

RCA Compact Color TV Tape Recording System, Type TR-60

- High gain servo
- Head resonance compensation
- Requires less floor space than any other color high band recorder
- Rear side master erase



Built-in
Picture Monitor

Rear Side
Master Erase

Built-in
Waveform Monitor

Pushbutton
Monitor
Selection

External
Scope Probe

Record Control Panel
Highband Lowband Operation
Non-Standard FM Indication

Crystal Deviation
Settings for all Standards

Pre-Wired
Splicer

Guide Servo

Tape Motion
Sensor

Servo Mode
Selector

Anti-Resonance
Adjustments

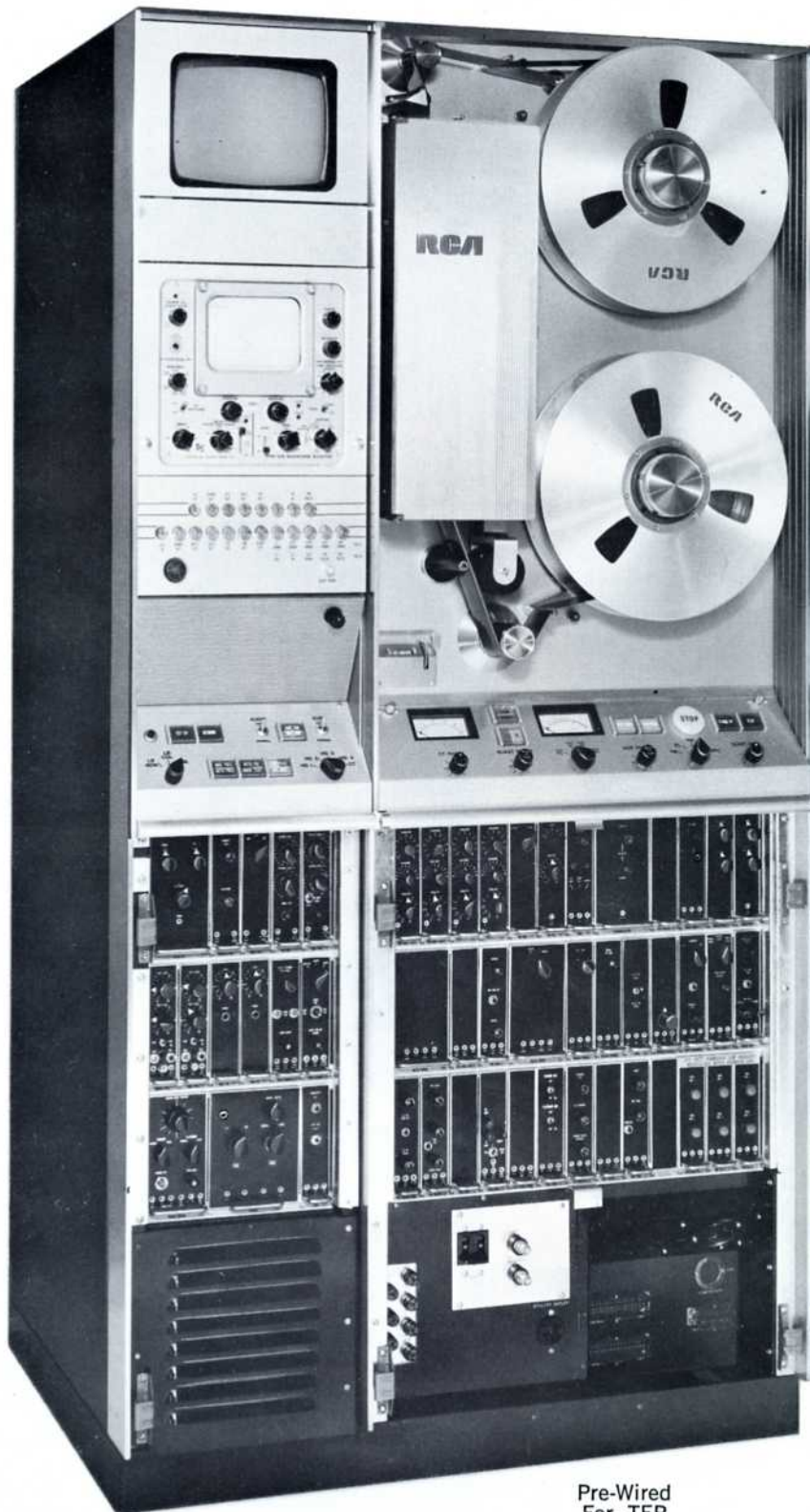
Pre-Wired
For DOC

Hi Gain
HW Servo

Available Accessories:

