



# TR-70 Television Tape Recorder

OPERATION MANUAL

COLOR

MI-35895

MI-35896

MI-35897

MONOCHROME

MI-35876

MI-35877

MI-35878



RADIO CORPORATION OF AMERICA

IB-31856

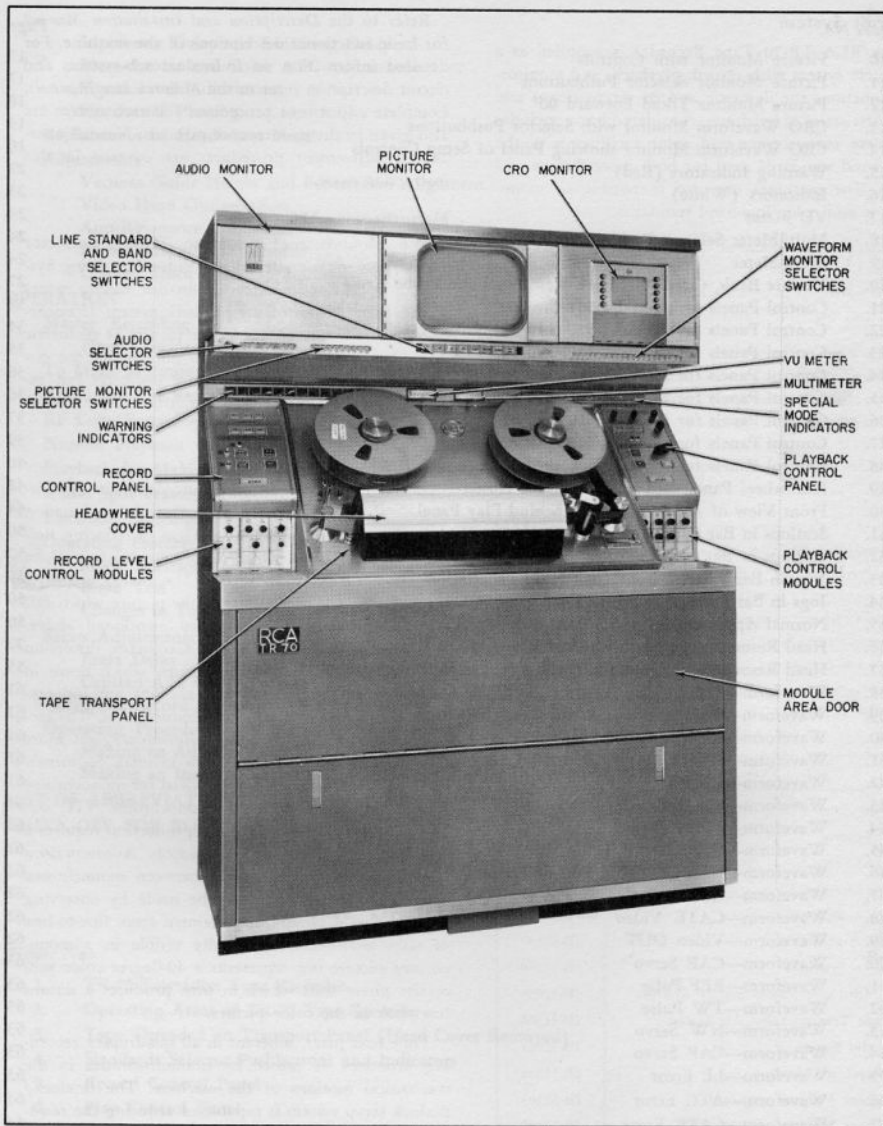


Figure 1—TR-70 Television Tape Recorder

## INTRODUCTION

### Overall System

The RCA TR-70 Tape Recorder is supplied as a complete system with record, playback, and monitoring functions for domestic and/or international use. The first series of machines, considered basic, includes complete monochrome and color facilities with the high-band standards used for both monochrome and color. The machines are also switchable to monochrome and color low-band standards.

Machines for domestic and international use are also available without color facilities. Color facilities can be added at a later date with a minimum of field work and machine down time.

Both types of machines are covered in this book, although most of the material is presented on the basis that color facilities are included in the machine. In general, material on color sections can merely be omitted if the machine is not equipped for color. However, appropriate notes are included where necessary.

A list of the basic instruction books is given here to assist in checking the completeness of your instruction book complement. Some of the individual books may not be available at time of machine shipment. These are to be supplied when available. Should a shortage or a loss occur use the individual instruction book number (below) in your correspondence.

### INSTRUCTION BOOKS FOR TR-70 TV TAPE RECORDER

Title	IB Number
Operation	IB-31856
Diagrams	IB-31853
Parts List	IB-31854
Description and Installation	IB-31855
Video and FM	IB-32113
Video Processing	IB-31857
Servo Systems	IB-31858
Control and Power Supply Systems	IB-31859
Tape Transport and Air Systems	IB-31860
Audio System	IB-31861
Waveform Monitor	IB-31825
Picture Monitor 525/625	IB-32103
Picture Monitor 405/525/625	IB-32107
Electronic Splicer*	IB-31872
Dropout Compensator*	IB-32136

Refer to the *Description and Installation Manual* for basic functional descriptions of the machine. For detailed information on individual sub-systems and circuit description refer to the *Maintenance Manuals*. Complete adjustment procedures for each system are also given in the maintenance manuals. Normal operational adjustment procedures are covered in this instruction book.

### Monochrome ATC

The Monochrome Automatic Timing Corrector (ATC) system is a part of the Video Processing System. The ATC eliminates line-by-line timing errors in the video output of the playback system. If uncorrected these errors appear in the picture as geometric distortion and jitter. ATC does not replace the circuits that normally affect picture geometry but removes imperfections remaining after these circuits have performed their functions.

### Color ATC

The function of the Color Automatic Timing Corrector (CATC) system is to operate in conjunction with the Monochrome ATC system in reducing timing errors to values which allow reproduction of an excellent quality color picture. The timing errors, if not reduced, produce effects in the picture which fall into the two general categories mentioned above, geometric distortion and jitter. Geometric distortion includes various segmentation errors which result in picture distortions such as jogs, scallops, and indentations caused by video head quadrature error. The section on the *Vacuum Guide Adjustment* gives more specific information later in this manual. Segmentation errors are sufficiently minimized for monochrome picture reproduction by the monochrome ATC system; however, optimum color reproduction requires a considerably greater error reduction. A comparison of segmentation error effects between monochrome and color reproduction may be made by observing the fact that a picture displacement from line-to-line of 0.03 microsecond is hardly visible in a monochrome picture but represents a 40-degree color sub-carrier phase shift which in turn produces a serious hue shift in the color picture.

Time base jitter, inherent in all quadruplex recording processes, is caused by nonuniformities in the mechanical motions of the machine. The linelock/pixlock servo system is capable of reducing the residual jitter to a value of approximately 7.0 ns, which is generally satisfactory for monochrome operation

\*Optional Accessory

but which represents a 130-degree subcarrier phase shift, and is therefore intolerable for color.

### High-Band Operation

Through the use of new techniques it is now possible to record both color and monochrome pictures using the same set of standards. The high-band, as opposed to the earlier low-band standards, produces superior results particularly in color operation. The signal-to-noise is improved considerably, and the freedom from beats and moiré effects due to the inter-modulation problems encountered with low-band is even more of a step forward.

The new techniques result in more generations in dubbing being possible before the picture deterioration is excessive. Other improvements in the TR-70 have also increased the reliability and stability of operation in this machine.

### Operating Areas

As shown in figure 2 all operating areas are positioned for aiding the operator in recording or playback procedures. A functional table for conventional reference has been made of all modules, Series 400, 500, and 600 (p. 28). Three monitors are mounted directly above the transport panel as shown in figure 1. Each of these monitors has a row of selector push-buttons below and each is easily identified. Two of the monitors have individual controls which also have to be correctly adjusted.

### Audio Monitor

The Audio Monitor is located at the extreme top left of the machine and houses the high fidelity loudspeaker unit. The VU meter is situated adjacent to the warning indicators and functions in conjunction with the audio selector pushbuttons. Refer to instruction book IB-31861 for details. The designations and functions of the TR-70 are tabulated on p. 16.

### Picture Monitor

Two picture monitors are available—one for two line standard 525/625 operation, supplied with domestic machines and one international for three line standards 405/525/625 operation. Details for these monitors are given in instruction books IB-31203 and IB-32107, domestic and international, respectively. The monitor and system controls shown in figures 10 and 12 are described in tabular form. Figure 12 shows the monitor tilted forward 90 degrees to make the internal controls more accessible.

### CRO Waveform Monitor TO-4 (MI-556523)

The CRO Waveform Monitor provides monitoring for both color and monochrome television signals. All information as to the panel pushbuttons and internal controls is explained in detail in instruction book IB-31825. The list of CRO switcher selector buttons and their functions, is shown with figures 13 and 14.

### Illuminated Standards Selection

The large indicating switches located directly below the picture monitor are provided for selecting the desired operating standards. These include 7 $\frac{1}{2}$ /15 in/s tape speed, the line standards desired on international machines, and use of Low-Band Monochrome, High-Band, and Low-Band Color. Transfer of the machine from Local to Remote operation can be performed at this position, provided the machine has been equipped with a Remote Control panel. (See figure 4.)

### Tape Motion Detector and Play Control System

This system permits safe, direct transition from WIND to PLAY modes without having to actuate the stop button. Overstressing of the tape is automatically prevented by delaying contact of the capstan roller with the tape until after the tape has come to rest. The circuit also prevents transition from WIND to SETUP or RECORD modes while the tape is in motion. These features are particularly desirable in remote or automatic operation where it is not conveniently possible to ascertain when the tape has come to rest.

### Electronic Splicer (Optional Accessory)

The installation of two modules is all that is necessary to convert the TR-70 for electronic splicing. Indicators have been provided and associated connectors and cable harness installed for simplicity. Two operating modes are possible with the Electronic Splicer, ADD ON and INSERT. In an ADD ON operation, the new recording is merely added at the end of the old recording operation and therefore no outgoing splice is required. In an INSERT operation the new recording starts at any desired point but ends before the old recording. Therefore an outgoing splice as well as an ingoing splice is required. Some features of its application and essentials of operation are included on page 64. However, for detailed information refer to instruction book IB-31872.



### Color Dropout Compensator (Optional Accessory)

The Dropout Compensator module 620 provides the means to eliminate the effect of dropouts in the play back of a tape. A "dropout" is a brief reduction of RF carrier amplitude due to irregularities in the tape surface. On the screen the loss appears as a dis-

tracting streak. Multiple dropouts appearing in rapid succession can severely degrade the signal display. The dropout compensator prevents such effects by replacing the missing information with stored video from the previous line. Refer to page 31 for control functions. This unit is also capable of restoring information in color and of the correct phase.

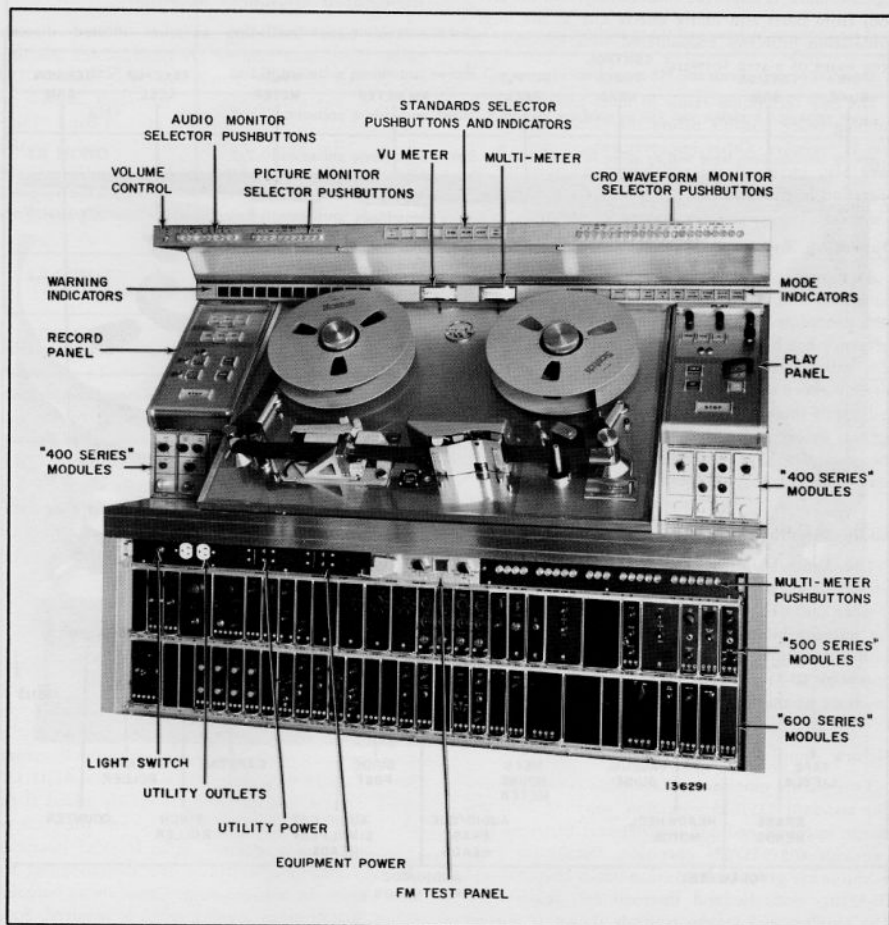


Figure 2—Operating Areas of TR-70 Tape Recorder

### Audio Spot Erasure

Two control buttons on the Erase Oscillator module 601 provide for the erasure by the audio erase head only of any spot by careful manual manipulation of the tape. Refer to the operating procedure on page 64.

The following photos and charts are presented as a means of explanation for the various controls and

pushbuttons used in the operational procedures for the machine. Some controls which fall more in the maintenance category are given here as a convenience. Individual operators will determine which category is applicable depending upon individual requirements. Many of the items may be considered as borderline, and experience will determine how they are to be handled.

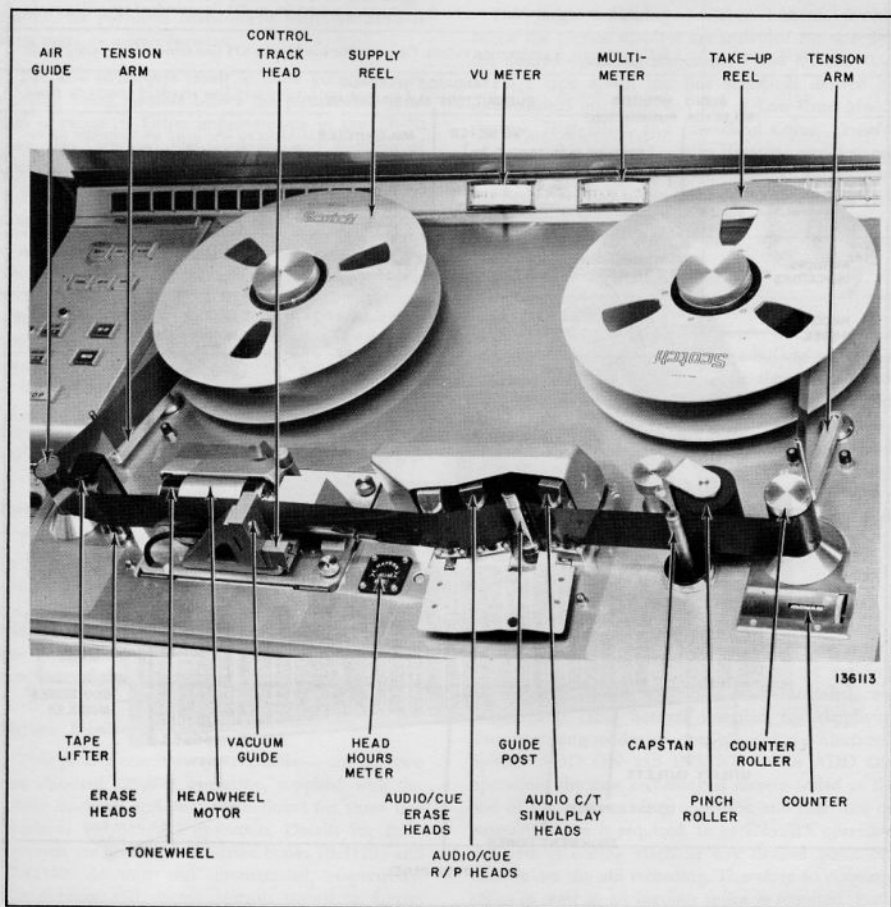


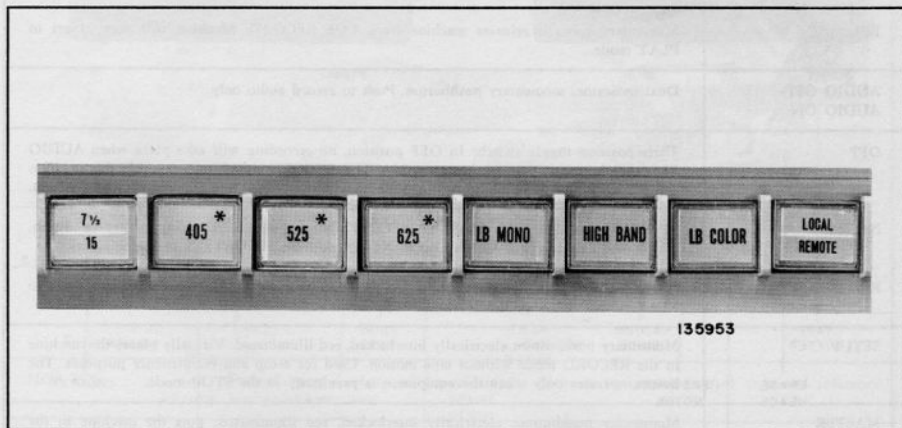
Figure 3—Tape Threaded on Transport Panel (Head Cover Removed)

## CONTROLS AND INDICATORS

### STANDARDS SELECTOR PUSHBUTTONS AND INDICATORS

Designation	Function
7½ 15	Capstan speed selector alternate action mechanically interlocked illuminated. In one position it selects 7½ in/s capstan speed, in the other position it selects 15 in/s.
405*	Self-illuminating pushbutton switch. Converts the machine to 405 line standard operating mode.
525*	Self-illuminating pushbutton switch. Converts the machine to 525 line standard operating mode.
625*	Self-illuminating pushbutton switch. Converts machine to 625 line standard operating mode.
LB MONO	Self-illuminating pushbutton switch converts the FM paths to low band monochrome parameters. This pushbutton can be selected on all line standards.
HIGH BAND	Self-illuminating pushbutton switch converts the FM paths to high band parameters for monochrome or color standards. This pushbutton can be selected in all line standards.
LB COLOR	Self-illuminating pushbutton switch converts FM paths to low-band parameters. This pushbutton can only be selected on 525 line standard.
LOCAL REMOTE	Self-illuminating alternate-action pushbutton switch is mechanically interlocked to provide choice of local or remote control when machine is wired for remote operation.

