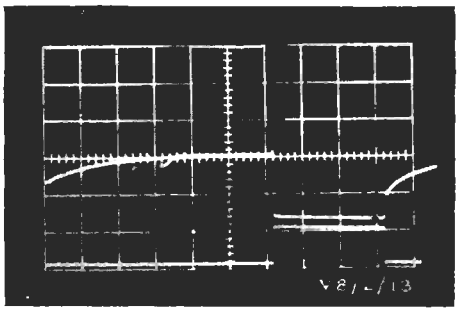
Waveform 5: VT37 Emitter
Vertical scale: 2 volts per square
Horizontal scale: 10 μsec per square



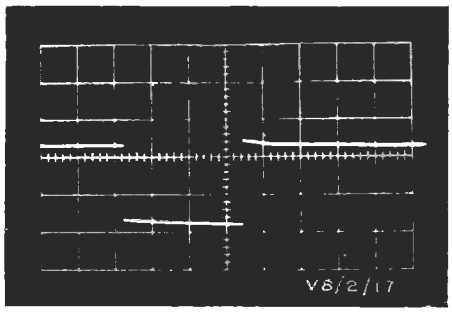
Waveform 3: VT38 Base
Vertical scale: 2 volts per square
Horizontal scale: 10 μsec per square



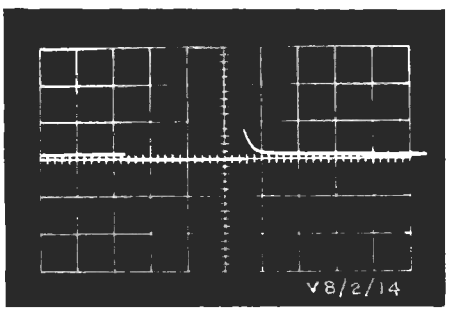
Waveform 6: VT38 Emitter
Vertical scale: 2 volts per square
Horizontal scale: 10 μsec per square



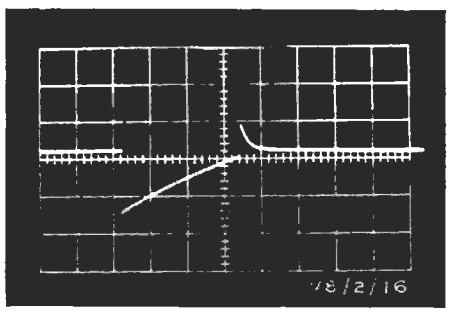
Waveform 7: Junction of R111 and C31. Also, lower, VT37 Collector
Vertical scale: 2 volts per square
Horizontal scale: 10 µsec per square



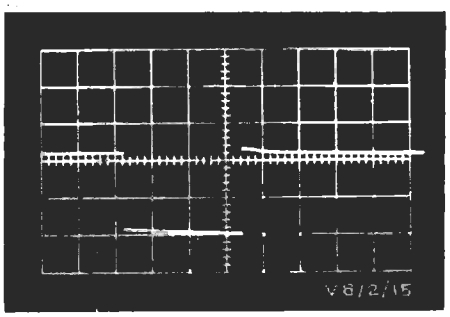
Waveform 10: VT20 Emitter
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



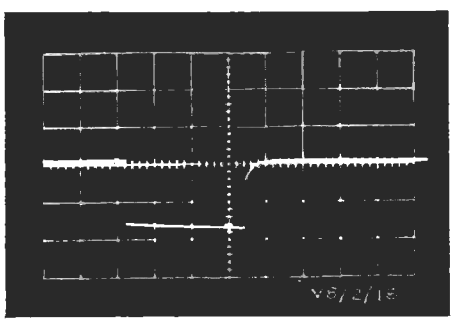
Waveform 8: VT21 Base
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



Waveform 11: VT21 Emitter
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



Waveform 9: VT21 Collector
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



Waveform 12: Junction of R71 and C15
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square

Circuit Description (Fig. 2.)

General

The complete circuit of the generator is shown in Fig. 2, and a block diagram in Fig. 2.3.

The output waveform of the generator (Fig. 2.2) consists as already described of a number of parts. These are:

line and frame sync pulses,
a platform,
a small 'black' pulse,
a small 'white' pulse, and
a wide pulse producing the white and grey bar.

the junction of R50 and R51, which are connected in series between the negative supply and chassis. Thus R50 and R51, effectively in parallel, form a common internal load across which the composite signal develops. The junction of R50 and R51 is connected directly to the output plug of the generator. The parallel value of the two resistors largely determines the source impedance of the generator.

Action of Multivibrators

Nine multivibrators time the introduction and govern the duration of the pulses that are additional to the sync signals and platform in the output

