

# DIGITAL AUDIO MASTERING SYSTEM



## OPERATING MANUAL

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Mincom Division/3M

**3M**

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## DIGITAL AUDIO MASTERING SYSTEM SPECIFICATIONS

FREQUENCY RESPONSE . . . . .	When measured from 20Hz to 18kHz within $\pm 0.3$ dB 10Hz to 20kHz within +0.5, -3.0dB
SIGNAL TO NOISE . . . . .	>90dB
HARMONIC DISTORTION . . . . .	<0.03% 100Hz–20kHz at maximum input/output level (+28dBm) <0.03% 20Hz–20kHz with input/output level of +15dBm
INTERMODULATION DISTORTION . . . . .	<0.03% for any two frequencies 100Hz–20kHz at maximum input/output level (+28dBm)
ERASURE . . . . .	No measurable residual signal
PRINT THROUGH . . . . .	Not measurable
INPUT . . . . .	Maximum +28dBm Normal (12dB headroom) range—6 to 16dBm adjustable 20K Ohm impedance for balanced or unbalanced line input
OUTPUT . . . . .	May be prewired for -6 to +16dBm for normal (12dB headroom) output with 600 ohm load Floating transformer output
FLUTTER . . . . .	Not measurable
TIMING ACCURACY . . . . .	Controlled by crystal oscillator
TAPE SPEED . . . . .	45 ips with $\pm 10\%$ vernier
PLAY TIME . . . . .	>30 minutes with 12-1/2" reels wound with 7200 feet of recommended tape (45 minutes with 14" max. reel size)
REWIND AND FAST FORWARD TIME . . . . .	<2-1/2 minutes with 12-1/2" reels
SIZE . . . . .	37-1/4" x 22-5/8" x 41" (plus 4" casters)
NUMBER OF CHANNELS . . . . .	32 on one inch tape 4 on half inch tape
RECOMMENDED TAPE . . . . .	Scotch Brand #265 Digital Audio Mastering Tape



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## GENERAL DESCRIPTION

The Digital Audio Mastering System is designed to replace the analog technology systems currently used for professional audio recording. The system consists of a 32 channel machine which uses 1" wide recording tape and a 4 channel machine using 1/2" tape. Master audio tapes recorded on either of these machines have exceptional signal-to-noise ratios and frequency response characteristics. Flutter and wow are simply not measureable. For any meaningful measurements the performance of the digital mastering machines exceeds or equals that of its analog counterparts. It is truly a "next generation" system.

The digital machines accept analog inputs and convert them to digital equivalents through an analog to digital (A-D) converter. The input signal is sampled at a 50 kHz rate and produces a 16 bit "word" which corresponds to the signal amplitude present when each sample is taken. The output (sequence of 16 bit words) of the A-D converter is changed into a frame format by a record encoder. The encoder adds parity bits, a frame check word (CRC), and sync. The frame data is then converted into a "delay modulation" format for recording on tape.

When the signal is reproduced from the tape it is routed to a play decoder board. The decoder board generates a tape clock signal and uses it, in conjunction with the frame sync recovered from the tape, to load the data into storage registers. The data is then strobed out of the storage registers with a crystal controlled clock pulse (correcting any timing errors) and into an error corrector. The CRC word is used to determine if the frame is good or bad. If the frame is bad, data and parity bits are used to reconstruct (correct) it. The output of the error corrector is sent to a digital to analog (D-A) converter. The output of the converter is a recreation of the original analog input to the machine. This audio signal is transformer coupled to the channel output.

The digital machine is addressed through a control unit located at the right of the transport. The unit is removable and may be operated at any location within 30 feet of the console. It provides all indicators and control functions necessary for operation once the machine has been placed in the standby (ready) mode. (Tape threading and tensioning must be done at the transport using the controls on the transport. The control sequences are simple and logical. After a brief familiarization, their use should become automatic.

# INSTALLATION

## GENERAL

The Digital Audio Mastering System is intended for use in a professional recording studio environment. It was designed with the special problems of studios and remote locations in mind. Each recorder is 37-1/4" x 22-5/8" x 41" (plus 4" castors) making it easy to move the recorders through standard size doors.

## POWER CONNECTION

The Digital Audio Mastering System machines connect to any conventional 3 prong 120 Vac 60 Hz power outlet. The 32 channel machine requires a normal 15 ampere line capacity; the 4 channel, slightly less.