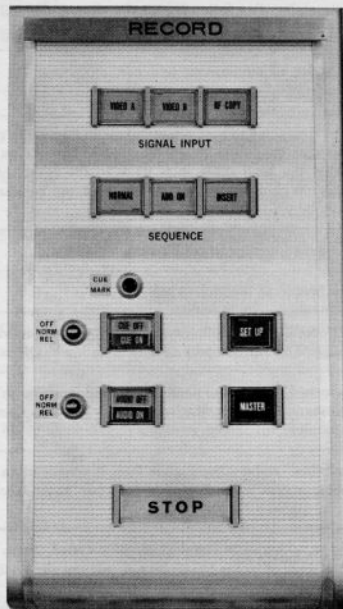
\*International machines only.



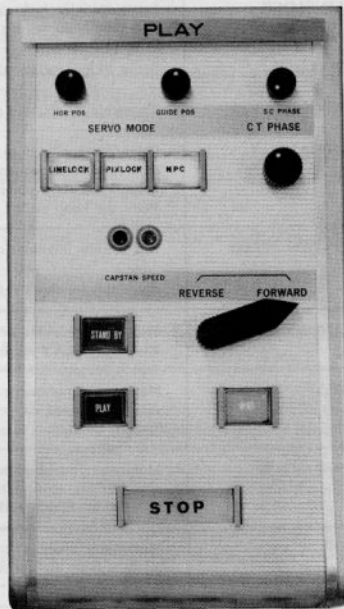
**Figure 4—Standards Selector Pushbuttons and Indicators**

## RECORD CONTROL PANEL

<i>Designation</i>	<i>Function</i>
VIDEO A	Illuminated pushbutton; selects one of two possible video inputs to the machine. Selects, also, Audio input A and Sync Loop A to correspond with Video A.
VIDEO B	Illuminated pushbutton; selects alternate Video input B, Sync Loop B, and Preview Audio input.
RF COPY	Illuminated pushbutton; selects RF input from an external tape machine which may be used in dubbing. The recording or copy is then made on the TR-70 as the slave machine.
NORMAL	Illuminated pushbutton; this is the switch selected unless electronic splicing is to be performed (Add On/Insert).
ADD ON	Illuminated pushbutton; for machines equipped with the electronic splicer. This button selects the circuitry required to make a splice for newly recorded material to continue after a previous recording.
INSERT	Illuminated pushbutton; used with splicer selects circuitry required to replace an existing segment of recording with new material. Both incoming and outgoing splices are made.
CUE MARK	Momentary pushbutton; causes a 400-Hz tone to be recorded over any existing information on the cue track without erasure of previously recorded information if in the PLAY mode. The circuit operates in the PLAY mode and in any of the record modes.
CUE OFF-CUE ON	Dual indicator; momentary pushbutton. Push to record cue only.
OFF	Three-position toggle switch. In OFF position, no recording will take place when either the MASTER or CUE RECORD button is pressed. CUE OFF indicator lights.
NORM	In NORM position, with MASTER RECORD button pressed, recording occurs in Cue, Video, and Audio tracks if Audio is also in the NORM position. CUE ON indicator lights.
REL	Momentary contact; releases machine from CUE RECORD. Machine will then revert to PLAY mode.
AUDIO OFF-AUDIO ON	Dual indicator; momentary pushbutton. Push to record audio only.
OFF	Three-position toggle switch; In OFF position, no recording will take place when AUDIO RECORD button is pressed, however, MASTER RECORD switch may override this position and the machine will record in Audio, Video, and Cue tracks if Cue is in the NORM position.
NORM	In NORM position, with MASTER RECORD button pressed, recording occurs in Audio, Video, and Cue tracks if Cue is also in NORM position. AUDIO ON indicator lights.
REL	Momentary contact; releases machine from AUDIO RECORD. Machine will then revert to PLAY mode.
SETUP	Momentary pushbutton; electrically interlocked, red illuminated. Virtually places the machine in the RECORD mode without tape motion. Used for setup and maintenance purposes. The button operates only when the equipment is previously in the STOP mode.
MASTER	Momentary pushbutton, electrically interlocked, red illuminated; puts the machine in the video, audio and cue record modes. An inhibit circuit prevents the machine from entering MASTER RECORD from the WIND mode until the tape motion has stopped.
STOP	Momentary pushbutton; horizontal bar type, electrically interlocked, white illuminated. Stops the machine from all modes of operation. Operation of either STOP button will place the machine in the STOP mode.



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Figure 5—Record Control Panel

Figure 6—Play Control Panel

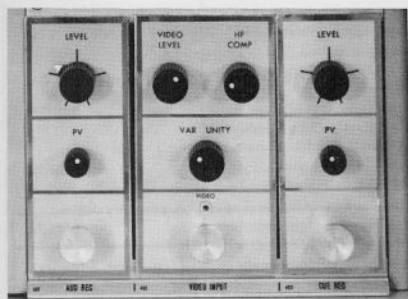
## PLAY CONTROL PANEL

<i>Designation</i>	<i>Function</i>
HOR POS	Potentiometer used to adjust coincidence between horizontal sync of tape and reference horizontal sync.
GUIDE POS	Potentiometer used to manually control the position of the head female guide in Playback.
SC PHASE	Potentiometer; used to make it possible to precisely adjust the phase of the tape machine so that when mixing various color sources, the phase of each is identical to that of the reference.

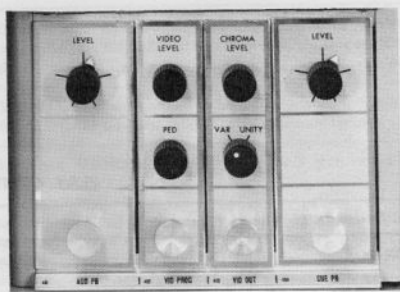


## PLAY CONTROL PANEL (Continued)

Designation	Function
Servo Mode	
LINELOCK	Servo initially locks vertically and horizontally, but following servos disturbance relocks horizontally to nearest line; disregards vertical coincidence.
PIXLOCK	Servo locks Horizontally and Vertically under all circumstances.
NPC	To enable satisfactory replay of non-phased color tapes.
CT PHASE	Potentiometer used to control capstan so that the heads sweep the recorded tracks on the tape in correct sequence. Also insures that the head scans each track in the center of its width to achieve maximum picture quality. With knob pushed in one track can be phased. With the knob pulled out four tracks may be phased.
CAPSTAN SPEED	Red Button increases capstan speed for synchronizing identical tapes. Black Button slows capstan speed for synchronizing identical tapes.
STANDBY	Momentary pushbutton; electrically interlocked, green illuminated. Puts the machine virtually in the PLAY mode without tape motion. The button operates only from the STOP mode.
PLAY	Momentary pushbutton; electrically interlocked, green illuminated. Puts the machine in the video, audio and cue play modes. See information on <i>Tape Motion Detector and Play Control System</i> , page 8.
WIND	Momentary pushbutton; electrically interlocked, amber illuminated. Puts the machine in the tape WIND mode. Direction and winding speed is controlled by the bar knob labelled REVERSE—FORWARD.
STOP	Momentary pushbutton; horizontal bar type, electrically interlocked, illuminated. Stops the machine from any mode of operation. Operation of either STOP button will put the machine in the STOP mode.



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Figure 7—Record Module Level Control Panels

Figure 8—Playback Module Level Control Panels

### AUDIO MONITOR SELECTOR PUSHBUTTONS

<i>Designation</i>	<i>Function</i>
SPKR VOL	Control; adjusts the volume of the monitor speaker by control of the monitor amplifier gain.
AUDIO PV	Pushbutton; when depressed allows monitoring of the PREVIEW input audio on speaker. That is, if input A is selected on channel input selectors on Record Panel, Preview button monitors B on speaker but not on VU.
AUDIO IN	Pushbutton; when depressed, the speaker monitors incoming line and the VU meter monitors the output of the record amplifier.
AUDIO REC	Pushbutton; when depressed, the speaker and the VU meter monitor the output of the Audio record amplifier.
AUDIO PB	Pushbutton; when depressed, the speaker and the VU meter monitor the output of the outgoing Audio line.
VU -10 db	Momentary pushbutton switch; reduces the sensitivity of the VU meter by -10 db to permit distortion measurements, or higher than normal signals.
CUE IN	Pushbutton; when depressed, the speaker monitors the incoming line and the VU meter monitors the output of the Cue record amplifier.
CUE REC	Pushbutton; when depressed, the speaker and the VU meter monitor the output of the Cue record amplifier.
CUE PB	Pushbutton; when depressed, the speaker and the VU meter monitor the output of the outgoing Cue line.

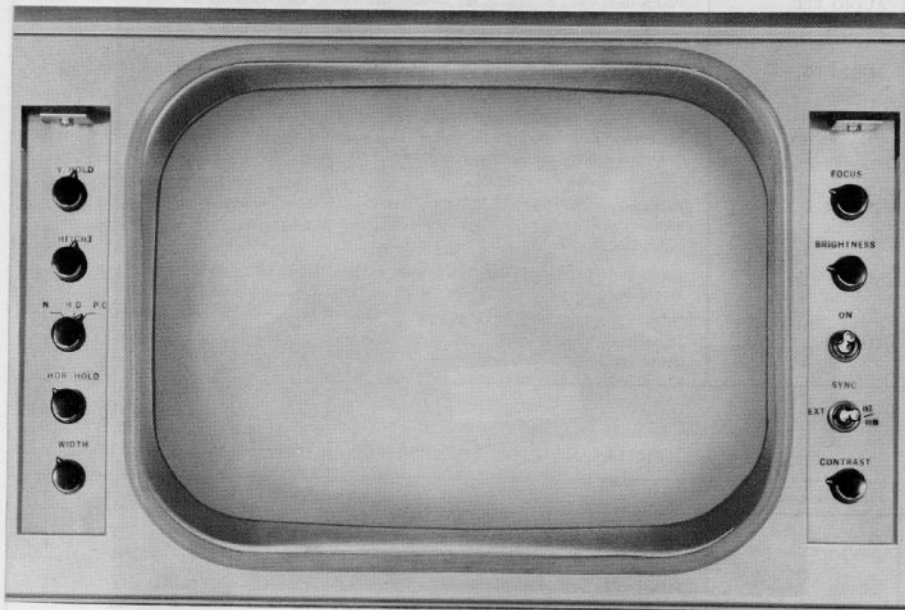
### PICTURE MONITOR SELECTOR PUSHBUTTONS

<i>Designation</i>	<i>Function</i>
PV	Selects video input B signal (preview line).
IN	Selects video input A signal.
DEMOD	Selects the video output signal of the Demodulator.
ATC	Selects video output from Mono ATC circuits.
CATC	Selects video output from Color ATC circuits.
OUT	Selects the outgoing video signal of the machine.
TW	Selects the TW pulse by a separately latched switch for superimposing on the picture monitor when the headwheel is running.
CH ID	Places a white bar on head no. 1 for identification purposes when Head Select Switch on Reference Generator Module 613 is in position 1.



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**Figure 9—Volume Control and Audio Monitor Selector Pushbuttons**



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**Figure 10—Picture Monitor with Controls**



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**Figure 11—Picture Monitor Selector Pushbuttons**

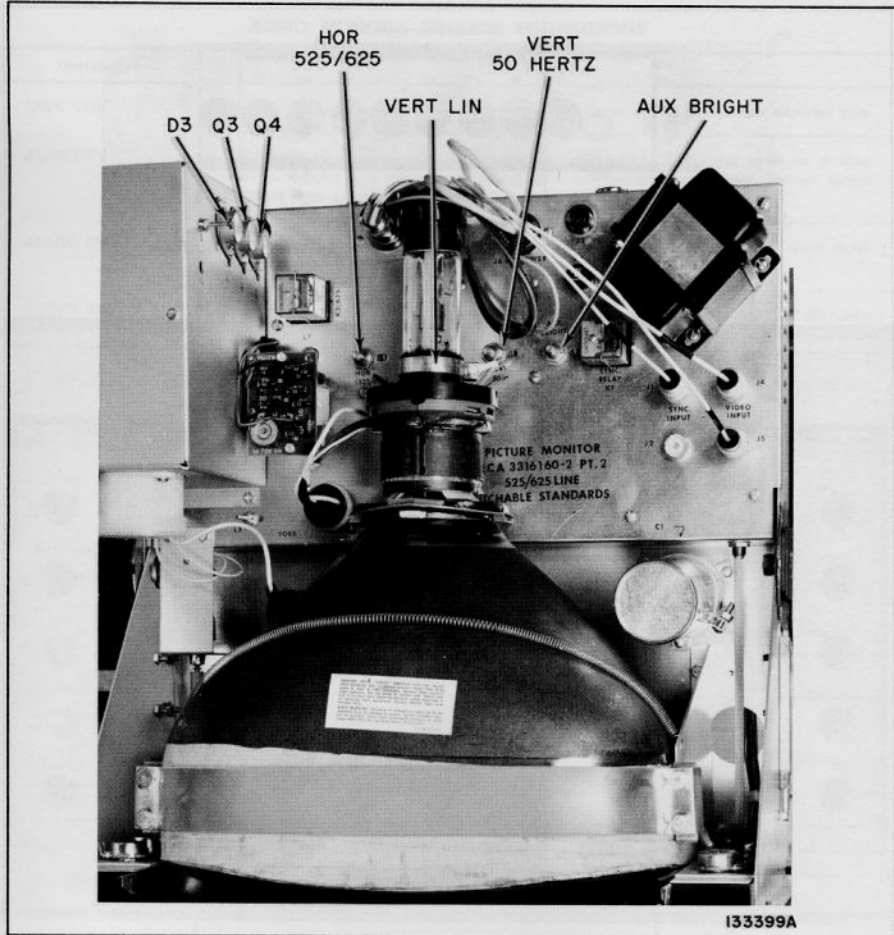
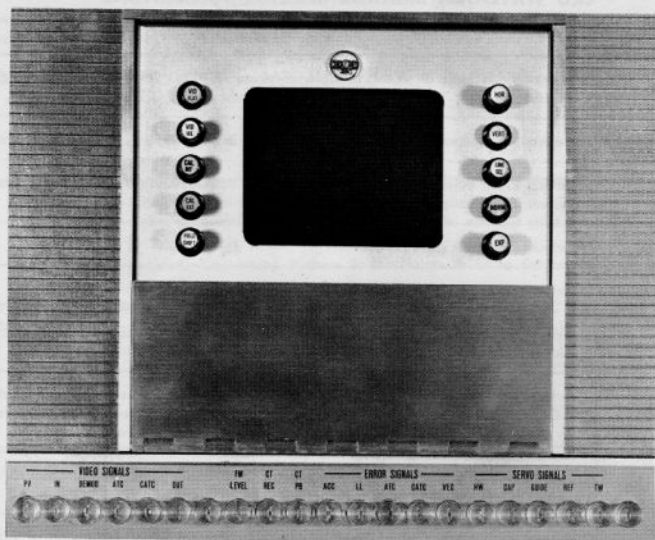


Figure 12—Picture Monitor Tilted Forward 90°

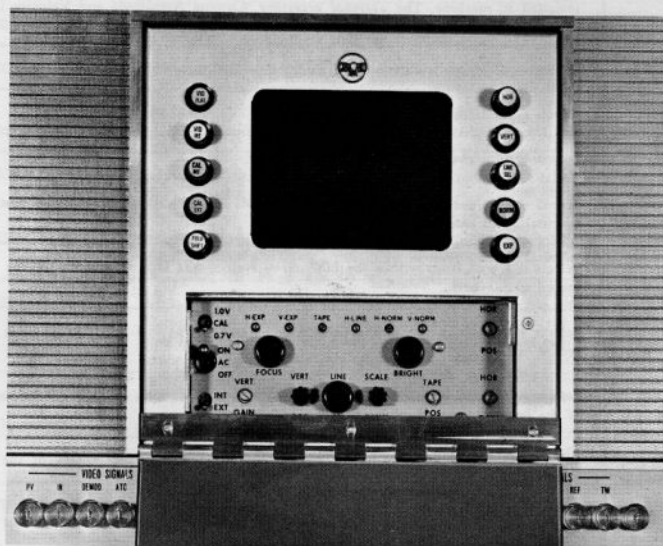
**PICTURE MONITOR INTERNAL CONTROLS**

<i>Designation</i>	<i>Function</i>
HOR 525/625	Potentiometer; adjusts frequency of horizontal oscillator.
AUX BRIGHT	Potentiometer; inserted into the circuit when the monitor is using external sync. Adjust for proper brightness in external operation.
VERT LIN	Potentiometer; adjusted for good linearity.
VERT 50-hertz	Potentiometer; switched into circuit when operating on 50-Hz. Adjust to lock vertical.



