ICL TAPE READER

TYPE TR6

APRIL 1967 E.P. 72

TECHNICAL MANUAL

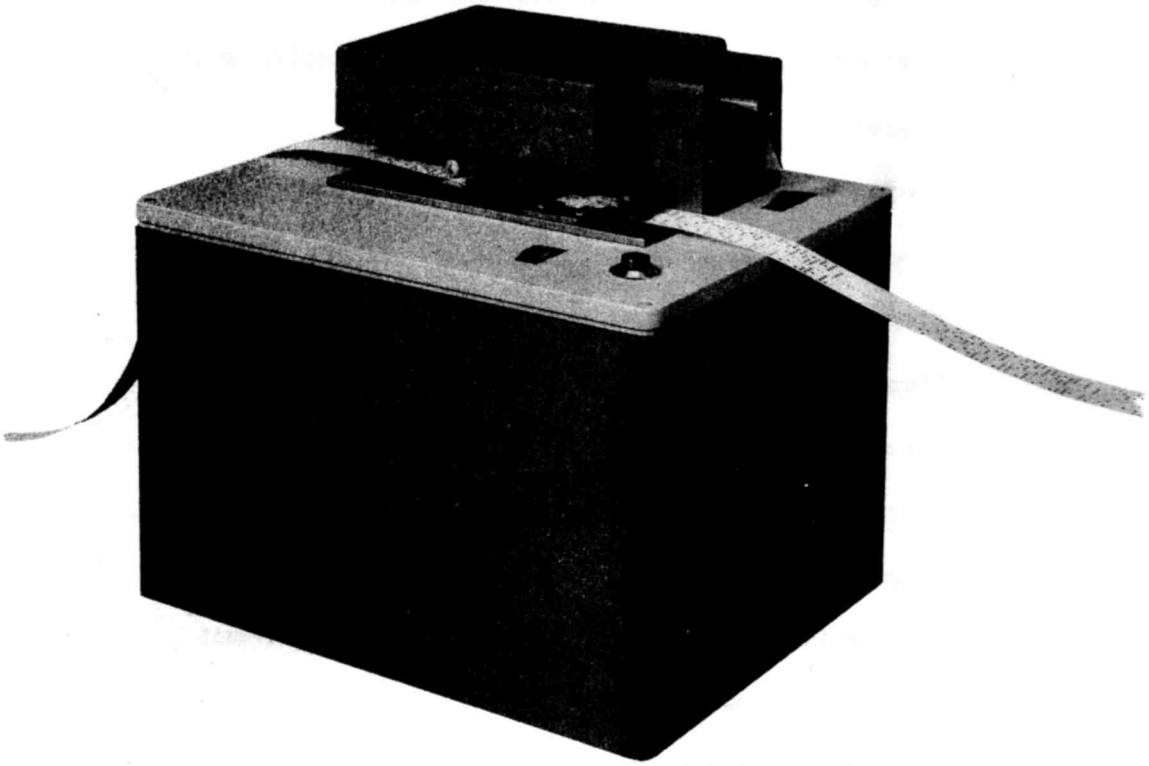
CONTENTS

DIAGRAMS

(Diagrams are grouped at the back of the book)

NOTE: Any queries relating to the TR6 reader should include the serial no. stamped on the chassis frame.

I.C.T. policy is one of continuous improvement and the right is reserved to revise equipment specifications and published details without notice.



GENERAL VIEW OF THE TR6 TAPE READER

CHAPTER 1

GENERAL

1.1 Purpose and function

These readers have been designed to read, photo-electrically, information punched on paper teleprinter tape and to convert this information into electrical signals.

Readers are available with maximum operating speeds of either 150 or 300 ch/sec. 5,6,7 and 8-track tape can be handled.

1.2 Physical description

The complete reader comprises the tape drive mechanism, power supplies, optical system, reading head unit, cooling system and packages for controlling the movement and reading of tape.

A pinch roller drive is used for tape transportation in order to minimise tape wear. It has the advantage that, should the tape be twisted or prevented from passing through the reader in an orthodox manner, it will slip in the drive mechanism without being torn. Also this system allows for larger permissible variations in tape and splice thickness.

The drive/brake mechanism is driven continuously by the blower motor. The low inertia driving drum is one of a pair driven by a differential. One or the other is braked while the opposite number is in motion. This permits the short duration start/stop times specified in section 1.3.

A MAINS on/off switch and RUN OUT button are also incorporated.

1.3 Technical specification

Size:-	9¼ in (241.25mm) x 11½ in (304.5mm) x 10½ in (276.5mm) high
Weight:-	35 lbs (16 kg)
Temperature:-	Maximum operating of 50°C ambient
Humidity:-	Maximum 70% RH. Minimum 30% RH.
Connectors:-	4 way Belling Lee Unitor for mains 25 way Belling Lee Unitor for signals
Power consumption:-	85 watts
Start time:-	Less than 6.6ms to full speed
Stopping characteristics from full speed:-	Distance less than 0.37 in (0.94mm) Time less than 1.5ms

Input control signal

START:-	0 to -6V minimum 0 to -9V maximum Edge time less than 3μs The input must be positive for 100μs minimum

Output signals

DIGITS, LOCATION HOLE and READY	Rise time 0.1 to 1.0μs Fall time 0.5 to 4.0μs These will drive 50mA from 0V Signals present at their negative level
Special facilities:-	MAINS on/off button RUN OUT button Tape width adjustment switch

1.4 External connectors

Plug A 4-way (mains) (103,104)

1	Mains live
2	Mains neutral
3, 4	Mains earth

Plug B 25-way (signal) (102,105)

1	DIGIT 1
2	DIGIT 2
3	DIGIT 3
4	DIGIT 4
5	DIGIT 5
6	DIGIT 6
7	DIGIT 7
8	DIGIT 8
9	STOP
10	LOCATION HOLE
11	START
12	READY
13	
14	
15	
16	COMMON 'A'
17	COMMON 'B'
18	5-TRACK
19	7-TRACK
20	8-TRACK
21	RUN OUT
22	0V
23	RUN OUT
24	-24V
25	SCREEN

Connect screen on plug A to plug body.

Connect screen on plug B to pin 22, i.e. 0V. This must be insulated from the plug body.

The -24V supply is available on pin 24 plug B for external monitoring facilities; not more than 50mA should be taken from this line.

CHAPTER 2

PRINCIPLES OF OPERATION

2.1 The cooling system

Air is driven through the reader by means of an axial flow fan, driven continuously by a capacitor start and run induction motor. Thus air is drawn into the body of the case through the grill situated on the right hand side of the reader. The reader is effectively divided into hot and cold compartments. The air, having been circulated around the package, is drawn into, and eventually exhausted from, the hot compartment through the grill situated on the left hand side of the reader. The hot compartment contains all heat dissipating components such as the motor, high power resistors, transistors etc. The motor shaft driving the blower is also connected through a worm to the tape drive mechanism which is outside the air flow path. It is recommended that the reader is not used for prolonged periods out of the case.

2.2 The tape transport system

Tape transportation is achieved by the use of a differential mechanism. In this system a continuously running motor is coupled via a wormwheel to a differential gear on a stationary main shaft. The main shaft carries two drums or output shafts, namely clutch and brake which are interconnected by the differential gear. With this type of arrangement, if either output shaft is held stationary the other will rotate. The tape feed is controlled by means of electromagnetically operated brake shoes engaging on the brake and clutch drums. The shoes are connected to armatures which are held in close proximity to the laminated core of an electromagnet. The shoes are held in light contact with the drums by means of springs, consequently negligible movement of the armature occurs upon energising the electromagnet and the force produced is utilised immediately in forcing the shoe against the drum. The air gap between the armature and laminated core is kept to a minimum, thus ensuring a high gap flux.

Two complete systems are employed, one each for clutch and brake. Each system uses two shoes and two electromagnets. In order to ensure quick transition from driving to brake state and vice versa, the systems are connected to the opposite phases of a control staticiser situated on the 497 package.

2.3 Optical system

The optical system comprises a 12V 21W lamp the light from which is collected, internally reflected through 90° and focussed by a lens onto a row of holes situated in the masking plate. The lamp is underrun from a stabilised d.c. supply.

Beneath the mask holes is situated the reading head assembly. This comprises 9 plug-in silicon photovoltaic photocells. A glass

window is mounted on the top plate in order to prevent dust from accumulating on the photocell faces and so decreasing photocell output.

2.4 Tape guide system

Tape is read with the constant 3-hole edge towards the front of the reader. Therefore the rear guide is adjustable, this being achieved by means of the engraved thumb switch situated at the front of the reader. Associated with this mechanism is a switch which serves two purposes:

(a) To set to the 'no hole' condition the digit channels not in use as shown in the following table:

Reader Setting	Digit 6 output (Plug B Pin 6)	Digit 7 output (Plug B Pin 7)	Digit 8 output (Plug B Pin 8)
5 Track	OV	OV	OV
7 Track	Output of digit 6 staticiser	Output of digit 7 staticiser	OV
8 Track	Output of digit 6 staticiser	Output of digit 7 staticiser	Output of digit 8 staticiser

(b) To inform the external equipment, if necessary, of the tape width setting by means of the 5,7 and 8 track pins on the signal plug. The levels of these signals are determined by the external equipment on two signal plug B pins designated 'COMMON A' and 'COMMON B'.

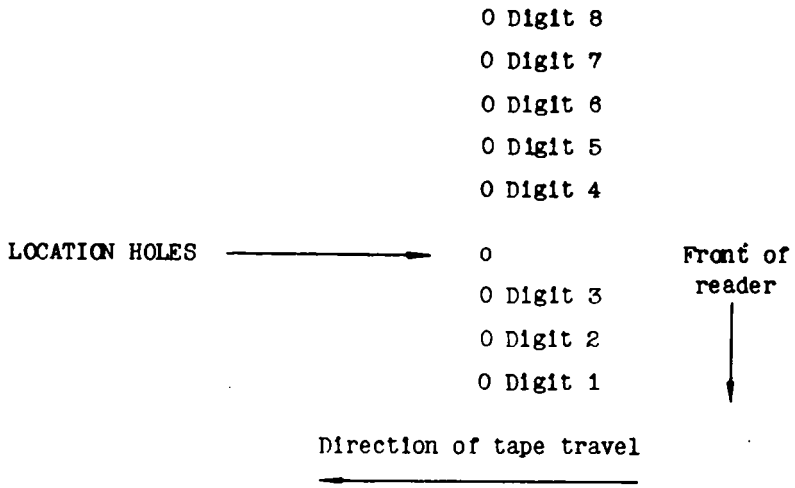
The connections are as shown in the following table:

Reader Setting	5 Track Line (Plug B Pin 18)	7 Track Line (Plug B Pin 19)	8 Track Line (Plug B Pin 20)
5 Track	COMMON B	COMMON A	COMMON A
7 Track	COMMON A	COMMON B	COMMON A
8 Track	COMMON A	COMMON A	COMMON B

2.5 Tape layout

The following shows 8 track tape layout and designation in the

TR6 reader:



It will be observed that a location hole is in line with the digit holes across the width of the tape. The location hole in the masking plate however, is offset 0.012 in. in the direction of the movement of the tape for reasons described in section 2.7.

2.6 Power supplies

The power supply transformer is situated in the reader motor compartment, and power supply components are mounted on the panel which separates the hot and cold compartments. Fuses are provided in each power line and these are accessible when the reader is removed from the case.

The following power lines are provided in the reader:

(a) ± 9V d.c. at 250mA supplying the 497/8/9 packages.

(b) -24V d.c. at 1.5 amps for the control circuits and clutch and brake electromagnets.

(c) -7.0V to -10.5V d.c. stabilised supply at 2.5 amps for the reading head 12V 21W lamp.

The potentiometer control for setting voltage (c) is the upper of the two accessible through the access flap at the rear of the reader case.

2.7 Logical operation

Four packages are provided as detailed below. Each package has monitoring facilities and is polarised in order to prevent its being fitted in incorrect positions.

1 type 497 which contains the staticiser for controlling the action of the clutch and brake.

1 type 498 which contains staticisers for digits 1 and 2, and a location photocell circuit which produces a RESET signal for the digit staticisers and a LOCATION HOLE signal for the control staticiser.

2 type 499 each containing 3 digit staticisers for digits 3 to 5 and 6 to 8 respectively.

A simplified logical arrangement for digits 1 and 2, location and control circuits, is shown on Diagram 1. This shows the arrangement using the 497 and 498 packages.

A START signal from the computer energises the clutch which starts the tape moving. A character on the tape arrives at the reading position and light passes through the holes in the tape on to the location photocell and whichever digit photocells are opposite digit holes. The outputs from the digit photocells are strobed on the digit bistable by a RESET pulse derived from the location photocell output. The information is thus staticised.

Meanwhile a STOP pulse, also initiated by the location cell, triggers the control bistable, resetting it and so energising the brake coils. The tape will come to a halt unless restarted before the brake shoes make contact with the drum.

A READY signal is set up at the same time as the BRAKE output energises the brake coils. The computer normally generates the next START signal upon receipt of this READY signal, which indicates to the computer that the reader has staticised one character and is in a condition to move to the next character on the tape.

By repeating this cycle all the information on the tape can be read into the computer at maximum speed.

Immediately a START signal is received, the control bistable on the 497 package is set producing the CLUTCH output. This is fed to a current amplifier, energising the clutch magnets and engaging the clutch. The tape then begins moving and the next character approaches the reading station.

The location hole has 0.012in further to travel beyond the line of the digit holes in the masking plate in order to reach its reading position. Thus the inputs to the digit photocells appear before the input to the location photocell, hence the digit outputs will be already established when the location cell output is produced.

The location photocell waveform enters the 499 package, is squared and the leading edge of the amplified output is differentiated and inverted to form the positive strobe pulse called RESET. This is applied to both sides of the digit bistables, triggering them according to the inputs from the digit photocells. The latter produce a negative-going waveform for a hole in the tape, as shown on Diagram 14, and will be giving their maximum output when the RESET pulse occurs. The character is therefore set on the digit bistables and will remain so until the next location hole is sensed, after the START signal has been given. The information is available for transfer into the computer during this time.

2.8 BRAKE and CLUTCH signals

The BRAKE signal drives a current amplifier shown on Diagram 16 which energises the brake coil, pressing the brake shoe against the

drum. The clutch output, now positive, switches off the clutch amplifier and the clutch is disengaged. The combination of the two processes brings the tape to rest in the absence of another START signal. As the CLUTCH and BRAKE signals are the outputs of opposite sides of the bistable, energising the clutch coil necessarily cuts off the brake, and vice versa.

The BRAKE signal will be reset only by another START signal. However, with full speed operation a START signal is received before the inertia of the braking system can be overcome, so the tape continues to run through without pause. If the START signal occurs more than 200μs after the brake has been energised, the time lapse will allow the brake to operate.

