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 Natlock[1] 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 comparator[2].

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 UN1/589, fused at 150 mA)
Operating Standard	625–lines PAL
Operating Temperature	0°C to 45°C (ambient)

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

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

TABLE 3

Error Control Signals

Correction Mode	*Error output*					
	logic states			*voltage levels*		
	A'	*R'*	*F'*	*A'*	*R'*	*F'*
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.

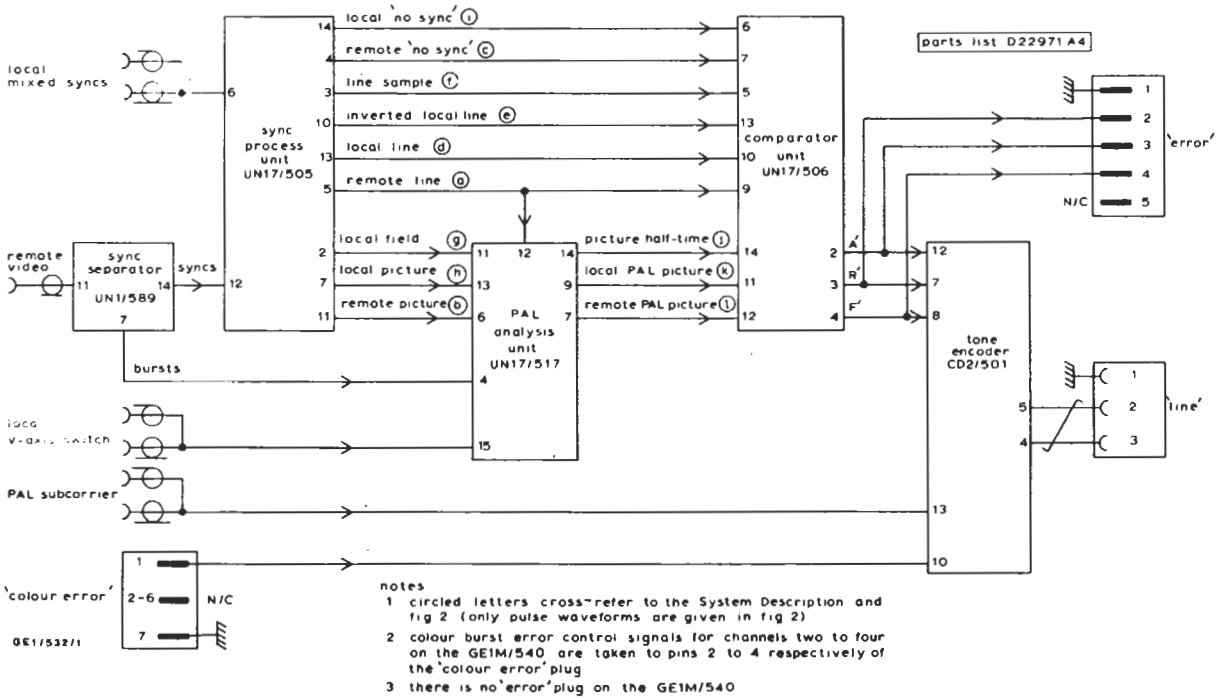


Fig. 1. Block diagram of the GE1L/532 and of one channel of the GE1M/540

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.

