TECHNICAL MANUAL

for the

UNDERWATER

SIT MONOCHROME TELEVISION CAMERA

OE 1323

Serial No. 0583

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OSPREY ELECTRONICS LIMITED

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and
GENERAL INFORMATION

(The Conditions and Information form part of the Company's conditions of trading)

Standard Conditions of Warranty

Instruments sold by Osprey Electronics Limited (hereinafter called the 'Company') are warranted only as stated below:

Subject to the exceptions and upon the conditions specified below, the Company agrees to correct, either by repair or at its election, by replacement, any defect of material or workmanship which develops within one year after delivery of the instrument to the original purchaser by the Company or by an authorised representative, provided that investigation and factory inspection by the Company discloses that such defect developed under normal and proper use.

The exceptions and conditions mentioned above are the following:

a. If any component or accessory manufactured by the Company such as glassware, optical components, light bulbs or cable, fails to give reasonable service for a reasonable period of time, the Company will, at its election, replace or repair such component or accessory. What constitutes reasonable service and what constitutes a reasonable period of time shall be determined solely by the Company after the Company is in possession of all the facts concerning operating conditions and other pertinent factors and after such component or accessory has been returned to the Company, transportation pre-paid.

b. The Company takes no warranty concerning components or accessories not manufactured by it. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

c. The Company shall be released from all obligations under its warranty in the event of repairs or modifications made by persons other than its own or authorised service personnel, unless such repairs by others are made with the prior written consent of the Company.

d. The Company expressly disclaims liability to its customers, dealers and representatives, and to users of its products, and to any other person or persons for special or consequential damages of any kind and from any causes whatsoever arising out of or in any way connected with the manufacture, sale, handling, repair, maintenance, or replacement of or arising out of or in any way connected with the use of said products.

e. Except as stated above, the Company makes no warranty, express or implied (either in fact or by opt of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by opt of law), statutory or otherwise.

f. Representations and warranties made by any person, including dealers and representatives of the Company, which are inconsistent or in conflict with the terms of the warranty (including but not limited to the limitations of the liability of the Company as set forth above), shall not be binding upon the Company unless reduced to writing and approved by a Director of the Company.

g. This warranty shall be governed by the laws of Scotland.

General Information

SPECIFICATIONS

The Company reserve the right to change specifications at any time without notice and without incurring any obligation to incorporate new features in instruments previously sold.

DAMAGE IN SHIPMENT

The Company's instrument is carefully examined and checked before it is shipped. It should be visually and operationally checked as soon as it is received. If it is damaged in any way, a claim should be filed with the carrier. New or repaired instruments damaged in transit should not be returned to the manufacturer without first obtaining specific shipping instructions.

REPAIRS

Shall any fault develop, the Company or its appointed service agents, must be notified immediately giving full details of the difficulty. Include in the notification the model number and serial number of the affected instrument. On receipt of this information the Company, or its service agent, will send service instructions or shipping data.

Upon receipt of shipping instructions, the instrument must be forwarded, carriage pre-paid, and repairs will be made by the Company or its service agents at their premises. If the instrument is not covered by warranty, or if it is determined that the fault is caused by misuse, repairs will be billed to the customer, and an estimate submitted for customer approval before the commencement of repairs.

CAUTION

The camera should not be used at light levels in excess of 20 lux average illumination on the faceplate of the SIT Tube for one minute or, 10^3 lux peak illumination with a highlight (point source) on the faceplate for one minute. Failure to observe this precaution will result in a shortening of the life of the tube or permanent damage to the target or photocathode.

Operate the camera within the range of temperature specified - see Chapter 2, section 2.5.

Do not operate the camera: in a strong magnetic field; in an area of powerful electromagnetic radiation; near a strong radioactive source or, in an helium atmosphere*.

When the camera has been unused for 90 or more days, operate it with the lens capped for one to eight hours before it is put into service. This will minimise possible damage to the photocathode of the SIT Tube from excessive ion generation.

Certain electronic devices can be destroyed by static electricity. It is essential therefore that full protection against static is practised by service engineers.

WARNING

High voltages up to 500 V and an extra high voltage up to 10 kV are generated to operate the SIT Tube.

*There is a possible danger to the user of the camera if an attempt is made to operate it in an helium atmosphere.

Devices containing cadmium or mercury are environmentally unsafe. Correct procedures should be adopted when disposing of such devices.

The camera is fitted with a device containing mercury.

MANUAL CHANGES

LATE PRODUCT CHANGES

The following change(s) should be read in the context of the manual

OPTIONS FITTED

Each option is described in a supplement at the back of the manual

MANUAL AMENDMENT RECORD

Amendment	Description	Authority
4 2-4-91	Recommendation to use Aqualube with screws on the camera housing which come into contact with sea water.	CRN4009

ISSUE	MOD. NO.	DATE
4	CRN4009	2-4-91
3	AN636	25-1-90
2	AN602	21-6-89

DRAWING NO. 1323-5001

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CHAPTER 1

INTRODUCTION

The OE 1323 monochrome television camera incorporates a silicon intensifier target (SIT) tube, which enables the camera to view underwater scenes where the level of illumination is low.

The iris of the fixed focus lens automatically adjusts to the prevailing level of scene luminance, and closes to its smallest aperture when the camera is switched off. Attenuation of the video signal as it passes through the umbilical cable to the surface control unit is compensated by circuits within the camera, and protection of the camera circuits is provided in the event of an accidental over-voltage or reverse voltage applied to the cable.

Space on the camera chassis is provided to accommodate one of a number of printed circuit boards so that changes to the normal mode of operation of the camera can be made. These and other optional features are described in Chapter 3.

CHAPTER 2

SPECIFICATION

2.1 Performance

Minimum Faceplate Illumination	: 5 x 10^{-4} lux
Resolution	: 600 lines horizontal
Signal-to-Noise Ratio	: 34 dB (with CCIR pass filter)
Geometric Distortion	: <3% (within BS5115 defined picture area)

2.2 Electrical

Signal System	: CCIR
Sensing Device	: Silicon Intensifier Target (SIT) tube
Field Frequency	: 50 Hz (625 lines)
Line Frequency	: 15.625 kHz
Video Signal	: 1 V peak-to-peak into 75 Ω (unbalanced)
Power	: 16-24 V* d.c. 650 mA *at the external connector

2.3 Optical

Lens	: 5.5 mm f/1.5
Iris	: automatic
Focus	: 150 mm (6 in) to infinity (fixed)
Angle of View	: 110° diagonal

2.4 Mechanical

Size	Length	: 308 mm ($12\frac{1}{8}$ in) excluding connector
	Diameter	: 101.5 mm (4 in)
Weight	In Air	: 3.5 kg (7.7 lb)
	In Water	: 1.05 kg (2.3 lb)
External Connector		: 5 pin Sea Con/Impulse XSL-5-BCR

2.5 Environmental

Operating Depth	: 1000 m (3280 ft) maximum
Operating Temperature	: −5 ℃ to 40 ℃ (23 ℉ to 104 ℉)
Storage Temperature	: −20 ℃ to 60 ℃ (−4 ℉ to 140 ℉)

CHAPTER 3

OPERATING CONDITIONS AND OPTIONAL FEATURES

The camera is compatible with a number of Osprey surface control units: the Cyclops which incorporates a video monitor, the OE 1230 series surface control units which require the addition of a video monitor and the OE 2200 control unit which also requires the addition of a monitor.

CAUTION

⚠ The camera should not be used at light levels in excess of 20 lux average illumination on the faceplate of the SIT Tube for one minute or, 10^3 lux peak illumination with a highlight (point source) on the faceplate for one minute. Failure to observe this precaution will result in a shortening of the life of the tube or permanent damage to the target or photocathode.

⚠ Operate the camera within the range of temperature specified - see Chapter 2, section 2.5.

⚠ Do not operate the camera: in a strong magnetic field; in an area of powerful electromagnetic radiation; near a strong radioactive source or, in an helium atmosphere.

⚠ When the camera has not been in use for 90 or more days, operate it with the lens capped for one to eight hours before it is put into service. This will minimise possible damage to the photocathode of the SIT Tube from excessive ion generation.

3.1 Surface Control Units

The camera may be used with the Cyclops 1210/11, the OE 1230 series units or the OE 2200 TVP unit.

The unit is connected to the camera by an umbilical cable terminated with a 5 pin Sea Con/Impulse connector at the camera end and a 17 pin Cannon connector at the surface end. The umbilical cable conveys the video signal from the camera to the control unit, and d.c. power and control signals from the unit to the camera.

see the note on the following page

NOTE: Before attaching the umbilical cable to the camera, ensure that the **O** rings on the Sea Con/Impulse connectors are clean and lightly smeared with silicone grease*; one ring is situated inside the connector receptacle on the camera, and the other ring encircles the connector plug attached to the umbilical cable. Make certain that the key on the plug is aligned with the keyway on the receptacle before tightening the threaded locking ring. To ensure that the connectors are mechanically secure, it is advisable to use half-shell clamps OE 1113.

*Molykote 111 is recommended

3.2 Optional Features

The camera can be fitted with certain options to suit the requirements of the user. These options are selected from a number of Feature Groups - e.g. Lens, Video Circuit, Power Regulator, Synchronisation, Housing and Back End.

FEATURE GROUP	OPTION
Lens	8.5 mm 12.5 mm* 18-90 mm zoom*
Video Circuit	Balanced video signal Video modulated RF signal
Power Regulator	Constant current - positive/negative chassis Constant voltage - positive chassis
Synchronisation	60 Hz (525 lines) Genlock
Housing	Stainless steel 1000 m (3280 ft) Stainless steel 3000 m (9850 ft) Aluminium 3000 m (9850 ft)
Back End	A number of alternative connectors are currently available *require alternative housing

Apply to Osprey Electronics for further information if the option required is not listed above.

CHAPTER 4

INTRODUCTION TO THE PRINCIPAL PARTS OF THE CAMERA

The principal signal and voltage paths between the parts of the camera are shown in Figure 4.1, and an isometric view of the camera chassis is shown in Figure 4.2.

4.1 Regulator Board

The main functions of the board are to provide a regulated 12 V supply for the camera circuits, and a circuit which drives the lens iris motor and automatically closes the iris when power to the camera is switched off. The board also provides protection against incorrect voltages accidentally applied to the video output circuit through the umbilical cable, and a current limiting circuit which is used when an alternative lens of variable focus is fitted.

4.2 Time-Base Board

A single circuit generates all the timing waveforms required by the Video Board, and the amplifiers which drive the vertical and horizontal scan coils. Operating voltages for the SIT Tube are generated by a circuit which is locked to the line frequency.

4.3 Video Board

A composite video signal is constructed with blanking and synchronising signals from the Time-Base Board. The Video Board also compensates signal attenuation in the external umbilical cable, and provides a signal which controls the output of the EHT Supply Module and the iris motor drive circuit on the Regulator Board.

4.4 Pre-Amplifier Board

The circuit accepts the signal from the target of the SIT Tube and amplifies it to a suitable level for the Video Board.

4.5 EHT Control Board

The board interfaces control signals from the Video and Time-Base boards to the EHT Supply Module. One signal activates the supply module while the other signal controls the

output voltage of the module.

4.6 Tube-Base Board

The board acts as an interface between the Time-Base Board and the SIT Tube.

4.7 SIT Tube and Coil Assembly

The tube employs a silicon diode array target which offers low lag and minimal blooming when exposed to bright light sources. The dynamic range (gain ratio) is high owing to good peak target current rating and beam discharge capability, with the result that comet tail effects are minimal when highlights are viewed. Focus, deflection and alignment is undertaken by a precision constructed coil assembly.

4.8 EHT Supply Module

The module is triggered by the horizontal drive pulse from the Time-Base Board thereby minimising spurious video interference. The module generates a high voltage which is proportional to the controlling voltage from the automatic light compensation circuit on the Video Board.

4.9 Iris Motor

The lens iris is driven by a d.c. motor and reduction gear-head. A current limiting circuit on the Regulator Board stops the motor from drawing too much current when it is in the stalled condition; that is, when the motor is still receiving a driving voltage even though the iris is at the end of its range.

4.10 Lens

The lens is a fixed focus unit which screws into a **C** mount attached to the front bulkhead of the camera chassis. The aperture of the iris is altered by the Iris Motor which is in contact with a gear ring on the lens.