2.9 READY signal

The READY signal appears at the same time as the BRAKE waveform, that is, when the bistable is reset by the delayed STOP signal. READY indicates that the present character is staticised so the information is available to the computer. The tape reader now awaits the next START signal, which will not be generated before the computer has received the READY signal.

Meanwhile a STOP pulse, also initiated by the location cell, triggers the control bistable, resetting it and so energising the brake coils. The tape will come to a halt unless restarted before the brake shoes make contact with the drum.

A READY signal is set up at the same time as the BRAKE output energises the brake coils. The computer normally generates the next START signal upon receipt of this READY signal which indicates to the computer that the reader has stabilised the character and is in a condition to move to the next character on the tape.

CHAPTER 3

CIRCUIT DESCRIPTIONS (Packages)

3.1 Type 497 control staticisers (Diagrams 7, 8 and 9)

The package consists of a staticiser which is set and reset by differentiated 'START' and 'STOP' signals respectively and the amplified outputs of the staticiser are used to control the action of the TR6 tape reader clutch and brake. A READY signal is derived from the clutch side of the staticiser.

The run out facility incorporated in the tape reader sets the staticiser to the 'started' condition.

Circuit description

Assume that the staticiser based on TR2, TR3 is in the 'stopped' condition i.e. BRAKE is negative and TR2 is cut off, TR3 conducting. The base of TR3 is held negative by R9, R6 and R7.

The signal START is differentiated by C1 and R3, the negative pulse overriding the positive bias on R3 and, through D1, that on R4. TR2 begins to conduct, R9 and the collector of TR2 move positive together with R6 and R7, and TR3 tries to cut off as R10 with the collector of TR3 move negative. R5, C5 and R4 swing the base of TR2 harder negative so completing the switch-over.

The collector output of TR2 now drives READY positive via TR5 (emitter follower) TR6 and TR7 (inverters). Through D2, the collector output of TR2 also pulls the chain R11, R12, R13 and the base of TR7 positive. This produces a negative output at pin F which switches a current amplifier causing the tape reader clutch magnet to be energised.

The staticiser remains in this state until a STOP signal appears on pin D. The edge of this signal is delayed by R23 and C3 and is sharpened by two stages of amplification and inversion in TR9 and TR8. It is differentiated by C2 and R8. The delay throughout which ensures that READY does not appear before the digit staticiser are reset, amounts to some 40μs. Thereafter the action is in reverse order to that describing switch over in the previous paragraphs the output of TR4 (BRAKE) going negative and TR1 (CLUTCH) going positive, i.e., the staticiser assumes its original state.

Pressing the RUN OUT button applies a positive voltage to the base of TR3 and the staticiser will thus assume the 'started' condition and energise the clutch magnet. At the same time the READY signal will go positive indicating a 'not ready' condition.

If a link between C2 and R23 is removed the package is converted to a type 495 thus a.c. coupling the STOP signal from pin M. With the link in position, the 497 package has a d.c. coupled STOP system and the delaying network output from pin D. When used as a type 495 (with the link removed) a delay of 40μs between LOCATION HOLE and STOP is

recommended.

3.2 Type 498 digit and location staticisers (Diagrams 10, 11 and 12)

The package consists of two identical digit staticisers which are set and reset according to the outputs of their respective photocells. Positive d.c. bias is applied to the inputs in order to provide a precise definition of the transition between 'hole' and 'no hole'. One output from each staticiser is amplified and it is arranged that a negative output signal represents a 'hole' condition.

The third circuit, driven by the output signal from the location photocell, is used to provide a strobe pulse (RESET) for the digit staticisers and a LOCATION HOLE signal which is normally used as the STOP signal to pin D on the control staticiser package type 497.

3.2.1 Circuit description: digit staticisers

For clarity only one circuit is described.

The digit photocell is d.c. coupled to the input pin F and OV. The input is positively biased by a voltage on pin A. This draws sufficient current through D1 to offset conduction through the photocell due to the translucence of the paper tape. A reset pulse, which is generated in the location circuit on this package is applied to the emitters of TR1, TR7. It is in the form of a 9V positive pulse, rising from approximately -0.6V. The RESET pulse is timed to occur when the maximum output is received from the photocell i.e. when a hole is directly over the photocell.

The circuit consists of a staticiser comprising TR3, TR4 which are controlled by long tailed pairs TR1, TR7 whose outputs are emitter followed by TR2, TR6. The emitter outputs are d.c. coupled to the base circuits of the appropriate staticiser transistors. The output of the staticiser goes negative for a 1, remaining in this condition if the next bit is a 1, or going positive if it is a 0.

Between RESET pulses the emitters of TR1, TR7 are held negative and so are cut off. At RESET time both are positive to OV. If there is no signal from the photocell TR1 is cut off and TR7, whose base is at OV, resetting the staticiser. If there is a signal from the photocell i.e. a hole in the tape is directly over the photocell, TR1 conducts and TR7 is cut off.

Assuming a signal from the photocell is present, then at the RESET time the output of TR1, emitter followed by TR2, drives the base of TR3 positive thus trying to cut off. R8 which has been drawing current through D4 and the collector of TR3, starts going negative, turning on TR4. R11 carries TR4 collector current and so swings positive, driving the base of TR3 further positive through D3 thus completing the switch over.

The resistor chain R11, R12, R13 drives the output inverter TR5. Edge speed of the output is reduced by C1.

3.2.2 Circuit description: location staticiser

This circuit is driven by the output of the location photocell and produces a RESET pulse and a LOCATION HOLE waveform. When there is no signal input TR15 and TR16 are cut off and TR17 conducts due to the action of the divider chain R39, R40 and R41. With the bias correctly adjusted by RV1 the location photocell output causes TR15 to conduct. R36 and R38 are driven towards positive, TR17 cuts off thus causing its collector to go negative. The TR17 output waveform is differentiated by C4 and R43 to drive TR18. The inverted output on pin J is the RESET pulse.

The TR17 output waveform is also directly coupled to the base of TR14, the inverted output signal from the TR19 collector being directly coupled to the base of TR20 where it is finally inverted giving the output signal LOCATION HOLE.

3.3 Type 499 digit staticisers (Diagrams 13, 14 and 15)

The package consists of three identical digit staticisers which are set and reset according to the outputs of their respective photocells. Positive d.c. bias is applied to the inputs in order to precisely define the transition between 'light' and 'dark'. One output from each staticiser is amplified and it is arranged that a negative output signal represents a 'hole' condition. In the TR6 tape reader a strobe pulse for the staticisers (RESET) is supplied by a 498 package.

Circuit description

For clarity only one circuit will be described.

The digit photocell for a circuit is directly coupled to the input pin E and OV. This is biased by an adjustable positive voltage on pin A. This draws sufficient current through the diode D1 to offset conduction through the photocell due to the translucence of the paper. A RESET pulse, which is generated by the LOCATION HOLE circuit on the 498 package is applied to the emitters of TR1, TR7. It is in the form of a positive pulse of about 9V rising from approximately -0.6V. The RESET pulse is timed to occur when the maximum output is received from the digit photocell when a hole is in a position directly over the digit photocell. RESET then acts as a strobing pulse.

The circuit consists of a staticiser comprising transistors TR3, TR4 which are controlled by long tailed pairs TR1, TR7 whose outputs are emitter followed by TR2 and TR6 respectively. The emitter outputs are directly coupled to the base circuits of the appropriate staticiser transistors.

The output of the staticiser goes negative for a 1, remaining in this condition if the next bit is a 1 or going positive if the next bit is a 0.

Between RESET pulses the emitters of TR1, TR7 are held negative and are both cut off. During the RESET pulse time both emitters are positive to OV. If there is no signal from the photocell, TR1 is cut off and TR7 whose base is at OV conducts, resetting the staticiser. If there is a signal from the photocell, TR1 conducts and TR7 is cut off.

Assuming a signal from the photocell is present, then at RESET time the output of TR1, emitter followed by TR2, drives the base of TR3 positive, thus trying to cut off. R6, which has been drawing current through D4, and the collector of TR3 begins to go negative, turning on TR4. R11 carries TR4 collector current and swings positive driving the base of TR3 more positive through D3 and completing the switch over.

TR5 is driven from the resistor chain R11, R12 and R13, R11 being the collector load of TR4 and after amplification and inversion the output signal appears on pin C. Edge speed is reduced by C1.

3.4 Current switches (Diagram 16)

The production of the CLUTCH and BRAKE waveforms by the control bistable has been described in section 2.8. These outputs are used in the circuit shown in Diagram 16 to operate the current switches, so that either the clutch or the brake electromagnet is energised.

When the stop signal resets the control bistable, the BRAKE output moves from OV to a negative level. Transistor TR2 conducts and its collector potential becomes approximately -0.5 volts, allowing a current of about ½ amp to flow in each brake coil. The armature is therefore attracted to the pole-face and the brake shoes engage on the brake drum and the tape comes to rest.

Diode D17 prevents the potential of the collector of TR2 rising above -25 volts at the time of switching off. Back e.m.f. produced by the clutch coil would otherwise exceed this value.

The brake electromagnet has two identical coils connected in parallel and the two brake shoes are actuated simultaneously to stop the tape. The clutch system also uses two coils and operates in the same manner as the brake system. Connector terminals 1F and 1E are points where the CLUTCH and BRAKE outputs may be monitored.

CHAPTER 4

INSTALLATION AND OPERATION

4.1 Switching on

The readers are supplied with the power supply transformer primary wired for 230V 50c/s. Primary taps are provided on the transformer to cater for mains supplies of between 200 and 250V 50c/s and the tappings should be adjusted if necessary.

The MAINS on/off switch, which is situated at the rear of the top platform on the righthand side of the reader, switches mains to both motor and power supplies.

4.2 Tape width adjustment

This is effected by means of the thumb control situated at the front on the top platform. The number uppermost on the control indicates the tape width to which the reader is set. Note that 6 track tape requires the 7 track position.

4.3 Loading the tape

The tape guide plate should be hinged upwards by means of the handle protruding from the top cover. The tape must be slid in sideways and the guide plate returned to its working position.

4.4 Tape position

From the front of the reader the tape travels right to left. The tape should be loaded with the 3-hole side towards the front. The digit nearest to the front is designated 'Digit 1'.

4.5 Tape run out

Depressing the button situated front right on the top platform will cause the tape to be transported through the reader at maximum speed for the duration of button depression. In order to allow run out to be monitored if required the line is routed via pins 21-23 on the signal plug B and these should be linked externally in order to make available the run out operation. During this time the reader will appear 'NOT READY' to the external equipment. The use of this facility, instead of unloading the tape, is not recommended.

4.6 Recommended tape

Waterlows Paper Tape A1 to I.C.T. specification. This is manufactured by:

Waterlow & Sons Ltd.,
(Paper Converting Division),
85, London Wall,
LONDON, E.C.2.

4.7 Tape splicing

It is recommended that opaque adhesive splicing tape, such as that manufactured by Sellotape, should be used.

Butt joints are preferable, and splices should preferably be double sided with ends trimmed in such a way that the tape width is not increased in the area of the splice.

CHAPTER 5

MAINTENANCE

5.1 Maintenance requirements

The following is a guide to the necessary periodic maintenance; however, the tape track must always be maintained free of lubricants and paper dust at all times.

The maintenance intervals are based on a forty hour week calendar calculated on the operation of a 300 ch/sec reader run continuously at half speed. Where a number of operations are itemised these are considered the more important guide to maintenance.

5.1.1 Daily

Clean lens and remove any dirt and dust from the vicinity of the mask.

5.1.2 Monthly or 100hr

Check digit photocell bias range (section 5.2.3) and location photocell output (section 5.2.1).

Lubricate tape drive gearing mechanism (see section 5.7.3). Check wire guide position (see section 5.4).

5.1.3 Three monthly (250 x 10^6 operations)

Check armature/magnet air gaps and reset if necessary (section 5.10.1). Check supply voltages (section 5.6). Remove reading head and clean photocell faces. Check digit photocell outputs (section 5.9.3).

5.1.4 Annually

Lubricate motor (section 5.7.1). Check pinch roller pressure (section 5.3) and condition of tape guide-plate linkages. Check on condition of tape guides.

5.1.5 Other maintenance

1. An initial armature/magnet air gap check after 25 x 10^6 operations will be necessary when:

   (a) Armatures and/or brake shoes have been replaced.

   (b) A new or reconditioned reader is being used.

   Thereafter these checks can be carried out on the 3 monthly routine as indicated in section 5.1.3.

2. If the 498 package is replaced, a check of the location photocell bias will be necessary (section 5.2.2).

5.2 Photocells and Bias Ranges

5.2.1 Location Photocell Output

In addition to the monthly routine this check will also be necessary when:

(a) the lamp is replaced and/or the optical system realigned,

(b) the location photocell is replaced,

(c) the reading head is realigned.

The reader need not be removed from the case for this adjustment, the method of adjustment being as follows.

(d) Ensure that no tape is in the reader and that the guide plate is in the clamped position.

(e) Open flap in the case at the rear of the reader and move the toggle switch to the upper position.

(f) Connect ammeter of 780k ohms impedance, typically AVO MK VIII 1mA F.S.D. range with +ve lead to centre and -ve to the upper monitoring socket.

(g) Adjust upper potentiometer to give an ammeter reading of 300 micro-amps.

(h) Return toggle switch to lower position.

5.2 2 Location Photocell Bias

This adjustment should only be necessary if any components on the 498 package or the package itself be replaced. It is advisable to use two tapes in the reader which represent the extremes of those encountered with regard to mispunching and opacity. The method of adjustm nt is as follows:

(a) Re. ove reader from case.

(b) Ensure that location photocell output is as prescribed in section 5.2.1.

(c) Connect a voltmeter between the upper (OV) and lower monitoring loop on the 498 package, -ve to OV.

(d) Using suitable checking equipment run each tape through the reader adjusting the trimpot situated at the base of the 498 package. Note the trimpot voltage range over which the reader operates correctly.

(e) Set the trimpot to the mean of these ranges in accordance with the following example:

Typical range with opaque tape: 2.5V to 6.0V.

5.3 PINCH ROLLER PRESSURE

With the tape guide plate in the clamped position check the pressure of the tape drive pinch roller on the brake drum using a tension gauge. The pressure should be between 1½lbs (0.7kg) and 2lbs (0.9kg). If the measured pressure is outside this range a cure may be effected by either

a) carefully bending the roller spring support (Item 20 Diagram 5) in the appropriate direction, or

b) replacing Item 20

5.4 WIRE GUIDE

This should be adjusted, by lightly bending if necessary, to be 0.005" to 0.015" (0.127 to 381 mm) above the top of the masking plate. The degree of bending required may be gauged by lightly trapping a piece of 0.004" paper tape between the wire guide and the masking plate. Final adjustments should be aimed at producing sufficient tension to avoid tape flutter during operations.

