

ERROR SIGNAL GENERATOR (PAL) GE1L/532**ERROR SIGNAL GENERATOR (PAL) FOUR-WAY GE1M/540****Introduction**

The GE1L/532 and GE1M/540 are sync-pulse timing comparators and error-signal tone coders for use in the Natlock¹ system.

The GE1L/532 accepts local syncs, V-axis switch and PAL subcarrier together with a remote colour video signal and a ternary-logic colour error control signal from the associated phase comparator².

It regenerates syncs from the remote signal and compares their timing in both four-field (PAL-picture period) phase and line phase with that of local syncs to provide binary-logic error control signal outputs. These signals, together with PAL subcarrier and the colour error signal, are fed to a tone coder which generates a Natlock tone error signal output.

The GE1L/532 comprises the six A-size units listed below as accommodated from left to right in a PN3A/16F rear interconnection panel.

PS2/13F	Power Supplier
UN1/589	Sync Separator
UN17/505	Sync Process Unit
UN17/517	PAL Analysis Unit
UN17/506	Comparator Unit
CD2/501	Tone Encoder

The GE1M/540 is a four-way version of the GE1L/532 and comprises four of each of the units listed above mounted in three PN3/23 chassis. Each channel of the GE1M/540 is electrically identical to the GE1L/532 except that the binary-logic error control signals are not available at the rear panel of the four-way generator.

General Specification

Signal Inputs

Local mixed syncs	2 V p-p)
Local V-axis switch	1 V p-p) can be reduced by up to 6 dB
PAL subcarrier	1 V p-p)
Remote video	standard level colour video signal. This can be reduced in level by up to 6 dB but the colour-burst amplitude may be within ± 6 dB of 0.3 V p-p.
Colour error	colour error control signal, C' nominal levels: normal 0 V colour retard -3 V colour advance -6 V

Input Impedances

Pulses and subcarrier	about 1 kilohm
Video	about 10 kilohms

Signal Outputs

Line	Natlock tone error signal, frequency coded by error control signals (see Table 2)
Error (GE1L/532 only)	Sync-pulse timing error control signals, A' , R' , F' (see Table 3)

Output Levels

Line (w.r.t. 1 mW into 600 ohms)	0 dB from 600 ohms (centre-tapped to earth)
Error (GE1L/532 only)	0 V and -6 V, nominal (see Table 1)

Power Input

	200 V to 250 V a.c., 100 mA (70 mA to PS2/13F, fused at 150 mA and 30 mA to UNI/589, fused at 150 mA)
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Operating Standard

	625-lines PAL
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Operating Temperature

	0°C to 45°C (ambient)
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Connectors

Pulses, subcarrier and video	coaxial, BNC 50-ohm sockets (two sockets in parallel for each input)
Colour Error	Painton series 159, 7-pole plug
Line	Cannon XLR-3-31 socket
Error (GE1L/532 only)	Cannon XLR-5-32 plug
Mains	Cannon XLR-LNE-32 socket

Weight

GE1L/532	6.1 kg (13.5 lb)
GE1M/540	30 kg (65 lb)

TABLE 1

Error Control Signal Tolerances

Nominal Voltage	Voltage Tolerances	
	binary logic	ternary logic
0	more +ve than -1.5	more +ve than -1.5
-3	-	from -2.5 to -3.25
-6	more -ve than -4.5	more -ve than -4.5

TABLE 2
Error Correction Modes and Output Frequencies

<i>Function</i>	<i>Time or Phase Error</i>	<i>Correction Mode</i>	<i>Tone Output Hz</i>
1. Picture timing Early Late	greater than 12 μ s	Fast Retard Fast Advance	892 1542
2. Line timing Early Late	less than 12 μ s and greater than 50 ns	Retard Advance	977 1407
3. Colour phasing Early Late	greater than 1.3°	Colour Retard Colour Advance	1071 1285
4. Normal Sync timing Colour phasing	less than 50 ns less than 1.3°	Normal	1173

