

The Studio 8 from Ferrograph Professional

a professional studio tape recorder
with superb tape handling characteristics



teller
Michael Otto
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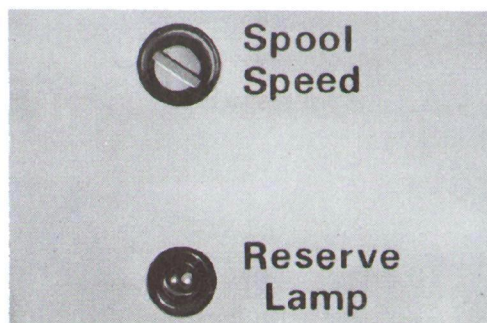
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Studio 8 tape recorders at Capital Radio,
Euston Tower, London

Outstanding features

Ferrograph have applied today's technology to producing an instrument that is extraordinarily easy and convenient to use — over its whole range of operation but especially in tape handling — and that sets new standards of versatility and reliability.

These qualities have been proved in 24 hour-a-day operation in broadcasting studios.



Even winding of tape in fast wind—electronic control of the spooling motors gives constant tape speed at controlled tension and consequent even tape winding throughout the whole reel.

Monitoring of all mechanical functions via fibre optics from a single precision long life lamp with a reserve lamp automatically switched into service when required—and indicated by the *reserve lamp* signal.

pool remains stationary whilst the tape runs otherwise as normal; this facility can be inhibited by an internal slide switch if not required.

Tape Deck Construction

The tape transport mechanism is built upon a robust aluminium casting machined to provide a single reference plane on which the three motors and the head and tape guide sub-assemblies are directly mounted.

Tape Motion Sensing

The Studio 8 recorder will pass directly from high speed winding into the run mode with absolute safety and in the minimum possible time. The LED time display uses signals derived from the tape driven counter wheel; information from this source is passed into the control logic which automatically adjusts the timing of the pinch wheel engagement so that it always occurs as the tape comes to rest—no sooner and no later. This protects the tape from excessive tensions and ensures a smooth start with freedom from tape snatch or loop formation. The machine can be tripped in and out of the record mode directly from *replay* without passing through *stop*, making it possible to record new inserts into an existing recording.

Editing Facilities

Three methods of editing are possible:

- lifters normally ease the tape away from the heads during spooling, but by pressing the *edit* button the tape remains in contact with the replay head so that a particular passage may be rapidly located.
- when the *edit* button is pressed during *run* or *stop* electrical back tension is applied to the tape and the brakes are released to allow hand operation of the spools; if the tape is withdrawn from its normal path a photo-electric sensor notes the movement and the brakes are automatically applied.
- when long sections of tape are to be edited to waste, by pressing the *edit* and *run* buttons simultaneously the take-up

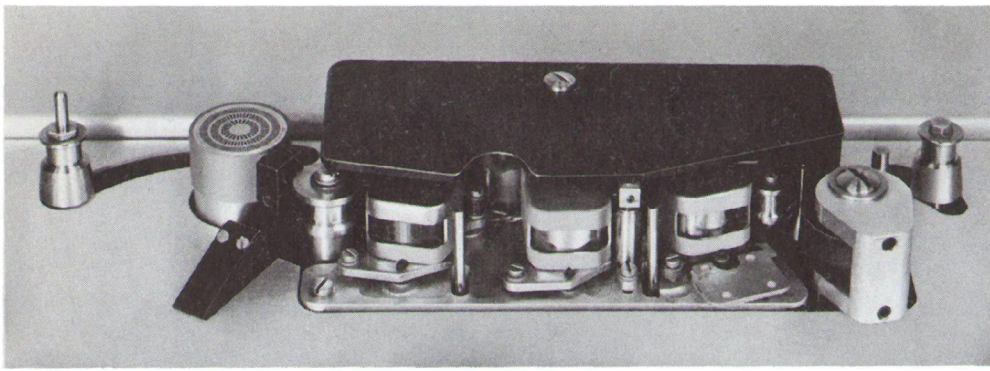
Tape Drive

The tape is driven directly by the shaft of the servo controlled capstan motor. The oven controlled servo amplifier uses a stable d.c. voltage which can be controlled externally. A Studio 8 recorder can therefore readily be synchronised with other equipment such as a film transport or videotape machine, especially so because of the exceptionally high speed of response of its servo control which is able to implement a speed change instruction of 2:1 in less than 4 seconds, both for increase or decrease in speed. Presets are provided to allow for the fine adjustment of both tape speeds that may be required for the compensation for differences in tape thickness or when the recorder is used with VTRs for an editing session.

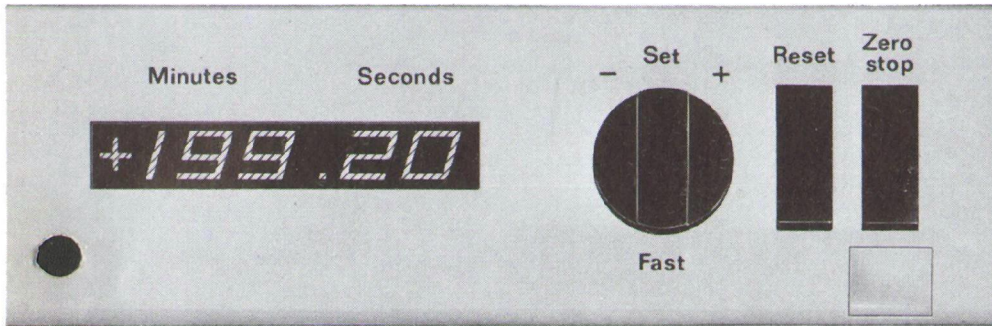
Tape Handling

Considerable effort has been devoted to producing a transport system with good tape handling qualities. Performance has been optimised for standard and long play tape and is satisfactory for double play. To minimise tape layering effects and obtain a good rewind the spooling speed is controlled throughout the reel. The tape is rapidly accelerated to and then maintained at a predetermined speed by the electronically regulated motors which can be preset over a wide range to suit different tapes and operator requirements by a control accessible from the top of the recorder. Separate adjustments set the tape tension both for the run and spooling modes. Electronic braking prevents possible tape damage by bringing the tape to a controlled stop before the mechanical parking brakes operate.

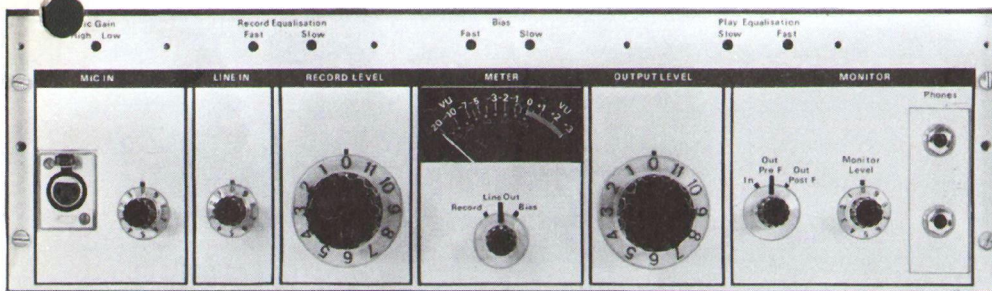
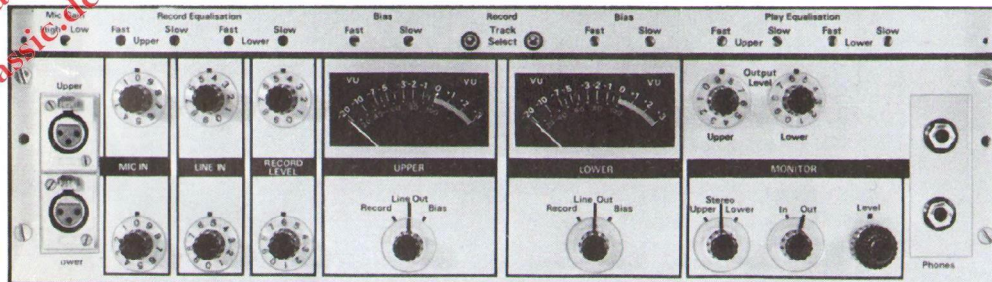
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Simple lacing and removal of tape results from straight line tape path and open face of plug-in head block.