## SIGNAL CONNECTION

Audio connections are made via a twisted shielded pair. The machine interface for audio inputs is through standard female XLR connectors. (Mating male XLR connectors are required.) Outputs are through male XLR connectors. (Female XLR connectors are required for mating.) Pin 1 of both input and output connectors is chassis (shield) ground. Pins 2 and 3 are transformer connections and may be wired for balanced or single ended operation at the option of the user.

Input and output connectors are located on the back panel of the machine. They are grouped and identified per function and each connector is identified by its associated channel number.

## TAPE LOCK TRACK SELECTION

One channel must be assigned to a tape lock function which controls tape speed during playback and/or synchronous recording. The signal used for tape lock is the tape clock signal automatically generated by the play decode board during playback operation. Use of a channel for tape lock does not preclude recording a full range of audio. The only restriction placed on the tape lock channel is that it cannot be used for synchronous (punch in or overdub) recording. Any track may be assigned to this purpose. Where the user has no preference, a center tape track (7,8,9 or 23,24, 25) is recommended.

Tape lock track assignment is made by installing a jumper connection on the play decode printed circuit board of the selected channel. The points to be jumpered are located in the lower front section of the board and are easily identified visually.

## NOTE

Only one channel should be configured for tape lock operation. If the selected channel is changed, the old jumper **MUST** be removed.

Access to the play decode boards is through the front doors of the machine cabinet. The boards are installed in the third row of the card file type electronics housing. The applicable channel is easily identified by the number located at the top of the board.

## INPUT SIGNAL LEVEL SET

The input level may require adjustment upon initial setup after the digital machine is connected to a mixing console.

The input level control (the only operator associated adjustment) is usually set to match the normal level of the mixing console. There is one input level control for each channel. Access to these controls is through the front doors of the machine cabinet. The input level controls are mounted on the printed circuit boards installed in the second row (from top) of the card file type electronics housing. The potentiometer is located at the lower front edge of each board and requires a small bladed common screwdriver for adjustment. The channel affected by each of the level controls is clearly identified by the number located at the top of the printed circuit board on which the control is mounted. Level readout is by means of the LEVEL indicators on the remote control unit.

The bottom green indicator lights when the signal level into the machine is about 24dB below clipping. For each 6dB increase in signal level an additional indicator lights. The red indicator lights when clipping can occur. Normal adjustment is to increase the input level until the first YELLOW indicator lights, then back off the adjustment until the indicator goes dark (both green indicators will be lit). This gives 12dB of operating headroom. If more headroom is desired, a further reduction of the input level control will be required.

### NOTE

If input level is reduced to give greater headroom, the output level will be reduced proportionally.



# OPERATION

## GENERAL

The Digital Audio Mastering System features convenience and ease of operation. Basically, after an initial installation setup, operation consists of applying power, threading tape, and establishing a setup for the task at hand. Basic operations are presented in a series of individual procedures keyed to location diagrams which highlight the applicable controls and indicators. The procedures are simple and one or two run throughs should be sufficient to familiarize the regular user with any operation.

The system does have characteristics with which the operator should become familiar. They are listed below as operating notes.

## OPERATING NOTES

1. When power is turned on, the INPUT and PLAY status indicators will light indicating that signals applied at the input appear at the output, and that when the PLAY mode on the transport is initiated, the output signals will be tape-derived (the INPUT indicators will go out when PLAY is entered).
2. The RECORD ENABLE, RECORD SYNC (Sync Record), INPUT, and CLEAR switches are back-lighted, push on - push off, switches. Backlighting indicates the switch mode is active.
3. CAUTION: When making an initial recording (i.e. first take) ALL tracks must be recorded continuously for the full anticipated length of the take. This allows total flexibility in assignment of the TAPE LOCK TRACK. (See Installation section.)

The TAPE LOCK TRACK must be assigned prior to performing any synchronous recording (i.e. punch in ; overdub, etc.). The TAPE LOCK TRACK must *NOT* be changed after sync recordings have been made. In addition, the TAPE LOCK TRACK must *NOT* be used for any form of synchronous recording as the servo system would lose lock thus spoiling recording being made.

4. The channel assigned to the tape lock function must not be used for synchronous recording. This channel can be re-assigned after the initial (all track recording) has been made. This allows the operator to select a track where synchronous recording will not be required. (See TAPE LOCK

TRACK SELECTION in the INSTALLATION section.) A tape lock channel recording must be made during initial recording. Normal playback operation requires the presence of a tape lock signal.