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Figure 13—CRO Waveform Monitor with Selector Pushbuttons



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Figure 14—CRO Waveform Monitor showing Panel of Setup Controls

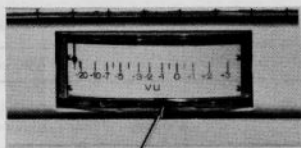


## CRO WAVEFORM MONITOR SELECTOR PUSHBUTTONS

<i>Designation</i>	<i>Function</i>
PV	Selects video input B signal, to allow checking of signal level and evaluation. (Momentary pushbutton.)
IN	Selects video input A signal to allow adjusting for the correct level into the system.
DEMODO	Selects video output signal of demodulator for determination of the proper operation of the system in E-E or playback modes.
ATC	Selects video out from ATC.
CATC	Selects video out from Color ATC.
OUT	Selects the machine outgoing video signal to allow level checking of the output signal, and aid in adjustment of processing.
FM LEVEL	Selects DC level of playback FM from P/B head amplifier. A feed from each amplifier before AGC is fed to the master equalizer module. It is then detected for its DC level, chopped by a 4X TW chopping signal to separate each head, and passed to CRO.
CT REC	Selects record current signal in the control track head during record. Used for setting the proper levels and phasing of the sine wave and frame pulse.
CT PB	Selects control track signal used in the capstan servo for determination of proper signal coming from the tape in record or by use of simulplay in record.
ACC	Selects error signal, derived by comparing line-by-line chroma levels when this unit is installed in machine. The <i>optional accessory</i> Chroma Amplitude and Velocity Error Corrector (CAVEC) must be installed.
LL	Selects error signal from horizontal comparator in Linelock Servo.
ATC	Selects error signal out of ATC Error module.
CATC	Selects error signal out of Color Error module.
VEC	Selects error signal obtained from comparing DC changes in ATC error signal when the unit is installed in machine.
HW	Selects a signal from within the HW servo system that indicates lockup of the system in record or playback.
CAP	Selects signals from within the capstan servo system that indicate lockup of the system in record or playback.
GUIDE	Selects a signal from within the guide servo system that assists in checking the performance of the system in record or playback.
REF	Selects the reference pulse for determination of the proper functioning of the reference generator.
TW	Selects the TW pulse for determination of the proper operation of the Tonewheel Processor in record or playback.
	NOTE: In the above CT, SERVO and PULSE positions, the CRO is on external sync and cannot be switched to internal sync.

## WARNING INDICATORS (RED)

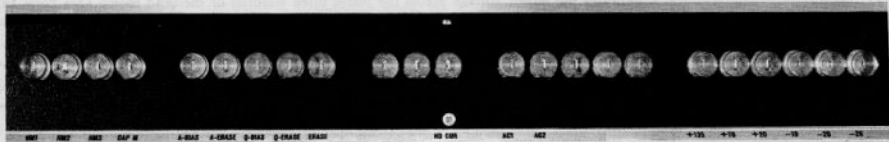
<i>Designation</i>	<i>Function</i>
MIC-AUDIO	Indicator illuminated when the switch on the Microphone module 504 is placed in the AUDIO position.
MIC-CUE	Indicator illuminated when the switch on the Microphone module 504 is placed in the CUE position.
SPOT	Indicates when SPOT ERASE pushbutton is depressed on the Erase Oscillator module 601 which is interlocked to operate only when the machine is in the STOP mode.
ERASE	Indicator illuminated if there is insufficient drive to the master erase head, in Setup or Record modes.
MOD FREQ	Indicator illuminated when carrier frequency of modulator is outside of the range of the modulator AFC circuit. Frequency is adjusted to extinguish light by vernier frequency control on Modulator module 510 with test selector switch in position 2, frequency.
HD CUR	Indicator illuminated if one or more of the video headwheel currents falls below a prescribed level.
HW UNLOCK	Indicator illuminated if the headwheel servo system does not lock up to the reference signal used in the system for any headwheel mode.
CAP DRIVE	Indicator illuminated if capstan servo drive is insufficient.
LOW CT	Indicator illuminated if the control track playback signal falls below a predetermined level. Operates in Record or Playback. Illuminated in STANDBY mode.
MODULE	Indicator illuminated if any module is removed from its position.
MAIN COOLING	Indicator illuminated if the main forced air cooling system is not operating. Machine goes to STOP mode automatically.
AUX COOLING	Indicator illuminated if the Record and Preamplifier air cooling system is not operating.
NS GUIDE REC	Indicator illuminated if Record control on Guide Servo module 506 is turned to manual while recording.
AIR PRESSURE	Indicator illuminated if there is insufficient air pressure to run an air bearing headwheel panel. Machine STOPS automatically, or will not run if pressure is too low.
FM TEST CH 1 CH 2	When Test select switch is off normal position and FM test button pushed the indicator illuminates to show which channel has been selected on the channel select ch 1 or ch 2 in head Record/PB channels 1 and 2. These indicators are mainly applicable on the noise and response position of the test select switch, showing which channel is being optimized. All these controls are located just above the top row of modules in the center of the machine.
FM TEST CH 3 CH 4	Functions for channels 3 and 4 as above.
TEST PROBE	Illuminated indicator shows that the Test Probe is not seated in its panel. The machine will remain in the stop mode in this condition. Circuitry prevents rotation of headwheel with probe in use.
REG COOLING	Illuminated indicator shows if regulator heat-sink blower fails.



ADJUSTMENT  
LEVER

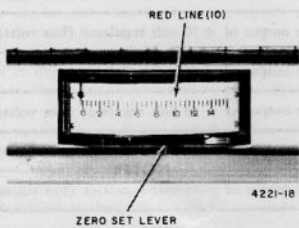
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Figure 17—VU Meter



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Figure 18—Multi-Meter Selector Pushbuttons



RED LINE(10)

ZERO SET LEVER

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Figure 19—Multi-Meter



LIGHT SWITCH

UTILITY OUTLET

UTILITY POWER

EQUIPMENT POWER

RECORD POSITION

MANUAL FIELD MANUAL AUTO

RECORD SET

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

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RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

501 CONTROL

502 SPL TIMING

503 SPL LOGIC

504

MISC

508

GUIDE SERVO

509

TW REF

509 MOD APC

510 MOD

511 REC EQ

512 REC AMP

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

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RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

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RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

RECORD POSITION

RECORD 1

RECORD 2

RECORD 3

RECORD 4

RECORD 5

RECORD 6

RECORD 7

RECORD 8

RECORD 9

RECORD 10

507

ERASE

507

508

509 CAP PA

510 HW PA

511 HW PA

512 HW PA

513 HW MOD

514 LINELOCK

515 TW SERVO

516 TW PROG

EQUIPMENT POWER

CH. NO. 1-4

CHANNEL SELECT

TEST

TEST SELECT

RES NOISE INPUT

RES NORM

REC AMP 1

REC AMP 2

REC AMP 3

REC AMP 4

PG 1

PG AMP 2

PG AMP 3

PG AMP 4

FM SW

FM EQ

FM FILTER

TW PROG

REF DEN

CAP OSC

CAP ERROR

CAP PHASE

CT AMP

IND

DO COMP

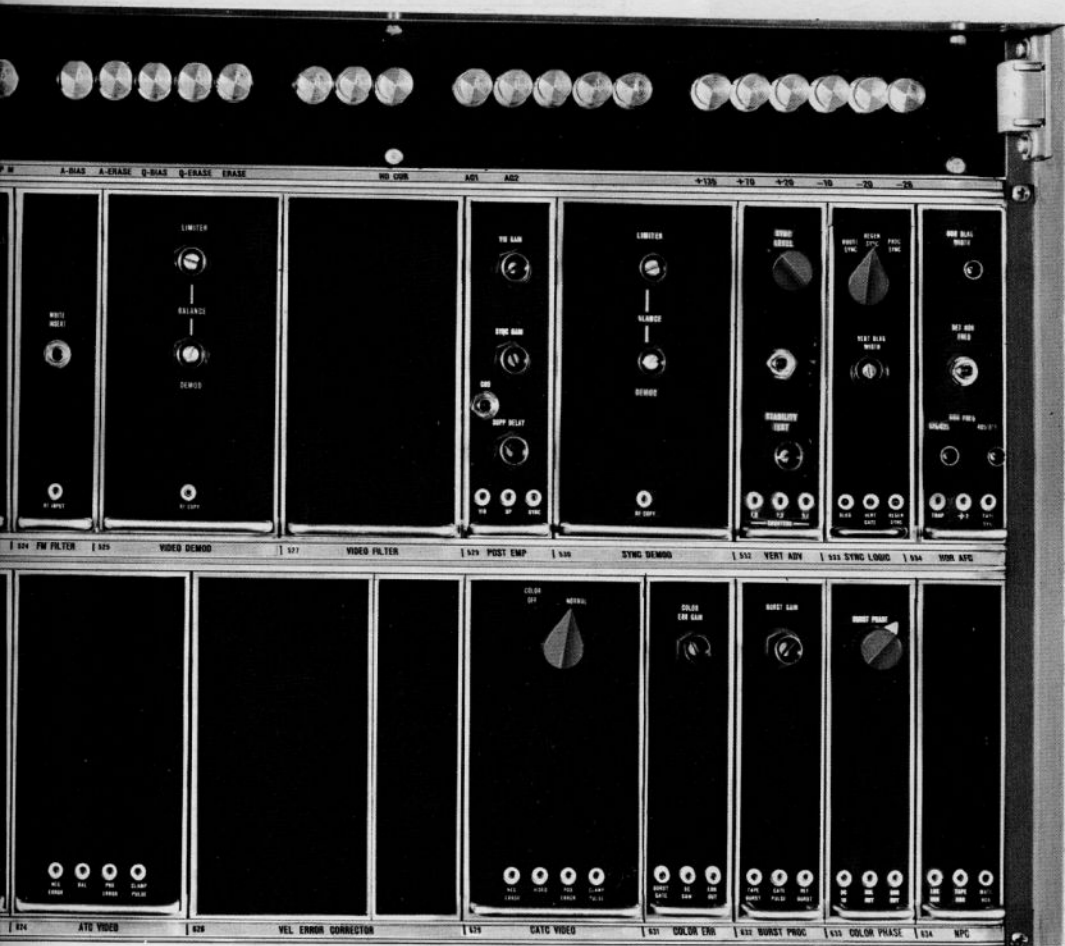
INT REF

YOP

ATO ERROR

136289





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Figure

## MODULE FUNCTIONAL DESCRIPTIONS

(Series 400, 500, and 600)

Designation	Module	MI-Number	Functional Description
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### RECORD CONTROL MODULES—SERIES 400 (See Figure 7)

401	Audio Rec	MI-35907	Amplifies incoming program audio signal to level required to drive the tape head for recording on the tape.
402	Video Input	MI-35908	Receives input video. Correctly terminates it. Corrects H/F response and feeds the various monitor points on the machine, CRO, etc. The main feed is then low pass filtered, correctly pre-emphasized for the standard in use, and passed at the right level to the modulator.
403	Cue Rec	MI-35907	Amplifies incoming cue channel signal to level required to drive the tape head for recording on the tape.

### PLAY CONTROL MODULES—SERIES 400 (See Figure 8)

431	Audio Playback	MI-40605A	Receives Audio signal from the Preamplifier and raises its level to the required amount to drive the outgoing lines.
432	Video Processor	MI-35910	In Play mode this module separates color and monochrome, clamps each separately, adjusts levels, reinserts blanking and burst, and passes the recombined video to the Video Output module. A second video feed is supplied from this module, Selected video. This is used to obtain tape sync for external use in E-E. Burst is not reinserted.
433	Video Output	MI-35911	This module provides 3 video outputs to line and 2 other composite feeds: one for picture monitor, the other for CRO. Sync is added in this module and on the three main feeds. Each feed has an internal switch which removes sync. The variable or unity gain of Video Proc operation is controlled from a switch on the front and the choice of local or remote sync gain is controlled by a relay in the module. This module also supplies an output of tape sync to the Sync Logic module.
434	Cue Playback	MI-40605A	Receives cue channel from the preamplifier and raises its level to the required amount to drive the outgoing line.

### MODULES—SERIES 500 (TOP ROW) (See Figures 21 thru 24)

501	Control	MI-35912	Part of control system. Provides inhibit logic and time delays.
502/503	Electronic Splicer (Accessory)	MI-43321/43322	Permits adding or replacing a sequence electronically in recorded color or monochrome video tape program material without mechanically cutting and rejoining tape.

## MODULES—SERIES 500 (Continued)

<i>Designation</i>	<i>Module</i>	<i>MI-Number</i>	<i>Functional Description</i>
504	Microphone	MI-40624A-S	Houses microphone and cable reel, with microphone amplifying circuits. Permits operator to record on either audio or cue tracks.
506	Guide Servo	MI-35913	Controls position of the guide to produce skew-free pictures. Functions in automatic or manual in playback, record, and record-set modes of operation.
508	FM Reference	MI-35914	Provides a white reference frequency keyed into the vertical blanking interval of the signal for check of FM deviation. Also provides the crystal-controlled reference frequency for the modulator AFC.
509	Modulator AFC	MI-35915	Provides precise control of the FM modulator black level frequency in accord with the crystal-controlled reference frequency from FM Reference module.
510	Modulator	MI-35916	Clamps pre-emphasized video at black level to modulate a capacity-diode-controlled heterodyne type modulator. Circuitry included for RF copy facility.
511	Record Equalizer	MI-35917	Provides compensation of the record drive signal so that constant current in the video head is maintained over the FM passband.
512/513/ 514/515	Record Amplifiers (Channels 1, 2, 3, 4)	MI-35918	Four identical modules. Output from record equalizer is increased in level to a value sufficient for recording on tape.
518/519/ 520/521	Playback Amplifiers (Channels 1, 2, 3, 4)	MI-35919	Provides amplification AGC control, head resonance compensation, and aperture compensation for correcting the playback characteristic of head channels.
522	FM Switcher	MI-35920	Switches between heads during playback, connecting the head scanning the tape to the output. Includes separate switching for two output channels; one for the picture, one for sync.
523	FM Equalizer	MI-35921	Provides additional aperture compensation for the overall playback equalization characteristic. Also includes control circuits for the head resonance test mode.
524	FM Filter	MI-35922	Provides the precisely controlled overall response characteristic required for optimum signal-to-noise ratio and frequency response of the tape playback system.
525	Demodulator (Video)	MI-35923	The FM signal is limited and demodulated to push-pull video.
527	Video Filter	MI-35924	Provides the low-pass filter characteristic after demodulation required for optimum noise, moire and frequency response. Appropriate filters are selected for each FM standard.
529	Post-Emphasis	MI-35925	Includes the necessary post-emphasis characteristic for the demodulated video, and also provides switching transient suppression and video line output functions.

**MODULES—SERIES 500 (Continued)**

<i>Designation</i>			<i>Function</i>
530	Demodulator (Sync Channel)	MI-35923	The FM signal is limited and demodulated for the sync channel.
532	Vertical Advance	MI-35927	Special circuitry counts out the number of pulses in a field to determine very accurately the position for regenerated vertical blanking.
533	Sync Logic	MI-35928	Generates horizontal and vertical blanking; combines them into composite blanking. Combines tape sync and regenerated horizontal sync into composite regenerated sync. Generates a start pulse which phases the counting of the vertical advance circuitry.
534	Horizontal AFC	MI-35929	Sync separated for the color corrected video signal is used to control the frequency and phase of a multi-vibrator. This, in combination with other circuits, generates a new horizontal sync, front porch, and blanking.

**MODULES—SERIES 600 (BOTTOM ROW) (See Figures 25 thru 28)**

601	Erase Oscillator	MI-40636A-S	Supplies 87.5 kHz erase and bias current to the audio, cue, and master erase heads. Also includes audio spot erase.
605	Capstan PA	MI-43384A	Power amplifier provides power sufficient to drive the capstan motor.
606-608	Headwheel Motor PA1, 2, 3 (Interchangeable with 605)	MI-43384A	Power amplifiers for the three phases required by the headwheel motor. (Identical modules)
609	Headwheel Modulator	MI-35926	Amplitude-modulates the headwheel motor-drive sine waves. Gives wide-band three-phase output.
610	Linelock	MI-35932	Provides line-by-line lockup in the Pixlock and Linelock modes.
611	Tonewheel Servo	MI-40627C-S	Derives error signal controlling the headwheel motor in all servo modes of operation.
612	Tonewheel Processor	MI-35953	Shapes the tonewheel pulse and also provides 4X TW switcher drive and 2X TW to HW motor for drive.
613	Reference Generator	MI-35933	Processes local sync to produce horizontal-rate reference, field-rate reference and frame-rate reference.
614	Capstan Oscillator	MI-35954	DC error voltage controls the frequency of the oscillator which supplies the drive frequency for the capstan motor. Tape speed is thereby synchronized to local reference.

## MODULES—SERIES 600 (Continued)

<i>Designation</i>	<i>Module</i>	<i>MI-Number</i>	<i>Functional Description</i>
615	Capstan Error Detector	MI-35934	A phase detector which compares incoming pulse to the local frame pulse and produces a DC voltage proportional to the magnitude of the phase error.
616	Capstan Phase	MI-40647B	The control-track pulse feeds a chain of binary counters which divide the pulse frequency by eight to produce a 30-Hz output pulse.
617	Control Track Record/Playback	MI-40632A-S	In record, processes a 240-Hz tonewheel signal to apply it as a sine wave to the tape; in P/B, processes the 240-HZ signal from C/T head and converts it into a pulse for the counter chain in the module.
618	Indicator	MI-35935	Senses machine performance and lights warning indicators in the event of malfunction.
620	Dropout Compensator (Accessory)	MI-35937	During a dropout, a delay line supplies the video signal by substituting stored information from the previous scan line. The video is supplied on demand thru a fast-acting diode switch.
621	Internal Reference	MI-35938	Provides AFC locked to the tape horizontal sync to provide precise timing of all switching, transient suppression, sync gating and ATC pulses.
622	Tape Sync Processor	MI-35939	Separates tape sync from the sync channel video and provides approximate noise immunity and transient gating for all sync functions.
623	ATC Error Detector	MI-35940	The time base error of the separated tape sync is measured and converted to the necessary control signal for ATC.
624	ATC Video	MI-35941	Contains the variable delay line and driver circuits for the ATC function.
629	Color ATC Video	MI-35942	Contains the variable delay line and river circuits for the Color ATC function.
631	Color Error	MI-35943	Color time base errors are detected to provide the control signal for Color ATC.
632	Burst Processor	MI-35944	Provides separation of burst from the tape signal for the color error detector. Also includes circuits for shaping the new burst from local subcarrier.
633	Color Phase	MI-35945	Provides adjustment of regenerated burst phase and system sub-carrier phase.
634	Non-Phased Color	MI-35946	Provides necessary pulse circuits for control of the non-phased color mode.