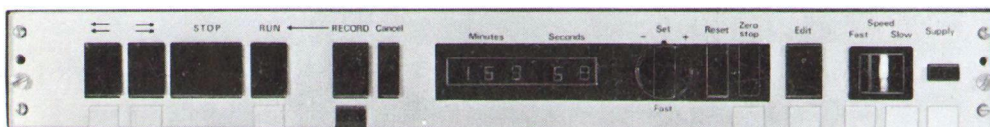


True elapsed time in minutes and seconds, for both speeds, achieved on digital tape position indicator. By using the *set* and *zero stop* facilities the counter can be programmed so that the recorder will locate any specific point on the tape.



The comprehensive input controls, metering facilities and monitoring arrangements come in a separate package that can be withdrawn as a complete assembly. Alignment is simplified by the accessibility from the front of the machine of the full range of preset controls—protected however from casual adjustment by a cover strip.

An alternative electronic assembly is available for use where signals are fed into the recorder and taken away at predetermined levels.



Light but positive action push buttons control the tape transport mechanism through solid state logic circuits giving fastest possible response, but only to valid commands. Tape motion sensing enables the Studio 8 to pass directly from one function into any other with absolute safety and in the minimum possible time.

Console, rack-mounted, trolley-mounted or transportable.

Parts needing routine servicing are immediately accessible.

Uses $\frac{1}{4}$ in tape: standard, long-play, double play.

Two speeds: $15\frac{1}{2}$ or $7\frac{1}{2}/3\frac{3}{4}$ in/s.

Servo controlled run and spooling.

Available as line in/line out, or with full metering/monitoring.

Models for stereo, twin track, full or half-track mono, on $\frac{1}{4}$ in tape.

Digital real time indicators direct reading at both speeds.

Auto-stop at counter zero can be set for any point on tape.

Provision for remote control and remote display panel.

Tape motion sensing and TTL/MOS logic gives fastest possible response to all valid commands.

Electronic interlocks give total protection against misuse.

Internal speakers, twin 10-watt amplifiers, phone outputs, optional.

Variable speed spooling.

NAB to 5 in spools.

Plug-in head block.

Record cancel facilities.

Instant start

External control of capstan speed.

Operates between vertical and horizontal.

Tape transport based on light weight alloy casting.

Specification

Tape width

$\frac{1}{4}$ in (6.3 mm)

Spool types

NAB, European or Cine, up to $10\frac{1}{2}$ in (270 mm) dia.

Tape speeds

15 and $7\frac{1}{2}$ in/s (381 and 190.5 mm/s) or $7\frac{1}{2}$ and $3\frac{3}{4}$ in/s (190.5 and 95.25 mm/s). Controlled by adjustable capstan servo. Speed stability $\pm 0.1\%$.

Wow and flutter measured to DIN 45507 and BS 4847

15 in/s (381 mm/s)

$\times 0.06\%$ (pk, weighted)

$7\frac{1}{2}$ in/s (190.5 mm/s)

$\times 0.08\%$ (pk, weighted)

$3\frac{3}{4}$ in/s (95.25 mm/s)

$\times 0.1\%$ (pk, weighted)

Start time

$\times 200$ ms to full speed (Record and Line outputs inhibited until tape is up to speed).

Rewind speed

Pre-set, constant. Maximum: greater than 1200 ft/min (6.1 m/s). Stop time from spooling < 3 s

Tape tension

Run: 0.7N (nominal). Adjustable approx. 0.5-1.0N. Spool 1.0N (nominal). Adjustable down to approx 0.5N.

Tape timer (referred to nominal tape speed)

Accuracy (Run or Spool): $\pm 0.1\% \pm 1$ digit. Maximum reading: ± 199 min 59s. Switched auto-stop at zero.

Head blocks

Interchangeable. Full track; Stereo 2.75 mm track; Two track 2 mm width.

Mic inputs

To suit 50/200 Ω balanced or 5 k Ω unbalanced sources, selected by links. Level ranges (referred to source impedance):

—77 to —33dBm (high gain setting).

—51 to —7dBm (low gain setting).

Noise, unweighted, 20kHz bandwidth: —120 dBm

Line inputs

Earth-free, balanced. Bridging impedance 10k Ω (sources $\times 600$ Ω) Level range —20 to +24 dBm, (reference 600 Ω) falling to +18dBm max. at 30Hz.

Line outputs

Earth-free, balanced. Normal setting: Nominal output impedance 75 Ω (< 600 Ω load). Maximum level +24dBm, falling to +18dBm at 30 Hz. On 600 Ω setting (selected by link) levels are 6dB lower. Line output amplifier protected against any incoming signals up to +24dBm.

Monitor facilities

Power to external speaker: 10W (8 Ω , 0.3% distortion) either channel. Total power, both channels driven: 15W above 100 Hz. Power to internal speaker(s) limited to 2.5W each. All ratings are nominal values, rms, continuous sine-wave. Phones jacks for Stereo and Mono.

Bias frequency

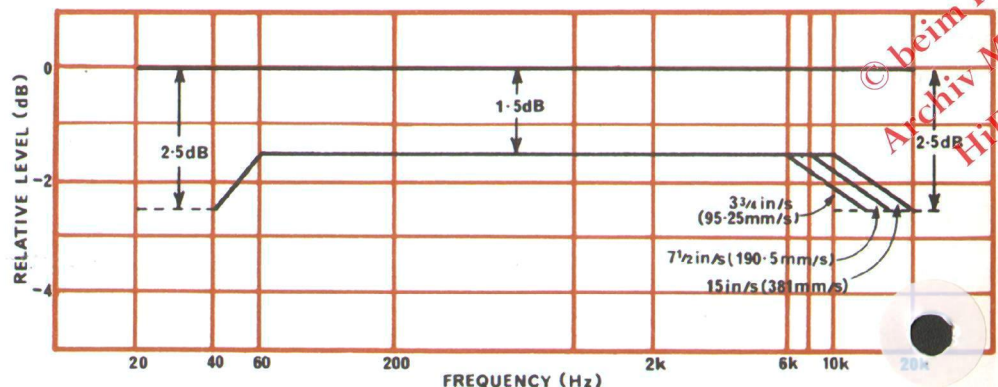
120kHz. Level sufficient for modern low-print tapes.

Erasure (120 kHz)

At least 75dB from 3% distortion levels at 1 kHz.

Frequency response

Replay and overall (record-play) limits shown on graph.



Typical amplifier distortion (excluding monitor amplifier)

$< 0.1\%$ at 1% tape distortion levels.
 $< 0.3\%$ at 3% tape distortion levels.

Equalisation

Plug-in units for NAB and IEC.

Signal/noise ratio

Dependent on tape, record level and equalisation. Performance exceeds current requirements of DIN 45511 and NAB standards. Example: using Agfa PER 525 and CCIR equalisation, flux level 514 nWb/m, weighted to DIN 45405:

15 in/s (381 mm/s) 62 dB

$7\frac{1}{2}$ in/s (190.5 mm/s) 59 dB

Stereo separation

Overall (record-play): Better than 40 dB (100 Hz-12.5 kHz 0.75 mm guard track).

Working position

Any, between horizontal and vertical.

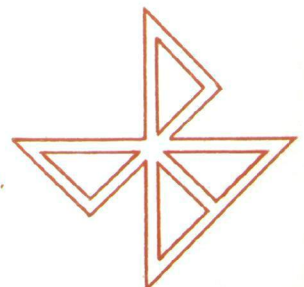
Ambient range

5 $^{\circ}$ C to 35 $^{\circ}$ C.

Power input

110-130V or 220-240V nominal. 50 or 60 Hz (2 models). Consumption approx. 320 VA.

