CHROMINANCE UNIT UN18/503

Introduction

This unit accepts inputs of RGB picture signals, (R−Y) and (B−Y) subcarriers, 625-line PAL Square wave, the 625-line PAL colour-burst gating pulses and positive-going clamp pulses. The output is a complete PAL-system chrominance signal.

The unit is on three printed-wiring boards accommodated in a Type CH1/12D Chassis (index-peg positions 2, 43). The front panel carries a four-position *Chrominance* switch and four pre-set controls. The switch enables the modulation to be removed (e.g. for test purposes) from either or both of the subcarriers. The pre-set controls *(R−Y) Gain*, *(R−Y) Carrier Balance*, *(B−Y) Carrier Balance* and *Chrominance Amplitude*, enable these parameters to be varied.

The UN18/503 operates as part of the GE1/526 PAL Colour Coder.

General Specification

Power-supply Potential	+12 V
Input-signal Amplitudes	
Picture signals (RGB)	0·7 V p-p each
Subcarrier feeds	0·5 V p-p
Clamp pulses	5·9 V p-p
Colour-burst gating pulses	1·6 V−2·5V p-p
PAL square wave	1 V p-p
Input Impedances	
Red picture signal	2·5 kilohms
Green picture signal	1·1 kilohms
Blue picture signal	3 kilohms
Colour-burst gating pulses	4 kilohms
PAL square wave	2 kilohms
Output-signal Amplitude (maximum)	4·4 V p-p

Circuit Description

The circuit of the unit is given in Fig. 1. The incoming RGB signals are combined in two resistive matrices to produce the (B−Y) and (R−Y) signals required to modulate the two incoming feeds of subcarrier. The (B−Y) signal must satisfy the equation:
$E_{(B-Y)} = 0{\cdot}886B - 0{\cdot}587G - 0{\cdot}299R$; because it is easier to synthesize a $-E_{(B-Y)}$ signal (only one component needs inversion) the blue component is inverted by TR1 and positive red and green components in the correct proportions, determined by R10 and R8 respectively, are mixed with the inverted blue component in TR1 collector circuit. The amplitude of the blue component depends on the gain of TR1, which is governed by the pre-set gain control R6, on the printed-wiring board. R6 is designated *(B−Y) White Balance* because for good quality white in a monochrome picture reproduced by a colour system the (B−Y) signal $E_{(B-Y)}$ must equal zero; in this condition the three colour-component signals are in the correct proportions. TR2 adds inverted burst-gating pulses in the correct proportion and the whole is inverted by TR3 to give a + (B−Y) signal.

The (R−Y) signal is produced in a similar manner by TR25 and TR26, to satisfy the equation $E_{(R-Y)} = 0{\cdot}301R - 0{\cdot}587G - 0{\cdot}114B$ but in this instance the burst gating pulses are not inverted. R98 is the *(R−Y) White Balance* pre-set control.

R109, the pre-set *(R−Y) Gain* control, enables the gain of the (R−Y) channel to be set accurately to 1·78 times that of the (B−Y) channel, in accordance with the requirements of the system.

L1, L2, C6, C8, C9 and L6, L7, C43, C45 form filters having linear-phase low-pass characteristics with a response −2 dB at 1·2 MHz and approximately −20 dB at 3 MHz and −35 dB at 4 MHz. These filters restrict the spectrum of the colour difference signals in accordance with the requirements of the system.

The emitter followers TR4 to TR7 and TR27 to TR30 provide the usual conditions of low-impedance source and high-impedance load at the points where clamping occurs, and drive the Carrier Amplitude Modulators Type MD2/504. TR6/TR7 and TR29/TR30 are pairs of complementary transistors in which the effects of changes of ambient temperature are, to a great extent, mutually cancelling. The modulators are of a type which normally requires equal standing potentials on its input pins 4, 5. Pairs of emitter followers TR8/TR9 and TR31/TR32 are therefore provided in circuits symmetrical with those of TR6/TR7 and TR29/TR30. The d.c. conditions are adjustable by means of the pre-set controls *(B−Y) Carrier Balance* (R34) and *(R−Y) Carrier Balance* (R121)

respectively. This arrangement has the advantage that effects of changes of temperature on TR6/TR7 and TR29/TR30 not cancelled by the complementary configuration of these stages are offset by similar residual effects on TR8/TR9 and TR31/TR32 giving a very high degree of overall stability to the circuits.