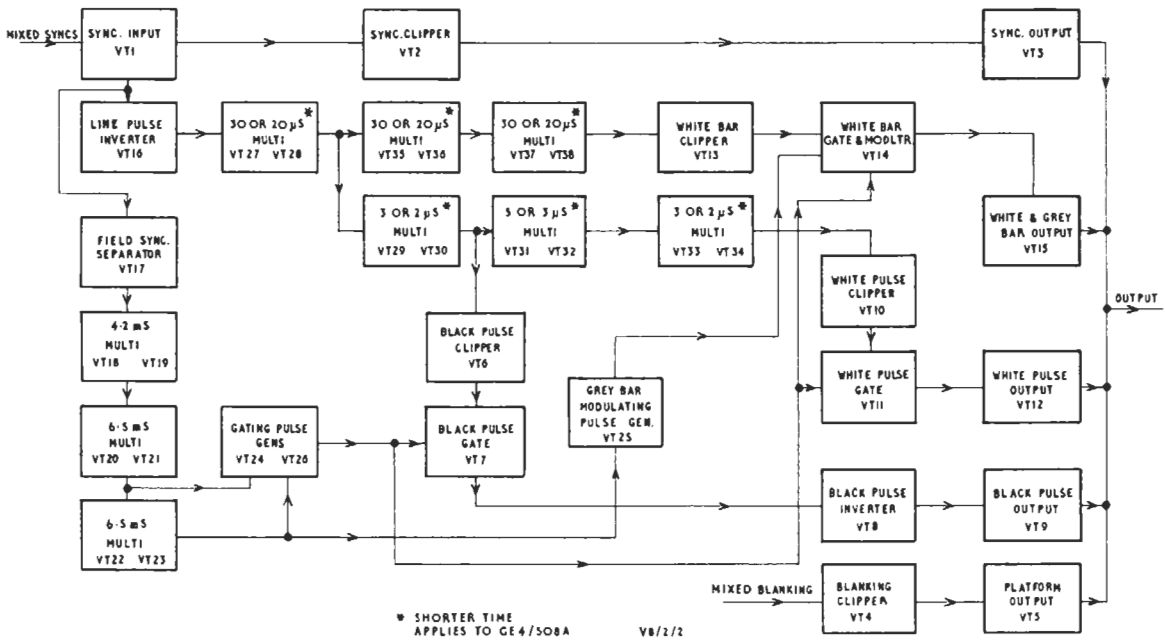


Fig. 2.3. GE4/508 and GE4/508A: Block Diagram

Drawing No. DSKA 6794

These components of the signal are individually produced in sections of the circuit. The sync pulses and the platform are introduced in the output waveform by clipping the incoming mixed sync pulses and mixed blanking pulses and reproducing them, via output stages, at the required amplitudes. The other parts of the waveform are generated by a number of multivibrators and pass through separate clipping, gating and output stages. The collectors of all the output transistors are fed from

waveform. All these multivibrators are monostable and emitter-coupled. Because of their similarity, the action of only one of them need be explained in detail.

Consider, therefore, the multivibrator shown in Fig. 2.4 employing transistors VT37 and VT38. This circuit is triggered at line frequency and has an unstable state lasting 30 μsec in the GE4/508 or 20 μsec in the GE4/508A. In the absence of triggering pulses, VT38 is conducting and VT37 is cut off;

this is because the base of VT38, connected to chassis via R108, is negative with respect to its emitter, which is fed from the positive supply, whereas the base and emitter of VT37 are both at about chassis potential. The collector of VT38 and the base of VT37 are held against going positive by diode MR20. When a positive-going trigger pulse (Waveform 3) is applied to the base of VT38 from capacitor C30, it cuts off the transistor, producing a negative-going pulse (Waveform 4) at VT38 collector. This negative-going pulse is received directly by the base of VT37, causing VT37 to conduct and produce a negative-going pulse (Waveform 5) at its emitter; the pulse develops across the unbypassed emitter resistor as in an emitter-follower. The negative-going pulse is

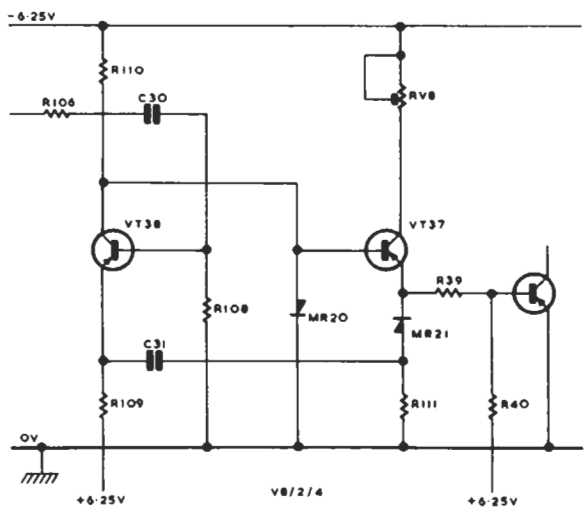


Fig. 2.4. GE4/508 and GE4/508A: Example of Multivibrator Circuit

applied from the emitter of VT37, via diode MR21 and C31, to the emitter of VT38, maintaining VT38 cut off (and therefore maintaining VT37 conducting) until C31 has charged through R109 (Waveform 6). As C31 charges, the emitter of VT38 becomes less negative, and eventually current again flows in VT38. When VT38 conducts again, its collector returns to approximately zero potential and, as the base of VT37 directly receives this change of voltage, VT37 is again cut off. The duration of the unstable state of the multivibrator is controlled by the variable resistor RV8 in series with the collector of VT37.

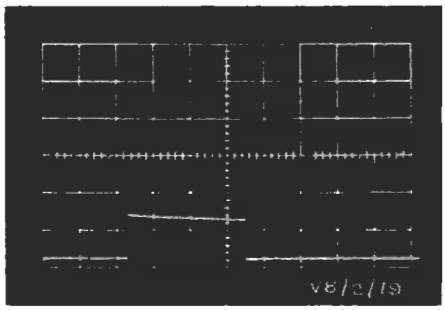
At the end of the unstable period, the positive-going rear edge of the pulse (Waveform 5) at the emitter of VT37 rises sharply. Diode MR21 allows this rise to occur independently of the arrested positive-going edge of the pulse (Waveform 7) at the junction of R111 and C31. Where the output is not taken from the corresponding emitter in other multivibrators, the diode is not fitted.

Waveforms 8 to 13 show the similiar functioning of the 6·5-msec multivibrator consisting of VT20 and VT21, which is triggered at field frequency.