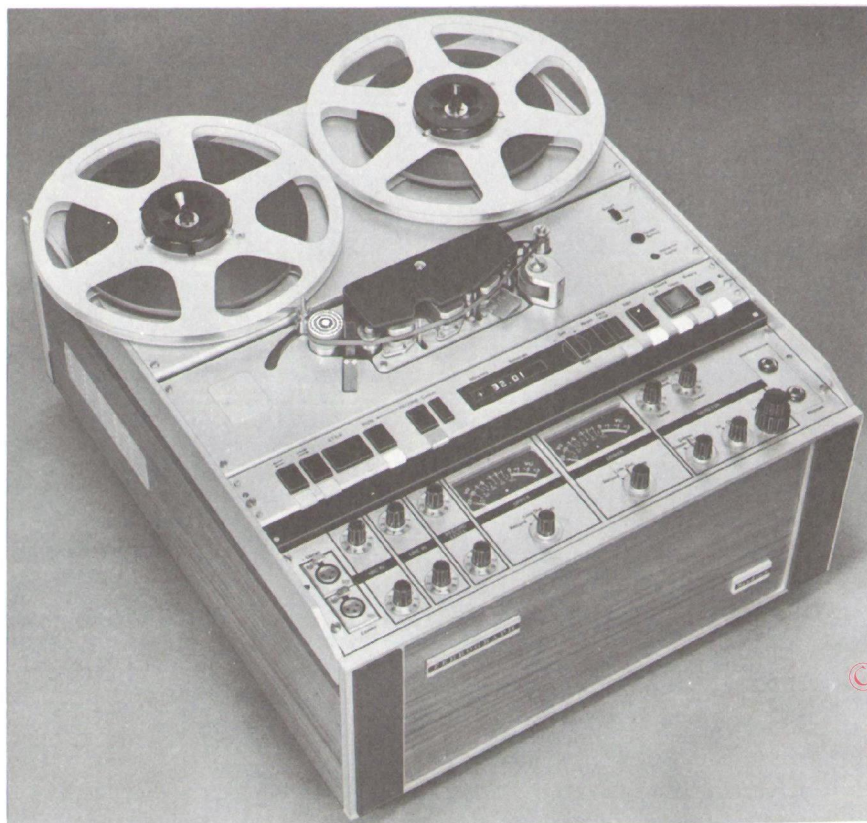
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A member of the Wilmot Breeden Group of Companies



Ferrograph Professional Recorder Company

ADVANCE
INFORMATION

Studio 8



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INTRODUCTION

The Studio 8 series of machines are the first products from a new group - Ferrograph Professional Recorder Company. Specialists recruited from other leading recording organisations joined a nucleus of experts drawn from Ferrograph, Wayne Kerr, and other companies in the Wilmot Breeden Group, to apply the latest electronic techniques to the design of an advanced audio recorder.

Design objectives were the achievement of foolproof operation, quick and flexible editing facilities, and a performance specification to meet the stringent requirements of

professional broadcasters, studio engineers and television news-room staff. These objectives have been achieved with a degree of compactness that belies the extremely comprehensive range of features provided, in many respects far exceeding those available on more costly and bulkier equipments.

Studio 8 Recorders utilise fibre optics, integrated circuits, electronic interlocking for control functions, light-emitting diodes and logic circuits. These technological innovations have been applied, in every instance, only where operational performance and long term reliability would be enhanced.

Very careful consideration, in design and construction, has been given to simplifying the maintenance procedures required. Accessibility for servicing, when needed, is exceptionally easy.

Mechanically and electrically, Studio 8 Recorders are suitable for continuous, heavy-duty use under the most arduous conditions. They will commend themselves to all engineers requiring dependable machines of outstanding performance.



Tape deck, Control Unit and Signal Electronics in portable format.

LEADING FEATURES

Uses $\frac{1}{4}$ inch tape, standard, long-play or even double-play.

Takes $10\frac{1}{2}$ inch NAB spools, and European platters up to $10\frac{1}{2}$ inches.

Also accepts cine-type domestic spools.

Two speeds, $15/7\frac{1}{2}$ or $7\frac{1}{2} / 3\frac{3}{4}$ in/s
(381/190.5 or 190.5/95.25 mm/s)

Interchangeable 3-head block.

Available in portable, trolley, console or rack mounting format.

Available as line-in/line-out or with full metering/monitoring.

Plug-in units for NAB or IEC equalisation.

Models for stereo, twin track, full or half-track mono.

Servo-controlled capstan motor.

Speed accuracy from oven-controlled reference.

Constant tape tension in Run modes.

Constant-speed adjustable spooling at constant tension.

Electrical braking with mechanical parking brake.

Tape position from LED display, covering $\pm 199\text{m}$ 59s real time.

Digital readout automatically correct at both speeds and on spooling.

Auto-stop at counter zero can be set for any point on tape.

Photo-electric tape stop.

Provision for remote control and remote display panel.

Synchronisation facility by external control of capstan reference.

Three editing modes available.

TTL/MOS logic gives fastest possible response to all valid commands.

Electronic interlocks give total protection against misuse.

The Recorder illustrated has also:

Mic and line mixing, adjustable, for each channel.

Record Level control and VU meter for each channel.

Level controls for each line output.

Monitor amplifiers with track selection and level controls.

Internal speakers, twin 10-watt amplifiers, phone outputs.

(Monitor controls and outputs are totally independent of line outputs).

Note: Facilities provided vary according to the particular model supplied.

TAPE DECK CONSTRUCTION

The tape transport mechanism is built on a robust aluminium casting machined to provide a single reference plane on to which the three motors and the head and guide sub-assemblies are directly mounted.

This arrangement ensures the high precision which is necessary for the excellent tape handling characteristics that have been achieved. In combination with careful detail design it ensures that this precision will be maintained over a long life even with hard usage.

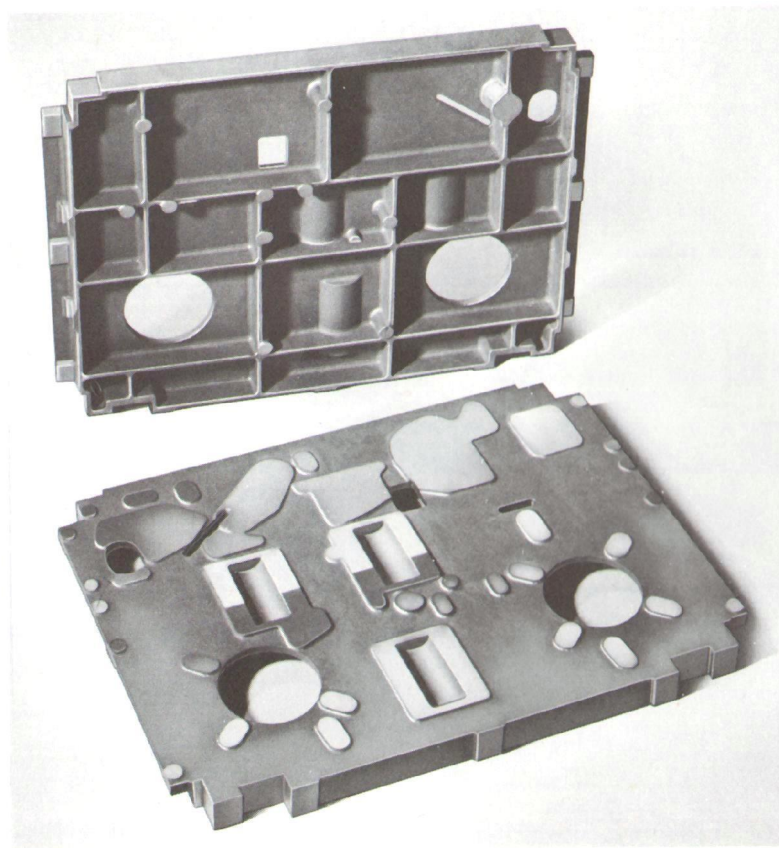
The tape deck has been so designed that all the parts on which normal maintenance operations are required lie above the deck

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casting and access to them is obtained simply by the removal of the top 'skin'. The control circuitry is carried below the deck casting.

The tape path is arranged to make lacing as simple and quick as possible and there is a photo-electric tape sensor that can stop the tape. The operating threshold can be adjusted to allow for differing levels of ambient lighting, if desired, by an external link.