In practice, slight departures are made from the ideal settings of R34 and R121 to offset spurious subcarrier signals which may exist at the output of the unit during periods of blanking, when the chrominance signal should disappear. Because the phase-alternation of the PAL system is likely to change these spurious signals during alternate picture lines, adjustments are effective only on alternate lines unless suitable provision is made to offset such changes. This is achieved by adding a proportion of the PAL square-wave signal to the mixed colour-components at the input (TR1 and TR25 collector circuits). In effect different d.c. components are thus added to the chrominance-difference signals during alternate line periods, which is equivalent to an automatic re-adjustment of R34 and R121 between two settings. The amplitudes and polarities of the two switching-signal components are adjustable by means of pre-set resistors R48 and R49 on the upper printed-wiring board.

The incoming feeds of subcarrier are applied, after amplification, to pins 8 of the modulators. Before the (R−Y) subcarrier is modulated in the normal manner by the (R−Y) signal, it is fed through a further Carrier Amplitude Modulator Type MD2/504 to which is applied the switching signal at an amplitude greatly exceeding that of the subcarrier at this point. Operated in this mode, the modulator behaves as a phase-inverting switch, reversing the phase of the subcarrier during alternate line periods.

Because the burst gating pulses have been combined with the (B−Y) and (R−Y) signals, colour bursts are generated without the use of a separate burst modulator.

The outputs from the modulators are combined in the common collector load R69 of TR18 and TR24 and, because the two subcarrier feeds are in phase quadrature, they add vectorially to give a resultant having a phase relationship with the (B−Y) subcarrier which depends at any instant on the relative amplitudes of the two modulated chrominance signals.

The combined chrominance signal is passed via the harmonic filter L4, C23 to C26 to an output amplifier TR19 to TR21, the gain of which is variable by means of the pre-set *Chrominance Amplitude* control R79 in the feedback path.

Examples of the unit may be encountered in which various component values and transistor types differ from those shown in Fig. 1, notably those of R22, R23, R25, R61, R68, R79, R85, R110, R112, C30, TR17 and TR23. These differences result from minor modifications made from time to time with a view to improving the performance of the unit.

Maintenance

Because this is one of a group of interdependent units it is not replaceable by other examples of the same unit type; it must always be aligned as described below in association with the other units of the parent equipment preferably on their permanent panel. The following alignment procedure assumes that the other units are already aligned.

Apparatus Required

Cathode-ray oscilloscope, with 50 mV/cm Y-plate sensitivity, 10-MHz bandwidth, time-base scale adjustable to 1 μs/cm differential facility; fitted with high-impedance probe.
Video oscillator covering frequency range 100 kHz to 10 MHz (e.g. Wayne Kerr Type 022B).
PAL Colour Coder GEIM/526 which is the parent unit with complement of other units already aligned.
Feeds of 100% colour-bar RGB components.
Feeds of mixed sync and colour-burst gating pulses, of 2-volt p-p amplitude, each loaded with 75 ohms externally to the panel.
Feed of PAL square-wave signal of 1-volt p-p amplitude, loaded with 75 ohms externally to the panel.
Feed of 4·43361875-MHz colour subcarrier.
A.C. Mains supply.

Test Procedure

1. Plug the unit into the panel of the parent unit and connect the signal feeds detailed above. The colour-bar signals are connected to the top three *Picture* input connectors of the parent unit to avoid the need for a relay-operating supply. Apply a.c. mains to the panel.
2. Set the *Chrominance* switch to *B−Y* and examine the signal at the *B−Y* test point, adjusting the oscilloscope controls to obtain a display in which successive picture lines are superimposed.

Fig 1 Circuit of the Chrominance Unit UN18/503

Adjust R48 to produce a single trace.
Adjust R6 to eliminate the white colour-bar.
Adjust L1 to optimise the transient response of the (B—Y) amplifier as indicated by the nearest possible approach to rectilinearity of the colour-bar envelopes.

