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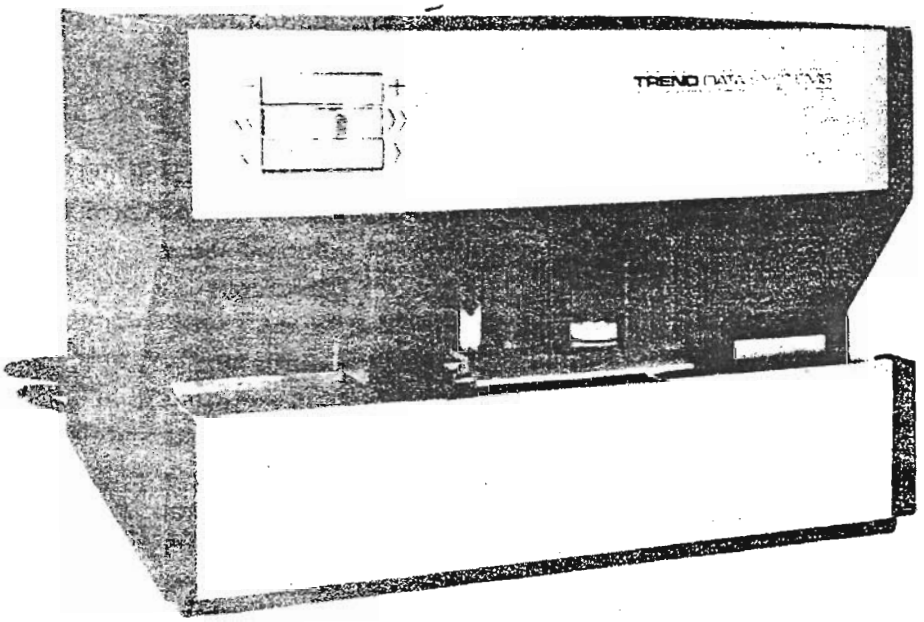
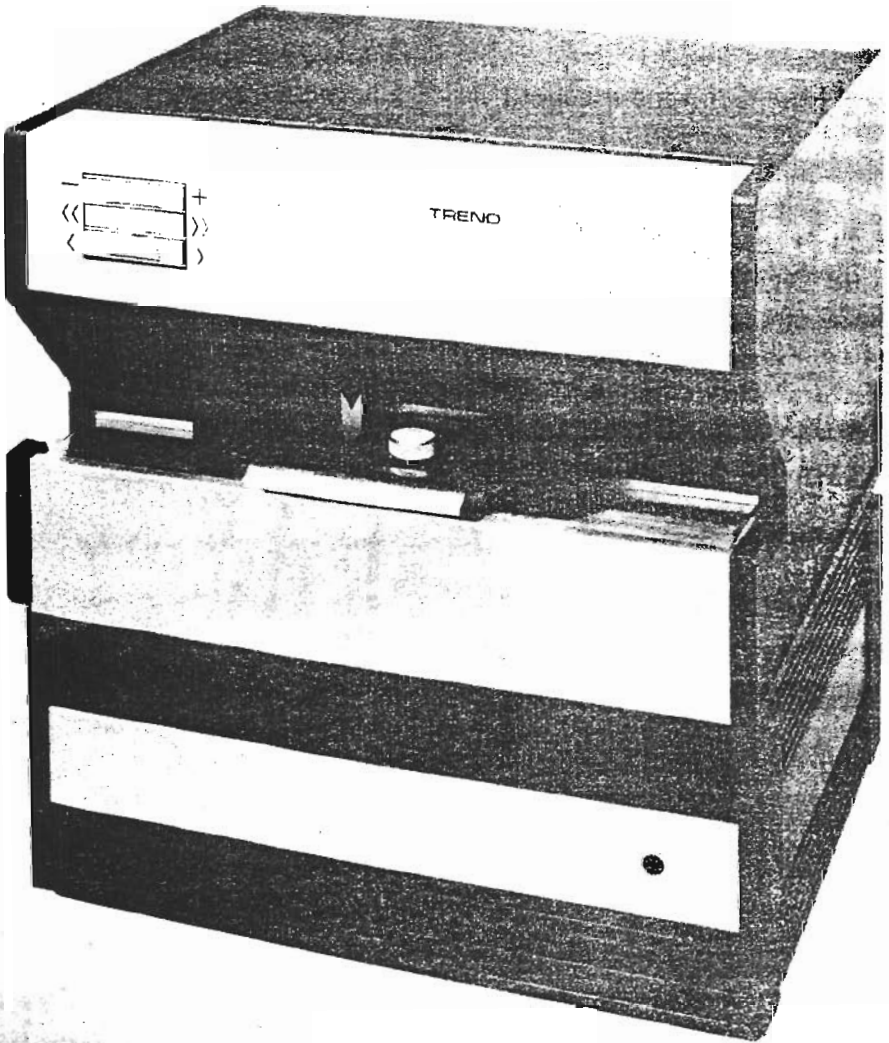




HSR 500 P

SECTION 1 - INTRODUCTION

The HSR 500 is a high performance, low cost input device for computers and other digital systems. It has been designed and is manufactured in Great Britain to meet the demand for a reasonably priced yet reliable high speed punched tape reader.

The HSR 500 employs photo-electric sensing which permits high reading speeds and virtually eliminates failures arising from mechanical wear. The use of capstan tape drive combined with the absence of mechanical sensing ensures that tape wear and damage is kept to an absolute minimum.

A unique (patented) differential photo-electric sensing system eliminates the problems normally associated with photo-electric reading, enabling reliable reading of tapes of widely differing opacities and colours and a remarkably large variation in light source intensity. The optical design provides excellent direct visibility of the character being sensed and those adjacent to it, and the reading station is clearly indicated. Tape loading is very simple and rapid and does not require careful tape alignment.

The tape transport control is bi-directional and is designed to allow fast step-by-step control as well as high synchronous speed. A unique electro-magnet braking control system attains reliable stopping on a character, making external code buffering unnecessary.

In spite of the sophisticated control electronics used in the HSR 500, the users interface is extremely simple and yet versatile. Silicon semi-conductors are used throughout, and all interface signals are inputs or outputs of 930 Series D.T.L. integrated circuits, which gives the user the best possible compromise between compatibility with other logic circuit systems, signal drive and loading factors, line driving capability and noise immunity, with the additional advantage of wired-OR capability for bus-oriented systems.

The HSR 500 can be run from d.c. supplies provided by the user with a.c. mains to supply the motor, or in HSR 500P form can be run on a.c. mains only with all necessary d.c. power supplied from an integral power unit. Either version may be supplied for table-top mounting, or for 19 inch rack mounting (Suffix R). In addition a rack mounted version complete with a tape dispensing spooler with powered re-wind is available (Suffix RS).

The basic interface of the HSR 500 may be augmented by an Extended Interface Unit which incorporates a tape out/tape tight detection circuit and latch, and a brake delay circuit to facilitate step-by-step control. This unit is provided with an input/output cable and multi-way connector.

This handbook is intended to aquaint the user with the details necessary for him to design an interface which makes maximum use of the capabilities of the HSR 500, and also to provide the details of design and construction necessary to enable him to undertake maintenance of the reader, and the standard accessories.

The majority of the information is applicable to HSR 500 and HSR 500P versions; that which is particular to the HSR 500P is distinguished as necessary.

SECTION 2 - SPECIFICATION

2.1 GENERAL DESCRIPTION

The HSR 500 is a punched tape reader capable of reading the various industry standard tapes at speeds up to at least 500 characters per second in either direction. Tape transport control is by means of two contra-rotating drive rollers selected alternatively by electro-magnetically activated pinch rollers, and a direct acting electro-magnetic brake.

Character sensing is effected by a photo-cell array mounted on the opposite side of the punched tape from a light source focused to a near parallel beam. The light source is a tungsten filament vehicle lamp which is under-run by 25% of its normal voltage rating. The photo-cell array is a monolithic array of silicon photovoltaic cells which are operated in the short circuit mode, with an additional 'reference' photo-cell arranged to compensate for tape and light source variations.

The reader is compactly arranged with a horizontal tape platform allowing simple and rapid tape loading. The reader is entirely cased, using robust materials and construction and attractive finishes. All solenoid control electronics and photo-cell amplifiers are built in.

The reader is available in two alternative basic versions:

(i) Basic Free Standing (HSR 500)
(ii) Free Standing with Integral Power Supply (HSR 500 P)

Both versions may be supplied in the following optional arrangements:

(a) Free Standing
(b) Rack Mounted (Suffix R)
(c) Rack Mounted with Supply Spooler/Rewinder (Suffix S)

In addition various options are available on all models to customer specification, such as:

(i) Paint finish colour
(ii) Legends
(iii) Control Switches
(iv) Supply voltage
(v) Connectors and Leads
(vi) Interfaces

The information in this section refers to both HSR 500 and HSR 500P models, unless specifically stated.

2.2 DIMENSIONS

	HSR 500	HSR 500P
Width:	247 mm	247 mm
Height:	169 mm	273 mm
Depth:	229 mm	229 mm
Weight:	9.3 Kilo (21 lbs)	14.0 Kilo (31 lbs)

Dimensions of rack mounted versions are given in Section 8.

2.3 FINISHES

Case (sides, top and back):	Black textured organasol paint. (Other colours to special order).
Base:	Black anodised aluminium.
Tape Platform:	Stainless Steel.
Loading Flap:	Stainless Steel.
Edge Guides:	Hard Chromium plated steel.
Front Panels:	Silver anodised aluminium.
Front Casting	Black textured organasol paint.
Power Unit:	Black anodised aluminium extruded fin sections;
(HSR 500P only)	Black textured organasol corner brackets;
	Anodised aluminium centre trims - silver at front and rear, black at sides.

2.4 TAPE REQUIREMENTS

Tape Materials:	Paper, Oiled Paper, Mylar Sandwich or Plasticised Paper (e.g. Syntosil). Mylar and Metallised Mylar can be read reliably, but with reduced transport performance. N.B. Plasticised Paper is recommended for maximum tape life.
Tape Width:	1 inch, 7/8 of an inch, or 11/16 of an inch may be accommodated by a simple adjustment of the outer tape guide to pre-determined positions.
Tape Thickness:	0.002 inches to 0.006 inches. Greater thicknesses may be accommodated, such as splices, but will reduce transport performance.
Tape Opacity:	Up to 50% total light transmission, any colour, without adjustment.
Punching Tolerances:	Tolerance is in excess of that specified by BS 3880.
Tape Width Tolerance:	±0.010 inches from nominal.

2.4 (continued)

Lateral Punching Tolerance:	± 0.010 inches from nominal
Longitudinal Punching Tolerance:	± 1 character/inch from 10 character/inch
Tape Splices:	Overlap and Butt Splices can be accurately read, provided that no light gaps are left in the latter case. They may cause reduced transport performance.
Tape Terminations:	Approximately 5 inches minimum of sprocket only or other 'feed' codes.
Tape Supply:	Tapes may be either reeled or fan-fold. N.B. Fan-fold tape is read intrinsically more reliably in the drive left direction when tape is 'stretched' between brake and capstan over the read head.
Tape Supply Tension:	8 oz. for specified transport performance. Greater tensions may be used if reduced transport performance is acceptable.

2.5 PERFORMANCE

Synchronous Speed:	(Skip or Slew speed) 500 ch/s minimum.
Stepping Speed:	(a) Isochronous (at constant rate): 0 to at least 300 ch/s. (b) With constant Stop time: 0 to at least 500 ch/s.
Stopping Distance:	Less than 0.025 inches from any speed up to maximum synchronous speed.
Brake Delay:	(a) To stop on a character: maximum of 350 μs from time of sprocket going light. (b) To stop before next character: maximum of 1.2 ms from time of sprocket going light.
Character Advance Time:	(a) At 70 ch/s stepping: approximately 3.5 ms. (b) From rest (<10ch/s) approximately 6 ms.
Acceleration Time:	Block of 10 characters read from rest in less than 25 ms provided that brake is not applied and tape tension is maintained within specified maximum.

2.6 ENVIRONMENT

Operating Temperature Range:	+5°C to +40°C ambient
Storage Temperature Range:	-10°C to +70°C ambient

2.7 RELIABILITY

M.T.B.F.:	Typically 1,000 Hours (estimated)
Lamp Life:	Typically 10,000 Hours in normal operating conditions: The reader will read accurately and without adjustment with light intensity reduced by 50% from nominal.

2.8 POWER REQUIREMENTS

2.8.1 HSR 500

Mains Voltage Alternatives:	220/240v, 50 Hz 110/120v, 50 Hz 110/120v, 60 Hz
Power Requirement:	35VA maximum
Voltage Tolerance:	±10%
Logic Supply Voltage:	+5v ±0.25v at 150mA maximum Ripple less than 50mV p-p.
Lamp and Coil Supply Voltage Alternatives:	+24v ±0.5v) +26v ±0.5v) Ripple less than 1.0v p-p +28v ±0.5v)
Maximum Average Current:	2.5A
Maximum Peak Current:	3.5A

2.8.2 HSR 500P

Mains Voltage:	115/220/240v selected by tap changer
Voltage Tolerance:	+10%, -15%
Supply Frequency Alternatives:	50Hz or 60Hz
Power Requirement:	115VA maximum

SECTION 3 - CONSTRUCTION AND OPERATION

3.1 READER MECHANISM LAYOUT

The reader mechanism is constructed around a vertical main-plate towards the front of the unit supported on a base plate by two side castings. To this main-plate is fixed a casting bearing the lamp assembly above the tape track. The tape track consists of a stainless steel table bracketed from the base plate and the main-plate.

A motor plate assembly is mounted behind the main plate, such that the drive rollers protrude through the main plate just above the tape track, where they are protected by extensions of the lamp assembly casting. The drive pulley train and cooling fan, driven by a circular section belt, are housed between the motor plate and the main-plate. The fan projects forward into a matched cut-out in the main-plate, behind the lamp assembly casting, such that a current of air is drawn from the rear of the reader and exhausted over the lamp and the lens, thus discouraging the ingress of tape dust into the optical system.

Beneath the tape table are mounted the photo-cell block, vertically below the lamp and lens; the brake magnet, to the right of this; and the two pinch roller assemblies, vertically below each of the drive rollers. Just above the table are the rear edge guides, fixed to the main-plate, and, supported between the two capstans, the tape loading flap. The tape loading flap carries the outer edge guide, which is adjustable to preset tape widths, and the brake armature, which is spring loaded downwards onto the tape track immediately above the brake magnet.

Decorative covers are mounted on the front above and below the tape track, and a continuous top and back cover is secured by two screws to a bracket at the back, and held captive at the front by a return, until released at the back and hinged up sufficiently to allow forward movement of the cover.

3.2 CONTROL ELECTRONICS LAYOUT

A 'mother' printed circuit board is supported on insulating runners from the base plate of the reader. On this board are mounted the power resistors which limit the various stages of drive currents in the magnets, and in the case of HSR 500 models also the lamp current. To the rear of the board are mounted two printed circuit edge connectors. The control electronics printed circuit board plugs vertically into the inner of these connectors, and the outer one serves as the interface socket.

Connections from the mother board to the magnet coils, the lamp, and the tape loading flap actuated microswitch are made through individual miniature sockets soldered to the board, which mate with plugs soldered to the end of each wire. Similar sockets are used to connect the optional control switch bank, the 18 sockets concerned being mounted at the extreme rear edge of the mother board. The mother board also carries two d.c. supply fuses, mounted on skeleton type

3.2 (continued)

fuse holders just forward of the control board socket, and the supply decoupling components for the brake primary drive circuit.

The control board is supported at the top by an extension from a screen plate which slots vertically between the side castings just forward of the control board. The photo-cell block is connected to the control board by a 'Varicon' edge connector via a cable passing beneath the mother board between two of the support runners. The control switches, when fitted, are connected to the mother board sockets described previously by a cable passing down the rear of the main plate and under the mother board.

The HSR 500P has an additional cable, soldered to the bottom of the mother board, which terminates in a connector which mates with the power unit output socket.

3.3 INTERFACE ARRANGEMENTS

All of the interface signals, including the d.c. power supply connections and the optional control switch signals are terminated at the rear edge connector socket. Connections may be made to this socket via the small mating printed circuit card provided with the reader. This card is provided with terminal pads for wiring to each of the interface signals, and with lacing holes to support the wires. The card may be secured in place by the clamp provided which straddles the two edge connectors. The input/output cable should be trained towards the exit aperture and clamp at the rear of the left side casting. This clamp is also used to secure the mains lead.

Alternatively, the connector card may be replaced by a printed circuit board, carrying interface circuitry within the reader case. This card may be almost as large as the control board. If it is made the same height as the control board, it will be supported by the projections of the screen plate. The input/output cable may be soldered directly to the interface card, or may be connected by a plug and socket such as that used for connecting the photo-cell block to the control board.

3.4 OPTIONAL CONTROL SWITCHES

The optional control switch bank mounted to the left of the lamp assembly when fitted, consist of a bank of six momentary action change over microswitches actuated by three rocker levers. The function of these switches is control led by the user. They are not connected to the control circuits, and appear at the interface socket as 18 separate connections, a common, a normally open and a normally closed contact for each switch.

The usual functions of these switches, indicated by the standard legends, are as follows:

STOP or OFF LINE	-	+	START or ON LINE
SKIP LEFT	<<	>>	SKIP RIGHT
STEP LEFT	<	>	STEP RIGHT

3.5 MOUNTING ARRANGEMENTS

The basic reader type HSR 500 may be free standing on any horizontal surface, or may be fixed in any desired position by two screws into tapped holes provided in the base plate. The overall dimensions and fixing details are given in Fig. 1. In addition to the standard base fixings, this figure shows the optional side casting fixings which may be specified.

A free standing reader should preferably be mounted on a resilient surface, such as a $\frac{1}{4}$" thick rubber mat, in order to minimise noise and vibration. Resonant cavities such as thin-walled box structures should be avoided.

Tape handling is facilitated by positioning the reader to overlap the front edge of the surface on which it is standing by the width of the tape track. The mounting feet positions and weight distribution of the reader make this arrangement practicable.

The HSR 500P model is intended for free standing table top mounting. The weight distribution of this version makes it very stable, and the elevation of the tape platform above the power unit facilitates the use of common types of passive tape supply holders. Overall dimensions and fixing details are given in Fig. 2.

Rack mounted versions of the reader are also available, and these are described in Section 8.

3.6 EDGE GUIDE ADJUSTMENT

Before loading the tape to be read, the outer edge guide, which is supported on the tape loading flap, must be set correctly for the nominal width of the tape as follows:

5 channel tapes (11/16" nominal width)	- set to inner position
6 channel tapes (7/8" nominal width)	- set to middle position
7 channel tapes (1" nominal width)	- set to outer position
8 channel tapes (1" nominal width)	- set to outer position

The knurled knob on top of the loading flap should be unscrewed completely, and the edge guide withdrawn from below if a change is necessary. The edge guide is then replaced in the required position, taking care to engage both locating pegs, and the knurled knob is then replaced and tightened by hand.

3.7 LOADING AND UNLOADING TAPE

The reader mechanism is arranged to make tape loading as rapid and simple as possible.

The reader should normally be switched on with the tape loading flap in the open (raised) position. If, however, the flap is closed it should be opened by applying upwards pressure to the front edge of the flap. This will automatically cause the motor to stop and the lamp to extinguish and the brake to release completely. The flap is held in the open position by a spring detent mechanism.

The tape to be read should be placed flat on the tape table, underneath the drive rollers and the tape flap, with track 1 towards the inner edge guide, and the data on the appropriate side of the reader for the reading direction to be used. The sprocket track of the tape should then be in line with the two smaller apertures of

3.7 (continued)

the read head. If it is required to start reading on a specific code on the tape rather than on leader/trailer codes, the tape should be positioned so that the centre between this code and the sprocket preceeding it is aligned with the arrowhead at the rear of the reading station.

When the tape is in position, the loading flap should be gently lowered. The action of the flap is such that the tape will be pushed back against the inner edge guide as the flap is lowered, and the motor will start, the lamp light and the brake will steady the tape, provided that the reader supplies are switched on. The quiescent braking force is such that the tape may safely be pulled gently through the reader manually if adjustment of the reading position is required. The reader transport may then be initiated.

The closure of the loading flap should not be used to initiate tape transport immediately, as it is necessary for the motor to run up to speed, and the lamp to run up to full brightness. This will normally take a few seconds.

When reading of a tape has been completed, the tape may either be run out of the reader by continuing tape transport to the end of the tape, or the tape flap may be lifted and the tape removed sideways. If the first method is used, care must be taken to disable the transport when the tape has run out, either by manually stopping the reader, by lifting the tape flap or preferably automatically by sensing the end of sprocket changes. Care must also be taken to ignore any spurious codes which may be read at the end of the tape.

SECTION 4 - INTERFACE

4.1 INTERFACE LEVELS

All interface connections to the HSR 500 are to or from 930 Series D.T.L. integrated circuit elements of the 0°C - 75°C specification. The only two types of element used are 936 inverter and 946 two input gates, which have similar input and output characteristics, as detailed below. Additional information may be obtained from the appropriate data sheets of any of the many manufacturers of 930 Series D.T.L.

4.1.1. Input Loads

Each unit input load is approximately equivalent to 4K ohm resistance to +5v in series with a diode which allows current only out of the load.

4.1.2 Output Drive

Each unit output drive is sufficient to sink the current from one unit input load whilst maintaining a logic 0 output. In the logic 1 state each output is approximately equivalent to 6K ohm to +5v.

4.1.3 Logic 0 Level

Inputs: 0.95v maximum
Outputs: 0.5v maximum

4.1.4 Logic 1 Level

Inputs: 2.0v minimum
Outputs: 2.5v minimum

4.1.5 Rise and Fall Times

Input: Preferably 0.1 μs to 10 μs
Faster transitions are likely to cause cross-talk in long cables and slower transitions may cause instability in the receiving circuits.

Outputs: Typically 0.1 μs to 10 μs
Dependent on load impedance, particularly capacitance.

4.1.6 Interconnecting Cables

It is recommended that generally interconnecting cables should be no longer than 20 ft. in length, and should be provided with an overall earthed screen. The d.c. power rails should be supplied by twisted pairs, preferably outside the earthed screen.

4.2 CONTROL SIGNALS

4.2.1 Drive Right - 2 unit loads

4.2.2 Drive Left - 2 unit loads

4.2.3 Transport Enable - 1 unit load

Provided that 'Transport Enable' is maintained at logic 1 the reader will drive tape from left to right if 'Drive Right' is at logic 1 and 'Drive Left' is at logic 0, or from right to left if 'Drive Left' is at logic 1 and 'Drive Right' is at logic 0. The reader brake will be applied if 'Transport Enable' is held to logic 0 or if both 'Drive Right' and 'Drive Left' are in the same logic state. The brake is also applied, for approximately 5 ms whenever a change of direction is demanded, even when 'Transport Enable' is held at logic 1 whilst 'Drive Left' and 'Drive Right' change states.

4.2.4 Sprocket Enable - 1 unit load

Logic 1 on this input gates the signal from the sprocket channel amplifier onto the 'Sprocket' output. Logic 0 holds the 'Sprocket' output in the 1 state (=dark). No connection is equivalent to logic 1.

4.2.5 Channels Enable - 1 unit load

Logic 1 on this input gates the signal from the channel amplifiers onto the corresponding 'Channel' outputs. Logic 0 holds all 'Channel' outputs in the 1 state (=dark). No connection is equivalent to logic 1.

4.2.6 Channels Inhibit - 1 unit load

Logic 0 on this input gates the signal from the channel amplifiers onto the corresponding 'Channel' outputs. A logic 1 holds all 'Channel' outputs in the 1 state. No connection is equivalent to logic 1, thus if this input is not required for control purposes, it must be connected to 0v.

4.3 OUTPUT SIGNALS

4.3.1 Sprocket - 8 units drive

This output is at logic 0 when a sprocket hole in the tape is in line with the read head (light), and at logic 1 when the read head is covered (dark), provided that 'Sprocket Enable' is at logic 1.

At uniform tape velocity (synchronous speed) the mark/space ratio of this signal is approximately 50/50, and is stabilised at this ratio by the reference cell system against tape opacity, lamp brightness and tape alignment variations.

'Sprocket' will switch to logic 0 at least 10 microseconds after all 'Channel' outputs have changed state, and will switch to logic 1 at least 10 microseconds before any 'Channel' output changes state again.

4.3.2. Channels - each 8 units drive

These outputs are at logic 0 when their respective data channel holes are in line with the read head (light), and at logic 1 when tape obscures the read head (dark), provided that 'Channels Enable' is at logic 1 and 'Channels Inhibit' is at logic 0.

Chan nel signals should be strobed when 'Sprocket' is at logic 0.

4.4 MICROSWITCH SIGNALS

The optional control switch bank consists of three momentary action rocker actuators each of which operates a separate microswitch when pushed to either side. The six microswitches are each of change-over action. The connections to the microswitches are all available at the interface and are not interconnected or loaded internally. The are designated Common, N/C (normally closed) and N/O (normally open). The switches may be used for any required function, but the standard assignment is as follows:

Switch 1 (Top):	Right Hand Side (1B)	- Start or On Line
	Left Hand Side (1A)	- Stop or Off Line
Switch 2 (Centre):	Right Hand Side (2B)	- Skip Right
	Left Hand Side (2A)	- Skip Left
Switch 3 (Bottom):	Right Hand Side (3B)	- Step Right
	Left Hand Side (3A)	- Step Left

4.5 POWER LINES

4.5.1 HSR 500

This basic version of the reader requires two d.c. supply rails as specified in Section 2.8.1. It should be noted that separate return circuit connections are provided for these two supply rails. The return for the +5v logic supply is designated '0v (signal common)' and that for the +24/26/28v supply is designated 'Power Earth'. It is necessary to connect these two return circuits together, preferably at the reader input/output connector. If a remote connection is necessary, for instance, at the power supply unit, care must be taken to ensure that the relative potentials of the two circuits at the reader terminals does not exceed 0.5v. Both return circuits are isolated from mains earth at the reader but may be linked to mains earth externally if required.

As the supply currents vary rapidly during reader operation, it is highly desirable to use twisted pairs for the supplies. This becomes essential for systems in which the supply cable exceeds 2 ft. in length and return commoning is carried out remote from the reader. A wire guage at least equivalent to 14/.0076 inches should also be used in order to meet the requirement for low potential difference between the return circuits at the reader terminals.

4.5.2 HSR 500 P

This version of the reader, with integral power supply unit, requires only a.c. mains input. The unit supplies all d.c. requirements of the reader as follows:

+5v ±0.2v	Logic Supply
+9v ±0.4v	Lamp and Coil Supplies
+31v ±3v	Brake Primary Drive Supply

Note that these are not identical to the supply requirements of the HSR 500 version.

In addition, the +5v supply is capable of providing up to 800 mA current to an external load, such as interfacing logic. Maximum peak to peak ripple on this supply is 50 mV at full load.

All three supplies appear at the input/output connector, and the return circuits for each are internally interconnected, but are isolated from Mains Earth.

The 0v line is normally used as signal common return, in which case +5v must only be used as an output. The +5v line may be used as signal common provided that input signal limits are maintained relative to the reader 0v line. This latter arrangement can be used to effect an interface with a logic system using a negative supply rail and positive common rail. Care must be taken to avoid connecting the reader +5v supply in parallel with any external voltage supply, even if nominally at +5v.

The +9v and +31v lines should not be connected externally.

4.6 SWITCHED LAMP SUPPLY

This signal is connected to the positive terminal of the lamp and coil supply, after the loading flap actuated microswitch. Thus when the loading flap is open, this line is connected to a low impedance load to 0v (less than 30 ohm), and when the loading flap is closed it is connected to the lamp and coil supply via the fuse in this supply.

The signal may be used as a remote indication that the loading flap is closed and that the supply is present. It is not at normal logic levels, and is current sourcing rather than current sinking. It should not be used as a means of by-passing the loading flap switch, as the fuse also would be by-passed.

The current drawn on this signal should not exceed 50 mA.

4.7 CONNECTOR PIN ASSIGNMENTS

4.7.1. HSR 500 Input/Output Connector:

24 + 24 Way Edge Connector, 0.15" Contact Pitch, 1/16" Board Thickness

Pin	Function	Pin	Function
1	Switched +26v	A	Power Earth
2	Power Earth	B	Power Earth
3	Connected Internally	C	Not Used
4	+26v	D	+26v
5	Polarizing Key	E	Polarizing Key
6	Channel 6	F	+26v
7	Channel 3	H	Microswitch 3B N/C
8	Channel 4	J	Microswitch 3B N/O
9	Channel 2	K	Microswitch 3B Common
10	Channels Enable	L	Microswitch 3A N/C
11	Not Used	M	Microswitch 3A N/O
12	Not Used	N	Microswitch 3A Common
13	Drive Right	P	Microswitch 2B N/C
14	Drive Left	R	Microswitch 2B N/O
15	Transport Enable	S	Microswitch 2B Common
16	Channels Inhibit	T	Microswitch 2A N/C
17	Sprocket Enable	U	Microswitch 2A N/O
18	Sprocket	V	Microswitch 2A Common
19	Channel 5	W	Microswitch 1B N/C
20	Channel 1	X	Microswitch 1B N/O
21	0v (Signal Common)	Y	Microswitch 1B Common
22	Channel 7	Z	Microswitch 1A N/C
23	+5v	AA	Microswitch 1A N/O
24	Channel 8	AB	Microswitch 1A Common

Notes:

1. The lettered contacts are nearest the rear of the reader.
2. Power Earth may be connected to any of the pins A, B or 2; +26v may be connected to any of the pins D, F or 4.
3. Pins 3, 5 and E are internally connected, and must not be connected externally.

4.7.2 HSR 500P Input/Output Connector:
24 + 24 Way Edge Connector, 0.15" contact Pitch, 1/16" Board Thickness

Pin	Function	Pin	Function
1	Switched +9v	A	0v
2	0v	B	0v
3	Connected internally	C	+3lv
4	+9v	D	+9v
5	Polarizing Key	E	Polarizing Key
6	Channel 6	F	+9v
7	Channel 3	H	Microswitch 3B N/C
8	Channel 4	J	Microswitch 3B N/O
9	Channel 2	K	Microswitch 3B Common
10	Channels Enable	L	Microswitch 3A N/C
11	(V_3)	M	Microswitch 3A N/O
12	(V_4)	N	Microswitch 3A Common
13	Drive Right	P	Microswitch 2B N/C
14	Drive Left	R	Microswitch 2B N/O
15	Transport Enable	S	Microswitch 2B Common
16	Channels Inhibit	T	Microswitch 2A N/C
17	Sprocket Enable	U	Microswitch 2A N/O
18	Sprocket	V	Microswitch 2A Common
19	Channel 5	W	Microswitch 1B N/C
20	Channel 1	X	Microswitch 1B N/O
21	0v	Y	Microswitch 1B Common
22	Channel 7	Z	Microswitch 1A N/C
23	+5v	AA	Microswitch 1A N/O
24	Channel 8	AB	Microswitch 1A Common

Notes:

1. The lettered contacts are nearest the rear of the reader.

2. 0v may be connected to any of pins 2, 21, A or B.

3. Pins 3, 5 and E are internally connected and must not be connected externally.

4. 0v, +5v, +9v and +3lv are internally connected. +9v and +3lv (pins 4, C, D and F) must not be connected externally.

5. V_3 and V_4 are not normally connected. These supplies are reserved for special interfaces.

SECTION 5 - EXPLANATION OF CIRCUITS

5.1 PRINCIPLE OF TRANSPORT CONTROL

Movement of the punched tape across the read head of the reader is controlled by two similar drive solenoids to select alternatively drive right or drive left, and a brake solenoid. In order to achieve optimum performance in respect of acceleration and deceleration of the tape, whilst minimising the power dissipation, the solenoids are pulsed at different drive levels at various stages of the transport cycle. In addition, the brake magnet is provided with two windings with a turns ratio of 3:10. The winding with the lower number of turns is referred to as the 'primary' and the other as the 'secondary'.