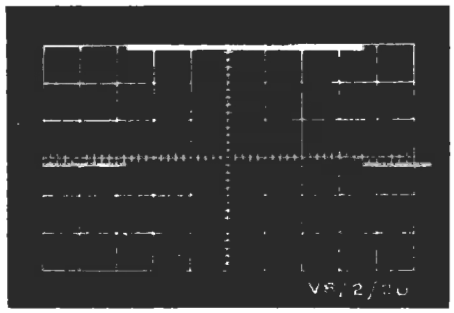
Sync Pulse Circuits

The incoming negative-going mixed sync pulses are applied through capacitor C4 to the base of transistor VT1, which is connected as an emitter follower and acts as a buffer stage. The negative-going sync pulses reproduced at the emitter of VT1 are coupled via C5 and R4 to the base of the clipper VT2. The resistor R4 limits the current passed by the base of VT2 during the pulses, which cause the collector of VT2 to be bottomed. VT2 produces clean pulses of fixed amplitude, largely independent of imperfections of shape and variations of amplitude (within normal limits) of the incoming sync pulses. The positive-going pulses from the collector of VT2 are applied through a potential-dividing network of resistors, including RV1, to the base of the sync pulse output transistor, VT3. The control RV1 permits adjustment of the amplitude of the line and field sync component in the composite output of the generator. The collector current of VT3 is drawn from the junction of R50 and R51, which form the common internal load. During a positive-going pulse at the base of VT3, the collector current is reduced and a negative-going reproduction of the pulse develops at the junction of R50 and R51.

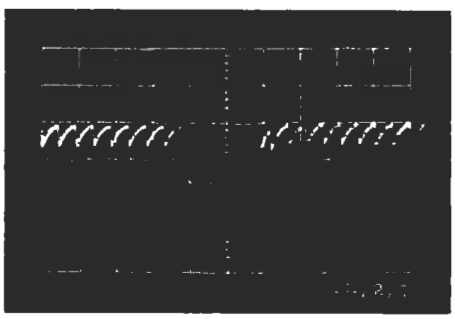
The emitter follower VT1 also feeds the incoming sync pulses to the bases of VT16 and VT17. Transistor VT16 inverts the sync pulses and from its collector they are applied to trigger, at line frequency, the multivibrator formed by VT27 and VT28. The function of VT17 is to separate the field pulses from the sync waveform; the sync pulses reach VT17 base via the integrating network comprising R52 and C11 (Waveform 14), and VT17 is so biased, by the potential dividers at base and emitter, that only the integrated field sync pulses cause it to conduct. The field sync pulses appear as a block (Waveform 15) at the collector of VT17 and this positive-going wave is used to trigger, at field frequency, the multivibrator formed by VT18 and VT19.



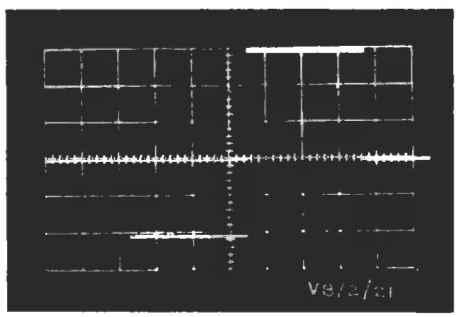
Waveform 13: VT20 Collector
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



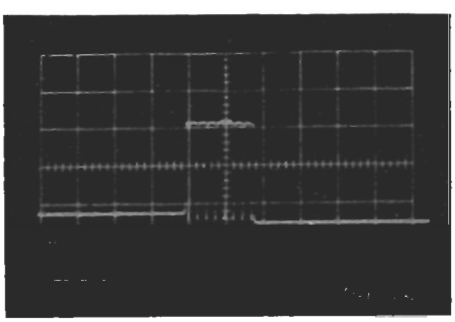
Waveform 16: VT24 and VT26 Collectors
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



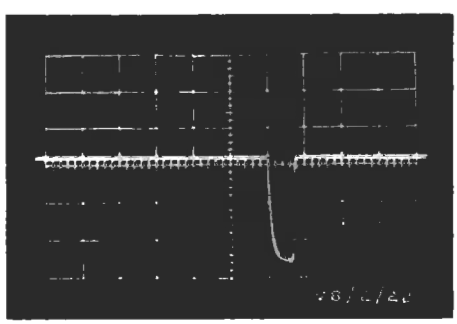
Waveform 14: VT17 Base
Vertical scale: 0·5 volt per square
Horizontal scale: 200 µsec per square



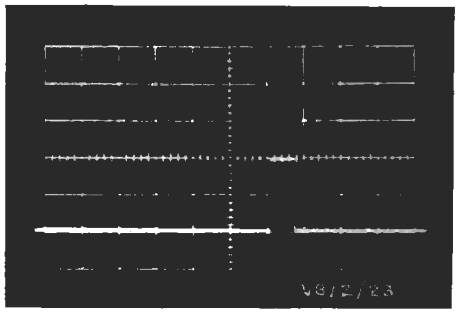
Waveform 17: VT25 Collector
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square



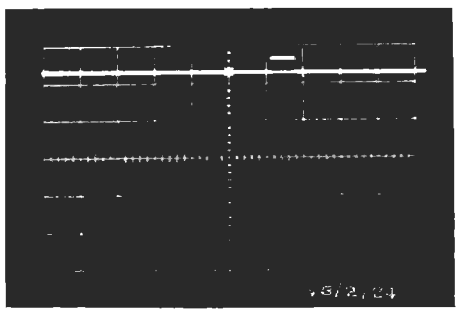
Waveform 15: VT17 Collector
Vertical scale: 1 volt per square
Horizontal scale: 200 µsec per square