## MODULE CONTROL FUNCTIONAL DESCRIPTIONS

### MODULE CONTROLS—SERIES 500 (TOP ROW)



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Figure 21—Control Panels for Modules 501 thru 509

Designation	Function
<b>Splice Timing Module 502*</b>	
SPLICE RECORD HOR PHASE	Multi-turn potentiometer; used to adjust headwheel phasing to coincide incoming horizontal phasing with playback horizontal phasing taking machine delay into account.
ERASE TEST	Two momentary pushbuttons connected in series. Both buttons are depressed during playback of tape. By observing FM LEVEL on CRO, indicates at which point a splice will occur.
ERASE DELAY	Screwdriver-adjusted potentiometer, while looking at FM LEVEL on the CRO and simultaneously pressing the erase test PB's, adjust until erase pulse occurs 1½ bands after the band containing the vertical frame pulse.
<b>Splice Logic Module 503*</b>	
Selector Control	
CAP ADJ/FIXED TW VAR TW	Three-position toggle switch; CAP ADJ position is spring loaded and is used when setting up the splicer in the Add-On mode and feeds a DC error voltage to the capstan servo.
	FIXED TW position used when playing back a recording made on the same machine, and in this position, disables the "splice record horizontal phase" control on module 502 and other "shift" circuits.
	VAR TW position, used when playing back tapes from another machine enabling correct splice phasing.
CAPST ADD ON ADJUST	Screwdriver-adjusted potentiometer; used when holding toggle switch in the CAP ADJ position and observing CAP SERVO on CRO to set pip on slope of trapezoid waveform.

\*Modules 502 and 503 are not supplied with standard TR-70 Recorder; these modules are available as accessories.

## MODULE CONTROLS—SERIES 500 (Continued)

<i>Designation</i>	<i>Function</i>
<b>Microphone Module 504</b>	
LEVEL	Control, variable; permits adjusting the gain of the microphone preamplifier.
AUD-OFF-CUE	Three-position toggle switch; OFF position, microphone is disconnected and the cue and audio input lines are connected to the recording circuits; in AUD or CUE position the microphone is connected to the selected circuit and the corresponding input line is disconnected.  NOTE: The microphone is attached to a cord reel behind the panel and can be easily pulled out to the desired position.
<b>Guide Servo Module 506</b>	
RECORD GUIDE POSITION	Potentiometer control; adjusts the position of the vacuum guide in a direction parallel to the tape transport panel when the machine is in the Record mode. Switch below must be in MANUAL.
RECORD MANUAL/FIXED	Switch in MANUAL position allows guide to be controlled by Record Guide position potentiometer. In fixed position, the guide is controlled by the setting of the hex nut on the head-wheel panel.
PLAYBACK MANUAL/AUTO	Switch in MANUAL allows control of the guide by the guide position potentiometer on the play panel. In AUTO, the guide position is continuously corrected by the Automatic Guide Servo.
RECORD SET	Pushbutton momentary contact switch; inserts the record Guide Position control in place of the PB Guide position control when the machine is set up in the Play condition. This permits the calibration of the Record Guide Position control while an alignment tape is being played back.
ZERO AUTO	Screwdriver-adjusted potentiometer; determines the optimum position, or the point at which the vacuum guide servo stabilizes when the circuit is in the automatic condition.
<b>FM Reference Module 508</b>	
SWEEP LEVEL	Screwdriver adjusted potentiometer adjusts level of 60-Hz sawtooth which goes to modulator and in the test mode drives the oscillators to produce the correct sweep signal.
<b>Modulator AFC Module 509</b>	
E-E OFF ON	Two-position selector switch. OFF position connects video PB heads to all playback amplifiers and allows noise to pass through the complete FM and Video system to the machine output. ON position feeds the modulated signal to the demodulator systems which allows video from the input to pass through the processing system and on to the machine output for checking purposes.
<b>Modulator Module 510</b>	
VERNIER FREQ	Screwdriver-adjusted potentiometer; permits a fine adjustment of the carrier frequency.
DEVIATION	Screwdriver-adjusted potentiometer adjusts the level of video into the modulator. Sets the frequency swing of modulator for peak white with reference to carrier frequency.

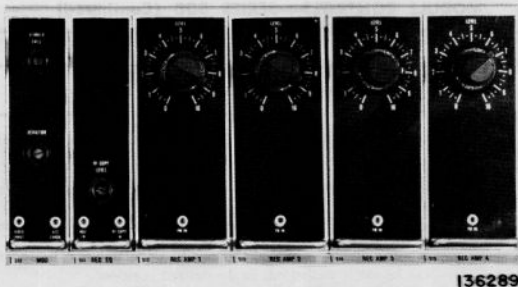


Figure 22—Control Panels for Modules 510 thru 515

MODULE CONTROLS—SERIES 500 (Continued)

Designation	Function
<b>Record Equalizer Module 511</b>	
RF COPY LEVEL	Screwdriver-adjusted potentiometer; allows adjustment of RF level feeding the record modules from an external playback machine when the record machine is used as a slave in the RF copy system.
<b>Record Amplifier Modules 512-515</b>	
LEVEL	Provides continuous control for adjustment of the amplitude of the four record currents fed into the video heads to the optimum values for the particular headwheel panel in use. Outer knob provides a locking device.
<b>Playback Amplifier Modules 518-521</b>	
RESISTANCE	Screwdriver-adjusted potentiometer; adjusts response of P/B. Is used to match heads and give linear overall response. Curve may be tilted.
REACTANCE	Screwdriver-adjusted capacitor; works in conjunction with Resistance above to tune response of P/B amplifier to match heads for flat-overall response (See waveforms figure 37A).
EQUALIZER	Control; adjusts individual playback channel 1, 2, 3, or 4 for best frequency response.
MGC	Screwdriver-adjusted manual gain control; sets the output level of the playback amplifier for head resonance test.
<b>FM Switcher Module 522</b>	
RF COPY/NORMAL	Rotary switch; RF COPY feeds FM playback output of the machine to second slave machine for use in RF copy dubbing. NORMAL is used for all other modes.
SW DELAY	Screwdriver-adjustment; sets switcher-timing for correct head channel switching during RF copy.
<b>FM Equalizer Module 523</b>	
STEP	Five-position switch selects taps on a coil to give coarse equalization.
EQUALIZER	Potentiometer; gives fine adjustment for best equalization.

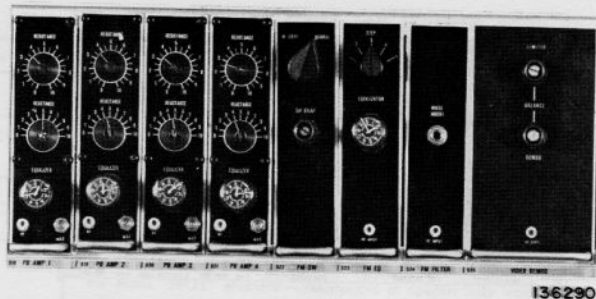


Figure 23—Control Panels for Modules 518 thru 525

MODULE CONTROLS—SERIES 500 (Continued)

Designation	Function
<b>FM Filter Module 524</b>	
WHITE INSERT	Momentary-contact pushbutton switch; places a peak white reference pulse on the output of the demodulator in play back.
<b>Video and Sync Demodulator Modules 525 and 530</b>	
Balance Controls LIMITER	Screwdriver-adjusted potentiometer; permits adjusting of limiter circuit so that the input to the demodulator is limited symmetrically at the positive and negative peaks.
DEMODO	Screwdriver-adjusted potentiometer; adjusted to balance the RF to a minimum while observing Demod Out on CRO.
<b>Post-Emphasis Module 529</b>	
VID GAIN	Screwdriver-adjusted potentiometer; permits adjustment of video output level of module.
SYNC GAIN	Screwdriver-adjusted potentiometer; permits adjustment of sync channel output level of module.
CRO	Momentary-contact pushbutton switch; permits monitoring of sync channel output in CRO demodulator position.
SUPP DELAY	Screwdriver-adjusted potentiometer; permits positioning of front porch clamp pulse to suppress switching transients. Used in RF copy only.
<b>Vertical Advance Module 532</b>	
SYNC LEVEL	Rotary attenuator controls level of sync output of video output module.
STABILITY TEST	Momentary-contact pushbutton switch; inserts the STABILITY TEST potentiometer in the vertical advance circuits.
	Screwdriver-type potentiometer; varies the supply voltage to the counters as it is rotated through its range while the pushbutton is depressed. Change in count indicates trouble.

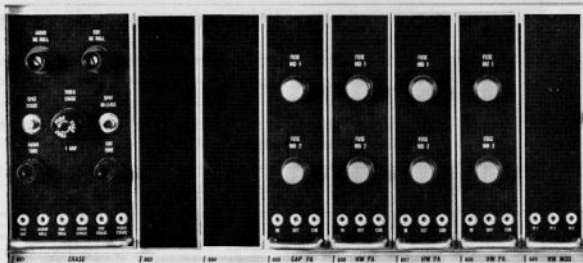


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Figure 24—Control Panels for Modules 525 thru 534

## MODULE CONTROLS—SERIES 500 (Continued)

Designation	Function
<b>Sync Logic Module 533</b>	
HOUSE SYNC/ REGEN SYNC/PROC SYNC	Three-position switch; permits selection of three types of sync: House—for use in full pix-lock mode only; Regenerated—for use with tapes having sync problems; and Processed—for use with normal tapes. Indicators show when using EXT house SYNC or REGEN SYNC.
VERT BLKG WIDTH	Screwdriver-adjusted potentiometer; adjusts the width of the regenerated vertical blanking.
<b>Horizontal AFC Module 534</b>	
HOR BLKG WIDTH	Screwdriver-adjusted potentiometer; adjusts width of regenerated horizontal blanking.
SET HOR FREQ	Momentary-contact pushbutton; breaks AFC path to 2H oscillator to allow free-running center frequency setting.
HOR FREQ 525/625 405/819	Screwdriver-adjustment; controls frequency of oscillator on 525/625 line standards
	Screwdriver-adjustment; controls frequency of oscillator on 405/819 line standards.



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Figure 25—Control Panels for Modules 601 thru 609

## MODULE CONTROLS—SERIES 600 (BOTTOM ROW)

Designation	Function
<b>Erase Oscillator Module 601</b>	
AUDIO DC NULL	Screwdriver-adjusted potentiometer; adjusted for near-zero volts output at TP2 (best signal to noise).
CUE DC NULL	Screwdriver-adjusted potentiometer; adjusted for near zero volts output at TP3 (best signal to noise).
SPOT ERASE	Pushbutton (with a hold-on circuit); when pushed, energizes the AUDIO ERASE HEAD for small "SPOT" erasures — interlocked to operate only when machine is in STOP mode.
VIDEO ERASE	FUSE.
SPOT RELEASE	Pushbutton; releases the above hold-on circuit.
AUDIO TUNE	Capacitor to be adjusted for the most symmetrical waveform at TP4.
CUE TUNE	Capacitor to be adjusted for best waveform at TP5.
<b>Linelock Module 610</b>	
LF GAIN	Screwdriver-adjustment; initially adjusted to one-half from fully ccw position. Adjusts low frequency gain of linelock servo.
VEL GAIN	Screwdriver-adjustment; initially adjusted to two-thirds from fully ccw position. Adjusts velocity gain of linelock servo.
DELAY	Screwdriver-adjusted potentiometer; adjusted to produce 4166 microsecond width positive pulse at TP2 (4000 microsecond, 50-Hz International Standards).
TVA-DELAY SET	Toggle Switch; in TVA position, adjust TVA potentiometer to sample at the center of the trapezoid slope.
	In DELAY SET position; adjust the Delay potentiometer to give correct pulse as given above.

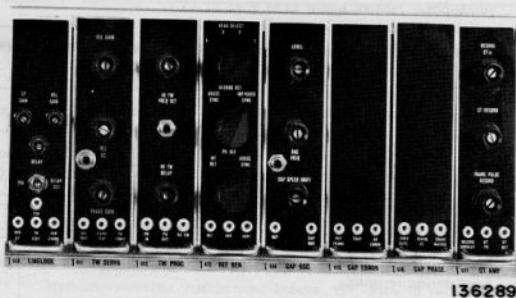


Figure 26—Control Panels for Modules 610 thru 617



## MODULE CONTROLS—SERIES 600 (Continued)

<i>Designation</i>	<i>Function</i>
<b>TW Servo Module 611</b>	
VEL GAIN	Screwdriver-adjusted potentiometer; permits adjusting the gain of the velocity loop in the TW servo system.
VEL TC	Screwdriver-adjusted potentiometer control; permits adjusting the time-constant of the velocity loop for correct headwheel speed when VEL TC button is held down.
VEL TC	Momentary-contact pushbutton switch; opens the phase loop for adjustment of velocity time constant with the VEL TC control.
PHASE GAIN	Screwdriver-adjusted potentiometer; permits adjusting the gain of the phase loop in the tonewheel servo system.
<b>TW Processor Module 612</b>	
4X TW	Screwdriver-adjusted potentiometer; permits adjusting the frequency of the 4X TW signal for the FM switcher and servo circuits.
FREQ SET	Momentary-contact pushbutton switch; opens the AFC circuit to permit adjusting the frequency of the 4X TW signal.
4X TW DELAY	Screwdriver-adjusted potentiometer; varies the delay of the 4X TW pulse for the FM switcher timing.
<b>Reference Generator Module 613</b>	
HEAD SELECT	Four-position selector switch; selects which of the four video heads play back vertical gain.
RECORD REF	Selects House Sync or separated sync from the Input-Video Sync for servo reference in the Record mode.
PB REF	Selects internal reference from the Reference Generator or House Sync for servo reference in the Play mode.
<b>Capstan Oscillator Module 614</b>	
LEVEL	Screwdriver-adjusted potentiometer; adjusts the amplitude of the drive signal fed to the single-phase capstan motor (120 V in PLAY).
OSC FREQ	Screwdriver-adjusted potentiometer; adjusts the frequency of the capstan servo oscillator when the pushbutton is pressed.
	Momentary-contact pushbutton switch; press to operate OSC FREQ control.
CAP SPEED SHIFT	Screwdriver-adjusted potentiometer; adjusts rate of change in capstan speed when fast capstan speed button is pressed. Usually set for 69Hz in fast condition (15% higher).
<b>CT Amplifier Module 617</b>	
RECORD CT $\phi$	Screwdriver-adjusted potentiometer; adjusts the phase of the signal fed to the control track head during recording.
CT RECORD	Screwdriver-adjusted potentiometer; adjusts the amplitude of the tonewheel derived signal fed to the control track head.

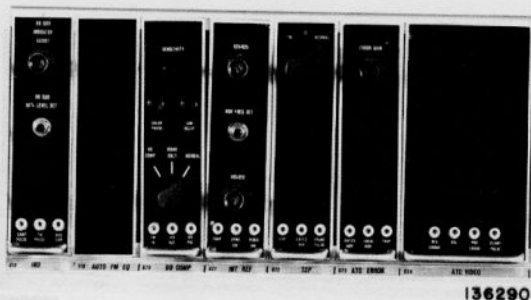


Figure 27—Control Panels for Modules 618 thru 624

MODULE CONTROLS—SERIES 600 (Continued)

Designation	Function
FRAME PULSE RECORD	Screwdriver-adjusted potentiometer; adjusts the amplitude of the frame pulse superimposed on the control track signal during record.
<b>Indicator Module 618</b>	
HD CUR INDICATOR ADJUST	Screwdriver-adjustment; used to adjust the threshold level of the HD CUR INDICATOR in conjunction with 90% level Test Switch.
HD CUR 90% LEVEL SET	Momentary-contact pushbutton; places an attenuator in the path to the indicator, so that the adjustment for threshold level is made when pushed. The attenuator is the amount of change allowed before indicator lights.
<b>Dropout Compensator Module 620*</b>	
SENSITIVITY	Knob-adjusted potentiometer; adjusts sampled RF to amplitude desired for dropout sensitivity range.
COLOR PHASE	Screwdriver adjustment; adjusts SC (sub-carrier) phase of reinstated color information.
LUM DELAY	Screwdriver adjustment; adjusts the position of the reinstated information to match the position of the dropout.
Selector Switch NO COMP	Three-position rotary switch; signal passes with no dropout compensation in this position.
MONO ONLY	If dropout occurs, inserts video information from previous line. Complete system operating for monochrome specifications.
NORMAL	If dropout occurs during color replay, reinserts video covering complete color specifications.
<b>Internal Reference Module 621</b>	
525/625	Screwdriver adjustment; controls frequency of horizontal frequency oscillator on 525/625 line standards.
HOR FREQ SET	Momentary-contact pushbutton; breaks AFC path to oscillator to allow frequency setting.
405/819	Screwdriver adjustment; controls frequency of horizontal oscillator on 405/819.

\*Optional Accessory

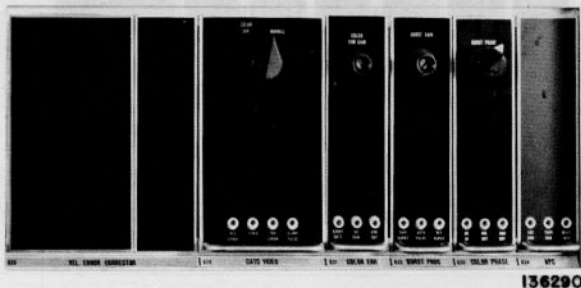


Figure 28—Control Panels for Modules 626 thru 634

MODULE CONTROLS—SERIES 600 (Continued)

Designation	Function
<b>Tape Sync Processor Module 622</b>	
TW-SL NORMAL	Three-position selector switch; selects two of the four servo modes of operation during playback: Tonewheel and Switchlock. Linelock and Pixlock are selected by additional push-buttons on the play panel when this switch is in NORMAL.
<b>ATC Error Module 623</b>	
ERR GAIN	Screwdriver-adjusted potentiometer; adjusted for minimum jogs in picture with 1-microsecond guide error.
<b>Color ATC Video Module 629</b>	
COLOR OFF/ NORMAL	Two-position rotary switch; NORMAL is the usual operating position for color and monochrome tapes. COLOR OFF position causes the CATC delay line to be clamped to a nominal value and kill the burst at the processor amplifier output.
<b>Color Error Module 631</b>	
COLOR ERROR GAIN	Screwdriver-adjusted potentiometer; when slight error is introduced (i.e., not exceeding 50 IRE units on the CRO) adjust control for best color presentation by using either a vector-scope or external color monitor. Adjust for minimum banding on picture monitor or minimum dot size on a vectorscope using color bars.
<b>Burst Processor Module 632</b>	
BURST GAIN	Screwdriver-adjusted potentiometer; utilized in setting the level of the regenerated burst.
<b>Color Phase Module 633</b>	
BURST PHASE	Potentiometer; used in adjusting the machine to obtain a proper color picture containing natural flesh tones, correct color bars, etc.

NOTE: Before operating the machine in Playback or Record the following pages should be studied carefully to become familiar with all the operating procedures; then return to the appropriate section as required.