The sequence of solenoid energising levels is shown in Fig. 3. The quiescent state, with the tape loading flap down is with the brake solenoid secondary partially energised, and the drive solenoids and brake primary de-energised. When tape transport is initiated the current rises exponentially in the selected drive solenoid to a maximum value governed by external resistance, and decays in the brake secondary, and the tape accelerates, typically moving one code pitch in 2.5mS. If at this point the tape is to be stopped, the brake primary winding is energised directly. The low-number of turns presents a low inductance and allows rapid current increase and thus rapid energisation and rapid tape deceleration. If this build-up were allowed to continue, it would cause burn-out of the solenoid, therefore when the current reaches an adequate level, the primary winding is switched off, but the flux established is maintained by the secondary winding which requires less current and power dissipation.

Whilst the brake is energised, the drive solenoid is partially de-energised to a level termed the 'hold-on' level which is sufficient to release pressure on the tape, but adequate to maintain light contact with the tape, for a period of up to nominally 100mS. During this period the brake remains fully energised by the secondary winding unless a new drive cycle is initiated, when the brake is immediately de-energised and the drive solenoid is fully energised again. At the end of the 100mS period, the drive solenoid is completely de-energised and the brake secondary is reduced to partial, or 'hold-on' energisation.

5.2 TRANSPORT CONTROL LOGIC

Fig. 19 shows the circuit diagram of the reader Control board. Tape transport is controlled by the three inputs: Transport Enable; Drive Right and Drive Left. The input gating network up to outputs 8/11, 7/3 and 7/6 ensures that only one transport function is selected, unambiguously, irrespective of input states, according to the following truth table:

INPUTS			OUTPUTS		
Transport Enable	Drive Right	Drive Left	Brake Solenoid	Drive Right Solenoid	Drive Left Solenoid
0	0	0	ON	OFF	OFF
0	0	1	ON	OFF	OFF
0	1	0	ON	OFF	OFF
0	1	1	ON	OFF	OFF
1	0	0	ON	OFF	OFF
1	0	1	OFF	OFF	ON
1	1	0	OFF	ON	OFF
1	1	1	ON	OFF	OFF

5.2 continued

This table refers to the effect on the tape rather than the actual solenoid energisation, as will be explained in the following sub-section.

The cross coupled gate bistable with outputs 4/3 and 4/6 performs the function of storing the direction of the last transport function selected. Whenever the direction of transport is changed, the bistable immediately changes state and causes a positive going pulse of nominally 4.7 mS duration on the collector of either TR44 (when changing from right to left) or TR45 (when changing from left to right), both of which cause 8/11 to be pulled to logic '0' which causes a 'Brake On' condition for the 4.7 mS period, irrespective of the input conditions.

When 8/11 is switched from '1' to '0' to cause a 'Brake On' condition, inverter output 6/4 switches from '0 to '1' and thence inverter output 5/6 switches from '1' to '0'. This causes TR43 to switch off until C5 discharges through R55, which takes nominally 100 mS, or until 8/11 switches back to a '1' state, whichever occurs soonest. During this period TR43 collector is at logic 1, which enables the 'hold-on' period of the selected drive solenoid through gate 4/11 or 4/8, and the brake secondary 'first stage drive' through inverters 6/6 and 6/10.

5.3 DRIVE SOLENOID AMPLIFIERS

The amplifier circuits controlling the Drive Right and Drive Left solenoids shown in Fig. 19 are identical, and that for Drive Left is described below, with the corresponding references for Drive Right in brackets.

When the input conditions for a Drive Left (Drive Right) operation, defined above, are established, output 7/6 (7/3) switches to logic 0 causing 7/11 (8/3) and 5/8 (6/8) to switch high. This allows transistors TR55 and TR56 (TR54 and TR53) and thence TR61 and TR62 (TR60 and TR59) to switch ON. Outputs 7/11 (8/3) and 5/8 (6/9) are held down to about 1.5v by their respective transistor loads (i.e. two Vbe drops).

From Fig. 21 it can be seen that outputs 12 and 2 (11 and 1) will both tend to sink current from the Drive Left solenoid with the current limited by the coil resistance and mother board resistor R3 in parallel with R6 (when fitted). However, output 12 (11) will not contribute significantly to the current sinking, as it acts through mother board resistor R4 (R5) whilst output 2 (1) acts directly.

When the Drive Left condition is terminated, 7/6 (7/3) switches back to logic 1 causing 5/8 (6/8) to switch to logic 0 and turn TR56 and TR62 (TR53 and TR59) OFF. At the same time 8/11 switches to logic 0, causing the brake to be energised and initiating the 100 mS pulse from TR43. Provided that the 'Drive Right' condition has not been immediately selected, gate inputs 4/9 and 4/10 (4/13 and 4/12) will now be at logic 1, thus output 4/8 (4/11) will be switched to logic 0 which in turn holds output 7/11 (8/3) to logic 1. Thus TR55 (TR54) and TR61 (TR60) remain ON and the current in the Drive solenoid is reduced to a value limited by the coil resistance and mother board R4 (R5) and R3 in parallel with R6.

5.3 continued

This reduction in the current drive to the solenoid causes an induced reverse voltage to appear across the solenoid, and the voltage at terminal 2 (1) rises until limited by diode D14 (D15) to the supply voltage V1.

If no further Drive condition is set up before the 100 mS pulse elapses, the end of the pulse will cause TR55 (TR54) and TR61 (TR60) to switch OFF and the current in the Drive solenoid will decay to zero. This decay is accompanied once more by a reverse induced voltage which is 'caught' to the supply voltage by D14 (D15).

Typical voltage waveforms at terminal 2 (1) are shown in Fig. 12 for HSR 500 and Fig. 13 for HSR 500P. It should be noted that the supply voltage V1 is nominally 26v for the former and 9v for the latter. Also resistors R77, R78, R79, R80 on the Control board and R3, R4, R5 and R6 on the Mother Board have different values for the two versions.

5.4 BRAKE SOLENOID AMPLIFIERS

In the quiescent condition, with the tape loading flap down but with tape stationary, 8/11 is low holding output 6/12 OFF which in turn allows TR52 and TR58 to be ON. After 100 mS from the last brake application, TR43 is ON holding 6/10 ON and thus TR51 and TR57 OFF. Also, through diode D9, 8/9 is held to logic 0 which puts 8/8 to logic 1 and thence 6/2 to logic 0 so that TR46, TR48, TR49 and TR50 are all OFF. Thus current flows in the Brake Secondary winding only (see Fig. 21) through D16 and limited by the coil resistance and mother board resistor R2.

As soon as either a Drive Right or Drive Left condition is set up 8/11 is switched to logic 1 and TR52 and TR58 switch OFF. The reverse induced voltage resulting from the current decay is 'caught' at terminal 3 by D12 to supply voltage V2 plus the zener voltage of D10 (16v). This large voltage overswing ensures rapid dissipation of the brake solenoid stored energy, and thus rapid de-energisation of the brake.

When the Drive condition is terminated, 8/11 switches back to logic 0 and TR43 pulses to logic 1 as described previously, switching 6/6 to logic 0 and 6/10 OFF, so that TR51 and TR57 switch on. TR52 and TR58 also switch on as described above. In addition the 1 to 0 transition at 8/11 is differentiated by C8 to pulse 8/4 to logic 0 for a few microseconds which sets the bistable output 8/8 to logic 0. This switches output 6/2 OFF and allows TR46 to switch on through diode chain D6, D7, D8 and D17. TR46 conducting pulls the complementary transistor TR48 on which in turn provides base drive for the Darlington pair TR49 and TR50. TR50 drives current through the brake primary winding from the reservoir capacitor C1 on the mother board via fuse link FS2. The current rises rapidly in the primary winding limited by the inductance of the winding, reaching a value of 5 Amp in typically 200 microseconds. When the current first exceeds 5 Amp, the voltage developed across R68 just exceeds 1v and is sufficient to switch the differential amplifier TR40 OFF and TR41 ON. This switches TR42 collector to logic 0 which resets bistable output 8/8 to logic 1 and consequently switches TR46, TR48, TR49 and TR50 all OFF.

5.4 continued

If a fault condition prevents the brake primary current from reaching 5A, or the differential amplifier from responding, 8/8 is switched to logic 1 at the end of the 100 mS pulse, or when the next Drive condition occurs, through diode D9.

Whilst current is flowing in the brake primary winding, a large reverse voltage is induced in the secondary winding through transformer action. This reverse voltage is blocked by D16, and no current flows in the secondary winding until the primary is de-energised even though TR57 and TR58 are both ON. As soon as TR50 is switched OFF, control of the magnetic flux established by the primary winding is switched instantaneously to the secondary, and the secondary current stabilizes to a value limited by the coil resistance and mother board resistors R1 in parallel with R2. However, a small amount of leakage flux associated with the primary winding causes a short overshoot spike at terminal 19 which is caught by D11 to supply voltage V2 plus the zener voltage of D10 (16v).

If the 100 mS pulse expires before another Drive condition is set up, TR57 switches OFF and the current in the secondary winding decays to the value limited by mother board resistor R2 which is termed the brake 'holding' drive. This decay, and also that caused when TR58 switches OFF at the next Drive condition, is accompanied by an induced reverse voltage overshoot which is limited by D12 to supply voltage V2 plus the 16v zener voltage of D10. It may be noted that the current passed by D12 and D10 tends to charge up the reservoir capacitor C1, and thus a proportion of the energy is conserved.

Typical voltage waveforms at terminal 3 are shown in Fig. 10 for HSR 500 and Fig. 11 for HSR 500P. It should be noted that V1 is nominally 26v for the former and 9v for the latter, and that V2 is the 26v supply decoupled by the reservoir capacitor for the former and a separate nominally 31v unstabilised supply for the latter. Also resistors R65, R68, R75 and R76 on the Control board and R1 and R2 on the Mother Board have different values for the two versions, and the alternative assembly of R8 or R9 on the Mother Board provides the correct source for V2 for the two versions.

5.5 PRINCIPLE OF PHOTOCELL AMPLIFIERS

The HSR 500 reader employs photo-electric sensing of the punched tape, to give reliable accurate reading at high speeds without wearing the tape. Registration of the tape and timing of the data outputs is also accomplished by photo-electric sensing, using the 'sprocket' track of the punched tape. The absence of a drive sprocket allows rapid acceleration and deceleration of the punched tape without damage to the tape, but increases the requirements for stability of the 'sprocket' signal.

The stability of the photocell outputs of a photo-electric reader is affected by the following factors:

(a) The light source brightness.
(b) The light loss in the optical path, e.g. by dust accumulation.
(c) The opacity of the tape.
(d) The accuracy of the tape punching, particularly laterally.

(e) The lateral guidance of the tape.
(f) The width of the tape, including wear of the width.
(g) The sensitivity of the photocells, e.g. variation through ageing and temperature changes.
(h) The leakage of the photocells when dark.

These factors combine to vary the amplitude of the output of each photocell as indicated in Fig. 4(a). In a conventional photoelectric sensing system, a threshold level is set, above which the output is switched to the 'light' logic state, and below to the 'dark' logic state. It may be seen that for a reduced output, the duration of the 'light' state is decreased, and will disappear if reduced to one half of the ideal output.

In the HSR 500, the threshold level is defined by the output of an additional 'reference' photocell which is in line with the 'sprocket' track but removed $1\frac{1}{2}$ code pitches (0.15 inches) from the 'sprocket' and code hole photocells. Fig. 4 (b) shows that the sprocket and reference outputs cross at about 1:1 light : dark ratio, and as the same factors affect both sprocket and reference outputs, the switching points remain virtually unchanged with reduced output level.

The waveform obtained from the larger code holes is shown in Fig. 4 (b), and it may be seen that the reference cell output may be used as the switching threshold for these also. However, a code hole is not necessarily punched, it may, unlike the sprocket output, be at a minimum whilst the reference output is at a minimum. Another potentially ambiguous condition is when tape is absent from the read head, when all outputs will be at their maxima. These problems are overcome by clamping the dark and light levels of the reference amplifier outputs, as indicated in Fig. 4 (d). This diagram also shows that the sensitivities of the channel, sprocket and reference photocell amplifiers are set to different levels. This ensures unambiguous outputs with no tape present, and also increases the separation of channel output transitions outside the sprocket light output period.

The photocell amplifiers are set up with no tape under the read head, but with a light reducing filter between the light source and the photocells, which reduces the photocell outputs by about 50%. In this condition the levels are set as indicated in Fig. 4 (d), and with the filter removed, and punched tape moved across the read head, the actual amplifier outputs are as shown in Fig. 4 (c). It can be seen that the 'cross-over' switching points still occur in the linear characteristic region, giving the required compensation, whilst a large reduction in the signal levels can be accommodated.

5.6 PHOTOCELL AMPLIFIER CIRCUITS

Each of the eight channel photocells are connected to similar amplifiers as shown in Fig. 19. That for channel 1 will be described. The photocell generates a current in the 'reverse' direction which is proportional to the light intensity acting on it.

5.6 continued

This current is passed into a low input impedance transistor amplifier TR1 which has nearly unity current gain. The base of TR1 is biassed to the forward voltage drop of D1 (approximately 0.7v) from the +5v supply, which balances the base to emitter voltage of TR1 leaving virtually zero voltage across the photocell and preventing the flow of leakage current. The current from the collector of TR1 generates a voltage across R2 and RV1 proportional to the current, and thus to the photocell illumination. The magnitude of the voltage for a particular light level can be adjusted by varying RV1 to compensate for differences between photocells and their illumination.

The sprocket and reference photocells have similar input amplifier stages, except that values of the collector load resistors are increased to compensate for the reduced area of illumination of these two cells, and in order to set the different sensitivities required, as explained in Section 5.5. The output of the reference cell input stage TR39 is amplified by complementary common emitter stages TR38 and TR37 to give an output at the same voltage but at lower output impedance, except that the upper and lower limits are clamped by diodes D3 and D2 respectively for reasons explained in Section 5.5. The output from TR37 (T.P.B.) is connected to one input of the differential amplifiers associated with each of the channels and the sprocket.

When the voltage at the collector of TR1 (T.P.1) is more positive than that at T.P.B., TR2 and TR3 will be OFF and TR4 ON, and the input 3/5 will be at logic 1. This corresponds to channel 1 in the LIGHT state. When the voltage at T.P.1 becomes more negative than that at T.P.B., TR2 switches ON and pulls TR3 ON, whilst TR4 switches OFF, and input 3/5 switches to logic 0, corresponding to channel 1 in the DARK state. It should be noted that the collector current of TR2 or TR4 when conducting is limited by the common emitter resistor R5.

The sprocket channel amplifier TR14, 15 and 16 operates in the same manner, except that the additional feedback resistor R81 gives the circuit a Schmidtt Trigger characteristic. When TR14 and TR15 are OFF, R81 tends to pull the differential input, TP9 more positive, but as soon as TR14 and TR15 begin to switch on, this positive bias is removed and then becomes reversed, accelerating the switching action. This ensures that the sprocket output switches cleanly even when the tape is moved very slowly across the read head, and allows a small amount of tape recoil after switching without reverting the output. The hysteresis imparted by this feedback has the effect of delaying the sprocket output slightly relative to the channel outputs.

5.7 OUTPUT GATING

The output from each channel amplifier is gated by a 2 input NAND gate with a common enable line. When the amplifier output 3/5 and the enable line 3/4 are both at logic 1, the interface output will be at logic 0, and if either input is at logic 0, the output will be at logic 1. For the enable line to be at logic 1, the Reader Channel Enable input must be at logic 1 and the Reader Channel Inhibit input must be at logic 0.

The output of the Sprocket channel amplifier is gated by a similar gate with a separate enable signal from the Sprocket Enable input.

5.8 MAINS CIRCUIT

The mains connections of the HSR 500 reader are shown in Fig. 24. A three wire single phase supply cable is terminated at a screw connector terminal block. The earth connection is connected to the metal chassis, and separately to the motor case. A ceramic disc capacitor is connected across each pair of the three input connections to decouple r.f., interference originating either internally or externally.

The 'LINE' connection is passed through a cartridge fuse then back to terminal 1 of the connector block. This is connected through the loading flap operated microswitch to terminal 3. The motor is a capacitive start induction type with two windings. One winding is connected from the switched line supply at terminal 3 to the NEUTRAL connection, and the other is connected from the NEUTRAL in series with the 'start capacitor' C1, connected at terminal 2, to the switched line supply.

The elapsed time meter is connected from neutral to switched line, so that it records the time for which the motor is actually running. A series resistor-capacitor combination is connected from switched line to neutral to suppress the inductive surge generated when the motor is switched off.

5.9 POWER SUPPLY UNIT

5.9.1 Mains Input

The circuit of the power unit fitted to HSR 500P models is shown in Fig. 25. The mains transformer has primary tappings at 115, 220 and 240 volts, selected by a tap changer. The mains LINE input is connected to the common terminal of this tap changer via a cartridge fuse. The internal fan, and the output socket for the reader motor supply are connected across the 220v primary tape and NEUTRAL such that provided that the mains tap changer is correctly set for the local input voltage, the fan and motor will be run at 220v through autotransformer action on the transformer primary winding. Similarly, the mains ON indicator neon will be run at 240v.

The series resistor-capacitor combination R17 and C6 are provided to suppress the inductive surges which occur when the fan, the reader motor and to a lesser extent the transformer, are switched off. The mains earth lead is connected to the chassis of the power unit, and to the transformer inter-winding screen. It is important that the earth input is connected externally to a good electrical earth for electrical safety, and also for mains transient suppression. The d.c. output common rails are not connected to the mains earth connection.

5.9.2 V2 Unstabilised Output

This supply is used to charge the reservoir capacitor supplying the brake primary winding. A transformer tapping of 24v rms. nominal output is rectified by the silicon rectifier bridge BR1 and smoothed by R1 and C1 to give a nominal average output of 31v.

5.9.3 5v Stabilised Output

From Fig. 25 it may be seen that the regulator for the +5v output is supplied by full-wave rectifier BR3 feeding into the smoothing capacitor C3 from a secondary winding of nominally 8.7v rms. This smoothed 'raw' d.c. supply is fused by FS3, which is an externally accessible cartridge fuse link.

The voltage regulator circuit has the series element TR6 which is a heat sink mounted power transistor pre-amplified by the complementary stage TR7. Control of this series element is achieved by the differential common emitter amplifier TR8 and TR9. One input, at the base of TR8 is a reference voltage provided by zener diode D7, and the other input, at the base of TR9, is a fixed proportion of the output voltage provided by the potential divider resistors R14 and R15. R15 is trimmed by a parallel connected resistor R16 which provides fine adjustment of the output voltage. Under all conditions of input voltage and output current, the differential amplifier achieves a balance of current in TR8 and TR9 such that the output voltage remains constant.

The arrangement of supplying the zener diode bias current through R11 which is connected to the stabilised output achieves a very stable reference voltage simply and cheaply, but this arrangement has the disadvantage that it is not self-starting. To overcome this, a starting reference level is provided by diode chain D4, D5 and D6 which are supplied through R10 from the 'raw' d.c. supply. At initial switch-on, D3 supplies a temporary starting reference level which enables the stabilised output to rise. This in turn provides a bias current for the zener reference D7, which when fully established is sufficient to reverse bias D3 which then has no further effect on the regulator.

The capacitor C7 provides decoupling to prevent high frequency parasitic oscillation, and output capacitor C5 provides decoupling for fast input voltage and output load transients.

5.9.4 9v Stabilised Output

The voltage regulator circuit for the 9v supply is similar to that for the 5v supply except for component values and the features described below.

Fig. 25 shows that the 9v regulator is supplied from a secondary tapping of 14v rms. nominal, through a full wave rectifier bridge BR2 and fuse link FS2, with an electrolytic capacitor C2 connected across the rectifier bridge output for smoothing. This regular has two power transistors TR1 and TR2, connected in parallel to cope with the greater output current of this supply. The emitter resistors R5 and R6 are included to aid near equal sharing of the output current between TR1 and TR2.

The 9v supply, like the similar 5v supply circuit, is not self-starting and requires an initial source of bias current for the reference zener diode. In the case of the 9v supply, this is provided by the 5v supply output acting through D1. Once the regulator circuit has started up, D1 is reversed biassed, and has no further effect on the circuit.

5.9.4 continued

It should be noted that the negative terminals of the 5v and 9v supplies are not connected internally, thus the 9v regulator is not started unless an external link between the negative terminals is completed. This link is normally made at the reader mother board, in order to minimise the effect of voltage drops in the supply leads.

5.9.5 Output Connections

Cinch 9-way Sub-miniature Socket (D-type)

Pin No.	Output	Symbol
1	+31v	V2
2	Reserved	V3
3	+9v	V1
4	Reserved	V4
5	+5v	+5v
6	Power Earth 2 (V2 return)	P.E.2
7	Power Earth 1 (V1 return)	P.E.1
8	Reserved (V3, V4 return)	P.E.3
9	0v (+5v return)	0v

NOTES:

1. Pins 6, 7 and 9 (and 8 when used) are linked together at the reader Mother board.

2. Outputs V3 and V4 are not normally provided. They are included only for special purpose units.

3. For maximum loads and output voltage limits see Section 7.

SECTION 6 - MAINTENANCE OF READER UNIT

6.1 DISMANTLING AND RE-ASSEMBLY PROCEDURES

6.1.1 Removal of Rear Cover

The two cover fixing screws ('A' Fig. 5) should be removed, after which the cover may be pivoted about its front edge and lifted at the rear through approximately 30°. The cover may then be disengaged from its retaining bar at the front edge by lifting forwards and upwards at approximately 30°.

6.1.2 Removal of Front Upper Cover

First remove the rear cover as in 6.1.1. The two fixing screws ('A' Fig. 6) should be slackened approximately two full turns. The cover may then be pulled forward and lifted clear.

6.1.3 Removal of Front Lower Cover

The three fixing screws ('B' Fig. 5) should be removed after which the cover may be lifted clear.

6.1.4 Removal of Input/Output Printed Board Connector

First remove the rear cover as in 6.1.1. The two screws securing the cable clamp to the end casting should then be removed together with one part of the cable clamp. The screw at the top of the connector retainer should be slackened, allowing the metal tab to be turned through 90°. If an all-plastic retainer is fitted the top should be pressed towards the control circuit board in order to relase it from the connector. The input/output connector, together with any attached cable, may now be disengaged from its socket and lifted clear.

6.1.5 Removal of the Control Circuit Board

First remove the rear cover as in 6.1.1 and the input/output connector as in 6.1.4. The aluminium screen which acts as a retainer for the circuit board should be lifted out. The circuit board should then be carefully disengaged from its edge connector and lifted slightly to enable the read head connector to be disengaged. The circuit board may now be lifted clear of the unit.

6.1.6 Removal of 'Mother' Circuit Board

First remove the following parts: Rear cover as in 6.1.1.
Input/output connector as in 6.1.4.
Control circuit board as in 6.1.5.

All flying lead connections to the 'mother'circuit board should be unplugged. The six fixing screws ('D' Fig. 5) should be removed, this will allow the 'mother' circuit board to be removed complete with its three mounting strips.

6.1.7 Removal of Motor Plate Assembly giving access to Motor, Pulleys, Belt and Tape Drive Rollers

First remove the following parts: Rear cover as in 6.1.1.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.
Mother circuit board as in 6.1.6.

The three hexagon socket screws which fix the motor plate in position should now be removed using a 4 mm hexagon wrench. The motor plate assembly should now be drawn to the rear until the tape drive rollers are clear of the main mechanism plate when the assembly may be lifted clear complete with the mains cable. Any component part may now be removed from the motor plate assembly. To gain access to the screws fixing the tape drive rollers the pulleys have to be removed from the rollers. They are fixed by three M3 hexagon-socket grub screws in each pulley.

6.1.8 Removal of the Drive Left and Drive Right Solenoids

First remove the following parts: Rear cover as in 6.1.1.
Front Lower cover as in 6.1.3.
Input/output connector as in 6.1.4.
Control circuit board as in 6.1.5.

The appropriate leads should be unplugged from the 'mother' circuit board, these being Nos. 3 and 4 for the drive left and Nos. 1 and 2 for the drive right. The lower stops should be adjusted to their lowest position by slackening the lock nut and turning with a screwdriver from below. The two screws which retain each solenoid should be removed. Each solenoid may now be removed from its location spiggot if it is turned slightly such that the rollers at the top of the assembly are clear of the tape platform.

6.1.9 Removal of the Brake Coil Assembly

First remove the following parts: Rear cover as in 6.1.1.
Front lower cover as in 6.1.3.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.

The leads from the brake coil, Nos. 5, 6, 7 and 8 should be unplugged from the 'mother' circuit board. The two screws which fix the brake coil assembly ('K' Fig. 6) should then be removed. This will leave the assembly free to be removed. The two spacers on which the assembly was mounted should also be removed.

6.1.10 Removal of Read Head

First remove the following parts: Rear cover as in 6.1.1.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.
Front upper cover as in 6.1.2.
Front lower cover as in 6.1.3.

The rear cover retaining bar should then be removed from the top edge of the main plate. The two screws which retain the lamp shield should be slackened and the shield removed. The single screw which retains the read head ('L' Fig. 6) may then be unscrewed, downward pressure should be maintained on the screwdriver whilst this is done so that the read head is forced downwards, disengaging the two location pins. The read head may then be lifted clear, but care should be taken in threading the cable and connector through the aperture in the main plate.

6.1.11 Removal of the Lamp

First remove the rear cover as in 6.1.1 and the upper front cover as in 6.1.2. The two screws which retain the lamp shield should be slackened and the shield removed. The screw in the locking collar around the lamp holder should be slacked after which the lamp may be removed.

6.1.12 Removal of Optional Control Switches

First remove the following parts: Rear cover as in 6.1.1.
Front Upper cover as in 6.1.2.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.
'Mother' circuit board as in 6.1.6.

The rear cover retaining bar which is screwed to the top edge of the main plate should then be removed. The control switches assembly should then be lifted, which will allow it to be disengaged from its mounting stud and removed.

6.1.13 Removal of the Brake Armature

First remove the following: Rear cover as in 6.1.1.
Front upper cover as in 6.1.2.
Front lower cover as in 6.1.3.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.
Read Head as in 6.1.10.
Motor Plate as in 6.1.7.

The lamp connections should be unplugged from the 'mother' circuit board (plugs 29 & 30). The front casting should then be removed, unscrewing its four fixing screws from the rear of the main plate. The loading flap cover

6.1.13 continued

plate and adjustable edge guide should then be removed by unscrewing the knurled screw ('H' Fig. 6). The section of the 'L' shaped edge guide marked 'M' in Fig. 6 should be removed by unscrewing its two fixing screws. The loading flap pivot pin may then be withdrawn and the complete flap assembly removed. The brake armature may be removed from the flap by unscrewing the two brass fixing screws. Care should be taken to retain the two springs which are positioned between the armature and the flap and also the two bushes on which the armature is mounted.

6.1.14 Removal of End Castings

First remove the following: Rear cover as in 6.1.1.
Front upper cover as in 6.1.2.
Front lower cover as in 6.1.3.
Input/Output connector as in 6.1.4.
Control circuit board as in 6.1.5.

Each end casting may be released by removing the three fixing screws, two through the main plate and one through the base plate.

6.1.15 Re-assembly

To re-assemble any parts of the reader, reverse the instructions for dismantling.

If, however, any of the following parts are removed the relevant setting procedure should also be carried out:

Parts being re-assembled	Setting Procedures to be carried out or checked
Motor Plate	6.2.1, 6.2.2, 6.2.3, 6.2.5.
Drive Left and Drive Right Solenoids	6.2.5.
Brake Coil Assembly	6.2.4.
Lamp	6.3.
Brake Armature	6.3.

6.2 MECHANICAL SETTINGS AND ADJUSTMENTS

6.2.1 Height of Motor Plate Assembly

The height of the assembly may be adjusted by slackening the three fixing screws and adjusting the two lower stop screws. The two stop screws may be turned by slackening the lock-nuts and turning from below with a small screw-driver.

The assembly should be positioned so that the lower surfaces of the two tape drive rollers are 0.2 mm above the tape platform.

6.2.2 Loading Flap Position

In its closed position the loading flap should rest at 90° to the main mechanism plate. Its position may be adjusted by turning the stop screw ('B' Fig. 8). The micro-switch assembly (Fig. 8) should be raised clear of the flap whilst this adjustment is carried out.

6.2.3 Micro-Switch Assembly Position

The micro-switch assembly (Fig. 8) should be positioned so that the switches are operated when the flap is in the closed position, even if a 0.05 mm feeler blade is placed between the stop screw and flap. The switches should not, however, be operated when the flap is closed with a 0.25 mm feeler blade interposed. Check that the detent spring roller holds the flap firmly against the stop screw in the closed position. If this is not the case the roller assembly must be moved up or down to achieve this.

6.2.4 Brake Coil Assembly Position

The laminations of this assembly should protrude above the top surface of the tape platform by 0.1 to 0.2 mm. If this is not the case the two screws fixing the unit should be slackened and the assembly moved to the correct position.

6.2.5 Drive Solenoid Settings.

Correct drive solenoid settings are important if optimum reader performance is to be obtained. Settings for both left and right solenoids are identical. It is important in each case that the pinch roller should be on the vertical centre line of the drive roller. To check this condition a length of paper tape about 25 mm long should be placed between the two rollers and gripped by lifting the armature. The edge of the tape should now be viewed from the front of the reader when it should appear parallel with the tape platform. If this is not the case the position of the solenoid assembly should be adjusted by turning its location spiggot which has an eccentric mounting. To do this the adjacent end casting should be removed (see 6.1.14) which will give access to the nut locking the spiggot at the rear of the main plate. The two solenoid fixing screws should be removed and the test using the piece of tape repeated. This time however a screwdriver should be used to turn the spiggot to the optimum position.

6.2.5 continued

The position of the solenoid assembly should now be set to give the correct air gap between the armature and the laminations (see Fig. 7a). To carry out this adjustment the two fixing screws should be very lightly tightened in position. A piece of standard paper tape (0.1 mm thick) should be loaded into the reader and the armature lifted to grip the tape. The air gap should now be measured with feeler gauges. The correct setting is 0.1 to 0.15mm. .0067" .004TH. If the setting is incorrect, the setting tool HRO4 may be used to adjust the position of the solenoid assembly by inserting it in the holes provided and turning. Firmly tighten the two fixing screws and re-check the setting. The lower stop screw should then be adjusted to give a clearance of 0.3 to 0.5 mm (see Fig. 7b). .012" - .020"

The axis of both drive and pinch rollers must be parallel if the tape is to be driven correctly without being thrust against either front or rear edge guide. To achieve this condition the reader should be operated in a 'skip' or continuous drive mode, and the pinch rollers which are driving should be viewed from below. The pinch rollers have considerable end float, when correctly operating they should 'float' in a central position without thrusting continuously to one side or the other. To adjust this condition the upper fixing nut marked 'A' on Fig. 7a should be slackened, the top of the front pivot plate may then be moved slightly to the left or right until the pinch rollers 'float' in a central position when the nut should be locked. The procedure should be repeated for the other solenoid assembly.

6.3 OPTICAL SETTINGS AND ADJUSTMENTS

6.3.1 Equipment Required

Lamp focussing pattern card - type HR02
Avo Model 8 or equivalent multimeter with connector clips.
A meter with a d.c. current sensitivity of at least 250 μA F.S.D. is required.