Waveform 18: VT29 Emitter
Vertical scale: 2 volts per square
Horizontal scale: 5 µsec per square



Waveform 19: VT6 Collector
Vertical scale: 2 volts per square
Horizontal scale: 5 μsec per square



Waveform 20: VT9 Base
Vertical scale: 2 volts per square
Horizontal scale: 5 μsec per square

Platform Generation

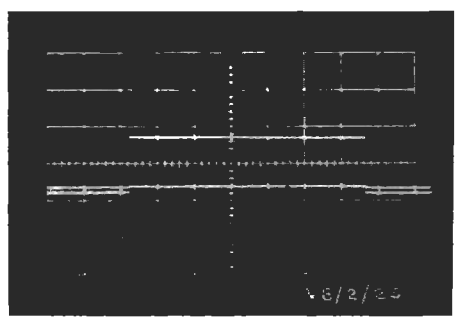
The platform in the output waveform is obtained by including in the waveform a low level of mixed blanking signal.

The incoming mixed blanking pulses are applied, through the d.c. blocking capacitor C6 and the resistor R11, to the base of the clipper VT4. The resistor R11 limits the current passed by the base of VT4 during the negative-going pulses and also serves to present a relatively high impedance to the external source of the blanking signal. During the blanking pulses, the collector of VT4 bottoms. The positive-going pulses obtained at the collector of VT4 are applied to the base of VT5, the platform output transistor. The collector of VT5 draws current from the common internal load formed by R50 and R51; the current drops during the pulses.

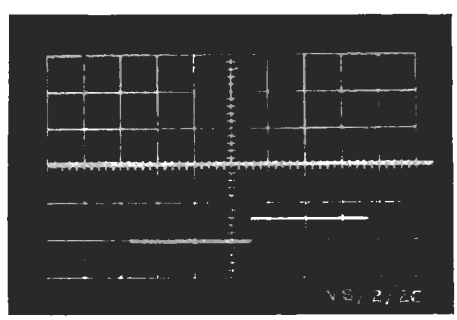
Field Gating and Modulating Pulse Circuits

The purpose of these circuits is to provide the necessary rectangular wave at field frequency for gating the black pulse, the white pulse, and the white and grey bar, so that these waveforms commence appearing in each output line after part of the field period has elapsed and cease before the end of the field. A second function of these circuits is to originate the modulating wave which reduces the grey and white bar to the grey level during the second half of the period over which the bar is gated.

The positive-going output from the collector of the field sync separator, VT17, is applied to trigger the 4·2-msec multivibrator comprising VT18 and VT19. The negative-going rectangular pulses at the collector of VT19 are differentiated by C14, R65, and R66, and the positive-going pulses derived from the rear edges of the 4·2-msec rectangular waves are used to trigger the 6·5-msec multivibrator comprising VT20 and VT21. In turn, the output from the collector of VT21 is differentiated by C16, R72, and R73, and positive-going pulses obtained



Waveform 21: VT14 Base
Vertical scale: 0·5 volt per square
Horizontal scale: 2 msec per square



Waveform 22: VT14 Collector
Vertical scale: 2 volts per square
Horizontal scale: 2 msec per square

from the rear edge of each 6·5-msec rectangular wave trigger the second 6·5-msec multivibrator, VT22 and VT23.

Negative-going 6·5-msec pulses from the emitter of VT20, in the first 6·5-msec multivibrator, are applied via C19 and R81 to the base of VT26, and during the pulses VT26 passes current. Similarly, negative-going pulses from VT22, in the second 6·5-msec multivibrator, are applied to VT24, causing it to pass current immediately after VT26. The collectors of VT24 and VT26 are connected in parallel and the two transistors consequently provide positive-going output pulses (Waveform 16) having a total duration of 13 msec, which are the waves used for gating.

Output from the emitter of VT22 is also applied to the base of VT25 (in a similar circuit to that of VT24 and VT26). The negative-going pulses from VT22 cause VT25 to produce at its collector a positive-going pulse during each second 6·5-msec period. As described later, these pulses are applied to VT14 and reduce the amplitude of the white and grey bar waveform from the white to the grey level. (Waveform 17 shows the positive-going pulse at the collector of VT25, where it is preceded by a negative-going wave received from the collector of VT14.)

During each negative-going pulse applied to VT24, VT25, and VT26, the coupling capacitor connected via a resistor to each transistor begins to charge due to base current. The diode, MR10, MR11, and MR12 respectively, between base and emitter presents a high resistance during the pulse, but when the pulse ends the diode provides a path for the capacitor to discharge and prevents the transistor being cut off to an unnecessary extent by the positive voltage acquired by the capacitor.

Black Pulse Generation

The low-amplitude black pulses in the GE4/508 output waveform are generated 30 µsec after the leading edges of the line sync pulses and have a 3-µsec duration. Because of the shorter line period in 625-line and 525-line operation, the GE4/508A has certain different component values which make the black pulses occur 20 µsec after the line sync pulses and give them a 2-µsec duration. In both models, a gate stage limits the output of black pulses to a period of 13 msec commencing 4·2 msec after the start of the field sync pulses.

The leading edge of the black pulse is timed in each line period by the 30-µsec or 20-µsec monostable multivibrator consisting of VT27 and VT28. This is triggered at VT28 base by the leading edges of the positive-going pulses fed from the line pulse inverter, VT16. The negative-going rectangular pulses generated at VT28 collector provide positive-going pulses from their rear edges by differentiation in R87, C22, and R88, and these trigger the 3-µsec or 2-µsec multivibrator consisting of VT29 and VT30.