## ROUTINE OPERATION

### Cleaning

For proper operation of the tape recorder, all components along the tape path must be kept clean. Proper cleaning results in improved headwheel and tape life. It also reduces scratches which produce objectional noise pulses in the picture. Excessive oxide pileup on the heads may cause loss of picture information. Only lint-free tissues and a good solvent are required. Freon TF is the recommended solvent and is available from:

John B. Moore Corporation  
Peerless Building  
P.O. Box No. 3  
Nutley, New Jersey

### Tape Transport Panel

Clean the following components and assemblies on the tape transport, as shown in figures 3 and 29, using lint-free tissues (such as Kim Wipe, Kimberly Clark Corp. Stk. No. 900S) moistened with the solvent:

Supply Reel Tension Arm  
Air Guide  
Master Erase Head  
Audio Heads  
Tape Edge Guide  
Capstan and Capstan Pinch Roller  
Takeup Reel Tension Arm  
Counter Roller  
Headwheel Panel

### Headwheel Panel and Audio Heads

The cleanliness of the video heads and vacuum guide is particularly important. Refer to figure 29. Open the headwheel cover and proceed as follows:

1. Open the vacuum guide by pressing the vacuum guide release lever up, at the same time pushing the vacuum guide down, until it pivots downward.

**CAUTION:** Do not use a brush to clean any area of the headwheel panel.

2. Clean the headwheel rim and video heads with a tissue dampened with solvent. Rotate by turning the tonewheel. Do not touch headwheel with fingers after cleaning. The headwheel may not turn easily without air, as in the STOP mode. Press the **STANDBY** button and then the **STOP** button to supply air to the motor. This will free the rotor and allow rota-

tion by hand several seconds after the rotor has come to a stop.

3. Clean the vacuum guide by wiping the tape supporting surfaces with a tissue dampened with solvent. Care should be taken to protect the tape supporting surfaces from scratches. Make sure that the vacuum passages in the guide are clear.

4. Clean the control track record/playback head by wiping with a lint-free tissue.

**NOTE:** Extreme care should be taken to prevent solvent from getting into the eccentric shaft bearing and slip ring brush housing area.

5. Completely clean all areas around the exposed locations to remove loose oxide and dirt not accessible in above steps.

6. Tilt the lower section of the audio head cover downward, by pulling it away from the tape path. Clean the audio heads, and be especially critical of small accumulations on the pole tips.

### Degaussing Headwheel Panel and Audio Heads

The video, control track, and audio heads may have become slightly magnetized due to usage. If they are not periodically demagnetized (degaussed) noise, distortion and loss of normal frequency response may result. A demagnetizer is supplied with the machine. The general procedure is as follows:

1. Remove any tape from the tape path.
2. Plug the demagnetizer in the machine utility outlet at the left of the circuit breaker panel.
3. Place the tip of the degausser close to the pole tip of the head to be demagnetized and slowly move the tip of the degausser in a rotary fashion a few times, then gradually pull it away from the head.
4. On the rotary headwheel where four heads are involved, rotate to the next head using the tonewheel to turn the wheel by hand. See step 2 on page 41 regarding the air supply while cleaning.
5. Be sure to degauss the control track head on the headwheel panel vacuum guide.

**CAUTION:** Do not damage the wires for the slip rings, video heads, or other parts with degausser.

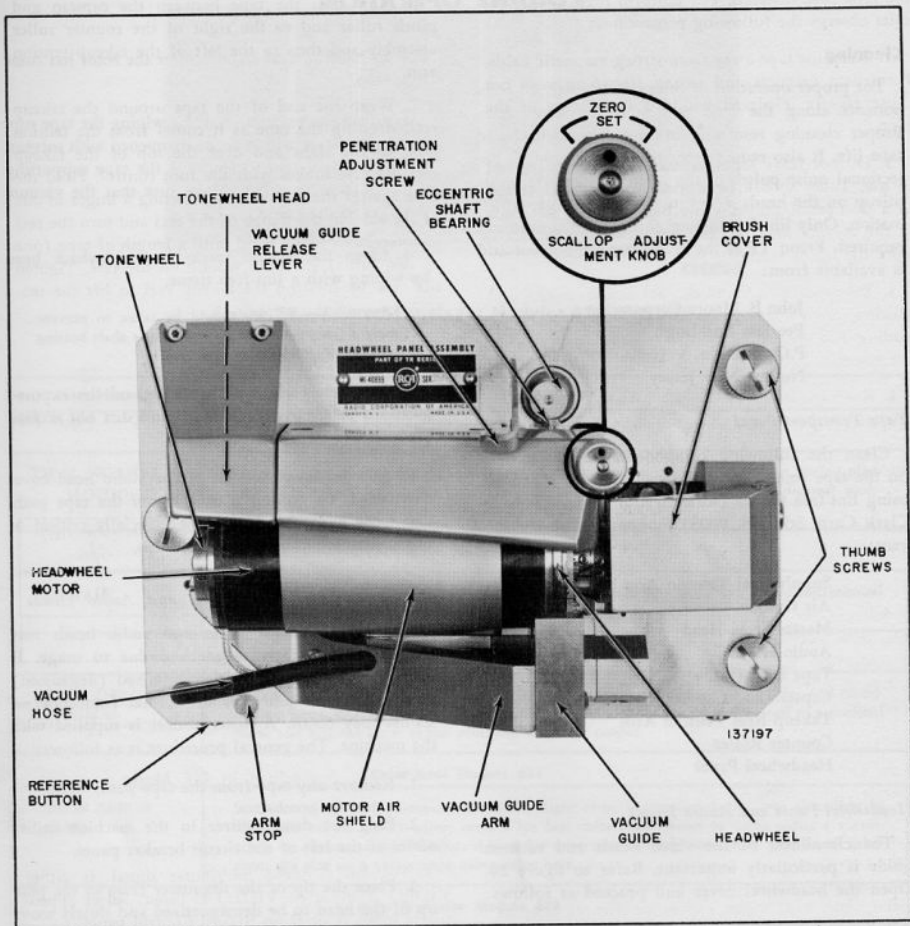


Figure 29—Headwheel Panel with Vacuum Guide closed

6. The audio, cue, and simulplay heads in the audio cluster should also be demagnetized.

7. It is unnecessary to process the erase heads since the 87-kHz erase currents perform this function while recording.

NOTE: These procedures should be repeated approximately once a week or more often if usage and indications of abnormal noise dictate.

## Tape Use

### Handling

The magnetic properties of video tape are stable for years unless altered by strong magnetic fields. If unsatisfactory recordings are obtained, a possible cause is poor head-to-tape contact. This may be due to improper tape handling; build-up of oxide between the heads, video, and audio; or distortion of

the tape base material. For uniform high quality results observe the following precautions:

1. Keep the tape away from strong magnetic fields. Permanent magnets and strong electro-magnets can cause erasure if placed within a few inches of the tape.
2. Do not leave tapes exposed when they are not in use. Tapes should be wound on reels and stored in a dust-proof polyethylene bag which is put back in the original box. To prevent damaging the reels, store the boxes vertically in a cool location.
3. When tape is handled, as during mechanical splicing, clean white gloves should be worn. During loading and unloading of the recording, gloves are not essential but are generally recommended.
4. Keep the heads, guides, and other items on the tape path clean.

#### Threading

The tape threading path is shown in figure 3. To install a reel of tape, turn the equipment power on and proceed as follows:

1. With the machine in STOP, turn the knob of the takeup reel hub counterclockwise as far as possible, then place an empty reel on the hub. Turn the reel clockwise until the reel slots line up with the springs. Tighten the hub by turning it clockwise while holding the reel steady.
2. Install the reel of tape on the supply reel hub in the same manner as in mounting the takeup reel. Operate brake release switch by gently touching with toe. Pull out a sufficient length of tape to pass around all the arms, heads and guides and then be secured to the takeup reel. *Do not allow end of tape to touch floor.* Check the tape end, and remove any securing tapes or bad ends which can cause damage later in rewinding.
3. Pass the tape to the right of the supply reel tension arm and to the left of the air guide, then along the erase head.
4. Slip the tape between the vacuum guide and the headwheel. Then pass the tape along to the audio head assembly. Be sure the tape rides over the control track head on the vacuum guide.
5. Align the tape around the tape guide post which positions the tape properly for the audio erase and record/playback heads, as shown in figure 3.

6. Now pass the tape between the capstan and pinch roller and to the right of the counter roller assembly and then to the left of the takeup tension arm.

7. Wrap the end of the tape around the takeup reel, dressing the tape as it comes from the tension arm, to the right and over the top of the takeup reel. Release brakes with the foot control. Hold the tape against the reel hub by inserting a finger in one of the slots in the flange of the reel and turn the reel counterclockwise by hand until a length of tape (one or two turns) has been wound on the reel. Tighten the tape by rotating the takeup reel to lift the tension arms off the stops.

#### Air and Vacuum

Place the machine in STANDBY and check the air and vacuum gauges behind the play panel for proper conditions as shown below:

#### STANDARD OPERATING CONDITION

Low Pressure Gauge	Vacuum Gauge	High Pressure Gauge
2.5 psi	5 (ins Hg)	55 psi
Refer to figure 30.		

If discrepancies are noted refer to the *Tape Transport and Air Systems Maintenance Manual*, IB-31860.

#### Check Out Procedure in E-E Mode

Turn the equipment on.

#### Video

1. Provide standard multiburst signal at either VIDEO A input or VIDEO B input. Select appropriate input A or B on Record Control panel.
2. Select IN on Picture and CRO Monitor Switcher buttons.
3. Select UNITY position on Video Input module 402, and check the CRO display for 1V P-P. (Be sure oscilloscope is calibrated.)

NOTE: Using 0.7V switch position, the calibration pulse should go from 0 to 100 on the scale. Press NORM and CAL INT buttons which are on the CRO. If adjustments are required, open the hinged door to reach the controls. See figure 14. Adjust VERT POS and VERT GAIN controls as necessary. When satisfactory, press VID FLAT button to restore circuit to normal.



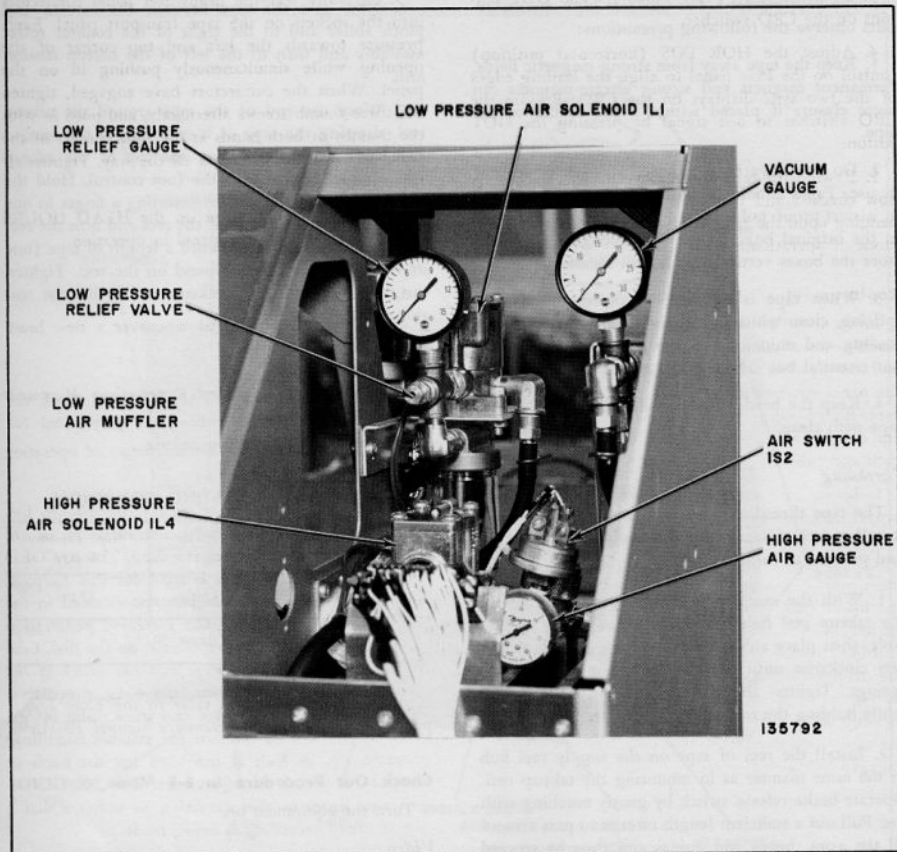


Figure 30—Front View of Air System Parts behind Play Panel

4. If variable input is desired, switch the VAR/UNITY switch to VAR and adjust VIDEO LEVEL and HF COMP on the Video Input module for 1V P-P with flat frequency response as observed on the CRO.

#### Audio

5. Select AUDIO IN on Audio Monitor Switcher and check for presence and sound quality.

6. Select AUDIO REC on monitor switcher and adjust level control on Audio Record module 401, for desired indication on VU meter (usually 0 for sustained peaks).

#### Video

7. Select desired operating standard on Standards switches located below the picture monitor.

8. Select DEMOD on Picture and CRO Monitor Switcher buttons. Use VERT and NORM on CRO.

9. Adjust Modulator carrier frequency by selecting FREQ position on the head test panel and depressing the TEST switch on the panel at center above main module bank.

10. Observe MOD FREQ light in red indicators above record panel. (3rd from left.) Adjust VERNIER FREQ on Modulator module 510, until red

light goes out. Turn test select switch back to normal.

11. Adjust the Demodulator Output for the video channel by setting VID GAIN on the Post-Emphasis module 529 for 1V P-P of white pulse as seen on the CRO. (140 IRE Units.) Refer to figure 47.

12. Adjust the DEVIATION control on the Modulator module 510, while observing the white insert pulse seen on the back porch while also observing the CRO. Proper deviation is attained when peak whites and the white insert amplitudes are equal.

13. Adjust LIMITER and DEMOD balance controls on Video Demodulator module 525 for a minimum of residual carrier. Observe signal at base line and sync tip portions of the waveform during adjustment.

14. Press the CRO button on the Post-Emphasis module and perform the same operation on the Sync Demodulator module 530, as done in step 13 on the Video Demodulator.

15. Press the CRO button on the Post-Emphasis module 529, and adjust the demod output for the sync channel by setting SYNC GAIN on this module for 1V P-P. Observe the CRO for this adjustment.

16. Select ATC on the Picture and CRO Monitor Switchers. Observe picture monitor and check the CRO. Check frequency of the Internal Reference module 621 by switching to RF Copy on the FM switcher. Press the frequency set button and adjust control corresponding to the line standard in use for a minimum number of black lines in the picture. Release button, and return RF Copy switch to Normal.

17. Select CATC on the Picture and CRO Monitor Switchers. Observe picture monitor, and check the CRO for proper level. Check for timing problems which might exist on the picture monitor.

18. Select OUT (video output of machine) on the Picture and CRO monitor Switchers.

19. Select the desired output condition of VAR or UNITY on Video Output module 433.

20. If VAR is selected above set VIDEO LEVEL and PED on the Video Processor module 432 to give 7.5 IRE units of pedestal (setup) and 92.5 IRE units of video.

21. Set the sync level for 40 IRE units (0.3V) by adjusting the SYNC LEVEL control on the Vertical Advance module 532, and adjust the BURST GAIN on module 632 for 40 IRE units.

22. Check the VERT BLKG (blanking) WIDTH on module 532.

23. Check the HOR BLKG (horizontal blanking) WIDTH on the Horizontal AFC module 534.

NOTE: If blanking adjustments are required refer to the *Video Processing Manual*.

24. Press the picture monitor button labelled OUT. Check the operation of the horizontal AFC in module 534 as follows:

a. Observe the picture monitor and depress the pushbutton SET HOR FREQ on module 534. Black lines should run thru the picture for a second or so. If these lines slope to the right or left, the AFC requires adjustment.

b. Release and depress the button while adjusting the HOR FREQ screwdriver control corresponding to the line standard in use.

c. The adjustment is correct when the black lines run vertically thru the picture during the first second or so after the button is depressed. In this condition, the frequency is well within the pull-in range of the AFC.

NOTE: Other adjustments for sync widths and front porch are module internal adjustments. See *Diagrams Manual and Video Processing Maintenance Manual* for these internal adjustments.

#### Audio

25. Select the Audio PB button on the Audio monitor switcher.

26. Adjust audio playback level for zero on the VU meter by adjusting the LEVEL control on the Audio Playback module 431.

#### Check Out Procedure for Playback Mode

NOTE: The TR-70 is equipped with three switchable TV line standards on international machines. The indicating switches below the picture monitor enable the operator to select 405-, 525-, or 625-line standard prior to any playback or record operation of the machine. The machine is electrically interlocked to prevent an improper mode such as 625-line low-band color. See Figure 4 and explanation.

Turn the equipment power on. If not recently checked perform the procedures for the E-E mode, covered in the previous pages. Select the proper standard for the tape being used.

**CAUTION:** Do not place the machine in the SETUP or RECORD mode while an alignment tape is threaded because portions of the tape may be erased.

### Vacuum Guide Playback Operation

During playback two modes are available, selected on module 506.

1. **MANUAL**—(Playback selector position.) In this position, control of the servo is initiated on the Play control panel by use of the **GUIDE POSITION** control. The total range of control is approximately 5 mils, but in practice the usual range is plus or minus 1/2 mil in either Playback or Record, depending upon conditions such as choice and operator care.

2. **AUTO**—(Playback selector position.) This allows automatic error correction, which is derived by comparing guide error with a reference, to give continuous self-correction as the tape is being played.

In conjunction with the two modes of operation, white indicators are provided to show the status of selection and operation. In **STOP** or **PLAY**, when the selector switch on module 506 is in the manual position, the **MANUAL** and **GUIDE** indicators light. If the selector switch on module 506 is in the **AUTO** position and the machine is in **STOP**, the **GUIDE** indicator only is lighted.

When the machine is switched to **PLAY**, the **GUIDE** light remains on until the guide closes. The light goes out when proper video comes from the tape and the servo switches to automatic control.

### Setting of Equalization

In playback this is accomplished by use of a multi-burst signal. The frequencies of the bursts desired are 0.5 mHz, 1.5 mHz, 2.0 mHz, 3.0 mHz, 3.6 mHz, and 4.2 mHz.\* It is desirable to have a prerecorded multi-burst tape for this check. Thread the tape on the machine.

NOTE: Tape should have leader which may be multi-burst, color bars, or similar test signals containing high frequencies to enable the operator to set the playback equalizers. In this procedure the multi-burst or color bars may be used. (The RCA standard test tape may be used to approximately set equalization.)