3. Set the *Chrominance* switch to $R-Y$ and examine the signal at the $R-Y$ test point, adjusting the oscilloscope controls to obtain a display in which successive picture lines are superimposed.
   Adjust R49 to eliminate all effects of the PAL square-wave switching signal.
   Adjust R38 to eliminate the white colour-bar.
   Adjust L6 to optimise the transient response of the (R—Y) amplifier.
4. Using the high-impedance oscilloscope probe, examine the signal at the emitter of TR17. Adjust L3 to obtain maximum subcarrier amplitude which should be about 4 volts p-p.
5. Using the high-impedance oscilloscope probe, examine the signal at the emitter of TR23. Adjust L5 to obtain maximum subcarrier amplitude which should be about 4 volts p-p.
6. Remove the a.c. mains supply from the panel. Use the high-impedance oscilloscope probe for the examination of signals called for in the following paragraphs unless otherwise stated.
7. Make a temporary connection between terminals 4 and 5 of the switch modulator.
   Apply a.c. mains to the panel and examine the signal at the emitter of TR23.
   Adjust the five pre-set controls of the switch modulator to obtain minimum subcarrier amplitude.
   Remove the a.c. mains supply and discard the temporary connection.
8. Make temporary connections (i) between terminals 4 and 5 of the (R—Y) modulator and (ii) across R65.
   Apply a.c. mains to the panel and examine the signal at the collector of TR24.
   Adjust the five pre-set controls of the (R—Y) modulator to obtain a minimum subcarrier amplitude.
   Remove the a.c. mains supply and discard the temporary connections.
9. Make temporary connections. (i) between terminals 4 and 5 of the (B—Y) modulator and (ii) across R89.
   Apply a.c. mains to the panel and examine the signal at the collector of TR24.
   Adjust the five pre-set controls of the (B—Y) modulator to obtain minimum subcarrier amplitude.
   Remove the a.c. mains and discard the temporary connections.
10. Remove the subcarrier feed to the panel, and substitute an 8·86-MHz zero-level signal from the video oscillator. Set the *Chrominance* switch to *On*.

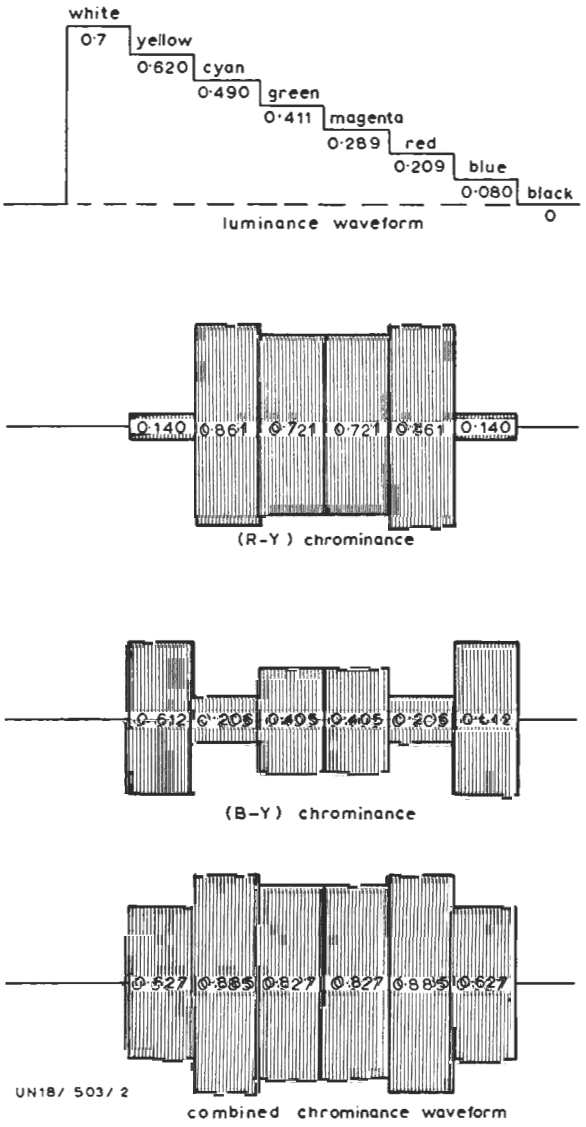

Fig. 2 Signal-envelope Parameters

Apply a.c. mains to the panel and examine the signal at the emitter of TR21. Adjust L4 to obtain minimum signal amplitude.
Disconnect the oscillator from the panel and restore the subcarrier feed.

11. Connect the oscilloscope to the output of the panel using a length of coaxial lead loaded at the instrument with 75 ohms; adjust the oscilloscope controls to obtain a display showing two successive picture lines.
Adjust the *B—Y Carrier Balance* and *R—Y Carrier Balance* controls to obtain equal minimum residual subcarrier amplitudes during the two line-periods; then adjust R48 and R49 to obtain a still lower minimum amplitude. Repeat these two adjustments until the optimum subcarrier suppression, equal during the two line-periods, is achieved.
12. Carry out items 8 and 9 of the maintenance instructions for the Power and Subcarrier-processing Unit UN1/549, and repeat 11 above.
13. Adjust the *Chrominance Amplitude* and *R—Y Gain* controls to obtain the signal-envelope amplitudes shown in Fig. 2. The complete chrominance waveform and that of the two component chrominance signals should agree within 1 per cent of the values given.
14. Check the alignment of the panel containing the unit before returning this panel to service.

