NON-LINEARITY MEASUREMENT FILTERS FL1/509A—F

Introduction

The FL1/509 is used, in conjunction with an oscilloscope, to measure the step height of a staircase waveform. From each step of the input waveform the filter derives a sine-squared pulse which has an amplitude which is proportional to the step height.

The FL1/509A operates on the 405-line standard and is suitable for use with 5, 7 and 10 step staircase waveforms. It has a bandwidth of about 600 kHz and the half-amplitude duration of the output pulses is 1·7 μs. The FL1/509B operates on the 625-line standard and is suitable for use with 5, 7 or 10 step waveforms. It has a bandwidth of about 900 kHz and the half-amplitude duration of the output pulses is 1·1 μs. Code numbers FL1/509C to FL1/509F have not yet been allocated.

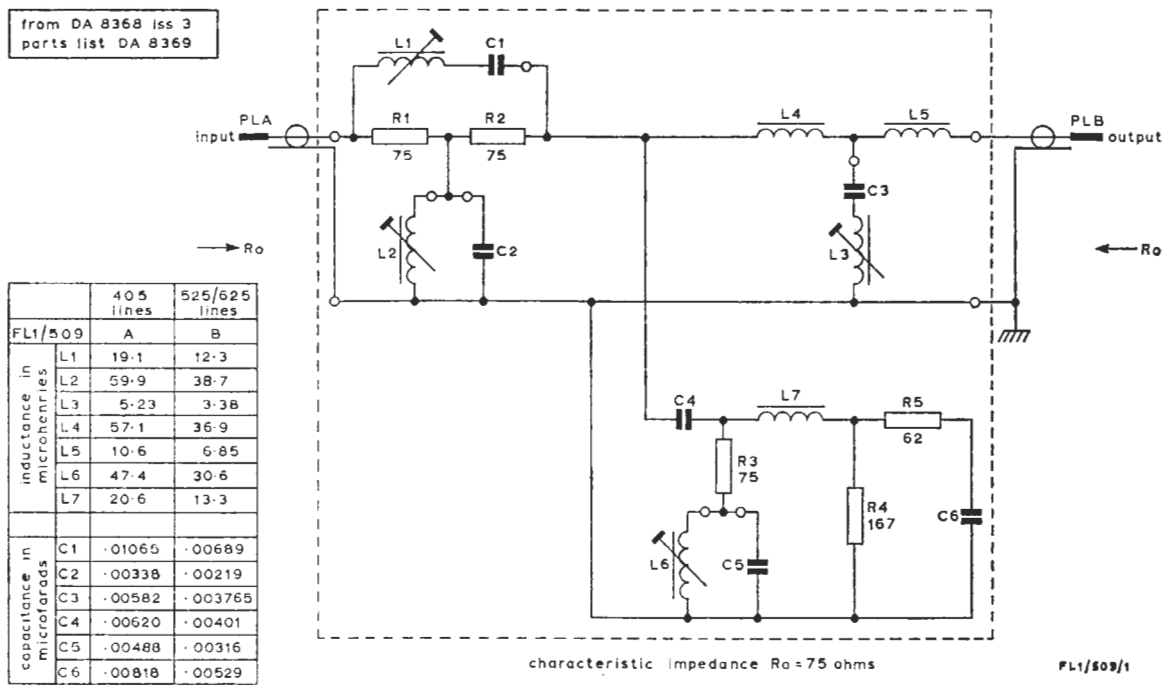
All filters in the FL1/509 series have the same circuit configuration and differ only in component values. The components are mounted on a printed-wiring board which is contained in an Eddystone box.

Circuit Description

The circuit diagram is shown in Fig. 1. The filter consists of three sections:

(a) a bandpass constant-resistance network
(b) a Thompson network which shapes the pulse train output from the bandpass section to produce pulses which are sine-squared in shape
(c) an impedance-matching section which ensures that the bandpass section is correctly terminated at all frequencies in the video band.

Pulses at the output of the filter have half the amplitude of the steps from which they are formed; i.e. if the steps on a 1-volt peak-to-peak staircase signal are of equal amplitude then the pulse amplitude is 0·35 volts divided by the number of steps. The filter output contains not only the wanted pulses but also unwanted pulses caused by the differentiation of the trailing edge of the staircase waveform and the leading and trailing edges of the line sync pulses. These unwanted



		405 lines	525/625 lines
FL1/509		A	B
inductance in microhenries	L1	19·1	12·3
	L2	59·9	38·7
	L3	5·23	3·38
	L4	57·1	36·9
	L5	10·6	6·85
	L6	47·4	30·6
	L7	20·6	13·3
capacitance in microfarads	C1	·01065	·00689
	C2	·00338	·00219
	C3	·00582	·003765
	C4	·00620	·00401
	C5	·00488	·00316
	C6	·00818	·00529

Fig. 1 Circuit of the FL1/509

pulses are of large amplitude and could cause overloading and synchronising difficulties on the associated oscilloscope. To avoid this, the output of the filter is normally applied to the oscilloscope via a processing amplifier[1] which removes the unwanted pulses and, additionally, provides switchable gain.