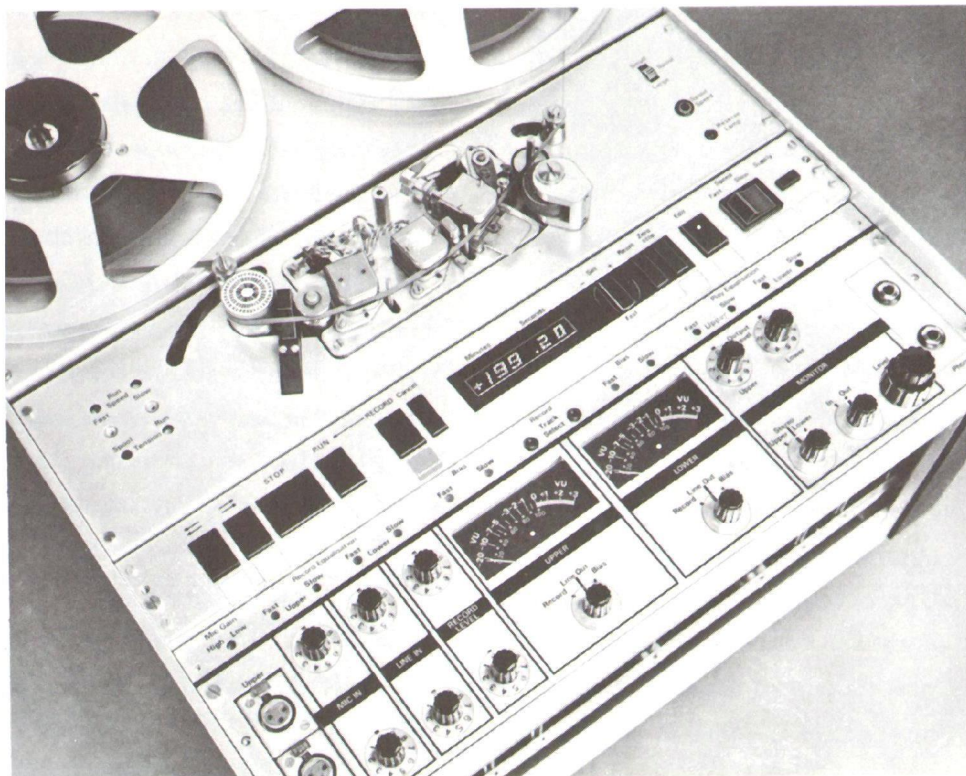
The signal electronics, in the form of plug-in boards, are assembled with the appropriate controls and metering in a unit which is itself plugged into the front of the tape transport deck. The casing of the machine does not form part of the main structure and can, therefore, be removed without further alterations if the recorder is to be fitted into a console or rack mounted.



Heavy, ribbed diecastings are machined to give reference mounting plane for motors, guides and head block.

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View with head cover removed,
also showing comprehensive range
of pre-set controls (normally covered).

TAPE DECK CONTROLS

The tape transport mechanism is controlled by a number of light action push-button switches which operate via logic circuits to give the necessary actions and achieve interlocking of the solenoids that operate the braking, tape lift and pinch wheel mechanisms. Being wholly electronic in operation the complete push-button assembly can be extended on a multi-core cable to provide control from one or more remote points.

There are separate control push-buttons for forward or reverse wind, stop, run, record and edit.

WIND/RUN

An important feature of the Studio 8 recorder is its ability to pass directly from high speed winding into the run mode with absolute safety and in the minimum possible time. The elapsed

time display uses signals from which information about the speed of the tape can be derived. Such information is passed into the control logic where it is used to ensure that timing of the pinch wheel engagement is adjusted automatically to ensure that it always occurs as the tape comes to rest; no sooner and no later. This not only provides protection against excessive tensions being accidentally applied to the tape; it also ensures a smooth start with freedom from tape snatch or loop formation. The logic circuits preclude selection of the record mode during spooling, thus giving protection against accidental erasure. This feature of absolutely safe and quick transition from wind to run can result in considerable savings of time in an extended editing session.

When stopping from fast wind, the electronics applies reverse wind bringing the tape to a stop before applying the brakes. The machine adopts automatically the sequence a skilled operator would use to prevent tape damage.

RECORD

This mode can be selected only by pushing run and record together. Recording currents may be checked if required with the tape stationary by selecting edit at the same time. Erasure of previous recordings is complete even if the tape is stopped during recording.

The machine can also be tripped in and out of the record mode directly from replay without passing through stop, an unusual facility which makes it possible to record new inserts into an existing recording. Independent output amplifiers for each record track and the erase allow separate control of track selection and level without interaction or change of bias frequency.

EDITING FACILITIES

Two methods of editing are provided for as standard and a third method can be made available by the user, if desired, by an internal link.

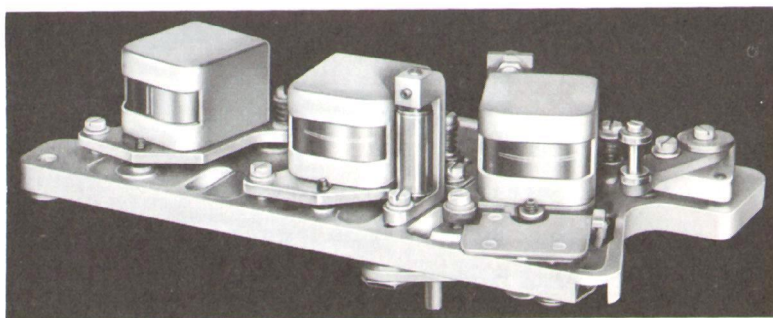
a) Rapid location of a particular passage is available by pressing the edit button during spooling. This is a non-locking function, avoiding unnecessary head wear since the tape is brought into contact with the replay head only while the edit button is held down.

b) When the edit button is pressed during run or stop, back tension is applied to the tape and the brakes are released, allowing hand operation of the spools. The machine remains locked in this mode until some other function is selected. If, during editing, the tape is withdrawn from its normal path, then a photo-electric sensor notes the movement and the brakes are automatically applied.

c) An internal switch, which can be brought into circuit by means of a link, makes available a further choice of editing. The switch can be set so that when the edit and run buttons are pressed simultaneously, the take-up spool is stationary whilst the tape runs otherwise as normal. This facility is valuable when longer sections of tape are to be edited to waste.

When the switch is set to make this method of editing available, a small LED is lit in the edit button. The alternative setting of the switch leaves only a) and b) available,

Flexibility aided by directly interchangeable head blocks.

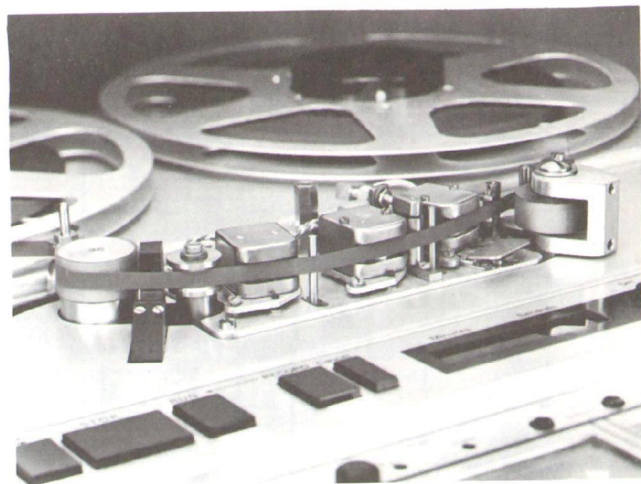


TAPE DRIVE

The tape is driven directly by the shaft of the capstan motor which is servo controlled, information about its speed being derived directly from the motor shaft. The internal reference for the servo control is a stable d.c. voltage which can be controlled externally. A Studio 8 recorder can therefore readily be synchronised with other equipment such as a film transport or videotape machine. Indeed it is particularly well adapted to work in this way because of the exceptionally high speed of response of its servo control which is able to implement a speed change instruction of 2 : 1 in about 4 seconds. An unusual feature is that the rapid change is obtained for decreased speed as well as for increased speed. The start-up time from stationary capstan to operating speed is only about 5 seconds. The time taken to reach operating speed in a normal start with a running capstan is, of course, much less than this, about one fifth of a second.

Using ancillary equipment, the speed of the tape during reproduction can also be controlled by timing information put onto the tape during recording and, by this means, a very high accuracy of programme timing can be achieved.

With the machine working from its internal reference, which is adjustable by pre-set controls, the mean speed accuracy of the capstan motor is of the order of 0.1%. The tape speed is not affected by normal changes of supply voltage or frequency. Tape tension is controlled in the run mode, the exact value being adjustable to suit various types of tape.