As a precautionary measure if a new headwheel panel is being aligned, back off (ccw) on the playback **GUIDE POS** control on the play panel. This will prevent the guide shoe from going too close to the headwheel which could cause damage. Proceed to make adjustments as follows.

1. Set the equalizers on individual channels to 0

\*On international standards, the two highest frequencies should be 4.4 mHz and 5.5 mHz.

on modules 518 to 521. Set the master equalizer switch on module 523 to step 1, and the vernier dial on 0. (If previous playbacks have been made, this step may not be necessary.)

2. Select the **TONEWHEEL** mode on the Tape Sync Processor module 622.

3. Select head one on the Reference Generator module 613.

4. Press the **PLAY** mode button and carefully adjust the **PB Guide** position control on the **PLAY** panel for proper penetration as instructed on page 49.

NOTE: Guide height adjustment may be required for pre-recorded tapes. If adjustment has been changed for playback, reset using standard alignment tape before making new recordings.

5. Check the control track phasing for maximum output on the **CRO** with the **FM** level button depressed on the **CRO** switcher.

NOTE: The **CT** (control track) **PHASE** control on the play panel works in two ways. When the knob is pushed in, it operates as a *fine* control and has sufficient range to adjust one head. With the knob pulled out it becomes a *coarse* control and optimum phasing can be reached for all four heads. The **NS TRACKING** indicator is illuminated when the dual tracking control on the play panel is pulled out in the *coarse* position. This allows tracking in any one of the four heads. Normally the control is pushed in for *fine*, or one-track control. Non-standard Control Tracks may require use of the *coarse* control.

6. Verify that head one is playing back the vertical information by looking at the picture monitor with **DEMOD** and **CH ID** (channel identification) buttons, both pressed. A white bar will appear on each of the head one bands. Looking at the vertical interval (picture monitor on pulse cross) and making sure the white bar occurs at this time, will verify whether head one is on the right track. If not, rephase to the correct track using the **CT PHASE** control.

7. Press the **DEMOD** button on the **CRO** switcher and adjust individual equalizer controls on modules 518 to 521 inclusive to obtain a match for flatness of all heads. Observe the burst patterns on the **CRO**.

8. Set the equalizer knob on the **FM Equalizer** module 523, for flattest response. It may be necessary to use a step other than number one of the five-position switch.

9. Release the channel identification by again pressing the **CH ID** button.

### Suppressor Delay and Switching Delay

The SUPP DELAY adjustment on the Post-Emphasis module 529 is used in the RF Copy mode only. Adjustment is made as follows:

1. Select the RF Copy position on the switch on the front panel of the FM Switcher module 522.
2. Operate the picture monitor on the Pulse Cross position. (The switch is on the left side of picture monitor behind the small door.) Press DEMOD on the picture monitor switcher.
3. Operate in the PLAY mode with a properly recorded tape.
4. Set the SUPP Delay on module 529 while observing the horizontal blanking region on the pulse cross monitor to position the gate just ahead of the front porch.
5. Adjust the switching dots to fall inside the gated area seen in step 4 above. This is done by turning the SW DELAY on the FM Switcher module 522.
6. Return the RF Copy switch to normal.

### Monochrome and Color ATC Adjustment

A tape with a five minute recording of color bars is required preferably on High Band. Thread tape on the machine.

1. Select PLAYBACK—MANUAL on the Guide Servo module 506.
2. Select NORMAL position on the switch on the Tape Sync Processor module 622. Select PIXLOCK servo mode of operation on the Play panel, and NORMAL on the switch on the CATC Video module 629.
3. Play the tape and adjust tracking using the CT PHASE control on the play panel. Also adjust GUIDE POS control on the Play panel for a small skewing error as observed on the picture monitor in DEMOD out.
4. When PIXLOCK is achieved the picture will frame up vertically, and can be framed horizontally using the HOR POS control on the Play panel. For the proper horizontal phasing adjustment procedure refer to *Horizontal Phasing* later in this section.

NOTE: If this procedure is being done on a monochrome only machine, delete steps 5, 6, and 7 and proceed.

5. Press ATC ERROR on the CRO switcher and slightly misadjust the ERROR GAIN on the ATC Error module 623, to introduce an error into the Color ATC system (30 to 40 IRE units on the CRO). Be sure the error signal does not exceed the correction range of the CATC.

6. Observe a color monitor and/or a vector scope on the machine output.

7. Adjust the COLOR ERR GAIN to minimize banding in the color picture. (Minimum dot size on the vectorscope.)

8. Adjust the GUIDE POS control for a one-microsecond error light guide pressure (See figure 33). This may be done by adjusting for 100 IRE units of ATC error signal on the CRO.

NOTE: The multi-burst signal may be used for measuring the vacuum guide pressure and/or error derived from the guide positioning. A 2.0-mHz burst cycle is equal to  $\frac{1}{2}$  microsecond and  $\frac{1}{2}$  millisecond. A 4.0-mHz signal is equal to  $\frac{1}{4}$  microsecond and  $\frac{1}{4}$  millisecond, etc.

9. Select ATC on the picture monitor and adjust the ERROR GAIN on the ATC error module for total correction of the one-microsecond error. (The ATC should correct in both directions, i.e., both light and heavy pressure.) This can be checked by alternate checking of the guide position observing DEMOD and ATC on the picture monitor.

10. Check using about  $\frac{1}{2}$  millisecond of heavy pressure, which is equivalent to 0.5 microseconds, to be sure the ATC corrects properly.

11. Set the Guide servo PLAYBACK switch in AUTO position, and check ZERO AUTO of the guide module by observing DEMOD on the picture monitor. If not correcting on vertical lines, readjust the ZERO AUTO control.

### Signal Level Adjustment

1. Check the demodulator output for the video channel by observing DEMOD on the picture and CRO monitors. If the tape was properly recorded, and the DEMOD gain previously set as in the E-E mode procedures, the level should be 1V P-P. Minor variances can be tolerated but large variations dictate readjustment of the VID GAIN on the Post-Emphasis module 529, for 1V on the CRO. Be sure the CRO is calibrated. Tapes may be checked for proper deviation by pressing the white insert button on the FM Filter module 524. The top of the pulse indicates where peak white level should be with correct deviation.

NOTE: Using the 0.7V pulse, the signal on the CRO should go from 0 to 100 on the IRE scale. Press NORM and CAL INT buttons which are on the CRO. If adjustments are required, open the hinged door to reach the controls. See figure 14. Adjust VERT POS and VERT GAIN controls as necessary. When satisfactory, press VID FLAT button to restore circuit to normal.

2. Likewise, check the sync channel by pressing the CRO button on the Post-Emphasis module 529. If required readjust the demodulator output for the sync channel by setting SYNC GAIN on this module using the same criterion as in step one. If during playback, adjustment to DEMOD levels in steps one and two were required, reset these to normal using the E-E mode, when finished with the non-standard tape.

3. Select ATC on the picture and CRO monitor switchers. Observe the picture monitor and check the CRO. If needed adjust the Internal Reference module 621 frequency control corresponding to the line standard in use and adjust for a minimum number of black lines in the picture. Press set button and release button.

4. Select CATC on the Picture and CRO monitor switchers. Observe the picture monitor and check the CRO (use RF Copy position on FM switcher for this check, but return to normal).

NOTE: Omit this step on a monochrome only machine.

5. Select OUT (video output of machine) on the Picture and CRO monitor switchers.

6. Select the desired output conditions of VARIABLE or UNITY on the Video Output module 433.

7. If VAR is selected in step 6, set VIDEO LEVEL and PEDESTAL on the Video Processor module 432 to give 7.5 IRE units of pedestal (setup) and 92.5 IRE units of video.

8. Check the sync level for 40 IRE units and adjust the SYNC LEVEL control on the Vertical Advance module 532. Check burst level for 40 IRE units. Adjust BURST GAIN if required on the Burst Processor.

9. Test stability by holding down STABILITY TEST button on Vertical Advance module 532 and rotating STABILITY control throughout its range. Normally, the picture should not change. If any effects are visible, maintenance is required on the Vertical Advance module.

10. Check the VERTICAL BLKG (blanking) WIDTH on module 532.

11. Check the HORIZONTAL BLKG (blanking) WIDTH on the Horizontal AFC module 534.

NOTE: Other adjustments for the sync widths and front porch are module internal adjustments. Refer to the *Video Processing Manual* for the procedure and to the assembly drawings in the *Diagrams Manual* for locations of these maintenance adjustments.

12. Observe the output signal on a color monitor and vectorscope and adjust BURST PHASE on the Color Phase module 633 for proper phasing of the color bars.

NOTE: If this is a monochrome only machine, omit steps 12 and 14 and the color part of step 15. Equalization may still be checked for minimum banding.

13. Select HOUSE SYNC, REGEN SYNC, or PROC SYNC on the Sync Logic module 533 as required.

NOTE: HOUSE SYNC can only be used in full PIXLOCK mode. For all other servo modes use REGEN or PROC SYNC. REGEN SYNC is used if the tape has recorded sync problems.

14. If using the tape machine in conjunction with other signal sources such as live color camera, the system phase of the tape machine can be matched with other signals by adjusting the SC PHASE control on the Play panel. This is usually checked at master control.

15. For best color playback, channel equalizers may require minor adjustment for minimum banding and proper saturation of color bars as seen on the color picture monitor and CRO. The vectorscope is very helpful in setting up the machine equalizers, vacuum guide, and ATC systems for the best differential phase. On outside tapes, head 2, 3, or 4 position on module 613 may give better head-to-tape characteristics.

#### WARNING

WHILE PLAYING BACK A TAPE DO NOT PRESS VIDEO INPUT A OR VIDEO INPUT B PUSHBUTTONS ON THE RECORD PANEL. THIS SWITCHES SYNC ALONG WITH VIDEO AND WILL INTERRUPT SERVO OPERATION CAUSING PICTURE BREAKUP.

#### Horizontal Phasing

1. Play the tape as above and select the Linelock or Pixlock mode of operation on the Play panel.

2. Press the OUT button on the picture monitor switcher.



3. Simultaneously, press Video IN and OUT buttons on the CRO switcher.

4. Adjust the HOR POS (horizontal position) control on the Play panel to align the leading edges of the two sync displays on the CRO. Restore the CRO switcher to one signal by pressing the OUT button.

5. Rewind the tape and remove it. The machine is now checked and ready for playback operation depending upon the tape to be played and the required mode of operation.

### Replacement of Headwheel Panel

Initial installation of the headwheel at time of the machine installation is covered in the *Tape Transport and Air Systems Manual*, IB-31860. Replacement of the panel requires much of the same technique, however, for operators convenience the important points are covered here. Remove any tape from the tape path and proceed as follows:

1. Locate the returnable shipping case with the proper serial number corresponding to the panel to be replaced. Remove the headwheel cover from the machine by pushing upward on the gold cover until the opening is clear as in threading. Carefully tilt the lower part of the cover downward. Release the latches inside the lower left and right corners by pushing upward on the latches. Grasp one end of the cover with both hands and pull upward approximately 1 inch to disengage the "banana" plug locating device. Then, grasp the opposite end using the same procedure and the cover will easily be disengaged. This is much simpler than trying to pull the cover away in one operation.

2. Loosen the three knurled screws on the headwheel panel and grasp the motor shield with the left hand. Work the panel out of the sockets by pulling upward alternately on the captive screws.

3. Lift the panel out and away from the machine and place in the shipping container. Enter the head hours reading on the meter of the tape transport panel on locally provided record sheet or card.

NOTE: The return authorization should be filled out along with actual head hours information etc., before returning to RCA for reworking.

4. Open the case for the replacement headwheel panel and loosen the three captive knurled screws. Grasp the motor shield with the left hand and lift out of the case. Insert the panel into the opening of the tape transport panel using the right hand on the lower right screw as a guide in inserting the panel.

5. Carefully seat the headwheel panel connectors into the sockets on the tape transport panel. Exert pressure towards the left and top corner of the opening while simultaneously pushing in on the panel. When the connectors have engaged, tighten the three thumb screws alternately, and push in with the thumbs of both hands at the four corners of the panel to be sure it is seated all the way. Tighten all three thumb screws again.

6. Record the indication on the HEAD HOURS meter before placing the panel in operation.

### Adjustments

Adjustments are required whenever a new headwheel panel is installed.

#### *Vacuum Guide Height and Penetration Alignment (Record Operation)*

While recording two different forms of operation may be used:

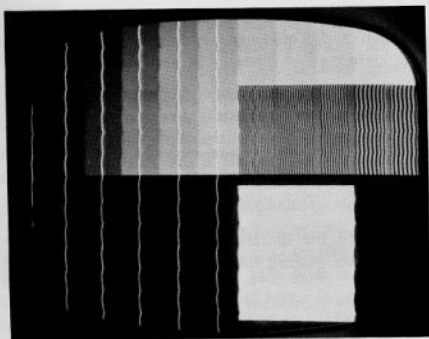
1. MANUAL (Record selector position)—In this position the control of head penetration can be adjusted, plus or minus, from standard. The RECORD GUIDE POSITION knob is used for this purpose. Zero corresponds to the adjustment attained in the fixed position of item 2. The increased penetration range is plus 1.5 mils above normal on the dial. *Caution—This limit is dangerous and can overload the servo.* Decreased penetration range on the dial is minus 3.5 mils. At this limit and some point before, head contact will be too low for reliable recordings or playbacks. A lock is provided for the knob to prevent accidental misadjustment. The NS GUIDE indicator lights in this condition to indicate that a non-standard recording is being made.

2. FIXED (Record selector position)—In this position the head penetration is reached that was attained by mechanical adjustment of the head penetration screw using the alignment tape as a standard.

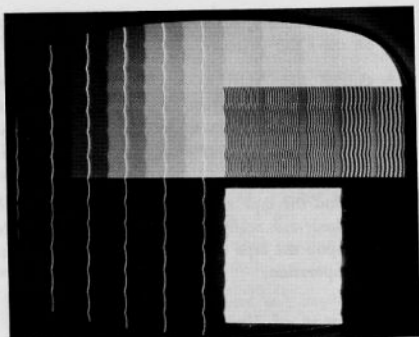
The vacuum guide position alignment is performed with the RCA alignment tape MI-40793 for 525, or MI-40797 for 625 line standards. The 1/4-inch open-end wrench supplied as Item 12 in the MI-35903 accessory kit included with the machine is also required.

*CAUTION: Do not operate the machine in either SETUP or RECORD modes while the alignment tape is threaded on the tape transport, or portions of the tape will be erased.*

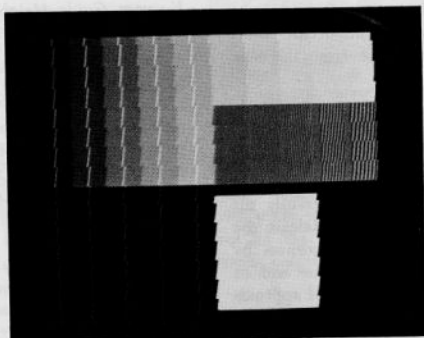




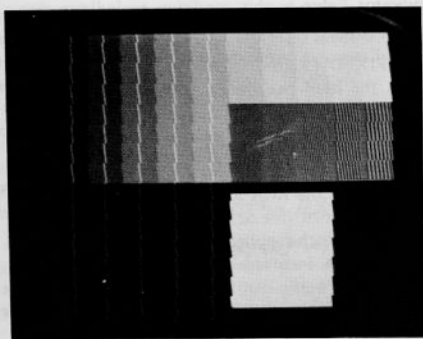
**Figure 31—Scallops in Bar Pattern,  
Vacuum Guide too High**



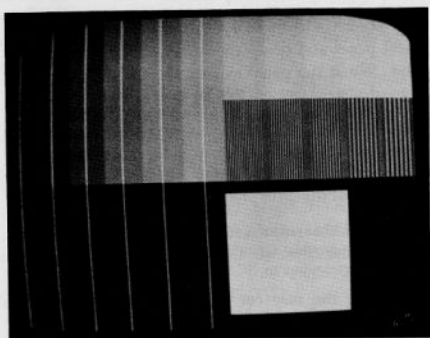
**Figure 32—Scallops in Bar Pattern,  
Vacuum Guide too Low**



**Figure 33—Jogs in Bar Pattern,  
Insufficient Head Penetration**



**Figure 34—Jogs in Bar Pattern,  
Excessive Head Penetration**



**Figure 35—Normal Appearance of  
Alignment Tape Playback**

The alignment procedure is for the purpose of correcting geometrical distortions in the picture. Improper perpendicular alignment of the vacuum guide causes scallops in vertical lines of the picture, see figures 32 and 33. Incorrect tape penetration by the video head pole tips causes jogs, see figures 34 and 35. Proper geometry is required to decrease banding in color operation and to prevent large errors from exceeding the MATC and CATC correction range.

Proceed as follows to align the vacuum guide:

1. Thread the alignment tape as shown in figure 3. Select manual position Playback on the Vacuum Guide Servo module 506. Move guide position control on the play panel to full ccw position.
2. Select proper operating standard for tape in use.
3. Place the machine in TONEWHEEL and PLAY modes of operation by pushing the button on the Play control panel, and selecting the TW position on the Tape Sync Processor module 622.
4. Press the DEMOD pushbutton on the picture monitor switcher.
5. Rotate the guide position control on the play panel slowly while observing the picture monitor for vertical alignment.
6. Adjust both the penetration range adjustment screw and the manual control knob on the play panel, to minimize vertical misalignment of picture elements so that this condition exists with the knob in the mid-position.

NOTE: The scallop adjustment knob is made with a factory-adjusted insert to provide a reference dot for "zero scallops" calibrated against the factory standard. When the panel is shipped with "zero scalloping" the dot location is in the position shown in figure 29.

NOTE: The CT Phase knob on the play panel may require adjustment for proper capstan tracking during this procedure.

7. Adjust the CT PHASE control on the PLAY control panel, for maximum output on channel 1 with head 1 playing back vertical sync. Press the FM Level button on the CRO switcher to observe the output.

8. Identify head 1 by pressing the CH ID (channel identification) button on the picture monitor switcher. The ID pulse should appear during the vertical interval. (Use pulse cross on the picture monitor deflection.)

9. If necessary, adjust the 4X TW DELAY control on the Tonewheel Processor module 612 to eliminate gaps or overlaps in head switching.