TABLE 3
Error Control Signals

<i>Correction Mode</i>	<i>Error output</i>					
	<i>logic states</i>			<i>voltage levels</i>		
	<i>A'</i>	<i>R'</i>	<i>F'</i>	<i>A'</i>	<i>R'</i>	<i>F'</i>
Fast Advance	0	1	0	-6	0	-6
Advance	0	1	1	-6	0	0
Normal	1	1	1	0	0	0
Retard	1	0	1	0	-6	0
Fast Retard	1	0	0	0	-6	-6

System Description

The block diagram of the GE1L/532 is given in Fig. 1. This is identical with one channel of the GE1M/540, except as noted. Waveforms relating to some of the inter-unit signal paths and to the pulses listed below are given in Fig. 2.

The Sync Separator UN1/589 provides remote separated syncs and colour bursts.

oscillating burst phase and regenerates from this signal a remote V-axis switch. The logic gates in the unit which change the pulse sequence are energised by the remote V-axis switch. Thus *local field* pulses recur at 40 ms intervals and are re-named *picture half-time* pulses, shown in Fig. 2(j). Local and remote picture pulses similarly recur at 80-ms intervals and are re-named *local* and *remote PAL-picture pulses*,

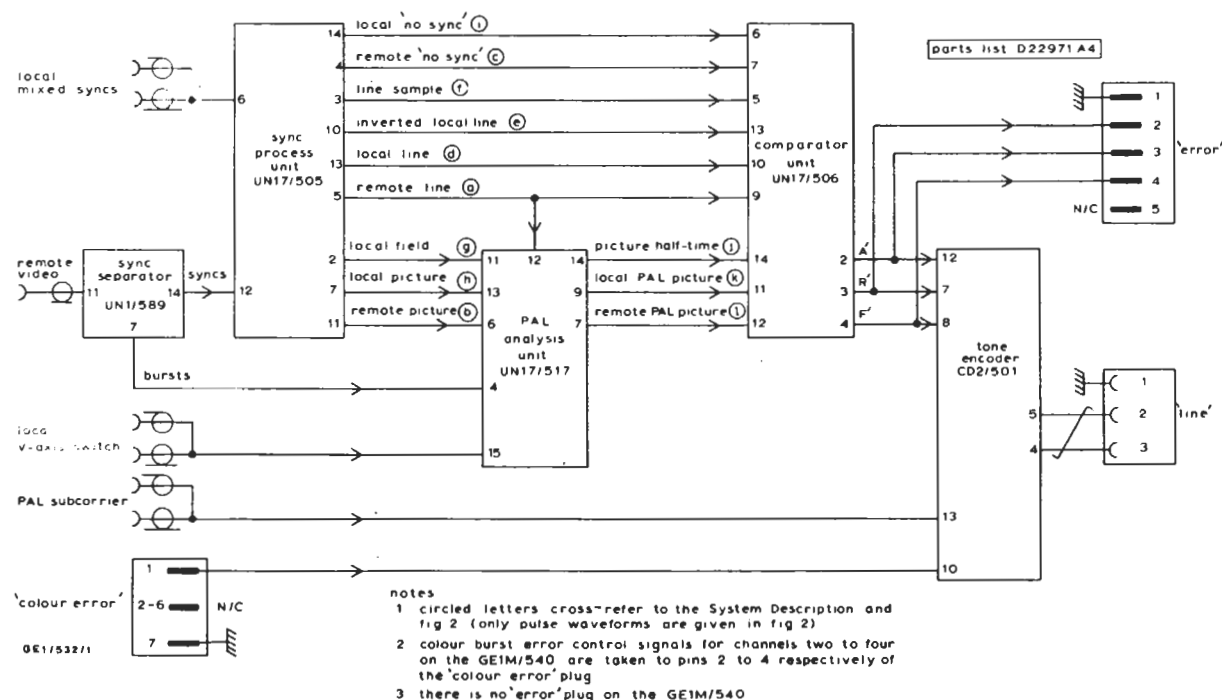


Fig. 1. Block diagram of the GE1L/532 and of one channel of the GE1M/540

Remote and local syncs are fed to the Sync Process Unit UN17/505 which generates two sets of waveforms related to the sync inputs:

- remote: a) line pulse
- b) picture pulse
- c) no-sync signal
- local: d) line pulse
- e) inverted line pulse
- f) line sample pulse
- g) field pulse
- h) picture pulse
- i) no-sync signal

Local V-axis switch and the remote colour bursts from the UN1/589 are fed together with pulses a), b), g) and h) to the PAL Analysis Unit UN17/517.

The function of the UN17/517 is to convert pulses b), g) and h) from the two-field monochrome sequence to a four-field sequence which takes account of the V-axis switch by inhibiting alternate pulses in each of the three pulse routes. If the PAL colour burst is missing on the remote video input the UN17/517 allows pulses b), g) and h) to pass unchanged, in their original two-field sequence. When the colour burst is present the UN17/517 detects the

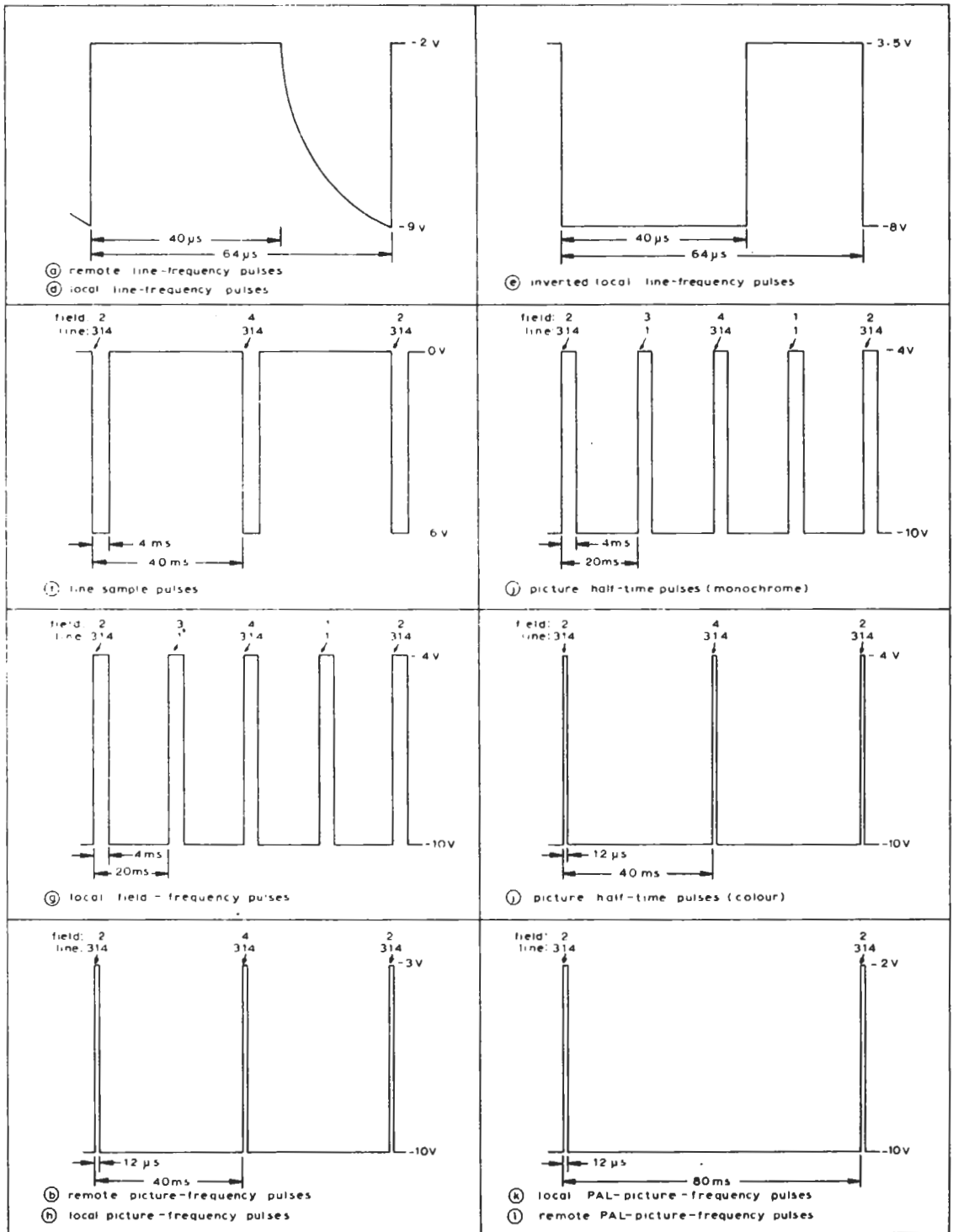
oscillating burst phase and regenerates from this signal a remote V-axis switch. The pulses recurring at line-frequency are not processed by this unit because there is no equivalent ambiguity at line-rate between monochrome and colour waveforms.