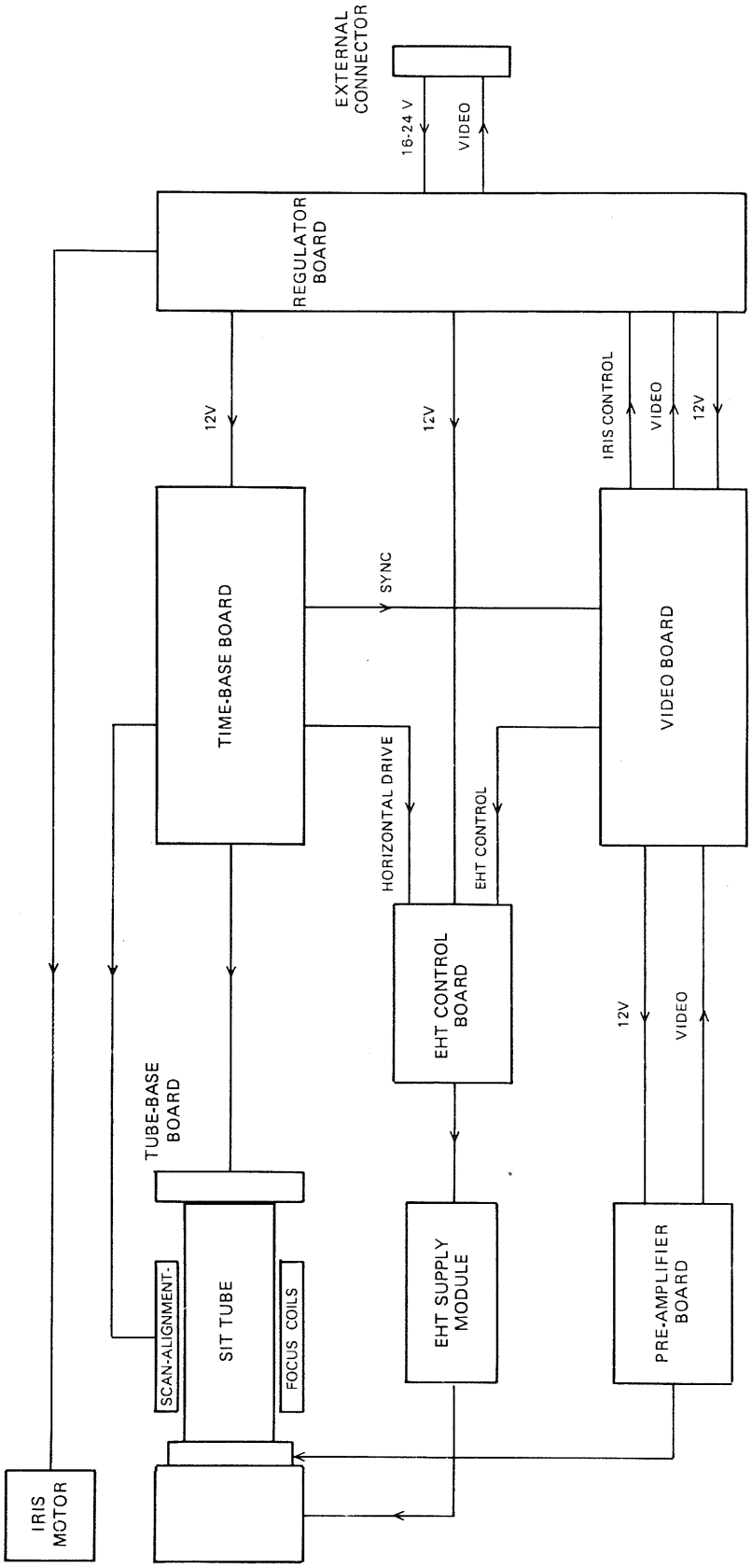

FIGURE 4.1 PRINCIPAL SIGNAL AND VOLTAGE PATHS IN THE CAMERA

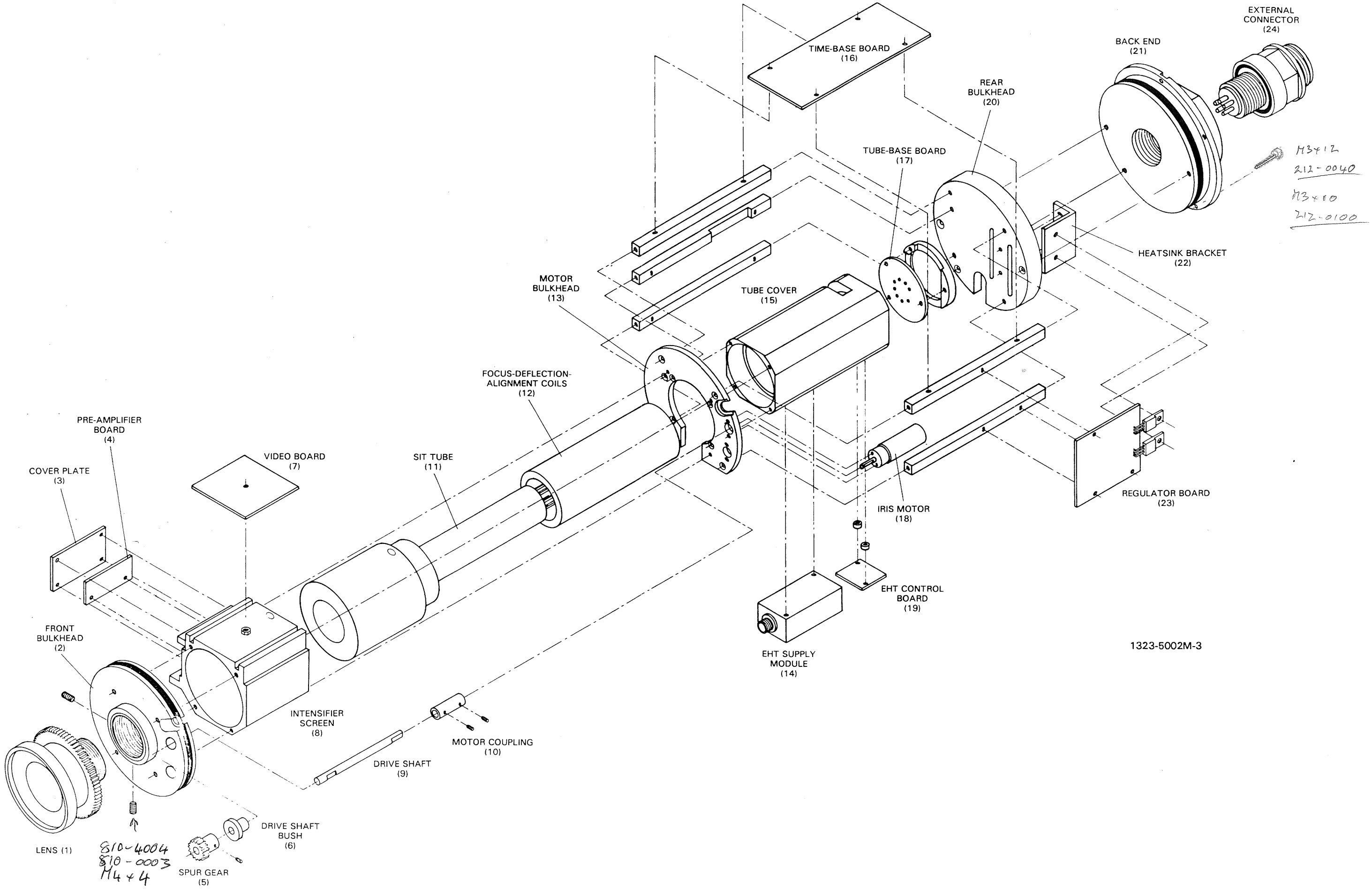

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FIGURE 4.2 LOCATION OF THE PARTS OF THE CAMERA CHASSIS

COMPONENT PARTS OF THE CAMERA

REF.	DESCRIPTION		PART NO.
1	Lens	5.5 mm f/1.5	1323-6026
2	Front Bulkhead		1323-2005
-	O Ring for Front Bulkhead	Dowty Ref: 200-234-8870	191-0001
3	Cover Plate		1323-1001
4	Printed Circuit Board	Pre-Amplifier	1323-6013
5	Spur Gear		781-0142
6	Drive Shaft Bush		1323-2019
7	Printed Circuit Board	Video	1323-6014
8	Intensifier Screen		1323-2014
9	Drive Shaft		1323-2021
10	Motor Coupling		1323-2018
11	SIT Tube	RCA 4804/H/P2 modified	1323-6018
12	Focus-Deflection-Alignment Coils	RCA AJ2216 modified	1323-6016
13	Motor Bulkhead		1323-2031
14	EHT Supply Module	RCA PF1040 modified	1323-6035
15	Tube Cover		1323-2007
16	Printed Circuit Board	Time-Base	1323-6011
17	Printed Circuit Board	Tube-Base	1323-6010
18	Iris Motor	12 V d.c. 485:1	1323-6027
19	Printed Circuit Board	EHT Control	1323-6008
20	Rear Bulkhead		1323-2036
21	Back End		1323-2001
-	O Ring for Back End	Dowty Ref: 200-236-4470	190-0011
22	Heatsink Bracket		1323-2035
23	Printed Circuit Board	Regulator	1323-6015
24	External Connector	Sea Con/Impulse XSL-5-BCR	680-0104
-	O Ring for External Connector	Dowty Ref: 200-016-4470	190-0002

NOT ILLUSTRATED IN FIGURE 4.2

-	Housing		1323-2034
-	Correction Lens (Port)		1321-4003
-	O Ring for Correction Lens	Dowty Ref: 200-153-4470	190-0009
-	Correction Lens Support		1323-2002

NOTE: Spare O rings are supplied with the camera

CHAPTER 5

CIRCUIT DESCRIPTIONS

The circuits are contained on six printed circuit boards. Wiring between the boards and the other parts of the camera is shown in Figure 5.15.

5.1 Regulator Board

The board comprises four independent circuits - see Figures 5.1 and 5.2.

5.1.1 12 V Regulator

The 12 V regulator operates from a constant voltage or constant current supply. A constant voltage (within the range 16-24 V) applied to the external connector of the camera passes to the fixed output regulator IC4. The resulting 12 V supply is taken to the Time-Base, EHT Control and Video boards by way of connector CN2 pins 1, 2 and 3. In the constant voltage mode, diode D10 protects the regulator from the application of a reverse voltage at the external connector, and diode D15 offers protection against the application at the external connector of a voltage in excess of 30 V. In the constant current mode, jumper link LK1 is fitted; in this arrangement the power transistor TR5 shunt-regulates the voltage at the external connector. Diode D10 is replaced by fuse FS2 when the camera is required to operate from a negative power supply. Zener diode D16 regulates the collector-emitter voltage of TR5 at 16 V and this voltage is applied to IC4. In either mode of operation the elapsed time meter RE1 shows the time the camera has been in use - the full-scale reading is 1000 hours.

5.1.2 Iris Motor Drive Circuit

The circuit accepts the iris control signal from the Video Board by way of connector CN2 pin 10. Two operational amplifiers (IC1a and IC1b) amplify the difference between the voltage set by the divider network R3, R18 and R4, and the iris control signal. When the iris control signal changes, it will cause a voltage of changing polarity to appear between CN3 pins 3 and 4. For example, an increase in the level of scene luminance will cause the iris control signal to switch IC1a and IC1b so that the polariscope of the voltage applied to the iris motor drives the iris towards a smaller aperture; and vice versa. When a balance is reached, the voltage between CN3 pins 3 and 4 is nominally zero.

The regulator IC2 acts as a current limiting device so that in instances when the iris is at either end of its range, the continued application of a driving voltage does not overload the motor. The current drawn by the motor in the stalled condition is limited

to 30 mA by R11.

In order to protect the SIT Tube from possible damage through exposure to excessive light levels when the camera is not in use, the iris motor drive circuit is arranged to close the iris to its smallest aperture. When the camera is in use, the two high-value capacitors C2 and C3 charge to about 10.8 V. As soon as power to the camera is switched off, the level at pins 3 and 6 of IC1 is held by the divider network which is now supplied by C2 and C3 through D4 (the iris control signal falls to 0 V, although in practice CN2/10 is held initially at about 2 V by the action of D5 - this avoids the misfunctioning of IC1 during the iris closure period) with the result that the polarity of the driving voltage at CN3 pins 3 and 4 causes the motor to close the iris. The purpose of D1 is to isolate the junction of D4 and R3 from the 12 V line when power to the camera is switched off.

5.1.3 Over-Voltage Protection Circuit

The circuit protects the output stage of the Video Board against the accidental application of a positive or negative voltage to the co-axial line of the external umbilical cable. Transient voltages on the video line are clipped by suppressor diode D12 or D14, but in the event of a longer duration voltage, protection is provided by fuse FS1. Degradation of the video signal is avoided by isolating D12 and D14 with diodes D11 and D13.

5.1.4 Current Limiting Circuit

Provision on the camera chassis is made for a focus motor when a variable focus lens is used as an alternative to the standard fixed focus lens. The motor is operated by a bi-polar voltage generated at the surface control unit and the current drawn by the motor is limited to 30 mA by IC3 and R6 so that it will not overload when it is in the stalled condition.

5.2 Time-Base Board

See Figures 5.3, 5.4 and 5.5

The synchronising pulse generator IC3 provides the vertical, horizontal, mixed blanking and synchronising pulses needed to generate the scanning raster and construct the composite video signal on the Video Board.

The vertical deflection circuit comprises an operational amplifier arranged as an integrator (IC4b) which drives a power amplifier, IC6; hence, the voltage output of IC4b is translated into a current signal by IC6 and R40. Capacitor C15 is discharged by the switching action of TR11 which receives field drive pulses from IC3 by way of TR8 and TR9.

The horizontal deflection circuit employs a power Hexfet (TR5) which drives the scan coil through L2 and C9. The Hexfet is switched by line drive pulses which pass from IC3

through TR1 and TR4 to the gate of the transistor. The horizontal position of the scanning raster is set by RV4 which acts on the non-inverting input of the unity gain operational amplifier IC7.

The Hexfet also drives transformer T1 in order to generate operating voltages for the SIT Tube. A voltage trebler circuit (D17, D20, D21) provides an high voltage for grids 2, 3 and 4. The voltage applied to grid 2 is shunt regulated by TR13 which in turn is controlled by IC5; and the voltage applied to grid 4 is shunt-regulated by TR12. The beam current (grid 1) of the tube is altered by RV2 which receives a negative voltage from the trebler circuit D6, D7 and D18.

A constant current supply for the focus coil is achieved with a current sink arrangement comprising IC4a, TR10 and R29. In series with the focus coil is a further circuit (TR14) which enables the correct current setting for the alignment coils to be made with RV10 and RV11.

Additional regulated voltage supplies are provided by IC2 which receives, together with other circuits on the board, a 5 V reference from IC1.

The jumper links LK1 and LK2 are set as follows:

LK1 open for 625 line CCIR operation
(crystal XL1 frequency 2.5625 MHz)

close for 525 line EIA operation
(crystal XL1 frequency 2.583 MHz)

LK2 close for normal operation
open when the camera is modified to accept a genlock signal

5.3 Video Board

See Figures 5.6, 5.7 and 5.8

The video signal from the Pre-Amplifier Board enters the Video Board at connector CN2 pin 5 where it is further amplified by the series feedback pair, TR1 and TR2. The signal at the collector of TR2 is applied to a quad bi-lateral switch (IC1) which is operated by clamp and mixed video blanking pulses from the Time-Base Board. The action of the clamp pulse fixes the blanking level of the video signal to a reference voltage determined by the potential divider R11, RV6 and R12: the adjustment of RV6 offsets the black level from the blanking level thereby creating a pedestal. The mixed video blanking pulses ensure that the video signal reaches the base of TR3 only during an active line of the signal. During each blanking pulse, the video signal is stopped from reaching TR3 and the reference voltage is switched to the base of the transistor. Mixed sync pulses are added to the video signal by TR4, while TR5 clips the peak white of the video signal - the level at which clipping takes place is set by RV3. The potential divider action of R22 and R23

holds the base of TR6 at a level which, if exceeded by the level of the video signal, causes it to conduct. This action and the attenuator effect of R15 and R21 apply gamma correction to the video signal. The gamma corrected video signal goes through a low-pass filter (C10, L2, C11) to a series feedback pair (TR7 and TR8) where compensation for high-frequency losses in the co-axial line of the umbilical cable is selected by a four-position switch, SW1. The composite video signal at the collector of TR8 is taken to a current amplifier (IC2) which drives the co-axial line.

Capacitor C26 charges through R43 and R45 to the mean level of the video signal, while a small proportion of the peak video signal is detected by R44 and D2. The value of R44 is selected so that the automatic level control circuit comprising IC3 responds to average scene luminance. Hence, an increase in the mean video signal at the non-inverting input of IC3a is detected by IC3b, and when the level exceeds the reference voltage set by RV5, the output of IC3b lowers the high voltage generated by the EHT Supply Module and also tends to close the iris by way of the Regulator Board.

Transistor TR9 counters a situation where the SIT Tube starts to draw too much target current. In such a situation, TR9 starts to conduct and acts on the inverting input of IC3b through R58, with the result that the output of IC3b causes a reduction in high voltage and tends to close the iris.

Transistor TR10 conducts as soon as power is applied to the camera and by way of R57 causes IC3b to bring about a reduction in EHT as well as tending to close the iris. The action of TR10 lasts for about 30 seconds, in which time C29 charges to 12 V and switches off the transistor. This period of time allows the tube heater to warm-up before the normal operating EHT is applied to the photocathode.

5.4 Pre-Amplifier Board

See Figures 5.9 and 5.10

The signal from the target of the SIT Tube is accepted by a Jfet (TR1) which acts as a low noise, high power gain input stage for the pre-amplifier circuit. The output signal from the drain of the transistor is taken to a differential amplifier comprising TR2 and TR3, which in turn feed the common emitter amplifier TR4. The four transistors are contained in a feedback loop the gain of which is determined by R2 and R10, with C3 acting in conjunction with R10 to boost the high frequency end of the passband. The video signal at the collector of TR4 is buffered by the emitter follower TR5. The capacitance-resistance network C7 and R17 filters the incoming target voltage which is derived from the Video Board.