5. The RECORD SYNC and INPUT switches should be deactivated (dark) after channel assignments have been completed. This action frees the keyboard for locate operations and prevents accidental change in channel assignments.
6. When doing synchronous recording (punch in - overdub) the machine should be put into record from play by pressing the RECORD switch (the RECORD ENABLE switch must have been previously activated). It should be taken out of record by pressing the PLAY switch. This method provides the minimum mode transition time.
7. The LOCATE TIME switch must be active (lit) and the RECORD SYNC and INPUT switches inactive (dark) to enable the time inputs from the basic keyboard.

## CONTROLS AND INDICATORS

All normal operating controls and indicators are located on a remote control unit or on the transport deck. The machine can be completely controlled from the remote control unit with the single exception of the tape threading sequence. An illustration is provided which shows all operating controls and indicators. Locator numbers are assigned to each and a brief description given. The applicable locator numbers are repeated at appropriate points in the individual operating procedures as a convenience and a cross reference.

## REMOTE CONTROL UNIT: CONTROLS AND INDICATORS

- ① **REC.** Lit indicator shows armed track is being recorded.
- ② **SYNC.** Lit indicator shows record is armed on indicated track.
- ③ **INPUT.** Lit indicator shows the input signal is appearing at the output. (Signal is processed but the tape is bypassed.)
- ④ **PLAY.** Lit indicator shows the output signal is tape derived.
- ⑤ **LEVEL.** Each track has an associated set of five input signal level indicators arranged in a vertical row. The lowest two indicators are green, the third and fourth are yellow, and the fifth is red. Green indicates normal operating level, yellow indicates caution, and red indicates the signal is too high and clipping is occurring.
- ⑥ **TAPE TIME DISPLAY.** Four digit display reads out tape time from an arbitrary preset zero reference. Readout is in minutes and seconds.
- ⑦ **LOWER DISPLAY.** Four digit, three function display:
  - a. When LOCATE TIME switch is lit, display reads time (in minutes and seconds) to which tape will drive if locate function is activated.
  - b. When TAKE TIME switch is lit, display reads the difference (in minutes and seconds) between current tape time and the locate time to which the tape would home in locate operation.
  - c. When the SPEED switch is lit, the display reads out tape speed in inches per second.

⑧ **RESET.** Sets tape time display to 00:00 which automatically establishes tape time zero reference.

⑨ **RESET.** Sets locate time display to 00:00. Not effective unless the LOCATE TIME switch is lit.

⑩ ↓ Tape Time Display Shift.

Shifts tape time display into locate time display.

⑪ ↑ Locate Time Display Shift.

Shifts locate time display into tape time display. This automatically resets the tape time zero reference. Not effective unless the LOCATE TIME switch is lit.

## DISPLAY Control Group

⑫ **TAKE TIME.** Interlocked with LOCATE TIME and SPEED switches. Active when lit. Causes lower display to read out the difference between current tape time and the locate time to which the tape will drive in locate operation.

⑬ **LOCATE TIME.** Interlocked with TAKE TIME and SPEED switches. Active when lit. Causes display to indicate

locate time, enables associated



shift and locate time

RESET switches, and enables basic keyboard functions (time entry, memory store and recall). The keyboard is over-ridden for locate functions if the RECORD SYNC or INPUT switches are active (lit).

⑭ **SPEED.** Interlocked with TAKE TIME and LOCATE TIME switches. Active when lit. Causes locate time display to readout tape speed in inches-per-second.

## SPEED (Tape) Control Group

⑮ **VAR SPEED.** Active when lit. Push on push off switch, enables the UP and DOWN control switches. These switches permit the tape speed to be varied  $\pm 10\%$  from 45 ips. The tape will return to 45 ips when the VAR SPEED switch is deactivated.

⑯ **DOWN.** Effective only when the VAR SPEED switch is lit. Pressing DOWN (switch lights) causes the tape speed to smoothly decrease until the switch is released or a 10% decrease occurs. The speed will remain as set until changed using the UP or DOWN controls or until the VAR SPEED switch is deactivated.

