EQUALISER TESTER TE1/502

Introduction

The Equaliser Tester TE1/502 is part of the equipment used to check the input impedance and transmission characteristics of fixed equalisers EQ5/503 and EQ5/510. Newly constructed equalisers are checked before being connected into their permanent positions.

The tester contains a comparison bridge, two standard resistors, a terminating resistor and a switch. The bridge and standard resistors are used to check the input impedance of an equaliser. The switch is included so that a single set of connections can be used for checking both the input impedance and the transmission characteristics of an equaliser. All the necessary alterations to the circuit are made within the tester by the switch. When checking the transmission characteristics, the function of the tester is merely to connect the equaliser input to the cable being equalised and to connect the equaliser output to an oscilloscope.

The bridge in the tester is suitable for comparing an unknown impedance with a standard impedance which has a value of between 75 ohms and 100 ohms. The test signal for the bridge is a 1-volt p-p pulse-and-bar waveform. With this signal the impedances are compared over a range of frequencies from line frequency to the upper limit of the video band. The bridge, when it is balanced, provides an output which is approximately 50 dB less than the input.

The unit is mounted in a portable box which, with the lid on, measures 9½ in. by 7½ in. by 4 in.

Circuit Description

The circuit diagram of the Equaliser Tester TE1/502 is shown in Fig. 8.3. The bridge is formed from the transformer T1 and is used with the switch in the position labelled *Impedance*. The bridge circuit, isolated from the remainder of the unit, is shown in Fig. 8.4. The standard or known impedance is connected between one end of the primary winding and the chassis, while the unknown impedance is connected between the other end of the primary winding and the chassis. The test signal is fed between the primary centre-tap and the chassis. If the unknown impedance differs from the known impedance, then the current through one half of the primary will differ from

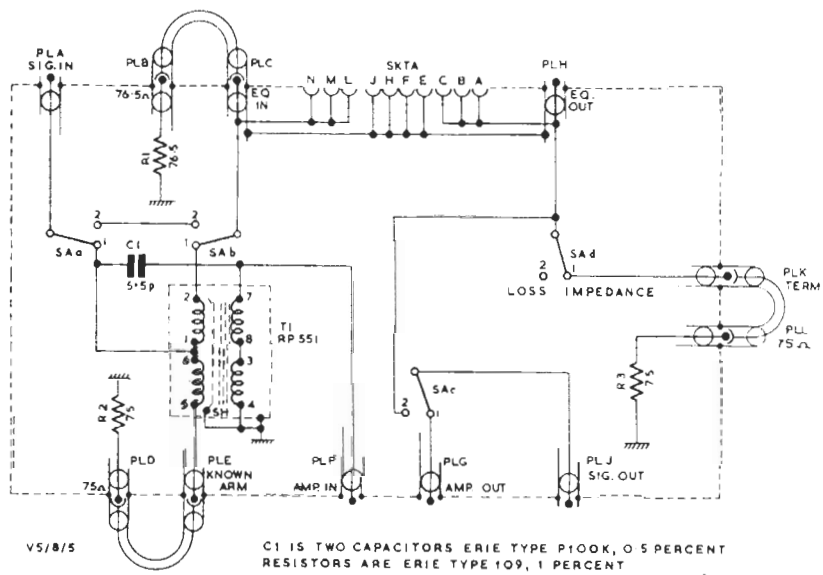

Fig. 8.3. Equaliser Tester TE1/502: Circuit Drawing No. DA 5166, Issue 2

that through the other half. The signal which is developed across the secondary winding is proportional to this difference in currents and is therefore a measure of the difference between the known and unknown impedances.

The capacitor C1 is included in the circuit to improve the balance of the transformer.

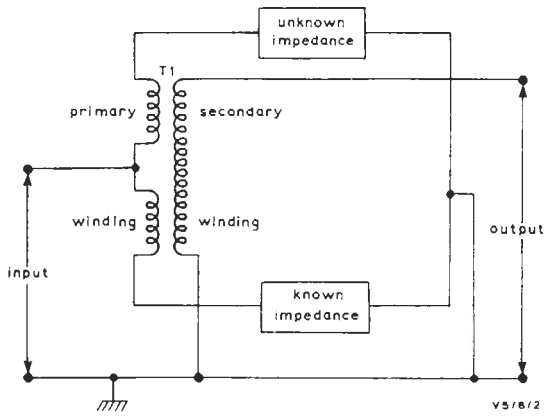

Fig. 8.4. TE1/502 Bridge Circuit, isolated from remainder of unit

Fig. 8.5 shows the circuit arrangement used to check the input impedance of an equaliser. The small output signal from the bridge is normally fed through a 40-dB amplifier before being displayed on an oscilloscope. Connections for the amplifier input, the amplifier output and the oscilloscope are provided in the tester. The output of the equaliser being checked is also connected to the tester and is terminated by the 75-ohm resistor R3 when the switch is in the *Impedance* position. The connection to R3 is through a U-link which can be removed if the termination is not required.

The standard resistor R2 is used as the known impedance in the bridge when checking an equaliser which has a nominal input impedance of 75 ohms. R2 has a value of 75 ohms ± 1 per cent. The other standard resistor R1 can be substituted for the equaliser input as the unknown impedance. This resistor has a value of 76·5 ohms, which is 2 per cent greater than 75 ohms. If R1 is connected as the unknown impedance while R2 is connected as the known impedance, then the output from the bridge is a 2 per cent error signal. This signal is compared with the error signal obtained when the equaliser input forms the unknown impedance to determine whether the input impedance is within ± 2 per cent of 75 ohms.

The two standard resistors are connected into the bridge by means of U-links.

To check the attenuation and phase characteristics of an equaliser, the switch is turned to *Loss*.