NOTE: Gaps or overlaps in head switching appear as horizontal lines in the picture.

10. Observe the picture monitor and compare it with the patterns shown in figures 31 and 32 to determine correct adjustment for minimum scallops.

11. The Scallop Adjustment Knob on the headwheel panel is shown in figure 29. It is correctly adjusted for proper vacuum guide height when all scallops are eliminated from the picture.

NOTE: The picture monitor may indicate that adjustment is required in the scallop setting, penetration, or a combination of both. Correct as needed for least amount of misalignment of vertical picture elements possible. Difficulties may be encountered in Playback of the test tape because of improper equalization and/or anti-resonance adjustments.

12. Set the RECORD switch on the Guide Servo module 506 to the FIXED position.

13. Hold the RECORD SET pushbutton on the guide servo module and compare the picture monitor with the patterns shown in figures 33 and 34 to determine the direction of rotation of the penetration screw adjustment.

#### *Video Head Optimization*

The video heads have to be optimized for maximum response for recording and playback when the headwheel panel is replaced. (Also after usage of 20 to 25 hours since last optimization.)

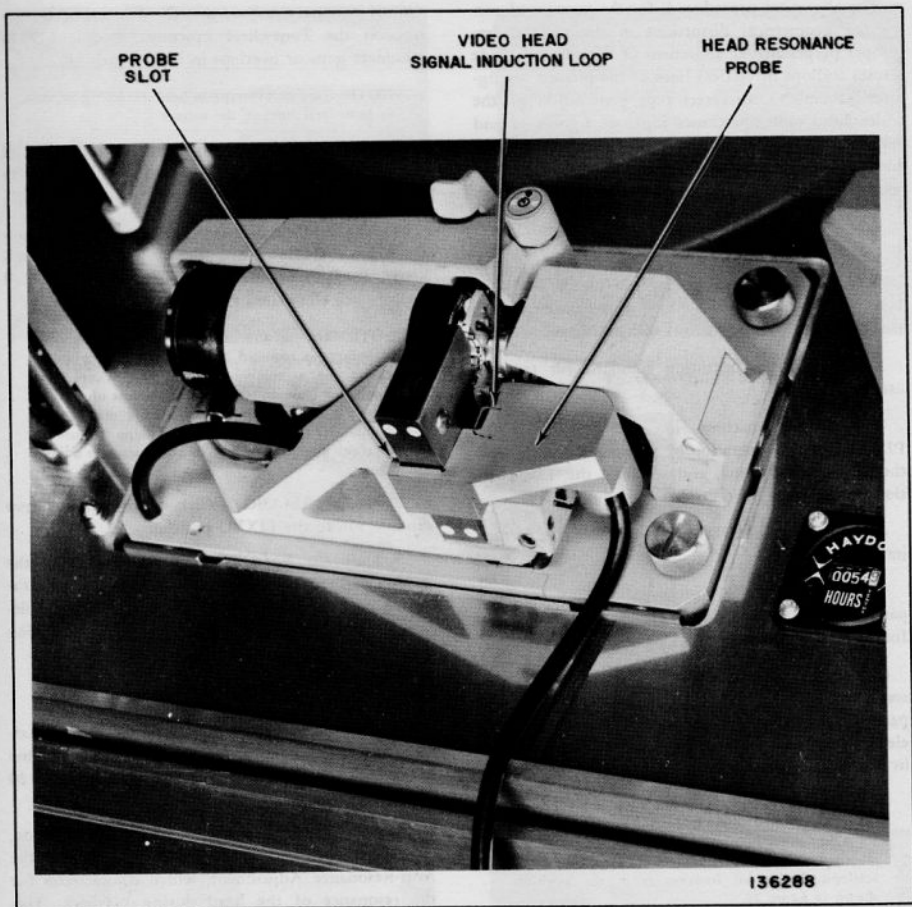
The video heads are optimized in two separate, but related procedures. The first procedure is the Anti-Resonance Adjustment, which compensates for the resonance of the head during playback. This should be followed by the Record Current Adjustment which adjusts for optimum record current to obtain maximum head output during playback.

Before reoptimization, the video heads should be demagnetized as a precautionary measure.

#### *Anti-Resonance Adjustment*

Proceed as follows to adjust for anti-resonance and a smooth response in the playback amplifier modules:

1. Place the machine in STOP mode, and remove the tape from the headwheel panel and audio heads (rewinding the tape is not necessary).



**Figure 36—Head Resonance Probe attached to Headwheel**

2. Set the TEST SELECT switch to RES and the CHANNEL SELECT switch to 1, on the switch panel just above the modules.

3. Remove the head resonance probe from the HD RES PROBE socket on the switch panel above the modules by rotating the probe clockwise approximately 45 degrees and pulling the probe out.

**NOTE:** The HD RES PROBE socket contains an interlock switch that prevents the machine from being placed in any operate mode when the head resonance probe is removed from the socket.

4. Insert the extruded portion of the head resonance probe into the slot provided for it on the headwheel panel, so that the "U" shaped wire loop is close to the headwheel (see figure 36).

5. Push the TEST switch/indicator on the switch panel above the modules.

6. Press the FM LEVEL button on the CRO switcher panel.

7. Manually rotate the tonewheel so that the notch on the tonewheel is lined up opposite the tonewheel

head. Observe the CRO presentation of head 1, and slowly rotate the tonewheel for maximum amplitude on the CRO presentation.

8. Alternately rotate the RESISTANCE and REACTANCE controls in either direction on Playback Amplifier 1 module to obtain a smooth or linear section on the waveform just prior to its rapid drop in amplitude (see figure 37A).

NOTE: The smooth or linear portion of the waveform may slope in either direction (as shown in figure 37A). Proper adjustment results in the desired smooth portion regardless of direction of slope.

9. Move the CHANNEL SELECT switch to position 2.

10. Manually rotate the tonewheel one-quarter turn in a clockwise direction (looking from the tonewheel-end of the headwheel panel) so that the tonewheel notch is located at the top of the headwheel motor, which is 90 degrees from the tonewheel head. Observe the waveform presentation on the CRO, and position the tonewheel for maximum amplitude from head 2.

11. Repeat the procedure described in step 8 except that now the procedure is for the anti-resonance adjustment for head 2 on Playback Amplifier 2 module 519.

12. Move the CHANNEL SELECT switch to position 3.

13. Manually rotate the tonewheel one-quarter turn in a clockwise direction so that the tonewheel notch is located 180 degrees from the tonewheel head. Observe the CRO, and position the tonewheel for maximum amplitude from head 3.

14. Repeat the procedure described in step 8 except that now the procedure is for the anti-resonance adjustment for head 3 on Playback Amplifier 3 module 520.

15. Move the CHANNEL SELECT switch to position 4.

16. Manually rotate the tonewheel one-quarter turn in a clockwise direction so that the tonewheel notch is located 270 degrees from the tonewheel head. Observe the CRO, and position the tonewheel for maximum amplitude from head 4.

17. Repeat the procedure described in step 8 except that now the procedure is for the anti-resonance adjustment for head 4 on Playback Amplifier 4 module 521.

18. Press the STOP switch on the RECORD or PLAY panel to release the TEST switch-holding circuit.

19. Replace the head resonance probe by inserting the probe into the HD RES SOCKET and rotating the probe 45 degrees in a counterclockwise direction.

#### *Record Current Adjustment*

(See figure 37B)

Optimum results are obtained from the four video heads by supplying the proper record current to each head during RECORD operation. The record current setting is made by adjusting the record LEVEL controls on record amplifiers 1, 2, 3, and 4 (modules 512, 513, 514, and 515, respectively) until maximum playback output signal is obtained. The following procedure describes the method of arriving at these optimum record levels for the headwheel in use.

The record currents obtained in optimizing when the headwheel panel is new should correspond very closely to the data sheet readings supplied with the panel. This is a check on the machine and the operator's results. Record currents obtained on one set of standards are the same for a given headwheel panel for all other standards.

It is suggested that the procedure be studied carefully before actually going through the various steps. Then, begin with step one.

NOTE: The optimum record current decreases and the output increases with head wear. Therefore, these procedures should be repeated whenever routine operating checks indicate that new optimum values should be obtained. Examples that indicate re-optimizing is required are when poor signal-to-noise ratio and/or bands of unequal contrast appear in the picture.

Prior to these procedures, set up the machine in the E-E mode as described in the previous section on page 43, steps 1 to 11.

1. Apply a monoscope signal, slide test pattern, or similar test signal that contains at least 30 percent peak whites, to the video input of the machine. Select High Band on the standard switch.

2. Thread a high performance tape on the tape transport panel and set the tape timer dial to 0.

NOTE: It is good practice to clean the tape transport panel prior to operating the machine, and especially after work has been performed on the panel, to prolong headwheel life and prevent tape scratching.

3. Set the microphone selector switch on the Microphone Module 504 to the CUE position.

4. Place the machine in SETUP mode of operation.

5. Press the FM LEVEL button on the CRO panel.

6. Press the CUE REC button on the audio monitor panel.

7. Withdraw the microphone from the microphone module and observe the VU meter while speaking into the microphone. Adjust the microphone gain for optimum cue record level by observing the VU meter.

8. Place the TEST SELECT switch on the panel above the modules, in the NOISE position, and the CHANNEL SELECT switch in the NORM position.

9. Press the MASTER button on the RECORD panel. Check for proper CT level using the CT PB button on the CRO switcher. See figure 37C.

10. Press the TEST switch/indicator on the panel above the modules. The red warning indicators; MIC CUE, HD CUR, and TEST should be lighted.

NOTE: Perform steps 8, 9, and 10 only in the sequence presented to obtain the desired results.

11. Unlock the outer knob and place the LEVEL control on each record amplifier module to position 5.

12. Reposition the LEVEL control on Record Amplifier 1 module 512 to the 0 position, and announce into the microphone the channel number and LEVEL control position (i.e., "This is channel number 1 at zero.")

13. Successively advance the LEVEL control from the 0 position to 0.5, then 1, 1.5, 2, 2.5, etc. Stop at each position momentarily and announce the control position into the microphone. Continue this procedure until position 10 is reached on the control.

NOTE: An FM output on playback may not be observed for the first several positions.

14. Return the record LEVEL control setting on Record Amplifier 1 module to position 5 and leave at this setting until playback.

15. Perform the procedures described in steps 12, 13, and 14 for channels 2, 3, and 4 on modules 513, 514 and 515, respectively.

16. Rewind the tape to the beginning of the recording. Press CUE PB selector switch.

17. Check that the HEAD SELECT switch on the Reference Generator module 613 is in position 1.

18. Place the selector switch on the Tape Sync Processor module 622 in the TW position.

19. Press the PLAY button on the PLAY control panel. Then press the TEST button.

20. Observe the peak detected playback output signal on the CRO (FM LEVEL button pressed), and adjust the CT PHASE control on the PLAY control panel to obtain maximum peak-to-peak signal.

21. Set the EQUALIZER controls on each Playback Amplifier module (518, 519, 520, and 521) to their No. 2.0 dial position.

22. Observe the peak detected FM envelope pattern of the four channels with the FM LEVEL button depressed on the CRO panel. While watching the changing pattern on the CRO, listen to the audio playback announcements to identify the setting of each LEVEL control on the record amplifier modules that produced the highest FM level. (See figure 37B).

NOTES: (a) When the TW pulse is pressed and latched in on the picture monitor switcher, the tonewheel pulse is superimposed on the picture monitor. During playback check of optimizing the TW pulse may be used to identify channel one on the picture monitor.

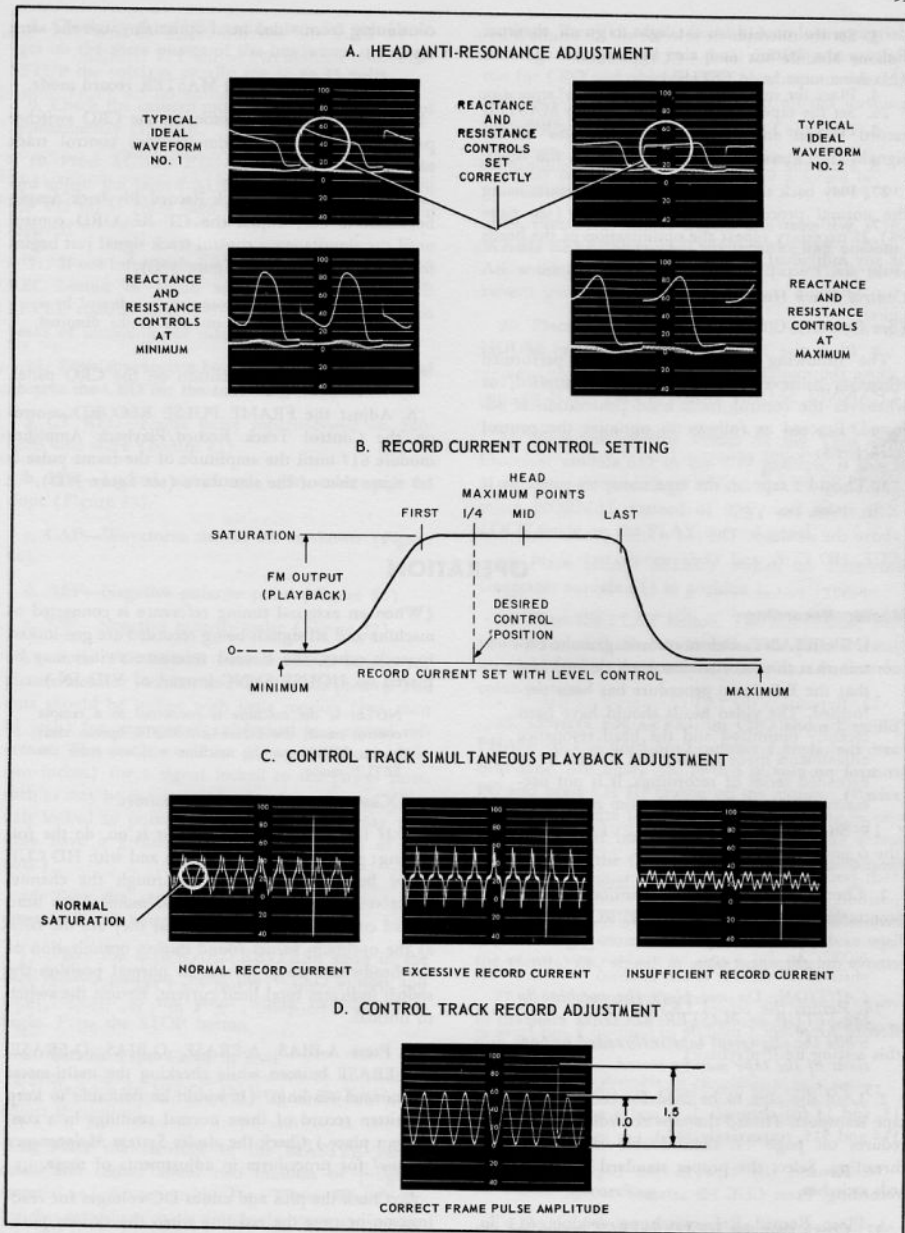
(b) The output level is maximum (no variation) for more than one record level setting. The output will decrease for successive record current. Optimum results are obtained by leaving the control set to the point that corresponds to the one-quarter point between the first and last maximum level positions, as shown in figure 37B.

23. Set each LEVEL control on the record amplifier modules to their optimum-gain positions as determined in step 22, and lock the control.

24. Put the machine in the SETUP mode and with the TEST SELECT switch in the NOISE position, select the HD CURRENT button on the multimeter selector. Press the TEST button. Using the CHANNEL SELECT switch on positions 1, 2, 3 and 4, read the head currents. (When the CHANNEL SELECT switch is in positions 1, 2, 3, or 4 the meter calibration is 100 milliamperes at 10 on the meter dial.) For future reference, log the current indications corresponding to the optimum record current settings. (The multimeter is calibrated to indicate 400 milliamperes at position 10 on the meter dial when the CHANNEL SELECT switch is in the NORM position.) Return the TEST SELECT and CHANNEL SELECT switches to NORM.

25. Calibrate the HD CURRENT indicator by pressing the button on module 618. Adjust the screw-





**Figure 37—Head Resonance and Control Track Adjustment Waveforms**



driver control on 618 for the light to go off, then on. Release the button and the light should go out. (Machine must be in SETUP.)

26. Set the tape timer to zero. Press the MASTER record button and record several minutes of the signal. Then rewind to the zero point on the timer.

27. Play back the tape and check the results using the normal procedures for equalization (see page 98). If necessary repeat the optimization of the heads or any individual head.

#### Control Track Head Optimization

(See figures 37C and 37D)

The following procedure should be performed whenever a new headwheel panel is installed, or whenever the control track head penetration is adjusted. Proceed as follows to optimize the control track head:

1. Thread a tape on the tape transport panel, or if

continuing from video head optimizing, use the same tape.

2. Place the machine in MASTER record mode.

3. Press the CT PB button on the CRO switcher panel and observe the simultaneous control track playback presentation.

4. On the Control Track Record/Playback Amplifier module 617, adjust the CT RECORD control until the simultaneous control track signal just begins to show saturation (see figure 37C).

NOTE: Control track saturation is indicated by a slight shoulder in the zero axis of the distorted sine wave.

5. Press the CT REC button on the CRO panel.

6. Adjust the FRAME PULSE RECORD control on the Control Track Record/Playback Amplifier module 617 until the amplitude of the frame pulse is 1.5 times that of the sine wave (see figure 37D).

## OPERATION

### Master Recording

**IMPORTANT:** Before recording, make certain that the recorder has been cleaned and that the E-E Setup procedure has been performed. The video heads should have been recently optimized and the head resonance adjustments made as described earlier. In an extended series of recordings, it is not necessary to repeat the initial setup procedures before each recording.

#### Final Checkout

1. Check the vacuum guide position and pole-tip penetration by playing back the RCA Alignment Tape as directed in the procedures on page 49. Then remove the alignment tape.

*CAUTION: Do not place the machine in the SETUP or MASTER RECORD modes while the alignment tape is threaded or portions of the tape may be erased.*

2. Load the tape to be used for recording on the tape transport. Thread the tape according to the procedures on page 43; then double check the tape threading. Select the proper standard on the standards switches.

3. Place Record Ref switch on module 613 in VID IN condition and place machine in SETUP.

(When an external timing reference is connected to machine and all signals being recorded are gen-locked to each other, the Record reference switch may be placed on HOUSE SYNC instead of VID IN.)