6.3.2 Cleaning

Before attempting lamp adjustment and amplifier setting-up, the lamp, lens and photocell head window should be cleaned with a soft dust-free cloth or brush. The lamp should be replaced if the bulb is extensively blackened or if the filament is badly distorted.

6.3.3 Lamp Adjustment

(i) Rotate the lamp holder until the lamp filament is horizontal.
(ii) Tighten the locking collar to firmly grip the lamp cap.
(iii) Place the lamp focussing pattern card HR02 on the tape table and align the arrowhead on the card with the reading position pointer.
(iv) Slacken the lock-nuts and adjust the three lamp positioning screws until an image is obtained which closely conforms to the pattern on the card.
(v) Tighten the lock-nuts, taking care not to disturb the setting attained. Remove the card.
(vi) Unplug the 12-way connector to the photocells from the Control Board. With the meter set to the 250 μA d.c. range, check between the 'common' connection (pin 5 of the 12-way connector) and each channel connection in turn, and ensure that in each case the reading is greater than 130 μA. For the 'sprocket' and 'reference' photocell outputs the reading should be greater than 50 μA. The pin number for each photocell output is listed in Fig. 23. D 23.
(vii) Finely re-adjust the lamp positioning screws if necessary, to obtain the specified outputs from each photocell.

6.4 ELECTRONIC SETTINGS AND ADJUSTMENTS

6.4.1 Equipment Required

Setting-up filter - type HR03
Avo Model 8 or equivalent multimeter with connector clips.

6.4.2 Reference Voltage Checks

The following reference voltages are set by fixed resistor potential dividers and should not normally require any adjustment. The limits are given for information in case of any doubt about the photocell amplifier settings.

With the meter on its 10v d.c. range, clip the negative probe to the 0v pin and check the following voltages:

6.4.2 continued

TEST POINT	NOMINAL VOLTAGE	LOWER LIMIT	UPPER LIMIT
R46 +ve end (+5v)	5.00	4.9	5.1
T.P.C	4.45	4.2	4.7
T.P.D.	3.92	3.7	4.1
T.P.E.	3.72	3.5	3.9
D2 -ve end	1.24	1.2	1.3
D3 +ve end	3.50	3.3	3.7

Note that the limits given are for a +5v supply within the limits ±0,1v. The unit will function correctly with the +5v supply up to ±0.25v from nominal, but all of the reference voltages will change proportionally.

6.4.3 Photocell Amplifier Adjustments

(i) Switch the meter to 50 μA d.c. range (or most sensitive d.c. current range).
(ii) Close the tape loading flap with no tape over the reading head and place the filter HR03 on top of the flap in the light path to all photocells.
(iii) Connect the meter leads between the test points on the Control Board listed below and adjust the corresponding variable resistor to obtain zero indicated on the meter.

PHOTOCELL	METER LEAD CONNECTIONS	ADJUST
CH. 1	T.P. C to T.P. 1	RV 1
CH. 2	T.P. C to T.P. 2	RV 2
CH. 3	T.P. C to T.P. 3	RV 3
CH. 4	T.P. C to T.P. 4	RV 4
CH. 5	T.P. C to T.P. 5	RV 5
CH. 6	T.P. C to T.P. 6	RV 6
CH. 7	T.P. C to T.P. 7	RV 7
CH. 8	T.P. C to T.P. 8	RV 8
SPROCKET	T.P. D to T.P. 9	RV 9
REFERENCE	T.P. E to T.P. A	RV 10

Test points and variable resistor identifications are marked on the control board, or may be identified from Fig. 20.

(iv) Switch the meter to the 10v d.c. range and connect the positive lead to T.P. B and the negative lead to the 0v test point. Check that the voltage is between 3.1v and 3.5v (typically 3.3v).
(v) Remove the filter and check that the meter reading does not alter more than 0.1v.
(vi) Lift the tape loading flap and check that the voltage drops to between 0.7v and 0.9v.

6.5 MAINTENANCE PROCEDURES

6.5.1 Routine Maintenance

It is recommended that the reader unit should receive routine maintenance at intervals of 500 hours service or three months, which ever is the shorter. The rear cover, front upper and lower covers, and lamp shield should be removed as described in 6.1. A clean camel-hair brush should now be used to remove any dust which is on either side of the lens or on the lamp. If the lamp appears badly blackened it should be replaced. Any dust around the drive solenoid assemblies should be brushed away. A spot of light machine oil should be applied to the pivots of each drive solenoid. The air-gap setting of each drive solenoid should be checked and adjusted if necessary as described in 6.2.5. If a new lamp has been fitted the optical settings and adjustments described in 6.3 should be carried out. Whether or not a new lamp has been fitted the amplifier settings described in 6.4 should be checked and adjusted if necessary.

6.5.2 Overhaul

After an extended period of service, wear of mechanical components will indicate the need to undertake an overhaul. The motor plate should be removed as in 6.1.7, the drive belt should be removed and discarded. Any radial play in a drive roller bearing will indicate the need to replace the drive roller assembly in question. The jockey pulley and lower adjustable pulley should also be examined for wear, and if excessive clearance between the bronze bush and the spindle is found then both pulley and spindle should be replaced in each case. The fan spindle and bearing should be treated in a similar way. Having fitted any new parts that are required a new belt should be fitted. The lower adjustable pulley should now be adjusted so that the jockey pulley assembly takes up the position shown in Fig. 9. Each drive solenoid should be examined for wear, and if the pivots of the pinch roller carrier have a clearance estimated to be greater than 0.05 mm or the pinch rollers have radial play in excess of 0.1 mm the unit should be replaced. The brake coil assembly need be replaced only if wear of the laminations makes it impossible to obtain the correct setting as details in 6.2.4. A new lamp should be fitted.

After overhaul mechanical, optical and electronic adjustments should be made as detailed in 6.2, 6.3 and 6.4 respectively.

6.6 TEST PROCEDURES

This section is intended to indicate the type of tests which should be applied to the HSR 500 after routine maintenance, and the performance and waveforms to be expected when fault-finding. These tests are most easily carried out using the TREND READER TEST SET, but similar tests may be devised using the equipment to which the reader is interfaced.

6.6.1 Equipment Required

Oscilloscope with high input impedance probe, at least 1 MHz bandwidth and good Internal/External triggering facilities.

Avo Model 8 or equivalent multimeter
Setting-up filter type HR03
Steel rule with fine graduations
Reader Test Set type HR01 or programmable control equipment
Test Tapes

6.6.2 Skip Speed

Set the reader skipping (continuous drive with no braking) through a loop or long length of clean undamaged tape in each direction in turn. Ensure that a minimum average speed of 560 characters per second is maintained against a moderate resistance applied to the tape.

6.6.3 Isochronous Stepping

Isochronous stepping is achieved by advancing the Reader one step each time a 'start' pulse is issued from a free-running oscillator or timer. As the repitition rate of the oscillator is increased, a rate is reached at which the Reader has not always completed a step when the next 'start' pulse is issued, and thus it misses occasional pulses. The maximum Isochronous Stepping speed of the Reader is the fastest repitition rate which can be maintained without missing pulses.

Load a loop of clean undamaged tape in the reader, and increase the stepping rate slowly until the point is reached at which the Reader can be heard to miss a 'beat' occasionally (ignore the effect of tape splices). The speed at which this occurs should be greater than 300 characters/second for a correctly adjusted reader, in both directions.

6.6.4 Stopping Distance

The test set or reader controller must be set to stop on a single specified code after skipping at least six inches of 'feed' codes. The test is more accurate in the drive left direction.

With the start of the tape loaded in the reader, remove the mains supply to the reader motor only and start the test set or controller. Move the tape manually to the left very slowly until a click is heard as the brake is switched on at the 'Stop' code. Make a fine mark on the tape using a steel rule resting on the tape such that its end is in contact with, and parallel to, the rear tape guide, and its side is in

6.6.4 continued

contact with the protrusion on the left hand side-casting, as a guide.

Move the tape back to the start, reconnect the reader motor supply and start the test set or controller. With the rule in position as described above, make another fine mark on the tape. The distance between the two marks on the tape is the stopping distance. This should not exceed 0.025 inches (0.625 mm).

6.6.5 Stopping Time

The test set or reader controller must be set to pause on a specified code repeated at intervals of approximately six inches on a tape loop, separated by 'feed' codes which must be skipped. The pause interval should be approximately 4 milliseconds.

Load a clean undamaged test loop in the reader and place the setting-up filter on the tape loading flap in the light path. Connect the oscilloscope probe to the control board sprocket signal test point T.P. 9, with the earth clip on the 0v test point. Select a Y range of 0.5v/cm and time base of 250 μs/cm and set to trigger externally from negative edges at I.C.8/11 (Brake).

The waveform observed should be as in Fig. 14 (a). Measure the stopping time, as indicated in Fig. 14 (a). This should be less than 450 μs.

Switch the oscilloscope time base to 1 ms/cm and check that the flat 'stop' part of the waveform occurs before the peak of that cycle, as indicated in Fig. 14 (b).

6.6.6 Amplifier Settings

The amplifier settings may be checked using a tape with a delete code (all channels punched) which has feed codes (no channels punched) on each side. Load the tape in the reader with a feed code in line with the reading position, and close the flap. Pull the tape very slowly against the resistance of the brake so that the delete code moves into the reading position, and check that all channels switch from OFF to ON before the sprocket switches ON. Continue moving the tape and check that all channels are still ON when the sprocket switches OFF. Continue until the next feed code and check that all channels have turned OFF before the sprocket turns ON again and that they all remain OFF whilst the sprocket is ON. Care must be taken to keep the tape in contact with the rear edge guide.

Repeat the above test with the light reducing filter HR03 placed on the tape loading flap.

Remove the tape completely and check that with the flap closed all channels and the sprocket are ON both with and without the light reducing filter in position.

6.6.7 Reading Accuracy

Reading accuracy can be checked by reading a tape consisting of alternately all even channels and all odd channels. Checking for even parity whilst the sprocket is ON will detect any mis-reading of channels, but will not detect mis-reading of the sprocket. This may be checked by comparing the data read with a stored data pattern corresponding to the tape being read and detecting any mis-matching whilst the sprocket is ON, or by punching or printing out the data either directly or via buffer storage, and examining the output.

These checks should be carried out over the full range of operating speed, both with and without the light reducing filter HR03 in position, and in both directions. Extended checks are most conveniently performed using a tape with reversing codes on each end, as this avoids the problems of splices on tape loops and the handling of very long tapes, whilst checking both directions and also the accuracy of stopping on a defined code. It should be noted that a four foot length of tape will be subjected to at least 3,600 passes per hour at maximum reading speed, and this is likely to approach the limit of the tape life. This rate is nearly two million characters per hour.

6.6.8 Drive Amplifier Waveforms

(i) Brake Primary Drive

Connect the oscilloscope probe across R68 on the Control Board, with the earth clip on the negative end (bottom). Switch the oscilloscope to 0.2v/cm and 50 μs/cm and trigger from positive edges of the waveform at the lowest level possible.

Set the reader stepping through a loop or long length of tape at approximately 100 ch/sec and observe that the waveform appears as in Fig. 10 (a) for an HSR 500 or Fig. 11(a) for an HSR 500P.

The voltage should rise to between 0.85 and 1.15v in a period of between 150 μs and 250 μs for an HSR 500 and 120 μs and 230 μs for an HSR 500P Reader.

(ii) Brake Secondary Drive - Fast Stepping

Connect the oscilloscope probe between the negative end of D12 and the Power Earth (P.E.) test point. Switch to 10v/cm and 2 mS/cm and trigger on the fast negative edge of the waveform. Set the reader stepping through a loop or long length of tape at approximately 100 ch/sec and check that the waveform appears as in Fig. 10 (b) for an HSR 500 or Fig. 11 (b) for an HSR 500P. If the brake coil is correctly connected and the primary drive is functioning, the voltage should be at zero during the primary drive period, as shown.

The voltage overshoot as the brake is removed should reach between 40v and 45v for an HSR 500 supplied at 26v ±0.25v, or between 43v and 48v for an HSR 500P reader.

6.6.8 continued

(iii) Brake Secondary Drive - Single Stepping

With the oscilloscope connected and triggered as above, switch to the 10 ms/cm range and step the reader one character at a time through the tape. The waveform should be as in Fig. 10 (c) for an HSR 500 and Fig. 11 (c) for an HSR 500P.

The 'Brake Secondary First Stage Drive' should last between 75ms and 160ms, and should assume a level of 19v to 23v for an HSR 500 or 3.8v to 4.6v for an HSR 500P. The 'Brake Secondary Hold-on Drive' should assume a level of between 23v and 24v for an HSR 500 or between 6v and 6.8v for an HSR 500P. The limits given for HSR 500 readers assume that the supply voltage is at 26v $\pm$0.25v.

(iv) Pinch Roller Drive - Fast Stepping

Connect the oscilloscope between the P.E. test point and the negative end of D15 for Drive Right or D14 for Drive Left. Switch to 2ms/cm and 5v/cm for an HSR 500 or 2v/cm for an HSR 500P reader. Trigger on the fast negative edge of the waveform.

Set the reader stepping through a loop or long length of tape at approximately 100 ch/sec and observe that the waveforms appear as in Fig. 12 (a) or Fig. 13 (a) for HSR 500 or HSR 500P readers respectively.

Maximum voltage as drive is removed should not exceed 27.5v for an HSR 500 supplied at 26v $\pm$0.25v, or 10.5v for an HSR 500P.

(v) Pinch Roller Drive - Single Stepping

With the oscilloscope connected as above, switch the time base to 20ms/cm and step the reader one character at a time through the tape. The waveform should appear as in Fig. 12 (b) or Fig. 13 (b) for HSR 500 or HSR 500P readers respectively.

The 'Drive Hold-on' should last between 75ms and 160ms and should be identical to the 'Brake Secondary First Stage Drive' duration measured in test (iii). The level should stabilise to between 15v and 19v for an HSR 500 supplied at 26v $\pm$0.25v or between 5v and 6.5 for an HSR 500P reader.

6.7 FAULT FINDING

6.7.1 Preliminary Checks

If the reader fails to operate correctly, the following preliminary checks should be carried out:

(i) Mains supply switched on.
(ii) All fuses intact (a) Power unit fuses
(b) Motor circuit fuse
(c) Mother board fuses
(iii) Circuit Board and Input connector firmly plugged in and contacts clean.
(iv) Photocell connector securely plugged in.
(v) All plugs on mother board securely located.
(vi) Loading flap microswitches both operating (see Sections 6.2.2 and 6.2.3).
(vii) Lamp in good condition and securely seated on adjusting screws.
(viii) Optical system is clean and light pattern correct (see Section 6.3).
(ix) Motor runs and drives freely all parts in contact with the drive belt.
(x) Brake armature moves freely against spring loading.
(xi) Punch rollers move freely in and out of contact with the tape and are correctly adjusted (see Section 6.2.5).
(xii) Tape is driven without excessive bias to either edge guide.
(xiii) Photocell Amplifiers are correctly set (see Section 6.4).

6.7.2 Procedure for Repairs

If all the above preliminary checks appear to be satisfactory, the reader should be replaced by a known working reader or connected to a known working equipment such as the Trend Reader Test Set in order to establish that the fault lies in the reader. A faulty reader should be return to Trend Electronics Ltd. or their appointed Agent or alternatively the user or his maintenance agents may attempt a repair at their own risk. It should be noted that any repair work carried out on the reader other than by Trend Electronics Ltd. or their appointed Agents will invalidate any warranty claim.

SECTION 7 - MAINTENANCE OF POWER SUPPLY

7.1 DISMANTLING AND RE-ASSEMBLY PROCEDURES

7.1.1 Removal of Power Supply Unit

The power supply unit of HSR 500P readers may be removed by unscrewing the screwlocks indicated in Fig. 2. The free-standing HSR 500P may then be lifted and placed in front of the power unit without removing the interconnections, provided that care is taken in training the leads. The layout of the power unit components is shown in Fig. 26.

7.1.2 Disconnection

The mains connection from the power unit to the reader may be unplugged, and the power unit output connections may be released by sliding the connector locking plate sideways.

7.1.3 Regulator Card

The regulator card plugs into an edge connector and may be removed by applying steady upwards force, taking care to avoid the fan supply lead.

7.1.4 9v Output Transistors

The series output transistors for the 9v supply TR1 and TR2 are located on the cooling fin mounted in front of the fan. This fin may be removed by unscrewing completely the two upper fixing screws for the fan.

When replacing a power transistor, care must be taken to replace the mica insulating washer, coating both sides with a thin film of Silicon grease, and to correctly assembly the mounting screw insulating bushes.

7.1.5 Mains Interconnection Bracket

The bracket on which the mains circuit components are mounted is screwed to fixed threaded inserts on the transformer by two screws.

7.1.6 Side Extrusions

The side extrusions are slotted into the corner brackets. They may be removed by first springing the screwlocks inwards to release them from their nylon retaining slips then pulling the extrusion firmly upwards. To remove the side extrusion at the mains bracket end which carries the series output transistor for the +5v supply (TR6) the mains bracket must first be released as in 7.1.5. in order to allow release of the screwlock.

7.1.7 5v Output Transistor

This transistor (TR6) is mounted on the side extrusion adjacent to the mains bracket with the connections covered by the decorative on the centre of this extrusion.

7.1.7. continued

To remove, the side extrusion should be unslotted as in 7.1.6 and the decorative removed. The connections may then be unsoldered, taking care to note the colour coding, and the transistor case unscrewed.

When replacing this transistor, care must be taken to replace the mica insulating washer, coating both sides with a thin film of silicon grease, and to correctly assemble the mounting screw insulating bushes.

7.1.8 Front and Rear Decoratives

These may be removed by first removing the side extrusions as in 7.1.6, then removing the corner brackets by releasing the two screws fixing each corner bracket to the front or rear extrusions. When replacing the corner brackets, the internal guides for the side extrusions must be adjusted in position to give a good fit for the sides.

7.1.9 Front and Rear Extrusions

These are screwed to the internal partitions by two screws each. To remove, first remove the decoratives as in 7.1.8 which gives access to the fixing screws.

7.1.10 Fan

The fan is fixed by four screws, one at each corner, screwed into threaded inserts at the bottom and into the heat sink fin mounting bracket at the top. To remove completely, the mains bracket should first be detached as in 7.1.5 and the fan leads unsoldered. The side extrusion nearest the fan should then be removed as in 7.1.6 and the four fixing screws may then be removed to release the fan.

7.1.11 Bridge Rectifiers

The bridge rectifiers are all located beneath the mains bracket, screwed to the base plate. To remove a rectifier the mains bracket and adjacent side extrusion should be removed as in 7.1.5 and 7.1.6 respectively. The connections may then be unsoldered, taking care to note their positions for correct re-connection, and the fixing screw removed to release the rectifier unit.

7.1.12 Electrolytic Capacitors

The three smoothing electrolytic capacitors may be exposed by removing the mains bracket as in 7.1.5 then the adjacent side extrusion as in 7.1.6. The connections may then be removed by releasing the clamp screw; C3 is most easily removed by first removing the rear extrusion as in 7.1.9 then releasing the clamp screw.

7.1.13 Transformer

The transformer is screwed to the base plate with four screws and free nuts and washers. To remove, the mains bracket must be released as in 7.1.5 and the transformer connections unsoldered. The side extrusion should then be removed to allow access to unsolder the transformer connections to each of the bridge rectifiers, as in 7.1.6. The front extrusion is then removed as in 7.1.9 and the cooling fin as in 7.1.4 to allow access to the fixing nuts. The transformer may then be removed.

7.2 SETTINGS AND ADJUSTMENTS

7.2.1 Equipment Required

Avo Model 8 or similar multimeter with d.c. ranges up to 50v and a.c. ranges (r.m.s.) up to 250v.

7.2.2 Fuses

Check that the correct fuses are fitted to the power unit as follows:

(i) Mains: 3A for 220v or 240v operation) Surge Resistant
5A for 115v operation) e.g. Alert TDC 211

(ii) 9v: 5A Quick Acting e.g. Alert TDC 13 or TDC 14

(iii) 5v: 1A Quick Acting e.g. Alert TDC 13 or TDC 14

All fuses should be size 20mm x 5mm.

7.2.3 Tap Setting

Check that the tap changer, accessible from the top of the power unit, is set to the correct tapping for the local mains supply.

7.2.4 5v Supply Voltage

The output voltage measured between pin 9 and pin 5 of SKT 2 in the power unit (see Fig. 26) should be 5v ±0.1v. This should be measured both with the normal load connected (or a 5 ohm 5w test load) and with no load.

If the voltage is outside the limits specified, the value of R16 on the regulator board (see Fig. 27) should be varied by substitution until the measured voltage is within the limits. R16 should be increased to reduce the output voltage or decreased to increase the output voltage.

7.2.5 9v Supply Voltage

The output voltage measured between pin 7 and pin 3 of SKT 2 in the power unit (see Fig. 26) should be 9v ±0.2v. This should be measured with the reader connected and stepping slowly through a loop of tape (at 10 to 20 characters/sec), and also with the tape loading flap open.

If the voltage is outside the limits specified, the value of R9 on the regulator board (see Fig. 27) should be varied by substitution until the measured voltage is within the limits. R9 should be increased to reduce the output voltage or decreased to increase the output voltage.

7.3 TEST PROCEDURES

7.3.1 Equipment Required

Avo Model 8 or similar multimeter with d.c. ranges up to 50v and a.c. ranges (r.m.s.) up to 250v.
Oscilloscope with sensitivity of 50mV/cm, a.c. coupled.
'Variac' or similar variable voltage transformer.
Load Unit connected by a 9-way sub-miniature plug mating with SKT 2 of of the power unit wired as follows:

Link together pins 6, 7 and 9.
Connect the following load resistances through independent switches to the pins specified using short, low resistance leads.

Supply	From	To	Load	Rating
5v	Pin 5	Pin 9	5 ohms	5w
9v	Pin 3	Pin 7	3 ohms	27w
31v	Pin 1	Pin 6	112 ohms	9w

7.3.2 Mains Connections

Set the tap changer to the nominal local supply voltage, and adjust the input voltage to the selected voltage, within ±2%. With no d.c. load connected, measure the r.m.s. voltage on the unselected tappings, and on the reader mains socket, with respect to neutral. The measured voltages should be within ±10% of the nominal voltages.

7.3.3 5v Output

Connect the load unit to the power unit output socket and monitor the 5v supply output as close to the socket as possible. Adjust the mains input voltage to 10% greater than the selected tapping voltage and switch out all load resistances. Check that the output voltage is no greater than 5.2v.

Adjust the mains input voltage to 15% less than the selected tapping voltage and switch in all load resistances. Check that the output voltage is greater than 4.8v.

With the conditions as set up above, connect the oscilloscope across the output, and check that the peak to peak ripple voltage is less than 50mV.

7.3.4 9v Output

Connect the load unit to the power unit output socket and monitor the 9v supply output as close to the socket as possible. Adjust the mains input voltage to 10% greater than the selected tapping voltage and switch out all load resistances. Check that the output voltage is not greater than 9.4v. Adjust the mains input voltage to 15% less than the selected tapping voltage and switch in all load resistances. Check that the output voltage is greater than 8.6v.

With the conditions as set up above, connect the oscilloscope across the output, and check that the peak to peak ripple voltage is less than 50 mV.

7.3.5 31v Output

Connect the load unit to the power unit output socket and monitor the 31v output as close to the socket as possible.

Adjust the mains input voltage to within ±2% of the selected tapping voltage and switch out all load resistances. Check that the output voltage is no greater than 34v.

Switch in all load resistances and check that the output voltage is no less than 28v.

With the conditions as set up above, connect the oscilloscope across the output, and check that the peak to peak ripple voltage is less than 7v.

SECTION 8 - ACCESSORIES

8.1 PANEL MOUNTING

8.1.1 Description

The panel mounting accessory is a steel panel with brackets attached at the rear to enable an HSR 500 reader to be mounted in a standard 19 inch rack. In the case of the HSR 500P the power supply unit is removed from its normal position under the reader unit, turned through 90° and placed behind the reader unit such that the base plate of the power supply unit is vertical at the rear of the unit. The panel is fitted with a mains on/off switch and a neon indicator lamp. The rear cover of the reader is not normally fitted if the reader is supplied complete with a panel mounting. In this case the front upper decorative panel is slightly larger than the free standing version and may be removed without access to the rear of the panel, as two holes are provided to give access to two extended fixing screws.

A reader with normal rear cover and front upper decorative may however by fitted into this accessory but must be removed from it to give access for servicing. The front panel of the accessory is finished in black textured 'organasol' enamel.

8.1.2 Dimensions

The dimensions of this accessory are given in Fig. 15. It should be noted that the front panel may be fitted either way up, i.e. with the reader aperture above or below centre. It is normally supplied as shown but may easily be reversed.

8.1.3 Dismantling and Re-assembly

The reader unit is fixed into the accessory by two fixing screws through the base plate of the accessory, into the base plate of the reader. The power supply unit, when fitted, is retained by the captive screw-locks shown in Fig. 2.

8.2 PANEL MOUNTING WITH SPOOLER

8.2.1 Description

This accessory provides a spooling device which enables approximately 400 ft. of tape to be rapidly wound onto a 2 inch diameter plastic hub. The spooling device also allows controlled unwinding of this reel of tape whilst it is fed through the reader. The panel mounting is intended to be fitted into a standard 19 inch rack, and in addition to the reader and spooler units will also accept the power supply unit from the HSR 500P.

8.2.2 Dimensions

The dimensions of this accessory are given in Fig. 16. Four $\frac{1}{4}$ inch B.S.F. socket-head screws are supplied with the unit for use in fixing the unit into a 19 inch rack.

8.2.3 Performance

The spooler unit will wind approximately 400 foot of tape from a tape bin in less than one minute. As the tape winding operation is controlled by hand the speed will be dependent upon the user. In the unwinding mode the unit will control the reel speed throughout the full speed range of the HSR 500 including any form of start-stop working.

8.2.4 Power Requirement

The additional power requirements for the spooler unit are as follows:

Mains Voltage Alternatives:	220/240v, 50Hz 110/120v, 50Hz 110/120v, 60Hz
Power Consumption:	35VA maximum

8.2.5 Operation

To use the spooler in the rewind mode the tape should be threaded as shown in Fig. 17. The motor drive is controlled by pressure on the lever 'A' and the tape speed and tension are controlled by finger pressure at point 'B'. The reader tape loading flap should be in the open position during rewinding. To use the spooler in the unwind mode the tape should be threaded as shown in upper view of Fig. 17.

8.2.6 Maintenance

The brake pad and drive wheel of the spooler unit should be inspected when the reader unit receives its routine maintenance. To gain access to these two parts the retaining collar should be removed from the rear end of the disc spindle together with the washer. The disc assembly may now be withdrawn. If the drive wheel '0-ring' appears worn a new one should be fitted. The disc assembly should now be replaced in the centre bearing and pushed carefully back towards the panel. If the brake pad is correctly adjusted the surface of the friction material will be 1-2 mm beyond the outside diameter of the disc. If this is the case the re wind lever may be pressed down which will allow the disc to be pushed home. If the brake pad is not in the correct position the disc should be withdrawn which will give access to the screws which fix the brake assembly and allow it to be adjusted (Fig. 18).

Having obtained the correct brake position the washer and retaining collar should be re-fitted to the disc spindle. No other adjustments should be necessary. If, for any reason, the mechanism has been further dismantled settings of the various parts should be made as follows:

(i) Ensure that the motor rests against the switch bracket when in the upper rest position. Ensure that the micro-switch is operated when the motor is in the rest position, and is still operated when 0.1 mm feeler gauge is inserted between the switch bracket and motor, but is not operated when a 0.3 mm feeler is inserted.

(ii) The cam should be set square with the mounting block as shown in Fig. 18.

8.2.6 continued

(iii) When in the rest position the mounting block should be square with the spooler main plate as shown in Fig. 18. The eccentric stop at the rear of the spooler main plate may be turned to adjust this condition.

(iv) The clearance in the rest position, between the rubber drive ring and the disc may be adjusted by slackening the two motor fixings and moving the motor in it's slotted mountings. The correct setting is most easily checked when the disc is pulled forward as previously described. The outside edge of the rubber drive ring should be 0.2 mm within the outside edge of the disc.

(v) The setting of the stop screw below the motor bracket should be carried out by slackening the lock-nut and adjusting the position of the screw such that the drive wheel just contacts the inside of the disc when the operating lever is fully depressed. The stop screw should then be turned 1-1½ turns downwards and the lock-nut tightened.

Figures 30 and 31 show the electrical circuit of the spooler unit.

8.3 EXTENDED INTERFACE

8.3.1 Description

The Extended Interface Unit is a small printed circuit component board to which is wired a multi-way cable terminated in a 'D' type sub-miniature 37-way socket. The circuit board is designed to plug directly into the input/output connector (SKT 2) of the reader inside the back cover, and the cable leaves the reader via the cable clamp provided. The cable length is approximately three feet.

The Extended Interface provides the following facilities:

(a) Brake Delay of 0.2ms from time of Sprocket going light;
(b) Tape flap open or power fail alarm signal;
(c) Tape out or tape tight time out alarm signal;
(d) Manually switchable drive direction control.

Each of these facilities may be independently disabled, and (d) is optional.

Two versions of the Extended Interface are available as follows:

(i) For HSR 500 (separate power supplies) Part No. 5038
(ii) For HSR 500P (integral power supplies) Part No. 5039

This interface is standard on Trend Paper Tape Stations, and is used with many of the Trend special interfaces.

8.3.2 Control Signals

The control signals of the Extended Interface are identical to those for the basic interface, described in Section 4.2, except as follows:

(i) Drive Right: This input is held to logic '0' if the optional direction switch SW1 is put in the 'L' position. Provided that the Drive Left input is left at logic 1 or open circuit, this will allow the reader to drive left under control of the Transport Enable input.

(ii) Drive Left: This input is held to logic '0' if the optional direction switch SW1 is put in the 'R' position. Provided that the Drive Right input is left at logic '1' or open circuit, this will allow the reader to drive right under control of the Transport Enable input.

(iii) Transport Enable: This input is 2 unit loads. This signal is over-ridden for nominally 0.2ms from the time of the sprocket output going to logic 0 (light), for which period the Transport Enable input to the reader standard interface is held to logic 1. This prevents the brake from being applied when the decision time for proceding to the next character is less than 0.2ms, whilst still allowing stopping with the Sprocket light if the Transport Enable input is taken to logic 0 during this period.

The brake delay is only effective if the Drive Right and Drive Left input remain unchanged. It may be disabled by breaking Link 1. The Transport Enable input is also over-ridden when a tape out/tape tight alarm condition occurs. In this state, the transport enable input to the basic interface is held to logic 0 irrespective of the input to the extended interface.

(iv) Reader Tape Alarm Reset: This input is 1 unit load. This input should normally be held to logic 1. When taken to logic 0 it resets the tape out/tape tight alarm latch. The reset condition must be maintained for at least 20 microseconds in order to reset the alarm latch. If this input is held to logic 0, the tape out/tape tight facility is disabled.

8.3.3 Output Signals

The output signals of the Extended Interface are identical to those for the basic interface, described in Section 4.3, except for the following additions and changes. The microswitch signals and the switched lamp supply are not provided at the 37-way socket.

(i) Sprocket: Output is unchanged, but drive capability is reduced to 7 units drive.

(ii) Sprocket Pulse: This additional output has 7 units drive capability. The output switches from logic 0 to logic 1 for a period of 0.2ms $\pm$0.05ms from each dark to light transition of the Sprocket output (logic 1 to logic 0).

This signal is linked via Link 1 to provide a 'brake delay' as described in Section 8.3.2 (iii).