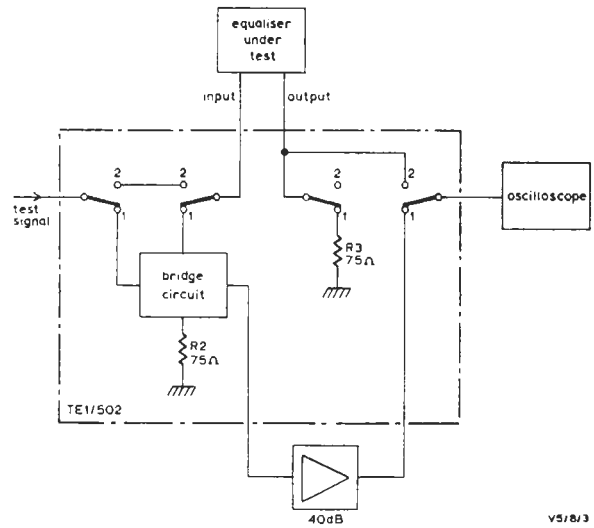

Fig. 8.5. Arrangement of TE1/502 used to check an equaliser input impedance (switch in position 1) and loss characteristic (switch in position 2)

Fig. 8.5 shows the circuit arrangement. The signal which is fed to the tester has already been transmitted through the cable being equalised. In the tester it is fed directly to the equaliser input. The equaliser output is fed to the oscilloscope. If the characteristics of the equaliser are correct then the waveform which is displayed on the oscilloscope is exactly the same as the waveform at the cable input.

Connections to Tester

The receiving end of the cable being equalised is connected to the signal-input plug in the tester. The sending end of the cable is connected to a pulse-and-bar generator.

An equaliser which is to be checked is normally plugged into the printed-wiring-board connector SKTA but alternatively it can be connected to the tester through Musa plugs. Musa plugs are provided for all the other connections to the tester.

The plug for each connector is shown in Table 1.

TABLE 1

Connections from	*Plug Label*
Cable to be equalised	SIGNAL IN
Equaliser Input (Unknown Impedance)	EQ. IN
Known Impedance	KNOWN ARM
Equaliser Output	EQ. OUT
40-dB Amplifier Input	AMP IN
40-dB Amplifier Output	AMP OUT
Oscilloscope	SIGNAL OUT

The three resistors are connected internally to Musa plugs which are labelled with the value of the resistor. The plug labelled *Term.* is linked to the equaliser output when the switch is in the *Impedance* position.

Procedure for Checking an Equaliser using an Equaliser Tester TE1/502

General

The method of checking an equaliser EQ5/503 or EQ5/510 before it is connected into circuit is outlined here. A full description is included in Designs Department Technical Memorandum No. 6.19(58) entitled *A Method of Equalising Cables for Video Transmission.*

Additional Test Equipment Required

Pulse-and-bar generator

Oscilloscope suitable for use with sine-squared pulses

40-dB video amplifier such as TV/A/1

Note:—The loss of the equalised cable is normally compensated for by an amplifier. Although this amplifier must have the best possible frequency response, any slight effect it might have on the response is allowed for by connecting it between the tester and the oscilloscope.

To Check the Input Impedance

1. Select the switch position labelled *Impedance.* Connect the cable and the 40-dB amplifier to the appropriate plugs in the tester and connect the compensating amplifier between the signal output plug and the oscilloscope. Connect the pulse-and-bar generator to the sending end of the cable if this has not already been done. Normally this connection is made earlier when selecting component values for the equaliser.
2. Insert a U-link between the plugs labelled *76·5Ω* and *Eq. In.* Also check that the other two U-links are connected. One U-link joins the plug labelled *Known Arm* to the adjacent plug labelled *75Ω* and the other joins the plug labelled *Term.* to its adjacent plug labelled *75Ω.* The bridge is now connected with the 76·5-ohm resistor R1 as the unknown impedance and the 75-ohm resistor R3 as the known impedance.
3. Adjust the gain of the oscilloscope so that the displayed waveform is a convenient size. Note carefully the shape and amplitude of the waveform. It represents a standard 2 per cent error signal. (The pulse has a smaller amplitude than the bar because the test signal is transmitted to the tester through the cable.)
4. Remove the U-link between the 76·5-ohm resistor and the *Eq. In* plug. Connect the equaliser to the tester and examine the waveform on the oscilloscope. The amplitude of this signal must be equal to or less than the amplitude of the 2 per cent error signal if the input impedance is within ± 2 per cent of 75 ohms. If the low-frequency components of the signal are too large, check the values of the resistors in the equaliser. When the low-frequency components are satisfactory, adjust the inductors to make the waveform the same shape as the 2 per cent error signal.

If the polarity of the signal with the equaliser input in the bridge is the same as that of the 2 per cent error signal then the input impedance is greater than 75 ohms. If the polarities are opposite, the input impedance is less than 75 ohms.

To Check the Transmission Characteristics

Turn the switch to the position labelled *Loss* and examine the waveform on the oscilloscope. It should have exactly the same shape as the waveform at the output of the pulse-and-bar generator. If necessary adjust the inductors in the equaliser until the waveform at the equaliser output has the correct shape. Check the effect of these adjustments on the input impedance. The input impedance

should still be within the limits of 75 ohms ±2 per cent over the frequency range of the pulse-and-bar waveform. If it is not, find out which inductor produces the unwanted alteration in input impedance and change the series capacitor corresponding to this inductor. If the inductance has been increased, change the capacitor for one with the next higher value. If the inductance has been decreased, change the capacitor for one with the next lower value. Then check the input impedance and transmission characteristics with the new capacitor in circuit.

J.W. 4/66