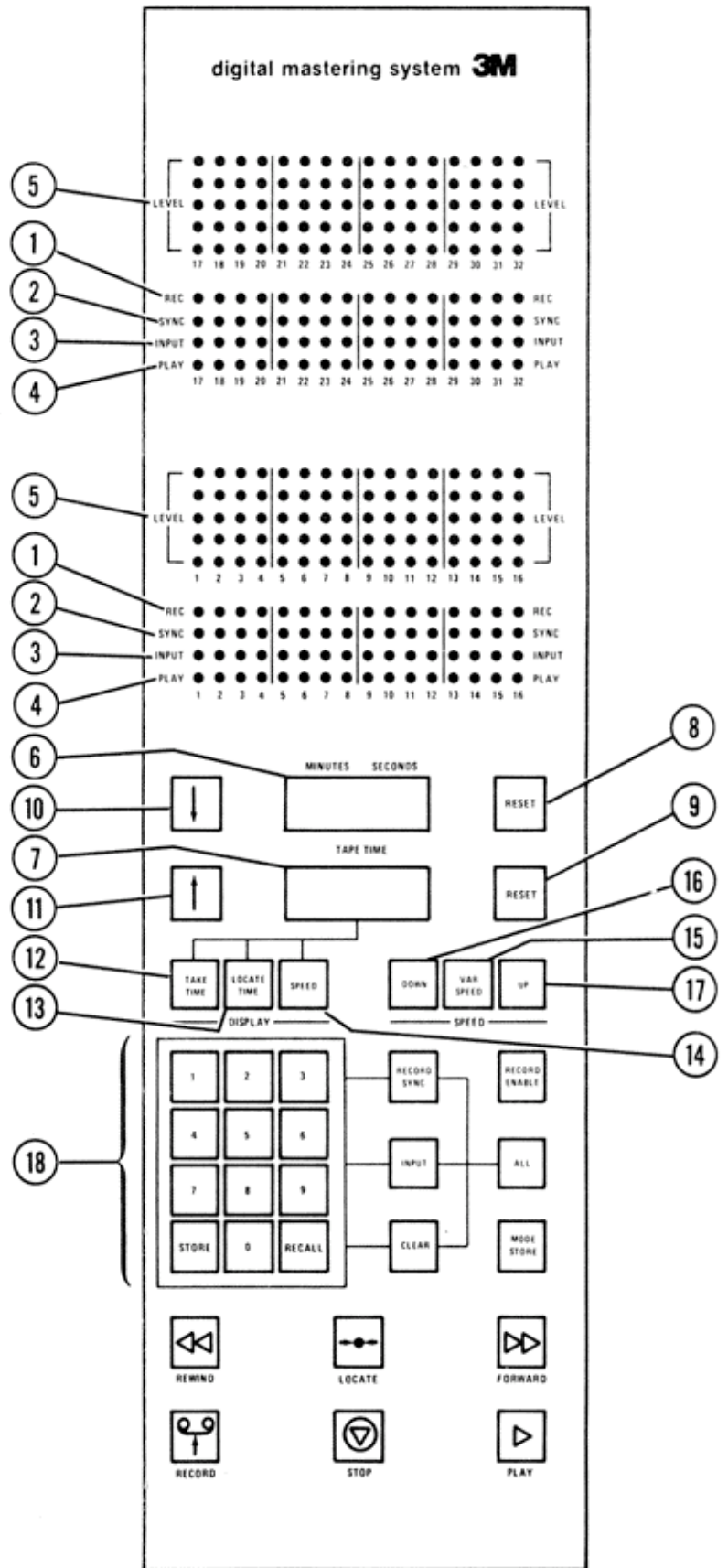
⑰ **UP.** Effective only when the VAR SPEED switch is lit. Pressing UP (switch lights) causes the tape speed to smoothly increase until the switch is released or a 10% increase occurs. The speed will remain as set until changed using the UP or DOWN controls or until the VAR SPEED switch is deactivated.



**18** Basic Keyboard. Numbers 0 through 9 plus STORE are used to enter locate times and to store locate times in memory. RECALL permits recall of previously stored locate times. The LOCATE TIME switch must be active (lit) and the RECORD SYNC and INPUT switches must be inactive (dark). When RECORD SYNC is active (lit), the numbers are used for record arming track assignment. When INPUT is active (lit), the numbers are used to assign tracks to input monitor.

**STORE** (keyboard). When a numbered key is pressed after STORE, the contents of the locate time display is stored in the corresponding memory (0-9). The LOCATE TIME switch must be lit and RECORD SYNC and INPUT must be dark.

**RECALL** (keyboard). When a numbered key is pressed after RECALL, the content of the corresponding memory (0-9) is displayed on the locate time display. The LOCATE TIME switch must be lit and RECORD SYNC and INPUT must be dark.



19 **RECORD SYNC.** Enables record arm mode when active (lit). Works with keyboard numbers, ALL switch, and CLEAR switch.

20 **RECORD ENABLE.** Record mode interlock. Record can be entered only when switch is active (lit).