Pulses j), k) and m) from the UN17/517 are passed with pulses a), c), d), e), f) and i) to the UN17/506. Absence of synchronism between local and remote inputs causes error control signals to be generated by the UN17/506.

The error control signal voltages are arranged so that in their absence the *Normal* instruction (indicating that correction is not required) is generated by the UN17/506 to give fail-safe protection.

The error control signals are generated by the UN17/506 in two stages. The unit detects first the error in picture phasing and generates appropriate *Advance* or *Retard* error control signals in a sense that will give correction to the timing of a slave-locked remote signal by the quickest path to synchronism. The unit also generates a *Fast* error control signal which continues until the timing error between local and remote pulses is less than 12 μs. The *Fast* error control signal then ceases.

Line phasing continues during which the *Advance*



notes

- 1 circled letters cross-refer to fig 1 and to the System Description
- 2 voltages shown are approximate

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Fig. 2. Idealised waveforms in the GE1L/532 and GE1M/540

or *Retard* error signal output goes to 0 V for 100 μ s every 40 ms for the comparator to sample. This process inserts positive-going pulses at picture frequency on the *A'* or *R'* error control signal. *Advance* or *Retard* error signals are generated until the line timing error becomes less than about 50 ns.

At this point (of line synchronism) the UN17/506 generates the *Normal* signal until a subsequent sample indicates that correction is required. The *Normal* signal is also generated if either sync input fails.

The Tone Encoder CD2/501 accepts the error control signals *A'*, *R'* and *F'* from the UN17/506, to which signals it gives precedence over the feed of the ternary-logic colour-burst error control signal *C'*. The CD2/501 is a subcarrier divider chain with a variable division ratio controlled by the seven possible error control signal combinations (see Table 2). Thus a discrete-frequency audio tone is generated corresponding to a particular combination of error control signal inputs.

More detailed descriptions and circuit diagrams are given in sub-unit Instructions.

Maintenance

Routine maintenance of the equipment is not possible.

If a fault is suspected on the equipment, inputs to the rear panel should be checked and inter-unit waveforms compared with the idealised ones given in Fig. 2.

The action of the Comparator Unit UN17/506 and Tone Encoder CD2/501 can be checked by the procedure below.

