VIDEO ONE-LINE DELAY UNIT UN14/507 SERIES

Introduction

The UN14/507 accepts an input of composite video signals at 1 volt p-p and produces an output of the same form and level, but delayed by a duration which is slightly less than that of one television line in the 525-line or 625-line standards.

The unit employs a Corning ultrasonic glass delay line operating on a 25-MHz carrier modulated with the incoming video signal. The delay remains sensibly constant with change of temperature, and therefore a temperature-controlled oven is not required. An automatic gain control circuit is included in the unit and used to counteract variations of delay-line insertion-loss with change of temperature.

The unit is constructed on a CH1/12A chassis with index-pin positions 31 and 15. It requires d.c. power inputs at +12 volts and −12 volts.

General Specification

Input Level	1 volt p-p
Input Impedance	3·3 kilohm
Output Level (terminated)	1 volt p-p
Output Impedance	75 ohms
Clipping Level (for sinusoidal input waveform)	Approx. 3·5 volts p-p
Delay	
UN14/507A	63·84 μs ±30 ns
UN14/507B	63·39 μs ±30 ns
Amplitude/Frequency Response (with respect to level at 100 kHz)	Flat within 0·5 dB to 5·5 MHz
Signal/Noise	
Design value	55 dB (at standard level and 5-MHz bandwidth)
Typical values	57-58 dB (at standard level and 5-MHz bandwidth)
Delay Variation (over range 0°-50°C)	Less than 5 ns
Gain Variation (over range 0°-50°C)	Less than 0·005 dB/°C
Power Supplies	+12 volts at 190 mA −12 volts at 180 mA

General Description

Fig. 1 shows a block diagram of the UN14/507. The 25-MHz carrier generated by a local crystal-controlled oscillator, is double sideband amplitude modulated with incoming composite video signals; the combined signal is then applied to the delay line.

Two values of delay are available. The

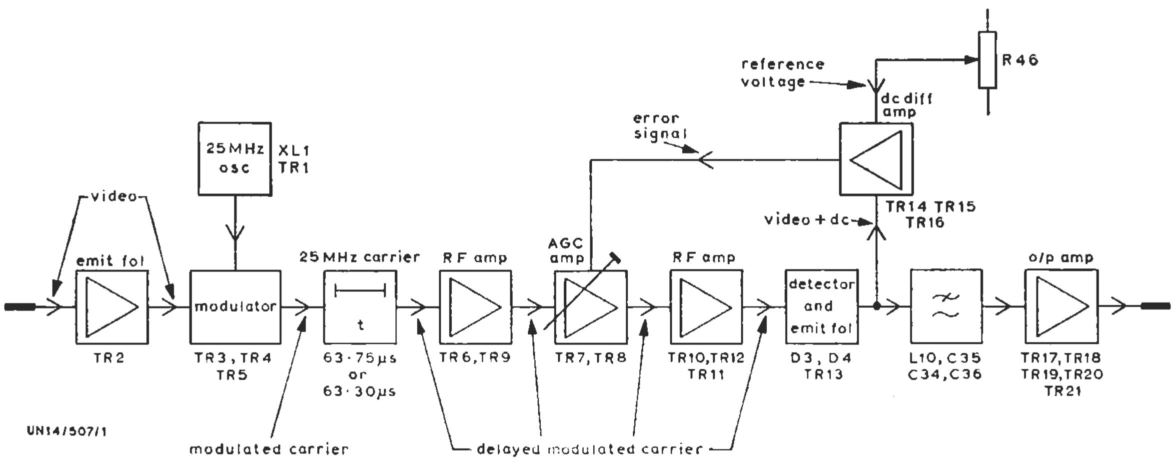

Fig. 1. Block Diagram of the UN14/507

UN14/507A uses a 63·75-μs delay line giving a total delay of 63·84 μs; this unit is normally associated with equipment handling 625-line-standard video signals. For use with 525-line-standard signals, the UN14/507B provides a total delay value of 63·39 μs.

The delayed modulated carrier from the delay line is amplified and then applied to a full-wave envelope detector. Two resultants of this detection process are used. One is the recovered video information which is again amplified and appears as the delayed-video output signal from the unit. The other detector output is a uni-directional voltage which varies in value according to the mean carrier-signal level. This varying voltage is compared with a reference voltage and the resultant error signal is used to increase or decrease as appropriate the gain of the modulated-carrier (r.f.) amplifier feeding the detector.

Circuit Description

Fig. 2 shows the complete circuit diagram for the UN14/507.

Input Circuit, Oscillator and Modulator

Composite video signals are applied to emitter follower TR2 and thence to the modulator-driver transistor, TR4. A d.c. supply at about 6 volts is obtained for TR2 by means of zenor diode D1.