The negative-going pulses at the emitter of VT29 (Waveform 18) are the basis of the black pulse component in the output of the generator. From VT29 emitter the pulses are applied, via R16, to the base of the clipper VT6, which reproduces them at its collector in a positive-going sharply rectangular form (Waveform 19). The collector of VT6 is coupled, through R19, to the base of the gate transistor VT7.

The base of VT7 receives a basic black pulse from VT6 in every line period. However, the base of VT7 is so biased from the negative supply, via R20, that VT7 is bottomed and the pulses from VT6 have no effect until the base of VT7 also receives the positive-going 13-msec gating pulse from VT24 and VT26, via R21. While the gating pulse is present in each field period VT7 ceases to be bottomed and the pulses from VT6 are transmitted by it.

Thus, during a gating pulse, VT7 generates negative-going pulses at its collector. These are inverted by VT8 and applied to the base of VT9, the black pulse output transistor (Waveform 20). The positive-going pulses received at the base of VT9 cause a reduction in the current drawn by VT9 collector from the common internal load formed by R50 and R51, and so produce the negative-going black pulses in the output.

White Pulse Generation

In the output of the GE4/508 the low-amplitude white pulses are spaced 5 µsec after the rear edges of the black pulses and have a duration of 3 µsec. Differing in certain component values, the GE4/508A generates a modified waveform in which the white pulses are spaced 3 µsec after the black pulses and have a duration of 2 µsec. As with the black pulses, in both models a gate stage limits the output of white pulses to a period of 13 msec commencing 4·2 msec after the start of the field sync pulses.

The time interval between the black and the white pulses is set by the 5-µsec or 3-µsec monostable multivibrator consisting of VT31 and VT32. From the rear edges of the rectangular pulses at VT30 collector (in the multivibrator originating the

black pulses), positive-going pulses are derived by differentiation in C24, R92, and R93, and these are used to switch off the normally-conducting transistor VT32 at its base. In turn, the output from VT32 collector is differentiated by R95, C26, and R98, and the positive-going pulses derived when VT32 recommences conduction are used to trigger the 3-μsec or 2-μsec multivibrator comprising VT33 and VT34.

The negative-going pulses at the emitter of VT33 are the basis of the white pulse component in the output of the generator. From VT33 emitter, the pulses are applied, via R29, to the base of the clipper VT10, which reproduces them at its collector in a positive-going sharply rectangular form. The collector of VT10 is coupled, through R32, to the base of the gate transistor VT11.

In addition to the basic white pulses from VT10, the base of VT11 also receives the positive-going gating pulse from VT24 and VT26, via R34. The action of VT11 is the same as that of the black pulse gate, VT7, which has been described previously. Accordingly, during a gating pulse, VT11 collector reproduces the input from VT10 in the form of negative-going pulses. These are applied to the base of VT12, the white pulse output transistor, via the potential divider consisting of R36 and R37. The negative-going pulses at VT12 base cause an increase in the current taken by the collector of VT12 from the junction of R50 and R51, and so produce the positive-going white pulses in the output.

White and Grey Bar Generation

In the line output waveform of the GE4/508 the white and grey bar follows 30 μsec after the leading edge of the black pulse and has a duration of 30 μsec. In the briefer line waveform of the GE4/508A the white and grey bar follows 20 μsec after the leading edge of the black pulse and has a duration of 20 μsec. As with the black and white pulses, in both models of the generator a gate stage limits the output of the white and grey bar signals to a period of 13 msec commencing 4·2 msec after the start of the field sync pulses. During the second half of the gating time, modulation reduces the amplitude of the bar from the white to the grey level.

The timing of the white and grey bar in each line period is governed by the 30-μsec or 20-μsec monostable multivibrator consisting of VT35 and VT36. From the rear edges of the rectangular pulses at VT28 collector (in the multivibrator timing the leading edges of the black pulses), positive-going pulses are derived by differentiation in R101, C28, and R102, and these are used to switch off the normally-conducting transistor VT36 at its base. In turn, the output at VT36 collector is differentiated by R106, C30, and R108, and the positive-going pulses derived when VT36 recommences conduction are used to trigger another 30-μsec or 20-μsec multivibrator, VT37 and VT38.

The negative-going pulses generated at the emitter of VT37 are the basis of the white and grey bar waveform in the output of the generator. They are applied, via R39, to the base of the clipper VT13, which reproduces them at its collector in a positive-going sharply rectangular form. VT13 collector is coupled, through R42, to the base of VT14, which acts as a gate and as a means of modulation.

The action of VT14 as a gate is the same as that of the black pulse gate, VT7. The base of VT14 receives a positive-going pulse from VT13 in every line period, but VT14 is bottomed by negative bias except while its base also receives the positive-going 13-msec gating pulse from VT24 and VT26, via R44. During the gating pulse, VT14 reproduces the pulses from VT13. (Waveform 21 shows the outline of the pulses from VT13 at VT14 base during a field period, and illustrates how they are suppressed outside the 13-msec gating period.)

Thus, in the gating period, VT14 generates negative-going pulses at its collector. However, during the second half of the gating period a positive-going 6·5-msec pulse is applied from VT25 to R46, which is connected to VT14 collector. This effectively lowers the negative supply feeding VT14 collector and reduces the amplitude of the pulses it produces (Waveform 22). In this way the two amplitudes of the white and grey bar waveform are obtained; the amplitude of the grey bar signals relative to the white bar signals is determined by the value chosen for R46.