Typical range with semi-transparent tape: 4.0V to 7.0V.
Net range 4.0V to 6.0V:
Setting figure: 5V.

5.2.3 Digit Photocell Bias

This adjustment may be made in the following manner. The reader should not be removed from the case.

(a) Lower flap at the rear of the case.

(b) Connect voltmeter between middle 0V and lower monitoring socket, -ve to 0V.

(c) Using the least opaque tape available, and using suitable checking equipment run the reader and note the voltage range over which adjustment of the lower of the two potentiometers allows the reader to operate.

(d) Set this potentiometer to the mean of this range.

5.3 Pinch roller pressure

With the tape guide plate in the clamped position check the pressure of the tape drive pinch roller on the brake drum using a tension gauge. This should be between 1½ lbs (0.7kg) and 2lbs (0.9kg).

5.4 Wire guide

This should be adjusted, by lightly bending if necessary, to be .005" to .015" (0.127 to 0.381mm) above the top of the masking plate.

The guide should be positioned in line with the masking plate holes and as close to them as possible without interfering with the light beam. This adjustment should be necessary only if a new guide is fitted.

5.5 Setting of tape guides

This adjustment should only be necessary if any component is replaced. The removal of the detachable cover, by unscrewing the single fixed Allen screw, will facilitate the adjustments.

5.5.1 Front fixed guide

Adjust in order that the distance from location hole to guide edge is between 0.396 inches (10.06mm) and 0.398 inches (10.09mm). Ensure that the guide edge is square with the row of masking holes.

5.5.2 Rear variable guide

Access to the adjustment of this item is gained by removing the reader from its case and removing the packages. The two rear guide fixing screws are then accessible underneath the top platform. Adjust the rear guide so that in the 7 track position the front to rear guide

gap is between 0.879 inches (22.33mm) and 0.881 inches (22.38mm). Ensure that the guide edge is square with the row of masking holes.

6 Power supply measuremen

Measurement of the power supplies involves the removal of the reader from the case.

The supplies are most conveniently measured on the monitor links on the 497 package. The four upper links carry -24V, -9V, OV and +9V respectively from top to bottom.

With the 498 and 499 packages in position and lamp on, all power rails should be within ± 5% of their nominal values.

5.7 Lubrication

5.7.1 Motor

Remove the reader from the case and the motor from the reader, remove the end caps and pack the bearing with Aeroshell Grease 6B.

5.7.2 Toggle linkage

Remove the detachable cover and supply Shell Clavus 17 sparingly to the linkage.

5.7.3 Tape drive mechanism

Open the hinged top cover. Apply Molytone LM grease to the following points:

(a) differential pinion gear teeth,

(b) differential wheel gear teeth,

(c) Wormwheel gear teeth.

Apply Shell Clavus 17 to the oil hole in each differential pinion.

5.8 Optical System (Diagram 2)

The optical system should only need adjustment if the lamp has been replaced. The hinged cover must be open

5.8.1 Removing the lamp

Unscrewing only the front screw 'A' will allow the lamp to be rotated and removed.

5.8.2 Replacing the lamp and resetting the optical assembly

Ensure that the lamp filament is parallel to the lens axis and lock screw 'A'.

Release nuts B and D, adjust screw C and rotate the lens to obtain a uniform wide light beam in the plane of the photocells 0.10 inches (2.54mm) to 0.12 inches (3.05mm) wide; tighten nuts B and D.

5.9 Reading head

5.9.1 Photocell cleaning

To clean the photocell faces remove the reader from the case and unfasten the head mounting nuts. Clean the photocell faces using a slightly moist cloth.

5.9.2 Realignment

Refit the head and check that the photocells are positioned directly under their appropriate mask holes.

5.9.3 Digit photocell measurement

Remove the 498 and 499 packages and measure short circuit digit photocell currents with a meter of 1.7k ohms impedance (Typically AVO MK VIII 250μA F.S.D. range).

No photocell should indicate an output of less than 160μA or more than 250μA. The variations in photocell output should be retained within ±10% of the average output of all the photocells.

5.10 Tape transport mechanism (Diagram 3)

For all adjustments dealt with in this section the motor and fan unit must be removed. The armature stop screws should be partially withdrawn and the spring removed for safety. These should be refitted as detailed in 5.10.4.

5.10.1 To adjust the armature/magnet air gap

When the clamp block is loosened slightly, the magnet energised and with a certain range of pressures applied externally to the armature these three elements constitute a rigid frame moving on the armature pivot as a fulcrum. The air gap is adjusted and fixed under such conditions.

Release screws C and D sufficiently to loosen the magnet and clamp block. Place a 0.006 (0.15mm) inch thick feeler gauge between armature and magnet pole faces and energise the electromagnet. Apply 1 lb pressure (0.45kg) through the slot in the platform in the direction indicated in the diagram. With this pressure applied tighten screws C and D. De-energise the magnet and remove the feeler gauge.

Repeat this procedure for each magnet.

5.10.2 To set up the armatures

This operation should only be necessary if any armature is to be

replaced. The following procedure is recommended:

(a) Remove the related brake magnet and brake magnet clamp block.

(b) Slightly loosen screws A and B.

(c) Using a protractor or other suitable measuring instrument, push the armature clamp plate towards the drum until the armature is at 3^{0} to the vertical as shown in Diagram 3. It is essential, when carrying out this operation, that the armature and the brake drum are kept in line with the drum.

(d) Tighten screw B.

(e) Apply a pressure of approximately 1 lb (0.45kg) on the armature through the slot in the platform and tighten screw A.

(f) Re-check the angle and also the alignment of the brake shoe on the drum.

In order to facilitate this operation, special gauges (ref. 65/87284) are available if required.

5.10.3 Brake shoe replacement

Brake shoes should be replaced when they have been worn down by approximately 0.040 inch (1.02 mm) and no more adjustment can be obtained In order to refit new brake shoes only screws A, C and D need be removed leaving the armatures effectively in position.

5.10.4 Armature stop screw setting

Having fitted the conical spring on the plain shoulder of the stop screw, adjust the screw until brake or clutch drum drags on the armature and brake shoe. Unscrew one quarter turn and fasten the locknut.

CHAPTER 6

ASSEMBLY SCHEDULE AND PARTS LIST

	DESCRIPTION	PART NO.
1	Cover Hinge Packer	DA 65/87171
2	Cover Assembly	AS 65/87107
3	Keeper	DA 65/87261
4	Magnet	2854-031
5	Fixed Cover	DB 65/87142
6	Lens Assembly	AS 65/87114
7	Guide Plate Pivot Pin	DA 65/12167
8	Tape Guide Pl.Spg. Dist Washer	DA 65/18004
9	Tape Guide Plate Spring	DA 65/18005
10	Toggle Assembly Dist. Washer	DA 65/18254
11	Toggle Bearing Stud	DA 65/18253
12	Pin for Ref. 14	2114-027
13	Operating Lever	DA 65/87144
14	Toggle Link Assembly	AS 65/12150
15	Tape Guide Plate	DB 65/87143
16	Tape Guide Spring	DA 65/87247
17	Roller Support Stem	DA 65/12154
18	Push Button Switch	2751-418
19	Platform	DD 65/87186
20	Spring Support	DA 65/12153
21	Slider switch	2751-322
22	Spring	DA 65/12109
23	Retainer	2138-305
24	Split Pin	2115-139
25	Retaining Screw	DA 65/11224
26	Bearing Roller	2522-281
27	Roller Spindle	DA 65/11222
28	Rubber Pad	DA 65/47008
29	Rotary Switch	2748-331
30	Switch Bracket	DA 65/87122
31	Lamp Contact	DA 65/87148
32	Lamp Contact Spring	DA 65/87156
33	Locknut	2168-408
34	Switch Knob & Cam	DB 65/87123
35	Adaptor Plate	DA 65/87134
36	Tape Setting Block	DA 65/87127
37	Slide	DA 65/87126
38	Slide Return Spring	2655-213
39	Shoulder Screw	DA 65/87129
40		

	DESCRIPTION	PART NO.
41	Spring Anchorage Stud	DA 65/87121
42	Switch Shaft Support	DA 65/87125
43	Cell Holder Assembly	AS 65/87119
44	Cells Set of 9	2887-876
45	Masking Plate Assembly	AS 65/87244
46	Dowel	DA 65/87245
47	2 BA Lock Nut	2168-048
48		
49	Guide Block	DA 65/87120
50	Glass	DA 65/87172
51	Head Fixing Screw	DA 65/87263
52		
53		
54	Lamp Back Plate	AS 65/87146
55	Circlip	2616-164
56	Lamp Adjuster Screw	DA 65/87214
57	Lamp Holder Body	DB 65/87262
58	Lamp Clamp	DA 65/87149
59	Suppressor	AS 65/47337
60	Lamp	AS 65/87324
61		
62	Magnet Assembly	AS 65/87113
63	Brake Assembly	AS 65/12043
64		
65	Magnet Assembly	AS 65/87112
66	Armature Spring	DA 65/11201
67	Armature Clamp Plate	DA 65/12189
68	Brake Assembly	AS 65/87255
69		
70	Armature Stop Screw	DA 65/87133
71	Spacer	DA 65/87238
72	Spacer	2632-008
73	Resistor 50 ohms	2818-051
74	Washer	2131-067
75		
76	Spacing Bush	DA 65/11225
77		
78	Roller Spring Clamp	DA 65/12155
79	Magnet Support Block	DA 65/87131
80	Magnet Support Block	DA 65/87130
81		
82		
83		
84		
85		

	DESCRIPTION	PART NO.
86	Identification Label	DA 65/87223
87	Grille	DA 65/87184
88		
89	Condenser Clamp	2338-728
90	Condenser 8,500µf 18V	2836-570
91		
92		
93	Transformer	2852-315
94	Trans. Mounting Strip	DA 65/87180
95		
96	Motor Worm	DA 65/47080
97	Motor	2773-410
98	Motor Support Plate	DA 65/87195
99	Fan	2381-822
100		
101	Plug Support Plate	DA 65/87140
102	25 Pin Retainer	2744-730
103	4 Pin Plug	2744-711
104	4 Pin Retainer	2744-726
105	25 Way Plug	2744-715
106	Plug Plate Support Stay	DA 65/47038
107		
108	Rear Door	DA 65/87177
109	Hinge	DA 65/87174
110	Spring Door Catch	DA 65/87176
111	Masking Plate	DA 65/87175
112		
113	Potentiometer Nut	2828-139
114	Potentiometer Mtg. Plate	DA 65/87178
115	Solder Tag	2716-054
116	Switch	2751-104
117	Potentiometer 5K	2823-156
118	Spacer	2632-010
119	Potentiometer 500 ohms	2823-147
120	12-way Socket Spacer	DA 65/47041
121	Chassis Frame	DC 65/87224
122	12-way Socket	2743-309
123	12-way Socket Dist. Piece	DA 65/47042
124	12-way Socket Loc. Stay	DA 65/47038
125	Fan Guard	DA 65/87206
126	Draught Plate	DB 65/87210
127	Printed Circuit Guide Strip	DA 65/47043
128	Mounting Bracket	DA 65/87170
129	Fuse Link 2A	2741-014
130	Fuse Link 5A	2741-016

	DESCRIPTION	PART NO.
131	Fuse Holder	2741-636
132	Resistor 1 ohm 9W	2816-601
133	Tag Board	DA 65/87201
134	Transistor Heat Sink	DA 65/87138
135	Transistor Heat Sink	DA 65/87139
136	Solder Tag	2716-011
137	Insulating Bush	2288-654
138	Transistor OC35	2881-604
139	Spacer	2632-040
140		
141		
142		
143	Resistor ½ ohm 6W	2816-480
144	4-way Socket	2744-574
145	Condenser 100µf 25V	2836-232
146	Condenser 100µf 25V	2836-232
147	Condenser 50µf 25V	2836-231
148	Diode ZR 201	2851-557
149	Diode ZR 201	2851-557
150	Insulating Piece	DA 65/87264
151	Solder Tag	2716-018
152	Diode ZR 201R	2851-558
153	Diode Heat Sink	DA 65/87137
154	Condenser 5000µf 12V	2836-158
155	Condenser 5000µf 12V	2836-158
156	Condenser 3000µf 25V	2836-163
157	Resistor 1K	2812-109
158	Resistor 33K	2804-327
159	Diode KS 37A	2882-203
160	Diode KS 37A	2882-203
161	Diode ZS 72	2851-597
162	Transistor TR1 ACY 21	2881-458
163	Transistor TR2 ACY 21	2881-458
164	Diode ZS 30B	2882-114
165	Diode ZS 30B	2882-114
166	Diode ZS 30B	2882-114
167	Diode ZS 30B	2882-114
168	Diode ZS 72	2851-597
169	Diode ZS 72	2851-597
170	Resistor 820 ohms	2804-278
171	Diode ZS 30B	2882-114
172	Diode ZS 30B	2882-114
173	Diode ZS 72	2851-597
174	Diode ZS 72	2851-597
175	Diode ZS 72	2851-597

	DESCRIPTION	PART NO.
176	Component Panel	AS 65/87117
177	Condenser Clamp	2838-722
178	Mica Washer	2888-653
179		
180	Monitor Socket Black	2743-146
181	Frame Stay	DA 65/47037
182	Chassis Tie Piece	DA 65/87235
183	Case	DD 65/87183
184		
185		
186		
187		
188		
189		
190	Fnd Cap Clutch side	DA 65/12127
191	Clutch Drum Assembly	AS 65/87293
192	Fnd Cap-Brake Side	DA 65/12128
193	Feed and Brake Drum Assembly	AS 65/87294
194	Special Screw	DA 65/87165
195	Bearing Plate	DA 65/87163
196	Bearing Shaft	DA 65/87164
197	Differential Pinion	DA 65/87162
198	Worm Wheel	AS 65/87295
199	Carrier Plate Stud	DA 65/12123
200	Carrier Plate Bush	DA 65/12123
201	Bearing Spacer	DA 65/87168
202	C'Balance Bush	DA 65/12136
203	C'Balance Stud	DA 65/12135
204		
205		
206		
207		
208	Bearing Spacer	DA 65/87169
209	Spindle Support Block	DA 65/12125
210	Spindle Support Block	DA 65/12126
211	Drum Spindle	DA 65/12134
212	Nut	2168-774
213		
214		
215		
216		
217		
218		

Lubricants

1. Shell Clavus 17 oil for differential pinion shafts (1761-405).

2. Rocol Molytone LM grease for gearing (1765-366).

3. Aeroshell grease 6B for motor (1765-232).

Sealants

Loctite Grade 'C' (1871-123)
Activator (1871-126)
For sealing differential pinion screw in the end plates.