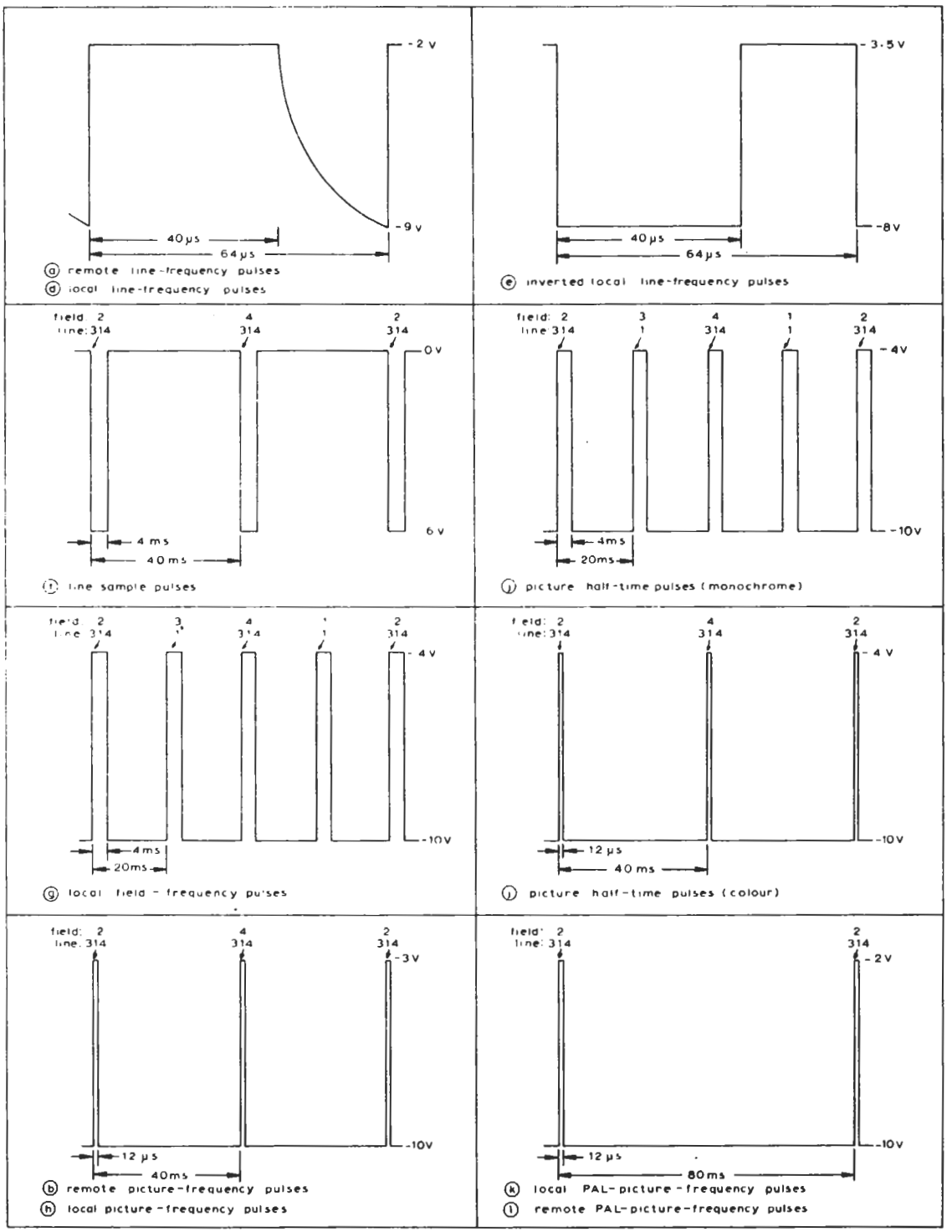
The function of the UN17/517 is to convert pulses b), g) and h) from the two-field monochrome sequence to a four-field sequence which takes account of the V-axis switch by inhibiting alternate pulses in each of the three pulse routes. If the PAL colour burst is missing on the remote video input the UN17/517 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 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. 2(k) and Fig. 2(m). 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

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

or *Retard* error signal output goes to 0 V for 100 μs 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.

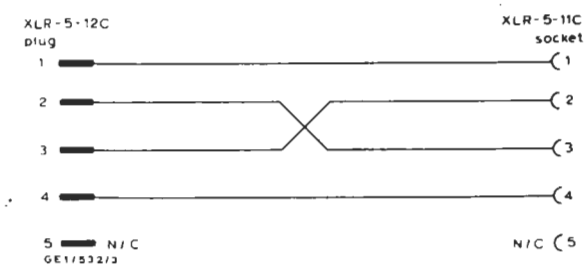


Fig. 3. Test lead for the GE1L/532

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 socilloscope.
   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 μs in one minute (equivalent to a frequency difference of 1 part in 10^8).

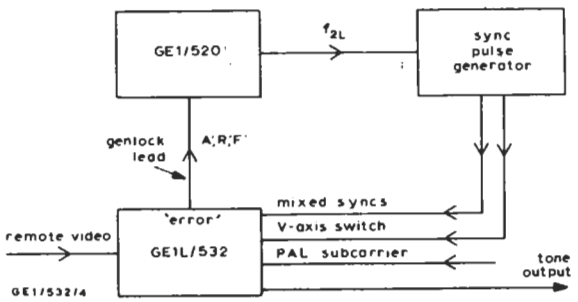


Fig. 4. Test circuit for the GE1L/532

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 μs 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 ±1 Hz.
   Select *Remote*. When the signals are within

12 μs of synchronism the frequency should change to 1407 Hz ±1 Hz, and when synchronous (i.e. within about 50 ns) to the *Normal* frequency, 1173 Hz ±1 Hz.

10. On *local* control, switch to *Retard* for about two seconds. The frequency should be 892 Hz ±1 Hz.
    Select *Remote*. When the signals are within 12 μs of synchronism the frequency should change to 977 Hz ±1 Hz, and to 1173 Hz ±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 ±1 Hz. Remove the −3 V.
    Apply −6 V to pin 1. The frequency should change to 1285 Hz ±1 Hz.

References

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

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