COLOUR MATRIX UNITS UN1/577 and UN1/577A

Introduction

The UN1/577 Colour Matrix Unit provides R, G and B monitoring signals when used with 4-tube colour cameras or other 4-tube colour sources. The unit accepts R, G, B and Y input signals and provides two sets of R, G and B output signals. The unit is constructed on a CH1/26A chassis and contains its own power supply. A neon mains-on indicator is provided and can be seen through an inspection hole in the front escutcheon.

The UN1/577A is similar to the UN1/577 but is supplied without matrix resistors. It is used to provide linear colorimetric correction for particular colour sources and an individual set of matrix resistors is specified for each application.

General Specification

Number of Inputs	four
Input Impedance	more than 4·7 kilohms
Number of Outputs	three channels, two outputs per channel
Output Impedance	75 ohms (return loss more than 46 dB at 10 kHz)
Propagation Delay	45 μs
Pulse-to-bar Ratio	98-102% (625 1T)
Pulse Response	3·5% post pulse overshoot (625 1T)
50-Hz Square-wave Sag	6 outputs, 2%; 3 outputs, less than 1%
Interchannel Coupling	more than 46 dB rejection at 16 kHz
Matrix Law (UN1/577)	$R_{out} = Y_{in} + 0{\cdot}701\ R_{in} - 0{\cdot}587 G_{in} - 0{\cdot}114\ B_{in}$ $G_{out} = Y_{in} - 0{\cdot}299\ R_{in} + 0{\cdot}413\ G_{in} - 0{\cdot}114$ Bin $B_{out} = Y_{in} - 0{\cdot}299\ R_{in} - 0{\cdot}587 G_{in} + 0{\cdot}886\ B_{in}$
Matrix Law (UN1/577A)	Any, provided that the parallel combination of matrix resistors driving each output channel is 1 kilohm
Weight	$2\frac{3}{4}$ lb
Power Requirements	50 mA at 200-250 V, 50 Hz
Identification Pins	8 and 35
Operating Temperature Range	10-50°C ambient

General Description

The four input signals are fed via identical phase-splitting stages to the matrix array. The matrix resistors provide the required signal coupling between each input and the appropriate output amplifier, and also provide the correct d.c. coupling between the input and output stages. Each output amplifier provides two outputs at an impedance of 75 ohms.

Circuit Description

A circuit diagram is shown in Fig. 1.

Input Amplifiers

The input amplifiers have identical circuit configurations but, for the sake of clarity, different component numbers; these start at 101 for Red, at 201 for Green, at 301 for Blue and at 401 for Luminance. The balance and gain controls in each channel are identified by appropriately coloured collars. The Red input amplifier is described below.

The amplifier has unity gain and supplies both inverted and non-inverted signals to the matrix. Transistors TR101 and TR102 form a long-tailed pair phase splitter; balance is controlled by R106. The inverted signal developed at the collector of TR101 feeds the matrix via compound emitter-follower stage TR103-TR104; the non-inverted signal developed at the collector of TR102 feeds the matrix via compound emitter-follower stage TR105-TR106. Negative feedback is applied from TR104 to TR101 via gain control R110 which is

adjusted for unity gain.

Matrix

To satisfy the d.c. bias requirements of the output amplifiers, the parallel combination of matrix resistors feeding each output amplifier must be 1 kilohm. For example, consider the red matrix equation for the UN1/577.

$R_{out} = Y_{in} + 0{\cdot}701\ R_{in} - 0{\cdot}587\ G_{in} - 0{\cdot}114\ B_{in}$

The required matrix coefficients are:

Y	1·000
R	+ 0·701
G	− 0·587
B	− 0·114
The sum of these coefficients, neglecting signs, is:	2·402

This value represents the admittance of a matrix using the reciprocals of the equation coefficients directly as resistor values. As the total admittance as been specified as 1 $k\Omega^{-1}$, the sum of the matrix coefficients may be used as a scaling factor to give the required values.