Alignment

The FL1/509 is a passive network and should not need realignment unless it suffers damage. Faulty units should be returned to Equipment Department for repair and realignment. The procedure given below provides a means of checking suspect units.

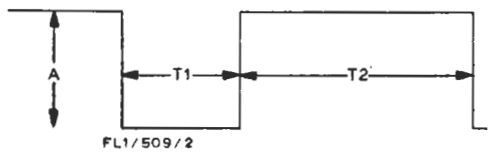
Check of Filter Response

The following equipment is required:

Non-linearity Test Signal Generator (GE4/505 or GE4/505A, as appropriate)
15-dB Video Amplifier
Oscilloscope
Source of rectangular waveforms (such as Pulse Waveform Generator or Cintel Square-wave Generator)

To check the sine-squared pulse-forming response of the filter:

1. Apply a rectangular waveform from a 75-ohm source impedance to the filter input.
   The waveform must meet the requirements indicated in Fig. 2.



A not greater than 2 volts.
T1 not less than 10 μs.
T2 not less than 20 μs.
Rise time of rising edge to be less than 0·2 μs.
Overshoot to be less than 5% of A with a total duration of less than 1 μs.

Fig. 2 Waveform Required to Check the Filter Response

2. Display the filter output on an oscilloscope. Examine the positive-going pulse formed by the positive-going edge of the input waveform to check that the wave-shape is sine-squared. This can be done by using an oscilloscope graticle engraved for sine-squared pulse and bar testing or by direct comparison with the output of a pulse-and-bar generator. Check that the half-amplitude duration of the output is 1·7 or 1·1 μs (as appropriate) and that the pulse is not markedly asymmetric.
3. Measure the amplitudes of the first undershoot and overshoot. Ideally these should be 1% and 0·5% respectively of the pulse amplitude. However, the figures are not critical and provided the undershoot is less that 1·5% and the overshoot less than 1% adjustment is not necessary. The figures obtained will be influenced by the rise-time of the input waveform and only if this is 0·1 μs or better can the 1% and 0·5% figures be obtained.
   Check that there are no further undershoots and overshoots after the first pair.

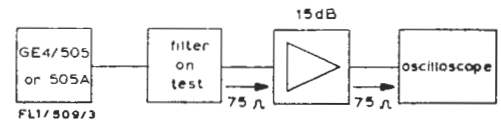


Fig. 3 Test Arrangement

To check the filter with a 10-step staircase input:

1. Connect up the equipment as shown in Fig. 3.
2. Check that the overshoot that occurs after each pulse in the train is completed before the next pulse begins and that there is a quiescent period between adjacent pulses (see Fig. 4).
   Check that the pulse derived from the first step is not disturbed by the pulse derived from the trailing edge of the input signal synchronising pulse.

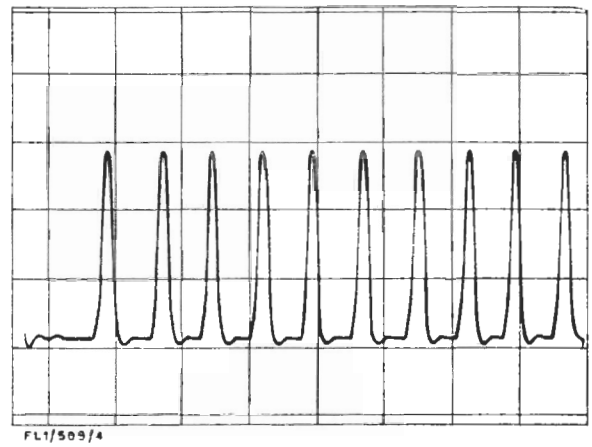


Fig. 4 Pulse Train Formed from 10-step Staircase Waveform

3. Remove the input signal from the oscilloscope and align the oscilloscope graticule with the horizontal trace. Replace the input and, using the oscilloscope on its most sensitive range, examine the base area of the pulse chain. The maximum deviation from the horizontal should be less than 0·2% of the pulse amplitude.

References to Typical Associated Equipment

1. Non-linearity Measurement Processing Amplifier AM1/505

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