5.5 EHT Control Board

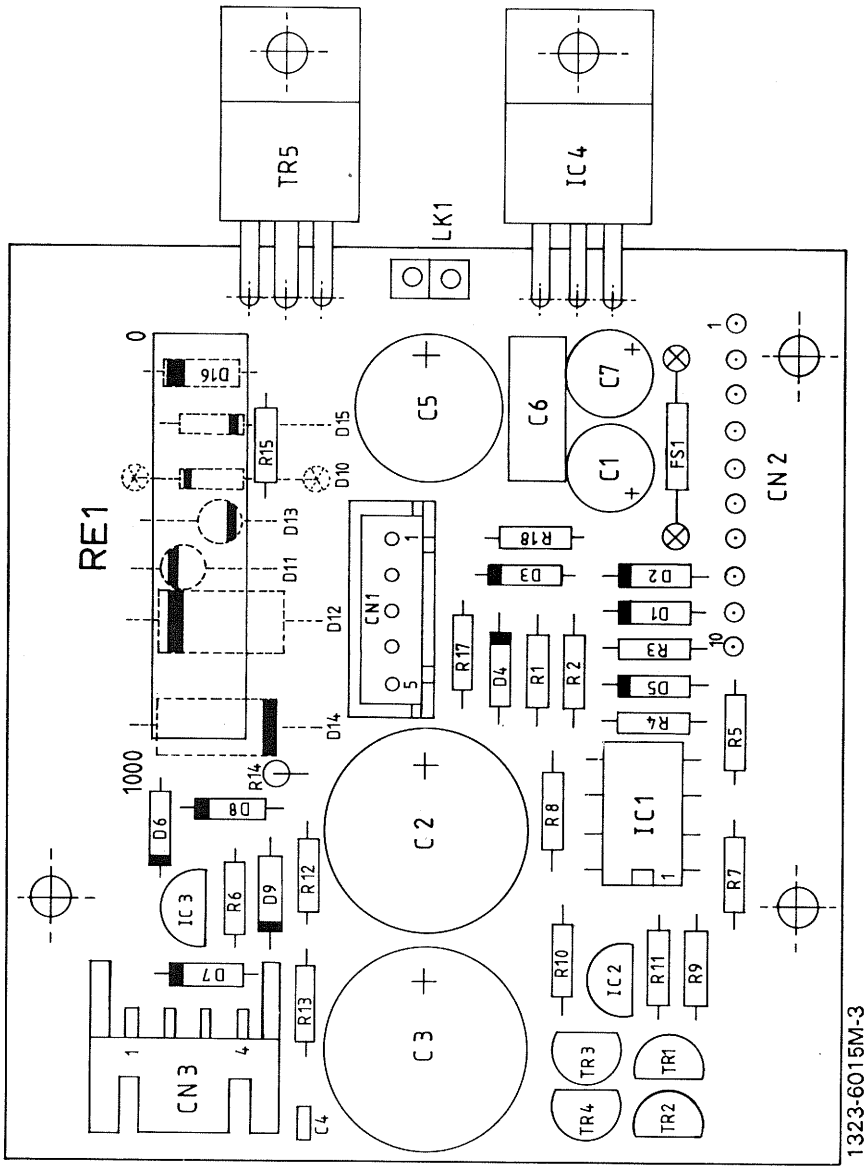
See Figures 5.11 and 5.12

The horizontal drive signal from the Time-Base Board passes directly through the control board to activate the EHT Supply Module. Similarly, the EHT control signal from the Video Board passes to the control board (connector CN1 pin 1) where the range of the signal is limited by the clamp action of IC1; that is, the control signal is unaffected while it remains within the limits determined by RV1 and RV2. The signal is applied to TR1 which acts as a current amplifier to drive the signal through L1 to the EHT Supply Module; hence, the signal controls the generation of EHT so that it does not exceed 10 kV or fall to a level which is too low for satisfactory operation of the SIT Tube.

5.6 Tube-Base Board

See Figures 5.13 and 5.14

Operating voltages for the SIT Tube pass directly through the board with two exceptions: the voltage applied to grids 3 and 4 are filtered by capacitance-resistance networks C2, R2 and C1, R1.



NOTE: D14, D12, D11, D13, D10, D15, D16 are on the reverse side of the board

FIGURE 5.1 COMPONENT LAYOUT OF THE REGULATOR BOARD

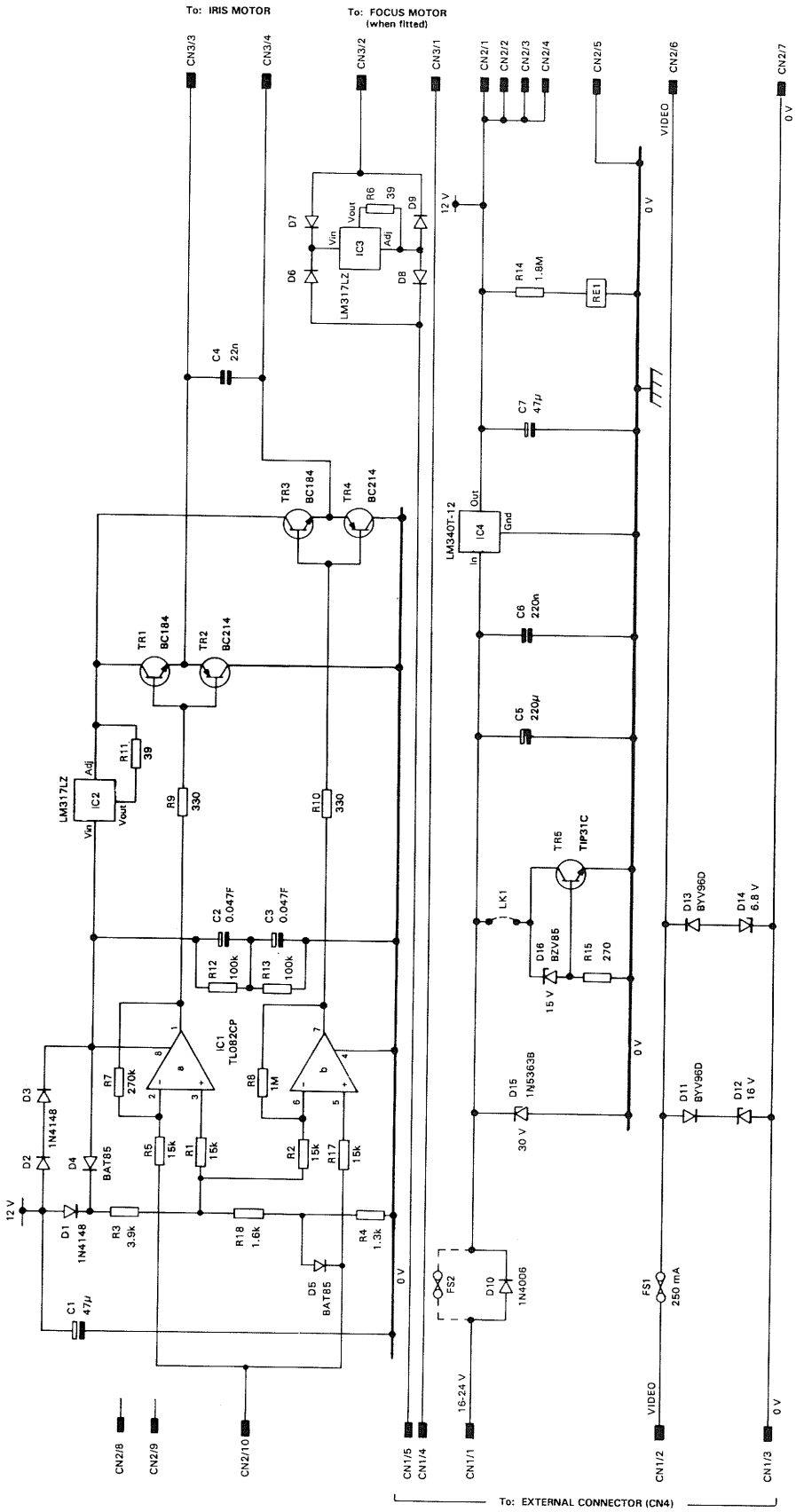


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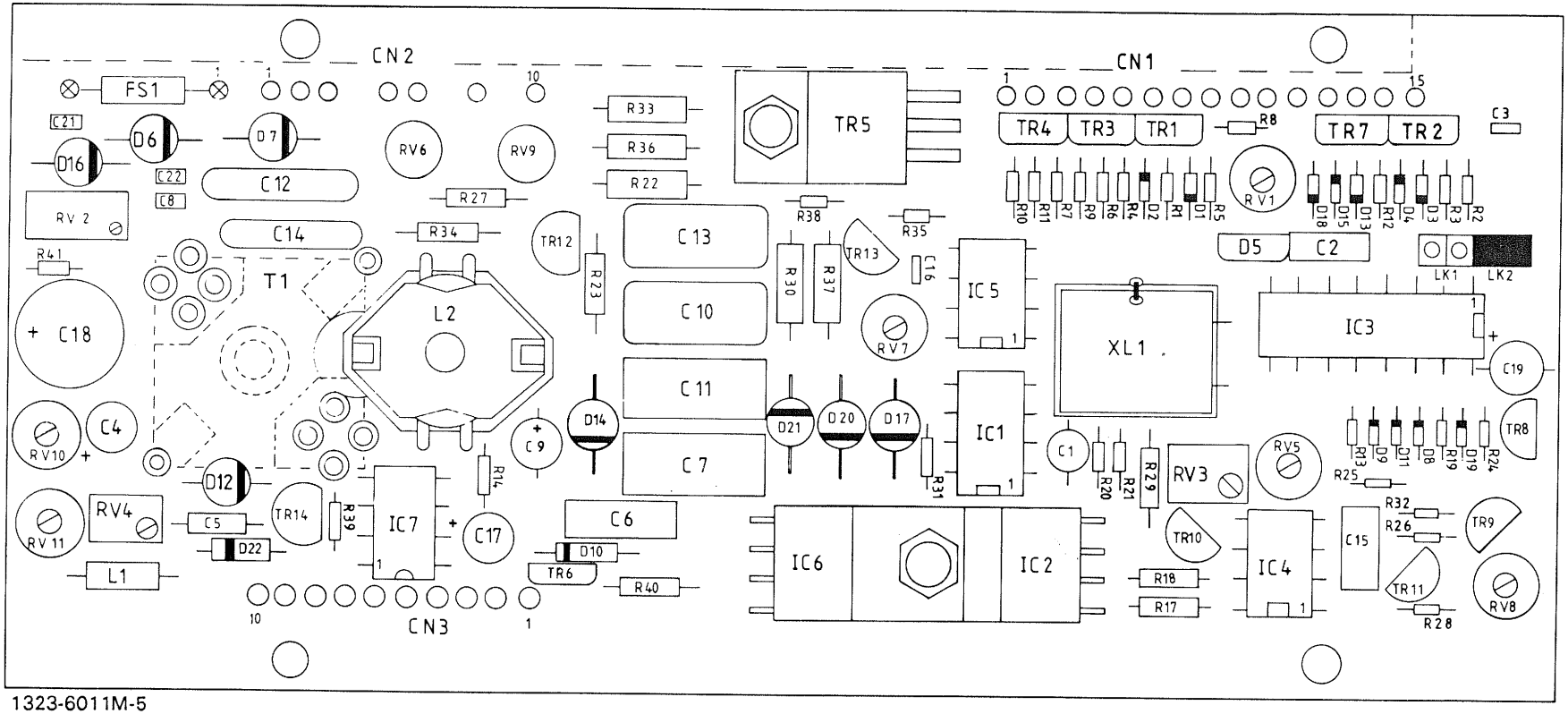
FIGURE 5.2 CIRCUIT OF THE REGULATOR BOARD

COMPONENT PARTS OF THE REGULATOR BOARD

REF.	DESCRIPTION				
C1	Tantalum Capacitor	47µF	±20%	16V	
C2	Supercap	0.047F		5.5V	
C3	Supercap	0.047F		5.5V	
C4	Ceramic Capacitor	22nF		63V	
C5	Electrolytic Capacitor	220µF	±20%	35V	
C6	Polyester Capacitor	220nF	±10%	100V	
C7	Tantalum Capacitor	47µF	±20%	16V	
CN1	Connector (male)	5 pin			
CN2	Connector pins				
CN3	Connector (male)	4 pin			
D1	Silicon Diode				1N4148
D2	Silicon Diode				1N4148
D3	Silicon Diode				1N4148
D4	Schottky Diode				BAT85
D5	Schottky Diode				BAT85
D6	Silicon Diode				1N4148
D7	Silicon Diode				1N4148
D8	Silicon Diode				1N4148
D9	Silicon Diode				1N4148
D10	Silicon Rectifier	1A		800V	1N4006
D11	Fast Soft-Recovery Diode	1A		800V	BYV96D
D12	Transient Voltage Suppressor			16V	
D13	Fast Soft-Recovery Diode	1A		800V	BYV96D
D14	Transient Voltage Suppressor			6.8V	
D15	Voltage Regulator Diode	30V	±5%	5W	1N5363B
D16	Voltage Regulator Diode	15V	±5%	1.3W	BZV85
FS1	Miniature Fuse	250mA			
FS2	Not Fitted				
IC1	Dual BiFET Operational Amplifier				TL082CP
IC2	Voltage Regulator				LM317LZ
IC3	Voltage Regulator				LM317LZ
IC4	Voltage Regulator				LM340T-12
LK1	Pin-Strip	2 way			
R1	Metal Film Resistor	15kΩ	±1%	0.4W	
R2		15kΩ	±1%	0.4W	
R3		3.9kΩ	±1%	0.4W	
R4		1.3kΩ	±1%	0.4W	
R5		15kΩ	±1%	0.4W	
R6		39Ω	±1%	0.4W	
R7		270kΩ	±1%	0.4W	
R8		1MΩ	±1%	0.4W	
R9		330Ω	±1%	0.4W	
R10		330Ω	±1%	0.4W	
R11		39Ω	±1%	0.4W	
R12		100kΩ	±1%	0.4W	
R13		100kΩ	±1%	0.4W	