Therefore:

Red matrix resistor $= \frac{2{\cdot}402}{0{\cdot}701} = 3{\cdot}425\ k\Omega$

Green matrix resistor $= \frac{2{\cdot}402}{0{\cdot}587} = 4{\cdot}090\ k\Omega$

Blue matrix resistor $= \frac{2{\cdot}402}{0{\cdot}114} = 21{\cdot}063\ k\Omega$

Luminance matrix resistor $= \frac{2{\cdot}402}{1} = 2{\cdot}402\ k\Omega$

The signs on the original coefficients dictate whether the matrix resistors should be connected to the positive or negative output of the input amplifier.

Output Amplifiers

The three output amplifiers have similar circuit configurations but different component numbers; these start at 501 for Red, at 601 for Green and at 701 for Blue. Gain and d.c. shift controls are identified by appropriately coloured collars. The Red output amplifier is described below.

The long-tailed pair amplifier comprising the two halves of TR501 amplifies the red output from the matrix and feeds the amplified signal to the compound emitter-follower output stage comprising transistors TR502 and TR503. Feedback is applied from the amplifier output to the base of TR501(b) via gain control R508. The bias on TR501(b) is varied by means of R506 which is adjusted for zero d.c. at the output under no-signal conditions. In the UN1/577 the gain control range in the green channel is offset slightly from that in the red and blue channels by making R607 680 ohms. In some applications of the UN1/577A, this resistor should be returned to the same value as R507 and R707, to give the gain controls on the three channels similar ranges.

Capacitor C501 controls high-frequency peaking in the amplifier and is adjusted on test to give the correct pulse-to-bar response through the complete matrix unit.

Power Supply

The mains-fed power supplier uses a full-wave bridge rectifier and a conventional stabiliser circuit. Stabilised supplies are provided at +5 volts and −11 volts with respect to the base of TR4.

Alignment

Apparatus Required

A suitably wired PN3A/2 with provision for one input signal to be fed to all four input pins.
High-gain oscilloscope with differential measuring facilities.
Avometer model 8, or similar.
Two resistors of between 1 kilohm and 5 kilohms, matched to 0·1% and connected in series.
625-line Pulse-and-bar Generator.
One 75-ohm terminating resistor.
Three 1-kilohm ±2% resistors (UN1/577A only).

Procedure (UN1/577)

1. Power the unit and check that the neon indicator lights.
2. With the Avo meter, check that the voltage across C4 is 5 volts ±1 volt and check that the voltage across C5 is 11 volts ±1 volt.
3. Clip the matched series-connected resistors between the inverted and uninverted outputs of the red input amplifier, and connect the oscilloscope probe to the junction of the matched resistors.
   Apply a 1T pulse-and-bar signal to the common input and adjust the red balance control (R106) for zero signal level.
4. Clip the matched resistors between the inverted red output and the negative end of C101;