Tools (1 off each)

1. Screwdriver - Philips No. 1 (5651-302)
No. 2 (5651-307)

2. 2BA x 4BA flat spanner (5653-663)

3. 6BA x 8BA flat spanner (5653-667)

4. Allen screwdriver 3/32 inch (5655-554)

5. Allen screwdriver 5/64 inch (5655-553)

6. Allen screwdriver 1/16 inch (5655-552)

7. Tension gauge for setting pinch roller pressure (5854-303)

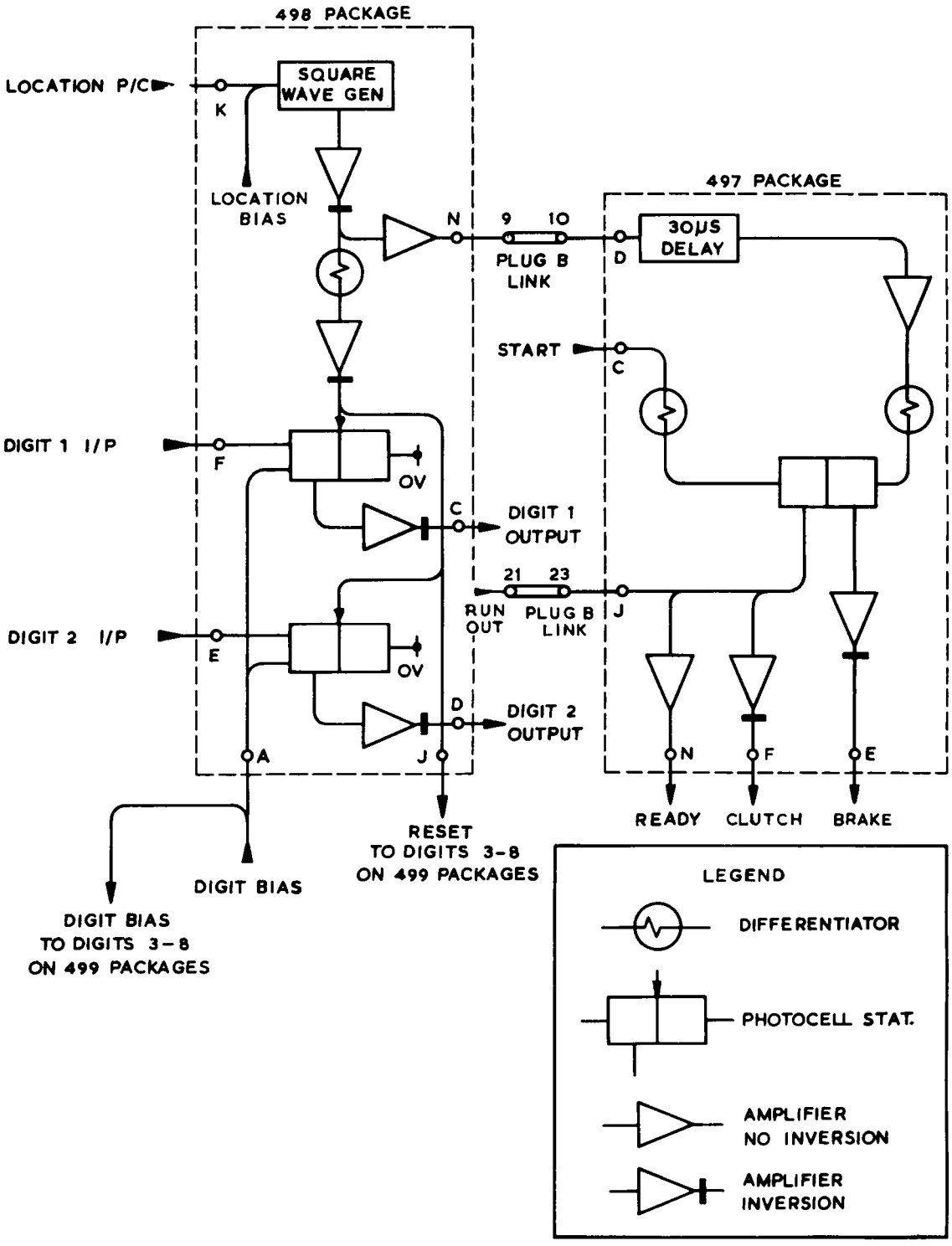


DIAGRAM 1. LOGICAL DIAGRAM

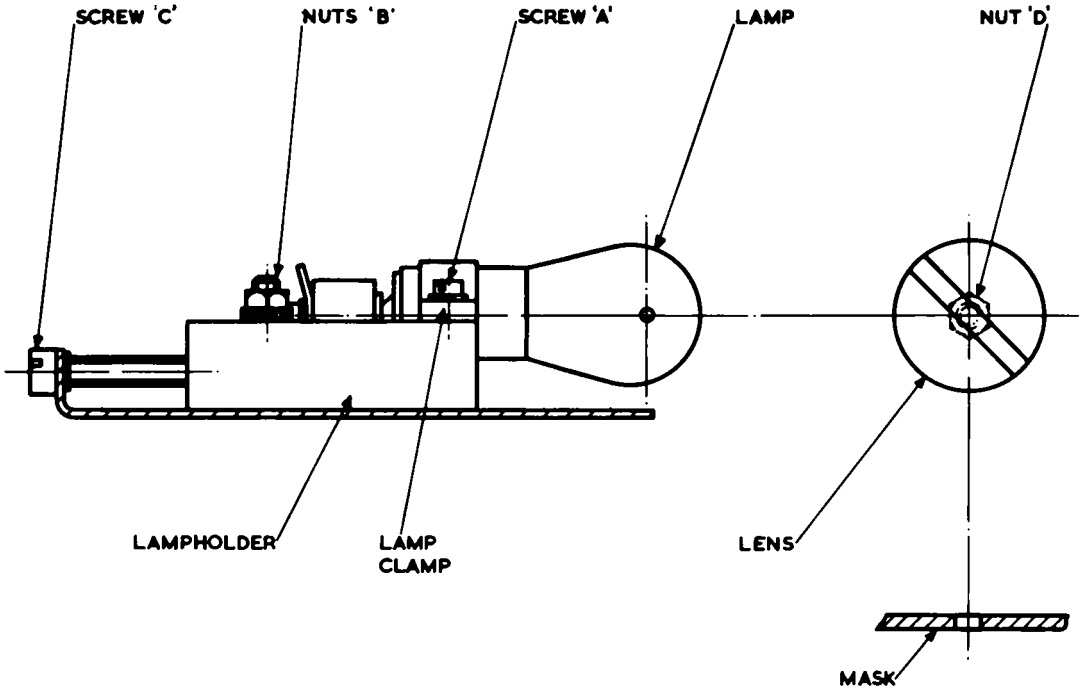


DIAGRAM 2. OPTICAL SYSTEM

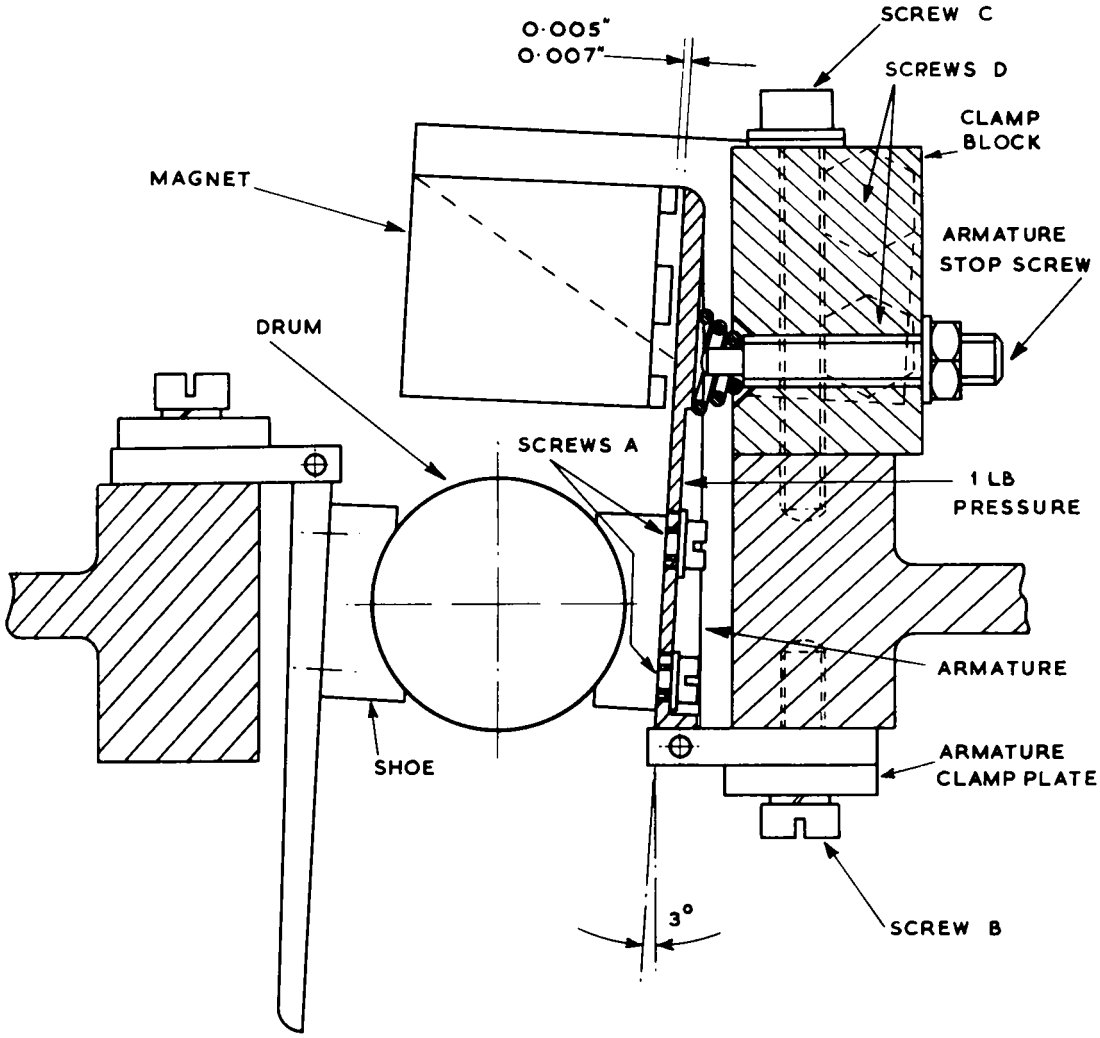


DIAGRAM 3. TAPE TRANSPORT MECHANISM

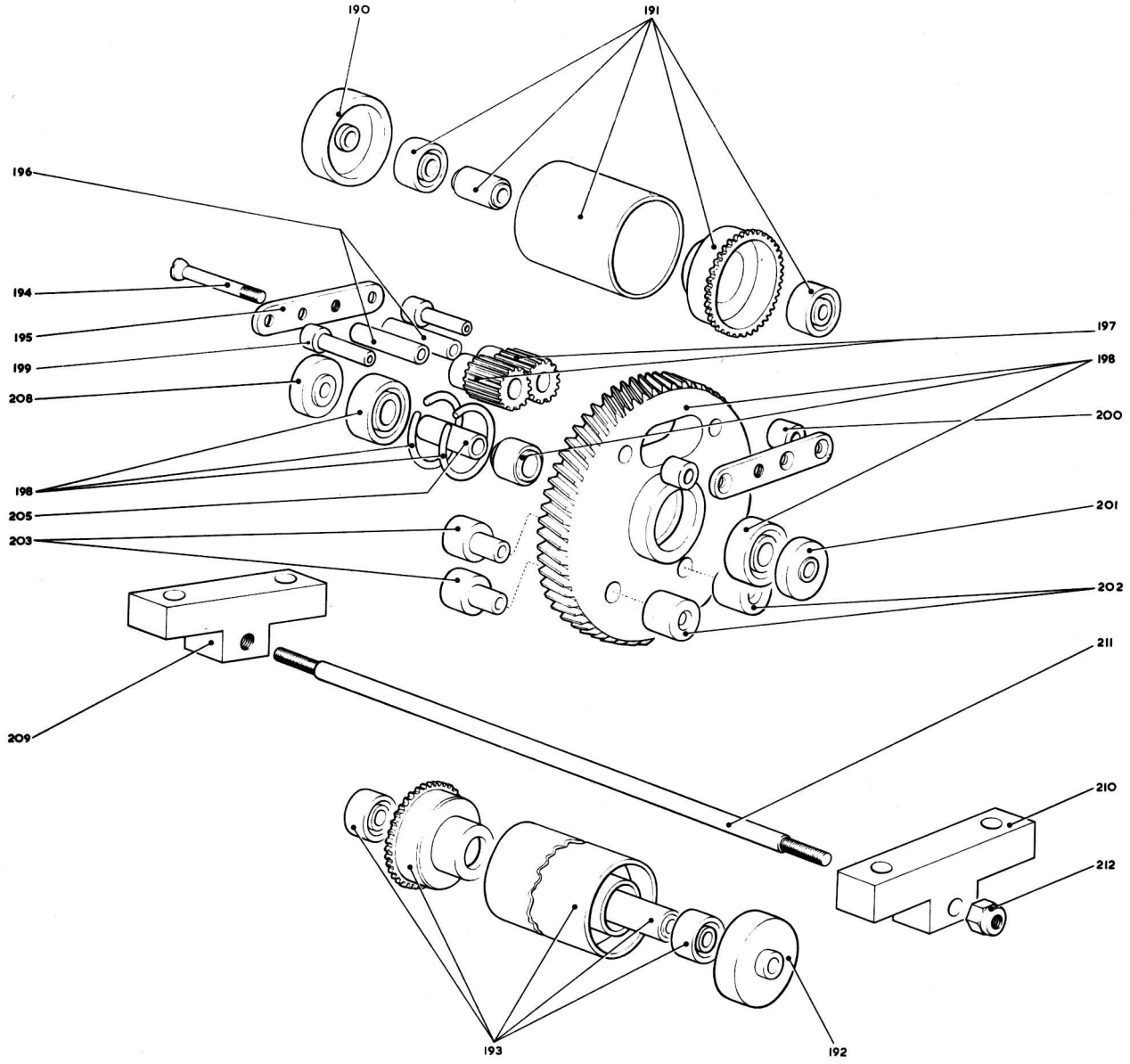


DIAGRAM 4. FEED MECHANISM

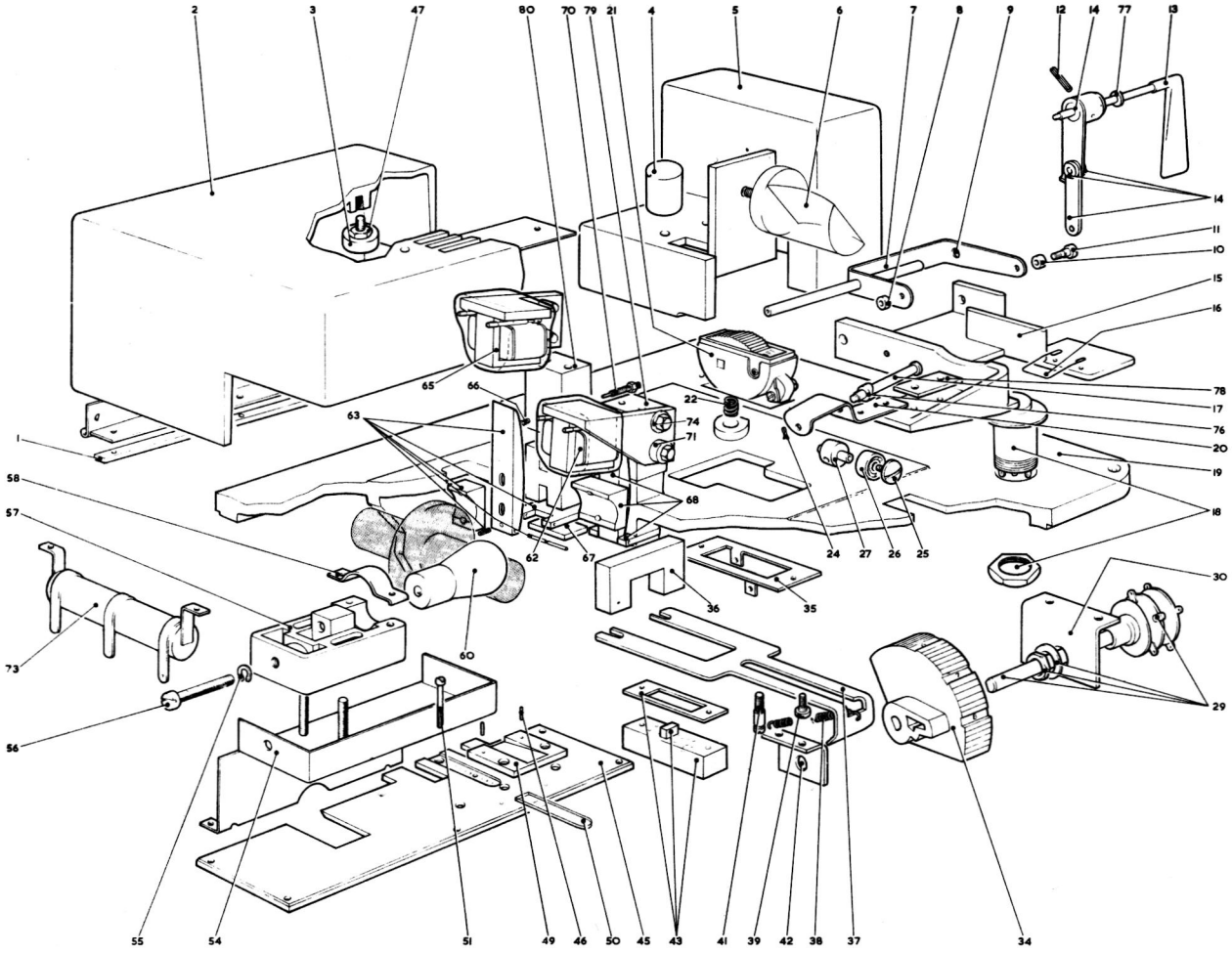


DIAGRAM 5. PLATFORM COMPONENTS

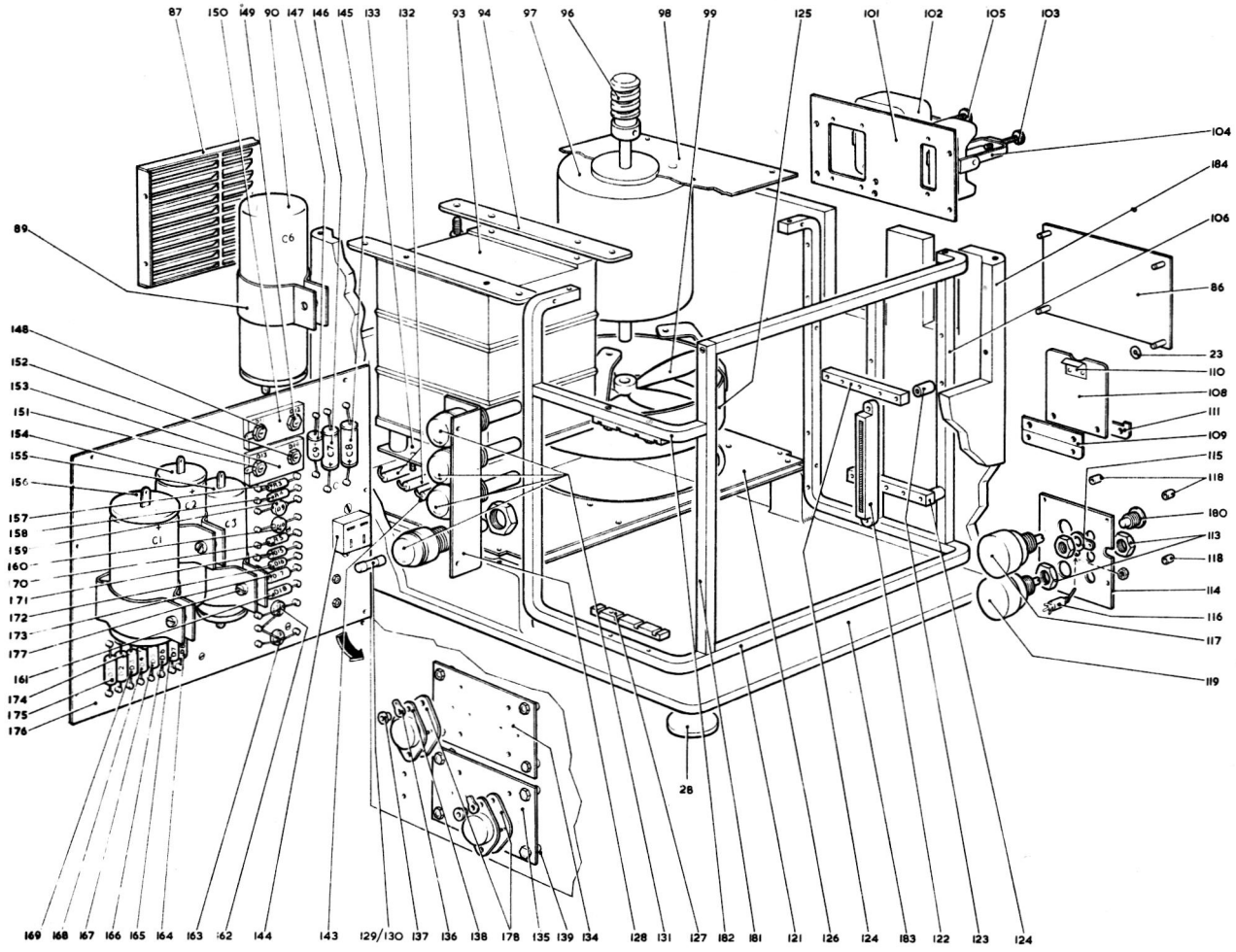
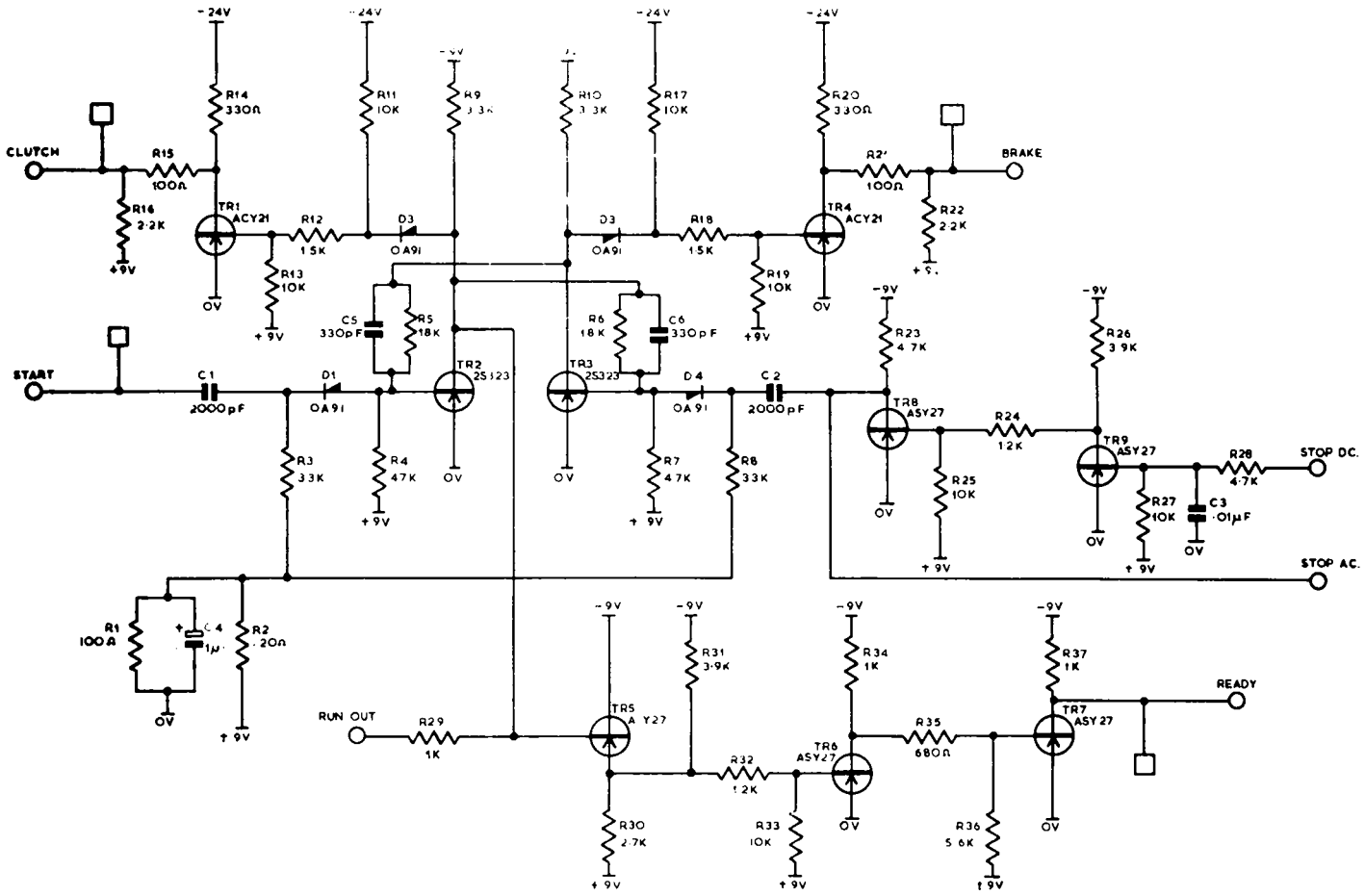


DIAGRAM 6 CHASSIS, POWER SUPPLY, MOTOR



MONITOR POINT