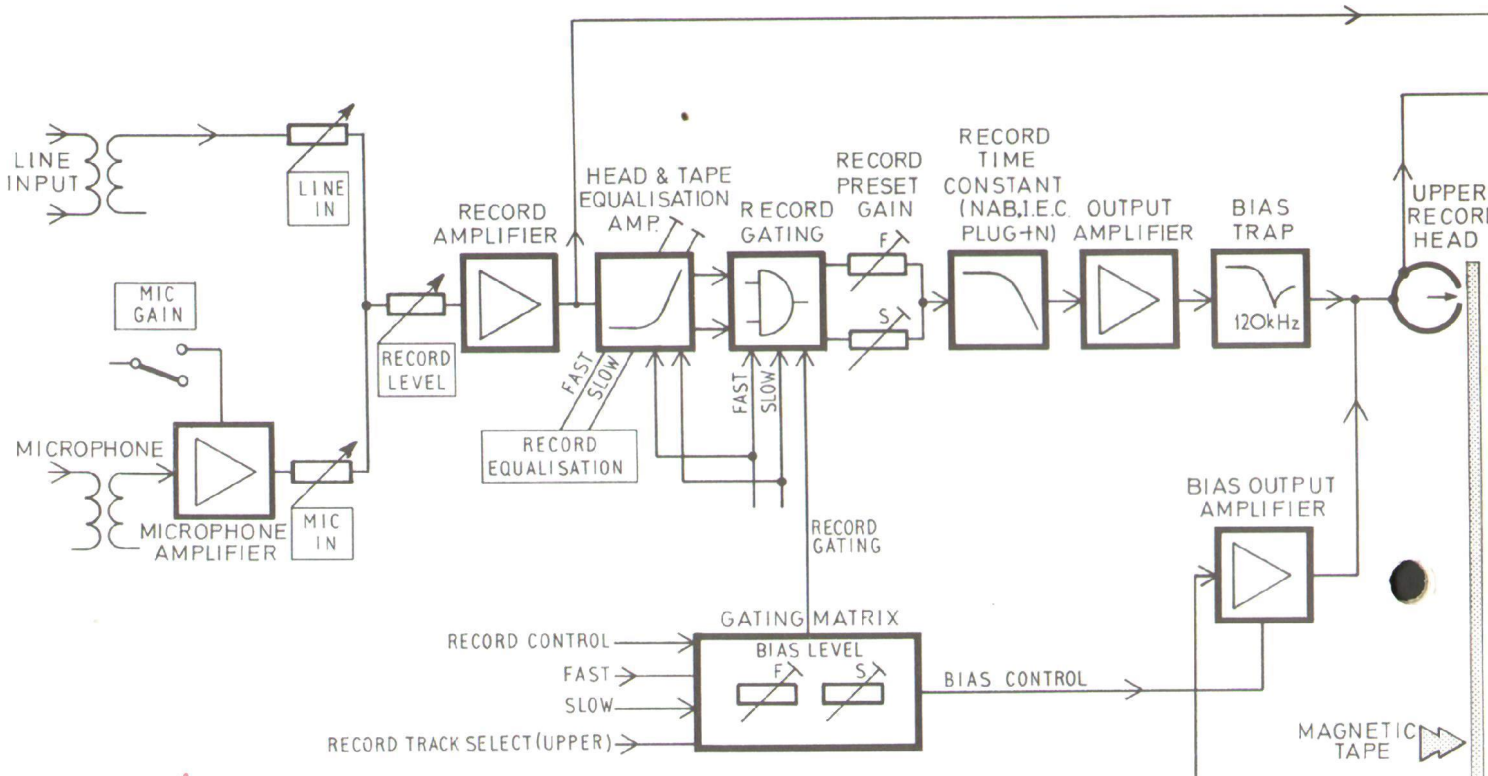
Close-up of counter wheel, photoelectric sensor and tape lift pillars.

TAPE LAYERING

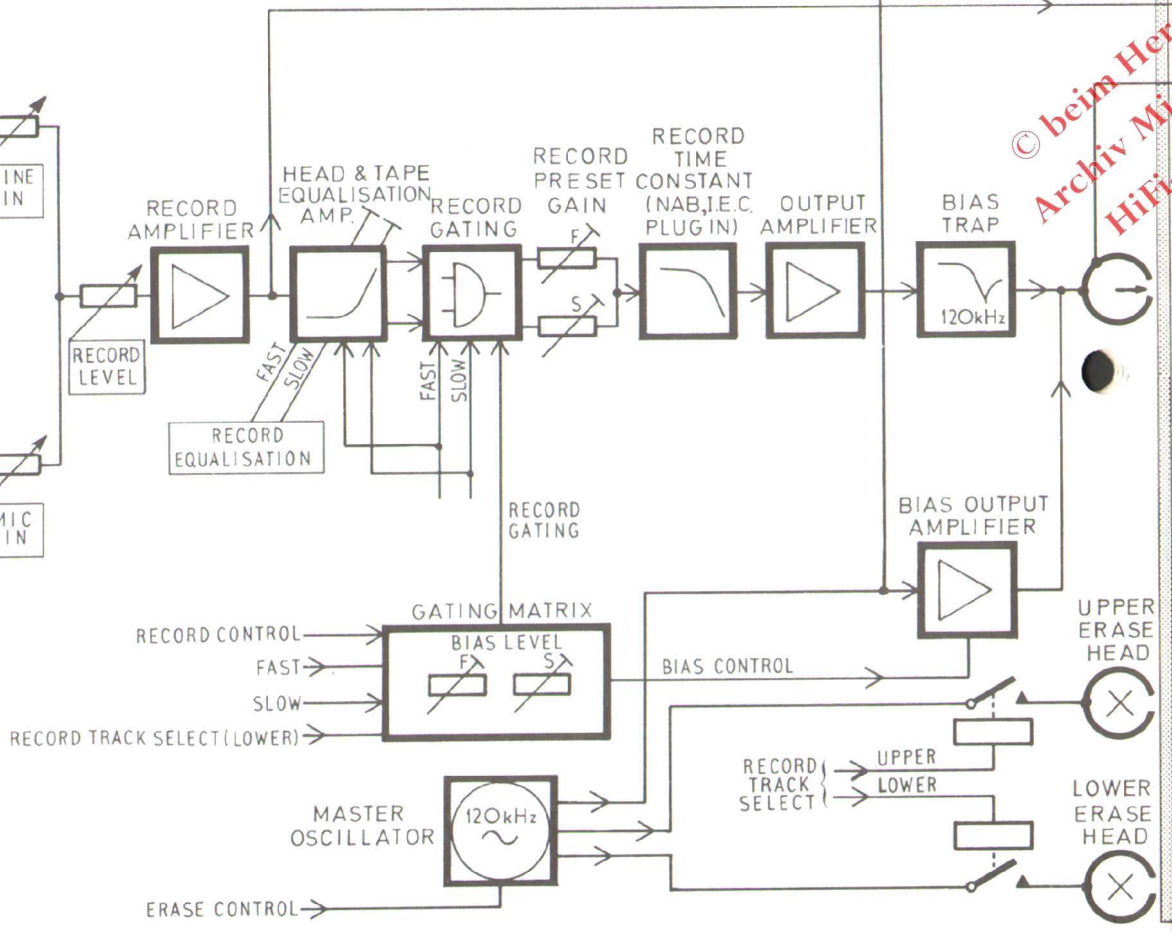
Much effort has been devoted to developing a tape transport system that will produce unusually even winding of the tape in fast wind without incurring the usual penalties of high tape tensions or slow spooling or both. Air trapped under the tape as it comes into contact with the tape already on the spool can make good layering impossible at the high winding speeds that are necessary if a sufficiently short spooling time is to be achieved.