21 **INPUT.** Enables input mode assignment when active (lit). Works with keyboard numbers, ALL switch, and CLEAR switch.

22 **ALL.** Operates with active RECORD SYNC and/or INPUT switches. When RECORD SYNC is active (lit) pressing ALL record arms all tracks. If CLEAR is pressed first, pressing ALL disarms all record tracks. When INPUT is active (lit) pressing ALL assigns all tracks to input monitor mode. If CLEAR is pressed first, pressing ALL assigns all tracks to play monitor.

23 **CLEAR.** Operates with active RECORD SYNC and/or INPUT switches. Pressing CLEAR before using keyboard or ALL switch, clears record arm on the addressed track(s) and/or assigns the track(s) to play monitor.

24 **MODE STORE.** Exchange memory key. Exchanges stored remote control signal mode setup for existing remote control signal mode setup each time the switch is pressed.

25 **LOCATE.** Backlighted pushbutton switch causes the tape to be driven at high speed to Locate Time and stop within  $\pm 1$  second without hunting. (See also PLAY.) Is cancelled by any (machine or remote) STOP, REWIND, or FORWARD command or tape runout.

26 **FORWARD.** Backlighted pushbutton switch. Causes the tape to wind on the takeup reel at high speed. Can be entered from any mode.

27 **REWIND.** Backlighted pushbutton switch causes tape to wind at high speed on the supply reel. Can be entered from any mode.

28 **RECORD.** Backlighted pushbutton switch selects record mode. To be effective RECORD ENABLE must be active (lit), at least one track must be record armed, and the machine must be at speed in the play mode.

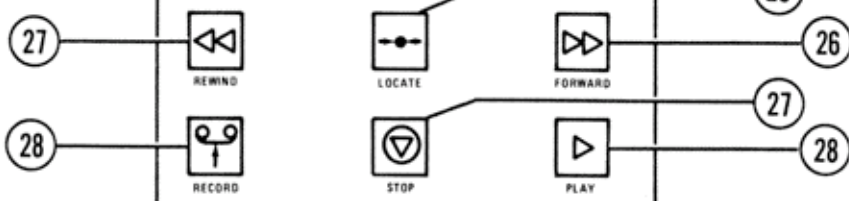
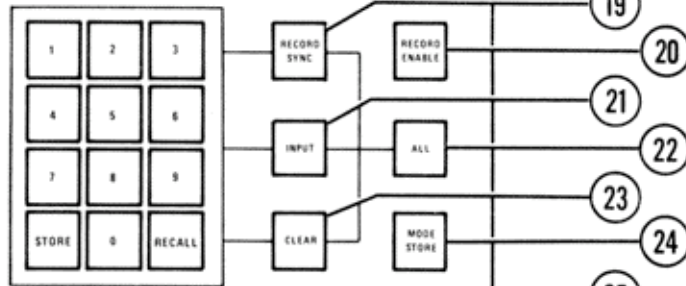
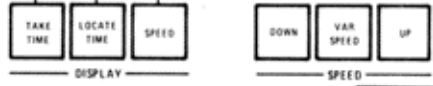
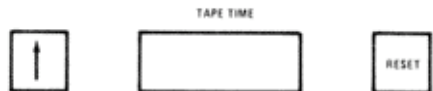
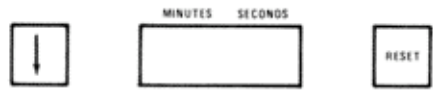
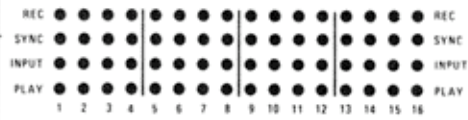
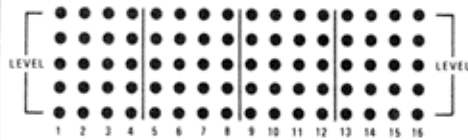
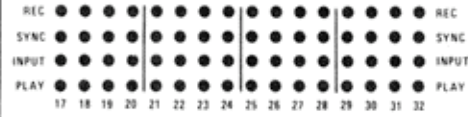
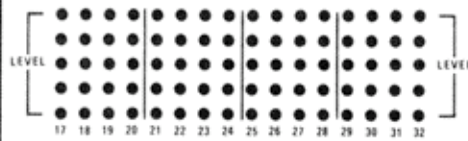
29 **STOP.** Backlighted pushbutton causes tape motion to cease and returns machine to standby status (ready to accept another operating command). Can be entered from any mode.