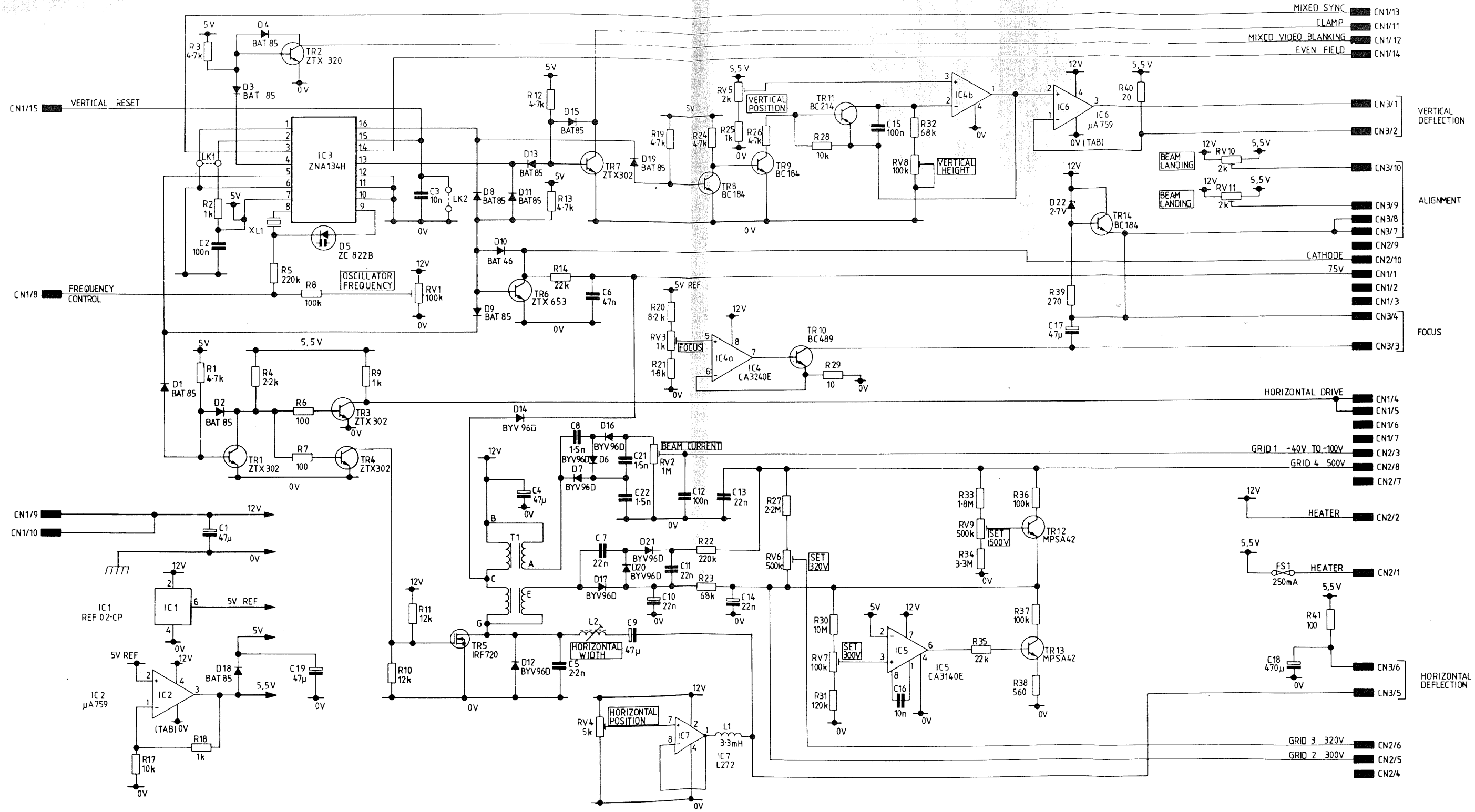
REF.		DESCRIPTION			
R14	Metal Film Resistor	1.8MΩ	±5%	0.33W	
R15		270Ω	±1%	0.4W	
R17		15kΩ	±1%	0.4W	
R18		1.6kΩ	±1%	0.4W	
RE1	Elapsed Time Meter	1000 h f-s			
TR1	Transistor	NPN		TO-92	BC184
TR2	Transistor	PNP		TO-92	BC214
TR3	Transistor	NPN		TO-92	BC184
TR4	Transistor	PNP		TO-92	BC214
TR5	Power Transistor	NPN		TO-220	TIP31C

NOTE: T1 is on the reverse side of the board



1323-6011M-5

FIGURE 5.3 COMPONENT LAYOUT OF THE TIME-BASE BOARD



1323-6011M-4

FIGURE 5.4 CIRCUIT OF THE TIME-BASE BOARD

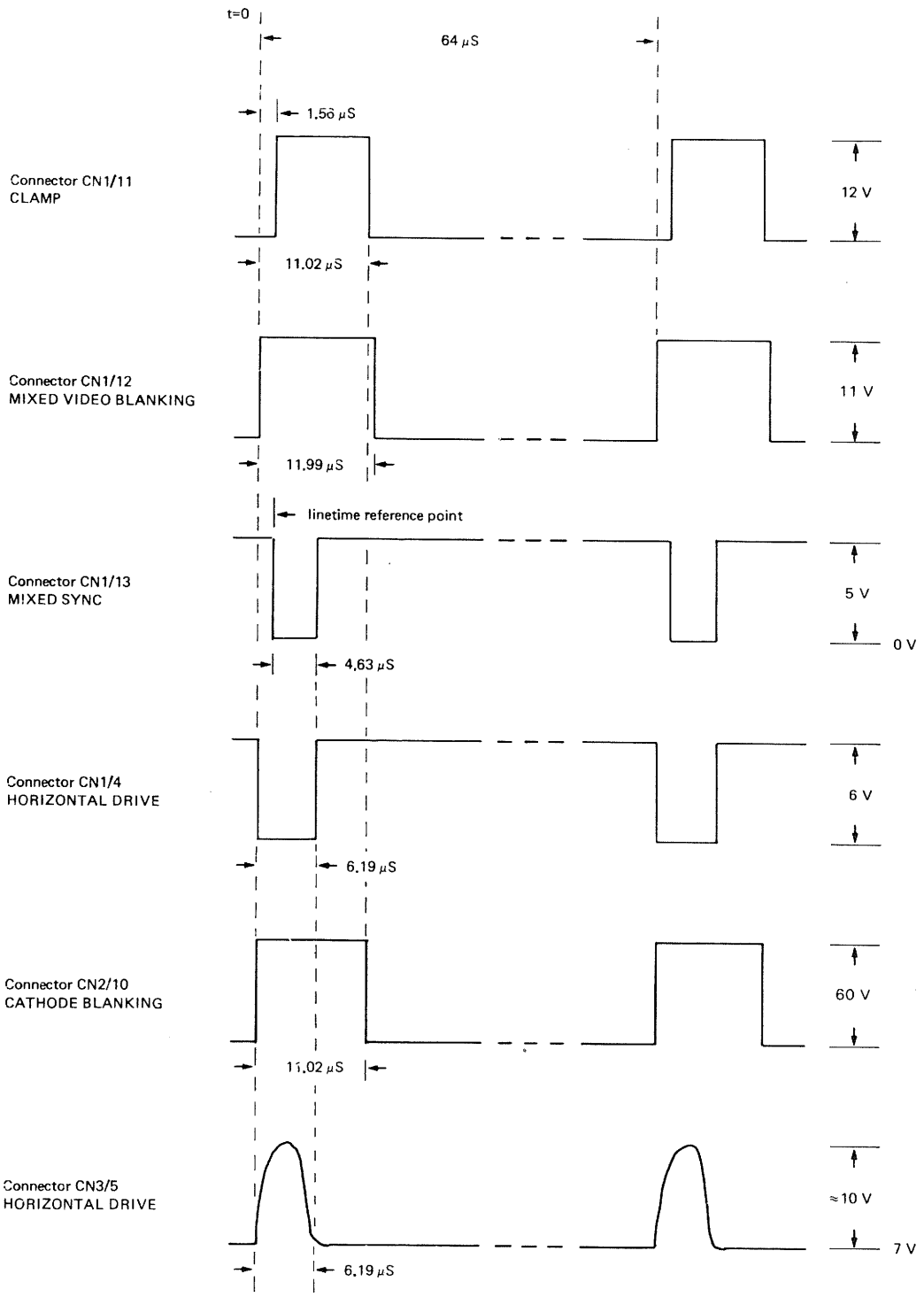


FIGURE 5.5 TIME-BASE BOARD WAVEFORMS

COMPONENT PARTS OF THE TIME-BASE BOARD

REF.	DESCRIPTION				
C1	Tantalum Capacitor	47µF	±20%	16V	
C2	Ceramic Capacitor	100nF	±10%	100V	
C3	Ceramic Capacitor	10nF	±10%	63V	
C4	Tantalum Capacitor	47µF	±20%	16V	
C5	Polyester Capacitor	2.2nF	±10%	400V	
C6	Polyester Capacitor	47nF	±10%	250V	
C7	Polycarbonate Capacitor	22nF		630V	
C8	Ceramic Capacitor	1.5nF	±10%	100V	
C9	Tantalum Capacitor	47µF	±10%	16V	
C10	Polycarbonate Capacitor	22nF		630V	
C11	Polycarbonate Capacitor	22nF		630V	
C12	Polyester Capacitor	100nF	±10%	250V	
C13	Polycarbonate Capacitor	22nF		630V	
C14	Polyester Capacitor	22nF	±10%	400V	
C15	Polyester Capacitor	100nF	±10%	100V	
C16	Ceramic Capacitor	10nF	±10%	63V	
C17	Tantalum Capacitor	47µF	±20%	16V	
C18	Electrolytic Capacitor	470µF	±20%	16V	
C19	Tantalum Capacitor	47µF	±20%	16V	
C21	Ceramic Capacitor	1.5nF	±10%	100V	
C22	Ceramic Capacitor	1.5nF	±10%	100V	
CN1	Connector Pins				
CN2	Connector Pins				
CN3	Connector Pins				
D1	Schottky Diode				BAT85
D2	Schottky Diode				BAT85
D3	Schottky Diode				BAT85
D4	Schottky Diode				BAT85
D5	Variable Capacitance Diode	22pF nom.	±5%		ZC822B
D6	Fast Soft-Recovery Diode	1A		800V	BYV96D
D7	Fast Soft-Recovery Diode	1A		800V	BYV96D
D8	Schottky Diode				BAT85
D9	Schottky Diode				BAT85
D10	Germanium Diode				OA91
D11	Schottky Diode				BAT85
D12	Fast Soft-Recovery Diode	1A		800V	BYV96D
D13	Schottky Diode				BAT85
D14	Fast Soft-Recovery Diode	1A		800V	BYV96D
D15	Schottky Diode				BAT85
D16	Fast Soft-Recovery Diode	1A		800V	BYV96D
D17	Fast Soft-Recovery Diode	1A		800V	BYV96D
D18	Schottky Diode				BAT85
D19	Schottky Diode				BAT85
D20	Fast Soft-Recovery Diode	1A		800V	BYV96D
D21	Fast Soft-Recovery Diode	1A		800V	BYV96D
D22	Voltage Regulator Diode	2.7V	±5%	0.4W	
FS1	Miniature Fuse	250mA			

REF.	DESCRIPTION				
IC1	Precision Voltage Reference	5V			REF-02CP
IC2	Power Operational Amplifier				μA759
IC3	Synchronising Pulse Generator				ZNA134H
IC4	BiMOS Operational Amplifier				CA3240E
IC5	BiMOS Operational Amplifier				CA3140E
IC6	Power Operational Amplifier				μA759
IC7	Power Operational Amplifier				L272M
L1	Inductor	3.3mH	±5%	0.25W	
L2	Inductor				
R1	Metal Film Resistor	4.7kΩ	±1%	0.4W	
R2		1kΩ	±1%	0.4W	
R3		4.7kΩ	±1%	0.4W	
R4		2.2kΩ	±1%	0.4W	
R5		220kΩ	±5%	0.5W	
R6		100Ω	±1%	0.4W	
R7		100Ω	±1%	0.4W	
R8		100kΩ	±1%	0.4W	
R9		1kΩ	±1%	0.4W	
R10		12kΩ	±1%	0.4W	
R11		12kΩ	±1%	0.4W	
R12		4.7kΩ	±1%	0.4W	
R13		4.7kΩ	±1%	0.4W	
R14		22kΩ	±1%	0.4W	
R17		10kΩ	±1%	0.4W	
R18		1kΩ	±1%	0.6W	
R19		4.7kΩ	±1%	0.4W	
R20		8.2kΩ	±1%	0.4W	
R21		1.8kΩ	±1%	0.4W	
R22		220kΩ	±5%	0.33W	
R23		68kΩ	±5%	0.33W	
R24		4.7kΩ	±1%	0.4W	
R25		1kΩ	±1%	0.4W	
R26		4.7kΩ	±1%	0.4W	
R27		2.2MΩ	±5%	0.33W	
R28		10kΩ	±1%	0.4W	
R29		10Ω	±1%	0.6W	
R30		10MΩ	±5%	0.33W	
R31		120kΩ	±5%	0.5W	
R32		68kΩ	±1%	0.4W	
R33		1.8MΩ	±5%	0.33W	
R34		3.3MΩ	±5%	0.33W	
R35		22kΩ	±1%	0.4W	
R36		100kΩ	±5%	0.33W	
R37		100kΩ	±5%	0.33W	
R38		560Ω	±1%	0.4W	
R39		270Ω	±1%	0.4W	
R40		20Ω	±1%	0.6W	
R41		100Ω	±1%	0.4W	
RV1	Trimming Potentiometer	100kΩ	±20%	0.5W	
RV2	Trimming Potentiometer	1MΩ	±10%		
RV3	Trimming Potentiometer	1kΩ	±10%	0.25W	
RV4	Trimming Potentiometer	5kΩ	±10%	0.25W	
RV5	Trimming Potentiometer	2kΩ	±20%	0.5W	
RV6	Trimming Potentiometer	500kΩ		0.5W	
RV7	Trimming Potentiometer	100kΩ	±20%	0.5W	
RV8	Trimming Potentiometer	100kΩ	±20%	0.5W	

REF.	DESCRIPTION			
RV9	Trimming Potentiometer	500kΩ		0.5W
RV10	Trimming Potentiometer	2kΩ	±20%	0.5W
RV11	Trimming Potentiometer	2kΩ	±20%	0.5W
TR1	Transistor	NPN	E-Line	ZTX302
TR2	Transistor	NPN	E-Line	ZTX320
TR3	Transistor	NPN	E-Line	ZTX302
TR4	Transistor	NPN	E-Line	ZTX302
TR5	HexFET	N-Channel	TO-220AB	IRF720
TR6	Transistor	NPN	TO-92	ZTX653
TR7	Transistor	NPN	E-Line	ZTX302
TR8	Transistor	NPN	TO-92	BC184
TR9	Transistor	NPN	TO-92	BC184
TR10	Transistor	NPN	TO-92	BC489
TR11	Transistor	PNP	TO-92	BC214
TR12	High Voltage Transistor	NPN	TO-92	MPS-A42
TR13	High Voltage Transistor	NPN	TO-92	MPS-A42
TR14	Transistor	NPN	TO-92	BC184
XL1	Crystal	2.5625MHz	HC-18/U	