Component changes in the stages of TR1, TR2 and TR25 and within the Modulators Type MD2/504 necessitate special re-alignment procedures for which the unit must be returned to Equipment Department.

Faulty modulators removed from units must be returned to Equipment Department.

References

1. Designs Department Technical Memorandum No. 8.213(66).
2. Designs Department Technical Memorandum No. 8.222(66).

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MODIFIED CHROMINANCE UNIT UN18/503 (164)

Introduction

The modified UN18/503 accepts inputs of the colour-separation signals, R, G and B, and two feeds (in phase quadrature) of the 4·5-MHz Intermediate-signal colour subcarrier. It produces a coded chrominance-signal output which has the form of an NTSC colour signal (i.e. two subcarriers in quadrature, modulated with the R-Y and B-Y colour-difference components, and having a constant-phase back-porch subcarrier burst; the R-Y modulation is not reversed in phase on alternate lines).

The unit also receives two subsidiary inputs of line-rate pulses. One of these inputs consists of a train of positive-going pulses, each of 1·6 μs duration and coincident with a line-sync pulse, which operate clamping circuits. For the other input, the pulses are negative-going and of about 4·4 μs duration. They are added to the B-Y signal so that a burst of about 20 cycles of subcarrier phased along the B-Y axis) is present during each line-blanking interval in the output chrominance signal.

This modified version of the UN18/503 forms part of the Intermediate-signal coding equipment contained in the input section of the Field-store Standards Converter CO6/506. It feeds the output chrominance signal to a modified Luminance Unit Type UN19/502 (key ref. 165).

In the converter, the coded Intermediate Signal is used to frequency modulate a 30-MHz carrier which is then subjected to various delaying and switching processes in the interpolation and field-store circuits.

The address of the modified UN18/505 in the CO6/506 equipment is 1/9/2 (see block diagram C).

General Specification

The specification given for the unmodified UN18/503 is applicable to the modified unit except that the input of PAL square wave is omitted.

Circuit Modifications

Fig. 3 is a complete circuit diagram of the modified UN18/503. It should be compared with the circuit diagram of the normal unit given in Fig. 1.

The two matrices for deriving the R-Y and B-Y colour-difference signals from the R, G and B inputs have not been changed. In the modified unit, however, burst-gating pulses are not added to the R-Y signal (because the subcarrier burst appears only in the B-Y phase), and resistor R104 has therefore been returned to earth instead of to the connector pin carrying burst-gating pulses.

Burst-gating pulses are added to the B-Y signal via amplifying transistor, TR2. Since a large (0·7-volt) burst level is required for subsequent processes involving the Intermediate Signal, the effective gain of TR2 has been increased. This has been accomplished by replacing a variable resistor in the TR2 emitter circuit with fixed parallel resistors, and by changing the value of R19 in the base circuit from 3·3 kilohms to 100 ohms. Note that the burst-gating pulses used here have nearly twice the duration of those in an unmodified coder; the resultant burst contains about 20 cycles of subcarrier.

Because the output chrominance signal is of the NTSC type (with no phase alternation of the R-Y component), the incoming feed of subcarrier in the R-Y phase is not passed through a modulator circuit as in the unmodified unit, but is directly coupled to TR22. In addition, the PAL 7·8-kHz switching signal is not supplied to the modified unit, and the contact pin which normally carries this signal is connected to earth. The absence of the line-by-line phase reversal process also means that there is no requirement for the automatic differential (d.c.) balance arrangement present in normal PAL coders; thus, the sliders of variable resistors R48 and R49 have been disconnected. TR13 and TR14 are, of course, inoperative because they are not fed with the switching signal.

One further circuit modification should be mentioned. The colour subcarrier second-harmonic trap circuit (L4) connected between TR8 and TR9 has been re-adjusted to correspond with the changed subcarrier frequency*. Thus, this circuit now discriminates against signal frequencies of about 9·00 MHz (as compared with the 8·86 MHz setting for unmodified units).

* The particular frequency chosen for the Intermediate Signal colour subcarrier is more nearly that of a standard PAL coded signal than the 3·58 MHz of an NTSC signal. An additional advantage gained from employing a unit designed for use with PAL signals, is that the output colour-difference signals in normal use (R-Y and B-Y) are of equal bandwidth (as opposed to the different bandwidths of the I and Q signals in an NTSC chrominance unit). These are the main reasons for modifying a PAL chrominance unit to produce an NTSC-type output.