- Electronic Splicing
- Drop-out Compensator
- TEP
- CAVEC
- Record Current Optimizer

Pre-Wired
For TEP



Compact Color TV Tape Recording System, Type TR-60

Description

The TR-60 is the most compact and inexpensive color highband/lowband machine available. It features many of the latest developments of larger, more expensive tape recorders such as rear side erase head, complete monitoring of all critical machine waveforms and video signals, accessible controls and prominent functional indication signals, high gain servo, and head resonance compensation. The machine has many new conveniences such as a tape motion sensor, utility power outlet for servicing, provision for accurately setting the position of the vertical interval, and three switchable composite or non-composite video outlets. It is prewired for rapid installation of four available accessories including electronic splicer, tape editing programmer, dropout compensator, and chroma amplitude and velocity error corrector.

Switchable Standards

The new TR-60 is available in two models. The domestic NTSC model and the international NTSC/PAL model. Both machines incorporate circuitry to permit operation on 525 or 625 line standards. Automatically, the machine logic insures selection of correct deviation standards, correct video low pass filter, and other internal machine time changes required by the switch in standards.

FM System Record

Operation on highband or lowband standards is selectable by an FM standards selector switch on the record panel. The combined video input circuitry and FM record and playback FM provide the highest degree of system linearity.

Input circuitry of the TR-60 provides for adjustment of video level and chroma level. Before the FM modulation process, a video low pass filter removes any spurious high frequency noise in the video signal.

FM modulation is achieved through a heterodyne modulator, insuring the lowest order of intermodulation distortion. Control of the modulator's oscillator frequency is accomplished through a crystal controlled AFC circuit with blanking level reference. A crystal controlled white reference pulse provides an accurate means for setting of the FM deviation. The FM signal with the necessary record process equalization is fed to the video heads through solid state record amplifiers.

To aid in the setting of individual record currents, a noise test position is provided that records a set carrier on the tape. When used with the Record Current Optimizer option, the adjustment takes approximately 30 seconds.

FM System Playback

A low noise, high impedance preamplifier is the first in a series of FM amplifiers in the playback signal path. It contributes to the excellent signal-to-noise ratio and differential gain of the TR-60. To compensate for the resonance effects that would otherwise be introduced by the heads that are feeding this high impedance circuit, two anti-resonance (resistance and reactance) controls are provided. The two controls permit the operator to match the response of the heads individually and very accurately eliminate the differential banding from the machine. The individual frequency equalization of the four heads plus the overall FM equalization is accomplished through uniform phase equalizers. Automatic adjustment of the FM frequency response can be accomplished through the use of the CAVEC option.

Demodulation of the FM signal is accomplished through a pulse count demodulator. The low pass video filter following the demodulation process is of the Golay type with cut-off frequencies selected to give low K factor ratings, minimum chrominance/luminance delay, and excellent moire performance.

Servo System

Selection of the servo replay mode is made by a convenient selector switch on the play control panel. Selection can be made of Tonewheel, Switchlock, Pixlock, Linelock, or NPC. The TW/SL positions are used in monochrome operation where the "off tape" horizontal sync phase is not controlled. Where production effects are required, or in color operation, Pixlock is the normal mode of operation. Linelock is a mode of operation that insures quick recovery of the servo lock during a non-synchronous switch. This mode is also used for color. The NPC mode is provided so that color dubs made by the heterodyne process can be replayed.

Hi Gain Headwheel Servo

In the record mode, the TR-60 servo operates with a higher gain than in earlier machine models. This higher gain insures that the position of the vertical interval as it is recorded on tape is controlled to a tighter degree, and thus provides better electronic and mechanical splices.