The gated and modulated output from VT14 collector is coupled, via C8 and the variable potential divider RV2, to the base of VT15, the white and grey bar output transistor. The collector of VT15 is connected to the junction of R50 and R51. Control RV2 permits adjustment of the amplitude of the white and grey bar component in the output of the generator.

Power Supply

The mains input is applied to the primary winding of transformer T1 via fuses FS1 and FS2. The transformer has two 12-volt secondary windings, which are connected in series. These feed the

rectifier bridge consisting of MR1, MR2, MR3, and MR4. The rectified output from the bridge is smoothed by the reservoir capacitor C1 and is applied, via R1, to the Zener diodes ZD1 and ZD2 in series. The junction of the Zener diodes is connected to chassis and two stabilised supplies are thereby provided: one of −6·25 volts relative to chassis from the negative side of ZD1, and one of +6·25 volts relative to chassis from the positive side of ZD2. Smoothing capacitors C2 and C3 shunt the two supplies respectively.

Test Schedule*

Apparatus Required

Tektronix Oscilloscope Type 515 or 545.

Television pulse generator or a supply of mixed sync and mixed blanking pulses providing 2 volts amplitude across 75 ohms. (Line standards to be those on which the generator will be operated.)

Cable Termination Block type PN3A/2 made up for use with GE4/508 and GE4/508A, including Musa plugs fitted (in place of lead-through adaptors) and connected to form an outlet for the generator signal, an inlet for the mixed sync pulses, and an inlet for the mixed blanking pulses, and also additional plugs in parallel with each of the inlets to permit termination.

Two 75-ohm Musa socket terminations.

One 75-ohm Series 83 (F. & E. type) plug termination.

One Series 83 coaxial T-junction adaptor.

Test Procedure

1. Plug the generator into the termination block and apply the mains to the generator, via the block.
2. Feed mixed sync and mixed blanking signals to the generator via the appropriate plugs on the termination block. Load these inputs with 75-ohm terminations using the parallel plugs on the block.
3. Apply the output of the generator to the oscilloscope. Use the T-junction adaptor on the oscilloscope inlet and fit the 75-ohm Series 83 termination to the free arm of the junction so that the output of the generator is simultaneously loaded by 75 ohms.
4. Set the oscilloscope to display the waveform of a line, or lines, including the black and white pulses and the white and grey bar, and check that the waveform is generally of the form shown in Fig. 2.2.
5. On the oscilloscope, measure the time between the leading edge of the line sync pulse and the leading edge of the black pulse. Adjust RV6 on a GE4/508, or a GE4/508A, to make this time 30 µsec, or 20 µsec, respectively.
6. Measure the time between the leading edge of the black pulse and the leading edge of the white and grey bar waveform. Adjust RV7 on a GE4/508, or a GE4/508A, to make this time 30 µsec, or 20 µsec, respectively.
7. Measure the duration of the white and grey bar. Adjust RV8 on a GE4/508, or a GE4/508A, to make this duration 30 µsec, or 20 µsec, respectively.
8. Reset the oscilloscope to display a field waveform. Measure the time between the start of the field sync pulses and the commencement of the white bar pulses. Adjust RV3 to make this time 4·2 msec.

   Note:—On GE4/508A generators to be operated on 525 lines, it may be necessary to set RV3 so that this time is shorter to prevent the grey bar pulses encroaching on the field sync period.
9. Measure the period occupied by the white bar pulses in a field. Adjust RV4 to make this time 6·5 msec.
10. Measure the period occupied by the grey bar pulses in a field. Adjust RV5 to make this time 6·5 msec.
11. Reset the oscilloscope to display the durations of the black and white pulses and the separation between them. The black and white pulses produced by a GE4/508 should have durations of 3 to 5 µsec and the separation between them should be 5 to 7 µsec. The black and white pulses produced by a GE4/508A should have durations of 2 to 4 µsec and the separation between them should be 3 to 5 µsec.
12. Adjust RV1 to make the sync pulse amplitude 0·3 volt below black level.
13. Reset the oscilloscope to measure the overall amplitude of the output. Adjust RV2 to make the overall amplitude 1 volt peak-to-peak (i.e. so that the white bar waveform is 0·7 volt above black level).

*This Schedule is based on Designs Department Specification No. 8.54(61).

COMPONENT TABLE: FIG. 2

PAGE 1

Comp.	Loc.	Type	Tolerance per cent
C1	D5	Hunt MEF45T 50V	
C2	E3	U.C.C. SC603/6LS 12V	
C3	E5	U.C.C. SC603/6LS 12V	
C4	E3	U.C.C. SM56S 12V	
C5	G5	U.C.C. SM56S 12V	
C6	J4	U.C.C. SM65S 12V	
C7	O4	U.C.C. SM56S 12V	
C8	X3	U.C.C. SC596/7LS 25V	
C9	A7	U.C.C. SM56S 12V	
C10	B10	U.C.C. SM56S 12V	
C11	B10	Hunt BM21KV 500V	
C12	C9	U.C.C. SM65S 12V	
C13	E10	U.C.C. SM39/1 6V	20
C14	D10	T.C.C. CM20N	
C15	G10	U.C.C. SM39/1 6V	20
C16	G10	T.C.C. CM20N	
C17	J10	U.C.C. SM39/1 6V	20
C18	K9	U.C.C. SM65S 12V	
C19	M9	U.C.C. SM65S 12V	
C20	O11	T.C.C. CSM20N	
C21	O10	T.C.C. CP34S/PVC	
C22	Q10	T.C.C. CSM20N	
C23	Q10	T.C.C. CSM20N	
C24	Q10	T.C.C. CSM20N	
C25	S10	T.C.C. CSM20N	
C26	T10	T.C.C. CSM20N	
C27	U10	T.C.C. CSM20N	
C28	V10	T.C.C. CSM20N	
C29	W10	T.C.C. CP34S/PVC	
C30	W10	T.C.C. CSM20N	
C31	X10	T.C.C. CP34S/PVC	
FS1	A3	Belling Lee L562/0·100	
FS2	A5	Belling Lee L562/0·100	
R1	D2	Painton P301A	
R2	F4	Erie 109 0·25W	2
R3	F6	Erie 109 0·25W	2
R4	G5	Erie 109 0·25W	2
R5	G6	Erie 109 0·25W	2
R6	G5	Erie 109 0·25W	2
R7	G4	Erie 109 0·25W	2
R8	H6	Erie 109 0·25W	2
R9	J6	Erie 109 0·25W	2
R10	J6	Erie 109 0·25W	2