8.3.3 continued

(iii) Reader Tape Alarm: This additional output has 8 units drive capability. The output is normally at logic 0. It switches to logic 1 under the following conditions:

(a) When Link 2 is completed and the tape loading flap is open;
(b) When Link 2 is completed and the lamp supply is switched off or has failed;
(c) When a Sprocket Pulse has not been generated in any period of nominally 25ms whilst the Transport Enable input is at logic '1'. This will occur if either there is no tape over the read head, or if tape is present but has stalled.

The output is latched to logic 1, and may be returned to logic 0 by either of the following methods:

(a) Restore the lamp supply if failed and open then close the tape loading flap. The time-out latch is reset when the loading flap is open, but the Tape Alarm output does not recover to logic 0 until the flap is next closed if Link 2 is in circuit.
(b) If the lamp supply is present and the tape loading flap is closed, take the Reader Tape Alarm Reset input to logic 0 for at least 20 microseconds.

In both cases, it is necessary to first or simultaneously take the Transport Enable input to logic 0 in order to avoid an immediate drive condition.

It may be noted that the time-out period is sufficient to allow at least 1 inch of sprocketless tape through the read head, thus tapes may be butt spliced by unpunched opaque tape up to 1 inch long on sections of 'Feed' codes (no code holes punched). Also, the time-out period will not be sufficient to allow 3 inches or more of sprocketless tape through the read head, and this may be used as a means of stopping tapes without the need to recognise a 'stop' code. In particular it may be used to prevent the end of a tape being read as a spurious code.

8.3.4 Connector Pin Assignment

Socket: Cinch 37-way sub-miniature 'D' type with die-cast cover and retainer clip.
Cable Length: Approximately three foot.

PIN	SIGNAL	WIRE COLOUR
1	Channel 1	Brown
2	Channel 2	Red
3	Channel 3	Orange
4	Channel 4	Yellow
5	Channel 5	Green
6	Channel 6	Blue
7	Channel 7	Violet
8	Channel 8	Grey
9	Sprocket	White
10	Drive Right	Black
11	Drive Left	Pink
12	Transport Enable	White/Red
13	Channels Enable	White/Green
14	Sprocket Enable	White/Blue
15	Channels Inhibit	Yellow/Blue
16	V1	Blue/Black
17	Power Earth	Yellow/Green
18	+5v Output	Red/Black and Red/Brown
19	0v Signal Common	Red/Blue and Red/Green and Screen
20	R.T.A. Reset	Orange/Green
21	Sprocket Pulse	Orange/Blue
22	Reader Tape Alarm	Yellow/Red
23	Not Used	
24	"	
25	"	
26	"	
27	"	
28	"	
29	"	
30	"	
31	"	
32	"	
33	"	
34	"	
35	"	
36	"	
37	"	

NOTE: Each wire rated at 0.25A maximum

8.3.5 Power Connections

(i) HSR 500

The Extended Interface for HSR 500 readers (external power unit) has a screened signal cable to the 37-way socket and a separate cable consisting of two twisted pair wires colour coded as follows:

+26v	Red)	Twisted Pair
Power Earth	Green)	
+5v	Blue)	Twisted Pair
0v	Black)	

The cable length is approximately three foot and the wires are terminated in soldered tails. Power Earth and 0v must be connected together either at the power supply or preferably by a link on the extended interface card. Both supplies are also connected to the 37-way socket, but the current rating of the +26v connection (V1) is not sufficient to supply the reader.

(ii) HSR 500P

The Extended Interface for HSR 500P readers (integral power unit) has the power supplies connected internally to the input socket of the reader. The +5v supply is available at the 37-way socket, and a maximum current of 0.5A may be drawn.

The +9v supply is also available at the 37-way socket (V1) and a maximum current of 0.1A may be drawn. Care must be taken to decouple this supply from excessive external load transients.

8.3.6 Circuit Explanation (See Fig. 28)

(i) Sprocket Pulse Generator

The Sprocket signal from the reader is connected through inverters 3/3,4 and 3/11,10 to capacitor C2. When the sprocket is dark 3/10 is at logic 1, TR3 is held ON by base current from R4 and C2 is charged to approximately 4.3v. The sprocket pulse output is then at logic 0. When the sprocket goes light (logic 0), 3/10 switches from +5v to approximately +0.5v, and through C2 instantaneously takes the base of TR3 through a similar negative voltage transistion which switches the collector current off and so causes a step to logic 1 at the sprocket pulse output. This output state continues until C2 discharges through resistor R4 sufficiently to cut TR3 ON again. This discharge, governed by the time constant of C2 and R4, takes nominally 0.2ms, thus a positive output pulse of this duration is formed.

When the sprocket next goes dark, C2 is recharged by the collector resistor of output 3/10 but TR3 remains ON, and the output is not affected.

8.3.6 continued

(ii) Tape Flap Open Detector

The reader output 'V1 Switched' can be seen from the Mother Board circuit Fig. 21 to be the lamp supply (24/28v for HSR 500 or 9v for HSR 500P) after the supply fuse and switch 2 which is operated by the tape loading flap. Whilst the loading flap is closed with the supply V1 present and the fuse intact, TR1 is held ON by base current supplied through R1. This takes inverter input 3/13 to logic 0 and output 3/12 to logic 1. When the flap is opened, or the supply fails, current ceases to flow through R1 and C1 discharges through R2 and TR1 base until insufficient base current flows to hold TR1 ON. C1 prevents TR1 from changing state until the short switch bounce period is over. TR1 switching OFF causes 3/12 to switch to logic 0 and if Link 2 is in circuit the Reader Tape Alarm output is switched to logic 1. When the flap is closed, switch 2 will close with switch bounce lasting a few milliseconds, or longer if the flap itself is caused to bounce. During this period, C1 is progressively charged through R1 whenever the switch is conducting, and then TR1 is switched ON, taking 3/13 to logic 0 and 3/12 to logic 1, thus allowing the Reader Tape Alarm output to switch to logic 0.

(iii) Time-out Circuit

When the supplies are first switched on, C3 is uncharged so that 2/13 is at logic 0 and 2/11 and 2/9 are at logic 1. As long as Transport Enable input remains at logic 0, 2/3 is held to logic 1, thus 2/10 is also at logic 1 and 2/8 at logic 0. This holds TR2 ON through inverter 3/9,8, maintaining C3 in the uncharged state. As soon as Transport Enable input is taken high, 2/3 switches to logic 0, because the sprocket pulse output is normally at logic 0. This causes 2/8 to switch to logic 1, provided that the tape flap is closed and the lamp supply is present, and assuming that the R.T.A. Reset input is normally at logic 1. This in turn causes TR2 to switch OFF and C3 begins to charge through the input circuit of 2/13 (approximately 4K ohm). If the conditions remain unaltered, C3 will charge to the logic 1 threshold of 2/13 after nominally 25ms, which will cause 2/11 to switch to logic 0, which through 2/9 latches the circuit in this state. C2 will not charge appreciably above the input threshold voltage of 2/13 (approximately 1.5v) because the leakage resistor R6 will hold the input diode slightly forward biassed. Normally however, Transport Enable will cause a Sprocket Pulse well within the 25ms period, and this will take 2/1 to logic 0 through inverter 3/5,6 which will cause 2/8 to pulse to logic 0 and TR2 to switch ON and rapidly discharge C3.

When a sprocket pulse does not occur within 25ms, causing the time-out circuit to latch on with 2/11 at logic 0, the Reader Tape Alarm output is taken to logic 1 because 1/12 is held to logic 0 through diode D1. This diode is included to ensure that the Tape Alarm output is not switched until the alarm has latched through 2/9, so that the Transport Enable input may be taken to logic 0 immediately. The latch is reset either by raising the tape loading flap to cause

8.3.6 continued

2/4 to go to logic 0, or by taking R.T.A. Reset input to logic 0. In either case 3/2 is taken to logic 0 which causes TR2 to switch ON and discharge C3 which in turn allows 2/11 to return to logic 1 and unlatch the circuit provided that the Transport Enable input has been taken to logic 0. The Reader Tape Alarm output returns to logic 0 after a short delay from the start of the reset. The reset condition must be maintained for at least 20 microseconds in order to ensure unlatching of the time-out circuit.

(iv) Brake Delay

If Link 1 is in circuit, each Sprocket Pulse takes 1/5 to logic 0 through inverter 3/5,6 and thus the Reader Transport Enable input is held to logic 1 for the duration of the sprocket pulse (0.2ms from Sprocket going Light) irrespective of the state of the Transport Enable input to the Extended Interface. This prevents unnecessary brake operation yet still allows stopping on a character.

SECTION 9 - SPARE PARTS

9.1 USE OF ALTERNATIVES

The components listed in the following sections are those normally fitted at the time of preparation of this handbook. However, Trend Electronics Limited pursue a policy of competitive purchasing, and different components and different suppliers may be used from time to time.

The most important characteristics of the passive components used are listed, and in most cases many compatible alternatives are available. These equivalents may be fitted if the listed component is not available, but if any doubt exists as to the suitability of any component, Trend Electronics Limited should be consulted. In the case of semi-conductor components, so many parameters have to be taken into consideration that it is not possible to list the characteristics required of an alternative. Generally the listed components should be used exclusively, and if not readily obtainable from the usual stockists they may be obtained from Trend Electronics Limited.

9.2 MOTHER BOARD COMPONENTS

Complete Assembly for HSR 500 Part No. 4451
Complete Assembly for HSR 500P Part No. 4771

9.2.1 Resistors

Circuit Reference HSR 500	HSR 500P	Resistance ohms	Tolerance ±1%	Rating W	Maker	Type
R1		27	5	12	Welwyn	W24
	R1	4.7	5	6	Welwyn	W22
R2		47	5	12	Welwyn	W24
	R2	12	5	6	Welwyn	W22
R3		68	5	12	Welwyn	W24
	R3	10	5	6	Welwyn	W22
R4		68	5	12	Welwyn	W24
	R4	22	5	6	Welwyn	W22
R5		68	5	12	Welwyn	W24
	R5	22	5	6	Welwyn	W22
R6		68	5	12	Welwyn	W24
R7 (25-28v)		10	5	12	Welwyn	W24
R7 (24v)		6.8	5	12	Welwyn	W24
R8		22	5	2	Welwyn	W21
	R9	2	5	2½	Welwyn	W21

9.2.2 Capacitors

Circuit Reference	Capacitance Micro-farads	Tolerance %	Rating volts	Maker	Type
C1	500	+50 / -20	50	Daly	D261/4*
C2	1	±20	150	Wima	Tropyfol M

* Note C1 is specially rated for high current working.

9.2.3 Fuses

Circuit Reference	Current Rating	Size	Type	Maker	Type No.
FS1	3A	20 x 5 mm	Quick Act.	Beswick	TDC 14
FS2	1A	20 x 5 mm	Anti Surge	Beswick	TDC 123

9.2.4 Connectors

Circuit Reference	No. of Ways		Maker	Type
SKT1, SKT 2	24/24		Ferranti	EWD 24/24FS
1 - 30	1		Cambion	450-3704-1-03
P.S.U. Plug	9	Carr	Carr Fastener	43/81/043
Plug Cover	9		Cannon	DE 51218-1
Plug Retainer	9		Cannon	DE 51224-1

9.3 CONTROL BOARD COMPONENTS

Complete Assembly for HSR 500 Part No. 4415
Complete Assembly for HSR 500P Part No. 4470

9.3.1 Resistors

Circuit Reference HSR 500	Circuit Reference HSR 500P	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R1	R1	1K	5	¼	Electrosil	TR5
R2	R2	15K	5	¼	Electrosil	TR5
R3	R3	100K	5	¼	Electrosil	TR5
R4	R4	100K	5	¼	Electrosil	TR5
R5	R5	47K	5	¼	Electrosil	TR5
R6	R6	15K	5	¼	Electrosil	TR5
R7	R7	100K	5	¼	Electrosil	TR5

9.3.1 Resistors continued

Circuit Reference HSR 500	Circuit Reference HSR 500P	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R8	R8	100K	5	¼	Electrosil	TR5
R9	R9	47K	5	¼	Electrosil	TR5
R10	R10	15K	5	¼	Electrosil	TR5
R11	R11	100K	5	¼	Electrosil	TR5
R12	R12	100K	5	¼	Electrosil	TR5
R13	R13	47K	5	¼	Electrosil	TR5
R14	R14	68K	5	¼	Electrosil	TR5
R15	R15	100K	5	¼	Electrosil	TR5
R16	R16	100K	5	¼	Electrosil	TR5
R17	R17	47K	5	¼	Electrosil	TR5
R18	R18	15K	5	¼	Electrosil	TR5
R19	R19	100K	5	¼	Electrosil	TR5
R20	R20	100K	5	¼	Electrosil	TR5
R21	R21	47K	5	¼	Electrosil	TR5
R22	R22	15K	5	¼	Electrosil	TR5
R23	R23	100K	5	¼	Electrosil	TR5
R24	R24	100K	5	¼	Electrosil	TR5
R25	R25	47K	5	¼	Electrosil	TR5
R26	R26	15K	5	¼	Electrosil	TR5
R27	R27	100K	5	¼	Electrosil	TR5
R28	R28	100K	5	¼	Electrosil	TR5
R29	R29	47K	5	¼	Electrosil	TR5
R30	R30	15K	5	¼	Electrosil	TR5
R31	R31	100K	5	¼	Electrosil	TR5
R32	R32	100K	5	¼	Electrosil	TR5
R33	R33	47K	5	¼	Electrosil	TR5
R34	R34	15K	5	¼	Electrosil	TR5
R35	R35	100K	5	¼	Electrosil	TR5
R36	R36	100K	5	¼	Electrosil	TR5
R37	R37	47K	5	¼	Electrosil	TR5
R38	R38	15K	5	¼	Electrosil	TR5
R39	R39	100K	5	¼	Electrosil	TR5
R40	R40	2K	2	¼	Electrosil	TR5
R41	R41	4.7K	2	¼	Electrosil	TR5
R42	R42	56K	5	1	Electrosil	TR5

9.3.1 Resistors continued

Circuit Reference HSR 500	HSR 500P	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R43	R43	40Ω.	5%	-	-	-
R44	R44	1.1K	2	¼	Electrosil	TR5
R45	R45	330	2	¼	Electrosil	TR5
R46	R46	560	2	¼	Electrosil	TR5
R47	R47	560	2	¼	Electrosil	TR5
R48	R48	220	2	¼	Electrosil	TR5
R49	R49	3.9K	2	¼	Electrosil	TR5
R50	R50	33K	5	¼	Electrosil	TR5
R51	R51	100K	5	¼	Electrosil	TR5
R52	R52	3.9K	5	¼	Electrosil	TR5
R53	R35	1K	5	¼	Electrosil	TR5
R54	R54	1K	5	¼	Electrosil	TR5
R55	R55	100K	5	¼	Electrosil	TR5
R56	R56	47K	5	¼	Electrosil	TR5
R57	R57	1K	5	¼	Electrosil	TR5
R58	R58	68K	5	¼	Electrosil	TR5
R59	R59	1K	5	¼	Electrosil	TR5
R60	R60	68K	5	¼	Electrosil	TR5
R61	R61	2.2K	5	¼	Electrosil	TR5
R62	R62	1K	5	¼	Electrosil	TR5
R63	R63	10K	5	¼	Electrosil	TR5
R64	R64	1K	5	¼	Electrosil	TR5
R65		3.3K	5	¼	Electrosil	TR5
	R65	1K	5	¼	Electrosil	TR5
R66		680	5	¼	Electrosil	TR5
	R66	100	5	¼	Electrosil	TR5
R67	R67	1K	5	¼	Electrosil	TR5
R68	R68	0.2	5	2½	Welwyn	W21
R69	R69	1K	5	¼	Electrosil	TR5
R70	R70	1K	5	¼	Electrosil	TR5
R71	R71	1K	5	¼	Electrosil	TR5
R72	R72	1K	5	¼	Electrosil	TR5
R73	R73	1K	5	¼	Electrosil	TR5
R74	R74	1K	5	¼	Electrosil	TR5

9.3.1 Resistors continued

Circuit Reference HSR 500	Circuit Reference HSR500P	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R75		470	5	2½	Welwyn	W21
	R75	120	5	1	Electrosil	TR6
R76		1K	5	1	Electrosil	TR6
	R76	220	5	½	Electrosil	TR5
R77		680	5	2½	Welwyn	W21
	R77	220	5	½	Electrosil	TR5
R78		2.2K	5	½	Electrosil	TR5
	R78	680	5	½	Electrosil	TR5
R79		2.2K	5	½	Electrosil	TR5
	R79	680	5	½	Electrosil	TR5
R80		680	5	2½	Welwyn	W21
	R80	220	5	½	Electrosil	TR5
R81	R81	1M	5	¼	Electrosil	TR5

9.3.2 Variable Resistors

Circuit Reference	Resistance Range	Rating	Maker	Type
RV1 to RV8	0 - 68K ohm	¼w	Davall	81P
RV9, RV10	0 - 100Kohm	¼w	Davall	81P

9.3.3 Capacitors

Circuit Ref.	Capacitance Micro-Farads	Tolerance ±%	Rating volts	Maker	Type
C1	0.22	20	160	Wima	Tropyfol M
C3	0.22	20	160	Wima	Tropyfol M
C4	0.1	20	160	Wima	Tropyfol M
C5	1.5	-20/+50	35	I.T.T.	TAG 1.5/35
C6	0.1	10	160	Wima	Tropyfol M
C7	0.1	10	160	Wima	Tropyfol M
C8	4700pf	20	160	Wima	Tropyfol F
C9	150pf	20	400	Wima	Tropyfol F

9.3.4 Diodes

Circuit Reference	Type	Maker	Type No.
D1 to D9	Silicon Signal Diode	Various	IN4148
D10	Silicon Zener Diode	Motorola	IN5353
D11, D12	Silicon Rectifier	Mullard	BYX36-150
D14, D15	Silicon Rectifier	Mullard	BYX36-150
D16	Silicon Rectifier	Ferranti	ZS 274

9.3.5 Transistors

Circuit Reference	Type	Case	Maker	Type No.
As circuit	P.N.P.	TO-18	S.G.S.	U19387/2
As circuit	N.P.N.	TO-18	S.G.S.	BC113
As circuit	N.P.N.	TO-18	S.G.S.	U19353/1
As circuit	N.P.N.	Flat-Pac	Motorola	2N5191
TR48	P.N.P.	TO-18	Motorola	2N2906
TR50	N.P.N.	Flat-Pac	Motorola	MJE3055

9.3.6 Integrated Circuits

Circuit Reference	Function	Grade	Maker	Type No.
1 to 4, 7, 8	Quad 2 1/P NAND Gate	Commercial	S.G.S.	946 A10
5, 6	Hex Inverter	Commercial	S.G.S.	936 A5

9.3.7 Connector

Varicon 12 way Connector type 8129-012-610-001

9.4 POWER UNIT COMPONENTS

Complete Assembly Part No. 4589
Regulator Board Assembly Part No. 4447

Circuit Ref.	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R1	0.1	10	2½	Welwyn	W21
R2	470	5	½	Electrosil	TR5
R3	1K	5	½	Electrosil	TR5
R4	560	5	½	Electrosil	TR5
R5	0.2	5	2½	Welwyn	W21
R6	0.2	5	2½	Welwyn	W21
R7	470	5	½	Electrosil	TR5
R8	1.5K	5	½	Electrosil	TR5
R9	A.O.T.*	5	½	Electrosil	TR5
R10	1.5K	5	½	Electrosil	TR5
R11	330	5	½	Electrosil	TR5

9.4.1. Resistors continued

Circuit Ref.	Resistance ohm	Tolerance ±%	Rating W	Maker	Type
R12	1K	5	½	Electrosil	TR5
R13	560	5	½	Electrosil	TR5
R14	330	5	½	Electrosil	TR5
R15	1K	5	½	Electrosil	TR5
R16	A.O.T.*	5	½	Electrosil	TR5
R17	220	5	½	Electrosil	TR5
R18	220	5	1	Electrosil	TR6

* Adjust on Test in the range 1K to 2.7K

9.4.2 Capacitors

Circuit Ref.	Capacitance Micro-Farads	Tolerance %	Rating volts	Maker	Type
C1	500	-20/+50	50	Daly	D261/4
C2	10,000	-20/+50	25	Erie	KA 90 D
C3	5,000	-20/+50	25	Erie	KA 3067
C4	100	-20/+80	16	Erie	(20101-100-
C5	100	-20/+80	16	Erie	(0101-0Z-0160
C6	470pf	±20%	400	Wima	Tropyfol F
C7	470pf	±20%	400	Wima	Tropyfol F

9.4.3 Diodes

Circuit Ref.	Type	Maker	Type
D1, D3-6	Silicon Signal Diode	Various	IN4148
D2	Silicon Zener Diode	I.T.T.	BZY88-C6V2
D7	Silicon Zener Diode	I.T.T.	BZY88-C3V3

9.4.4 Rectifiers

Circuit Ref.	Type	Maker	Type
BR1, BR3	Encapsulated Bridge	General Instrument	WP005
BR2	Encapsulated Bridge	Motorola	MDA980-1

9.4.5 Transistors

Circuit Ref.	Type	Case	Maker	Type No.
TR1,2,6	N.P.N.	TO-3	R.C.A.	2N3055
TR3	P.N.P.	Flat-Pac	Motorola	2N4918
TR4,5,8,9	N.P.N.	TO-18	S.G.S.	BC113
TR7	P.N.P.	TO-18	Motorola	2N2906

9.4.6 Miscellaneous

Component Type	Circuit Ref.	Maker	Type No.
Transformer	T1	Revco	T539
Fan	Fan 1	Papst	Series 8550
Mains Socket	SKT 1	Belling Lee	L1436S
Fuse Holder	FS1 to FS3	Bulgin	F296
Board Connector	BD 1	Carr Fastener	R88-00652
Neon	LP 1	Belling Lee	L1897
Mains Connector		Klippon	MK1/3-2616
Tap Changer		Carr Fastener	80/75/880
Output Socket	SKT 2	Carr Fastener	43/81/044
Output Socket Locking Posts	SKT 2	Cannon	D53018

9.4.7 Fuses

Circuit Ref.	Current Rating	Size	Type	Maker	Type No.
FS 1 (220/240v)	3A	20 x 5mm	Anti-Surge	Beswick	TDC 211
FS 1 (115v)	5A	20 x 5mm	Anti-Surge	Beswick	TDC 211
FS2	5A	20 x 5mm	Quick Acting	Beswick	TDC 14
FS 3	1A	20 x 5mm	Quick Acting	Beswick	TDC 14

7A. 15 x 3 Min FITTED.

9.5 READER CHASSIS COMPONENTS

Component Type	Circuit Ref.	Value	Rating	Maker	Type No.
Motor			220v	I.T.T.	EMK40-30/2 1aa
Elapsed Time Meter			240v	Sangamo Weston	5477
Capacitor	C1	1 uf	440v a.c.	B.I.C.C.	Stud Mounting
Capacitor	C2	0.47 uf	250v a.c.	Filmcap	AC 3
Capacitor	C3, 4, 5	4700 pf	250v a.c.	Erie	K80001/811/101
Resistor	R1	220 ohms	1w	Electrosil	TR6
Fuse Holder	FS1			Belling Lee	E6011
Connector Block				Klippon	MK3/6-2435
Microswitch	SW1, SW2		5A	Burgess	V4T6
Control Switch	1A,B,2A,B 3A,B		5A	Burgess	V4T6
Lamp Holder				Bulgin	SCC 4
Lamp (HSR 500)		24v	24w	Osram	339
Lamp (HSR 500P)		12v	21w	Osram	382
Mains Fuse	FS 1		2A	Beswick	TDC 211
Miniature Plugs				Cambion	460-3308-1-03
Insulator Sleeves				Cambion	508-1974-06-0010.
Drive Belt				Dowty	200.259.9970
Belt Tension Spring				Terry	709074
Lens				English Glass	1775

9.6 TREND PARTS

The principal replaceable TREND manufactured parts are listed below with the part numbers used to identify them:

Part	Part No.	Number used per Reader	Key No. in Fig. 32
Solenoid Assembly - Left	4259	1	1
Solenoid Assembly - Right	4260	1	2
Brake Coil Assembly	2638	1	3
Read Head Assembly	5832	1	4
Lamp Adjuster Assembly	2763	1	5
Brake Armature Assembly	2783	1	6
Spring Detent Roller Assembly	2796	1	7
Backing Spring	2629	1	8
Cable Clamp Inner Part	2750	2	
Cable Clamp Outer Part	4284	2	
Motor Pulley	4008	1	
Tape Drive Roller Assembly	4422	2	9
Tape Drive Roller Pulley	4174	2	10
Fan	2773	1	11
Fan Pulley	2623	1	
Fan Spindle	2641	1	12
Fan Bearing Housing Assembly	2781	1	13
Jockey Pulley	4420	2	14
Adjustment Pulley Spindle	4235	1	15
Pulley Plate Assembly	4418	1	16
Pulley Plate Spindle	4236	1	

9.7 SPOOLER UNIT COMPONENTS

Component	Value	Rating	Maker	Type/Part No.
Motor		220v	I.T.T.	EMK40-30/2 1aa ✓
Microswitch			Burgess	V4T6
Motor Start Capacitor (C1)	1 uf	440v a.c.	B.I.C.C.	Stud Mounting
Capacitor (C2)	0.47 uf	250v	Filmcap	AC 3 ✓
Resistor	220 ohm ±5%	1w	Electrosil	TR6 ✓
Rubber drive band			Ronald Trist	OS 32
Brake pad material			A & N Rubber Co.	BC 2540
Plastic hub			Willis Computer Supplies	H 200

9.8 EXTENDED INTERFACE UNIT COMPONENTS

Complete Unit for HSR 500 Part No. 5038
Complete Unit for HSR 500P Part No. 5039

9.8.1 Resistors

Circuit Ref.	Resistance ohms	Tolerance ±%	Rating W	Maker	Type
R1	100K	5	¼	Electrosil	TR5
R2	27K	5	¼	Electrosil	TR5
R3	5.6K	5	¼	Electrosil	TR5
R4	27K	5	¼	Electrosil	TR5
R5	390	5	¼	Electrosil	TR5
R6	22K	5	¼	Electrosil	TR5

9.8.2 Capacitors

Circuit Ref.	Capacitance Micro-Farads	Tolerance %	Rating volts	Maker	Type
C1	0.1	±20	160	Wima	Tropyfol M
C2	0.01	±10	100	Wima	Tropyfol M
C3	22	-20/+80	63	Erie	20101-100-0220-0Z-0630

9.8.3 Transistors and Diodes

Circuit Ref.	Type	Case	Maker	Type No.
D1	Silicon Signal Diode		Various	IN4148
TR1,3	N.P.N.	TO-18	S.G.S.	BC 113
TR2	N.P.N.	TO-18	S.G.S.	U19353/1

9.8.4 Integrated Circuits

Circuit Ref.	Function	Grade	Maker	Type No.
1, 2	Quad 2 I/P NAND gate	Commercial	S.G.S.	946
3	Hex Inverter	Commercial	S.G.S.	936

CHANGED TO 9308

9.8.5 Miscellaneous

Component Type	Circuit Ref.	Maker	Type No.
37 way Socket		Carr Fastener	43/81/050
Socket Cover		Carr Fastener	43/81/966
Socket Base and Clip		Carr Fastener	43/81/967
Cable		R-S Components	25 way Min. Multicable
Switch	SW 1	Egen	522/O.C.

9.9 SPECIAL SERVICE TOOLS

Trend Reader Test Set	HR01
Lamp Alignment Chart	HR02*
Setting-up Filter	HR03*
Solenoid Adjusting Tool	HR04

* These items are supplied free with every reader.

9.10 RECOMMENDED SPARES

For service centre covering up to 20 readers.

Component Type	Value	Maker	Type	HSR 500 No. off	HSR 500P No. off
Resistor	220 ohm	Electrosil	TR6	2	2
Resistor	1K	Electrosil	TR5		2
Resistor	1.2K	Electrosil	TR5		2
Resistor	1.5K	Electrosil	TR5		2
Resistor	1.8K	Electrosil	TR5		2
Resistor	2.2K	Electrosil	TR5		2
Resistor	2.7K	Electrosil	TR5		2
Capacitor	500 uf	Daly	D261/4	2	2
Capacitor	1.5 uf	I.T.T.	TAG 1.5/35	2	2
Capacitor	100 uf	Erie	20101-100-0101-OZ-0160		2
Capacitor	0.47 uf	Filmcap	AC 3	2	5
Variable Resistor	68K	Davall	81P	1	1
Variable Resistor	100K	Davall	81P	2	2
Diode		Various	IN4148	5	10
Rectifier		Mullard	BYX36-150	2	2
Rectifier		Ferranti	ZS 274	2	2
Zener Diode		Motorola	IN5353	2	2
Zener Diode		I.T.T.	BZY88-C6V2		2
Zener Diode		I.T.T.	BZY88-C3V3		2
Transistor		S.G.S.	BC113	5	10
Transistor		S.G.S.	U19387/2	5	5
Transistor		S.G.S.	U19353/1	5	5
Transistor		Motorola	2N2906	2	5
Transistor		Motorola	2N5191	5	5
Transistor		Motorola	2N4918		2
Transistor		Motorola	MJE3055	2	2
Transistor		R.C.A.	2N3055		2
Integrated Circuit		S.G.S.	936	6	6
Integrated Circuit		S.G.S.	946	6	6
Microswitch		Burgess	V4	2	2
Plug		Cambion	460-3308-1-03	10	10
Socket		Cambion	450-3704-1-03	10	10
Transistor Mounting Pads		Permark	H181	20	20

9.10 Recommended Spares continued

Component Type	Value	Maker	Type	No. off HSR 500	No. off HSR 500P
Capacitor	5,000 uf	Erie	KA 3067		1
Capacitor	10,000 uf	Erie	KA 90 D		1
Rectifier Bridge	+5v +31v	G.I.	WP005		2
Rectifier Bridge	+9v	Motorola	MDA980-1		1
Fuse Holder		Bulgin	F296	1	2
Fuse	1A	Beswick	TDC 123	5	5
Fuse	1A	Beswick	TDC 14		5
Fuse	3A	Beswick	TDC 14	5	5
Fuse	5A	Beswick	TDC 14		5
Fuse	2A	Beswick	TDC211	5	5
Fuse (220,240v only)	3A	Beswick	TDC211		5
Fuse (115v only)	5A	Beswick	TDC211		5
Motor	220v	I.T.T.	EMK40-30/2laa	1	1
Lamp	24v ,24w	Osram	339	2	
Lamp	~~24~~12v, ~~24~~12w	Osram	382		2
Mother Board		Trend	4451	1	
Mother Board		Trend	4771		1
Control Board		Trend	4415	2	
Control Board		Trend	4470		2
Power Unit		Trend	4589		1
Regulator Board		Trend	4447		2
Solenoid Assy Left		Trend	4259	1	1
Solenoid Assy Right		Trend	4260	1	1
Brake Coil Assy		Trend	2638	1	1
Tape Drive Roller Assy		Trend	4422	1	1
Fan Bearing Assy.		Trend	2781	1	1
Fan		Trend	2773	1	1
Fan Spindle		Trend	2641	1	1
Read Head Assembly		Trend	5832	1	1
Jockey Pulley		Trend	4420	2	2
Pulley Plate Assy.		Trend	4418	1	1
Spindle(for lower adjustable pulley)		Trend	4235	1	1
Spring Detent Roller Assembly		Trend	2796	1	1
Backing Spring		Trend	2629	1	1
Drive Belt		Dowty	200.259.9970	2	2
Belt Tension Spring		H. Terry	709074	2	2
Plastic Clip.		Trend	4788		2

9.11 ORDERING PROCEDURE

All parts listed in this Section may be obtained from Trend Electronics Limited. Prices will be quoted on application. The following information should be given in any enquiry or order for spare parts:

(a) The instrument Type Number (e.g. HSR 500P)

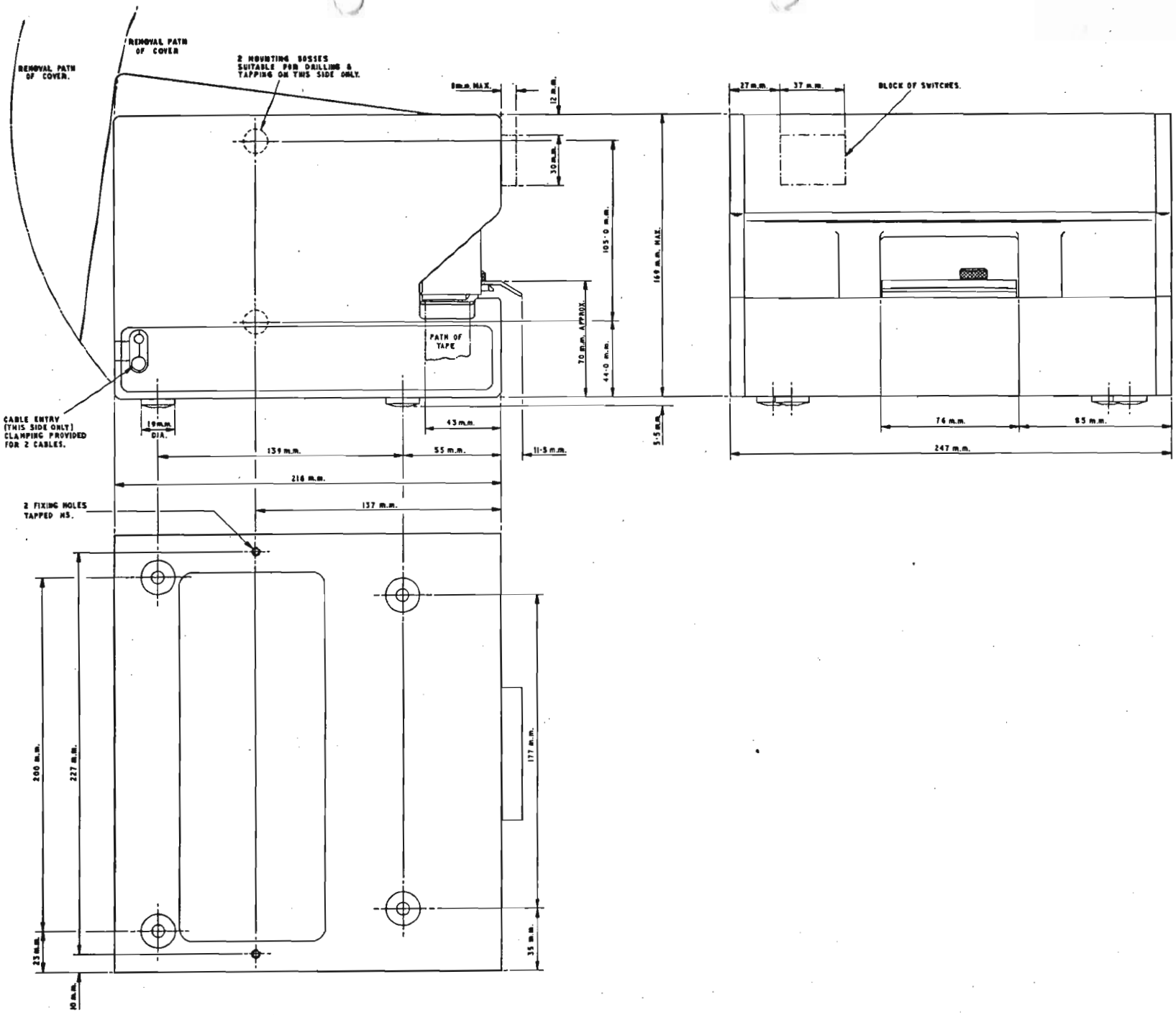
(b) The instrument Serial Number, if known

(c) The Trend Part Number for Trend parts

(d) The Circuit Reference and Assembly Part Number for non-Trend parts. The component type and value is also required.