As an option that is left to the customer's discretion, is the ability to record 15 Hz edit pulses. This permits the editing together of the correct color fields. The international machine edit pulse frequency when recording color is 12.5 Hz.

Vertical Interval Positioning

As a further aid to operators, the small tonewheel markers that can be displayed on the monitor have a definite phase relationship to the recorded vertical position on tape. Thus, by correctly setting up the markers, all tapes are recorded uniformly with respect to the positioning of the vertical interval.

Day-to-day operational stability of the RCA servo is maintained through a few controls that seldom need to be adjusted.

Time Base Correction

Correction of residual servo jitter and minute headwheel geometry differences is accomplished with ATC and CATC units that are electrically identical to those in use in the RCA TR-70 machines.

Control over horizontal phase, burst phase, and system phase is provided so that the tape signal can be considered completely synchronous with other signal sources. On international tape recorder systems, control is also provided over the burst quadrature.

The CATC unit supplied with the International TR-60 can operate on either NTSC or PAL coded color signals. It should be noted that in order to record PAL color signals correctly, it is necessary to have installed the CATC.

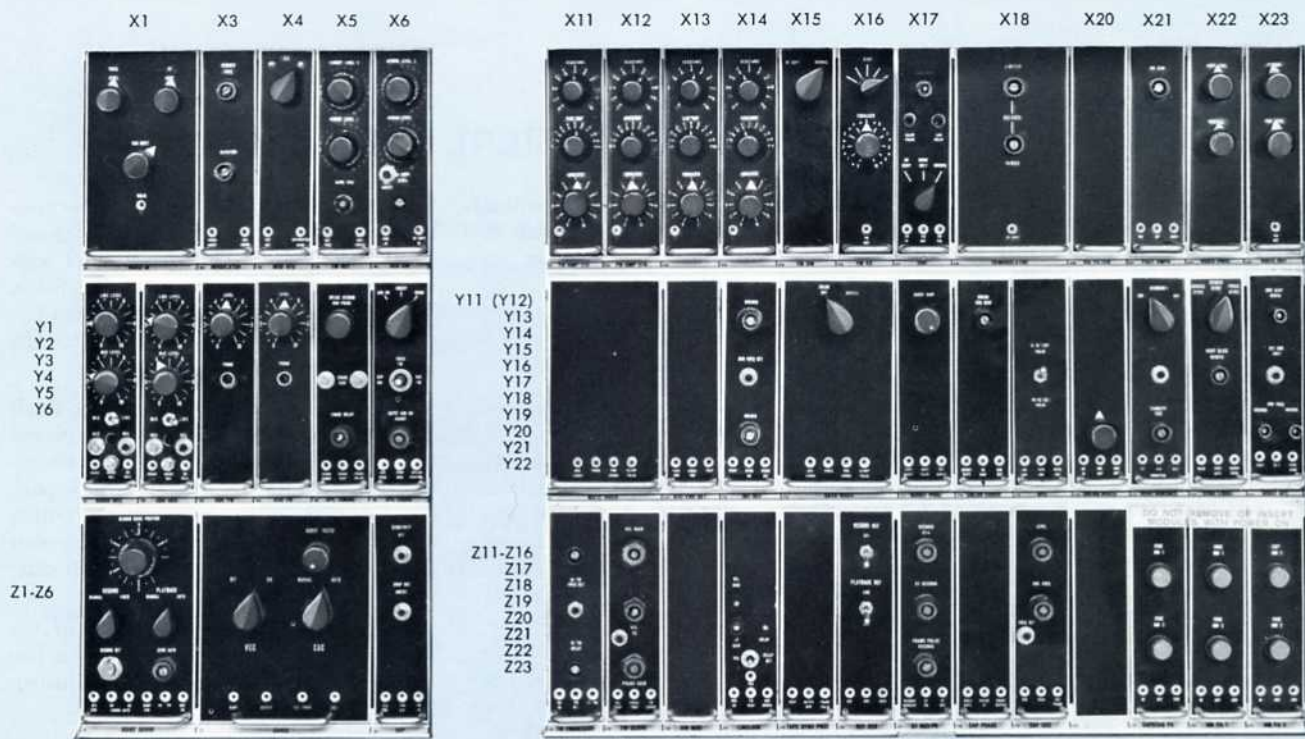
Signal Processor

The TR-60 signal processor unit completely regenerates the horizontal sync, vertical sync pulses, and blanking. When used with a color signal, regenerated local subcarrier is "gated in" to form the color burst. The new burst is correctly positioned and contains the correct number of cycles of burst even if the original signal that was recorded was incorrect.