30 **PLAY.** Backlighted pushbutton switch which causes tape to be driven by the capstan. Can be entered from STOP, REWIND, and FORWARD. If PLAY is pressed during LOCATE, the command (machine or remote) is stored until the cycle is complete. Then the PLAY mode will be initiated.

#### **TAPE TRANSPORT CONTROLS AND INDICATORS (not illustrated)**

1. The FORWARD, REWIND, PLAY, RECORD, and STOP controls on the tape transport function identically to those described for the remote control unit with one exception. The STOP switch has the additional function of initiating the standby mode (tensioning the tape after threading). These controls are located in the lower right quadrant of the deck.
2. The power switch is located in the lower left quadrant of the deck. Power is on when the switch is backlit.


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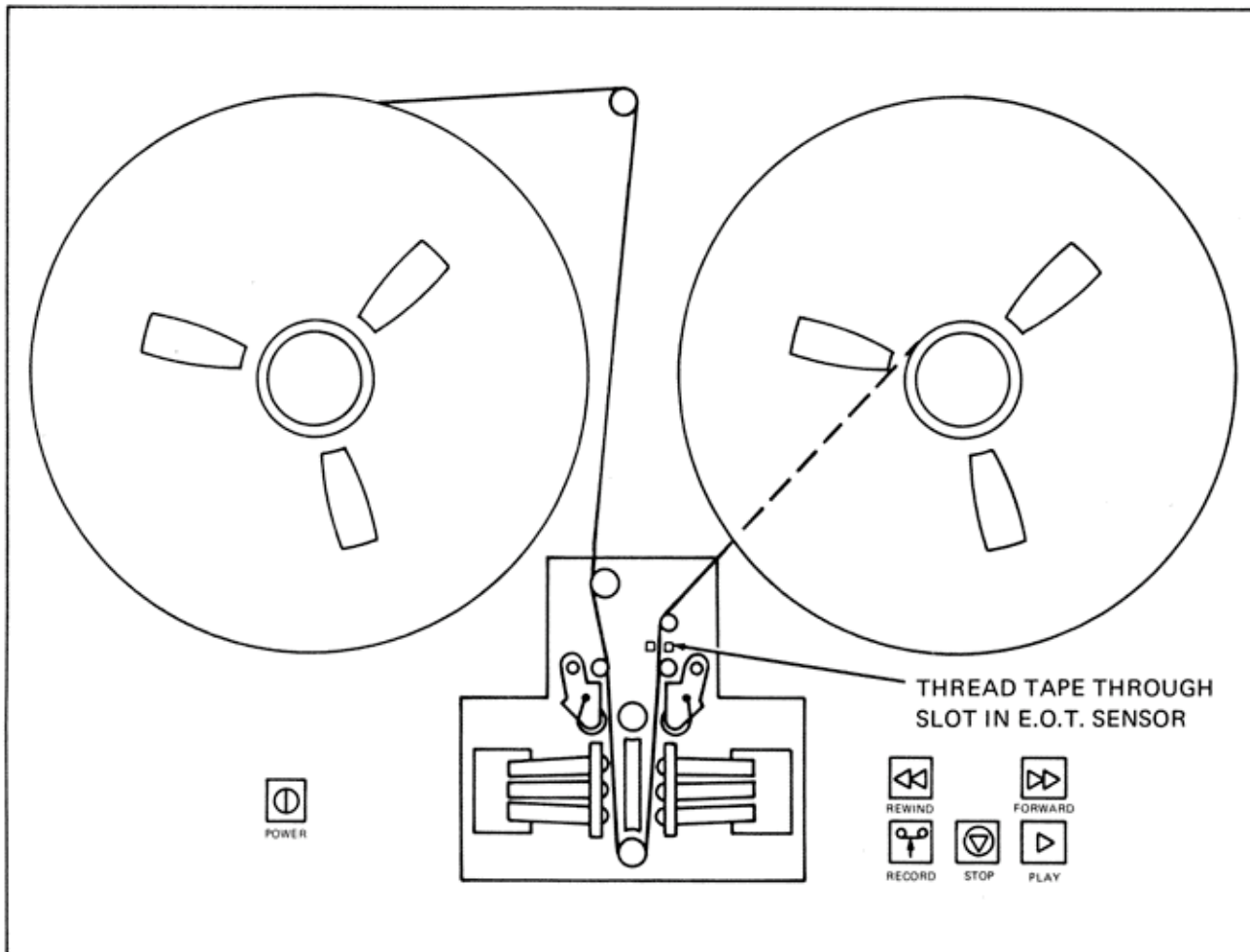