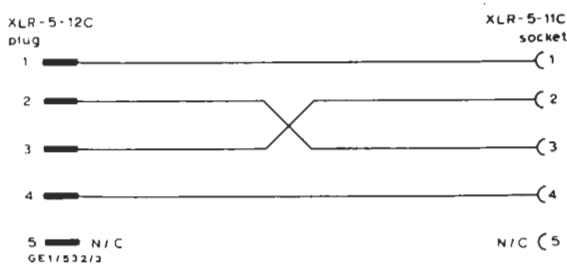


Fig. 3. Test lead for the GE1L/532

EQUIPMENT AND SIGNALS REQUIRED

- Waveform Generator Drive Unit GE1/520
- Sync Pulse Generator providing Mixed Syncs and V-axis Switch
- Frequency Counter to resolve 1 Hz at 2 kHz
- Double-beam Oscilloscope
- A.C. Testmeter ATM1
- Remote feed of 625-line colour video signal (ex network)
- Feed of PAL subcarrier
- Genlock lead connected as shown in Fig. 3.

PROCEDURE

a) *Comparator Unit UN17/506*

1. Interconnect the equipment and pulses as shown in Fig. 4.
2. Trigger the oscilloscope externally from the local mixed syncs. Switch the GE1/520 to *Local* control and monitor the remote video signal on the oscilloscope. Adjust the variable resistor RV1 on the rear panel of the GE1/520 to midrange. If necessary, remove the rear cover and adjust the internal capacitor of the GE1/520 oscillator type OS2/505,A so that the drift rate of the remote signal is less than 0.6 μ s in one minute (equivalent to a frequency difference of 1 part in 10⁸).

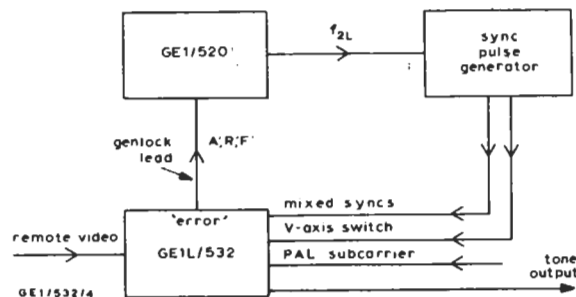


Fig. 4. Test circuit for the GE1L/532

3. Operate the *Advance/Retard* switch on the GE1/520 so that field blanking pulses, as monitored on *Monitor Input 1* and *Monitor Input 2* on the UN17/505 front panel are outside 12 μ s of coincidence.
 4. Select *Remote* on the GE1/520 and check that the local sync pulses can be genlocked to the remote video signal by the correction signals applied to the GE1/520 via the genlock lead.
 5. Select *Local* control and manually mis-phase the signals as in operation 3 and check that synchronism is restored by the shorter correction path when *Remote* is selected.
 6. Repeat the mis-phasing in the opposite sense and again check the correct path.
- b) *Tone Encoder CD2/501*
7. Check that 1 V p-p of PAL subcarrier is present on pin 13 of the unit.
 8. Adjust R31 to set the output tone level between pins 2 and 3 of the *Line* socket to be 0 dB into the 600-ohm input of the ATM1.
 9. Connect the frequency counter input to pin 5 of the CD2/501 socket and the earth to pin 14. Switch the GE1/520 to *Local* and select *Advance* for about two seconds. The tone frequency should be 1542 Hz \pm 1 Hz. Select *Remote*. When the signals are within

- 12 μ s of synchronism the frequency should change to 1407 Hz \pm 1 Hz, and when synchronous (i.e. within about 50 ns) to the *Normal* frequency, 1173 Hz \pm 1 Hz.
10. On *local* control, switch to *Retard* for about two seconds. The frequency should be 892 Hz \pm 1 Hz.
- Select *Remote*. When the signals are within 12 μ s of synchronism the frequency should change to 977 Hz \pm 1 Hz, and to 1173 Hz \pm 1 Hz when synchronism is achieved.

11. Remove the remote video feed.
- Apply -3 V to pin 1 of the *Colour Error* plug. The frequency should be 1071 Hz \pm 1 Hz. Remove the -3 V.
- Apply -6 V to pin 1. The frequency should change to 1285 Hz \pm 1 Hz.

References

1. Picture Source Synchronising; Instruction P.1.
2. Colour Subcarrier Phase Comparators EP5/505,6 series.

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