There are controls to regulate video level, setup, sync level, and burst level. Thus, the signal output of the tape machine is completely standard.

Remote Control

Certain machine functions can be controlled from a remote position through the use of the RCA Remote Control Panels, or through the use of customer built panels. Functions that can be remotely are: Stop, Record, Play, Fast Forward, Rewind, Video Level, Setup, Sync Level, Burst Phase, and System Phase.



Module Description

X1—Video Input

Basically a video distribution amplifier with control over video level and high frequency response. A video low pass filter is also included to prevent high frequency noise from passing onto the modulator.

X3—Modulator

Provides the heterodyne modulation system to change the video signal to an FM signal.

X4—Modulator AFC

Provides the necessary clamp signals and DC voltages to control the blanking frequency of the modulator. The reference level being crystal controlled.

X5—FM Reference

Provides the video pre-emphasis characteristics. Houses the channel 1 and 3 record amplitude controls. The crystals for the white reference markers are also contained in this module.

X6—Record Switch

Houses the channel 2 and 4 record amplitude controls plus the individual 4 lead record amplifier drivers.

X11/12/13/14—Playback Amplifier

Contains the playback amplifier for one each of the video heads. Variable compensation is provided for setting the head resonance and frequency response characteristics of each of the heads. An AGC system controls the level of the FM.

X15—FM Switcher

Combines the output of the 4 individual heads into one continuous signal.

X16—FM Equalizer

Provides for the overall equalization of the FM through the use of a cosine equalizer with variable frequency cutoff.

X17—Dropout Compensator

This space is allotted to the dropout compensator option. Machine is prewired.

X18—Demodulator

Provides limiting to the FM signal and employs a pulse count demodulation system to derive the AM video component.

X20—Video Filter

Provides 2 video low pass filters to remove residual FM carrier and to pulse form the demodulated video. $F_c = 4.2$ MHz and 4.5 MHz in domestic unit or $F_c = 4.2$ MHz, 4.5 MHz, 5.0 MHz, 6.0 MHz in international model.

X21—Post Emphasis

Supplies the necessary de-emphasis characteristics to the video signal prior to processing by the ATC, CATC, and video processor.

X22—Video Processor

The regenerated blanking, burst chroma, and luminance signals are combined to form a non-composite signal.

X23—Video Output

Sync is added to the non-composite signal from X22. Five video outputs are available at the output of the module, two are used internally and three are available for external use. The three external signals are selectable either composite or non-composite.

Y1—Audio Record

Provides audio amplification and level control, bias and erase current. Audio only record is activated by a pushbutton on the module front.

Y2—Cue Record

Same as for Y1.

Y3—Audio Output

Provides the audio line out with standard program levels.

Y4—Cue Output

Same as for Y3.

Y5 & 6—Splicer Modules

Space is provided for the Electronic Splicer option. Machine is prewired.

Y11—ATC Video

Contains the variable delay line and video circuits associated with the ATC.

Y13—ATC Error

Supplies and generates the ATC error signal that is used to modulate the ATC variable delay line.

Y14—Internal Reference

Tape sync is processed to form reference pulses for the machine use. Pulses are timed through the use of a tapped delay line.

Y15—CATC Video

Contains the variable delay line and driver circuits for the CATC.

Y17—Burst Processor

Provides for the processing of both the local subcarrier and the off tape burst. This off tape processed burst is used in the CATC error detector and the CAVEC. The locally processed subcarrier is used in the CATC for the regenerated burst for the processor.

Y18—Color Error

Generates the CATC error signal through comparison of off tape burst to the local subcarrier. The error signal modulates the variable delay line in the CATC video module.