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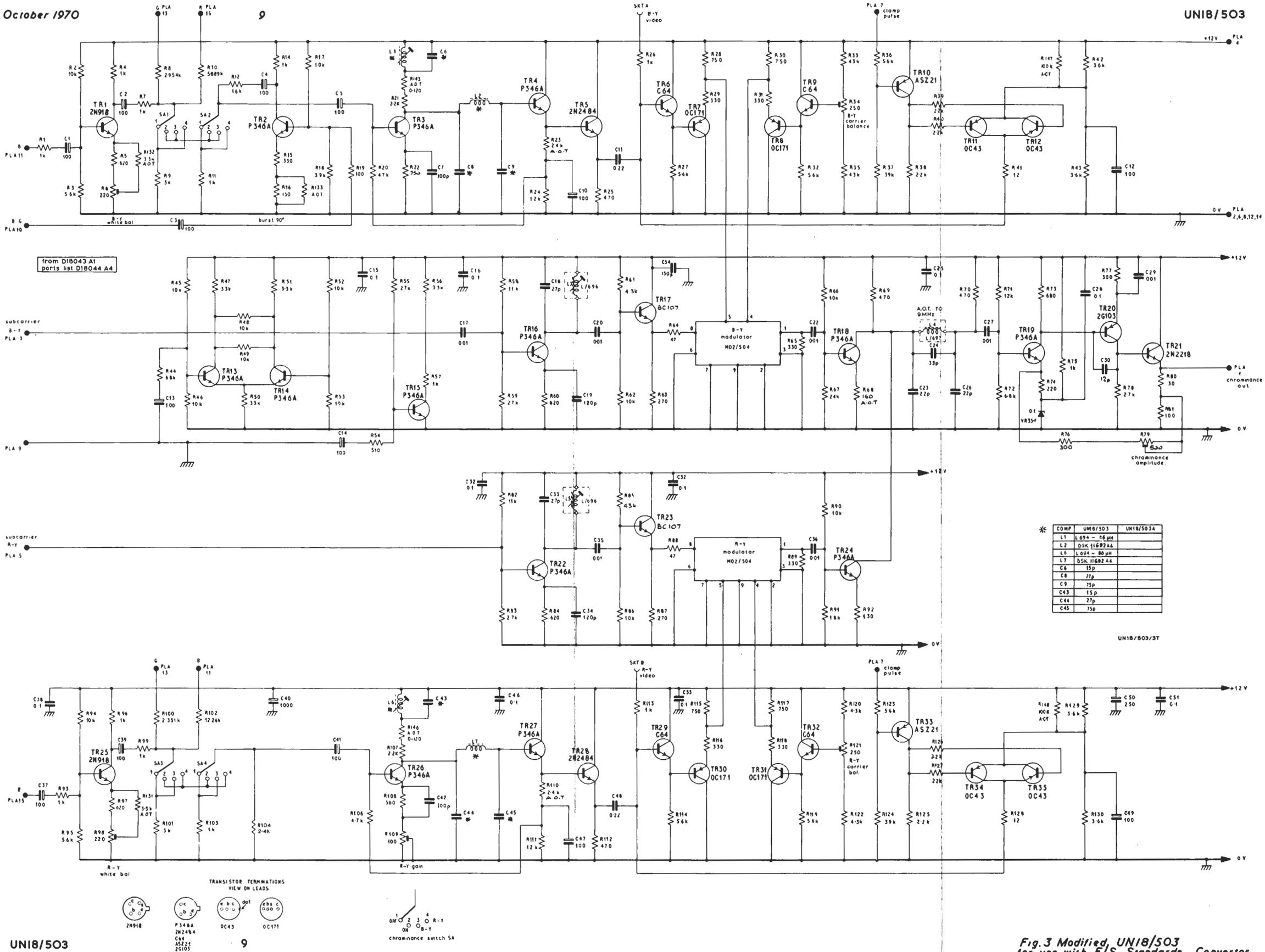

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COMP	UNIB/503	UNIB/503A
L1	L694 – 56 µH	
L2	DSK 11692A4	
L6	L694 – 80 µH	
L7	DSK 11692A4	
C6	15p	
C8	27p	
C9	75p	
C43	15p	
C44	27p	
C45	75p	

UNIB/503/3T