SECTION 6

SIGNAL MEASURING UNIT UN1/511

Introduction

Signal measuring unit UN1/511 has been designed for use with oscilloscopes to facilitate the accurate measurement of signal amplitude. It provides an unambiguous and simple method of measuring repetitive waveforms to an accuracy of $\pm 0{\cdot}1$ dB.

The unit is a transistorised version of calibration unit UN2/501 (Instruction V.3, Section 5) plus a passive network for mixing the signal to be measured with the calibration signal. It comprises a 9-kc/s square-wave generator, followed by the mixing network which includes a variable resistor (calibrated as a ± 1 dB attenuator) and a switchable step-attenuator. The mixed output, when applied to an oscilloscope, appears as a double-trace display with the waveform to be measured riding on the calibration waveform.

In operation, the step-attenuator is switched to make the amplitude of the calibration waveform the same as the nominal amplitude of the incoming waveform and the ± 1 dB attenuator is adjusted to make the top of the lower trace and the bottom of the upper trace coincide. The variation of the incoming waveform from its nominal value can then be read off on the ± 1 dB attenuator dial.

Facilities are provided for the measurement of three parameters of the video waveform:—(1) the peak-to-peak composite signal amplitude, (2) the picture amplitude and (3) the sync-pulse amplitude. With the output of the voltage calibration section of the unit switched to the *Cal.* position, the unit may be used as a voltage reference source of one volt when terminated in 75 ohms.

Mechanical Details

The unit complete with power supplies is contained in a portable metal box 10 in. long by 7 in. high by 6 in. deep and weighs 9 lb. Signal connections may be provided at either the front or the rear of the unit. The power connection is at the rear.

Circuit Description (Fig. 11)

Calibration Section

Transistors TR1 and TR2 form a free-running multivibrator with an operating frequency of about 9 kc/s. (For information on multivibrators see *Television Engineering*, Vol. 3.) The waveform appearing at the collector of TR2 is applied to the base of the emitter-follower TR3. The emitter load of TR3 consists of RV1, R6, R7 and the Zener diode ZD3; this diode acts as a clipper, the clipping level being the Zener voltage of the diode. To guard against variation of the operating point due to changes in the ambient temperature of the unit, the diode is enclosed in a temperature-controlled oven and so the clipping level, and hence the amplitude of the signal applied to the output transistor TR4, remains constant.

Transistor TR4 is held slightly on at all times by the bias provided by R7. This prevents changes in the temperature of the base-emitter junction of the transistor from affecting the output signal amplitude. TR4 is stabilised by a negative-feedback chain in its emitter circuit; adjustment of RV2 varies the amount of this feedback and so provides a fine control of the amplitude of the output signal.

Mixing and Attenuation Section

The signal appearing at the collector of TR4 is applied to one wiper of a 5-way 8-pole function switch SB, of which only seven poles are used. The signal conditions for the various positions of this switch are given below, it being assumed that the UN1/511 is terminated at the oscilloscope in 75 ohms.

1. *Cal.* position:—The 9-kc/s square-wave calibrating signal is switched to plug B, the output plug. Both the variable attenuator RV3 and the step-attenuator are out of circuit and the signal input plugs, C and D, are terminated in 75 ohms. The output signal at the oscilloscope is 1 volt p-p.
2. *Signal* position:—The calibrating signal is connected to an internal termination, RV3 and the step-attenuators are out of circuit, and the signal input plugs C and D are disconnected from the termination supplied by resistor R23 and connected to the output plug.
3. *Signal Measure* position:—The calibrating signal is applied to RV3 and the step-attenuator connected in series, the step-attenuator being set for 0 dB attenuation. The calibrating

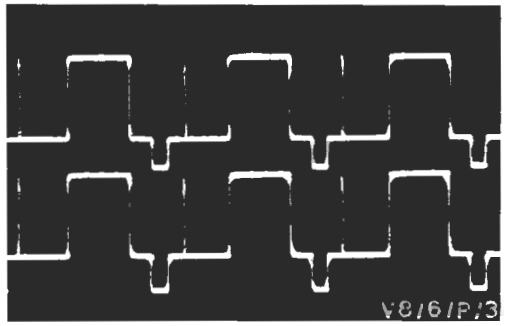

Fig. 6.1. Measurement of Signal Amplitude

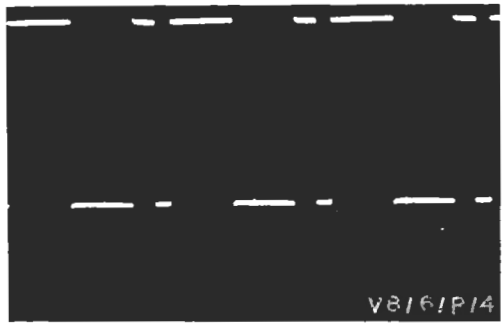

Fig. 6.2. Centre Portion of Fig. 6.1 Expanded

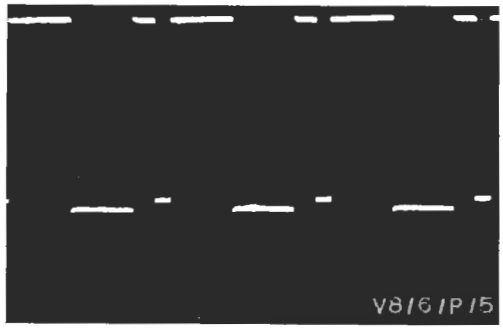

Fig. 6.3. As Fig. 6.2, but with calibrating waveform amplitude increased by 0·1 dB