(e) If an Assembly Part Number or Circuit Reference is not applicable or not know, a full description of component type, maker and type number should be given.

(f) In the case of Mains operated components, the supply voltage and frequency should be given.



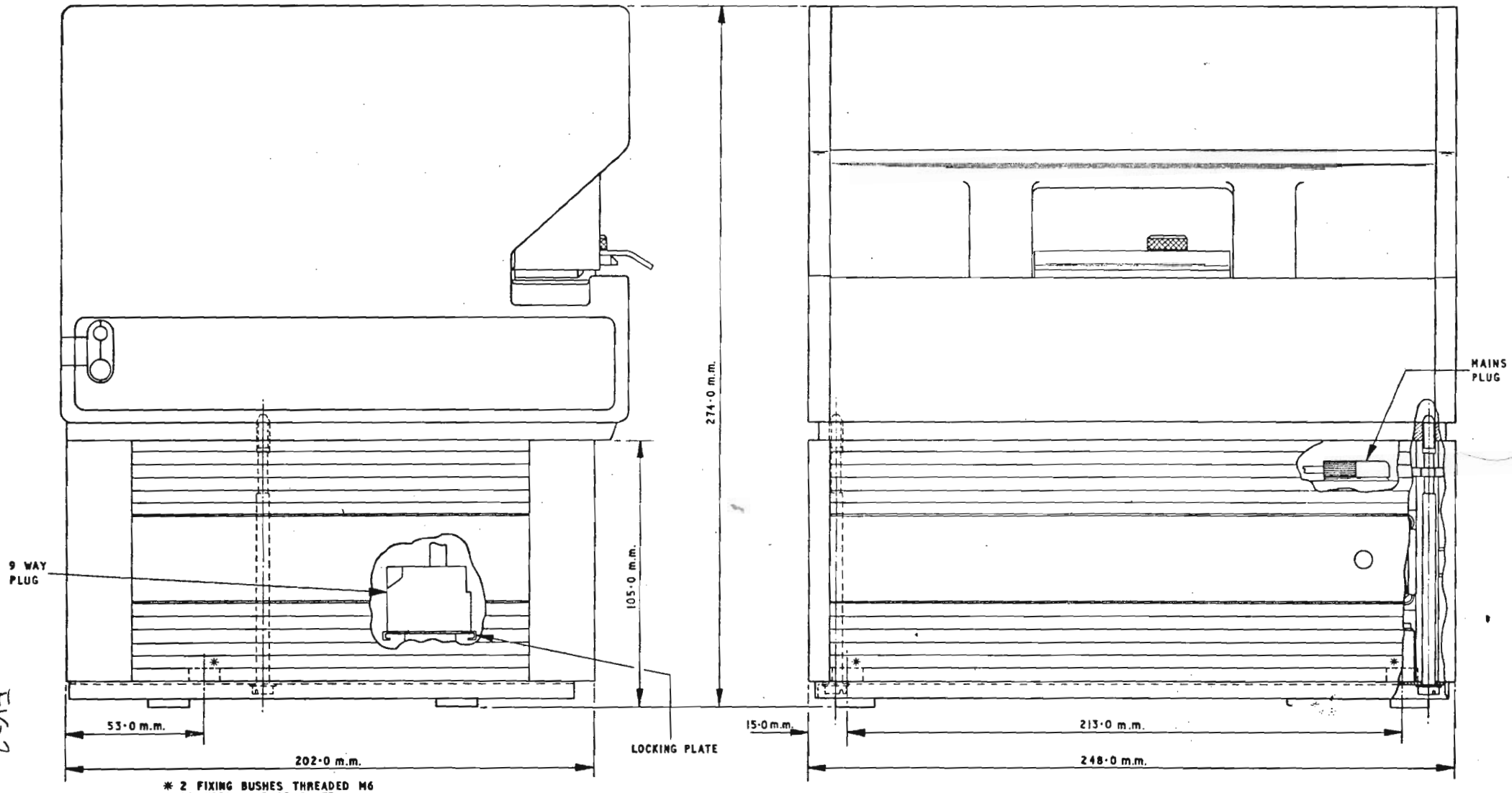
AMD-5883/1

INSTALLATION DETAILS OF H.S.R. 500.

FIG.I.

FIG 1
D1

D2.

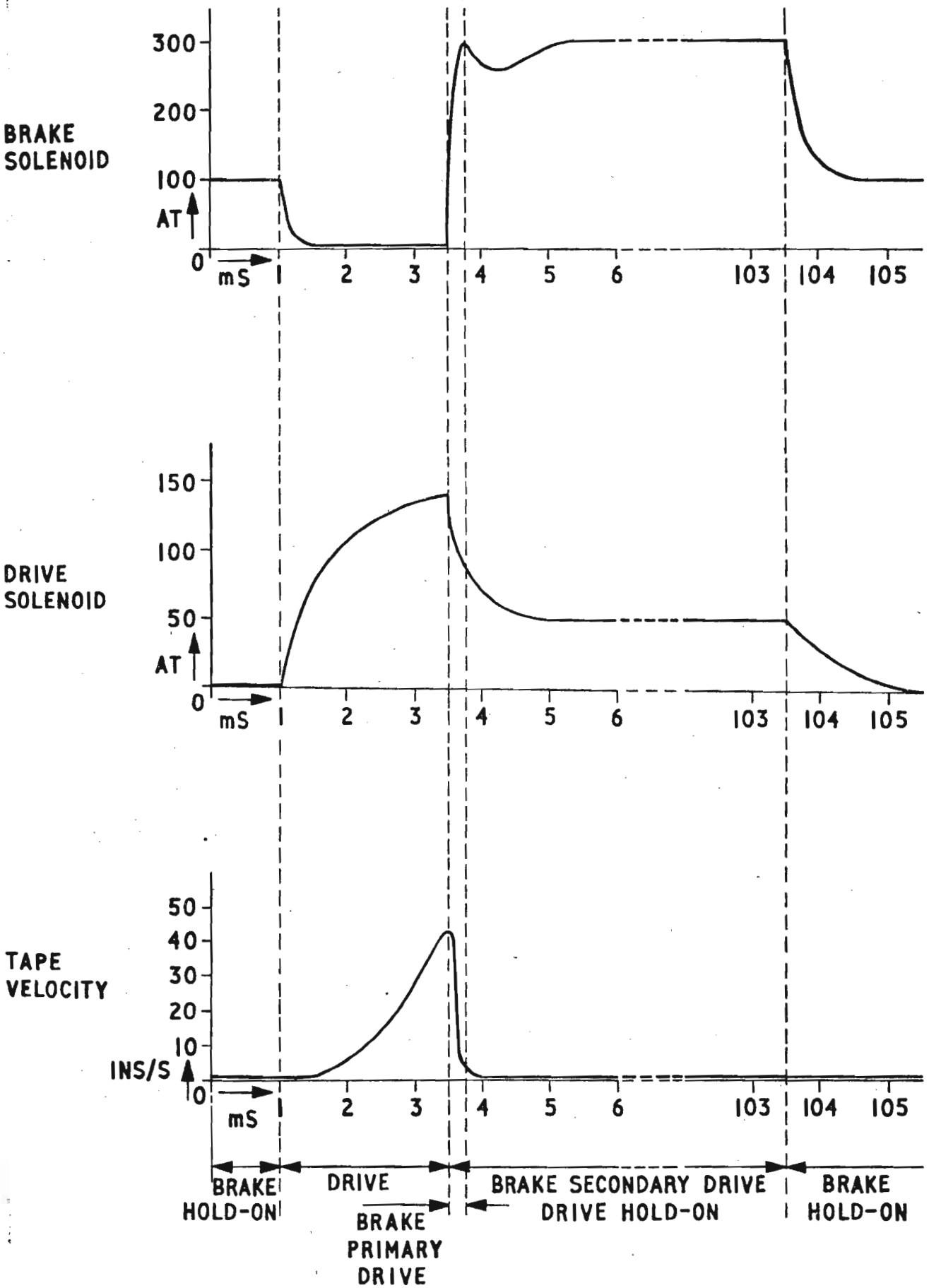


AHB-5514/1

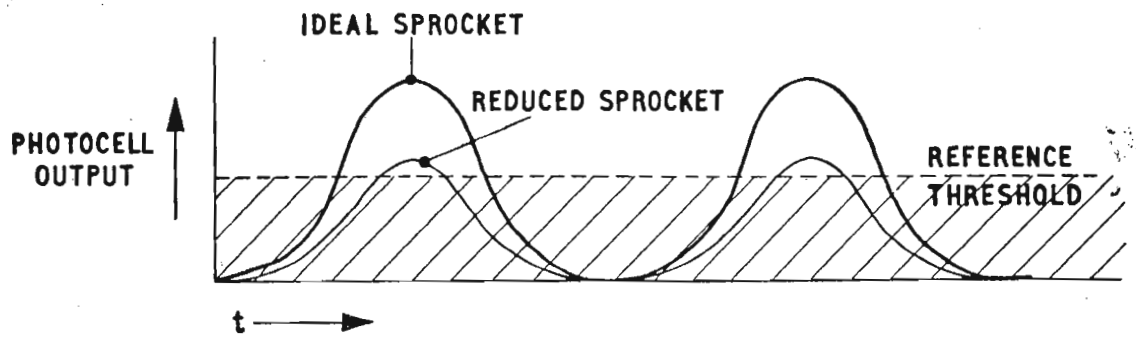
INSTALLATION DIAGRAM OF H.S.R.500P.

FIG.2

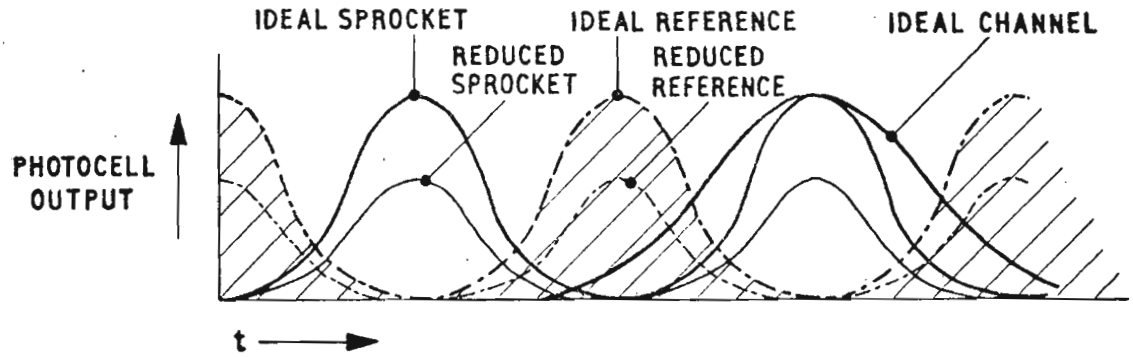
Fig2



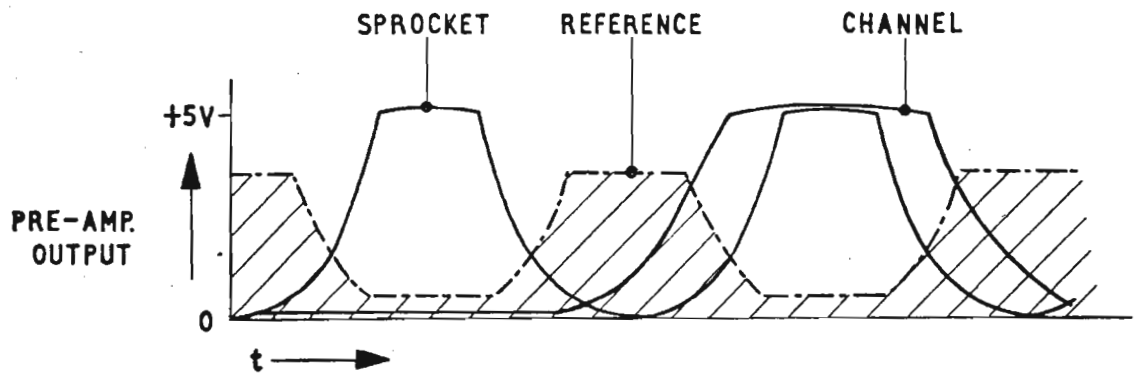
AHB-5830/1 TRANSPORT SOLENOID WAVEFORMS FIG.3



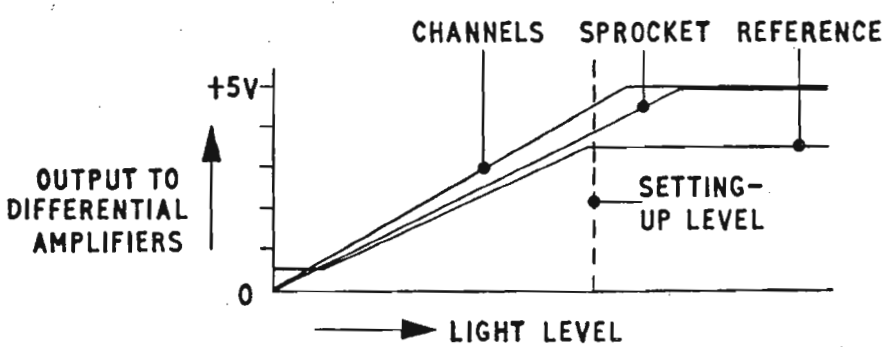
(a) CONVENTIONAL THRESHOLD SYSTEM.



(b) REFERENCE PHOTOCELL THRESHOLD SYSTEM.



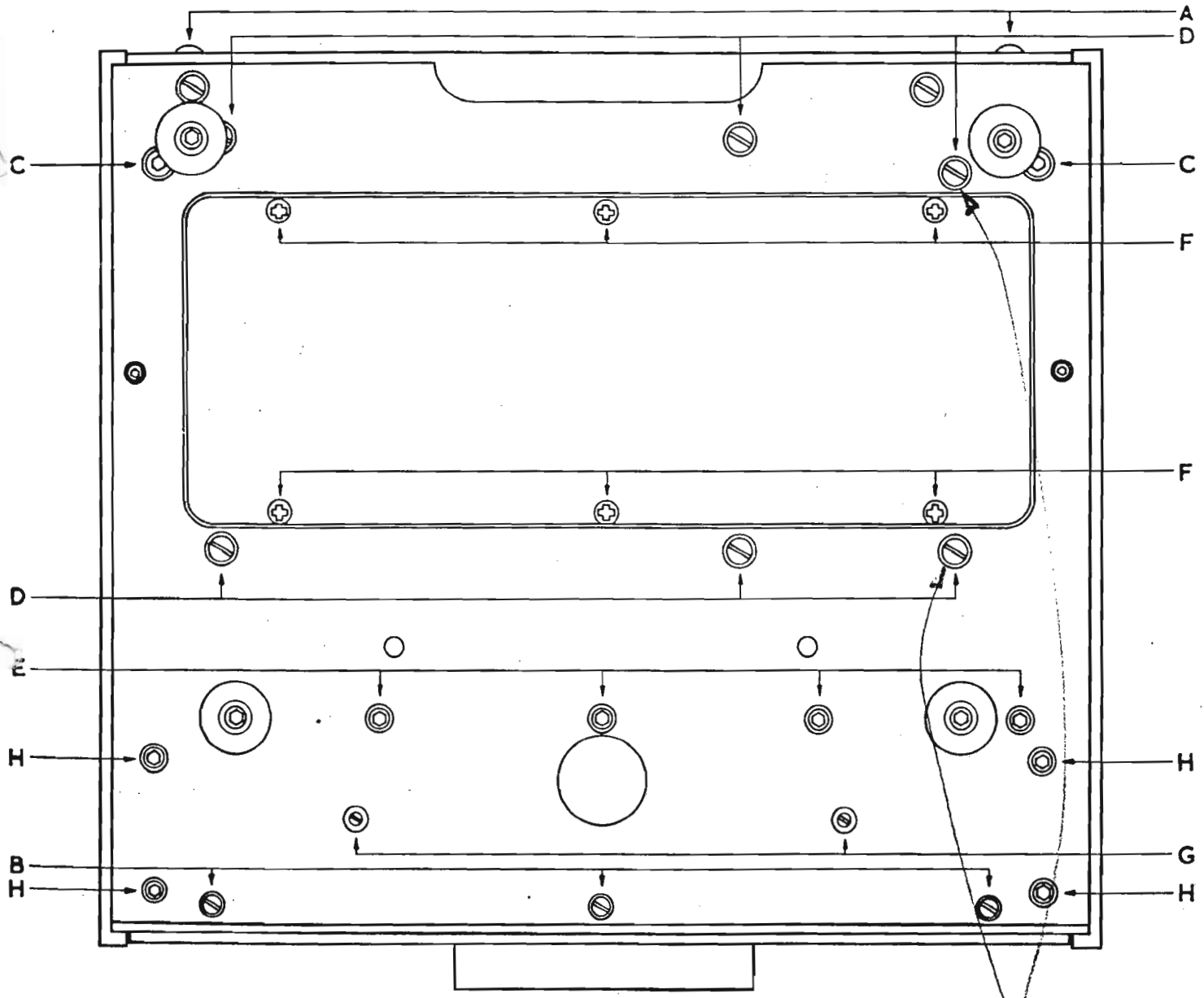
(c) MODIFIED OUTPUTS OF H.S.R. 500 SYSTEM.



(d) PRE-AMPLIFIER OUTPUT CHARACTERISTICS.

AHB-5831/1 PHOTOCELL WAVEFORMS FIG. 4.

A REAR COVER RETAINING SCREWS. (2)
B FRONT COVER RETAINING SCREWS. (3)
C SIDE COVER RETAINING SCREWS. (LH & RH)
D MOTHER BOARD SUPPORT RETAINING SCREWS. (6)
E MECHANISM PLATE RETAINING SCREWS. (4)
F BASE PLATE LABEL SCREWS. (6)
G LOWER STOP ADJUSTING SCREWS. (2)
H TAPE PLATFORM RETAINING SCREWS. (4)

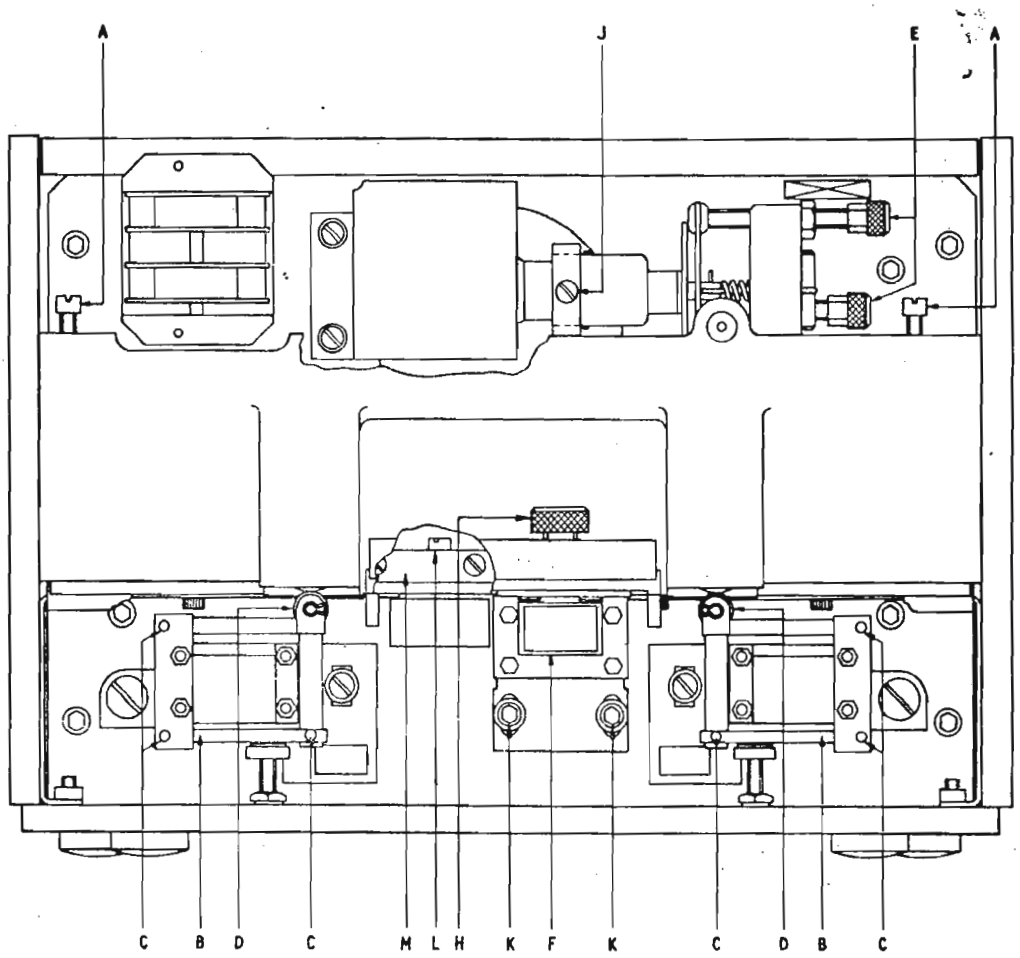


NEED NOT REMOVE.
TO TAKE OUT MOTHER BOARD.

AHB-5154/1

BASE PLATE FIXINGS.

FIG. 5
MK 1 READER ONLY.



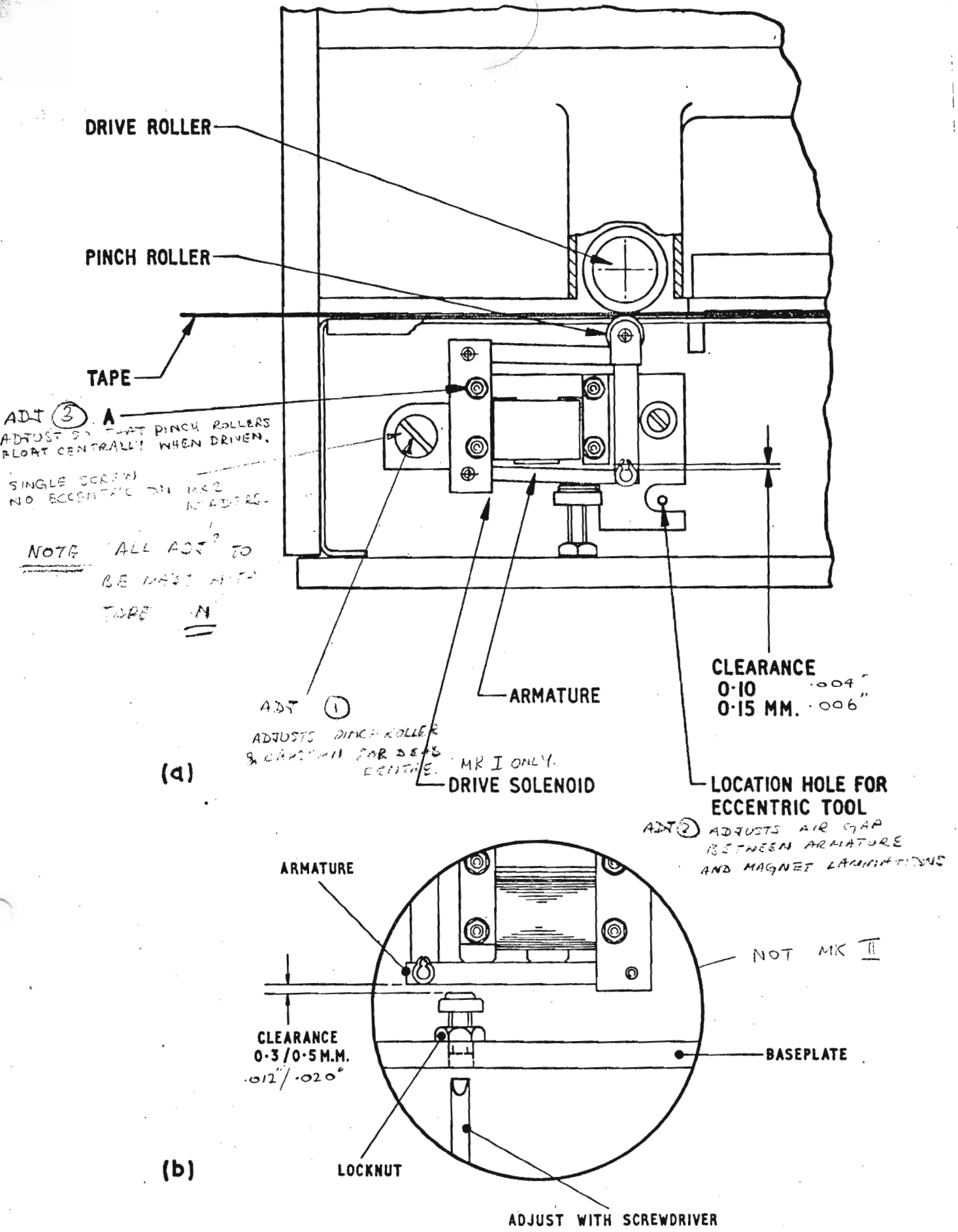
A – TOP FRONT COVER RETAINING SCREWS (2)
B – DRIVE SOLENOID ASSEMBLY (R.H. & L.H.)
C – SPINDLE (LUBRICATION POINT) (6)
D – PINCH ROLLER (2)
E – LAMP ADJUSTING SCREWS (3)
F – BRAKE COIL (1)
H – FRONT EDGE GUIDE RETAINING SCREW (1)
J – LAMP LOCKING COLLAR SCREW (1)
K – BRAKE COIL ASSEMBLY FIXING SCREWS (2)
L – READ HEAD FIXING SCREW (1)
M – SEE TEXT

AHB-5155/1

FRONT VIEW CUTAWAY

FIG. 6

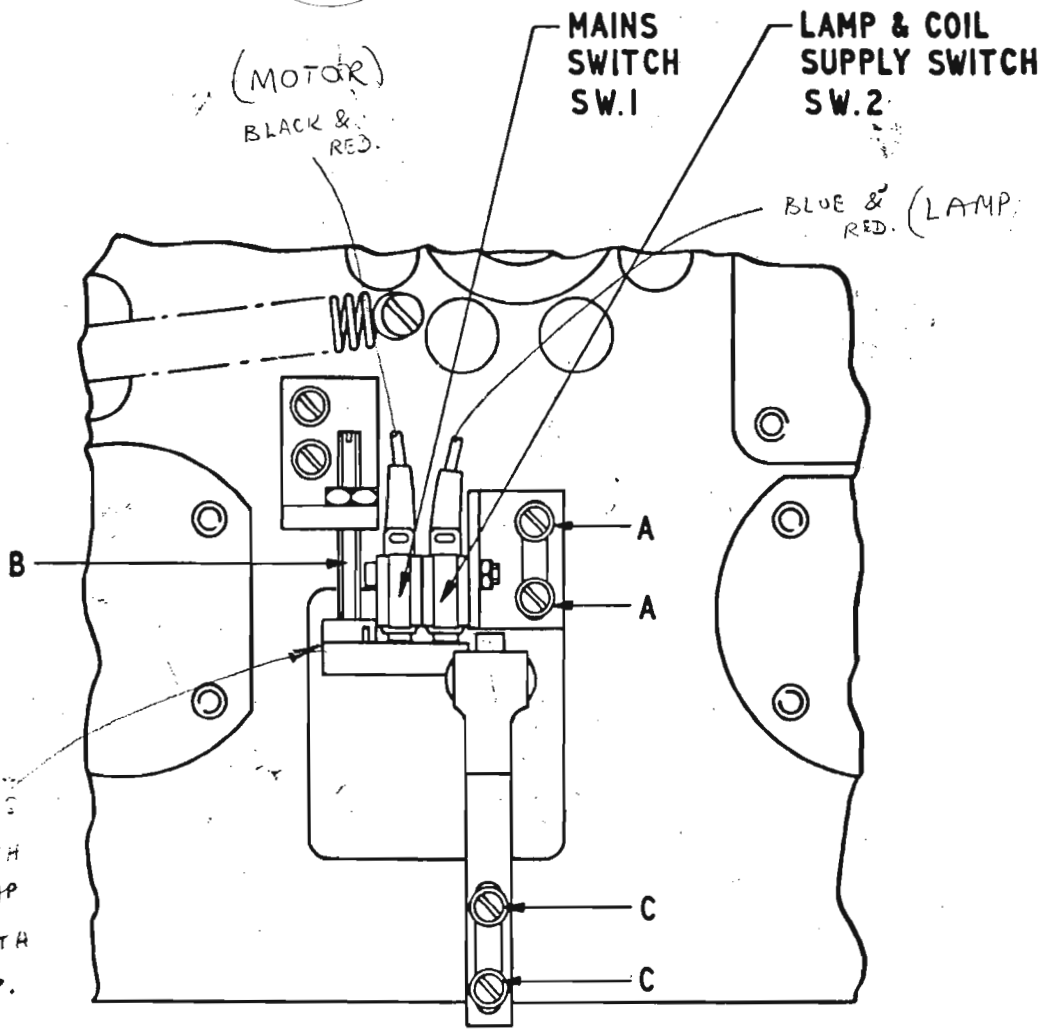
D6



AHB-5884/1

DRIVE SOLENOID ADJUSTMENT.