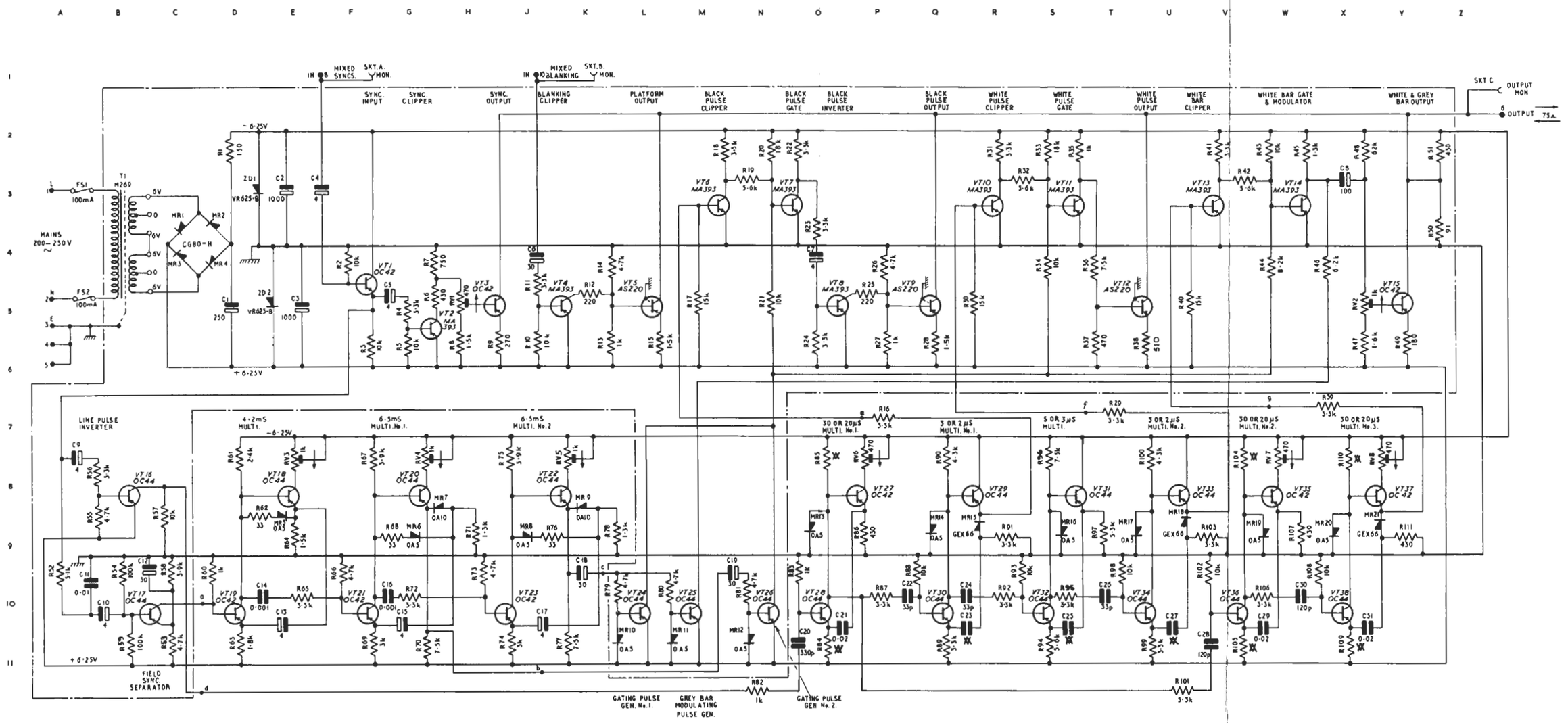
Comp.	Loc.	Type	Tolerance per cent
R11	J5	Erie 109 0·25W	2
R12	K5	Erie 109 0·25W	2
R13	K6	Erie 109 0·25W	2
R14	K4	Erie 109 0·25W	2
R15	L6	Erie 109 0·25W	2
R16	P7	Erie 109 0·25W	2
R17	M5	Erie 109 0·25W	2
R18	M2	Erie 109 0·25W	2
R19	N3	Erie 109 0·25W	2
R20	N2	Erie 109 0·25W	2
R21	N5	Erie 109 0·25W	2
R22	O2	Erie 109 0·25W	2
R23	O4	Erie 109 0·25W	2
R24	O6	Erie 109 0·25W	2
R25	P5	Erie 109 0·25W	2
R26	P4	Erie 109 0·25W	2
R27	P5	Erie 109 0·25W	2
R28	Q5	Erie 109 0·25W	2
R29	T6	Erie 109 0·25W	2
R30	R5	Erie 109 0·25W	2
R31	R2	Erie 109 0·25W	2
R32	R3	Erie 109 0·25W	2
R33	S2	Erie 109 0·25W	2
R34	S4	Erie 109 0·25W	2
R35	S2	Erie 109 0·25W	2
R36	T4	Erie 109 0·25W	2
R37	T6	Erie 109 0·25W	2
R38	U6	Erie 109 0·25W	2
R39	X6	Erie 109 0·25W	2
R40	U5	Erie 109 0·25W	2
R41	V2	Erie 109 0·25W	2
R42	V3	Erie 109 0·25W	2
R43	W2	Erie 109 0·25W	2
R44	W4	Erie 109 0·25W	2
R45	W2	Erie 109 0·25W	2
R46	X4	Erie 109 0·25W	2
R47	X6	Erie 109 0·25W	2
R48	X2	Erie 109 0·25W	2
R49	Y6	Erie 109 0·25W	2
R50	Z4	Erie 109 0·25W	2
R51	Z2	Erie 109 0·25W	2
R52	A9	Erie 109 0·25W	2
R53	C11	Erie 109 0·25W	2
R54	B9	Erie 109 0·25W	2
R55	B9	Erie 109 0·25W	2
R56	B8	Erie 109 0·25W	2
R57	C9	Erie 109 0·25W	2