Y19—Non-Phased Color

Provides the necessary delay generators to permit the replay of a heterodyne dub.

Monitoring

The TR-60 is equipped with an extensive system monitoring facility. The picture monitor can show the video signal at the input, demodulator output, ATC output, CATC output, and processor output as a normal picture or in the pulse cross position.

The waveform monitor is capable of monitoring 16 separate waveforms plus the expansion capability that is afforded by the use of an external probe facility.

Standard Features

The TR-60 now has as standard features, the guide servo, 7½/15-inch operation, cue channel, indication of modulator AFC failure, rear side erase head, tape motion sensor, and indication of non-standard PAL operation. The operator-oriented, sloping control panels of the TR-60 follow in the footsteps of the big machines. Record and Playback controls are grouped and separated to elimi-

nate any possibility of error. Generous use of meters and status lights permits the operator to duplicate quality to many generations.

Record Current Optimizer, ES-43563

The Record Current Optimizer (RCO) is a new accessory that can be added to the TR-60 to reduce the time required to optimize headwheel. By reducing the tape speed yet maintaining the normal headwheel rotation speed, a simultaneous record, replay system may be achieved. The RCO provides the necessary switching and gating signals so that when channel 1 is recording channel 2 is replaying the signal just recorded by channel 1, and so on. Thus during the optimizing process the peak RF level being recorded can be detected quickly and accurately set through the simultaneous replay facility. Installation of this accessory into the TR-60 requires both wiring harness and some module modifications.

Y20—Color Phase

Provides for the adjustment of burst phase and system phase.

Y21—Vertical Advance

Provides the means to switch between 525 and 625 TV standards. Also provides the necessary counters to regenerate the vertical interval.

Y22—Sync Logic

Generates horizontal and vertical blanking and combines them into composite blanking. Provides selection of house sync, gated sync or re-generated sync to be used in the video output module. Generates a start pulse to trigger the vertical advance circuitry.

Y23—Horizontal AFC

Time base corrected tape sync is used to generate new horizontal sync, front porch, and horizontal blanking.

Z1—Guide Servo

A servo unit to automatically position the vacuum guide in both the record and playback modes.

Z3—CAVEC

Space is provided for the CAVEC option. Machine is basically prewired with some modification required to the FM equalizer and burst processor.

Z7—Dropout Processor

Space is provided for this module which forms part of the Dropout Compensator option.

Z11—TW Processor

Processes the tonewheel pulses and provides the 960 Hz for the FM switcher.

Z12—TW Servo

Produces an error signal that controls the headwheel in playback and record.

Z13—HW Modulator

Provides the amplitude modulated drive to control the headwheel. The O/P of this module feeds the H/W power amplifiers. Control is also provided over the recorded headwheel phase.

Z14—Linelock

Provides the necessary headwheel phase control in the Pixlock and Linelock modes of playback operation.

Z15—Tape Sync Processor

Provides noise immunity processing to the off tape sync.

Z16—Reference Generator

Produces reference horizontal and vertical pulses from the incoming external composite sync.

Z17—Control Track Record/Playback

Circuitry is provided to record and replay the control track signal.

Z18—Capstan Phase

The control track pulses feed a chain of counters which eventually determine the capstan motor phase.

Z19—Capstan Oscillator

This module contains the oscillator to drive the capstan motor. A DC error voltage controls the actual frequency of the oscillator.

Z20/21/22—Power Amplifier

This module contains a power amplifier to drive the capstan or headwheel motors.

Z29—PAL

The module is only used on international machines. When operating on PAL, certain machine operating parameters must change. These changes are accomplished with the PAL module circuitry.



The use of a rear side erase head minimizes the possibility of scratching the oxide surface of the record tape.



The wide range of built-in monitoring is further expanded through the use of an external scope probe. The probe can be used to view the waveforms at the module test points.



Ability to match the individual head responses is provided by the RESISTANCE, REACTANCE, and EQUALIZATION controls.