COMPONENT REFERENCES	VALUE	TYPE
TR1, TR4.		MULLARD ACY21
TR2, TR3.		TEXAS 2S323
TR5, TR9.		MULLARD ASY27
C1, C2.	2000pF	GEC PF 2%
C3	01μF	HUNTS 250V
C4	1μF	PLESSEY CE97/1 50V
C5, C6	330pF	HS7/E
R1, R15, R21	100Ω	WELWYN F20 5%
R2	220Ω	WELWYN F20 5%
R3, R8.	33K	WELWYN F20 5%
R4, R7.	4·7K	WELWYN F20 5%
R5, R6.	18K	WELWYN F20 5%
R9, R10.	3·3K	WELWYN F20 5%
R11, R13, R17, R19, R25, R27, R33.	10K	WELWYN F20 5%
R12, R18.	1·5K	WELWYN F20 5%
R14, R20.	330Ω	WELWYN F20 6W
R16, R22.	2·2K	WELWYN F20 5%
R23, R28.	4·7K	WELWYN F20 5%
R24, R32	1·2K	WELWYN F20 5%
R26, R31.	3·9K	WELWYN F20 5%
R29, R34, R37.	1K	WELWYN F20 5%
R30	2·7K	WELWYN F20 5%
R35	680Ω	WELWYN F20
R36	5·6K	WELWYN F20 5%
D1-D4		MULLARD OA91

CONTACTS

- A — -24V
- B — -9V
- C — START
- D — STOP DC
- E — BRAKE
- F — CLUTCH
- H — +9V
- J — RUN OUT
- K — (CODING SLOT)
- L — 0V
- M — STOP AC
- N — READY