FIG.7

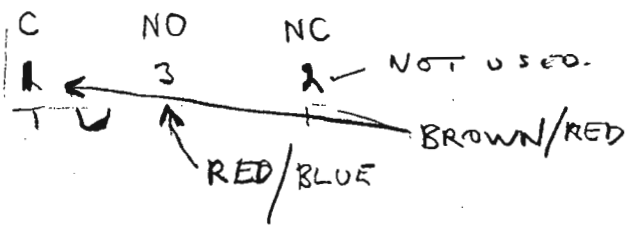


A – MICRO-SWITCH MOUNTING BRACKET SCREW (2)

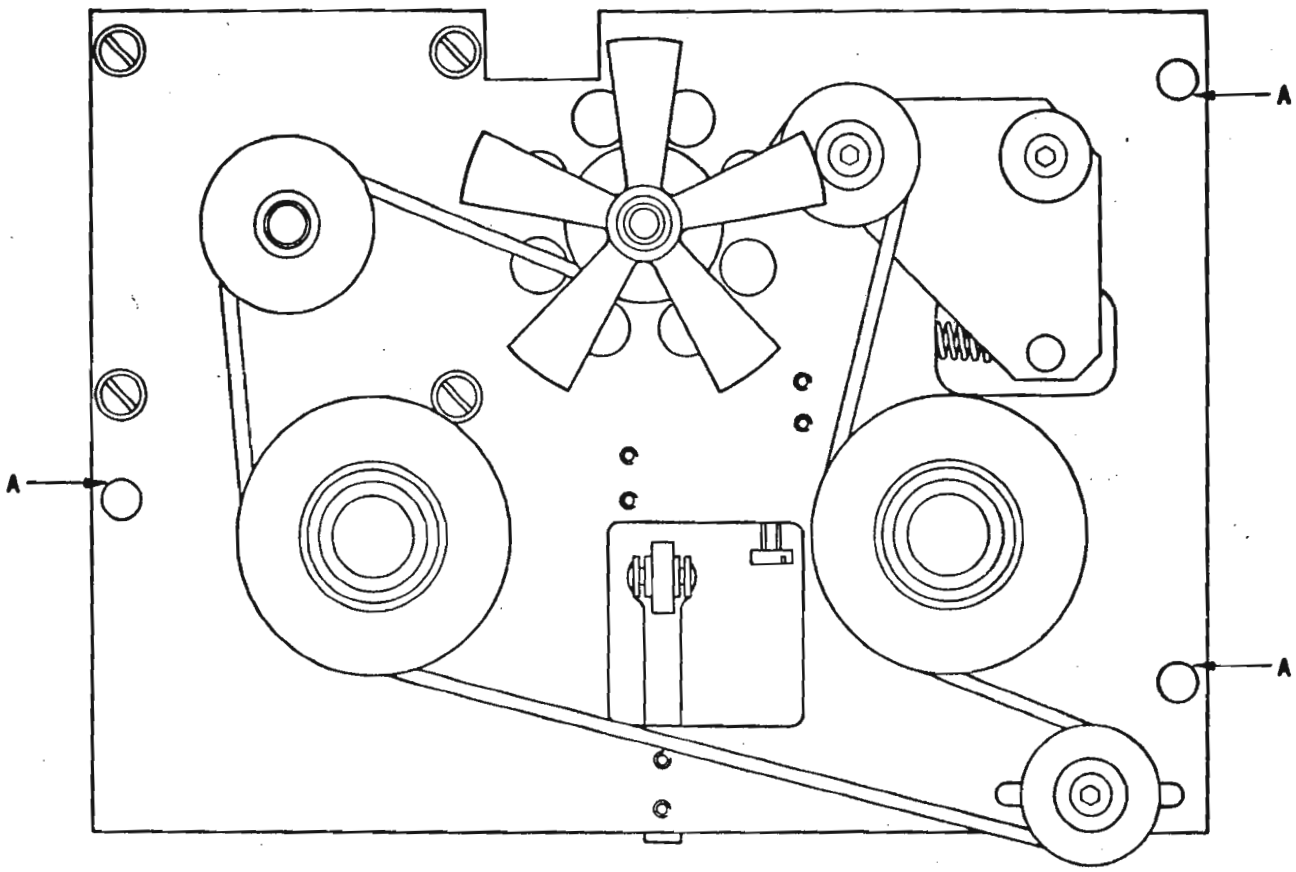
B – LOADING FLAP STOP SCREW (1)

C – DETENT SPRING ARM SCREWS (2)

BURGESS MICRO SWITCH REPLACEMENT



AHB-5157/1 TAPE LOADING FLAP ADJUSTMENTS FIG.



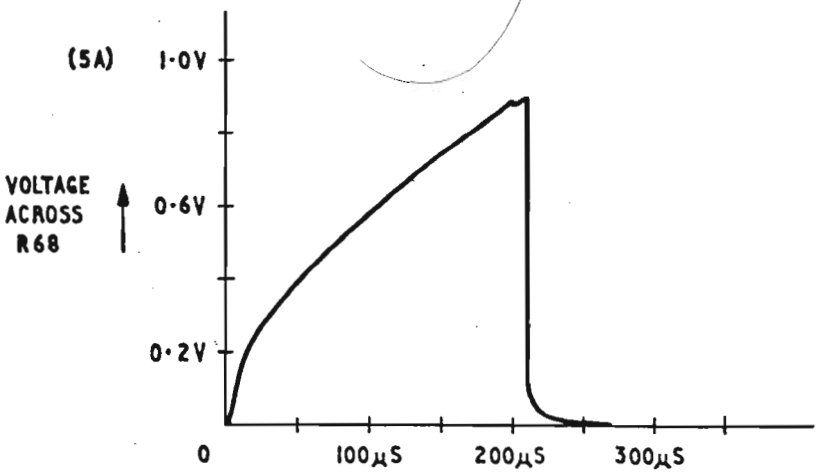
A - HOLE POSITIONS FOR M5 CLAMP SCREWS (3)

AHB-5156/1

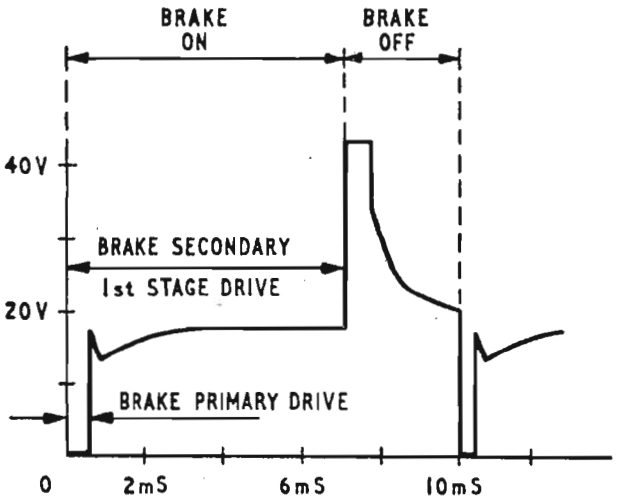
MOTOR PLATE

FIG. 9

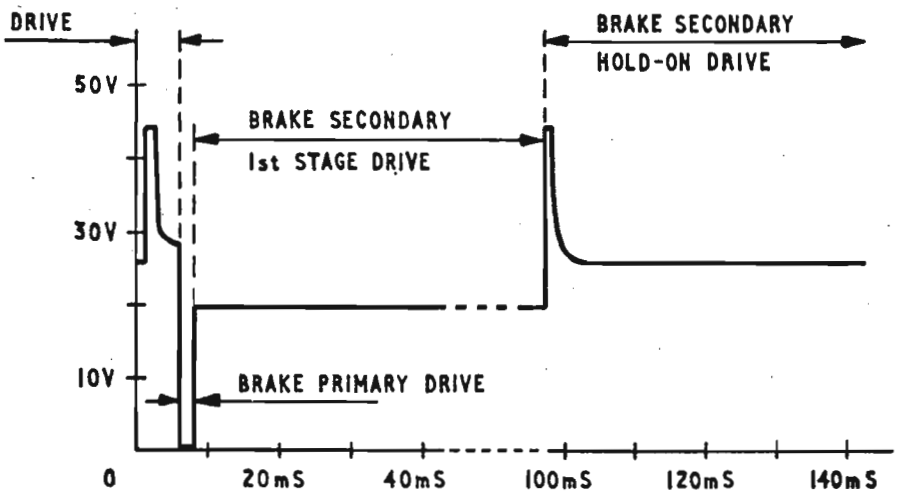
D 9



(a) PRIMARY BRAKE COIL CURRENT WAVEFORM



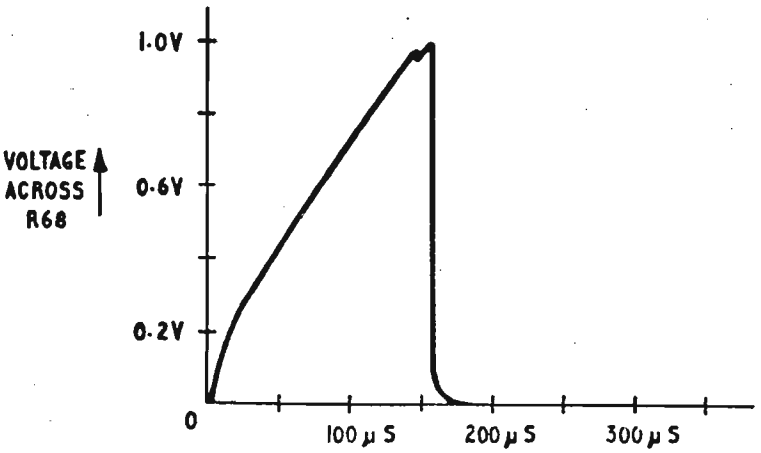
(b) SECONDARY BRAKE COIL DRIVE WAVEFORM ~100 CH/S.



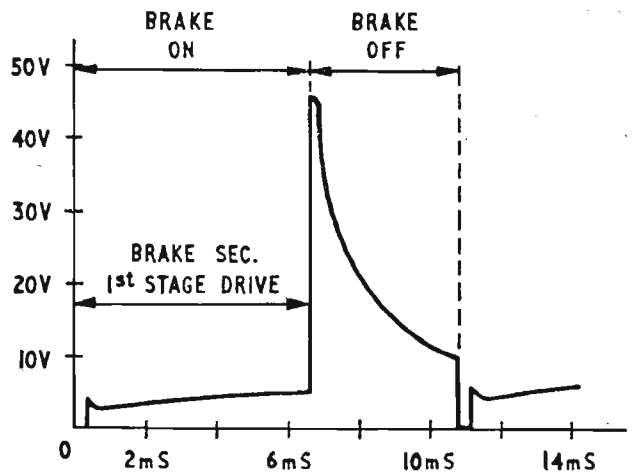
(c) SECONDARY BRAKE COIL DRIVE – SINGLE STEP

AHB-5885/1 TYPICAL BRAKE WAVEFORMS – H.S.R.500 FIG. 10

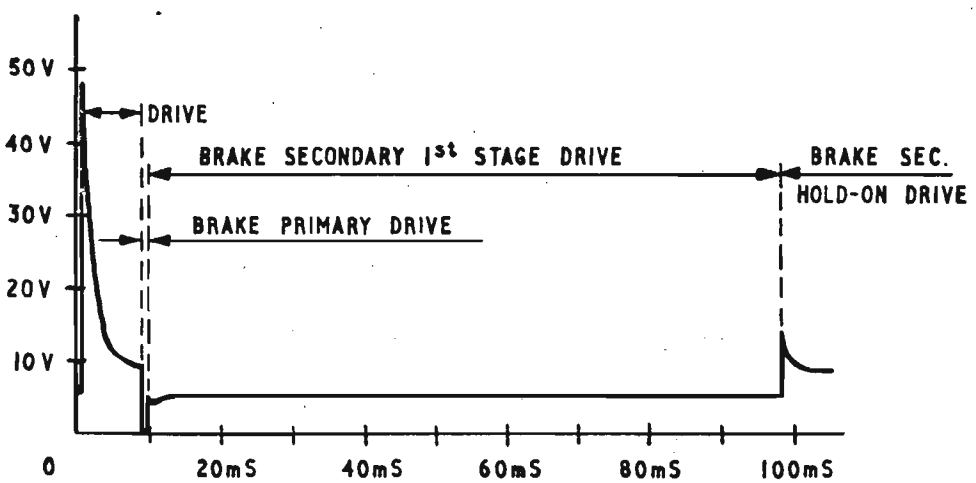
D 10



(a) PRIMARY BRAKE COIL CURRENT WAVEFORM

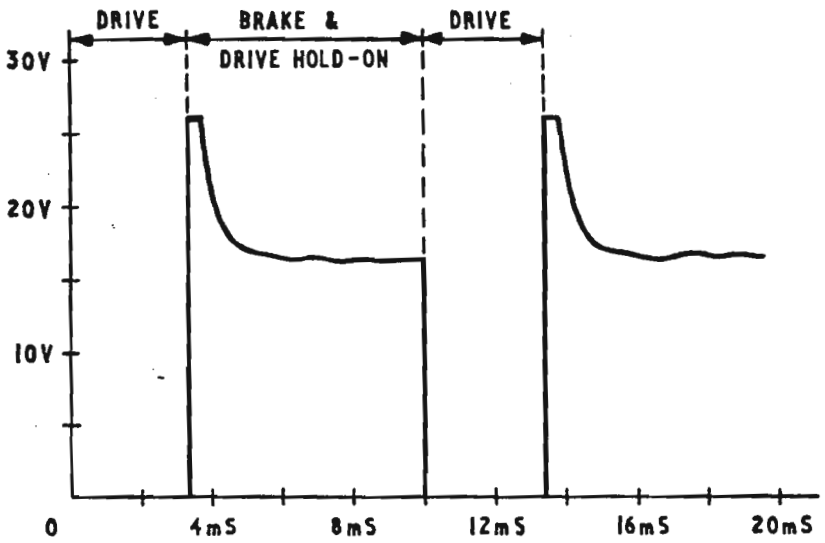


(b) SECONDARY BRAKE COIL DRIVE WAVEFORM~100 CH/S

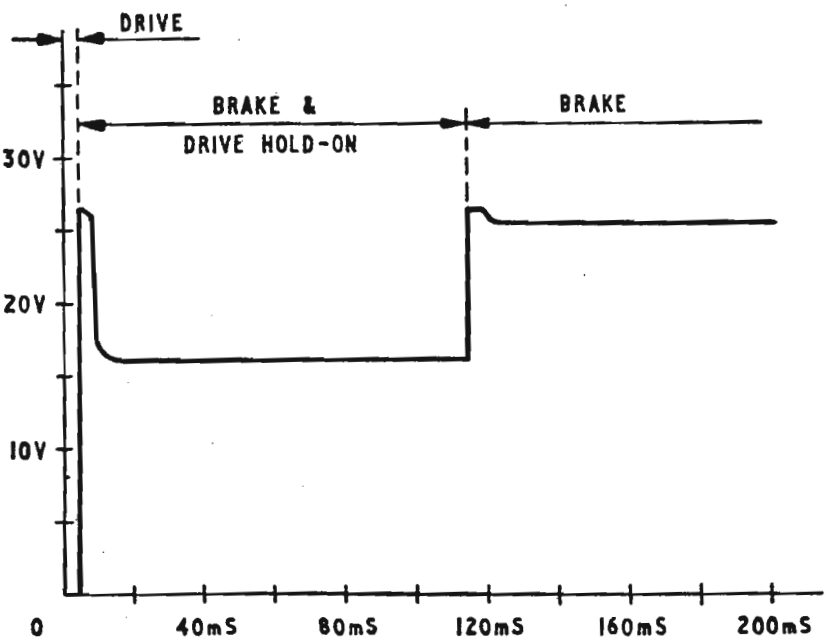


(c) SECONDARY BRAKE COIL DRIVE – SINGLE STEP

AHB-5886/1 TYPICAL BRAKE WAVEFORMS-H.S.R.500P FIG. 11

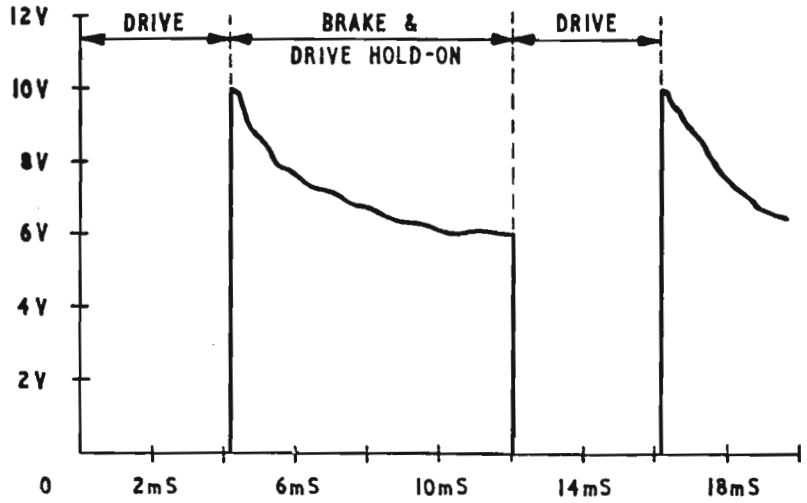


(a) DRIVE COIL WAVEFORM~100 CH/S.

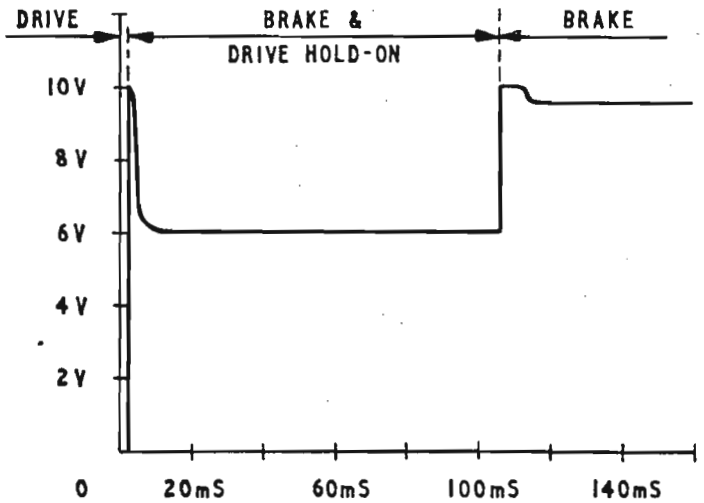


(b) DRIVE COIL WAVEFORM - SINGLE SHOT

AHB-5887/1 TYPICAL DRIVE WAVEFORMS-H.S.R.500 FIG.12



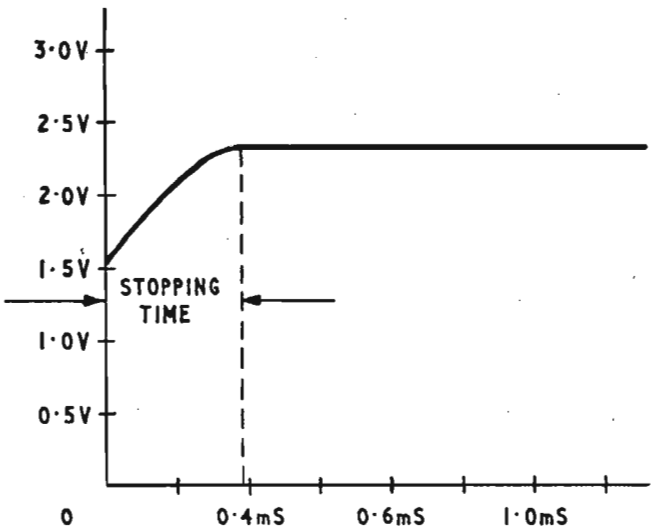
(a) DRIVE COIL WAVEFORM ~ 100 CH/S



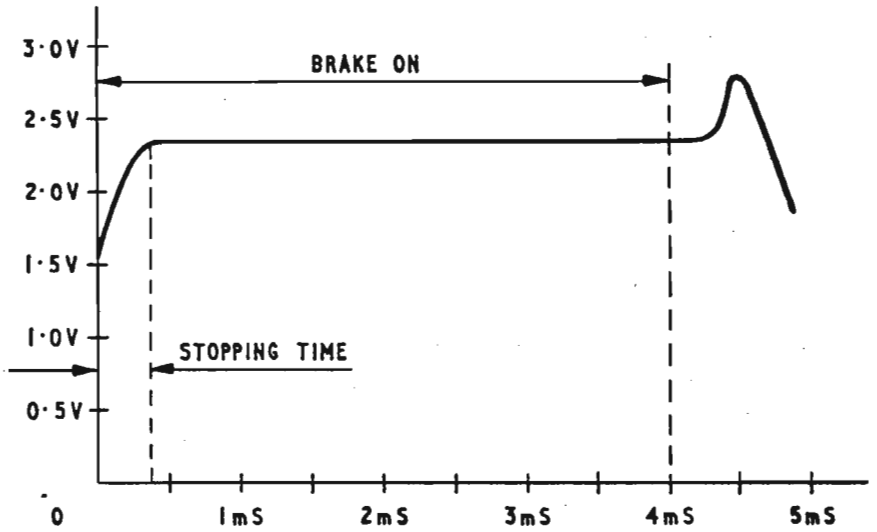
(b) DRIVE COIL WAVEFORM – SINGLE STEP

AHB-5888/1 TYPICAL DRIVE WAVEFORMS–H.S.R.500P FIG.13

(a)



(b)

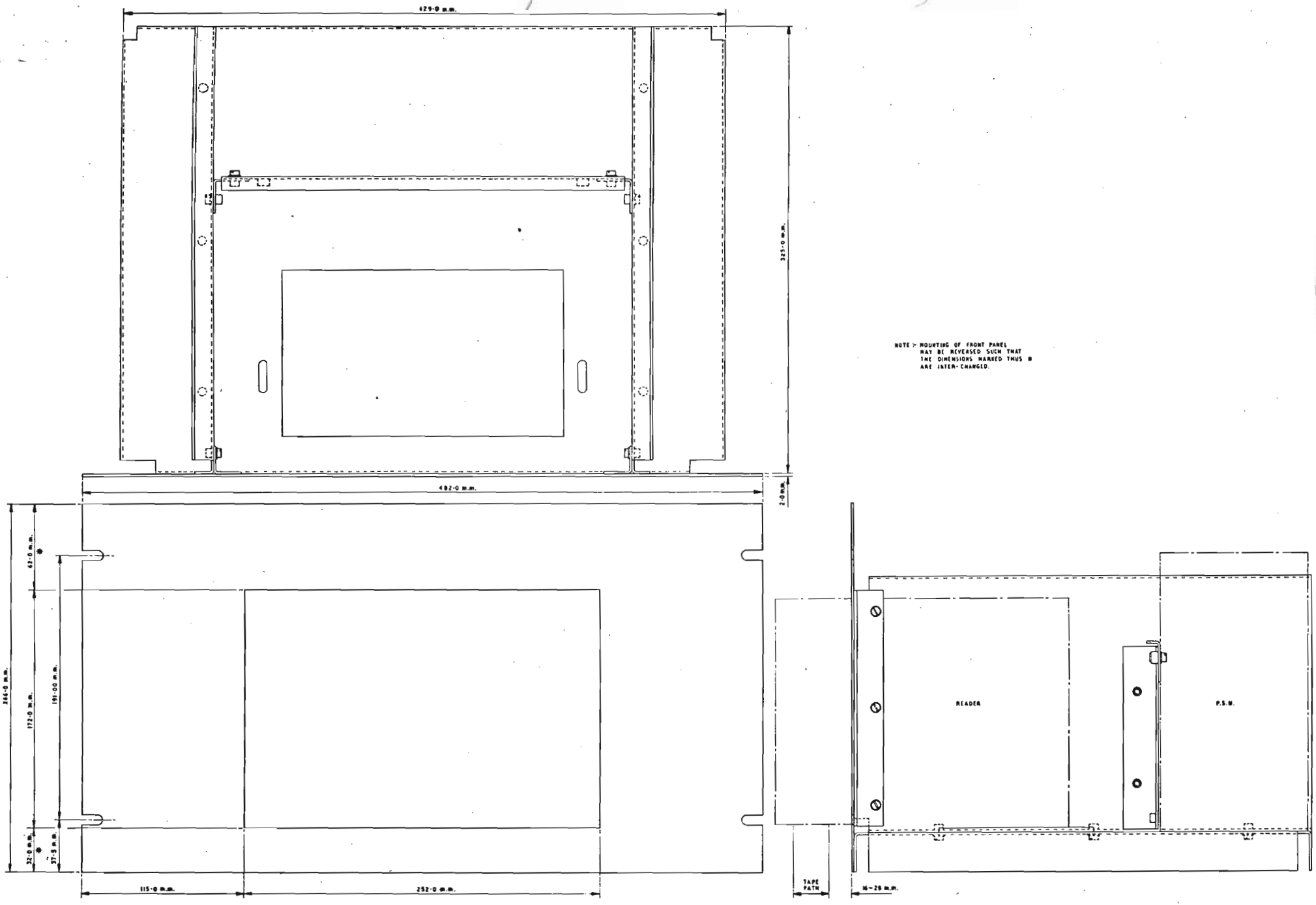


AHB-5889/1

STOPPING TIME WAVEFORMS

FIG.14

D14

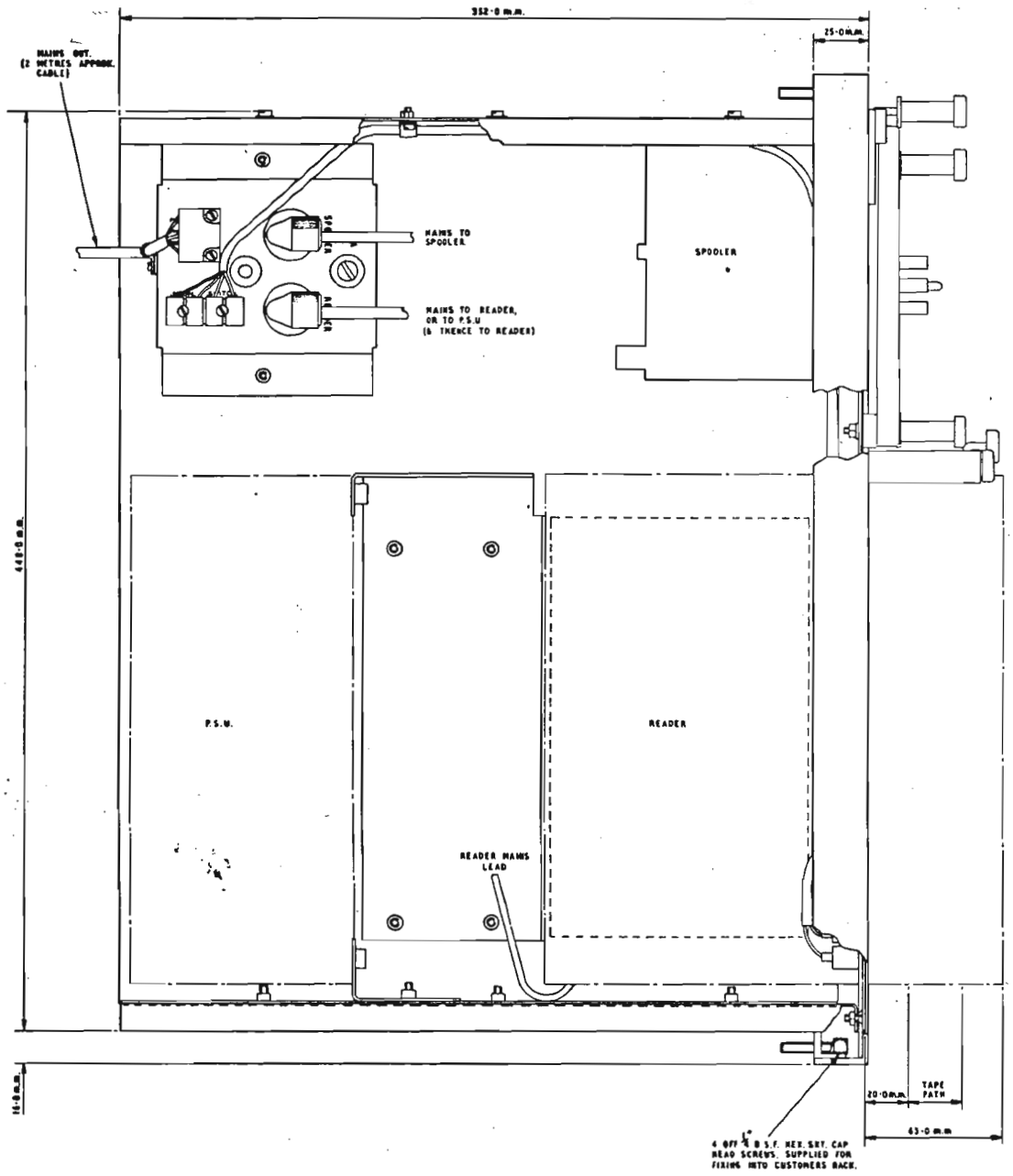


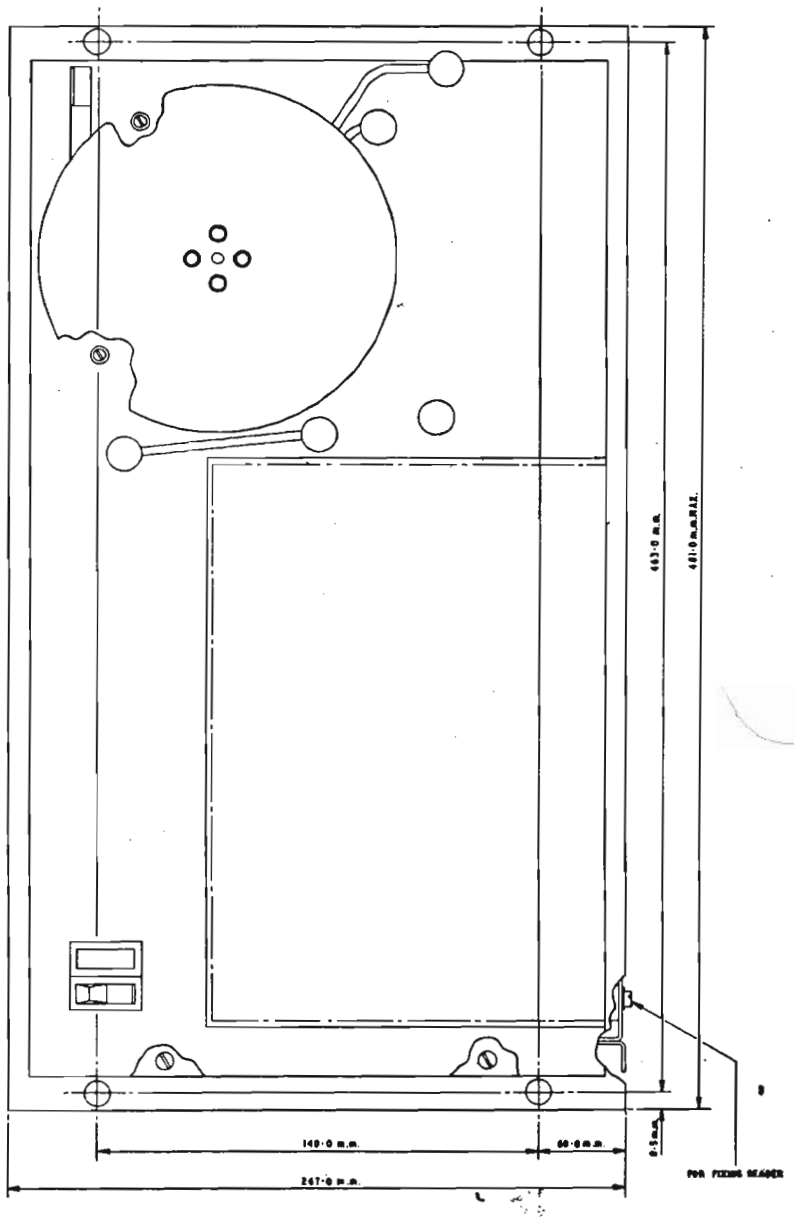
NOTE :- MOUNTING OF FRONT PANEL MAY BE REVERSED SUCH THAT THE DIMENSIONS MARKED THUS * ARE INTER-CHANGED.