### TAPE THREADING (See figure below)

1. Press the transport POWER switch. (Switch is back-lighted when power is on.)
2. Install a full reel (12-1/2 or 14 inch) of the recommended tape type on the left (supply) reel table. Install the reel so it will rotate clockwise when tape is pulled from the reel. Press down firmly on the center of the reel to seat it. The reel automatically locks into place when properly seated.
3. Install an empty reel on the take-up (right) reel table. Press down firmly on the center of the reel to seat it properly against the reel table.
4. Unwind 2 or 3 feet of tape from the supply reel and thread it through the tape path as shown in figure below.

Thread the tape onto the take-up reel so that clockwise rotation of the reel will wind tape. Manually wind several turns of the take-up reel to hold the tape. Be certain the tail end of the tape is flat (not folded or creased) before overlapping successive turns.

5. Press the STOP button  (on the transport) to tension the tape and place the machine in the standby mode ready to operate. The STOP button will back-light to indicate the standby condition.
6. Press the TAPE TIME RESET button on the remote control unit to establish a zero tape time reference for locate operations.



Tape Threading Diagram



## Operating Procedures

The following procedures presuppose the digital recorder (32 or 4 channel system) has been properly connected to the mixing console, Input signal levels have been set, and that the machine is connected to a suitable power source. (See INSTALLATION section.) The POWER switch (on transport deck) must be on (backlighted).

### Record Arming

Two types of record arming are available: Initial (all tracks armed) and arming by individual track.

For initial recording, where no synchronization with, or preservation of existing material is desired, activate the RECORD SYNC switch **19** then press ALL **22**. All SYNC indicators **2** will light indicating that record is armed on all tracks.

For individual track arming (adding parallel material or changing material - punch in, overdub, etc.), activate the RECORD SYNC switch **19** then address the desired tracks by track number using the basic keyboard **18**.

A two digit address is required (i.e. track 1 is addressed as 01, track 2 as 02, track 12 as 12, etc.) The corresponding SYNC indicators **2** will light as each two digit address is completed. To prevent further track assignment, deactivate the RECORD SYNC switch **19**.

### Recording

The recording process can be accomplished only if tape has been threaded and the recorder placed in the standby mode as described under TAPE THREADING (see previous page).

#### NOTE

Initial recording MUST have all tracks recorded (see caution note) for the full length of anticipated recording.

The record mode (actual recording of signals on tape) is interlocked as follows:

1. At least one SYNC indicator must be lit (record arming present).
2. The RECORD ENABLE switch **20** must be active (lit).
3. The recorder must be in the play/record mode. (Press PLAY switch **30** then RECORD Switch **28**.)

4. The transport must be locked on speed.

When all the interlocking conditions are met, the REC indicators **1** of all armed tracks will light indicating the system is in record and signals are being recorded on the armed tracks. When all tracks are armed (initial recording) the output signals will automatically be tape derived allowing verification of proper record/reproduce operation. (See Input Mode if input monitor is desired.) During synchronous (individual tracks armed) recording (review operating notes 3 and 5), the armed tracks are in INPUT due to the synchronous recording requirement.

The record mode may be terminated (all armed tracks) by any of the following actions:

1. Deactivating the RECORD ENABLE switch **20**.
2. Pressing the PLAY switch **30**.
3. Pressing the REWIND switch **27**.
4. Pressing the FORWARD switch **26**.
5. Pressing the STOP switch **29**.
6. Pressing the LOCATE switch **25**.
7. Pressing the MODE STORE switch **24**.

Recording of signals on individual tracks (or all tracks) can also be terminated by disarming the appropriate armed track(s).

To disarm all armed tracks, activate the RECORD SYNC **19** switch, press CLEAR **23** (switch backlights), then ALL **22**. The SYNC indicators **2** (armed tracks) the CLEAR switch **23**, and the RECORD SYNC switch **19** will go dark, indicating that the record mode is disarmed on all tracks.

To disarm individual record armed tracks, activate the RECORD SYNC **19** and CLEAR **23** switches then address the tracks to be disarmed by track number using the basic keyboard **18**. A two digit address is required (i.e. track 1 is addressed as 01, track 2 as 02, track 12 as 12, etc.) The corresponding SYNC indicators **2** will go out as each address is entered indicating that the track is disarmed and recording is no longer taking place on the track. RECORD SYNC **19** and CLEAR **23** are both deactivated by pressing RECORD SYNC **19** or CLEAR **23** can be deactivated separately.