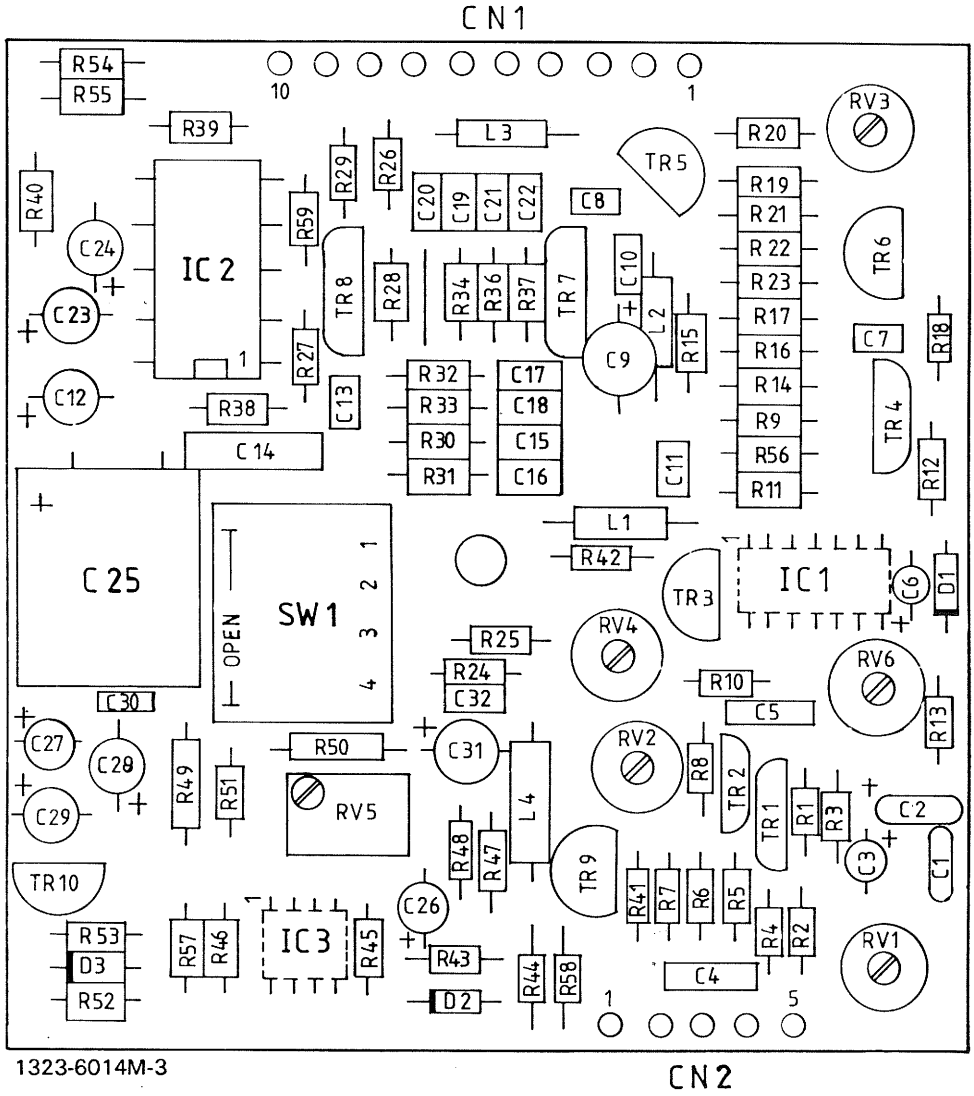


FIGURE 5.6 COMPONENT LAYOUT OF THE VIDEO BOARD

1323-5001-4

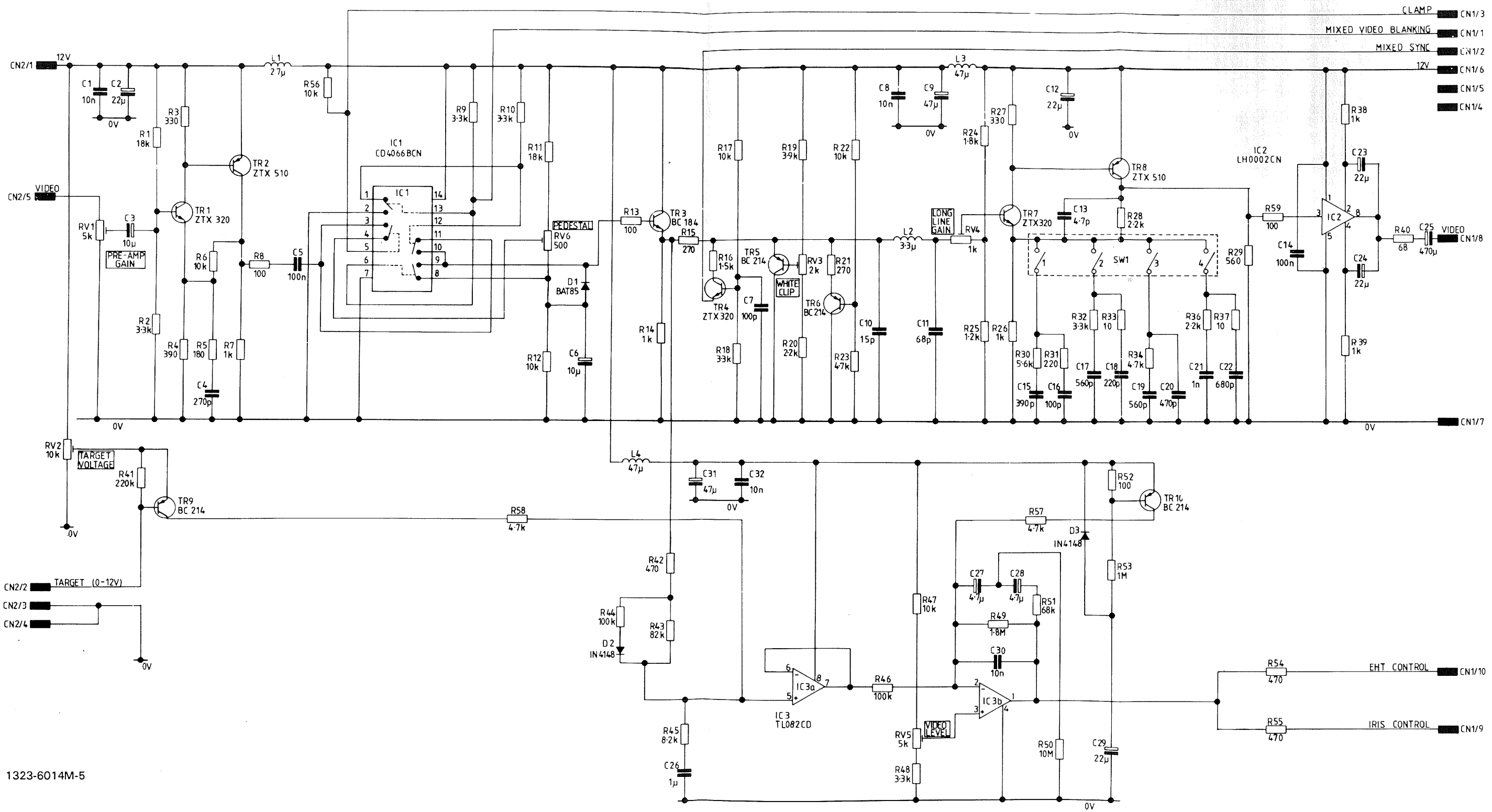


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FIGURE 5.7 CIRCUIT OF THE VIDEO BOARD

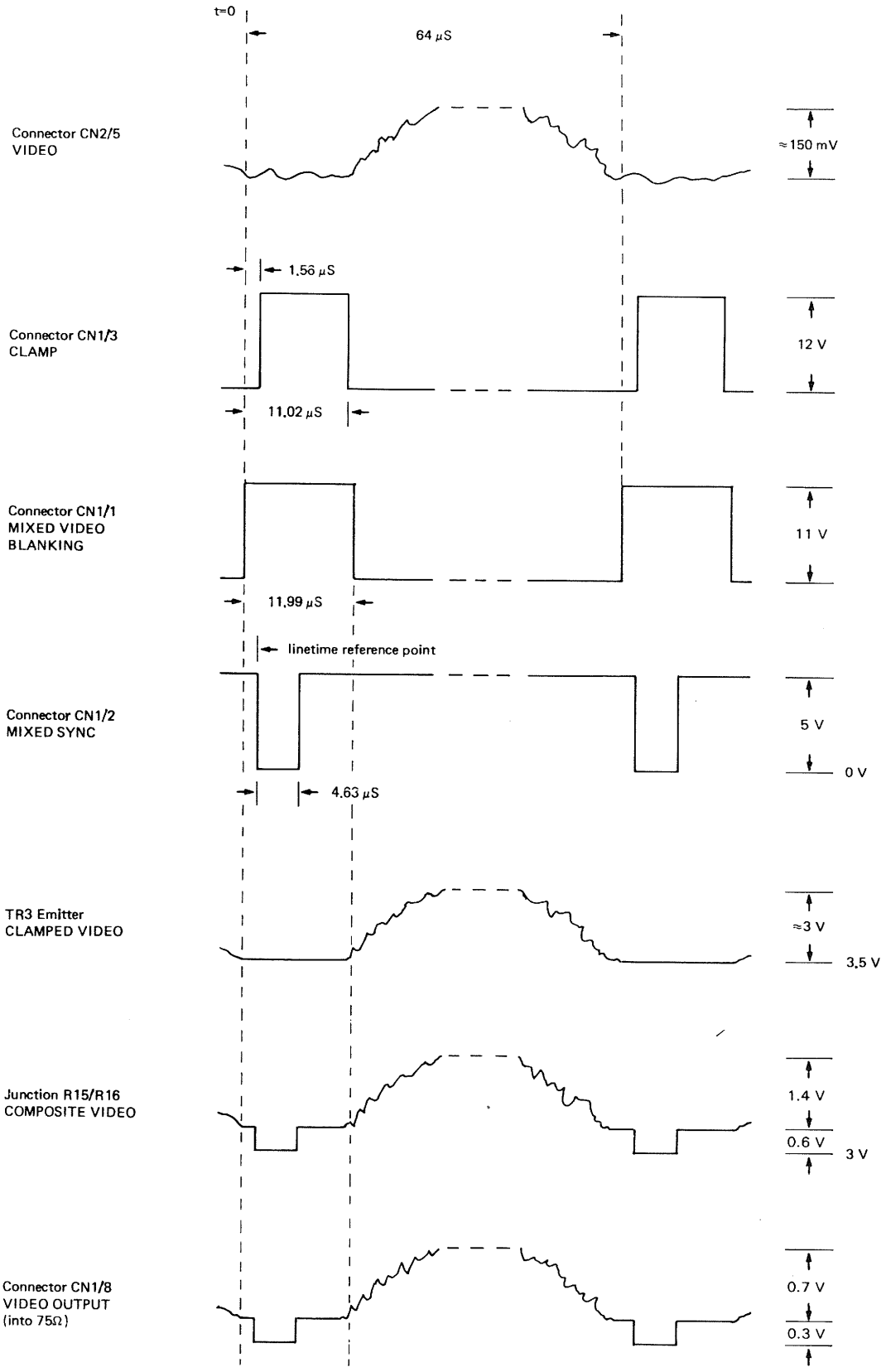

FIGURE 5.8 VIDEO BOARD WAVEFORMS

COMPONENT PARTS OF THE VIDEO BOARD

REF.	DESCRIPTION				
C1	Ceramic Capacitor	10nF	±10%	63V	
C2	Tantalum Capacitor	22μF	±20%	16V	
C3	Tantalum Capacitor	10μF	±20%	16V	
C4	Ceramic Capacitor	270pF	±2%	100V	
C5	Ceramic Capacitor	100nF	±10%	50V	
C6	Tantalum Capacitor	10μF	±20%	16V	
C7	Ceramic Capacitor	100pF	±2%	100V	
C8	Ceramic Capacitor	10nF	±10%	63V	
C9	Tantalum Capacitor	47μF	±20%	16V	
C10	Ceramic Capacitor	15pF	±2%	100V	
C11	Ceramic Capacitor	68pF	±2%	100V	
C12	Tantalum Capacitor	22μF	±20%	16V	
C13	Ceramic Capacitor	4.7pF	±0.25pF	100V	
C14	Ceramic Capacitor	100nF	±10%	100V	
C15	Ceramic Capacitor	390pF	±10%	100V	
C16	Ceramic Capacitor	100pF	±2%	100V	
C17	Ceramic Capacitor	560pF	±10%	100V	
C18	Ceramic Capacitor	220pF	±2%	100V	
C19	Ceramic Capacitor	560pF	±10%	100V	
C20	Ceramic Capacitor	470pF	±10%	100V	
C21	Ceramic Capacitor	1nF	±10%	100V	
C22	Ceramic Capacitor	680pF	±10%	100V	
C23	Tantalum Capacitor	22μF	±20%	16V	
C24	Tantalum Capacitor	22μF	±20%	16V	
C25	Electrolytic Capacitor	470μF	±20%	16V	
C26	Tantalum Capacitor	1μF	±20%	16V	
C27	Tantalum Capacitor	4.7μF	±20%	16V	
C28	Tantalum Capacitor	4.7μF	±20%	16V	
C29	Tantalum Capacitor	22μF	±20%	16V	
C30	Ceramic Capacitor	10nF	±10%	63V	
C31	Tantalum Capacitor	47μF	±20%	16V	
C32	Ceramic Capacitor	10nF	±10%	63V	
CN1	Connector Pins				
CN2	Connector Pins				
D1	Schottky Diode				BAT85
D2	Silicon Diode				1N4148
D3	Silicon Diode				1N4148
IC1	CMOS Quad Bi-Lateral Switch				CD4066BCN
IC2	Current Amplifier				LH0002CN
IC3	Dual Operational Amplifier				TL082CD
L1	Inductor	27μH		0.25W	
L2	Inductor	3.3μH		0.25W	
L3	Inductor	47μH		0.25W	
L4	Inductor	47μH		0.25W	
R1	Metal Film Resistor	18kΩ	±1%	0.4W	
R2		3.3kΩ	±1%	0.4W	
R3		330Ω	±1%	0.4W	

REF.		DESCRIPTION		
R4	Metal Film Resistor	390Ω	±1%	0.4W
R5		180Ω	±1%	0.4W
R6		10kΩ	±1%	0.4W
R7		1kΩ	±1%	0.4W
R8		100Ω	±1%	0.4W
R9		3.3kΩ	±1%	0.4W
R10		3.3kΩ	±1%	0.4W
R11		18kΩ	±1%	0.4W
R12		10kΩ	±1%	0.4W
R13		100Ω	±1%	0.4W
R14		1kΩ	±1%	0.4W
R15		270Ω	±1%	0.4W
R16		1.3kΩ	±1%	0.4W
R17		10kΩ	±1%	0.4W
R18		3.3kΩ	±1%	0.4W
R19		3.9kΩ	±1%	0.4W
R20		2.2kΩ	±1%	0.4W
R21		270Ω	±1%	0.4W
R22		10kΩ	±1%	0.4W
R23		4.7kΩ	±1%	0.4W
R24		1.8kΩ	±1%	0.4W
R25		1.2kΩ	±1%	0.4W
R26		1kΩ	±1%	0.4W
R27		330Ω	±1%	0.4W
R28		2.2kΩ	±1%	0.4W
R29		560Ω	±1%	0.4W
R30		5.6kΩ	±1%	0.4W
R31		220Ω	±1%	0.4W
R32		3.3kΩ	±1%	0.4W
R33		10Ω	±1%	0.4W
R34		4.7kΩ	±1%	0.4W
R35		Replaced by wire link		
R36		2.2kΩ	±1%	0.4W
R37		10Ω	±1%	0.4W
R38		1kΩ	±1%	0.4W
R39		1kΩ	±1%	0.4W
R40		68Ω	±1%	0.4W
R41		220kΩ	±5%	0.5W
R42		470Ω	±1%	0.4W
R43		82kΩ	±1%	0.4W
R44		100kΩ	±1%	0.4W
R45		8.2kΩ	±1%	0.4W
R46		100kΩ	±1%	0.4W
R47		10kΩ	±1%	0.4W
R48		3.3kΩ	±1%	0.4W
R49		1.8MΩ	±5%	0.33W
R50		10MΩ	±5%	0.33W
R51		68kΩ	±1%	0.4W
R52		100kΩ	±1%	0.4W
R53		1MΩ	±5%	0.5W
R54		470Ω	±1%	0.4W
R55		470Ω	±1%	0.4W
R56		10kΩ	±1%	0.4W
R57		4.7kΩ	±1%	0.4W
R58		4.7kΩ	±1%	0.4W
R59		100Ω	±1%	0.4W
RV1	Trimming Potentiometer	5kΩ	±20%	0.5W
RV2	Trimming Potentiometer	10kΩ	±20%	0.5W

REF.		DESCRIPTION			
RV3	Trimming Potentiometer	2kΩ	±20%	0.5W	
RV4	Trimming Potentiometer	1kΩ	±20%	0.5W	
RV5	Trimming Potentiometer	5kΩ	±10%	0.25W	
RV6	Trimming Potentiometer	500Ω	±20%	0.5W	
SW1	4 Position Switch	SPST			
TR1	Transistor	NPN		E-Line	ZTX320
TR2	Transistor	PNP		E-Line	ZTX510
TR3	Transistor	NPN		TO-92	BC184
TR4	Transistor	NPN		E-Line	ZTX320
TR5	Transistor	PNP		TO-92	BC214
TR6	Transistor	PNP		TO-92	BC214
TR7	Transistor	NPN		E-Line	ZTX320
TR8	Transistor	PNP		E-Line	ZTX510
TR9	Transistor	PNP		TO-92	BC214
TR10	Transistor	PNP		TO-92	BC214