A 25-MHz sinusoidal-waveform signal is generated by crystal-controlled oscillator TR1, and fed via L2 to the bases of emitter-coupled pair TR3 and TR5. TR4 supplies current to these two transistors such that, with no video input signal, the square wave-form collector currents of TR3 and TR5 change in anti-phase at a 25-MHz rate between zero and 55 mA (this second value being the maximum current that can be supplied by TR4). With a signal at the unit input, however, the maximum current available from TR4 is limited according to the instantaneous value of the applied signal; thus, the peak value of the TR3/TR5 collector-current excursions is similarly limited. The signal at the collector of TR5 is fed to a bandpass filter comprising C9, L3, L4, C11 and R14 together with the input capacitance of the delay-line transducer. The filter output (which is applied to the delay line) is a 25-MHz carrier signal, double-sideband amplitude modulated by the incoming video signal.

Note that, because the incoming video signal is capacitively coupled to the modulator and is not clamped, a low depth of modulation is necessary to avoid peak clipping on signals of either low or high average picture level. Thus, a 30-per cent modulation depth corresponds to a 50-per cent average picture level at the input (for a standard-level video signal).

The collector of TR3 is connected to earth through R9 and C10 to prevent spurious signals from affecting the correct operation of the modulator.

RF Amplifier, Gain-control Stage and Detector

The delayed modulated carrier from the delay line is applied to a feedback amplifier comprising TR6 and TR9. C18 is connected in parallel with R58 to compensate for a reduction in effective feedback at the upper end of the frequency band; this reduction is caused by the capacitive impedance presented by the delay line at the amplifier input.

The output from TR9 is fed to the automatic gain-control stage, TR7 and TR8, and thence to a second feedback pair, TR10 and TR12. TR8 is a variable-gain common-base r.f. amplifier operating in push-pull with TR7. The bases of these two transistors are fed with opposing-polarity control voltages developed by a d.c. difference amplifier (see *Gain-Control Error-signal Generator*). By varying the relative values of the two voltages, the gain of TR8 (and thus the r.f.-signal level applied to TR10) is adjusted so that the video output from the unit is maintained at a constant level.

Thc signal from TR12 collector is fed to TR11, operating as a tuned-load, common-base amplifier, and thence via centre-tapped auto-transformer L9 to the full-wave detector circuit comprising D3 and D4. To achieve maximum bandwidth, the inductor forming the load on TR11 is tuned with the minimum possible capacitance represented by the output capacitance of TR11 and stray capacitances. The 3-dB points on the response curve for this single-tuned arrangement are at frequencies approximately 12 MHz on either side of the centre (carrier) frequency of 25 MHz; this response compensates for peaks created by over-coupling of the modulator filter.

Emitter-follower TR3 feeds the output from the detector load (R28) via C32 to a low-pass filter (L10, C34, C35 and C36). This circuit has a pass band extending to 13 MHz with a frequency of maximum attentuation at 25 MHz. The video signals passing through the filter are fed to the output amplifier stages TR17 to TR21.