Modular Accessories for every taping need

Cavec Accessory, ES-43537

When the ultimate in color quality is required, CAVEC through its line-by-line corrective action of both phase and gain variations of the color subcarrier, eliminates all but the most extreme errors. The velocity error corrector portion of the CAVEC unit insures that head-wheel velocity scanning errors due to differences in mechanical parameters between record and replay machines are reduced below the level of perceptibility,

even through multiple generations. Likewise, the line-by-line corrective action of the chroma amplitude corrector insures that both the band-by-band and the line-by-line chroma amplitude errors are corrected.

CAVEC is required on either the NTSC or PAL systems of color transmission. Installation of the CAVEC unit into the TR-60 can be accomplished in less than one hour.

Electronic Splicer, MI-35961

Disturbance free splicing is assured through the use of the RCA Electronic Splicer. Set up and adjustment of the splicer can be accomplished with internally generated test signals. The overlap splicing technique utilized in the RCA Electronic Splicer insures that small mechanical differences between tape machines do not affect the quality of the splice. Any combination of Audio, Video,

and Cue recording can be accomplished with the Electronic Splicer.

When editing must be done, preserve tape life and reduce splicing time through the use of an Electronic Splicer. The Electronic Splicer can be fitted to a TR-60 in a matter of minutes with no modifications. The splicer works equally well on 525 or 625 line TV standards, monochrome or color.

Dropout Compensator, ES-43538

The function of the Dropout Compensator (DOC) is to remove the visible disturbances caused by small head-to-tape contact discontinuities. Dropouts are characterized by a white or black flash that occurs instead of the original picture information. A memory system consisting of a glass delay line with an equivalent delay of one TV line is used to store video information for use when a dropout occurs. In effect, when a dropout in the RF exceeds a predetermined level, the

DOC inserts stored information from the previous line.

To set up the DOC to insure the levels are correct and the sensitivity of the unit is adjusted correctly, a dropout processor module is furnished along with the Dropout Compensator module.

When operating on NTSC standards, the DOC inserts color of the correct phase. On PAL standards, it is recommended that wide bandwidth monochrome only information be reinserted.

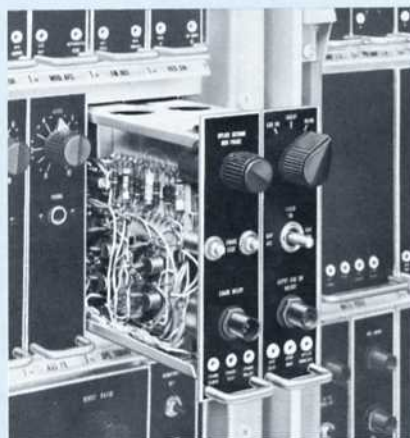
Tape Editing Programmer, ES-591903

TEP extends the production capability of the TR-60 so as to provide accurate editing and production effects.

The TEP works in conjunction with the electronic splicer in determining the actual position of the splice position. By programming the TEP, splices to an accuracy of one TV frame can be accomplished. In addition to obtaining a high degree of splicing accuracy, the TEP permits the tape editor to preview the edits without destroying the original material. External cues are also available

automatically from the TEP electronics at 8, 4, and 2 seconds before the edit is made.

During the preview cycle, if the selected edit points are incorrect, a correction factor of ± 3 seconds in one frame increments is available. All of the timings required for the pre-programming of the TEP are provided by a single cue tone placed on the cue track approximately 14 seconds ahead of the ingoing splice point.



Specifications

General

Recording MediumMagnetic tape 2" (50.80mm) wide
RCA 7200 or equivalent

	60 Hz Field Rate	50 Hz Field Rate
Nominal Tape Speed	15 in/sec (38.1 CM/sec)	15.6 in/sec (39.6 CM/sec)
	7.5 in/sec (19.05 CM/sec)	7.8 in/sec (19.8 CM/sec)

Picture Sound Separation	18.5 Frames Sound Leading at 15 IPS	14.8 Frames (235mm) Sound Leading at 39.6 CM/sec
	37 Frames Sound Leading at 7½ IPS	29.6 Frames (235mm) Sound Leading at 19.8 CM/sec

Recording Time	96 min. on a 14" reel (7200 ft.) at 15 IPS	92 min. on a 35.56 CM reel (2.194 KM) at 39.6 CM/sec
	192 min. on a 14" reel (7200 ft.) at 7.5 IPS	184 min. on a 35.56 CM reel (2.194 KM) at 19.8 CM/sec