COMPONENT TABLE: FIG: 2

PAGE 2

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
R58	C9	Erie 109 0·25W	2	R92	R10	Erie 109 0·25W	2
R59	C11	Erie 109 0·25W	2	R93	R9	Erie 109 0·25W	2
R60	D9	Erie 109 0·25W	2	R94	S11	Erie 109 0·25W	2
R61	D7	Erie 109 0·25W	2	R95	S10	Erie 109 0·25W	2
R62	E9	Erie 109 0·25W	2	R96	S7	Erie 109 0·25W	2
R63	D11	Erie 109 0·25W	2	R97	T9	Erie 109 0·25W	2
R64	E9	Erie 109 0·25W	2	R98	T9	Erie 109 0·25W	2
R65	E10	Erie 109 0·25W	2	R99	U11	Erie 109 0·25W	2
R66	F9	Erie 109 0·25W	2	R100	U8	Erie 109 0·25W	2
R67	F7	Erie 109 0·25W	2	R101	U11	Erie 109 0·25W	2
R68	G9	Erie 109 0·25W	2	R102	V9	Erie 109 0·25W	2
R69	F11	Erie 109 0·25W	2	R103	V9	Erie 109 0·25W	2
R70	G11	Erie 109 0·25W	2	R104	V8	Erie 109 0·25W	2
R71	H9	Erie 109 0·25W	2	R105	V11	Erie 109 0·25W	2
R72	G10	Erie 109 0·25W	2	R106	V10	Erie 109 0·25W	2
R73	H9	Erie 109 0·25W	2	R107	W9	Erie 109 0·25W	2
R74	J11	Erie 109 0·25W	2	R108	W9	Erie 109 0·25W	2
R75	J8	Erie 109 0·25W	2	R109	X11	Erie 109 0·25W	2
R76	J9	Erie 109 0·25W	2	R110	X8	Erie 109 0·25W	2
R77	K11	Erie 109 0·25W	2	R111	Y9	Erie 109 0·25W	2
R78	K9	Erie 109 0·25W	2				
R79	K10	Erie 109 0·25W	2				
R80	L10	Erie 109 0·25W	2	RV1	H5	Plessey 404/1/00142/471	
R81	N10	Erie 109 0·25W	2	RV2	X5	Plessey 404/1/00142/102	
R82	N11	Erie 109 0·25W	2	RV3	E8	Plessey 404/1/00142/102	
R83	O9	Erie 109 0·25W	2	RV4	G8	Plessey 404/1/00142/102	
R84	O11	Erie 109 0·25W	2	RV5	K8	Plessey 404/1/00142/102	
R85	O8	Erie 109 0·25W	2	RV6	P8	Plessey 404/1/00142/471	
R86	P9	Erie 109 0·25W	2	RV7	W8	Plessey 404/1/00142/471	
R87	P10	Erie 109 0·25W	2	RV8	Y8	Plessey 404/1/00142/471	
R88	Q9	Erie 109 0·25W	2				
R89	Q11	Erie 109 0·25W	2				
R90	Q7	Erie 109 0·25W	2	T1	B4	M269	
R91	R9	Erie 109 0·25W	2				

FIG 2



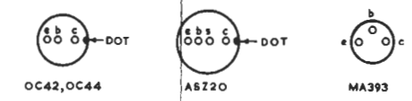
NOTE:– 1. COMPONENTS ENCLOSED BY CHAIN DOTTED LINE ARE LOCATED ON UPPER PRINTED BOARD DB8464. ALL OTHER COMPONENTS ARE ON LOWER PRINTED BOARD DB8467 EXCEPT FUSES, MONITOR SOCKETS, AND 15-WAY PLUG

2. POSITIONS MARKED a, b, c, d, e, f, & g ARE POINTS OF CONNECTION BETWEEN THE TWO MAIN PRINTED BOARDS

3. COMPONENTS MARKED ✕ HAVE VALUES AS SHOWN BELOW

COMPONENT REF			COMPONENT VALUE	
			GE4/508	GE4/508A
R85	R104	R110	4·3k	2·7k
R84	R105	R109	3·3k	2·2k
C23	C25	C27	0·0012	820p

TRANSISTOR TERMINATIONS, VIEW ON LEADS



PICTURE LINE-UP TEST GENERATORS GE4/508 & GE4/508A : CIRCUIT