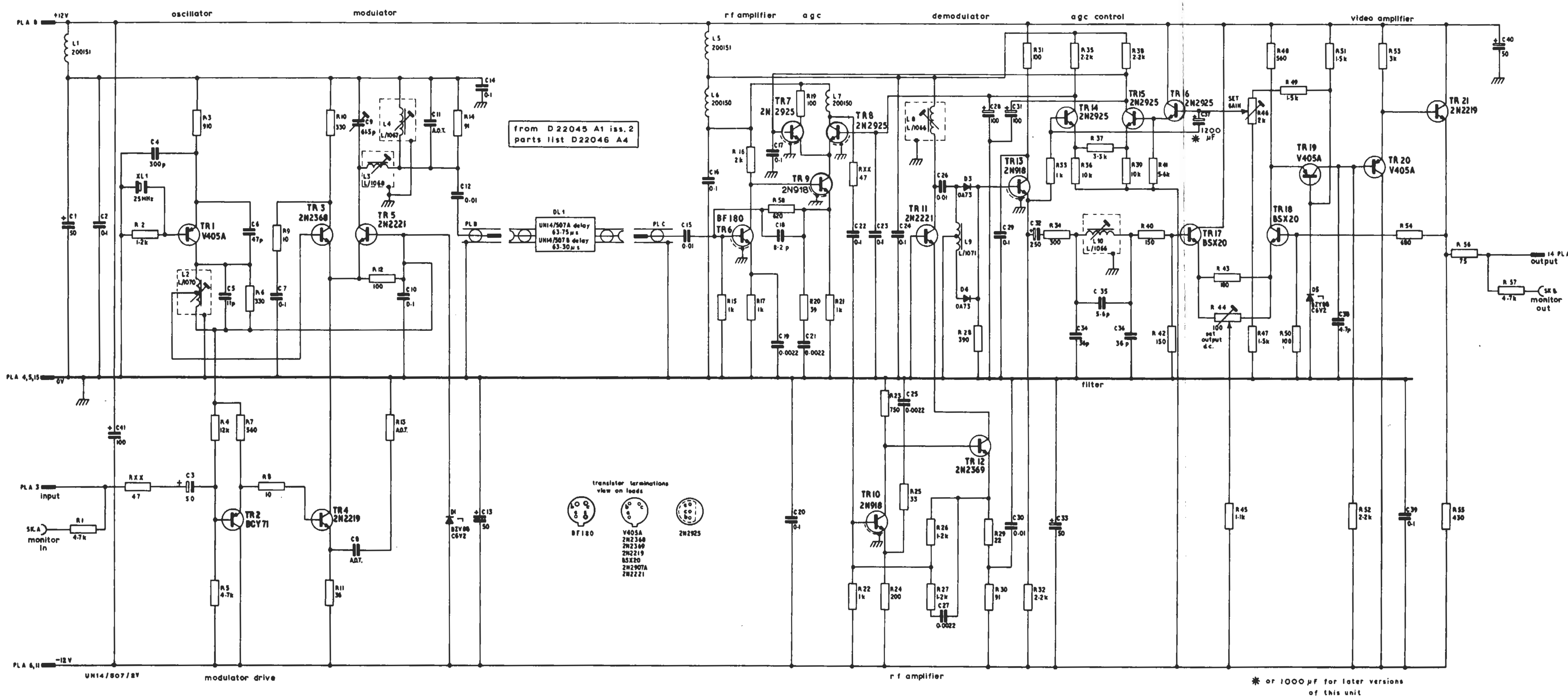

Fig. 2 Video One-line Delay Unit UN14/507

Gain-control Error-signal Generator

TR14 and TR15 form a difference amplifier. The demodulated video signal from TR13, together with a uni-directional voltage which varies according to the mean carrier level, is fed directly to TR14 base; the video signal is also fed via C37 and TR16 to the base of TR15. Temperature changes affecting the d.c. operating conditions of TR13 are automatically compensated by similar variations in TR16. A d.c. reference (at a voltage determined by the *Set Gain* control, R46) is also passed by TR16 to TR15 where it is used for deriving the error signal returned to the a.g.c. stage as shown below.

The bases of TR14 and TR15 are virtually connected in parallel for a.c. signals and the detector video output produces equal, in-phase signals at the collectors of TR14 and TR15 which are by-passed to earth through C28 and C31. Capacitor C37, however separates the two bases in respect of d.c. signals. Thus, any change in mean carrier level applied to the detector (resulting in a change in the d.c. component of the detector output) is compared with the reference potential from R46 and appears as a d.c. difference-signal output from TR14 and TR15.

Suppose, for example, the mean carrier level from the delay line increases, then the d.c.-component change at TR13 emitter will cause TR14 to draw more current and TR15 less; the collector potential of TR14 therefore moves negatively as TR15 moves positively. These opposing changes are fed back to the r.f. amplifier circuit and act to decrease the gain of TR8 as that of the alternative signal path through TR7 is increased. Thus, the signal-transfer conditions of TR9 itself are unaffected, but the detector input level is reduced to bring the output video level to the required value.

Output Amplifier

TR17 and TR18 are connected as a long-tailed pair, and feed an amplified video signal from the low-pass filter to common-base stage TR19. The correct output-signal d.c. conditions are established by means of the differential-bias resistor, R44.

Complementary emitter-followers TR20 and TR21 produce the unit output signal with R56 providing the required 75-ohm source impedance.

Negative feedback is applied between the output and TR18 via R54. This connection reduces the overall output-amplifier gain to approximately 10 dB. C38 provides a necessary reduction in the loop gain at high frequencies, and also acts as a response-correction component for the five output-amplifier stages.

Maintenance

To assist in fault-finding, the following table shows various transistor potentials which are typical for a correctly-operating unit. The voltages are measured with respect to the 0-volt line (chassis earth), using a Model 8 Avometer operating on the 25-volt (d.c.) range.

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Transistor	*e* (volts)	*b* (volts)	*c* (volts)
TR1	+0·3	—	−5·0
TR3	—	−5·0	+2·7
TR4	−10·0	—	—
TR5	—	−5·0	—
TR6	+2·7	—	+6·4
TR9	+5·6	—	—
TR10	−10·5	—	−6·0
TR12	−6·8	—	−0·6
TR13	+4·0	—	—
TR14/TR15	—	—	+8·7
TR16	+4·0	—	—
TR17	−0·7	—	—
TR18	−0·7	—	—
TR19	—	—	−0·1