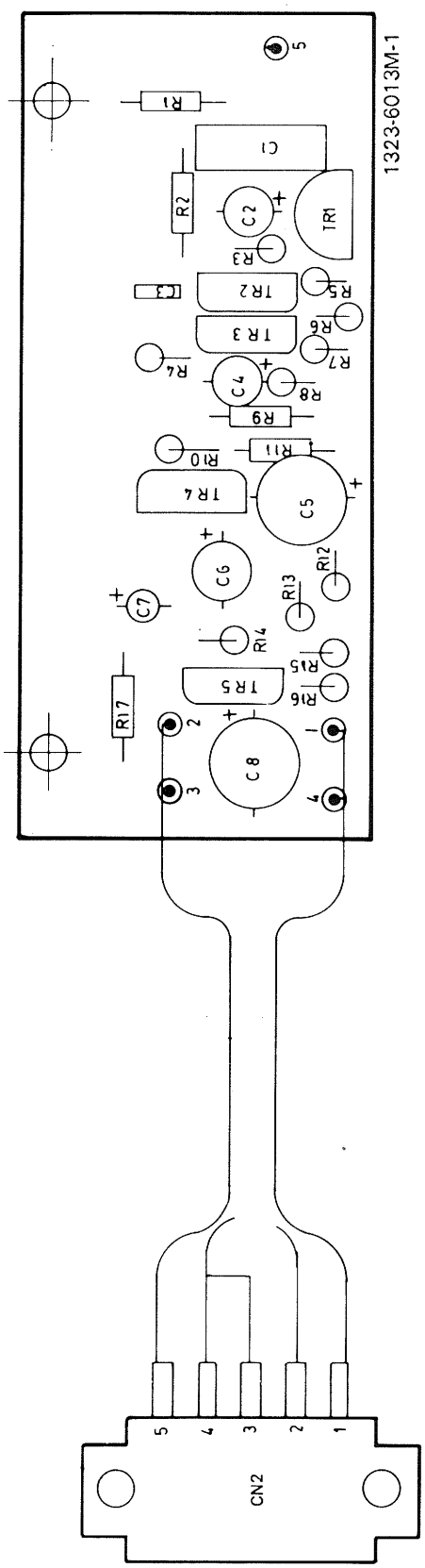

FIGURE 5.9 COMPONENT LAYOUT OF THE PRE-AMPLIFIER BOARD

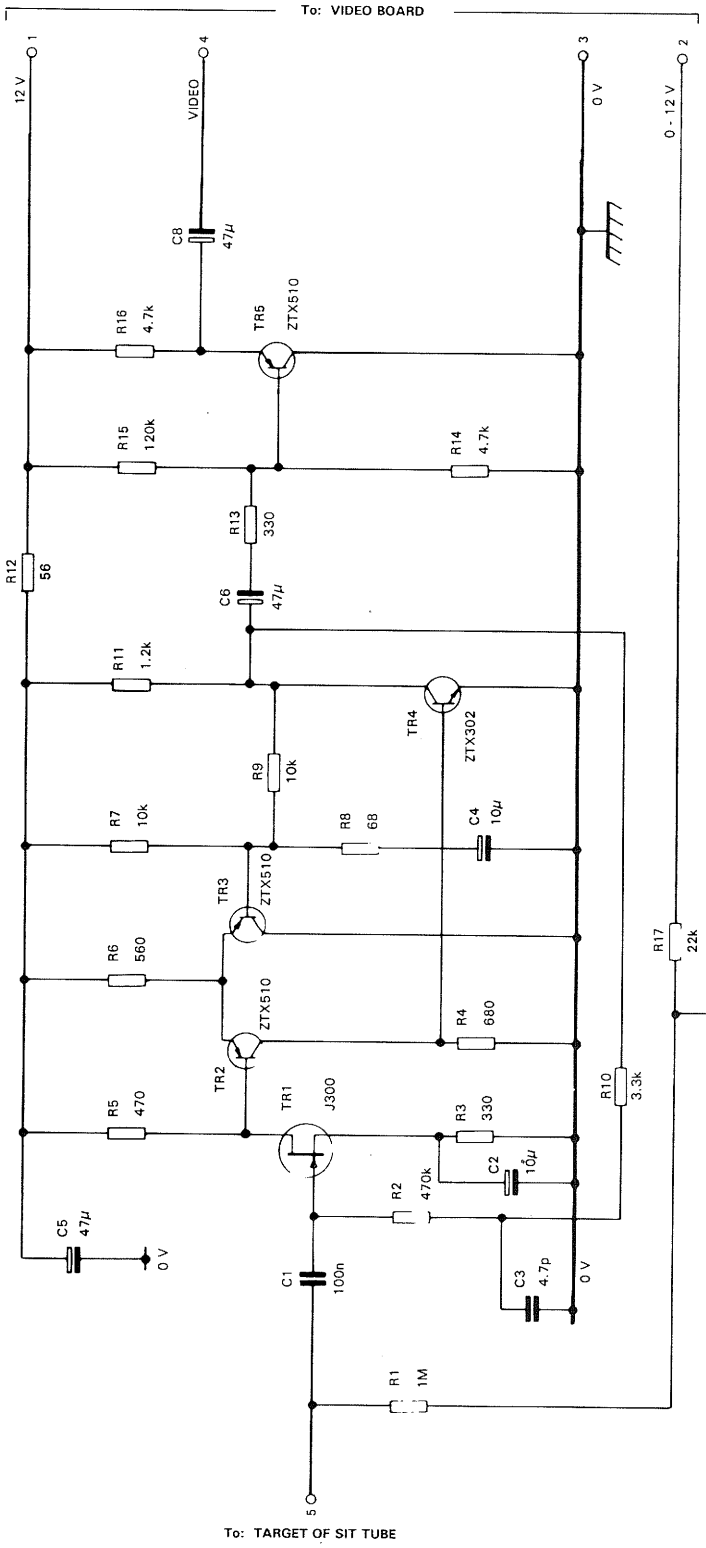

FIGURE 5.10 CIRCUIT OF THE PRE-AMPLIFIER BOARD

COMPONENT PARTS OF THE PRE-AMPLIFIER BOARD

REF.		DESCRIPTION		
C1	Ceramic Capacitor	100nF	±10%	100V
C2	Tantalum Capacitor	10μF	±20%	16V
C3	Ceramic Capacitor	4.7pF	±0.25pF	100V
C4	Tantalum Capacitor	10μF	±20%	16V
C5	Tantalum Capacitor	47μF	±20%	16V
C6	Tantalum Capacitor	47μF	±20%	10V
C7	Tantalum Capacitor	0.47μF	±20%	35V
C8	Tantalum Capacitor	47μF	±20%	10V
CN2	Connector (female)	5 way		
R1	Metal Film Resistor	1MΩ	±5%	0.5W
R2		470kΩ	±5%	0.5W
R3		330Ω	±1%	0.4W
R4		680Ω	±1%	0.4W
R5		470Ω	±1%	0.4W
R6		560Ω	±1%	0.4W
R7		10kΩ	±1%	0.4W
R8		68Ω	±1%	0.4W
R9		10kΩ	±1%	0.4W
R10		3.3kΩ	±1%	0.4W
R11		1.2kΩ	±1%	0.4W
R12		56Ω	±1%	0.4W
R13		330Ω	±1%	0.4W
R14		4.7kΩ	±1%	0.4W
R15		120kΩ	±5%	0.5W
R16		4.7kΩ	±1%	0.4W
R17		22kΩ	±1%	0.4W
TR1	JFET	N-Channel	TO-92	J300
TR2	Transistor	PNP	E-Line	ZTX510
TR3	Transistor	PNP	E-Line	ZTX510
TR4	Transistor	NPN	E-Line	ZTX302
TR5	Transistor	PNP	E-Line	ZTX510

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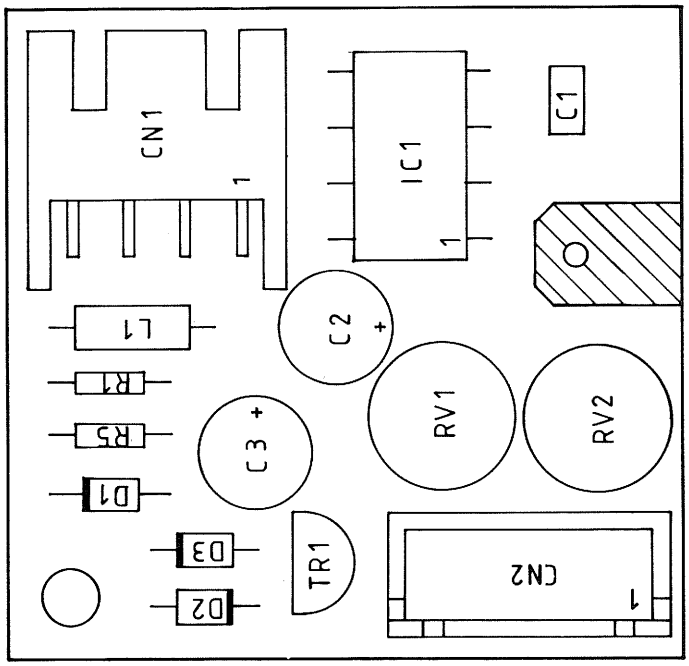
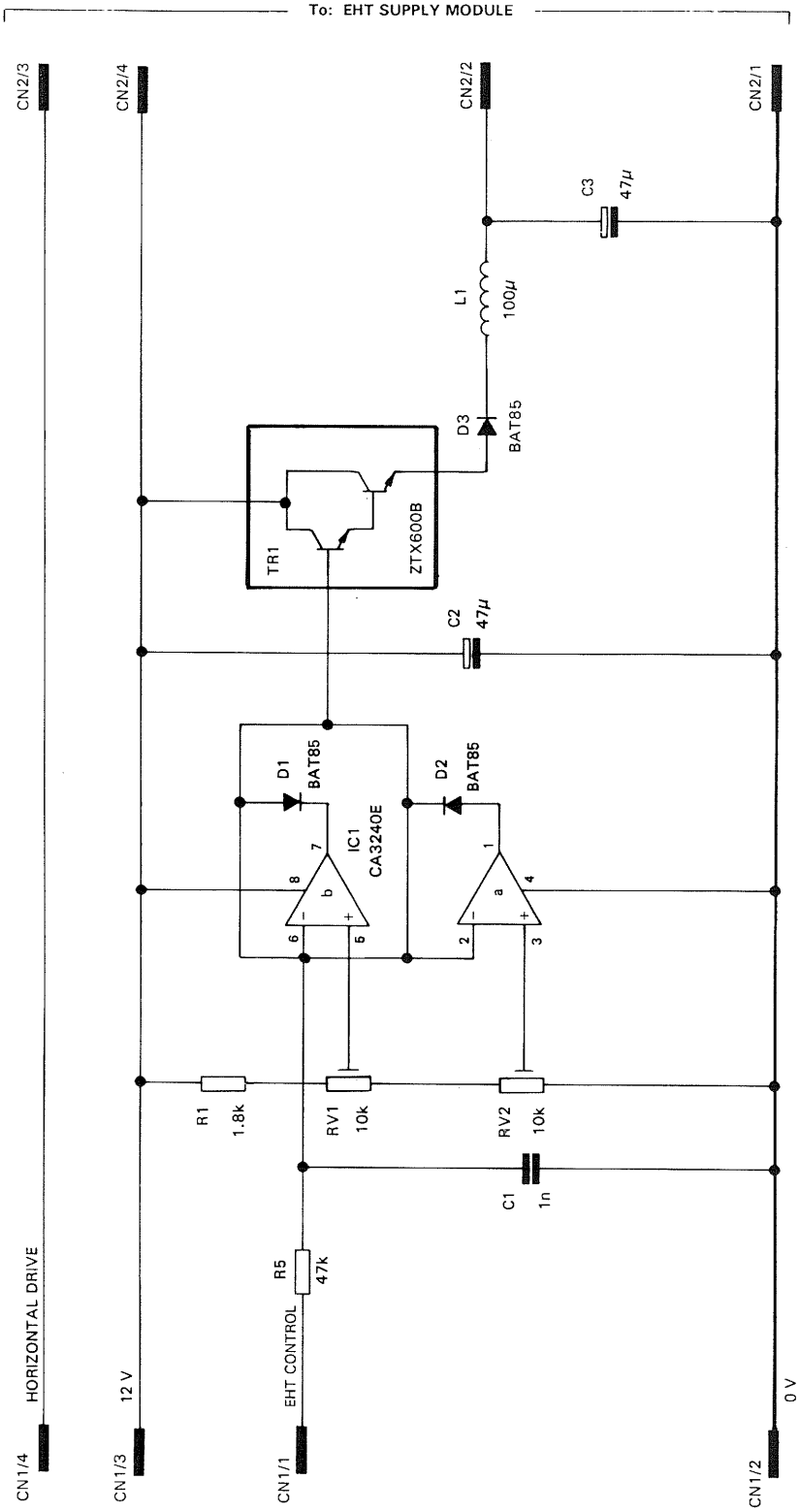


FIGURE 5.11 COMPONENT LAYOUT OF THE EHT CONTROL BOARD

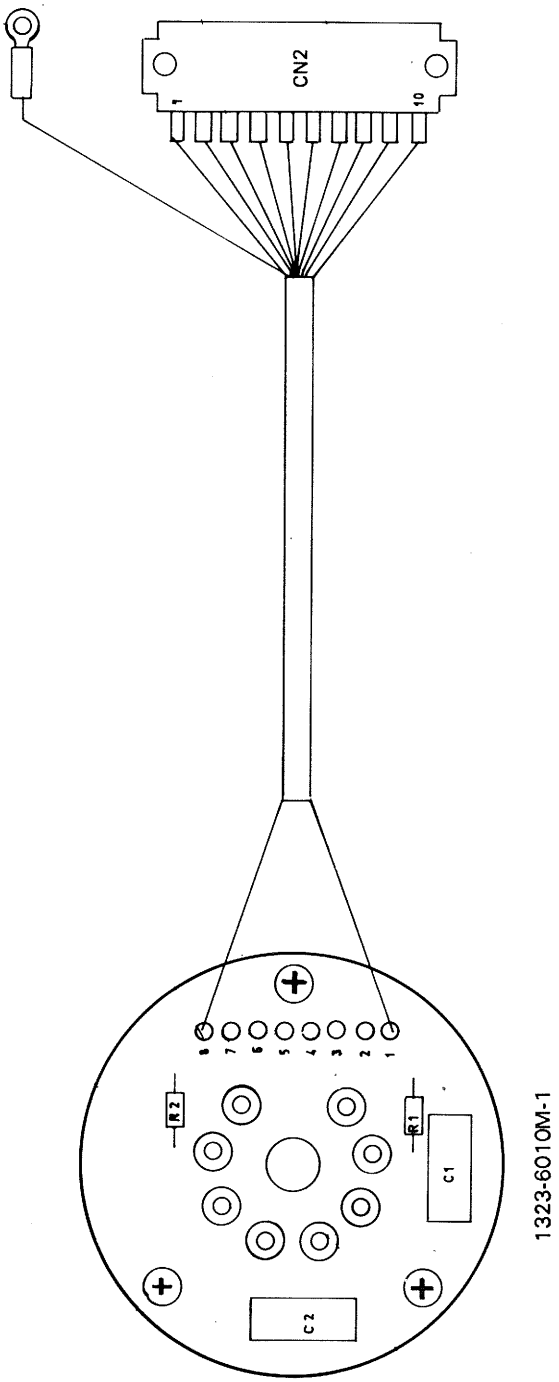


1323-6008M-2

FIGURE 5.12 CIRCUIT OF THE EHT CONTROL BOARD

COMPONENT PARTS OF THE EHT CONTROL BOARD

REF.	DESCRIPTION				
C1	Ceramic Capacitor	1nF	±10%	100V	
C2	Tantalum Capacitor	47μF	±20%	16V	
C3	Tantalum Capacitor	47μF	±20%	16V	
CN1	Connector (male)	4 pin			
CN2	Connector (male)	4 pin			
D1	Schottky Diode				BAT85
D2	Schottky Diode				BAT85
D3	Schottky Diode				BAT85
IC1	BiMOS Operational Amplifier				CA3240E
L1	Inductor	100μH	±10%	0.25W	
R1	Metal Film Resistor	1.8kΩ	±1%	0.4W	
R5	Metal Film Resistor	47kΩ	±1%	0.4W	
RV1	Trimming Potentiometer	10kΩ	±20%	0.5W	
RV2	Trimming Potentiometer	10kΩ	±20%	0.5W	
TR1	Transistor	NPN		TO-92	ZTX600B



