SECTION 13

VIDEO DISTRIBUTION AMPLIFIER AM4/513

General Description

The AM4/513 is a mains operated video distribution amplifier with a gain of 6 dB. It is intended to handle colour signals in the R.G.B. form. It gives three outputs at standard level into 75 ohms from a 75-ohm source and, to maintain accurate colour balance, the source impedances are provided by resistors with a tolerance of 0·1 per cent. The input impedance is high.

A plug-in chassis CH1/12A is used with printed wiring. The power and signal connections are made via a multi-way connector when the amplifier is plugged into one of the standard mounting panels of the PN3/21 or PN3/23 type.

Input and output monitoring sockets and mains fuses are provided on the front of each amplifier.

General Data

Voltage gain	6 dB ±0·2 dB.
Number of outputs	3.
Maximum difference in gain between any 2 outputs terminated in matched resistors:	0·01 dB.
Nominal output level	1 V peak-to-peak across 75 ohms.
Overload point	2·8-V peak-to-peak sine wave at 10 kHz. 2·0-V peak-to-peak sine wave at 5·5 MHz.
Amplitude-frequency response:	±0·1 dB from 3 Hz to 7 MHz at nominal level with all three outputs terminated.
50-Hz square-wave response	1% sag on a 50-Hz symmetrical square wave.
Low-frequency bump	<14% overshoot for a d.c. step signal on the input fed through any single *CR* circuit. Nil overshoot for a d.c. step signal on the input.
Pulse-and-bar response (625 lines)	<0·5% *k* factor for 10 amplifiers in cascade (excluding low-frequency bar).
Input impedance	10 kΩ ±5% in parallel with 30 pF ±10% from 1 Hz to 1 MHz. Approximately 3·3 kΩ in parallel with 20 pF, at 5·5 MHz.
Output impedance return-loss figure (with respect to 75 ohms)	>40 dB from 10 kHz to 3 MHz. >35 dB at 5·5 MHz.
Separation between outputs	>60 dB at 10 kHz. >43 dB at 3 MHz. >35 dB at 5·5 MHz.
Permitted d.c. at input	The d.c. at the input terminal must not exceed +6 V or fall below −14 V.
Permitted a.c. at input	Peak-to-peak a.c. excursion at the input not to exceed 6 V.
D.C. at output	Within ±0·1 V for ambient temperature range 20°—30°C. Within ±0·2 V for ambient temperature range 10°—40°C.
Hum on output	<0·5 mV peak-to-peak.
Mains bump	A variation of mains voltage from 250 V to 200 V r.m.s. causes a signal excursion of less than 12 mV d.c. and a gain change of less than 0·01 dB at all frequencies.

Non-linearity or picture signal distortion factor	<0·5%.
Differential phase	Less than 0·15° at 4·43 MHz.
Operating temperature	10°—40°C.
Change of gain with temperature	Less than ± 0·05 dB at 15 kHz and ± 0·07 dB at 5·5 MHz with a relative change less than ± 0·05 dB at 5·5 MHz with reference to 15 kHz from 10°C to 40°C.
Power requirement	210—250 V r.m.s., 50 Hz.
Current consumption	About 35 mA at 240 V.
Weight	2 lb 1 oz.
Index Pegs	5 and 27.

Circuit Description

General

The circuit of the amplifier is shown in Fig. 13.1. The amplifier stages consist of five directly-coupled transistors TR1, TR2, TR3, TR4 and TR5, of which the last three are connected as a d.c. feedback loop with the signal applied to the emitter of TR3. The voltage gain from the emitter of TR3 to the emitter of TR5 is about 12 dB.

The input signal, which is 0·5 volt peak-to-peak, is applied to the base of TR1 via the reversible capacitor C1. The control RV1, associated with TR1 base, varies the d.c. working point of the five transistors, and is adjusted so that the d.c. at the output terminals is zero. TR1, an emitter-follower, is directly coupled to TR2, also an emitter-follower.

The emitter of TR2 is also directly coupled to the emitter of TR3, which is the first of the three transistors in the direct-coupled feedback loop. The function of TR1 and TR2 is to transform the low input impedance of TR3 into a high impedance at the input of the amplifier itself; the input impedance of the amplifier is this transformed impedance in parallel with the impedances forming the bias chain of TR1.

Transistor TR3 provides the gain of the amplifier, which is obtained by driving the stage from a low impedance and working it into a high impedance comprising R7 in parallel with the input impedance of TR4.

The transistors TR4 and TR5, which are connected as emitter-followers, transform this high impedance into one of lower value, which is further reduced by feedback. The resultant very low impedance at TR5 emitter is needed to provide three adequately separated outputs via R14, R15 and R16, the impedance of each output being in fact completely determined by the value of the resistor concerned. These resistors have a tolerance of 0·1 per cent and therefore when the outputs are terminated in resistors of a similar tolerance the levels between any two outputs differ by less than 0·02 dB.