AMD-5090/1

PANEL MOUNTING ACCESSORY.

FIG. 15

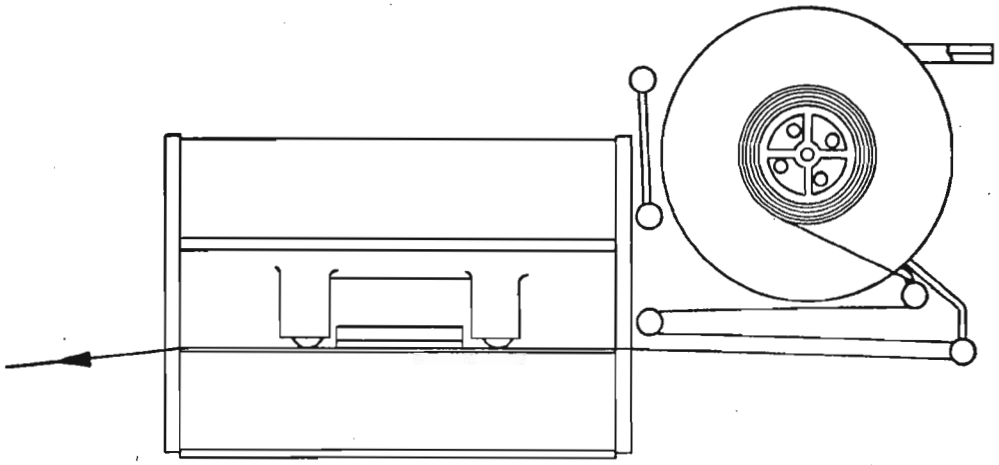




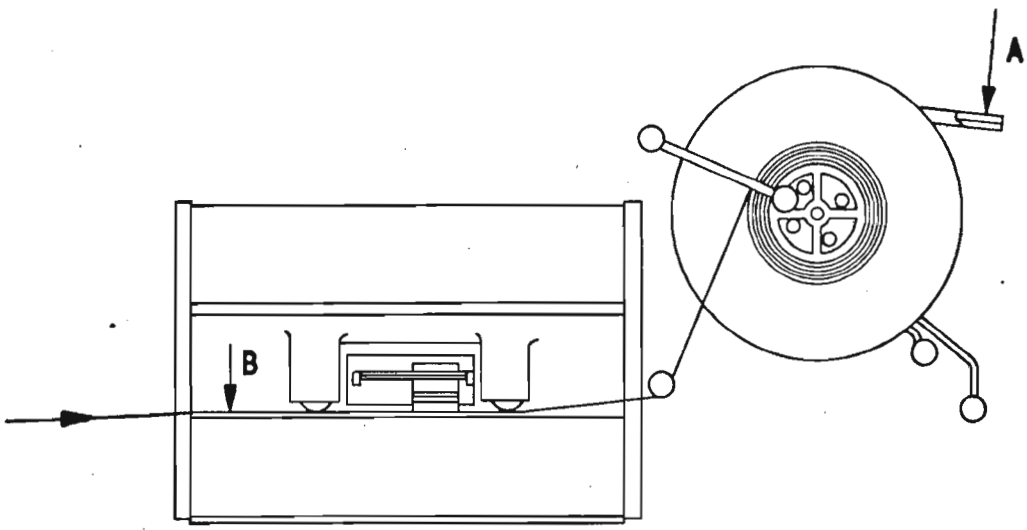
AMD-5094/1

PANEL MOUNTING WITH SPOOLER

FIG. 16

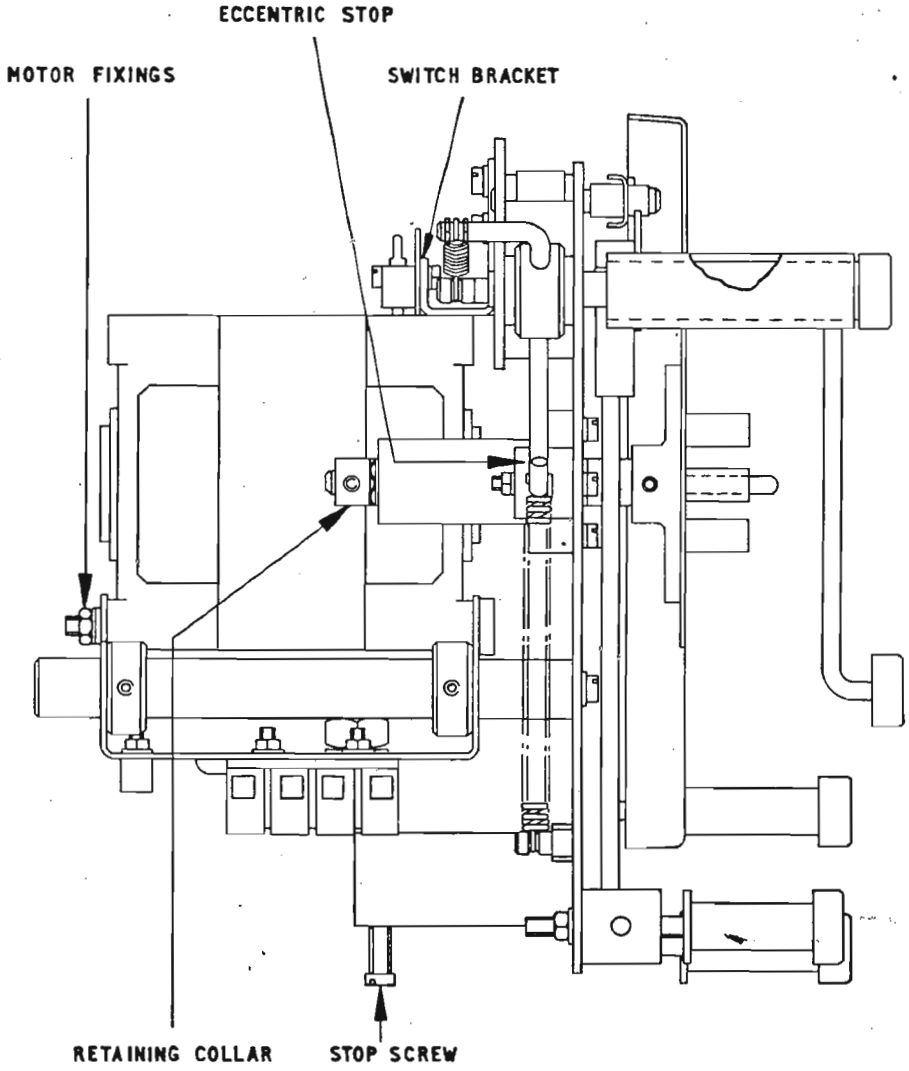


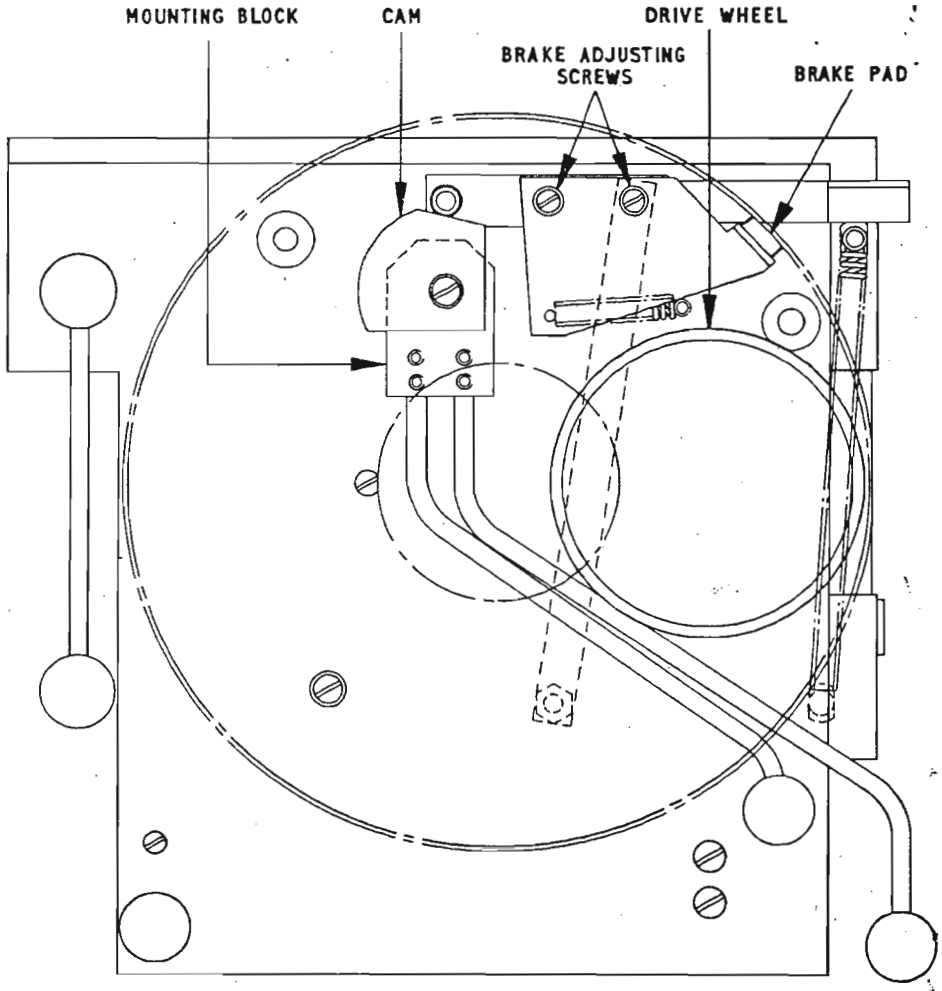
SPOOLER IN READER SUPPLY MODE



SPOOLER IN REWIND MODE

AHB-5892/1 SPOOLER TAPE PATHS. FIG.17

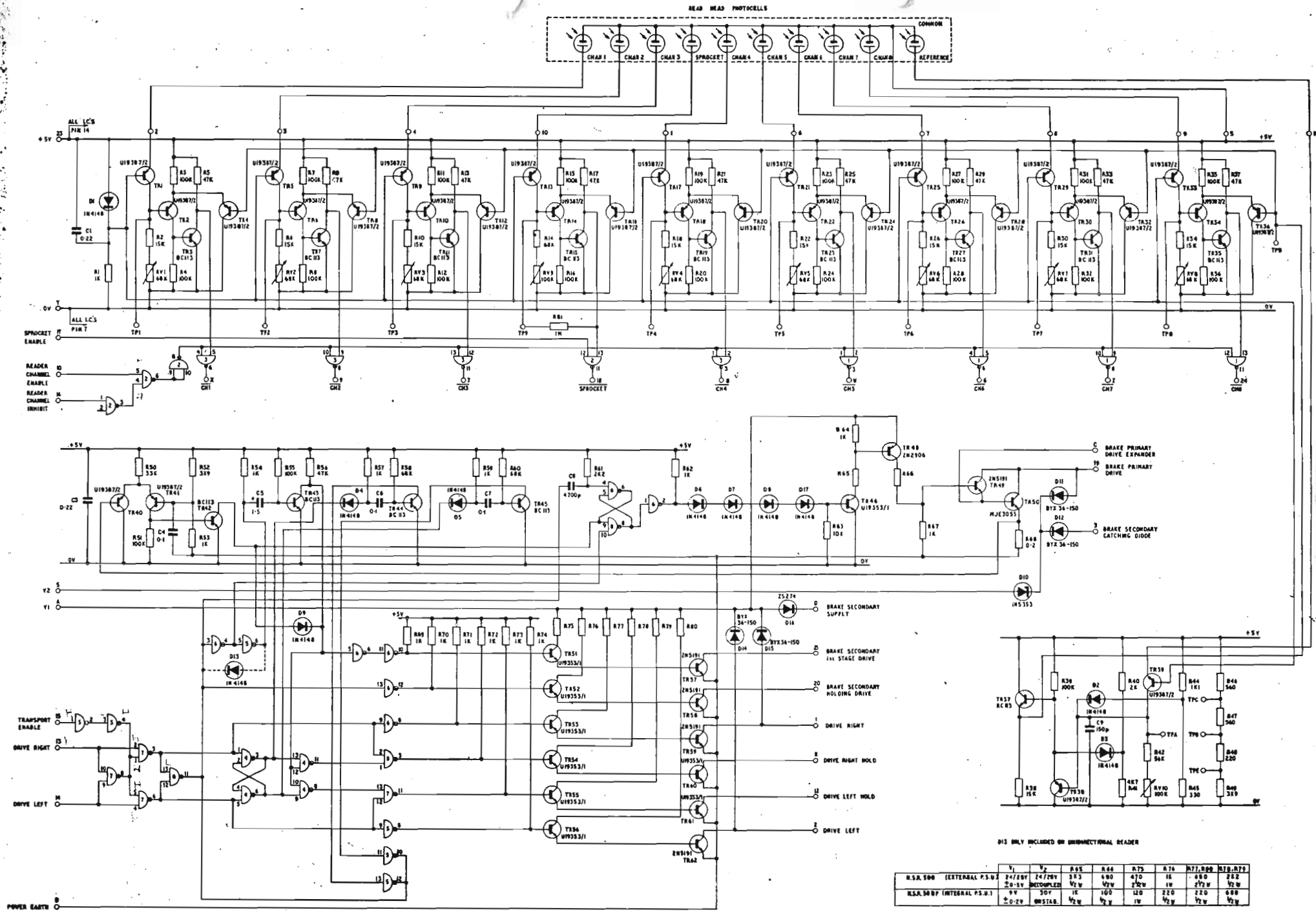




AHB-5893/1

SPOOLER UNIT

FIG.18



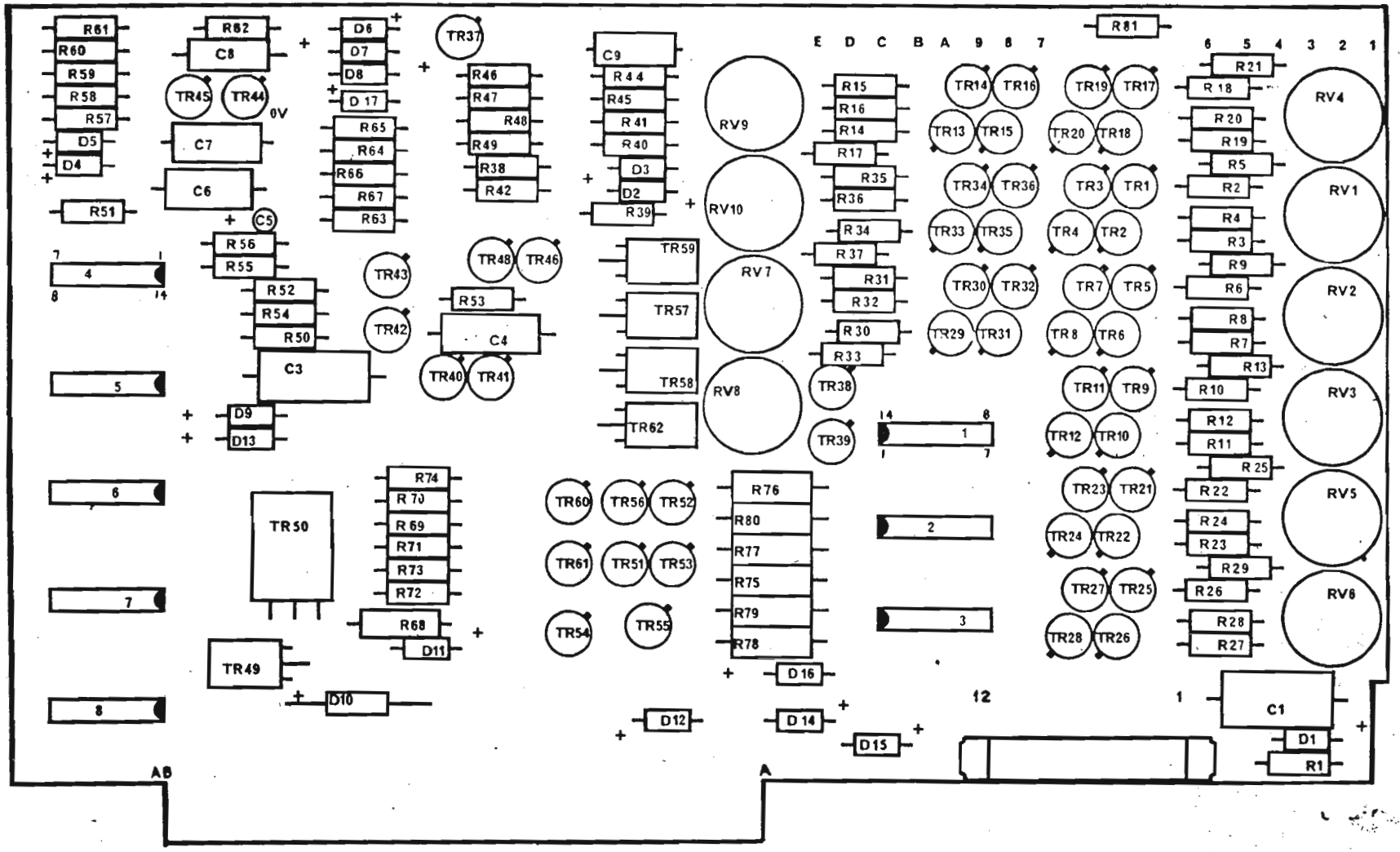
D13 ONLY INCLUDED ON BIDIRECTIONAL READER

	V_1	V_2	R65	R66	R75	R76	R77, R80	R78, R79
R.S.A. 500 (EXTERNAL P.S.U.)	24/28V	24/28V	3R3	680	470	1K	680	282
	±0-5V	DECOUPLED	½W	½W	2½W	1W	2½W	½W
R.S.A. 50 BP (INTEGRAL P.S.U.)	9V	30V	1K	100	120	220	220	680
	±0-2V	UNSTAB.	½W	½W	1W	½W	½W	½W

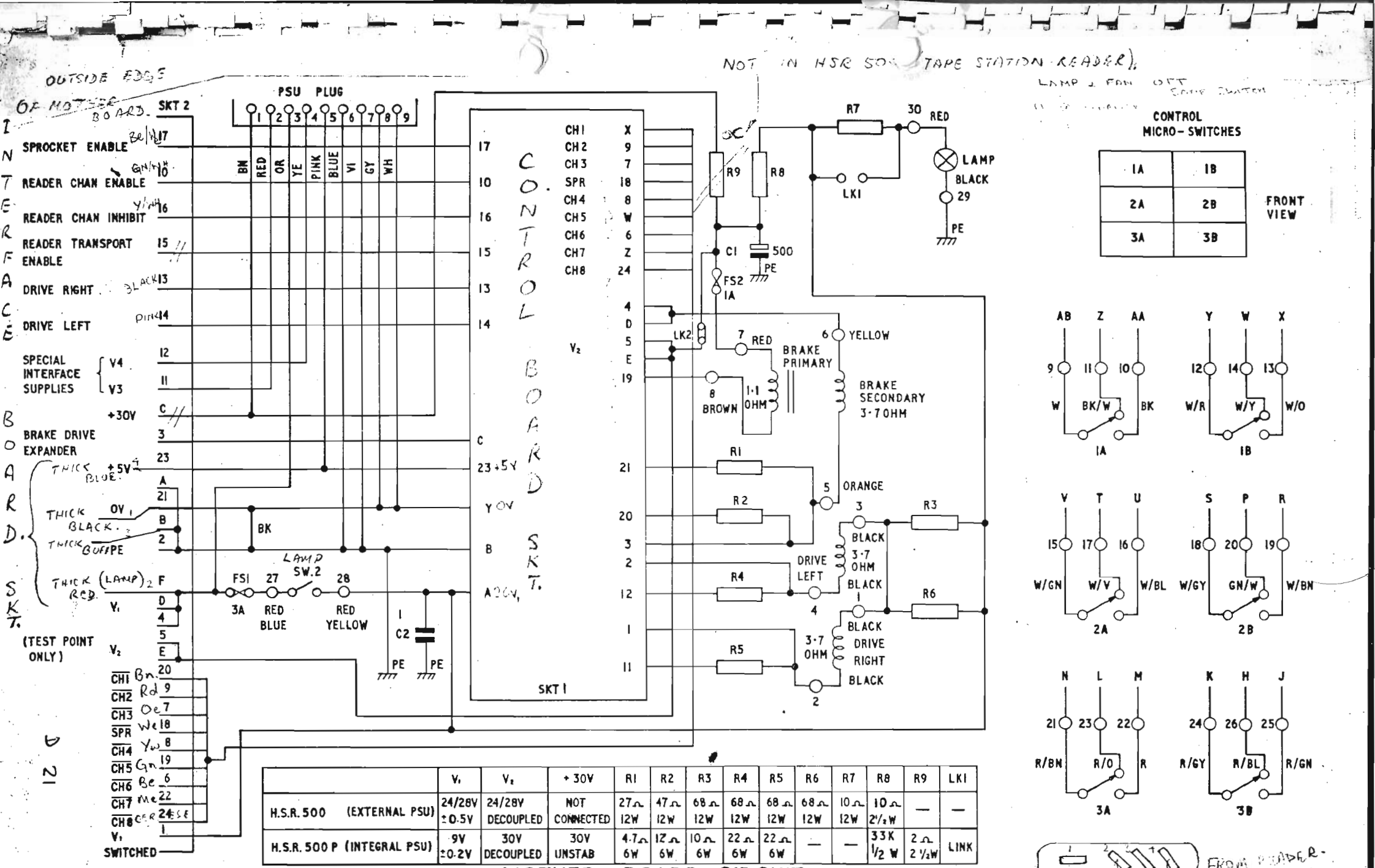
AMD-9894/1

CONTROL BOARD CIRCUIT

FIG. 19



AHB-5264/1 CONTROL BOARD COMPONENT LAYOUT · FIG 20

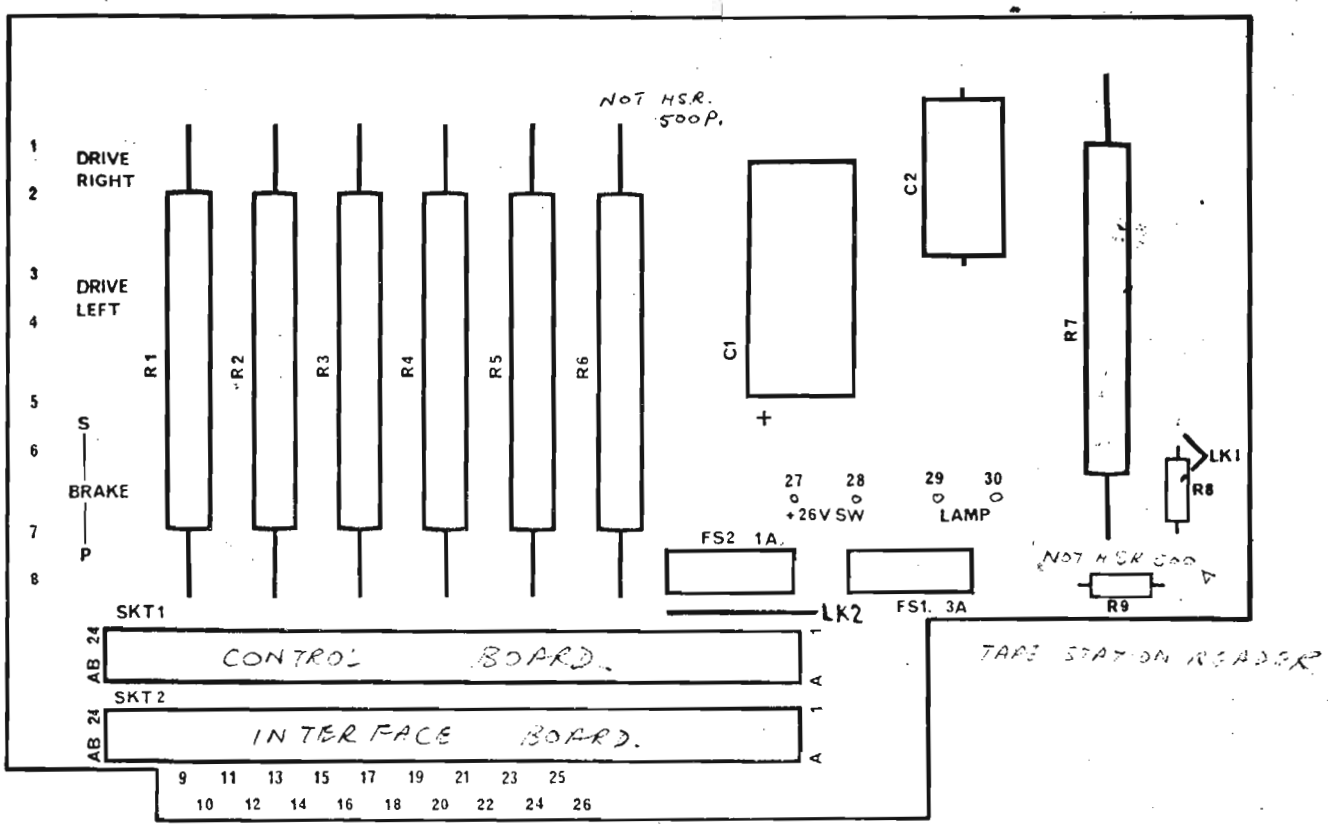


	V_1	V_2	+30V	R1	R2	R3	R4	R5	R6	R7	R8	R9	LK1
H.S.R. 500 (EXTERNAL PSU)	24/28V ±0·5V	24/28V DECOUPLED	NOT CONNECTED	27Ω 12W	47Ω 12W	68Ω 12W	68Ω 12W	68Ω 12W	68Ω 12W	10Ω 12W	10Ω 2½W	—	—
H.S.R. 500 P (INTEGRAL PSU)	9V ±0·2V	30V DECOUPLED	30V UNSTAB	4·7Ω 6W	12Ω 6W	10Ω 6W	22Ω 6W	22Ω 6W	—	—	33K ½ W	2Ω 2½W	LINK

MOTHER BOARD CIRCUIT

HB-5895/2

FIG. 21



D22.

H.S.R.500 R9 & LK1 NOT FITTED
H.S.R.500P R6, R7 NOT FITTED

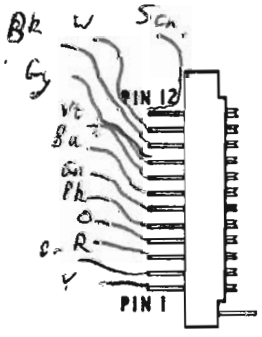
AHB-5265/2 MOTHER BOARD COMPONENT LAYOUT FIG.22

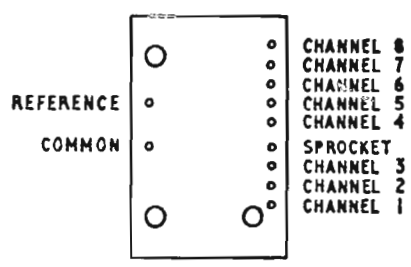
OUTPUT HIGHER THAN 130μA. ON ALL BUT SPROCKET & REFERENCE WHICH SHOULD BE GREATER THAN 50μA

CHANNEL No	PIN No	COLOUR CODE
1	2	BROWN
2	3	RED
3	4	ORANGE
4	1	YELLOW
5	6	GREEN
6	7	BLUE
7	8	VIOLET
8	9	GREY
REF	11	WHITE
SPROCKET	10	BLACK
COMMON	5	PINK

PIN 2.

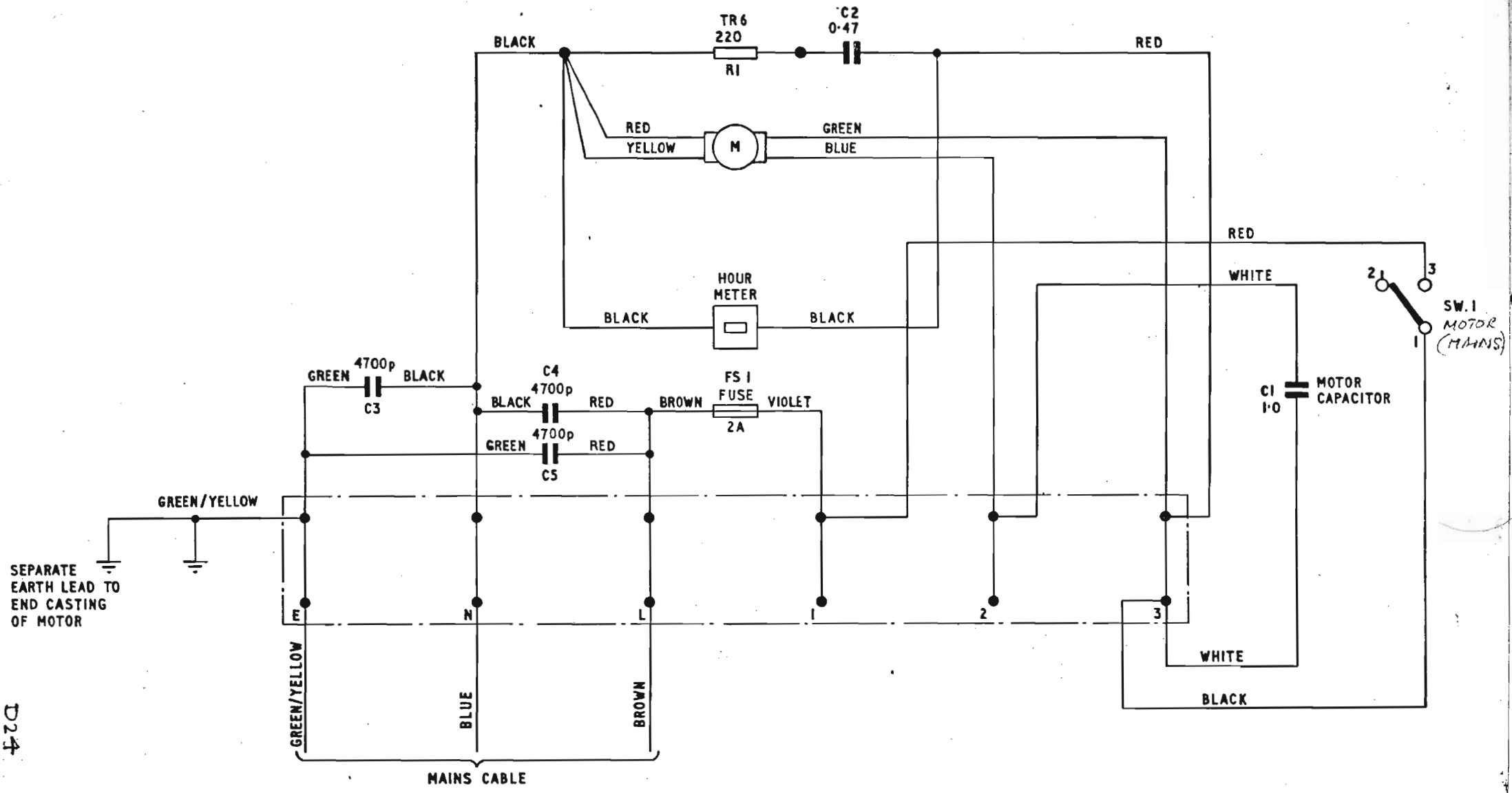
PIN 9





D23.