In the Studio 8 recorder the spooling motors are powerful enough to secure a quick 'get-away' and rapid acceleration whatever the distribution of the tape between the two spools. Such a situation left unchecked, as is usually the case, soon leads to excessive tape speed and bad layering. In the Studio 8, however, the counter wheel is also used to supply information about tape speed and this information is used to control the torques of the spooling motors and thus the tape speed. Consequently, constant-speed

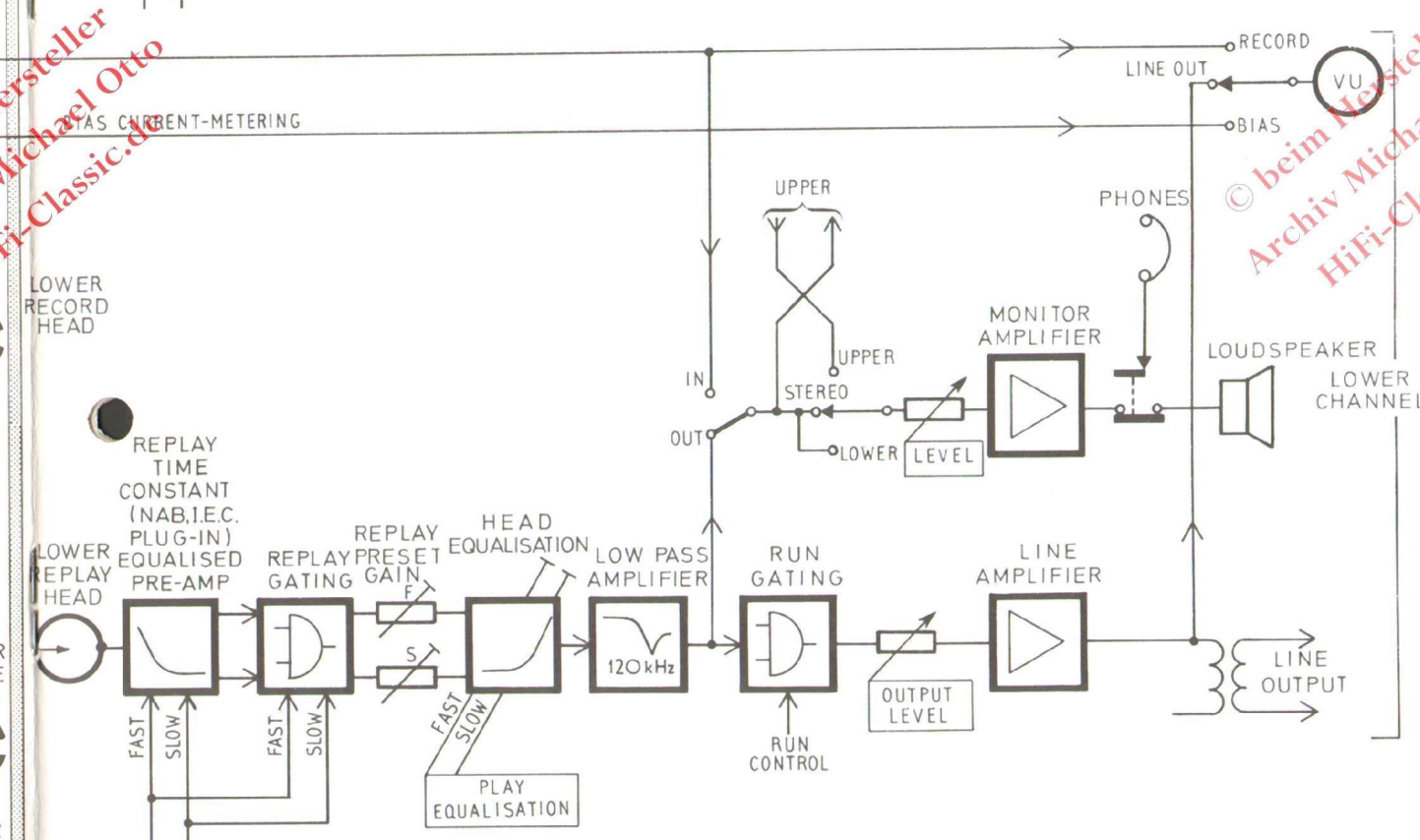
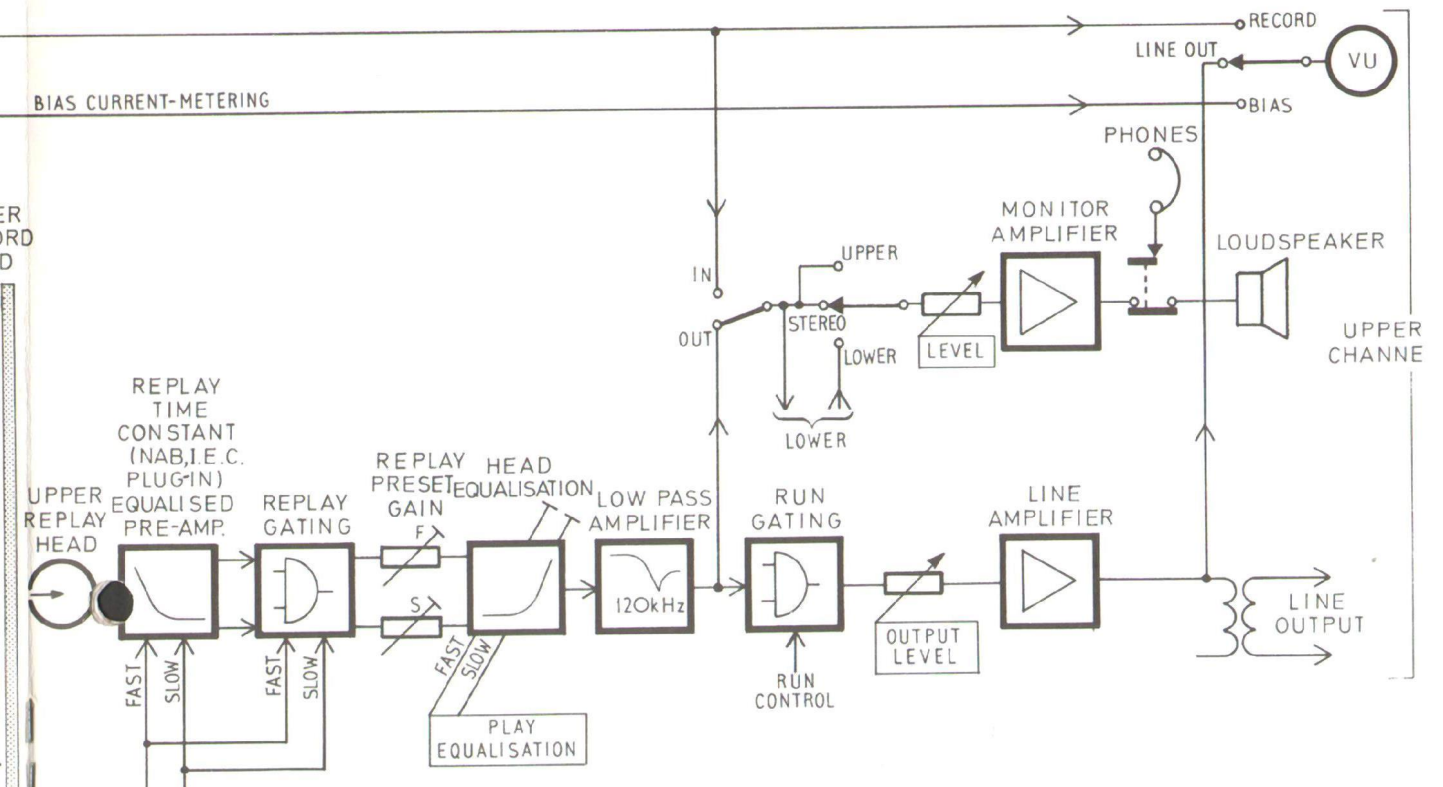
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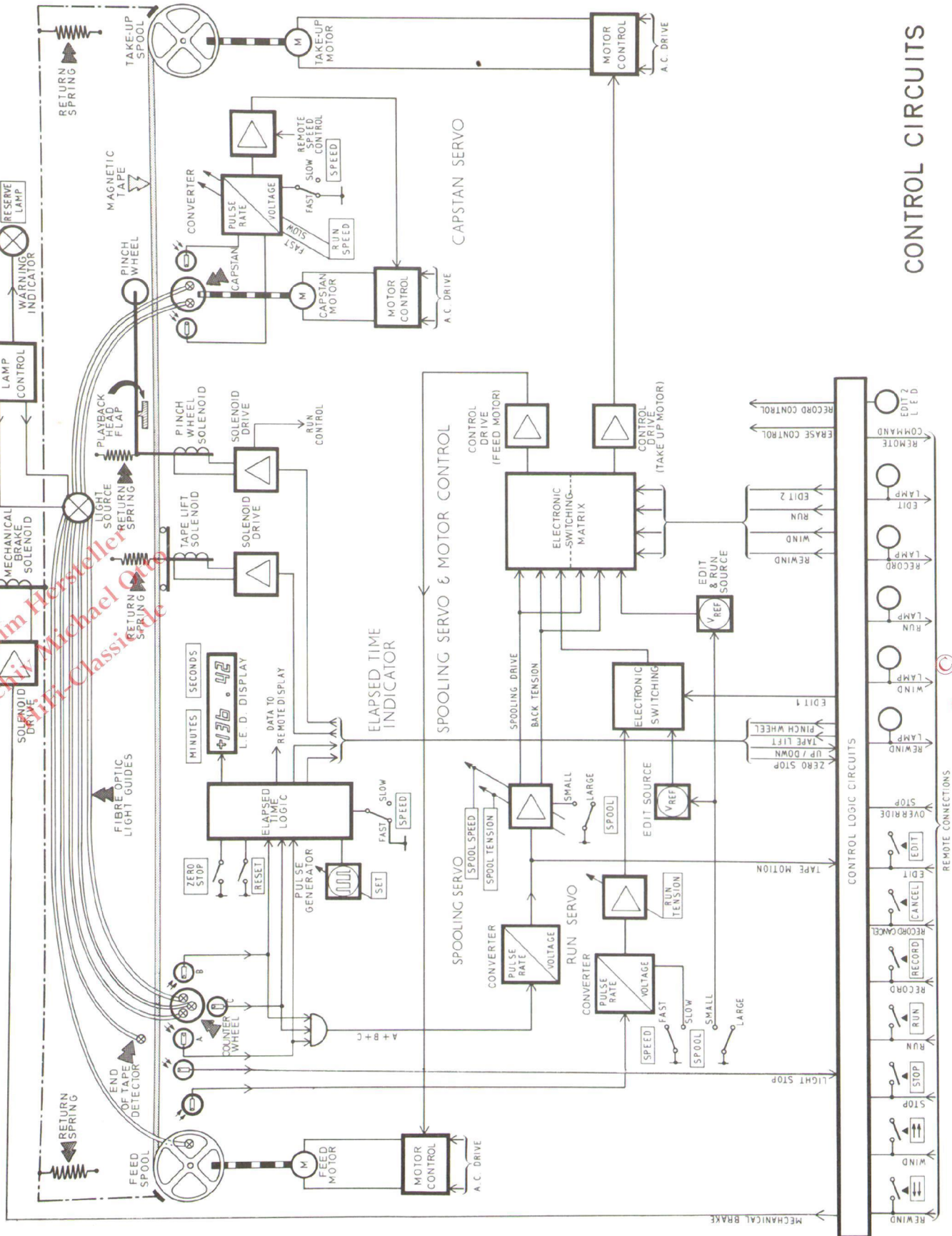