The high-frequency performance of the amplifier is controlled by L1 and C2 which enable stability to be obtained without loss of high-frequency feedback. Differential-phase distortion is thus reduced.

RV2 provides a limited amount of gain control.

Power Supply

The power for the amplifier is obtained from three separate rails having voltages of +9 volts, −6 volts and −14 volts respectively. These voltages are subject to variations from one amplifier to another, but should not go outside the limits given under *Test Procedure*.

The incoming mains is applied via T1 to the rectifier bridge MR1, MR2, MR3 and MR4, which supplies the feedback series stabiliser consisting of TR6, TR7 and TR8. The output of this stabiliser is about 23·5 volts with a current capacity of up to 200 mA. The 9-volt Zener diode ZD3 provides the reference potential applied to TR8. The three rail voltages are obtained from the 23·5-volt rails by two Zener diodes, ZD1 and ZD2 acting as shunt regulators fed by R19. The hum appearing on the 23·5-volt rail is about 1 mV peak-to-peak.

The resistor R9 and capacitor C3 are used to decouple the output signal current from the Zener diode ZD1.

Test Procedure

Apparatus Required

Wayne Kerr Video Oscillator Type 022B.
Tektronix Oscilloscope Type 515.
H.F. Double-pole Change-over Box.
General-purpose Panel Connector Block Type PN3A/2.

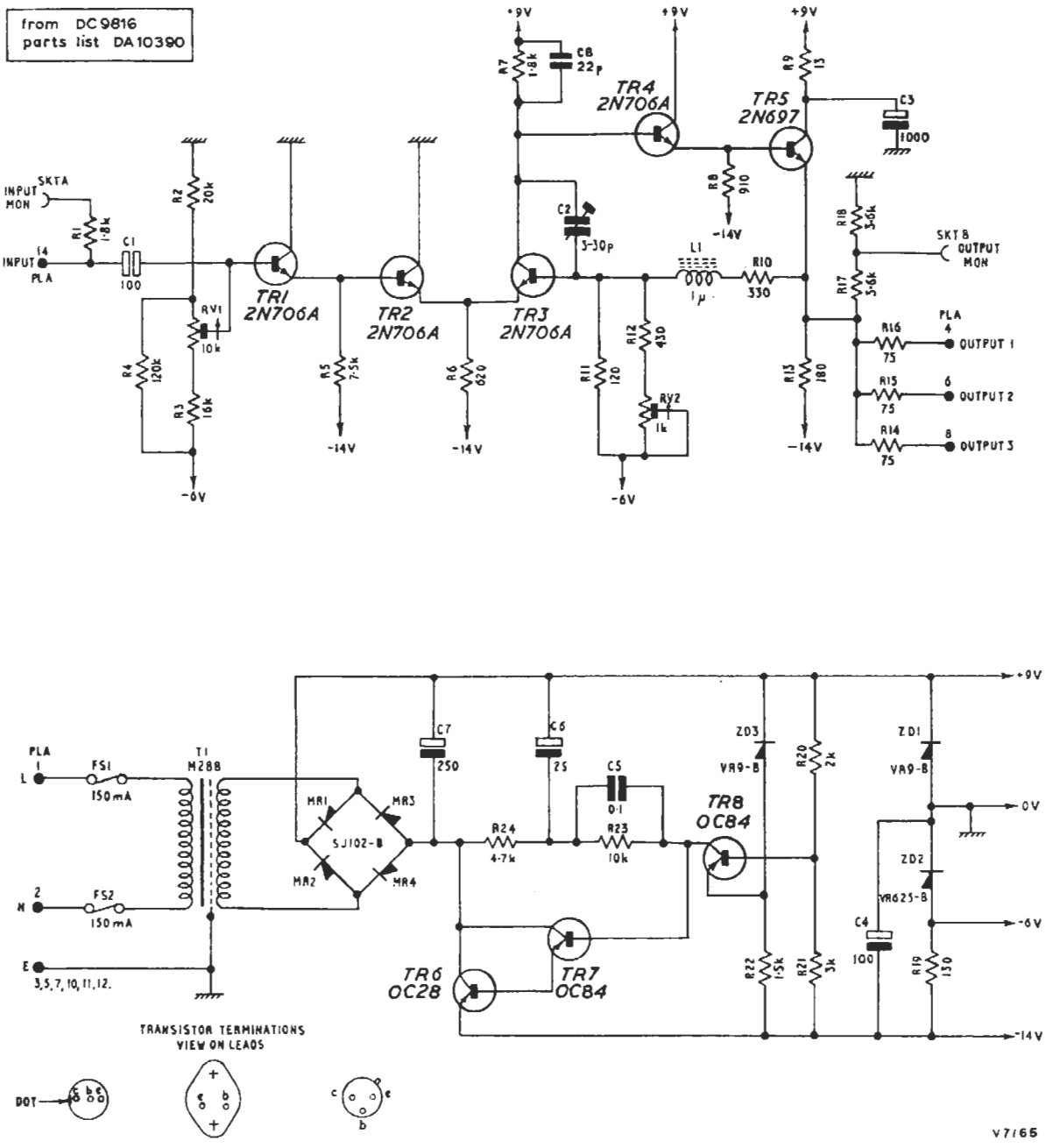

Fig. 13.1 Circuit of the AM4/513

75-ohm Unbalanced Wide-band Decibel Meter Type E3233
Three 75-ohm Musa Terminations
75-ohm F. & E. Termination
75-ohm 6-dB (±0·1 dB) Loss-pad