Edit Pulse Frequency	30 Hz mono signals	25 Hz lowband standard
	30 Hz color signals	12.5 Hz highband standard
		Phase of pulse in accordance with EBU standards 3084-E

Rewind TimeApprox. 4 min. for 7200'
Approx. 5 min. for 2.194 KM

Record ReferenceTo incoming video or external composite sync

Playback ReferenceTo external reference or power line (color playback must be referenced to external)

Stopping TimeLess than .2 secs. from record or play mode

Tape Interchangeability:

60 Hz Field RateTapes that are recorded on the TR-60 are made in accordance with SMPTE recommended practices and USASI standards and may be replayed on any quadruplex machine meeting these standards

50 Hz Field RateTapes that are recorded on the TR-60 are made in accordance with EBU standards for Tape Recording 3084E and may be replayed on any quadruplex machine meeting these standards

Tape TimerAccumulated time measured in minutes and seconds to an accuracy of 3 secs. per hour at 15 IPS/15.6 IPS

Playback Stability:

Monochrome SystemsTotal jitter and geometric distortion over a 30 sec. period, 50 nsecs. peak-to-peak

Color SystemsTotal phase jitter of the color subcarrier, 6 nsecs. peak-to-peak

Temperature Range0°C-45°C

Relative Humidity20%-90%

Lock Up Time for Synchronous

Color OperationLess than 6 secs. from stop

Burst Switching Angle for PAL Systems±45°

Burst Flag for PAL Systems4 V peak-to-peak

Input Signal Requirements

Video/Sync:

Video Signal Input0.5 V to 1.4 V P-P composite signal unbalanced. Terminated in 75 Ohms ±1%

External Sync InputNegative going 3-5 V P-P. Hi impedance bridge or terminate

Color Subcarrier Input1.5-2.5 V P-P sine wave. Hi impedance bridge or terminate

Burst Flag (PAL Systems Only)3.5-4.5 V P-P negative going. Hi impedance bridge or terminate

Audio:

Line input level between +4 and +36 dBm when bridging a 600 Ohm line600 Ohm termination available. May be reconnected for 600 or 150 Ohm matching input balanced or unbalanced

Cue Signal Input LevelSame as for Audio Channel

Power:

60 Hz117 V ±10% single phase 3.2 KW
Line Frequency 60 Hz ±2 Hz

50 Hz230 V ±10% single phase 3.2 KW
Line Frequency 50 Hz ±2 Hz

(one utility outlet is provided rated at 1 KW)

Output Signals

Video:

OutputsThree individually selectable composite or non-composite, 75 Ohms unbalanced. 1 additional output used for internal monitoring

Video Level0.5-1.0 V P-P

Sync Level0.2-0.4 V P-P

Pedestal±20% of video level

Burst Level0.2-0.4 V P-P

Chroma Level±20% of nominal

Audio:

OutputsOne line, +18 dBm in 150 or 600 balanced or unbalanced, and one monitor, +37 dBm into internal 8 Ohm load. (Connections are available for external speaker). Audio Monitor output switchable to cue channel

CueSame as for Audio

System Performances Video

60 Hz Field Rate:

	525 Low Band Mono	525 Low Band Color	525 Highband Mono/Color
Deviation Standards	4.28 MHz-6.8 MHz	5.5 MHz-6.5 MHz	7.06 MHz-10.0 MHz
Bandwidth			
(100 kHz Reference)	±1 dB 60 Hz-3.8 MHz	±1 dB 60 Hz-3.8 MHz	±0.75 dB 60 Hz-4.1 MHz
	-3 dB max. at 4.2 MHz	-3 dB max. at 4.2 MHz	-3 dB max. at 4.5 MHz
Rise and Decay Times	120 nsecs.	120 nsecs.	110 nsecs
Signal-to-Noise at 15 IPS (P-P video to RMS Noise on an interchange basis)	43 dB	40 dB	46 dB