DIAGRAM 7 CIRCUIT 497 PACKAGE

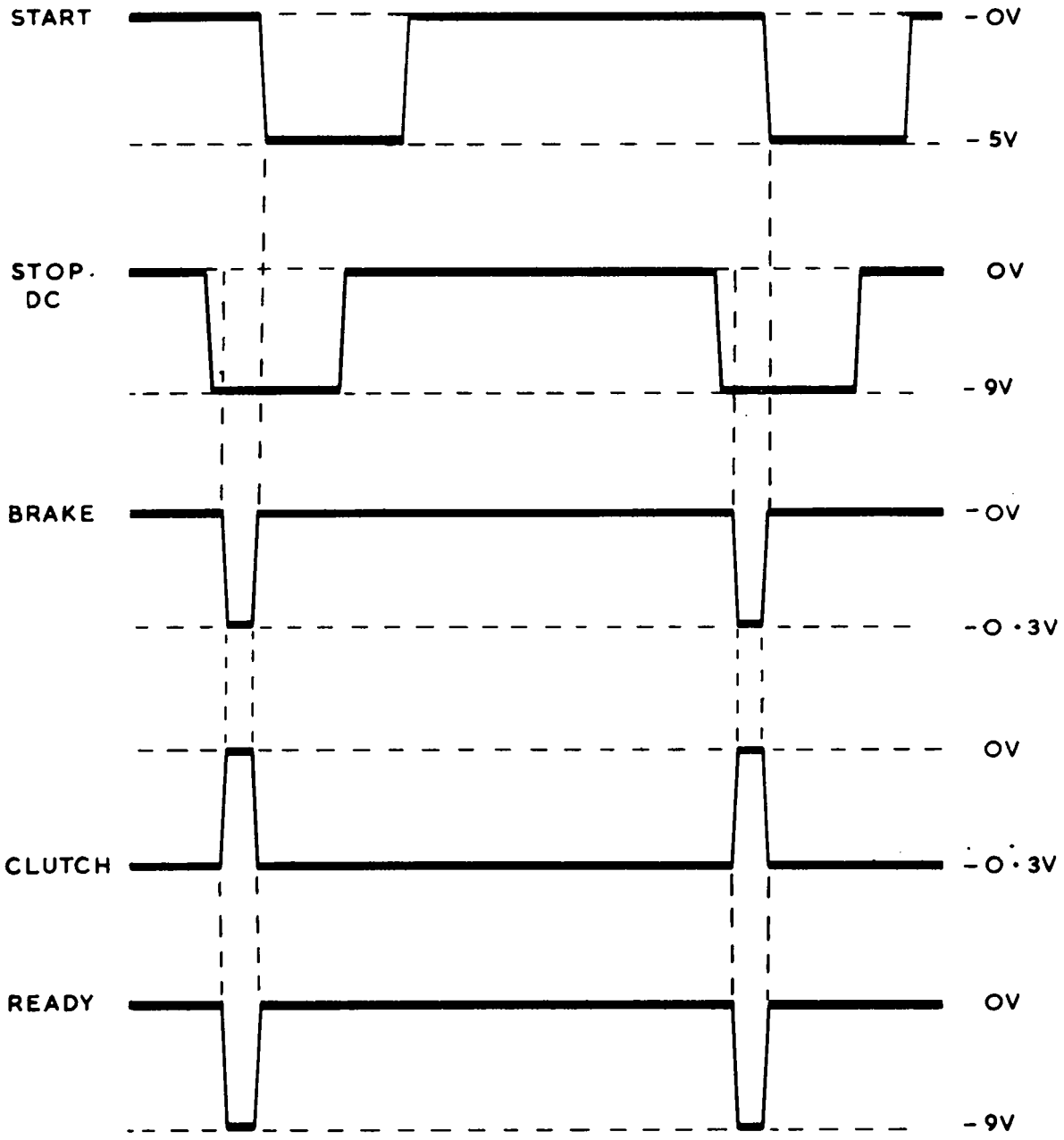
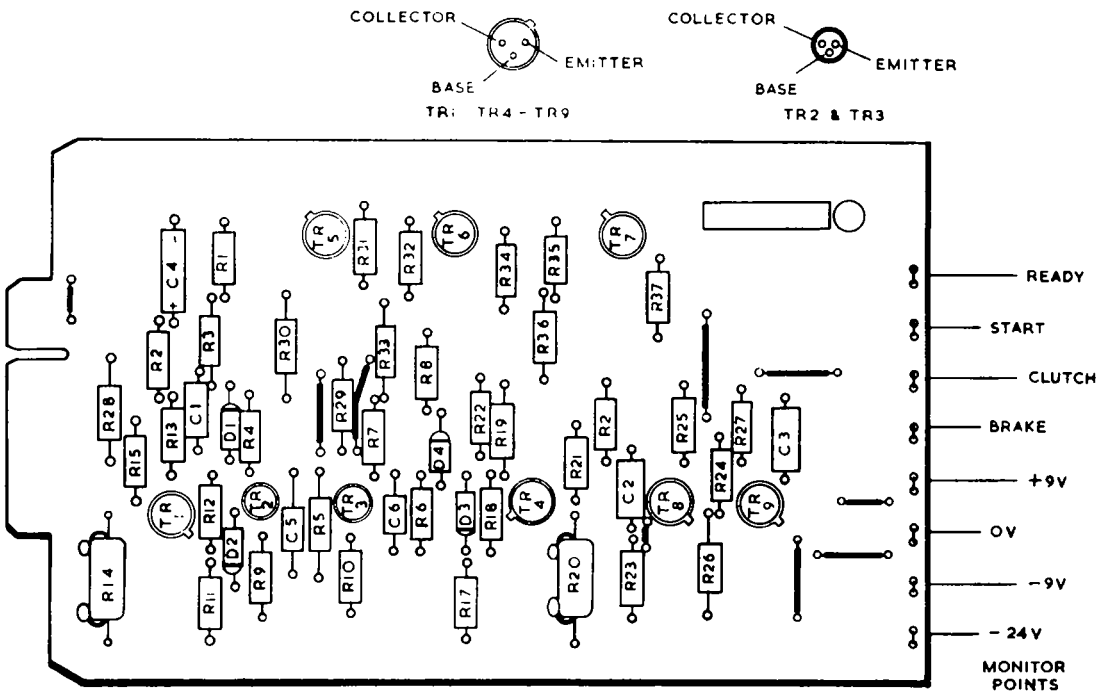
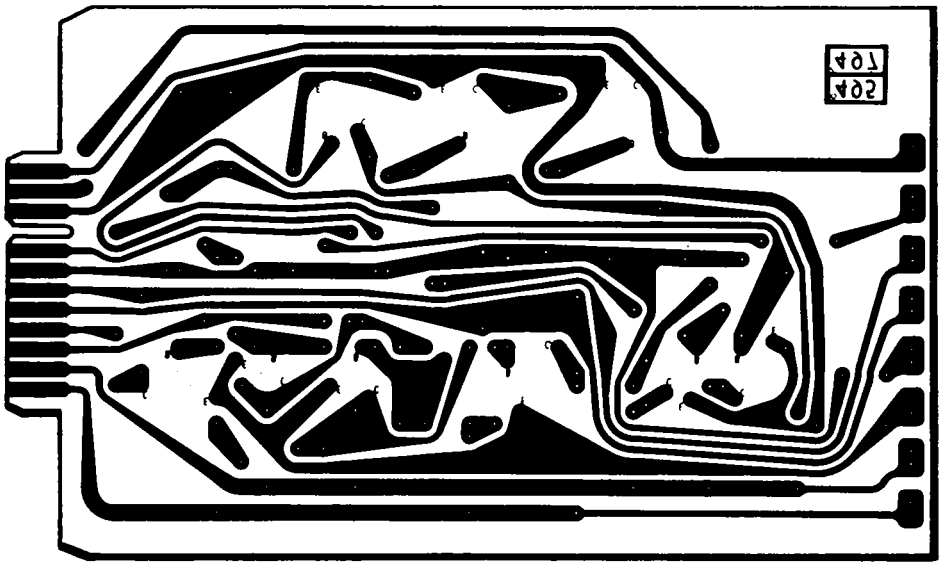


DIAGRAM 8. IDEALISED WAVEFORMS 497 PACKAGE

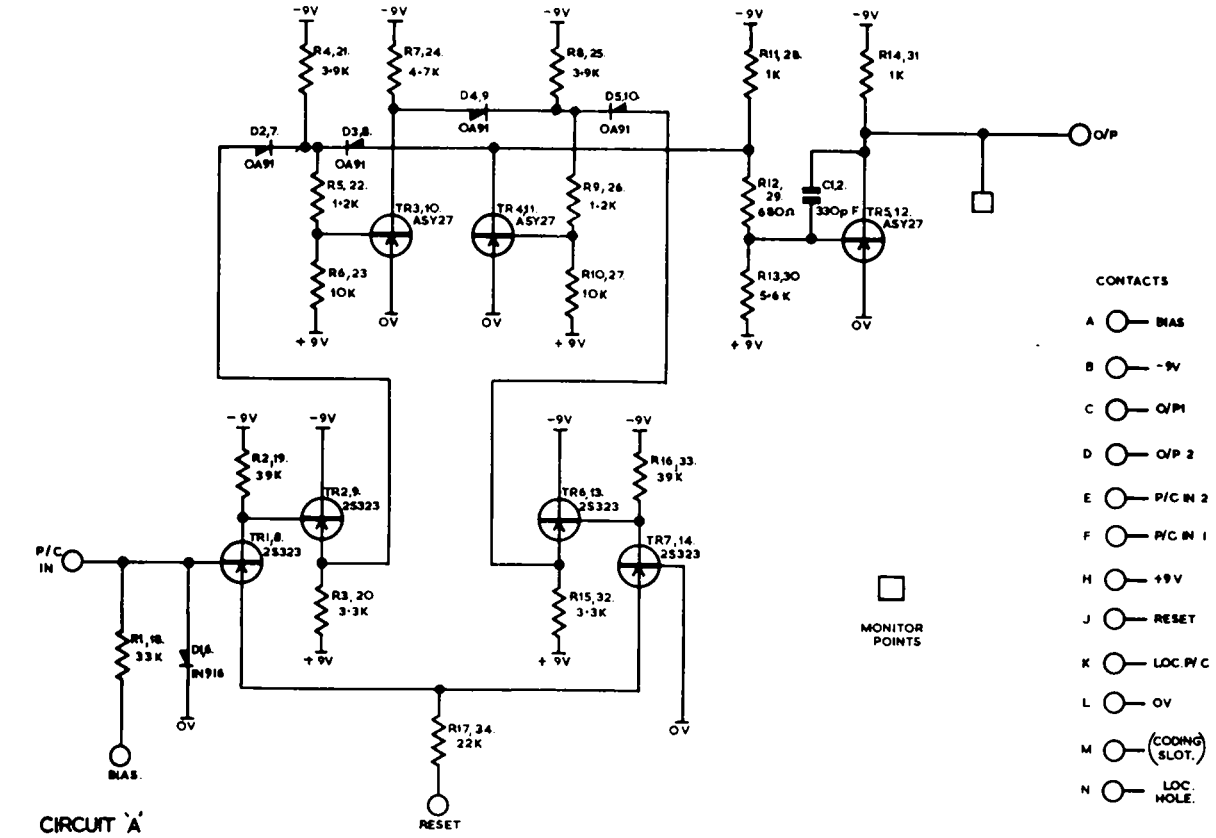


COMPONENT LAYOUT



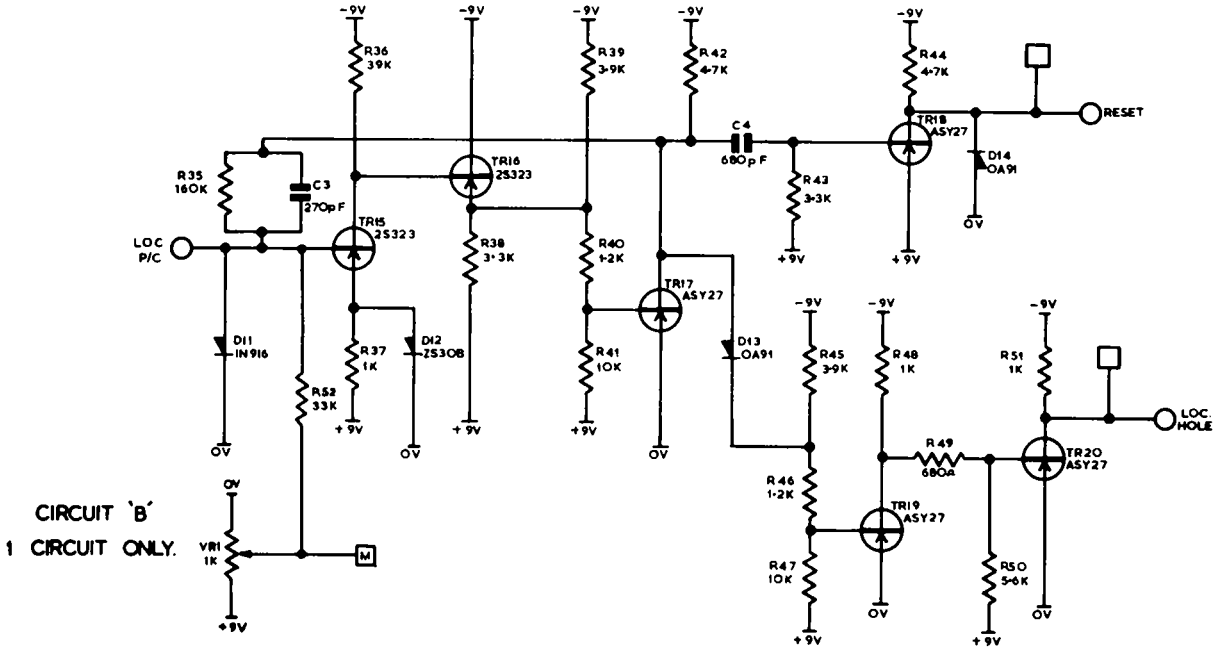
PRINTED CIRCUIT (GHOST VIEW)

DIAGRAM 9. 497 PACKAGE



CIRCUIT 'A'

2 IDENTICAL CIRCUITS.



CIRCUIT 'B'

1 CIRCUIT ONLY.

COMPONENT REFERENCE	VALUE	TYPE	COMPONENT REFERENCE	VALUE	TYPE
TR1, TR2, TR6–TR9, TR13–TR16		TEXAS 2S323	R6, R10, R23, R27, R41, R47	10K	WELWYN F20 5%
TR3–TR5, TR10–TR12, TR17–TR20		MULLARD ASY27	R7, R24, R42, R44	4·7K	WELWYN F20 5%
C1, C2	330pF	HS7/E	R11, R14, R28, R31, R48, R51, R37	1K	WELWYN F20 5%
C3	270pF	HS7/E	R12, R29, R49	680Ω	WELWYN F20 5%
C4	680pF	HS10/F	R13, R30, R50	5·6K	WELWYN F20 5%
R1, R18	33K	1%	R17, R34	22K	WELWYN F20 5%
R2, R16, R19, R33, R36	39K	WELWYN F20 5%	R35	160K	WELWYN F20 5%
R3, R15, R20, R32, R38, R43	3·3K	WELWYN F20 5%	D1, D6, D11		TEXAS IN916
R4, R8, R21, R25, R39, R45	3·9K	WELWYN F20 5%	D2–D5, D7–D10, D13, D14		MULLARD OA91
R5, R9, R22, R26, R40, R46	1·2K	WELWYN F20 5%	D12		FERRANTI ZS308
R52	33K	WELWYN F20 5%	VR1	1K	AMPHENOL 860PC TRIM POT 5%