Alignment

1. Arrange the apparatus so that the video oscillator feeds the 75-ohm F. & E. termination on the oscilloscope via the change-over box which switches the signal either direct or via the 6-dB pad and amplifier. The pad should be in the input side of the amplifier and the amplifier should be terminated at the input with 75 ohms and the two unused outputs terminated.
2. Adjust RV2 to the centre of its range. Switch on. Set the oscilloscope to a suitable d.c. range and switch the video oscillator to *Osc. E.M.F.* Adjust RV1 to give zero d.c. at the output using the changeover box to provide a reference zero.
3. Wait 10 minutes.
4. Readjust RV1 to give zero d.c. at the output.
5. Replace the oscilloscope with the decibel meter terminated in 75 ohms and switch the video oscillator output to *Load Ohms.*
6. Using the change-over box technique, adjust the gain of the amplifier at 10 kHz by means of RV2 to give a reading of 0 dB on the decibel meter for both switch positions.
   In the same way, set the gain at 5·5 MHz by adjustment of C2.
7. Check that the reading at 10 MHz lies within ±0·2 dB.
8. Check that the other two outputs give a reading within ±0·1 dB at 10 kHz.
9. Replace the decibel meter with the oscilloscope and increase the input voltage to give 2·8 V peak-to-peak at the output of the amplifier at 10 kHz. Check that there is no limiting occurring on the output signal when all three outputs are terminated.
10. With no input signal, but the input terminated in 75 ohms, check that the hum on the output cannot be discerned from the hum on the oscilloscope on the most sensitive range of the oscilloscope amplifier (50 mV/cm).
11. Finally, reset RV1 to give zero d.c. output if necessary.

Power Supply Voltages

	Avo 8 Range	*Minimum Voltage*	*Maximum Voltage*
+9 V rail	10	+9·0	+9·8
−6 V rail	10	−6·4	−5·9
−14 V rail	25	−14·5	−12·0
C7 −ve side (240-V mains in)	25	−24	−22
TR1 emitter	10	−5·0	−4·5
TR5 emitter (20°—30°C)	2·5	−0·2	+0·2

Installation and use

Connections on Mounting Panel

To obtain the correct performance of the amplifier it is imperative that the 15-way socket on the mounting panel into which the amplifier is plugged is wired to the external bay wiring connectors on the panel in a satisfactory manner. In particular, an independent earth wire must be taken from each of the pins 3, 5 and 7 to the earth tag directly opposite. Failure to do this will result in poor separation figures at high frequencies between the three outputs. Pins 10, 11, 12, which are consecutive, may be joined together and earthed to one tag. All other connecting wires between pins and connectors should be as short as possible.

The connectors are normally part of Cable Termination Block PN3A/2, which is used on mounting panels of the PN3/21 type.

Equaliser Loss

As the amplifier gain is 6 dB, the normal input level is 0·5 volt peak-to-peak. When used on cables which require equalisation, therefore, the equaliser loss should be adjusted to be 6 dB. Where there is no equaliser loss and the amplifier is being fed by a standard-level signal, the amplifier should be preceded by a 6-dB resistive pad.

Input Conditions

The input impedance of the amplifier is 10 kilohms and the amplifier has been designed to be driven from an equivalent resistive source im-

pedance of 37½ ohms, or lower. If driven from source impedances higher than this figure the amplitude frequency response may be affected. The input impedance of 10 kilohms allows up to three amplifiers to be paralleled at their inputs without causing a change in level of greater than 0·1 dB.

The input impedance of 10 kilohms is only applicable when the amplifier is powered, and falls to a lower value when the amplifier is switched off.

D.C. Applied to the Input

In no circumstances must the d.c. applied to the amplifier be allowed to exceed 6 volts positive or 14 volts negative with respect to earth. If these figures are exceeded damage may result to the input coupling capacitors or the first two transistors.

Termination of Outputs

Each output should normally be terminated in 75 ohms whether it is used or not. When an output feeds a long length of cable the cable should, whenever possible, be correctly terminated. Open-circuited lengths of cable will be coped with however, subject to reflections breaking through, in accordance with the separation figures which may slightly modify the high-frequency amplitude response.

References

D.D. Specification 8.92(62).
D.D. Technical Memorandum 8.123(62).

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