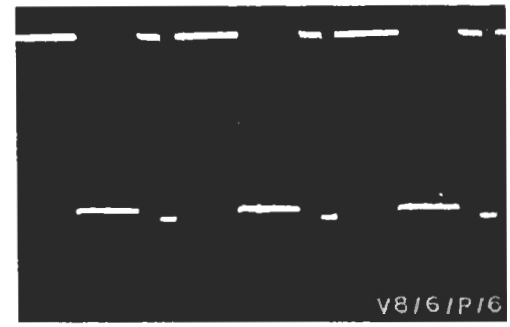

Fig. 6.4. As Fig. 6.2, but with calibrating waveform amplitude decreased by 0·1 dB

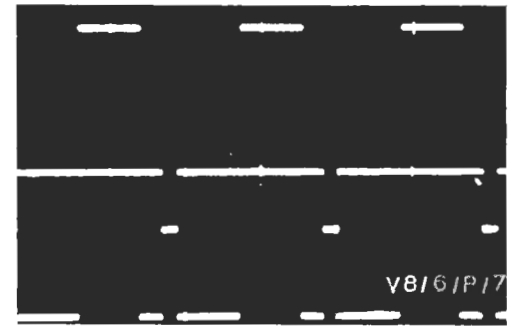

Fig. 6.5. Measurement of Bar Amplitude

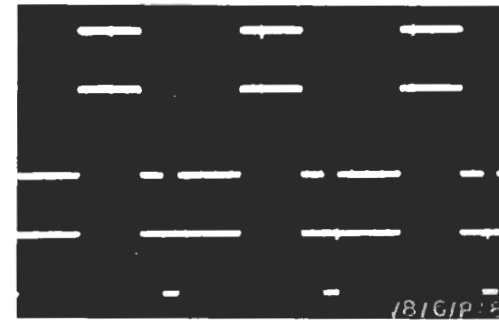

Fig. 6.6. Measurement of Sync-pulse Amplitude

signal is then mixed with the input signal in a resistive pad and the resultant signal, at 1-volt p-p amplitude, appears at the output plug.

4. *Picture Measure* position:—This gives the same condition as position 3, except for the amount of attenuation applied by the step-attenuator. This reduces the amplitude of the calibrating signal to 0·7 volt.
5. *Sync Measure* position:—This also gives the same condition as position 3, except that the step-attenuator reduces the calibrating signal amplitude to 0·3 volt.

In each of the last three switch positions, RV3 can be used to vary the calibration waveform amplitude by up to ±1 dB, thus permitting measurements to be made of the incoming waveform within a range of ±1 dB of its nominal value; this is 1 volt p-p for a composite signal (position 3), 0·7 volt p-p for a picture signal (position 4) and 0·3 volt p-p for syncs (position 5).

The parallel connection of R13 and C7 across RV3 compensates for the inherent inductance of RV3 and, with this resistor, forms a constant-impedance network.

Power Supplies

The output from the 25-volt winding on mains transformer T1 is rectified by a full-wave bridge circuit, MR1—MR4, and smoothed by R24, C3, R5 and C4. Stabilisation is provided by the Zener diodes ZD1 and ZD2. The power supply output is reduced to −17 volts by resistor R10, which is decoupled by C6. A separate 12-volt winding on the transformer supplies a.c. for the temperature-controlled oven containing Zener diode ZD1.

Power consumption is 12 watts.

Maintenance and Calibration

Routine maintenance is unnecessary and the unit remains accurate to within ±1 per cent over long periods of time. It should, however be returned to Equipment Department for a calibration check by the date given on the recalibration label attached to the front of the unit.

Method of Operation

The following instructions, and the associated photographs, describe the measurement of a pulse-and-bar waveform, but the same method can be used to measure any other television waveform.

Measurement of Peak-to-peak Amplitude

1. Set the function switch SB to position 3.
2. Feed the waveform to be measured to the input plug, C, of the unit. Connect the output plug, B, to an oscilloscope which is terminated in 75 ohms and trigger the oscilloscope from the waveform to be measured. The resultant display on the oscilloscope will be of the form shown in Fig. 6.1, with the waveform to be measured riding on the calibrating waveform. The actual calibrating waveform cannot be seen in the photograph because of the long exposure time of the film.
3. Adjust variable attenuator RV3 until the top of the lower waveform is almost coincident with the bottom of the upper waveform and, as the point of coincidence is approached, increase the gain of the oscilloscope to give an amplified display of the area where the waveforms meet. See Figs. 6.2. to 6.4.
4. When coincidence is reached, the amplitude of the measured waveform with respect to 1 volt p-p is indicated by the setting of RV3.