SIGNAL CIRCUITS

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CONTROL CIRCUITS

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spooling with even tape winding is achieved throughout the reel with both standard and long play tapes. Users can pre-set speed and tension to suit particular types of tape.

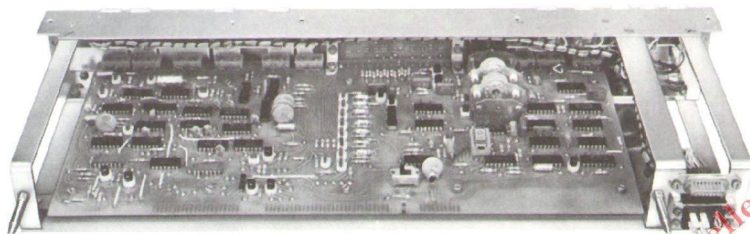
The total winding time for a 10½ inch diameter N.A.B. spool full of Standard Play tape is under 2 minutes and the machine can reverse from full speed in one direction to full speed in the other in about 8 seconds. Braking and accelerating tensions in the tape are similar and only in 'worst case' conditions transiently reach a value as high as 3 Newtons.

single operation. A second control enables the digital display to be run either forwards or backwards at discrete speeds to a desired number.

The third control is a self-cancelling 'zero stop' feature that can be switched in or out of circuit at will.

Used in association with the counter setting controls, the recorder can be switched to return to the commencement of any particular recording and stop automatically at that point, or to stop after any pre-set period of time.

Control Unit, showing integrated circuits and total accessibility for maintenance.



REMOTE OPERATION

The Studio 8 is so designed that all the normal control facilities can be made available remotely on a control unit carrying duplicates of the push-buttons on the machine itself. The remote unit, which is linked to the recorder at TTL levels, has an over-riding function for determining whether control shall be from the remote point or returned to the recorder controls. All the indicators on the recorder control unit, including the LED tape position display, have remote signals so that they too can be copied externally.

TTL-compatible signals derived from elsewhere, e.g. from a computer, can be used to control a Studio 8 recorder which, in its turn, can feed back information concerning its mode of operation, position on the tape, etc. Thus a complete control system can be established.

ELAPSED TIME DISPLAY

The electrically operated tape position indicator of the Studio 8 machine offers a number of valuable facilities that hitherto have not generally been available.

A wheel driven by the tape generates electrical signals for an up-down counter which feeds a digital L.E.D. display on the tape deck adjacent to the control push-buttons. The display shows the elapsed time in minutes and seconds up to ± 199 mins. 59s. The counter is direct-reading at either tape speed so that true elapsed time is always indicated.

Three controls for the counter are provided. One is a push-button giving re-set to zero in a

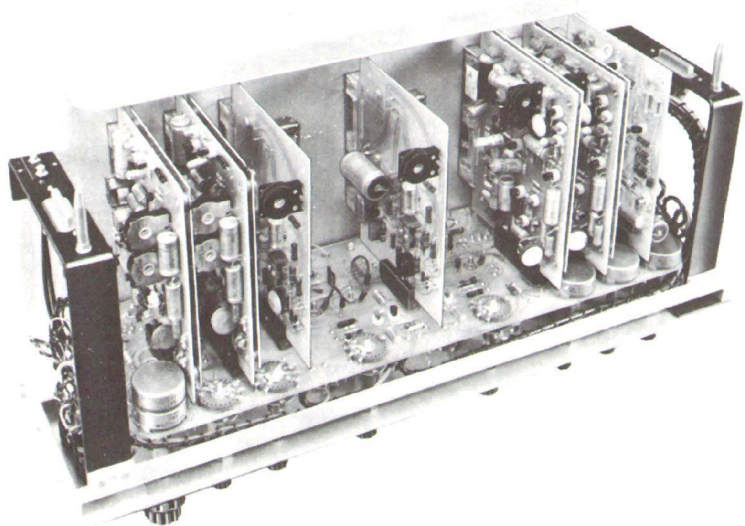
SIGNAL ELECTRONICS

The signal electronics form a separate package that can be withdrawn from the machine as a complete sub-assembly. A modular construction is used with individual printed circuit cards plugging into a printed mother board. A separate amplifier card is provided for two microphone channels (when fitted). The record amplifier and the replay amplifier cards carry plug-in networks that enable a rapid change to be made from the I.E.C./C.C.I.R. characteristics provided as standard to N.A.B. or other characteristics (to special order).

The replay amplifier has sufficient surplus gain to enable normal output level to be obtained from a tape recorded at 10dB too low a level and a generous excess of bias and erase current is provided against possible future requirements.

and taken away from it at fixed, pre-determined levels. No fader, metering or monitoring arrangements are therefore needed on the recorder which provides only simple 'line-in' and 'line-out' facilities, normally for two channels. Inputs and outputs are balanced, free from ground and designed for 600-ohm sources. The input impedance is in excess of $10k\Omega$ bridging 600 Ω lines, and the output source impedance is less than 75 Ω , from which a drive of +24dBm into 600 Ω is available.