DIAGRAM 10. CIRCUIT 498 PACKAGE

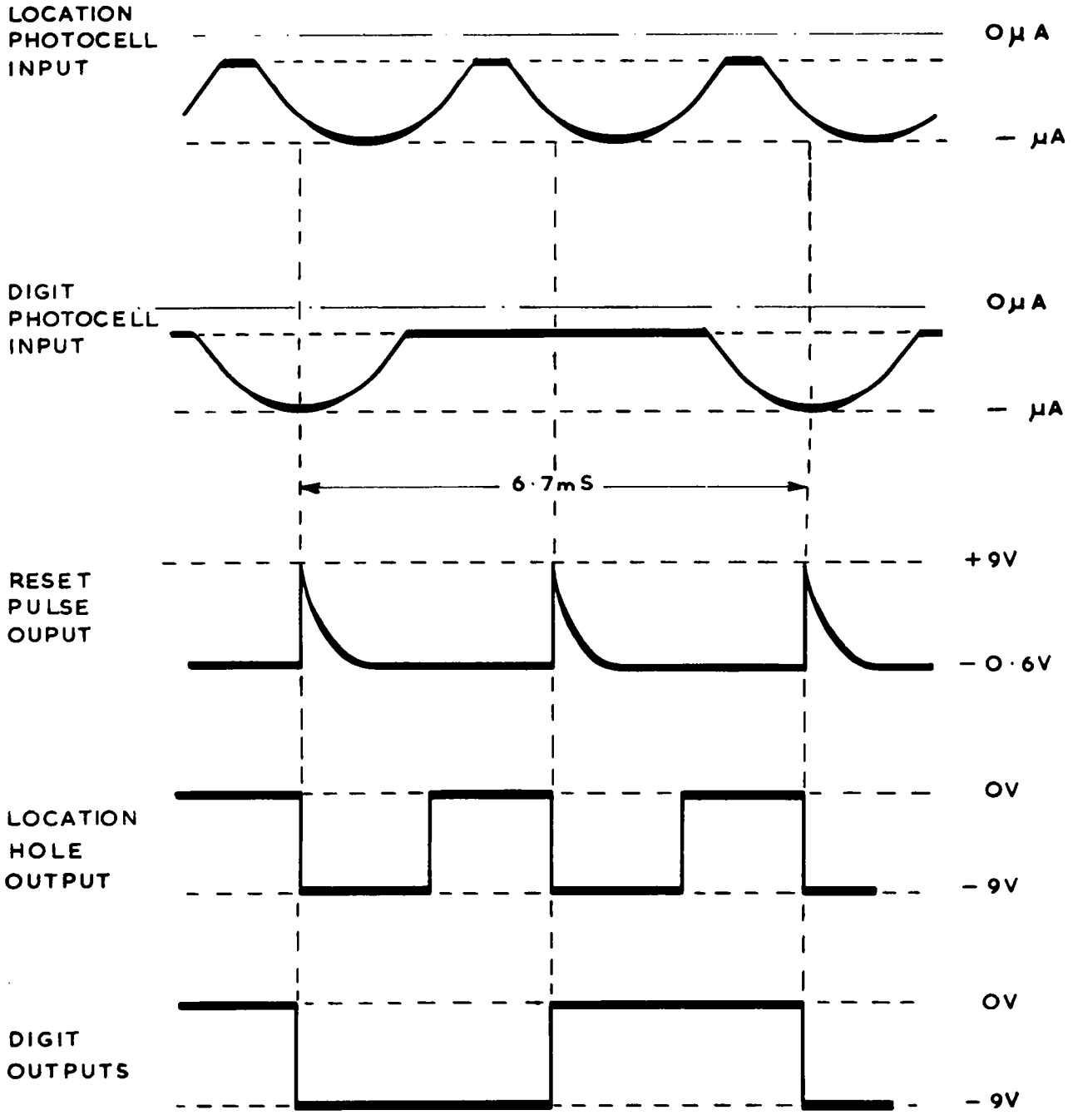
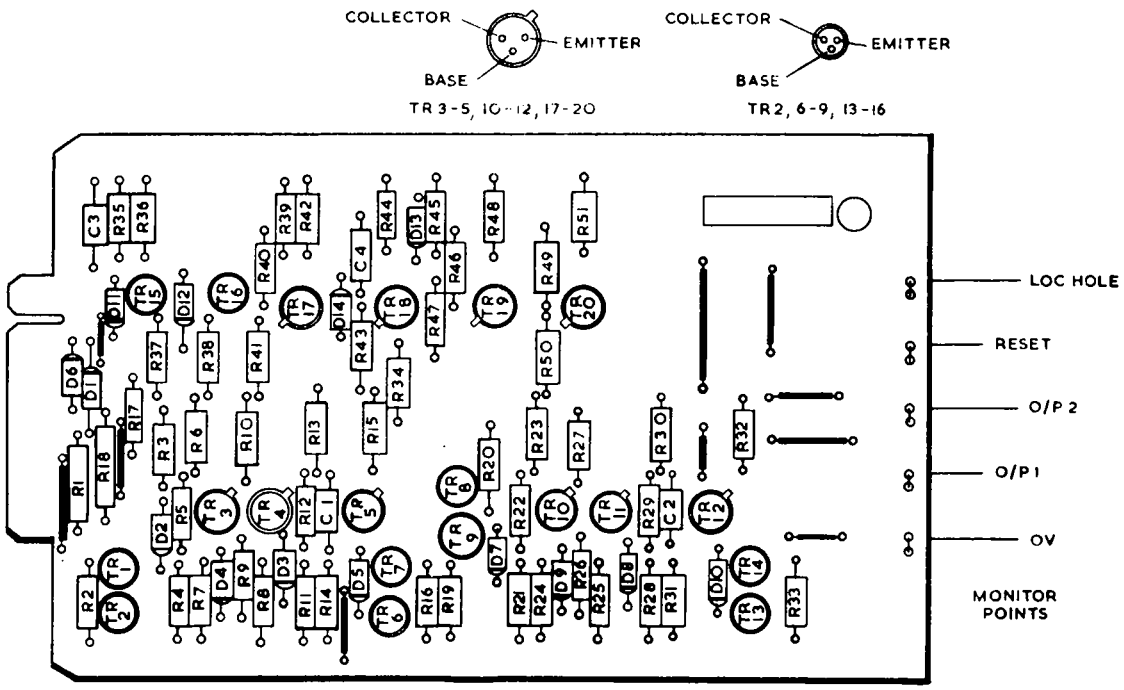
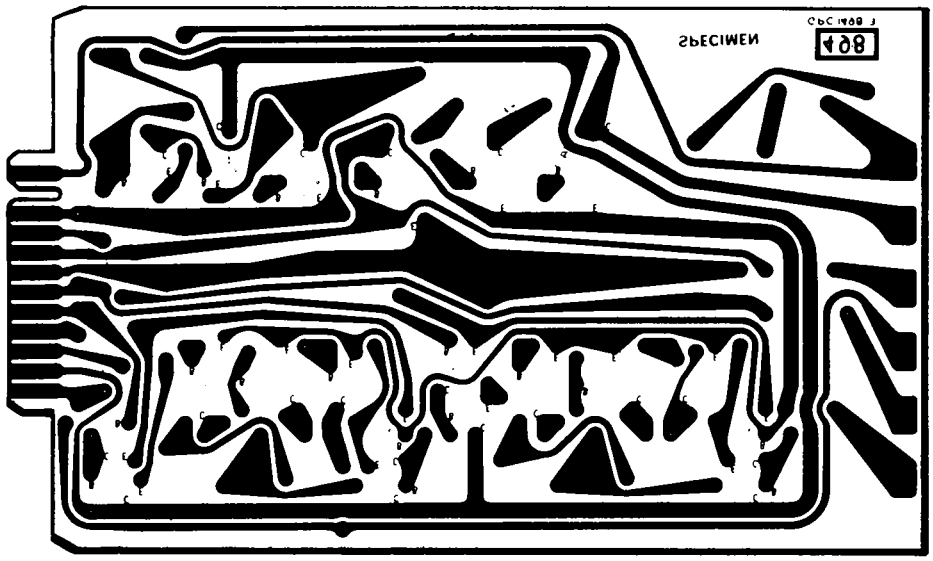


DIAGRAM 11. IDEALISED WAVEFORMS 498 PACKAGE

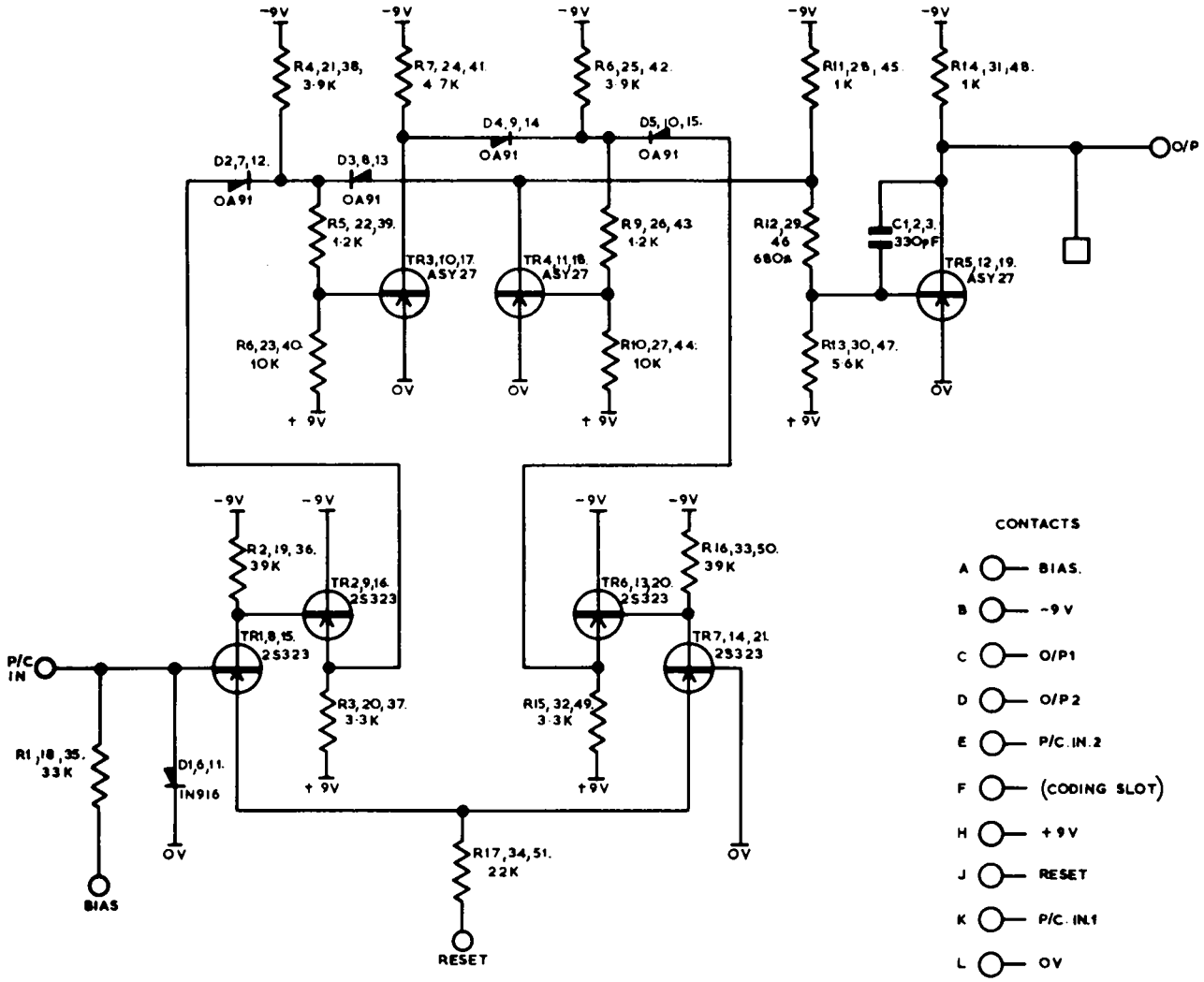


COMPONENT LAYOUT



PRINTED CIRCUIT (GHOST VIEW)

DIAGRAM 12. 498 PACKAGE



3 IDENTICAL CIRCUITS.

COMPONENT REFERENCES	VALUE.	TYPE.	
TR1, TR2, TR6–TR9, TR13–TR16, TR20, TR21		TEXAS	2S323
TR3–TR5, TR10–TR12, TR17–TR19		MULLARD	ASY27
C1–C3	330pF	HS7/E	
R1, R18, R35.	33K		1%
R2, R16, R19, R33, R36, R50.	39K	WELWYN F20	5%
R3, R15, R20, R32, R37, R49.	3·3K	WELWYN F20	5%
R4, R8, R21, R25, R38, R42.	3·9K	WELWYN F20	5%
R5, R9, R22, R26, R39, R43.	1·2K	WELWYN F20	5%
R6, R10, R23, R27, R40, R44.	10K	WELWYN F20	5%
R7, R24, R41.	4·7K	WELWYN F20	5%
R11, R14, R28, R31, R45, R48.	1K	WELWYN F20	5%
R12, R29, R46.	680Ω	WELWYN F20	5%
R13, R30, R47.	5·6K	WELWYN F20	5%
R17, R34, R51.	22K	WELWYN F20	5%
D1, D6, D11.		TEXAS	IN916
D2–D5, D7–D10, D12–D15.		MULLARD	OA91

MONITOR POINTS.