If all tracks are armed and one or more tracks are disarmed the system automatically switches to synchronous recording.



## Input Mode

The input mode is entered automatically in all transport modes other than play and play/record during initial (all tracks) recording. Selected tracks may be locked in input by activating the INPUT switch (21) and pressing the desired track number(s). The corresponding PLAY (4) indicators will go out, indicating that normal tape-derived reproduction is locked out.

Normal play mode operation may be restored by deactivating the input on the desired track or tracks.

Activate INPUT (21) and CLEAR (23) (see Note) and press the desired track number(s). (Press ALL (22) instead of individual track number if normal play mode is desired on all tracks.)

### NOTE

RECORD SYNC (19) and INPUT (21) may be activated at the same time. Track assignments made with both active will assign that track(s) to both modes. If RECORD SYNC (19) INPUT (21) and CLEAR (23) are active deactivating RECORD SYNC (19) or INPUT (21) will not deactivate CLEAR (23) automatically. CLEAR is automatically deactivated when both RECORD SYNC and INPUT are deactivated, and CLEAR cannot be activated if neither RECORD SYNC nor INPUT is active.

## Playback

1. Thread the pre-recorded tape and place the machine in the standby mode as previously described under TAPE THREADING. (If necessary, set pre-recorded zero tape time reference.)
2. Press the PLAY switch (30) to place the machine in the play mode. In play the tape derived signal is automatically present at the output unless deliberately overridden by selection of the INPUT mode. Tracks without a playback signal will mute.


## Selectake Functions

The selectake function identifies a specific tape position in terms of tape time elapsed from a zero tape time reference. Data is located by repositioning the tape to the tape time which occurred concurrently with the data. To accomplish this it is necessary to establish an arbitrary tape time zero reference or, in the case of a previously recorded tape, reestablish the original reference.

## WARNING

While RECORD SYNC (19) or INPUT (21) switches are active (lit) the basic keyboard is dedicated to one function (track assignment). The basic keyboard cannot enter times unless RECORD SYNC (19) and INPUT (21) are inactive.

## Setting The Tape Time Zero Reference:

1. The system is automatically set to a zero reference when power is turned on.
2. An alternate zero reference can be established at any tape location by pressing the locate time display RESET (9) switch. The RESET switch, used in conjunction with a slate tone or other electrical or physical reference establishes a particularly convenient zero reference.
3. To recover the zero reference of a previously recorded tape, use the function controls (30) (29) (27) and (26) to position the tape on an event for which the tape time is known then:
  - a. Use the keyboard (18) to enter the tape time of the event into the locate time display (7). Four digits must be entered reading from left to right. The first digit entered appears at the right in the display and advances to the left as additional digits are entered. Multiple digit entries are electronically inhibited, data is only accepted one digit at a time.
  - b. Press the locate time transfer  switch (11) to shift the time into the TAPE TIME display (6).

## Using the Memory Section

The input and output of the memory section is through the locate time display (7). To store, the memory section is addressed by pressing the STORE key on the basic keyboard (18). To recall, the memory section is addressed by pressing the RECALL key. The specific memory is selected by pressing the appropriately numbered key on the basic keyboard.

## Storing A Locate Time

1. Insert the number to be stored into the locate time display (7) by:

- a. Transferring the time from the tape Time display (6) by pressing the tape time transfer switch (10).
- b. Using the basic keyboard (18) to enter the desired locate time into the LOCATE TIME display (7).

2. Press the STORE key.
3. Press the numbered key (basic keyboard) whose number corresponds to the memory position desired.

**NOTE**

The data entered in the display is not effected by the storing operation.

A log should be kept of the significant contents of the memory section to retain the stored locate times against accidental loss and to identify the memories still available.

**Recalling A Stored Locate Time:**

1. Press the RECALL key on the basic keyboard (18).
2. Press the numbered key (basic keyboard) of the memory containing the locate time to be recalled.
3. The contents of the selected memory will appear in the Locate Time display (7).

**Locate Operation:**

1. Enter the desired location time in the locate time display (7) by:
  - a. Directly using the keyboard,
  - b. by recalling the locate time from the memory section.
2. Press the LOCATE switch (25). The tape transport will begin a high speed tape transfer in the direction required to bring the TAPE TIME display (6) to the time entered in the LOCATE TIME display (7). The high speed transfer will automatically slow as the locate time is approached and stop when the TAPE TIME display reads within  $\pm 1$  second of the locate time.