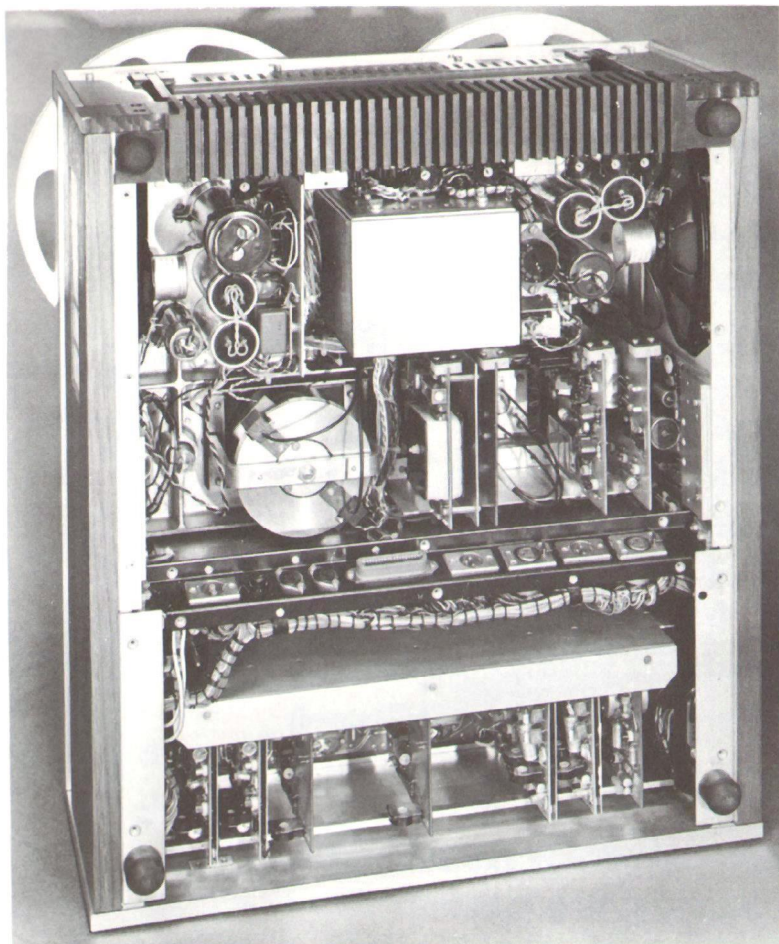
Although no operating controls are provided on this type of machine, there is a full range of pre-set controls which enable the various operating conditions to be adjusted. All these controls are immediately available on the top panel. Separate controls are provided for adjusting recording gain, bias current, replay and recording equalisation trimming (for head wear compensation), and output level. Each channel has a set of



Signal Electronics, showing plug-in circuit cards.

Initially, two electronics assemblies are available, both suitable for use in sound recording studios. The first and simplest assembly is for use in situations where the signals are processed and measured outside the tape recorder and are fed into

controls for each speed and changing the speed selector on the deck automatically makes the appropriate changes in gain, equalisation and bias.



Underside (cover removed). Note angled line of recessed connectors below capstan motor.

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A second type of electronics assembly provides all the essentials of the type mentioned above with, in addition, comprehensive input controls, metering facilities and monitoring arrangements. Microphone inputs for both channels are provided, with operating gain controls for each and two further gain controls for the line inputs. Two large VU meters are fitted, with switched circuits for reading bias, record level or output level in each channel.

The monitoring circuits operate independently of the line outputs, including separately derived power supplies. Switches select

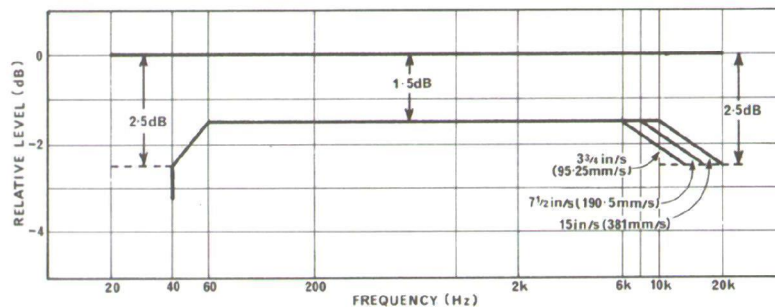
the input or output signals, and upper track, lower track or stereo. The selected signal is fed to two power amplifiers and internal speakers. When one track is selected, its signal is fed to both monitor outputs. One phones jack provides a conventional stereo output; a second jack (standard Post Office) is wired permanently for a mono output. Insertion of a plug in either position mutes the internal speakers. The monitor amplifiers have separate gain controls for each channel, governing speaker volume or phones output level.

Other electronic assemblies for special requirements can, of course, be made available when quantities justify it.

SUMMARY OF PERFORMANCE

Tape width	1/4in (6.3mm)
Spool types	NAB, European or Cine, up to 10 1/2in (270mm) dia.
Tape speeds	15 and 7 1/2in/s (381 and 190.5 mm/s) or 7 1/2 and 3 3/4 in/s (190.5 and 95.25mm/s) Controlled by adjustable capstan servo. Speed stability $\pm 0.1\%$.
Wow & flutter (DIN 45507)	15 in/s (381 mm/s) $\nless 0.06\%$ (pk, weighted) 7 1/2 in/s (190.5mm/s) $\nless 0.08\%$ (pk, weighted) 3 3/4 in/s (95.25 mm/s) $\nless 0.1\%$ (pk, weighted)
Start time	$\nless 200$ ms to full speed (Record and Line outputs inhibited until tape is up to speed).
Rewind speed	Pre-set, constant. Maximum : 1200 ft/min (6.1 m/s). Stop time from spooling < 3 s
Tape tension	Run: 0.7 N(nominal). Adjustable approx. 0.5 - 1.0N Spool: 1.0N (nominal). Adjustable down to approx. 0.5N Max. (transient) : $\nless 3$ N
Tape timer (referred to nominal tape speed)	Accuracy (Run or Spool) : $\pm 0.1\% \pm 1$ digit. Maximum reading : ± 199 min 59s. Switched auto-stop at zero.
Head blocks	Interchangeable. Full track; Stereo 2.75 mm track; Two track 2 mm width.
Mic inputs	To suit 50/200 Ω balanced or 5 k Ω unbalanced sources, selected by links. Level ranges (referred to source impedance): -78 to -33dBm (high gain setting). -52 to -7dBm (low gain setting). Noise, unweighted, 20kHz bandwidth: -120dBm

Line inputs	<p>Earth-free, balanced.</p> <p>Bridging impedance $10k\ \Omega$ (sources $\neq 600\ \Omega$)</p> <p>Level range -20 to + 24dBm, falling to + 18dBm max. at 30Hz</p>
Line outputs	<p>Earth-free, balanced.</p> <p>Normal setting: Nominal output impedance $75\ \Omega$ ($\neq 600\ \Omega$ load).</p> <p>Maximum level + 24dBm, falling to + 18dBm at 30Hz.</p> <p>On $600\ \Omega$ setting (selected by link) levels are 6dB lower.</p> <p>Line output amplifier protected against any incoming signals up to + 24dBm.</p>
Monitor facilities	<p>Power to external speaker : 10W ($8\ \Omega$, 0.3% distortion) either channel</p> <p>Total power, both channels driven : 15 W above 100Hz .</p> <p>Power to internal speaker(s) limited to 2.5 W each.</p> <p>All ratings are nominal values, rms, continuous sine-wave.</p> <p>Phones jacks for Stereo and Mono.</p>
Bias frequency	120kHz $\pm 2\%$. Level sufficient for modern low-print tapes.
Erasure (120kHz)	At least 75dB from 3% distortion levels at 1kHz.
Frequency response	Overall (record-play) within limits shown on graph.



Amplifier distortion < 0.1% at 1% tape distortion levels.
(excluding monitor < 0.3% at 3% tape distortion levels.
amplifier)

Equalisation Plug-in units for NAB and IEC.

Signal/noise ratio	Dependent on tape, record level and equalisation. Performance exceeds current requirements of DIN 45511 and NAB standards. Example : using Agfa PER 525 and CCIR equalisation, flux level 514 nWb/m, weighted to DIN 45405 : 15 in/s (381 mm/s) 62dB 7 1/2 in/s (190.5 mm/s) 59dB
Stereo separation	Overall (record-play) : Better than 40dB (100Hz -12.5kHz).
Working position	Any, between horizontal and vertical.
Ambient range	5°C to 35°C.
Power input	110-130V or 220-240V nominal. 50 or 60Hz (2 models). Consumption approx. 320 VA.
Dimensions	Portable case : 19in (482mm) wide x 22in (559mm) deep x 11in (280mm) high Overall, including 10 1/2in (270mm) spools: 21 1/4in (540mm) wide x 23 1/4 (590mm) deep.
Weight	Approx 80lb (37kg)

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