Measurement of Bar Amplitude

1. Set the function switch SB to position 4.
2. Proceed as in 2 above; the display on the oscilloscope will be of the form shown in Fig. 6.5, and RV3 reading is with respect to 0·7 volt p-p.

Measurement of Sync Amplitude

1. Set the function switch SB to position 5.
2. Proceed as in 2 above; the display on the oscilloscope will be of the form shown in Fig. 6.6, and RV3 reading is with respect to 0·3 volt p-p.

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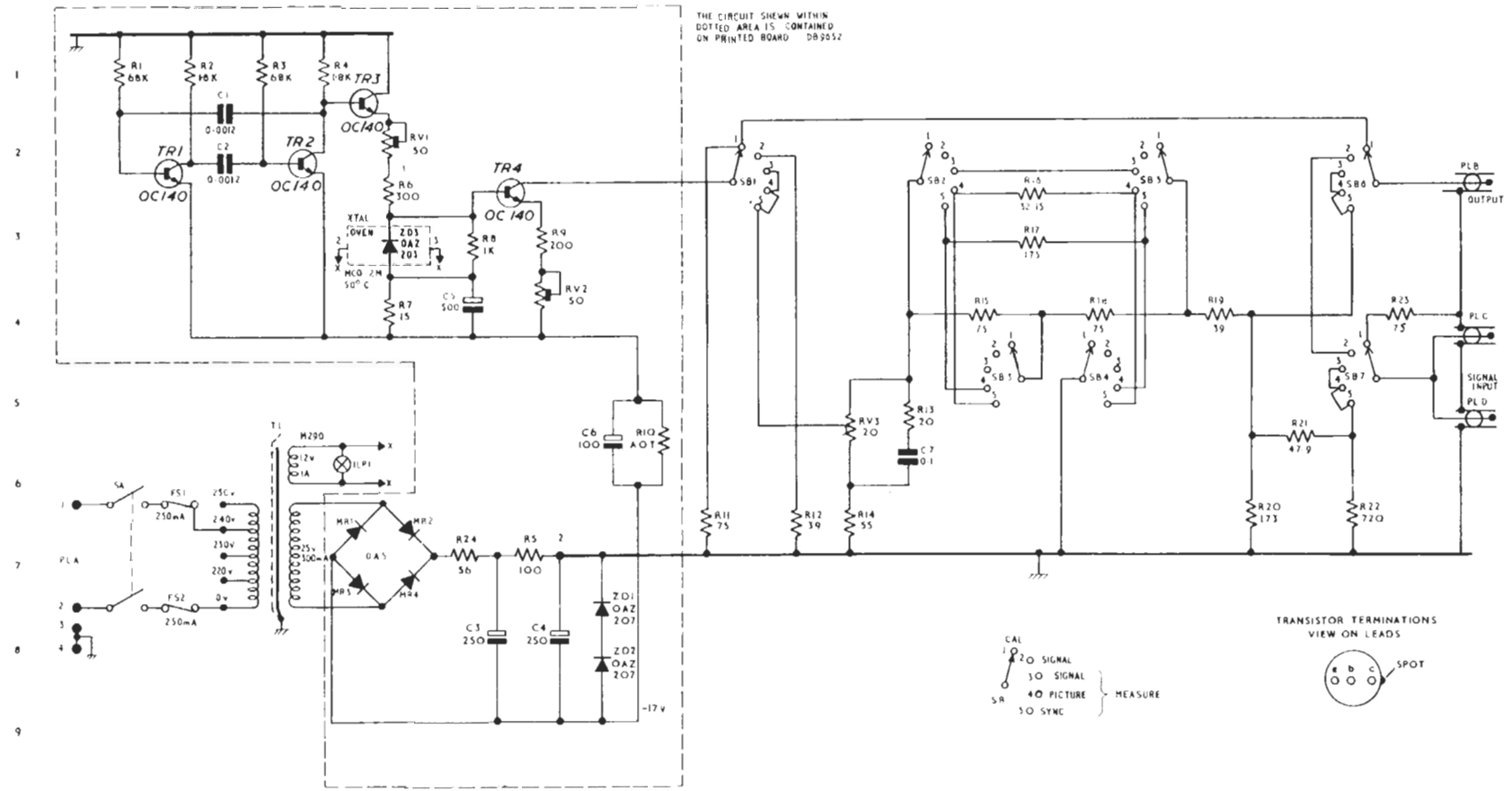

SIGNAL MEASURING UNIT UNI/511:CIRCUIT.

FIG 11