System Performances Video

60 Hz Field Rate:
(Continued)

	525 Low Band Mono	525 Low Band Color	525 Highband Mono/Color
K Rating 2T/20T (2T HAD 0.25 μ sec)	2%/NA	2%/1.5%	1.5%/1.5%
Amplitude Linearity (Blanking to white)	1%	1%	1%
LF Tilt	1%	1%	1%
Moire (75% saturated color bars) ..NA		30 dB	40 dB
Differential Gain (Blanking to white)	NA	Less than 5%	Less than 5%
Differential Phase (Blanking to white)	NA	Less than 5°	Less than 5°

50 Hz Field Rate:

	625 Line Low Band	625 Line Highband
Deviation	4.95 MHz-6.8 MHz	7.16 MHz-9.30 MHz
Bandwidth	± 1 dB 50 Hz- 4.5 MHz -3 dB max. at 5.0 MHz	± 0.75 dB 50 Hz- 5.5 MHz -3 dB max. at 6.0 MHz
Rise and Decay Time	100 nsecs.	80 nsecs.
Signal-to-Noise at 39.6 CMS (P-P video to RMS Noise on an interchange basis— unweighted)	42 dB	43 dB
K Rating 2T/20T (2T HAD = 0.2 μ sec.)	2%/NA	1.5%/1.5%
Amplitude Linearity (Blanking to White)	2%	2%
LF Tilt	1%	1%
Moire (75% saturated color bars)	NA	32 dB
Differential Gain (Blanking to White)	NA	5%
Differential Phase (Blanking to White)	NA	5°

Audio **15 IPS/39.7 CMS** **7½ IPS/19.8 CMS**

Bandwidth	± 2 dB 50 Hz- 15 kHz	± 2 dB 60 Hz- 10 kHz
Wow and Flutter (for components 0.5 Hz to 250 Hz)	0.15%	0.2%
Signal-to-Noise (measured with reference to a level correspond- ing to 3% THD)	50 dB	

Cue

	15 IPS/39.7 CMS	7½ IPS/19.8 CMS
Bandwidth	± 2 dB 50 Hz- 12 kHz with 36 dB notch at 240/250 Hz	± 3 dB 60 Hz- 10 kHz with 36 dB notch at 240/250 Hz
Wow and Flutter (for components 0.5 Hz to 250 Hz)	0.15%	0.2%
Signal-to-Noise (measured with reference to 5% THD at 1 kHz)	40 dB	

Mechanical

Dimensions:	
Width	33" (84 cm)
Height with built-in casters	66" (168 cm)
Depth	24" (61 cm)
Shipping Information:	
Width	38¾" (98.2 cm)
Depth	29" (73.5 cm)
Height	77" (195 cm)
Volume	60.1 ³ (1.80 M ³) Gross
Weight	1200 lbs. (524.3 kg)

Accessories

CAVEC	ES-43537
Color Dropout Compensator	ES-43538
Electronic Splicer	MI-35961
Remote Control Panel (Mode)	MI-40691-B
Remote Control Panel (Signal)	MI-40692-B
Spare Headwheel Panel, 10 mil	MI-40899-A
Spare Headwheel Panel, 5 mil	MI-40913-A
Mechanical Tape Splicer (15 IPS) including developer	MI-40772
Record Current Optimizer	ES-43563
Alignment Tape (525 line)	MI-41699
Alignment Tape (625 line)	MI-41698
Test Module Extender	MI-40649
Test Module Extender (Control Section)	MI-557301
CATC — NTSC Only	ES-591208
CATC — NTSC/PAL	ES-591209
Tape Editing Programmer	ES-591903

Ordering Information

The Type TR-60 TV Tape Recorder is available for operation on 525/625 line tv standards. Normally color. Monochrome on request.

Two basic models are available:

- (1) 525 60 Hz machine
NTSC ColorES-591910
- (2) 525/625 50 Hz machine
NTSC/PAL ColorES-591912

All 405 and 819 Line Requirements on Request
SECAM Requirements on Request

All models include the following equipment:

- 1 TV Tape Recorder
(Cabinet Mounted) complete
- 1 Headwheel Panel Assembly
- 1 Kit of Maintenance Materials
- 1 High-Band Video Alignment Tape