1323-6010M-1

FIGURE 5.13 COMPONENT LAYOUT OF THE TUBE-BASE BOARD

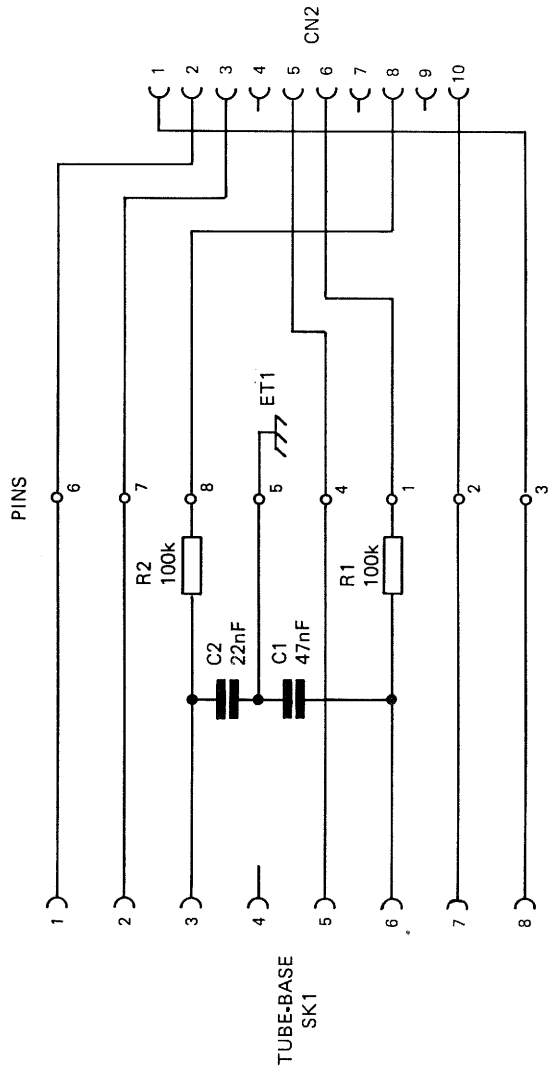
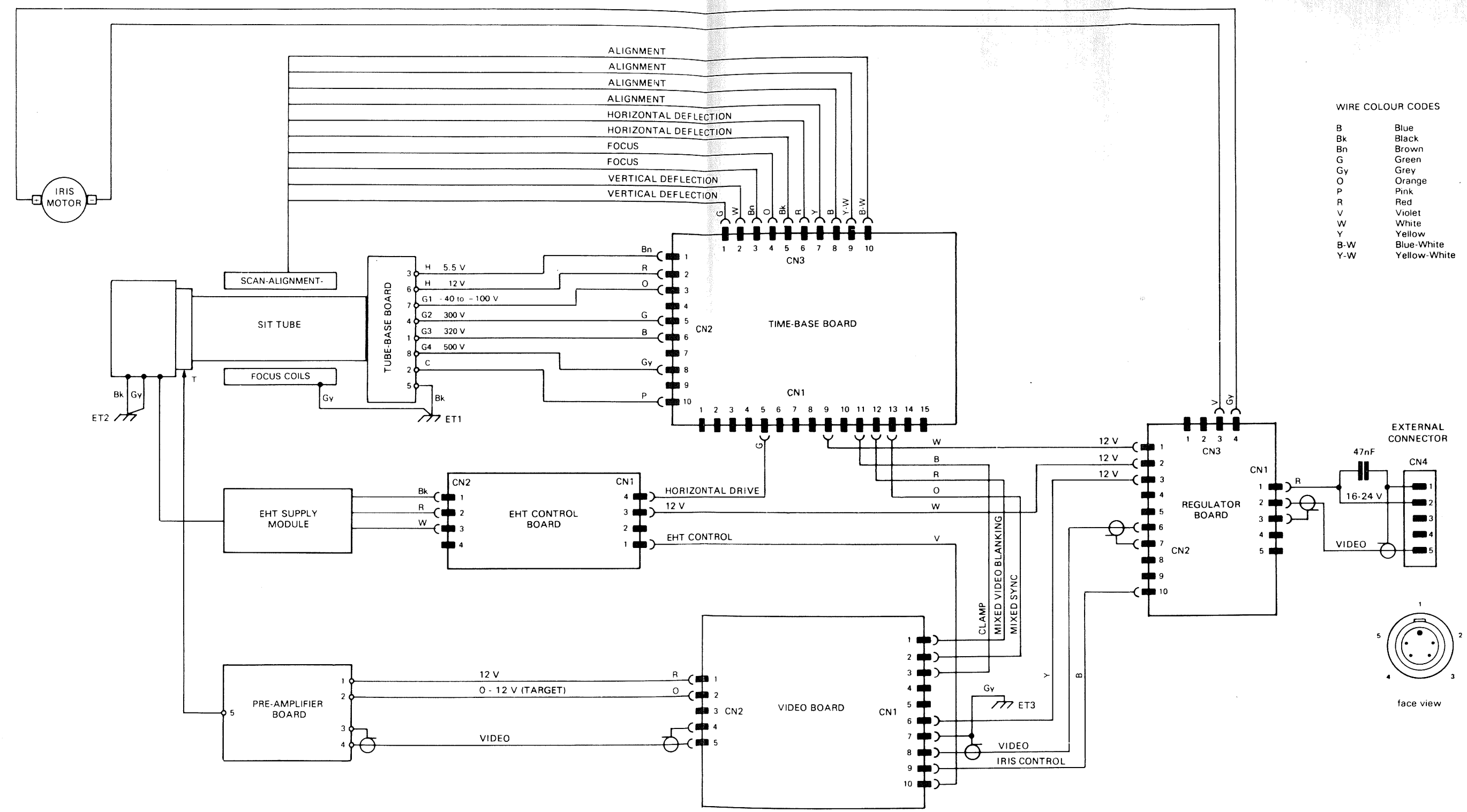


FIGURE 5.14 CIRCUIT OF THE TUBE-BASE BOARD

COMPONENT PARTS OF THE TUBE-BASE BOARD

REF.		DESCRIPTION		
C1	Polyester Capacitor	47nΩ	±10%	400V
C2	Polycarbonate Capacitor	22nF		630V
CN2	Connector (female)	10 way		
R1	Metal Film Resistor	100kΩ	±5%	0.33W
R2	Metal Film Resistor	100kΩ	±5%	0.33W



WIRE COLOUR CODES

B	Blue
Bk	Black
Bn	Brown
G	Green
Gy	Grey
O	Orange
P	Pink
R	Red
V	Violet
W	White
Y	Yellow
B-W	Blue-White
Y-W	Yellow-White

1323-5005M-5B

FIGURE 5.15 CAMERA CHASSIS WIRING

CHAPTER 6

SETTING-UP PROCEDURES

The setting-up procedures fall into three groups. The first group of procedures detail the adjustments needed when different lengths of umbilical cable are used with the camera. And the second group detail the adjustments needed when one or more of the preset controls on the printed circuit boards have been disturbed, or a board has been repaired or replaced. The second group of procedures may also be necessary in instances when the camera has been in service for some considerable time and is no longer giving its best performance. The third group of procedures is concerned with the orientation of the picture and the optical focus of the lens.

CAUTION

Certain electronic devices can be destroyed by static electricity. It is essential therefore that full protection against static is practised by service engineers.

The camera should not be used at light levels in excess of 20 lux average illumination on the faceplate of the SIT Tube for one minute or 10^3 lux peak illumination with a highlight (point source) on the faceplate for one minute.

WARNING

High voltages up to 500 V and an extra high voltage up to 10 kV are generated to operate the SIT Tube.

6.1 Cable Compensation

It is necessary to compensate for signal attenuation in the co-axial line of the umbilical cable caused by high frequency and low frequency (resistive) losses. The following procedures describe how to compensate for a change in the length of the umbilical cable.

6.1.1 Compensation for High Frequency Losses

The compensation settings are for Osprey umbilical cable or a cable of similar attenuation, that is, 6 dB attenuation/100 m at 10 MHz or, RG59 co-axial line.

Compensation is selected by a four position switch (SW1) on the Video Board - see Chapter 5, Figure 5.6. Table 6.1 (see page 47) specifies the switch settings for cables of 200, 400, 900 and 1200 metres; for intermediate lengths

the nearest setting should be adopted.

6.1.2 Compensation for Low Frequency Losses

To compensate for low frequency losses in the co-axial line, the preset control RV4 on the Video Board is adjusted until the sync portion of the video signal is 300 mV in amplitude at the surface end of the cable, which must be terminated in 75 Ω.

If it is not convenient to make the measurement at the surface end of the cable it can be made at the external connector (pin 5) of the camera by adjusting RV4 until the sync portion of the video signal is as specified in Table 6.2 - see page 47. This procedure must be carried out with the cable disconnected from the camera and the video signal at the external connector terminated in 75 Ω.

6.2 Procedures for the Video, Time-Base and EHT Control Board

Position the camera chassis in front of an evenly illuminated test card (473 mm - $18^5/_8$ in - diagonal to the outside edge of the castellations) so that the face of the card is 150 mm (6 in) from the front of the lens.

Connect the camera by a short length of cable to a source of power and a video monitor with an input impedance of 75 Ω - allow at least ten minutes after power is switched on before any procedure is undertaken. Finally, ensure that the camera 12 V internal supply (measured at connector CN2 pin 1 - Regulator Board) is 12 ±0.24 V.

6.2.1 Setting Up the Video Board - see Chapter 5, Figure 5.6

a. Set all the rockers on SW1 (cable compensation) to the open position, RV1 (pre-amplifier gain) and RV3 (white clip) fully clockwise, RV4 (long line gain) fully anti-clockwise, and RV5 (video level) three quarters clockwise.

b. Loosen the spur gear on the iris motor drive shaft - see Chapter 4, Figure 4.2.

c. Set RV2 (target voltage) fully clockwise (12 V).

d. Cap the lens and adjust RV6 so that the centre of the black level noise is 40 ±10 mV from the blanking level.

e. Adjust RV5 until the video component of the signal at CN1 pin 8 is 700 mV, that is, from the blanking level to peak white at the centre of the signal waveform.

f. Introduce a highlight (reflection of a light source) into the picture and

adjust RV3 until the video component of the signal at CN1 pin 8 is limited to 950 ±40 mV above the clamping level.

g. Tighten the spur gear on the drive shaft making sure that the set-screw locates with the flat on the shaft.

h. Repeat instruction **e**.

i. Set SW1 and RV4 for the length of umbilical cable in current use - see section 6.1.

6.2.2 Setting-Up the Time-Base Board - see Chapter 5, Figure 5.3

a. Ensure that the test card is central and at right-angles to the axis of the camera chassis.

b. Loosen the spur gear on the iris motor drive shaft - see Chapter 4, Figure 4.2.

c. Set the SIT Tube grid voltages in the following order:

Grid 2 to 300 ±1 V at CN2 pin 5 by adjusting RV7 (Set 300 V).
Grid 4 to 500 ±1 V at CN2 pin 8 by adjusting RV9 (Set 500 V).
Grid 3 to 320 ±1 V at CN2 pin 6* by adjusting RV6 (Set 320 V).

*Use a 10 MΩ impedance meter

d. Adjust RV3 (Focus) for an evenly focussed picture.

e. Adjust RV5 (Vertical Position) and RV4 (Horizontal Position) until the picture is centered on the monitor screen.

f. Adjust RV8 (Height) and L2 (Width) until the picture inclusive of castellations fills the monitor screen. Repeat instruction **e** if necessary.

g. Set RV3 (White Clip) on the Video Board fully clockwise.

h. Cap the lens and adjust RV6 (Video Board) so that the centre of the black level noise is 40 ±10 mV from the blanking level.

i. Introduce a highlight (reflection of a light source) into the picture and adjust RV2 (Beam Current) until a compromise between highlight blooming and black streaking is obtained. Check that the amplitude of the sync portion of the signal is 300 ±20 mV and if it is not, adjust RV4 (Long Line Gain) on the Video Board.

j. Retain the highlight and adjust RV3 (White Clip) on the Video Board until

the video component of the signal at CN1 pin 8 is limited to 950 ±40 mV above the clamping level.

k. Remove the highlight from the picture.

l. Reduce the tube target voltage (RV2 on the Video Board) until shading appears on the picture.

m. Adjust RV10 and RV11 (Beam Landing) until symmetrical shading and a well defined area at the centre of the picture is obtained.

n. Reset the tube target voltage to 12 V by setting RV2 on the Video Board fully clockwise.

o. Check focus (RV3) and vertical and horizontal position (RV5 and RV4).

p. Tighten the spur gear on the drive shaft making sure that the set-screw locates with the flat on the shaft.

q. Carry out instruction **e** in sub-section 6.2.1.

r. Finally, check the oscillator frequency at pin 8 of IC3. Adjust V1 for a reading of 2.5625 MHz ±7 Hz.

6.2.3 Setting Up the EHT Control Board - see Chapter 5, Figure 5.11

a. Remove the high voltage lead from the EHT Supply Module by undoing the plastic union.

b. With the camera lens capped, measure the EHT at the supply module outlet with a suitable probe and adjust RV1 on the control board for 10 kV ±1%.

c. Re-attach the high voltage lead to the EHT Supply Module, remove the lens cap and switch on power to the camera. For a period of about 30 seconds the EHT applied to the SIT Tube will be at a reduced level. During this period, adjust RV2 so that a picture appears on the monitor screen; then, re-adjust RV2 until the highlights in the picture just disappear. It is important that the adjustment is completed before the normal operating EHT is applied to the tube.

6.3 Other Adjustments

The adjustments described on the following page should be carried out when the scan focus-deflection-alignment coils or the lens is replaced or, they have moved their position owing to a loose locking screw.

6.3.1 Adjusting the Coil Assembly

a. Loosen the coil assembly locking screw.

b. Rotate the camera chassis until the Video Board is at the top and at the same time ensure that the chassis is level. Rotate the coil assembly until the picture on the monitor screen is horizontal. The coil assembly is moved by placing a pointed instrument in contact with the nylon end ring of the assembly and levering against the tube intensifier screen.

c. Tighten the coil assembly locking screw - do not overtighten.