DIAGRAM 13. CIRCUIT 499 PACKAGE

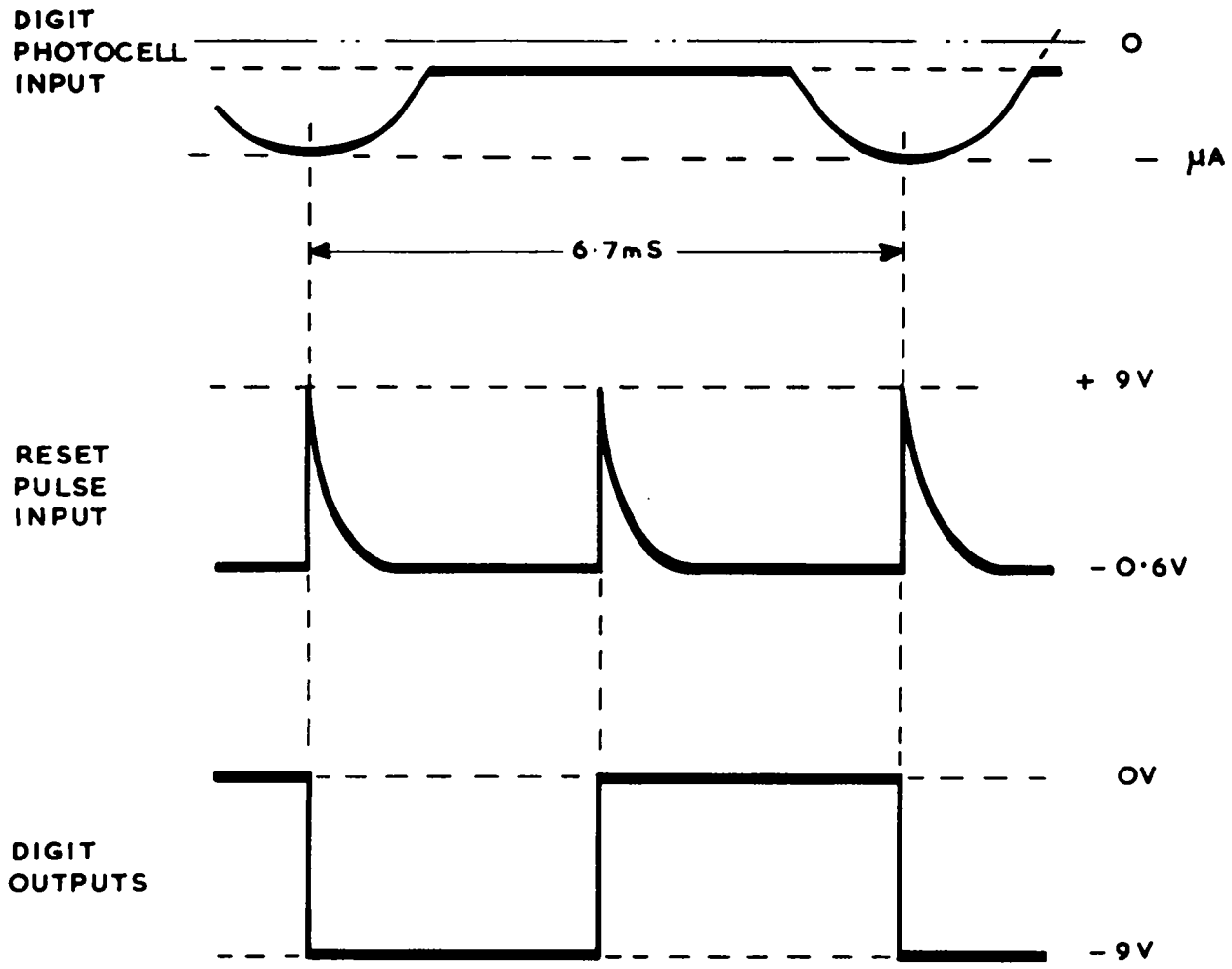
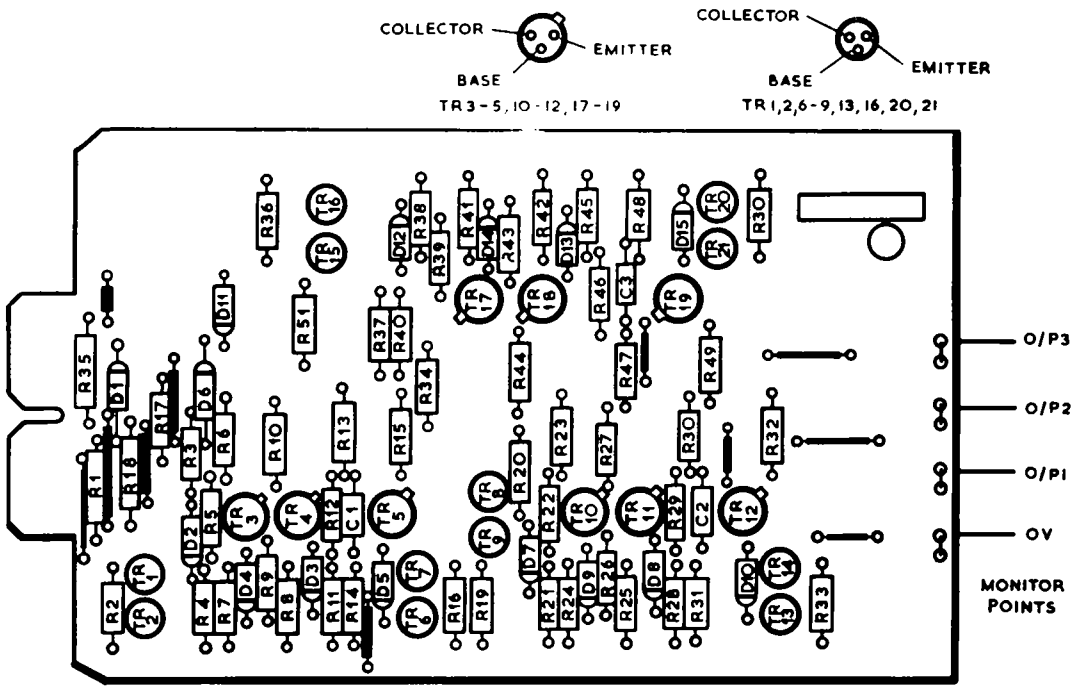
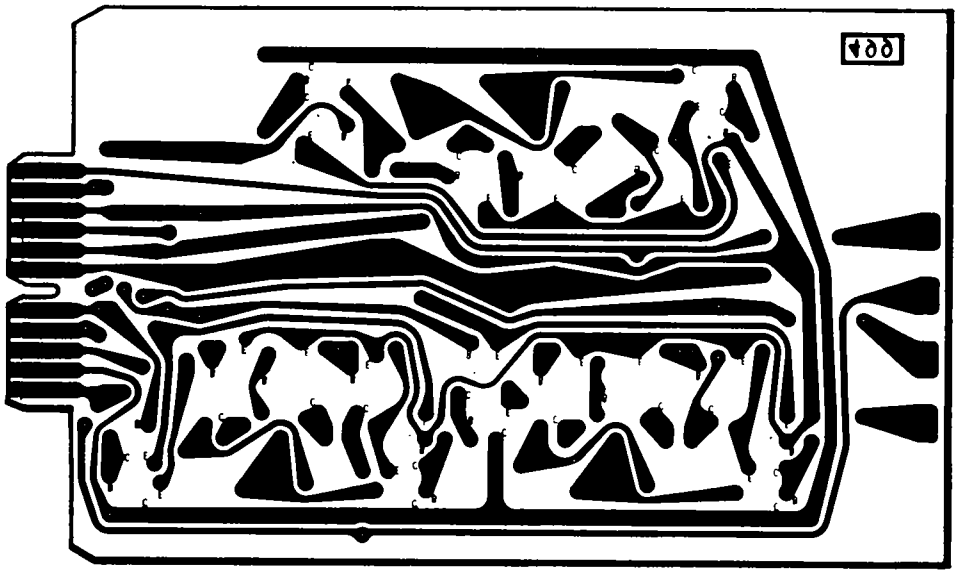


DIAGRAM 14. IDEALISED WAVEFORMS 499 PACKAGE



COMPONENT LAYOUT



PRINTED CIRCUIT (GHOST VIEW)

DIAGRAM 15. 499 PACKAGE

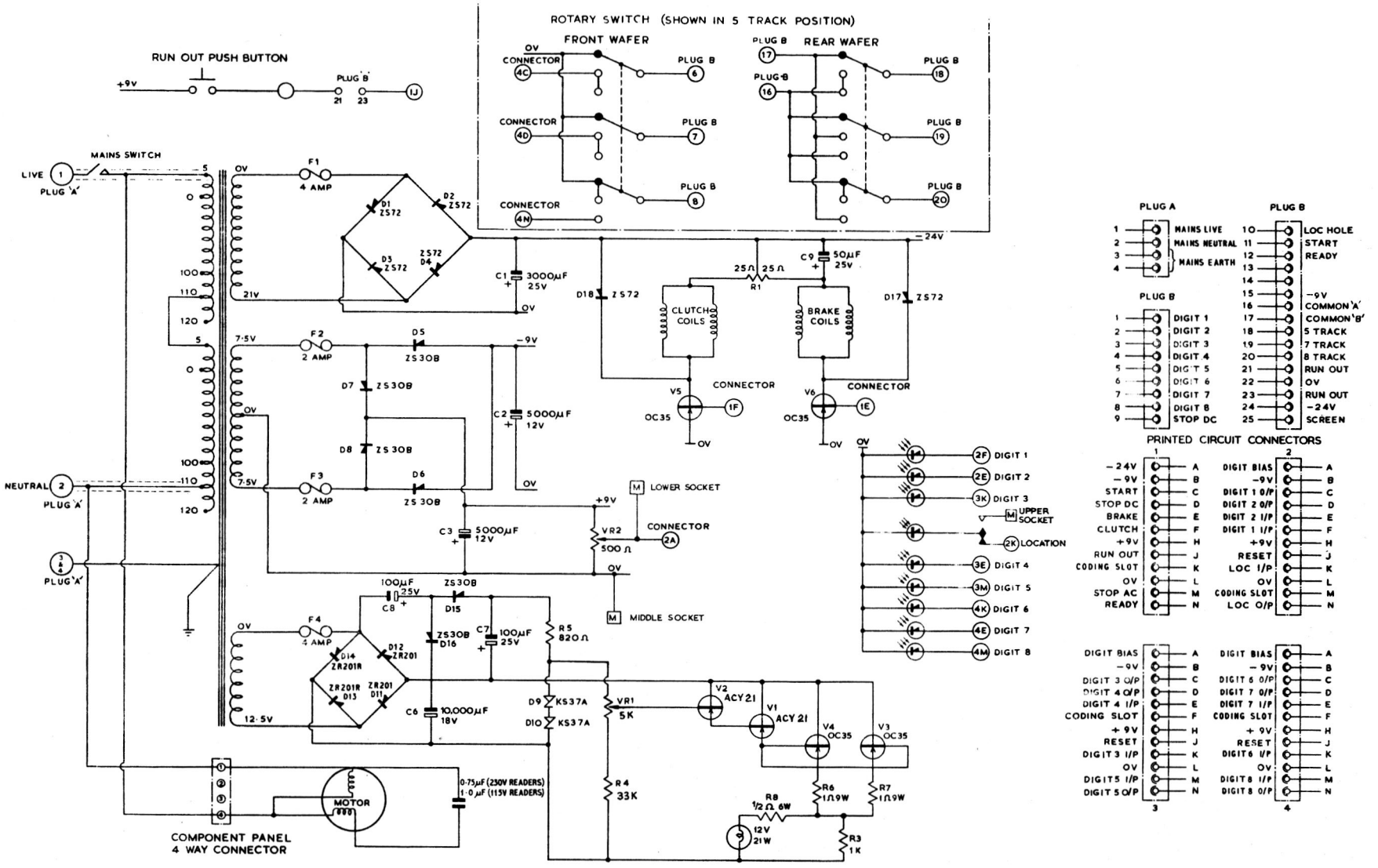
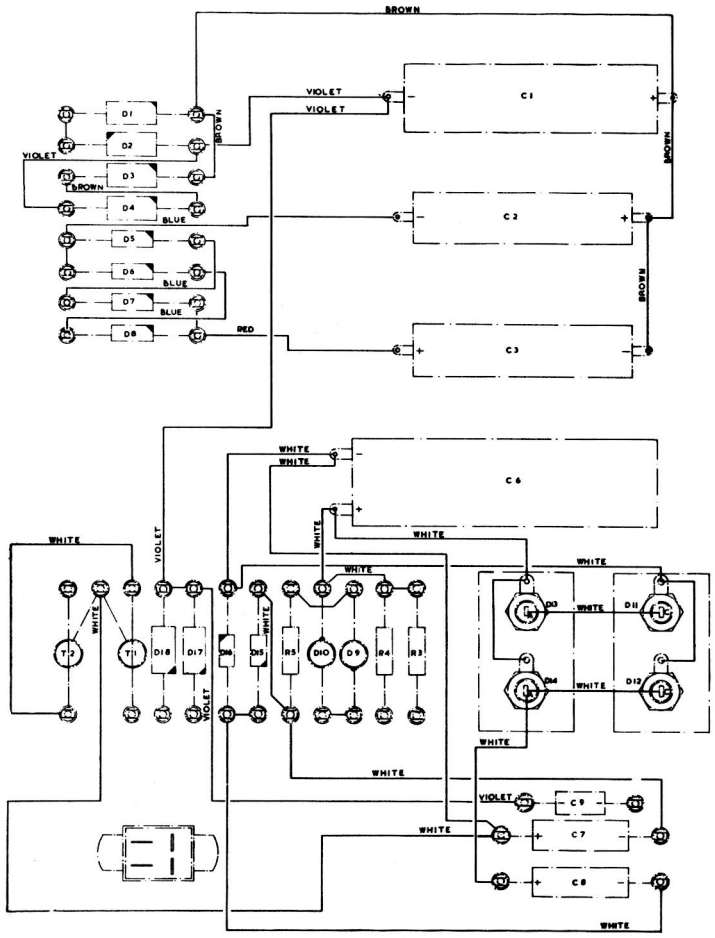
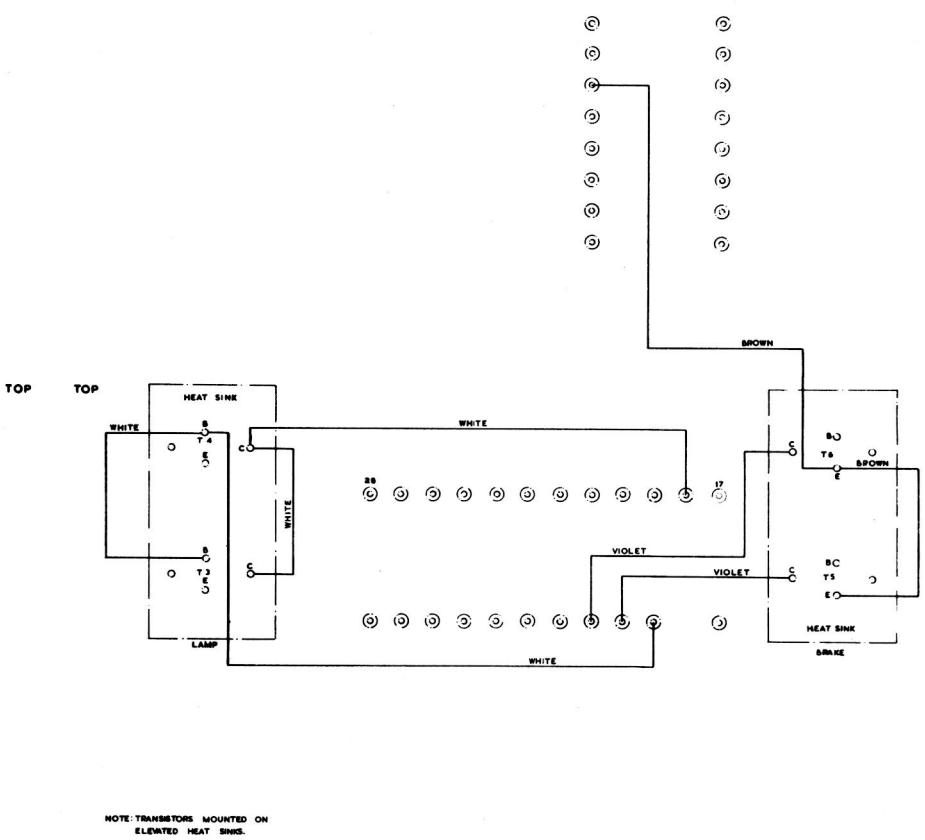


DIAGRAM 16. POWER SUPPLIES



COMPONENT SIDE



NOTE: TRANSISTORS MOUNTED ON ELEVATED HEAT SINKS.

TRANSISTOR SIDE

DIAGRAM 18. COMPONENT PANEL WIRING