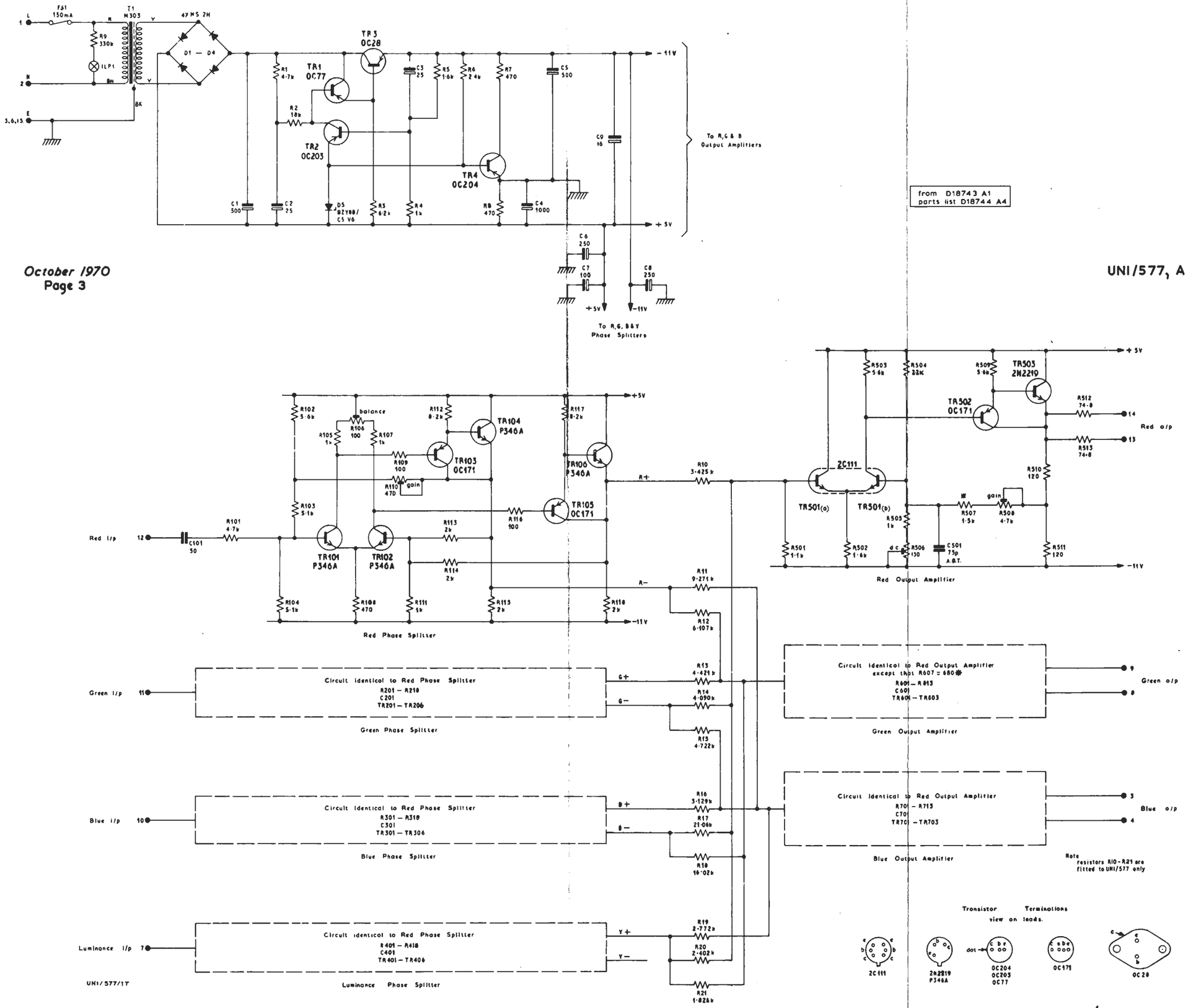

Fig.1 Colour Matrix Units UNI/577 Series

connect the oscilloscope probe to the junction of the matched pair as before. Adjust the gain control (R110) for minimum signal level.

5. Repeat steps 3 and 4 for the green channel (component numbers are in the 200 series).
6. Repeat steps 3 and 4 for the blue channel (component numbers are in the 300 series).
7. Repeat steps 3 and 4 for the luminance channel (component numbers in the 400 series).
8. Terminate the red output of the unit in 75 ohms; the pulse-and-bar signal should still be applied to the common input.
   Use the oscilloscope differential facility to compare the red input and output signals, and adjust gain control R508 for unity gain through the red channel.
9. Remove the input signal and adjust R506 to set the d.c. output level of the red channel to zero ± 5 mV.
10. Repeat steps 8 and 9 for the green channel (component numbers in 600 series).
11. Repeat steps 8 and 9 for the blue channel (component numbers in 700 series).
12. Re-apply the 1T pulse-and-bar signal to the input and monitor the red output with the oscilloscope terminated in 75 ohms. Adjust C501 for unity pulse-to-bar ration ($\pm 2\%$).
13. Repeat step 12 for the green channel (adjust C601).
14. Repeat step 12 for the blue channel (adjust C701).
15. Examine the pulse response at all three outputs to confirm that the post-pulse overshoot does not exceed $3\frac{1}{2}\%$.

Procedure (UN1/577A)

The alignment procedure given for the UN1/577 applies also to the UN1/577A but the following points should be noted.

(a) The UN1/577A is supplied without matrix resistors and, initially, only the power supplier and input amplifiers can be checked.
(b) To test the output amplifiers in the absence of a matrix, connect 1 kilohm $\pm 2\%$ resistors in the positions normally occupied by R10, R13 and R16. After the tests have been completed these resistors must be removed.

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