6.3.2 Adjusting the Optical Focus of the Lens

a. Position the camera chassis in front of a test card as described in section 6.2.

b. Loosen the two socket head set-screws which lock the lens to the front bulkhead and loosen the set-screw on the spur gear.

c. Set the iris gear ring for maximum aperture of the lens iris (minimum depth of field) and if necessary reduce the level of test card illumination.

d. Rotate the lens in one direction or the other until the picture on the monitor screen is in focus.

e. Tighten the set-screws on the front bulkhead and spur gear, making sure that the set-screw on the spur gear locates with the flat on the drive shaft.

NOTE: The tables must not be used when the camera is modified to drive a balanced twin cable.

The tables refer to the actual length of the cable and not the depth at which the camera is operating.

Table 6.1 Switch settings to compensate for high frequency attenuation in Osprey umbilical cable and RG59 co-axial line

Cable Length	Switch SW1 1	2	3	4
0 m	Off	Off	Off	Off
*200 m (660 ft)	**ON**	Off	Off	Off
*400 m (1330 ft)	Off	**ON**	Off	Off
**900 m (3000 ft)	Off	Off	**ON**	Off
**1200 m (4000 ft)	Off	Off	Off	**ON**

*Osprey **RG59

Table 6.2 Sync pulse amplitude to compensate for low frequency (resistive) losses in Osprey umbilical cable and RG59 co-axial line

Cable Length	Low Frequency Loss	Sync Pulse Amplitude at the External Connector (pin 5)
0 m	0 dB	300 mV
*200 m (660 ft)	1.4 dB	350 mV
*400 m (1330 ft)	2.8 dB	410 mV
**900 m (3000 ft)	3.15 dB	430 mV
**1200 m (4000 ft)	4.2 dB	486 mV

*Osprey **RG59

CHAPTER 7

FAULT FINDING AND MAINTENANCE

The fault finding procedures are designed to help the service engineer locate the area of the camera in which the fault lies. In the event that the fault is on one of the printed circuit boards, replacement of the board, as opposed to replacement of a component part of the board, is the preferred procedure. If the replacement of a printed circuit board or a principal part of the camera is necessary, disassembly procedures are given in Chapter 8. Before attempting to locate a fault the service engineer must assure himself that a genuine fault condition exists and the alleged fault is not simply a misinterpretation of the operating procedures by the user. Table 7.1 on the following page lists a number of symptoms and some possible causes.

Before attempting the following procedures, ensure that the surface control unit and the video monitor are operating correctly, and check the umbilical cable which is in current use for continuity and insulation:

5 pin Sea Con/Impulse Connector		17 pin Cannon Connector
pin 1	----------	pin M & F
2	----------	G
3	----------	H
4	----------	S
5	----------	A

CAUTION

Certain electronic devices can be destroyed by static electricity. It is essential therefore that full protection against static is practised by service engineers.

WARNING

High voltages up to 500 V and an extra high voltage up to 10 kV are generated to operate the SIT Tube.

Table 7.1 List of symptoms and some possible causes

SYMPTOM	POSSIBLE CAUSE
No video signal See section 7.1	Blown protection fuse Fault on one of the printed circuit boards, the EHT Supply Module or, a defective SIT Tube
Degraded video signal See section 7.2	Fault on the Pre-Amplifier, Video or Time-Base Board or, a defective SIT Tube
Automatic iris fails to operate See section 7.3	Faulty iris motor or mechanical link Fault on the Video or Regulator Board

7.1 No Video Signal

Check fuse FS1 on the Regulator Board; a blown fuse will stop the video signal from reaching the external connector (CN4) of the camera. If the fuse is intact, determine whether the supply voltage (nominally 24 V) is reaching the input pin of IC4 on the Regulator Board. Failure to obtain a reading indicates a faulty reverse voltage protection diode D10. If 24 V is present, see whether 12 V is present at the output pin of IC4 - connector CN2 pin 1. Failure to obtain a reading indicates that IC4 is probably faulty. In the event that 12 V is present, there are a number of areas which can be investigated:

a. See whether the iris is closed (the white indicator spot on the lens body will be opposite C) and if it is, look for a mechanical fault between the spur gear and the iris motor. If no fault is found, determine whether the iris motor is in the stalled condition, that is, the motor continues to try to drive the iris beyond its minimum aperture. If the motor is in the stalled condition, look for a fault on the Regulator Board circuit which controls the motor.

b. Determine whether the tube operating voltages are correct - grid and target voltages must be measured with a 10 MΩ impedance meter:

Grid 1	−40 to −100 V	Heater	6.5 V
Grid 2	300 V		
Grid 3	320 V		
Grid 4	500 V		
Target	12 V		

If one or more of the grid voltages is in error, suspect a fault on the Time-Base Board. If the heater voltage is not present, suspect fuse FS1 on the Time-Base Board. No target voltage indicates a fault on the Video Board - check TR9 and its

associated components.

c. Determine whether the EHT Supply Module is operating. See whether horizontal drive pulses are on connector CN2 pin 3 of the EHT Control Board. Normally, the EHT control signal on CN2 pin 2 (EHT Control Board) which controls the output of the EHT Supply Module will vary from about 3 to 8 V with changes in the level of the video signal. However, with no video signal present, the control signal will be at a maximum of about 8 V. Under these conditions the supply module should generate −10 kV. When the control signal is present and there is no output from the supply module, suspect the module.

d. Determine whether the waveforms shown in Chapter 5, Figure 5.5 are present on the Time-Base Board. If they are, see that mixed video blanking, mixed sync and clamp pulses are reaching the Video Board on connector CN1 pins 1, 2 and 3 - see Chapter 5, Figure 5.8. When all timing waveforms are present, look for a video signal on pin 4 of the Pre-Amplifier Board. The presence of a video signal at this point indicates that the fault probably lies on the Video Board. Failure to obtain an output from the Pre-Amplifier Board indicates a faulty board or alternatively a defective SIT Tube.

7.2 Degraded Video Signal

The term degraded refers to a video signal which although present at the external connector of the camera, produces a picture on the monitor screen which is poor in contrast, resolution, linearity or proportions.

a. A picture lacking in contrast (or the converse) may be caused by a faulty automatic iris - see section 7.3. Once it is determined that the automatic iris mechanism is operating normally, check the SIT Tube operating voltages as described in section 7.1b. If these are correct, the fault may be in the Pre-Amplifier or Video Board, but owing to the uncertainty of assessing signal levels on these boards, it is advisable to replace each board in turn commencing with the Video Board. It should not be discounted that the tube may be faulty.

b. A picture exhibiting poor resolution should not be confused with a picture that is simply not in focus. Assuming that the optical focus of the lens has not been altered, an out of focus picture is most likely to be caused by a fault in the focusing circuit (IC4a and TR10) which is situated on the Time-Base Board. Poor resolution may be caused by a fault on the Pre-Amplifier or Video Board, and each board should be replaced in turn, commencing with the Video Board. Again, a faulty tube should not be discounted.

c. Errors in picture linearity are most likely to be caused by a fault on the Time-Base Board; waveforms and voltage levels should be checked - see Chapter 5, Figure 5.5.

d. A picture of incorrect proportions is most likely to be the result of a fault on the Time-Base Board; waveforms and voltage levels should be checked - see Chapter 5, Figure 5.5. It should be noted that although picture proportions may be corrected by the Height (RV8) or Width (L2) controls, the presence of a fault can not be precluded.

7.3 Automatic Iris Fails to Operate

Failure of the automatic iris will result in the camera being unable to follow changes in scene luminance. It can be determined whether the automatic iris is operating by placing a piece of card in front of the camera lens and seeing whether the Iris Motor operates to increase the lens iris aperture. If there is no movement, examine the mechanical link between the motor and the gear ring on the lens. Finally, determine whether a bi-polar voltage of about 8 V appears on connector CN3 pins 3 and 4* on the Regulator Board when the level of scene luminance is changed. If the bi-polar voltage is present, the Iris Motor should be suspected. If the bi-polar voltage is not present, it can be determined whether the fault lies in the iris control circuit (Video Board) by loosening the spur gear on the drive shaft and manually adjusting the gear ring on the lens for a normal picture. The presence of a normal picture indicates that the video signal at the emitter of TR3 (Video Board) is within normal limits, and the fault lies in the circuit comprising IC3a and IC3b (Video Board) or IC1, TR1-TR4 on the Regulator Board.

*Measure with CN3 disconnected as a stalled motor will reduce the voltage to about 1 V between pins 3 and 4 and hence give a false impression.

7.4 Maintenance

The camera does not require routine maintenance. However, on occasions when the camera chassis is removed from its housing, attention must be given to the **O** ring seals and the port (correction lens) before it is rehoused. Instructions for cleaning the **O** rings and the port are given in the following chapter.

Before the camera is stored for any length of time, wash the housing with fresh water and dry with a suitable cloth (do not use a hot-air dryer) and finally, cover the port with the black protection cap and the external connector with the yellow cap. Ensure that the camera is maintained within the specified temperature range - see Chapter 2, section 2.5.

CHAPTER 8

DISASSEMBLY PROCEDURES

The following procedures are concerned with the disassembly of the principal parts of the camera; reference to the location diagram (Chapter 4, Figure 4.2) is recommended for some of the procedures. In instances when additional information is needed to ensure that the original or replacement part is fitted correctly, further instructions are given as part of the procedure.

NOTE: Molykote 111 is a silicone grease suitable for **O** rings. Aqualube is a lubricant containing a corrosion inhibitor suitable for use with retaining screws which come into contact with sea water.
Hexagon keys for the first two procedures are supplied with the camera.

8.1 Removal of the Chassis from the Camera Housing

Undo the three socket head screws at the back end of the camera and screw them into the three threaded holes displaced by 60° . Tighten the socket head screws by equal amounts so that the housing is parted from the back end. Withdraw the chassis from the housing with care and finally remove the amber coloured insulating material which encircles the chassis. This procedure should be carried out with the umbilical cable disconnected from the external connector.

Before re-assembling the chassis and housing, the insulating material must be replaced; remake the longitudinal join with double-sided self-adhesive tape. Also, ensure that the **O** ring on the front bulkhead and the back end is clean and lightly coated with silicone grease. See that the grooves the rings fit into are clean and the three socket head screws are lightly coated with Aqualube. Do not overtighten the screws.

8.2 Removal of the Correction Lens from the Camera Housing

Withdraw the chassis from the housing as described in the preceding section and undo the three socket head set-screws which hold the correction lens in position. Using a blunt tool covered with a wad of soft material, push the correction lens out of the housing.

Before re-assembling the correction lens, clean the surfaces with propanol or a proprietary brand of lens cleaning fluid and a non-abrasive cloth. Ensure that the **O** ring is clean and lightly coated with silicone grease. Also, see that the groove the ring fits into is clean and the three set-screws are lightly coated with Aqualube. Do not overtighten the set-screws.

8.3 Removal of the Regulator Board

a. Separate connectors CN1 and CN3.

b. Undo the pan head screws which hold the TIP31C (TR5) and LM340T-12 (IC4) to the heatsink bracket.

c. Undo the three pan head screws which hold the board to the chassis rails.

d. Prise the board from the 10 way connector (CN2) which is attached to the chassis rail, taking care not to damage the connector pins on the underside of the board.

When a replacement board is fitted, ensure that the thermal transfer pads and insulating bushes on the TIP31C and LM340T-12 are in good condition. If their condition is in doubt, replace them.

8.4 Removal of the Time-Base Board

a. Undo the four pan head screws which hold the board to the chassis rails.

b. Prise the board from the three connectors (CN1, CN2, CN3) which are attached to the chassis rails, taking care not to damage the connector pins on the underside of the board.

When a replacement board is fitted, carry out the setting-up procedure detailed in Chapter 6, sub-section 6.2.2.

8.5 Removal of the Video Board

a. Undo the pan head screw which holds the board to the intensifier screen.

b. Prise the board from the two connectors (CN1, CN2) which are attached to the sides of the intensifier screen, taking care not to damage the connector pins on the underside of the board.

When a replacement board is fitted, carry out the setting-up procedure detailed in Chapter 6, sub-section 6.2.1.

8.6 Removal of the Pre-amplifier Board

a. Remove the Video Board - see the preceding section.

b. Remove the cover plate which is attached to the intensifier screen by four

countersunk head screws.

c. Undo the two pan head screws which hold the connector (CN2) to the side of the intensifier screen.

d. Unsolder the lead (attached to pin 5 of the board) from the SIT Tube target connection.

e. Undo the two pan head screws which hold the board to the intensifier screen.

NOTE: A replacement board is supplied with wiring and connector.

8.7 Removal of the EHT Control Board

a. Separate connectors CN1 and CN2.

b. Undo the two pan head screws which hold the board to the tube cover. Do not mislay the two spacers between the board and the cover.

When a replacement board is fitted, carry out the setting-up procedure detailed in Chapter 6, sub-section 6.2.3.

8.8 Removal of the EHT Supply Module

a. Separate connector CN2 on the EHT Control Board.

b. Undo the plastic union which is at the front end of the module.

c. Undo the two countersunk head screws which hold the module to the tube cover.

d. Disengage the module from the high voltage lead.

NOTE: A replacement module is supplied with wiring and connector.

8.9 Removal of the Iris Motor

a. Separate connector CN3 on the Regulator Board.

b. Turn the iris gear ring on the lens until the set-screws on the motor coupling are accessible.

c. Loosen the set-screws which lock the motor coupling to the motor shaft and the spur gear to the drive shaft.

d. Partly withdraw the drive shaft until the two countersunk head screws which hold the motor to the motor bulkhead are accessible.

e. Undo the screws and release the motor from the bulkhead.

When re-assembling, make sure that the lens iris is set to the position marked **C** before the spur gear is tightened to the drive shaft. Note the flats on the shafts.

NOTE: A replacement motor is supplied with screen, wiring and connector.

8.10 Removal of the Lens

a. Loosen the set-screw on the spur gear and remove the gear from the drive shaft.

b. Loosen the two socket head set-screws which hold the lens to the front bulkhead and unscrew the lens in an anti-clockwise direction.

When re-fitting the lens or fitting a replacement lens, follow the procedure in Chapter 6, sub-section 6.3.2.

8.11 Removal of the SIT Tube

CAUTION: To be carried out in subdued lighting.

a. Remove the Time-Base and Video Board (see sections 8.4 and 8.5); also, remove the cover plate which is attached to the intensifier screen.

b. Remove the 10 way connector (CN1) which is attached to the side of the intensifier screen and joins to the Video Board.

c. Loosen the set-screw which locks the motor coupling to the drive shaft, and undo the plastic union which is at the front end of the EHT Supply Module.

d. Release the solder tag (ET2) which is attached to the intensifier screen - the tag is joined to two wires: grey and black.

e. Unsolder the wire from the target connection of the tube.

f. Undo the four socket head screws (use an hexagon ball driver) which hold the motor bulkhead to the intensifier screen and pull the two assemblies apart. As they part, release the Tube-Base Board from the tube.

g. Undo three pan head slotted screws which are part of the tube assembly - two of the screws are recessed.

h. Pull the tube out of the tube cover, but do not pull on the black target cover of the tube.

i. When a replacement tube is fitted, first observe the caution given at the beginning of Chapter 3 and secondly, reset the optical focus of the lens as described in Chapter 6, sub-section 6.3.2.

8.12 Removal of the External Connector

a. Separate connector CN1 on the Regulator Board.

b. Undo three countersunk head screws which hold the rear bulkhead to the back end.

c. Unscrew the connector in an anti-clockwise direction from the back end.

When the connector is re-fitted, tighten to a torque of 130 ±5 lb in.