AHB-5896/1 READ HEAD CONNECTIONS FIG.23

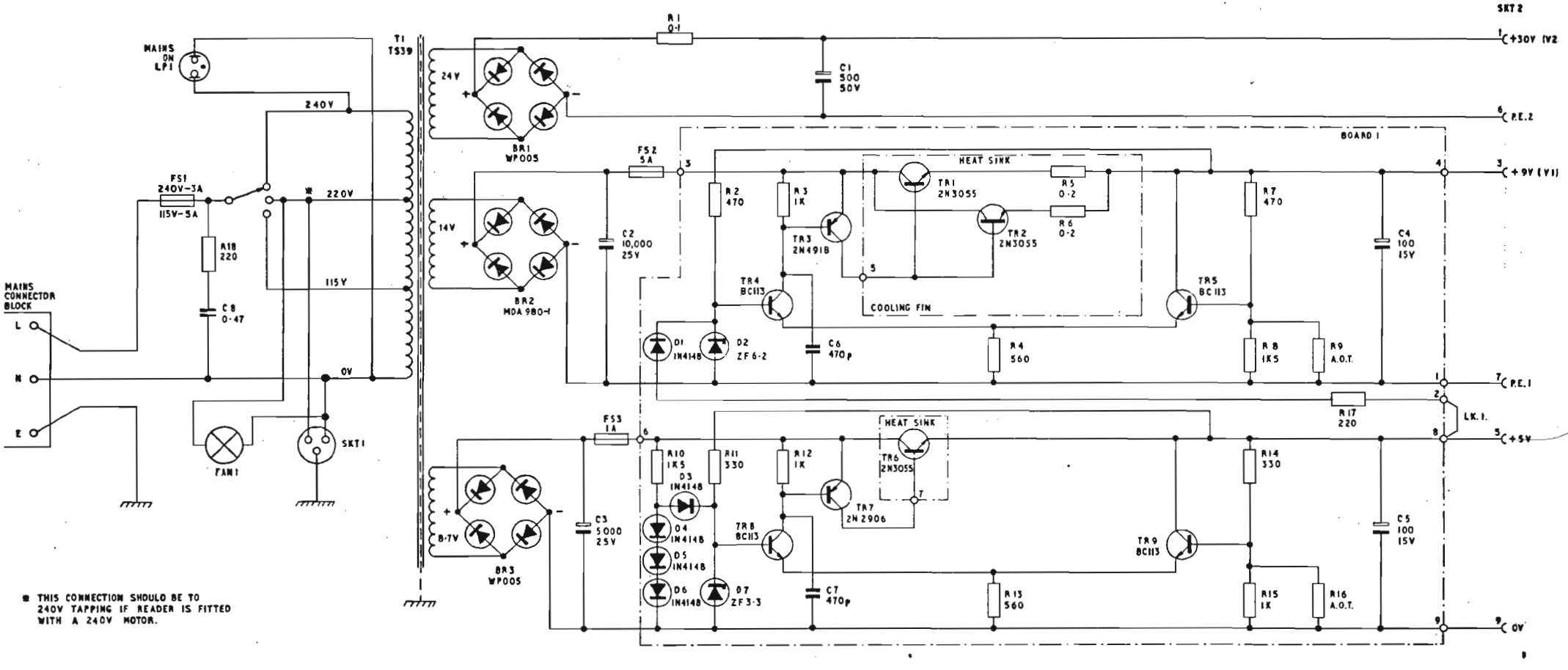


D24

AHB-5897/1

READER MAINS CONNECTIONS

FIG. 24



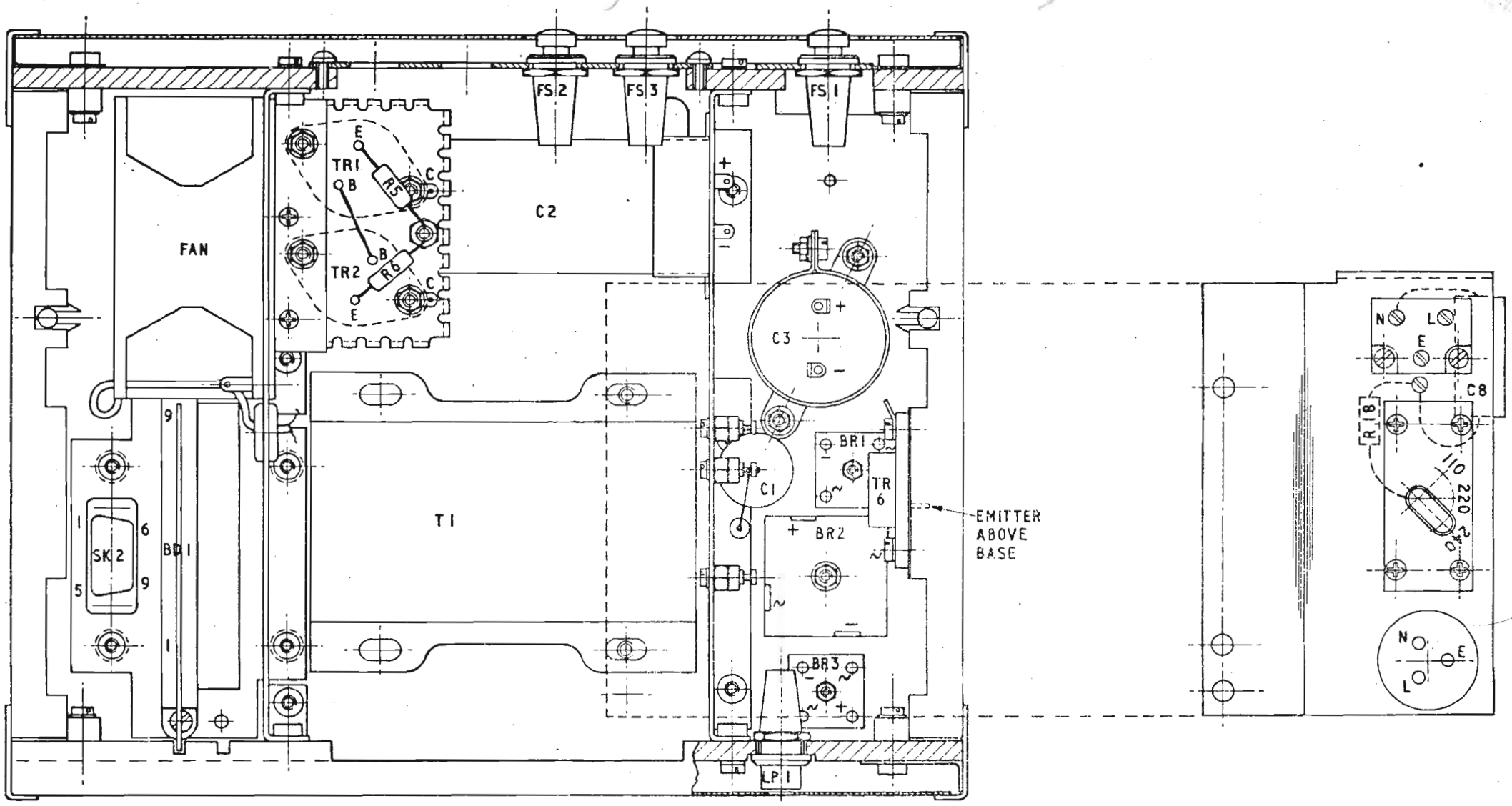
* THIS CONNECTION SHOULD BE TO 240V TAPPING IF READER IS FITTED WITH A 240V MOTOR.

AHB-5898/1

POWER UNIT CIRCUIT

FIG.25

14 SR 500P.

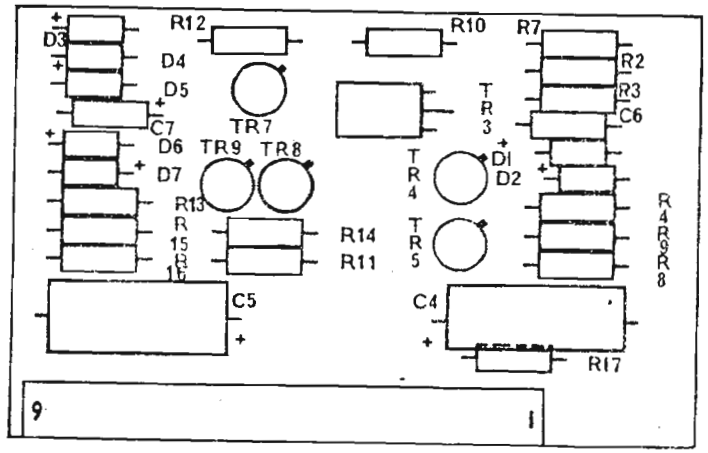


D 26

AHB-5899/1

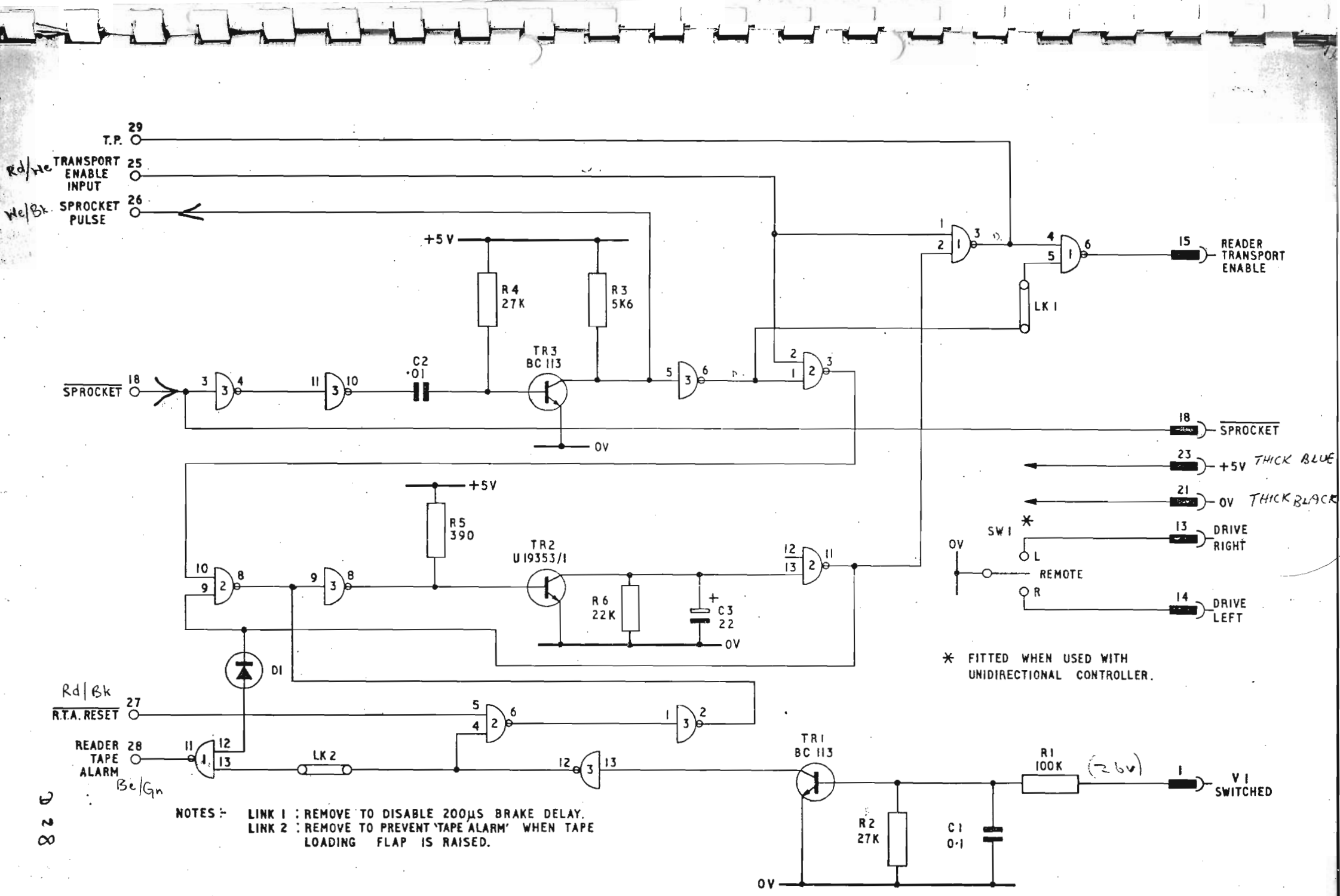
POWER UNIT LAYOUT. HSR 500 P.

FIG. 26



ON [illegible] SIDE.

AHB-5900/1 REGULATOR BOARD LAYOUT FIG. 27

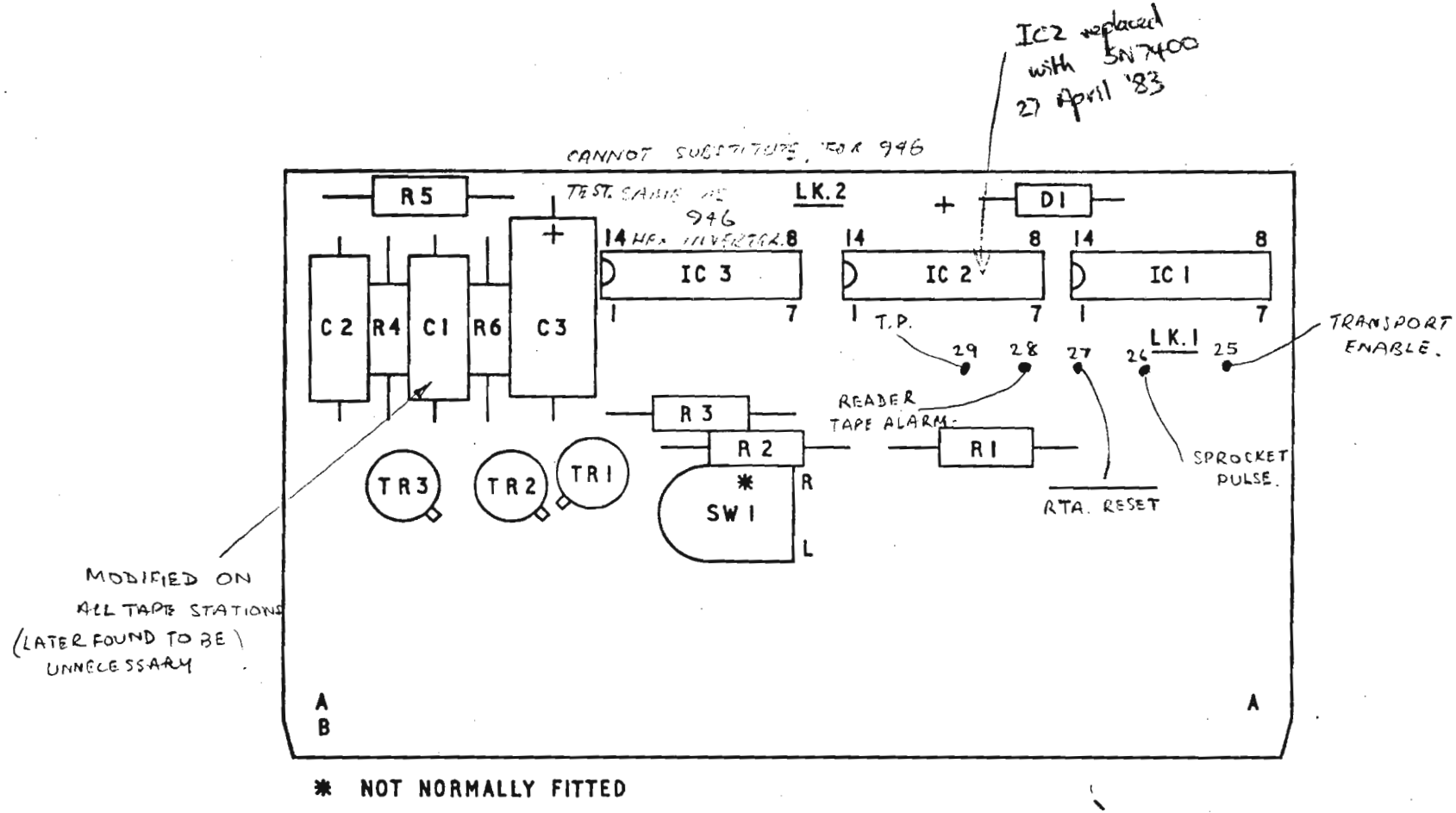


NOTES :- LINK 1 : REMOVE TO DISABLE 200µS BRAKE DELAY.
LINK 2 : REMOVE TO PREVENT 'TAPE ALARM' WHEN TAPE LOADING FLAP IS RAISED.

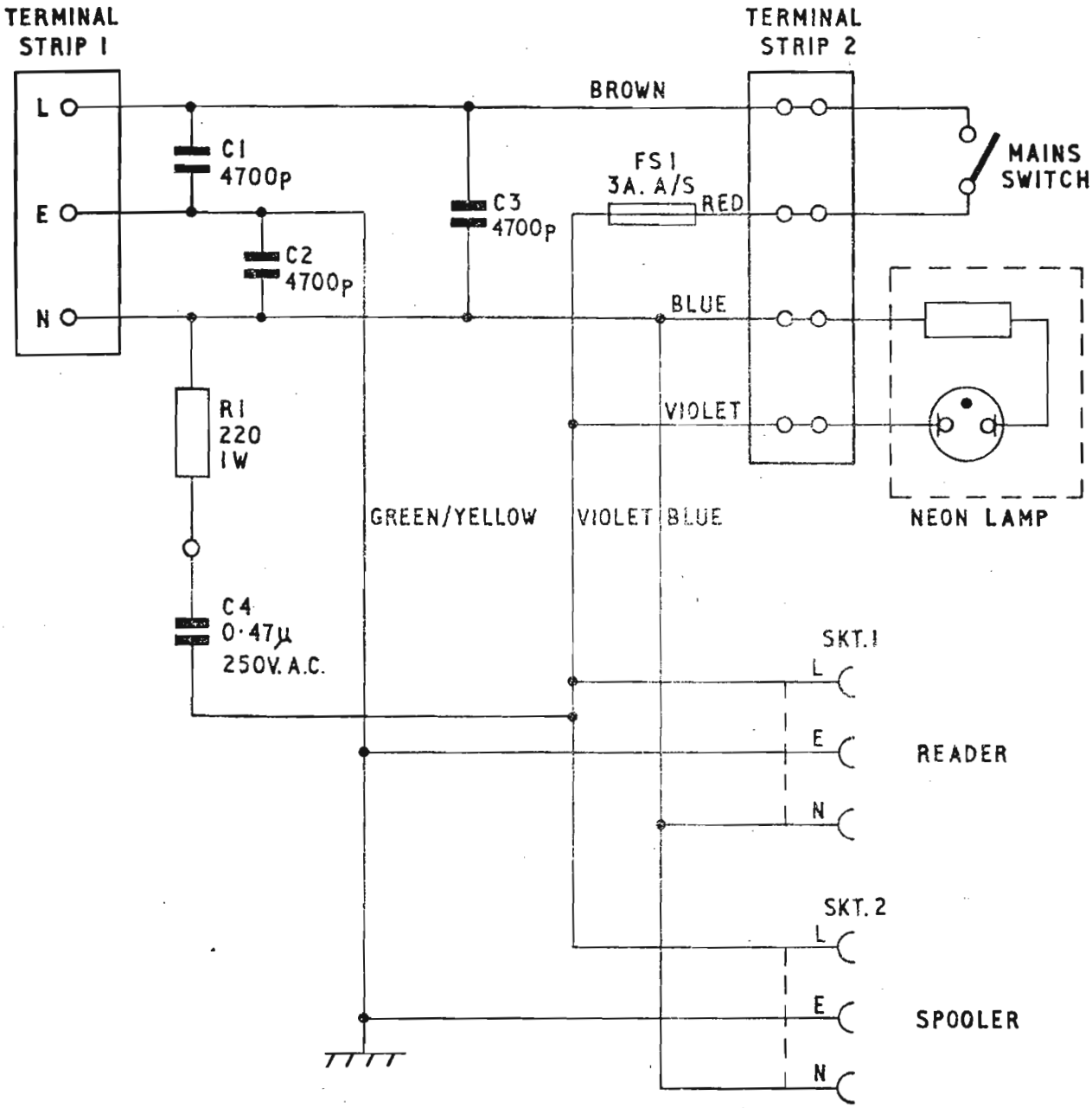
AHB-5901/1

EXTENDED INTERFACE CIRCUIT

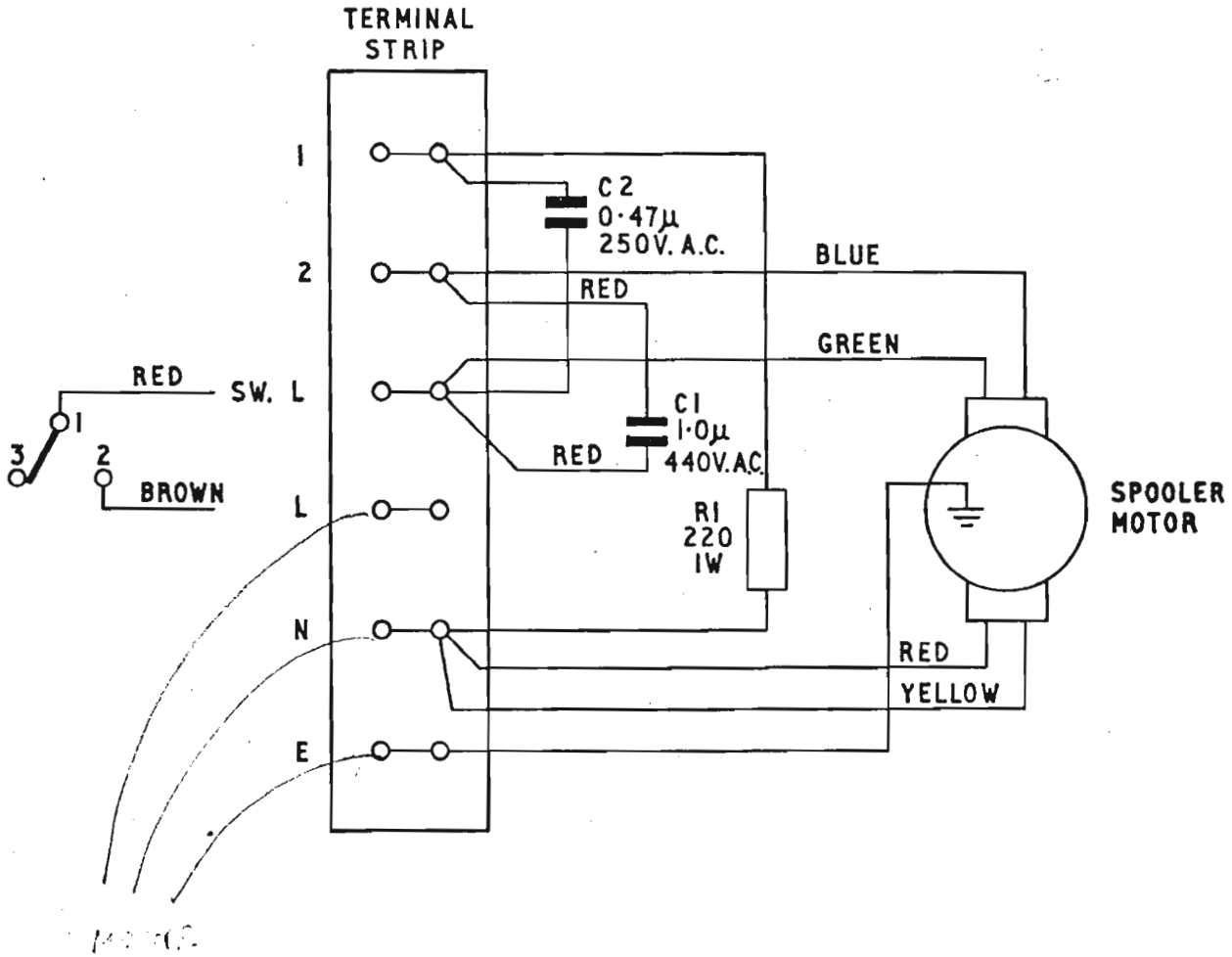
FIG. 28



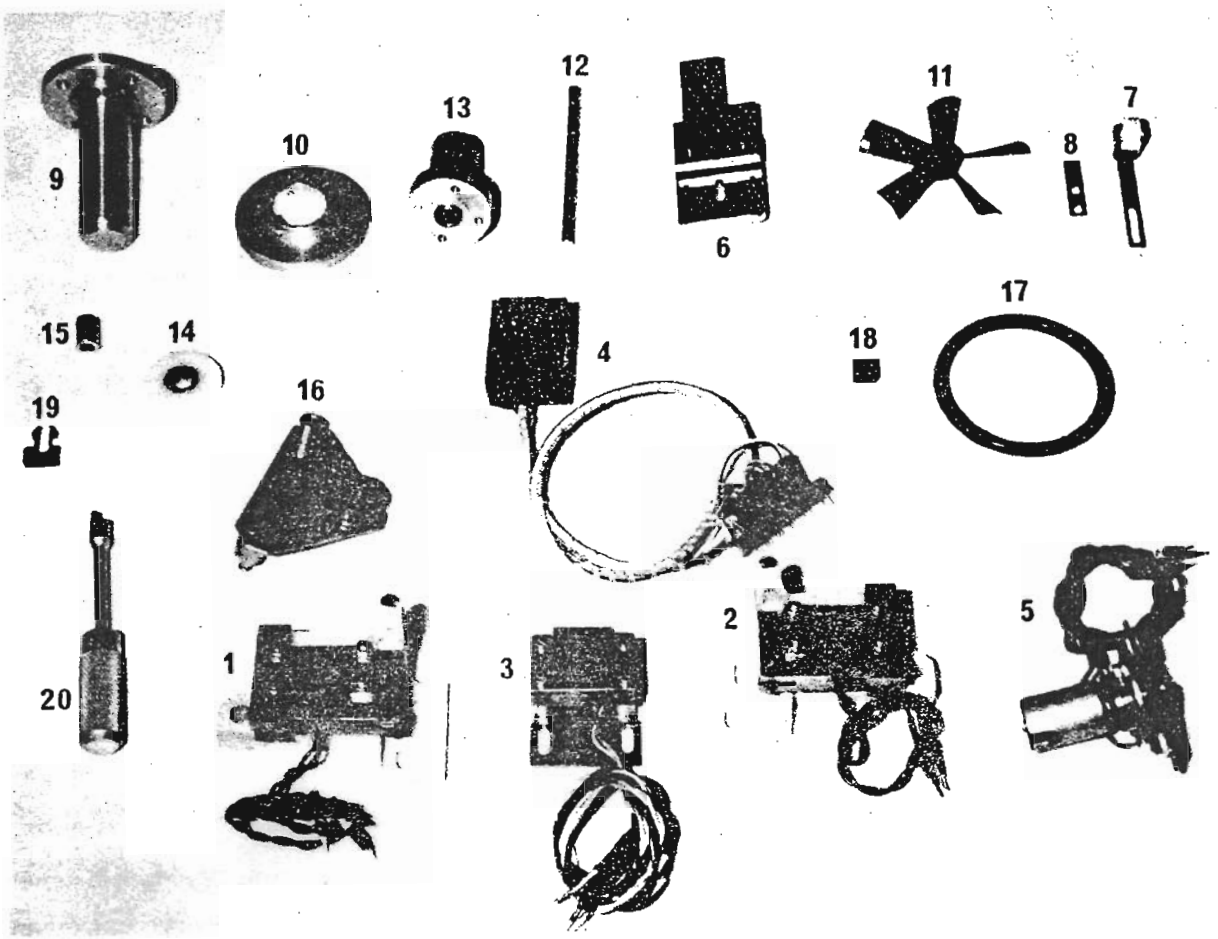
AHB-5840/1 **EXTENDED INTERFACE LAYOUT** **FIG. 29.**



AHB-5837/1 SPOOLER UNIT MAINS CONNECTIONS. FIG.30.



AHB-5838/1 SPOOLER UNIT MOTOR CIRCUIT. FIG. 31.



Key	Part	Part No.	Key	Part	Part No.
1	Solenoid Assembly - Left	4259	11	Fan	2773
2	Solenoid Assembly - Right	4260	12	Fan Spindle	2641
3	Brake Coil Assembly	2638	13	Fan Bearing Housing Assy.	2781
4	Read Head Assembly	5832	14	Jockey Pulley	4420
5	Lamp Adjuster Assembly	2763	15	Adjustable Pulley Spindle	4235
6	Brake Armature Assembly	2783	16	Pulley Plate Assembly	4418
7	Spring Detent Roller Assy.	2796	17	Spooler Rubber Drive Band) see Section	
8	Backing Spring	2629	18	Spooler Brake Pad Material) 9.7	
9	Tape Drive Roller Assembly	4422	19	Plastic Clip (retains screw locks in P.S.U.)	4788
10	Tape Drive Roller Pulley	4174	20	Special Service Tool (Solenoid Adjustment)	HR04

AMENDMENT LIST. MODEL :- H.S.R.500

ITEM No.	HANDBOOK DESIGNATION	COMPONENT OR PART No.	DESCRIPTION OF CHANGE	DATE OF CHANGE	'TREND' CHANGE NOTE No.
1	FIG. 21&22	FS2. LK1.	SK.1 & SK.2. PINS 5&E CONNECTED TO SUPPLY SIDE OF FS2	24-4-72.	1873.
			LK.1. ADDED.		
2	FIG. 21	R8	R8 TO BE 10Ω 2½W.	24-4-72	1933
3	P.L.'S.	CABLE CLAMP	CABLE CLAMP (INNER & OUTER) QTY. NOW 2OFF EACH	24-4-72	2064
4	FIG.21	R8.	R8 ADDED TO (H.S.R.500P). MODEL. 33K. ½W.	24-4-72.	2071
5	9-3-1	R82	4K7 ADDED	1-12-72	2134
6	9-3-4	D18 D19	IN4148 ADDED	1-12-72	2134
7	9-4-6	TAP CHANGER	TO READ TYPE No B1118 00 000	1-12-72	2202
8	FIG 20	R86 D18 D19	ADDED PICTORIALLY	1-12-72	2134
9	9-3-5	PNP U19387/2	TO READ BCY70	1-12-72	2165
10	9-3-5	NPN U19353/1	TO READ BC113	1-12-72	2165
11	9-3-5	NPN 2N5191	TO READ BD131	1-12-72	2165
12	FIG19	TRANSISTORS	CHANGED AS ITEMS 9.10 & 11	1-12-72	2165