NOTE: If the machine is connected to a remote control panel, the LOCAL/REMOTE button must be on LOCAL or the machine will not enter the SETUP mode.

4. Check the red warning indicators.

5. If the head current indicator is on, do the following: press FM test pushbutton and with HD CUR meter button pressed switch through the channel select switch positions 1 to 4 and monitor the head record current values to check that they are the same as the optimum values found during optimization of the headwheel panel in use. In normal position the switch indicates total head current. Return the switch to normal.

6. Press A-BIAS, A-ERASE, Q-BIAS, Q-ERASE, and ERASE buttons while checking the multi-meter for normal readings. (It would be desirable to keep a written record of these normal readings in a convenient place.) Check the *Audio System Maintenance Manual* for procedures in adjustments of these.

7. Check the plus and minus DC voltages for readings on or near the red line when the various push-buttons are selected.

8. Check the three HM pushbuttons for equal voltages on the three phases of the headwheel motor. In SETUP the voltages usually are 30 to 55 volts.
9. Check the capstan motor voltage for a value of approximately 115 volts.
10. Press AUDIO REC button of audio monitor and adjust the record AUDIO LEVEL control until the VU meter reads zero VU on peaks of program material.
11. If cue information is to be recorded, press CUE REC button of audio monitor and adjust CUE LEVEL control until VU meter reads zero VU on peaks of incoming cue information.
12. Press appropriate buttons on CRO selector and observe the CRO for the following indications:
  - a. CT REC—Frame pulse superimposed on 240-hertz sine wave (Figure 43).
  - b. HW—Locked waveform with stable pip on slope (Figure 53).
  - c. CAP—Waveform should be as shown (Figure 54).
  - d. REF—Negative polarity pulse (Figure 51).
  - e. TW—Negative polarity pulse (Figure 52).
13. Press TW PULSE selector switch button for picture monitor switcher and observe the picture. The dots should be locked with little motion (less than  $\frac{1}{4}$  inch) for an input signal locked to a crystal reference. The motion will be greater (approximately two inches) for a signal locked to the power lines, such as may be encountered using monochrome. (Signals locked to portable engine generators may possibly have a greater than two-inch motion of the dots.)
14. Take the recorder out of SETUP mode by pressing STOP button.
15. Place the FORWARD-REVERSE knob in the FORWARD position. Press the WIND button and wind forward to the point where recording will begin. Press the STOP button.
16. Set the Tape Timer to zero.
17. Recheck the VIDEO IN level on the CRO, and adjust if required.
18. Place the recorder in the MASTER record mode and record about two minutes of program material as indicated on the Tape Timer. While making this recording, check the simultaneous audio playback (press AUDIO PB button on monitor switcher)

level on the VU meter, and listen to the program audio on the speaker. Also press CT PB selector button for CRO and observe CRO for simultaneous control track playback. Make sure that all red warning indicators are out.

NOTE: On simultaneous audio playback there is a delay of approximately one-tenth of a second between sound and video.

19. Press the WIND button and turn the FORWARD-REVERSE control to the REVERSE position. Allow the tape to rewind until the Tape Timer reads zero.
  20. Place the play SERVO REF switch in the HOUSE Sync condition.
  21. Place the GUIDE POSITION switch on module 506 in the AUTO condition.
  22. Place the selector switch on the Tape Sync Processor module 622 in the TW position, if this is a monochrome recording. If it is a color recording, select NORMAL instead of TW, and select PIX-LOCK mode on the PLAY control panel.
  23. Place HEAD SELECT switch on Reference Generator module 613 in position 1.
  24. Press the PLAY button. The information previously recorded can be viewed on the picture monitor and heard on the speaker. If in color, examine the color picture.
  25. Observe FM LEVEL on CRO and adjust CT PHASE control until head number 1 plays back vertical sync. See figure 38. Switch picture monitor to PC and press CH ID button on the monitor selector switch. The white ID signal should be setting in vertical interval; if not, readjust tracking. Make a fine adjustment of the CT PHASE control for maximum peak-to-peak signal.
  26. Observe VID OUT on picture monitor and adjust FM EQ on module 523 for best appearance of the picture, i.e., signal to noise vs resolution.
  27. After the preceding tests are concluded, rewind to the place where the program recording is to begin, stop the machine, reset Tape Timer to zero.
- NOTE: It is desirable on recordings to have audio and video lead-in material such as multi-burst or color bars at the beginning of the recordings for playback setup and checking purposes.
- ### To Make Recording
- To record simultaneously on the video, audio, cue, and control track, proceed as follows:

1. On the Record control panel press SETUP button to start capstan and HW motor and put relays in record position.

2. If remote operation is required, switch the LOCAL/REMOTE switch below the picture monitor to REMOTE.

3. Then press the RECORD button on the remote control panel or the MASTER button if in LOCAL.

4. During the recording observe the picture on the picture monitor and listen to the simultaneous audio playback on the speaker. Also check the following items:

- a. Red warning lamps—all lamps should be out.
- b. VU meter—should read normal levels.
- c. CT PB Waveform—locked waveform indicating presence of control track on simultaneous playback.
- d. HW servo waveform—locked waveform with pip on slope.
- e. CAP Servo—locked.

5. After all desired program information is recorded, press the STOP button. Switch to LOCAL.

6. Press the WIND button and turn FORWARD-REVERSE knob to reverse. Allow tape to rewind until Tape Timer returns to zero and then press STOP button.

NOTE: It is possible to go directly to WIND without going through STOP condition.

7. If desired, spot check the recording by playing back the beginning, middle, and end.

### Audio and Cue Recording

To record exclusively on either the audio or cue tracks or both while playing back the video signal, proceed as follows:

1. Before threading the tape, press AUDIO REC or CUE REC button on the audio monitor switcher and adjust the LEVEL controls on the Audio and Cue modules 401 and 403, until VU meter reads zero VU on peaks of incoming program material. Then, thread the tape.

*CAUTION: Never place the recorder in SETUP or RECORD while a recorded tape is threaded unless a new recording is to be made, portions of the tape may be erased.*

2. When recording from the incoming lines, leave the selector switch on Microphone module 504 in the OFF position. When recording directly via the micro-

phone on module 504, place the selector switch in either AUD or CUE position as desired. Pull out the microphone on its cord reel. Speak directly into the microphone and adjust the LEVEL control until the VU meter reads zero VU on voice peaks.

NOTE: Red indicators, MIC AUD or MIC CUE, will light, indicating that the microphone is in use on either the audio or cue channel and the corresponding input line is disconnected.

3. When ready to record, set the AUDIO or CUE switch at NORM, then press the AUDIO or CUE record button, or both, as desired. (If machine has remained in the WIND or MASTER record modes, press STOP button first.)

4. While recording, observe picture on picture monitor and listen to the simultaneous audio playback. (If recording with microphone, turn down speaker volume control on audio monitor to prevent feedback.) Check VU meter for normal level.

NOTE: To record a tone signal on the cue track, hold down the CUE MARK button on the record control panel when the tape reaches the desired spots. This button is effective in any record or playback mode.

5. At the end of the recording, if it is desired to release the audio or cue record circuit and enter the PLAY mode, press the RELEASE toggle switch of the corresponding circuit. If machine was simultaneously in both modes, it will enter PLAY mode when both RELEASE switches are pressed; when only one RELEASE switch is pressed the machine will remain in the unreleased mode. (If the STOP, MASTER, WIND, or PLAY buttons are pressed, the machine is automatically released from the AUDIO or CUE record modes without use of the RELEASE switches.)

NOTE: If the microphone was in use, make certain to restore the selector switch on the microphone module to the OFF position at the end of the recording. Until this is done the red MIC warning indicator will remain on.

### RF Copy Recording

Before recording in this mode, it is necessary to have cables provided from the FM output of another machine which would be used as a master machine in playback for making dubs. See *Installation* section in IB-31855.

The record currents at the heads should be set to the same values as used in regular video recordings.

To record RF copy information entering the recorder from another machine, push RF Copy push-button on the Record Control panel and then follow

the procedure under *Master Recording*. At the end of the recording, make certain to return the RF Copy button on the Record panel.

### Normal Playback

It is assumed that the check-out procedure for playback has been recently performed on the machine. If in doubt, and time permits, consult the section on *Check-Out Procedure for Playback Mode*. Otherwise, proceed as follows:

1. Ascertain the type of tape to be played (monochrome or color, low-band or high-band). If on a line standard other than normal check to see what it is (405, 525, or 625). If unknown, trial tests may have to be made.
2. Select the proper standards on the switches below the picture monitor.
3. Clean the tape path as previously explained.
4. Thread the tape on the machine and set the tape timer to zero.
5. If the playback is to begin at some point other than the start of the tape, wind forward to the approximate "time location" on the reel.
6. Select the desired mode of servo operation (TONEWHEEL, SWITCHLOCK, LINELOCK, or PIXLOCK). LINELOCK is recommended, but PIXLOCK may be required in either mono or color if using special effects, fades, etc.
7. To select SWITCHLOCK, turn the rotary switch on the Tape Sync Processor module 622 to the SL position. For LINELOCK, the switch should be in the normal position. Also select LINELOCK on the Play panel.
8. Select manual playback on the Guide Servo module 506. Set the GUIDE POS (position) knob on the Play panel to mid-position.
9. Set the PB reference switch on the Reference Generator module 613 to HOUSE SYNC.
10. Select PROC SYNC on the Sync Logic module 533.
11. Select VAR or UNITY on the Video Output module 433.
12. The switch on the CATC Video module should be in the NORMAL position.
13. Place the machine in the STANDBY mode and check the following zero signals on the CRO switcher:
  - a. TW—a 240-Hz (or 250-Hz)\* tonewheel pulse should be present, See figure 52.
  - b. REF—a 60-Hz (or 50-Hz)\* reference pulse should be present, See figure 51.
  - c. CAP—a 240-Hz trapezoid should be seen as in figure 50.
  - d. HW—The 240-Hz (nearly square wave) should be present with a pip on the slope as shown in figure 53.

14. Press the Video DEMOD pushbutton on the picture monitor switcher. Press FM LEVEL on the CRO switcher.

15. Press the Play button and quickly adjust the CT PHASE control on Play panel for maximum level, while observing the CRO (See figure 39). Proceed quickly to step 16.

16. Examine the picture monitor for improper vacuum guide condition and adjust the GUIDE POS control on the Play panel for best vertical alignment. See figures 31 to 35. (ATC error signal may be used and should be minimized.)

17. If necessary, check the scalloping adjustment.

18. Check to see that channel one is playing back vertical sync. Use the channel ID button on the picture monitor switcher. This button puts a white bar on channel one.

19. If necessary readjust the CT phase control knob (pull out on the knob if the coarse range is needed) to obtain tracking of head one on channel one.

20. Re-examine and adjust vacuum guide adjustments for best conditions.

21. Switch the guide servo to AUTOMATIC position on the front of module 506.

22. Select Video OUT on the picture and CRO switchers. If in VAR position on the Video Output module 433, check and adjust the level as required on module 432 (92.5 IRE units). Also, check and adjust the pedestal for 7.5 IRE units.

23. Check the sync for 40 IRE units. If required, adjust SYNC LEVEL control on the Vertical Advance module. Check and adjust BURST GAIN for 40 IRE units on Burst Processor module 632.

24. Check the AUDIO PB level, by pressing the Audio Monitor button and observe the VU meter.

\*International Standards

Adjust the level control on the Audio Playback module for zero on the meter on sustained peaks.

25. Adjust the SPKR VOL control for comfortable sound level and check on sound quality.

26. Check the CUE PB level, by pressing the CUE monitor button and observe the VU meter. Adjust the level control on the Cue Playback module for zero on the meter.

27. Return the monitor switch to the audio PB position.

28. Check the picture for banding on the picture monitor. Adjustment of the channel individual equalizers on modules may be necessary for best signal-to-noise and for minimum banding on a monochrome picture. If the picture is in color, examine for proper saturation of the color bars and minimum banding, using the channel equalizers.

29. Adjustment of the master equalizer may be required to get best results on some tapes. Use of the switch on the FM Equalizer module 523, may be required in this adjustment.

30. Check the lockup of the machine by stopping and starting several times. The picture should frame-up vertically. If in color, the horizontal should go to horizontal framing as well, even in the LINELOCK mode. Check horizontal phasing using the HOR POS on the play panel. Push IN and OUT on the CRO. Align the syncs.

31. Recheck the video OUT signal alone for proper levels and if in color, check the burst phase on module 633, using flesh tones as a guide if color bars are not available.

32. Cue up the tape, by playing and winding to the proper position. Press the STANDBY button. The machine should then be ready for playback, press PLAY button at the proper time.

NOTES: (a) On older low-band color tapes or tape made on a different headwheel panel, some improvement in banding and matching may result by using the Head Select switch on the Reference Generator module.

(b) During playback, monitor the picture and the audio and observe the indicator for warning of trouble.

(c) When a protection copy is being played back on a second machine, the second machine may be synchronized with the first. After the first machine is on the air and the backup machine is running, manipulation of the Capstan Speed buttons, on the

Play panel will enable the operator to synchronize using the audio. *The buttons should not be pressed*

*on the machine that is on the air. Picture breakup will occur.*

(d) If difficulties are experienced in steps 1 to 30 refer to the *Check-Out Procedure for Playback* or the Servo or other maintenance procedures as needed. Check the CT PB signal on the CRO, see figure 42.

(e) If the machine is slow to go into Pixlock, the pixlock PHASE GAIN on module 610 may be set too high. (The additional phase gain supplied by the THA loop of the ATC makes an excessively high setting of phase gain more noticeable. Slightly reduce the gain by 10 degrees on the control and try lockup for best overall results.

(f) Degauss the heads periodically as explained under *Routine Operation*.

### Playback for Making RF Copies

In using the playback RF Copy facilities it will be necessary to check the Suppressor Delay and Switching Delay to be sure the switching dots or transients are suppressed. The suppressor delay is used only in the RF Copy mode.

To make adjustments proceed as follows:

1. Thread a pre-recorded tape of good quality on the machine, and operate in the PLAY mode.

2. Select the RF Copy position of the switch on the front panel of the FM Switcher module 522. Press DEMOD on the picture monitor switcher.

3. Operate the picture monitor on the Pulse Cross position. (The switch is located on the left side of the picture monitor behind the small door).

4. Set the SUPP DELAY on the Post-Emphasis module 529, while observing the horizontal blanking region on the pulse cross monitor to position the gate just ahead of the front porch.

5. Adjust the switching dots to fall inside the gated area seen in step 4 above. This is done by turning the SW DELAY on the FM Switcher module 522.

6. The procedure from here on is the same for normal playback of a tape.

NOTE: It is necessary to have the RF Copy output from the machine feeding a second machine, for use of this facility. The RF output leaves the machine on 12J17 on the connector board at the rear of the machine. (Do not use a DA because of the bandwidth requirement.)

7. After using the RF Copy facilities, return the RF Copy switch on module 522 to NORMAL. (The RF Copy mode indicator above the playback control panel will light when the switch is in the RF COPY position.)



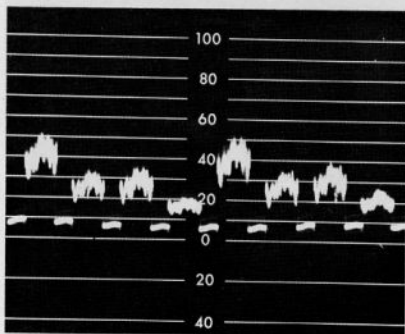


Figure 38—FM LEVEL

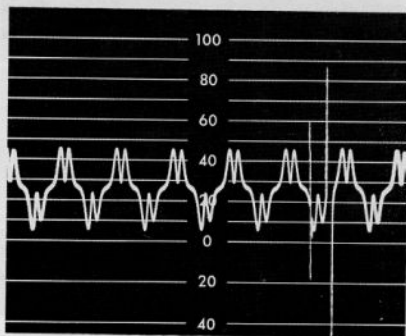


Figure 39—Simultaneous  
Control Track Playback (Record)

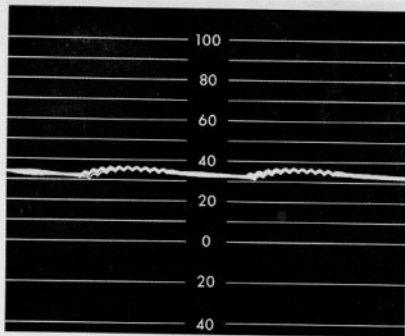


Figure 40—GUIDE Servo,  
Normal

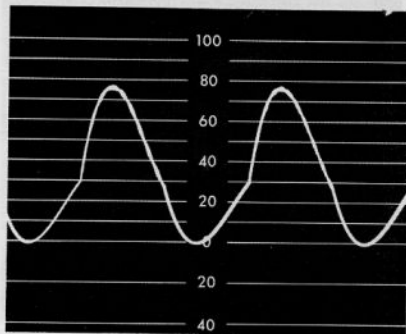


Figure 41—GUIDE Servo,  
Abnormal

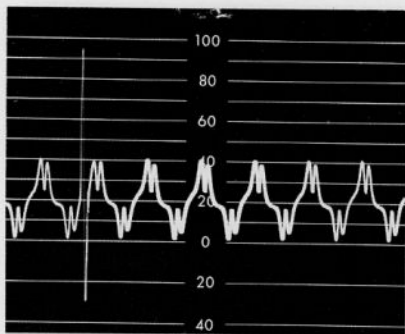


Figure 42—CT PB

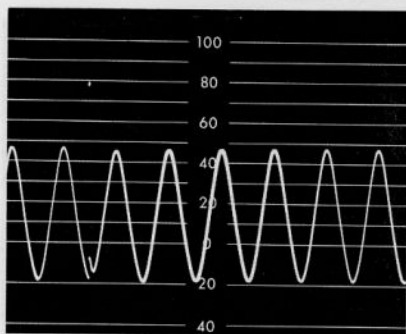
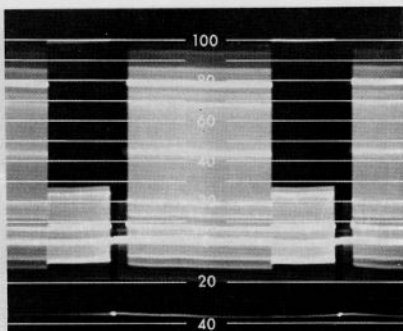
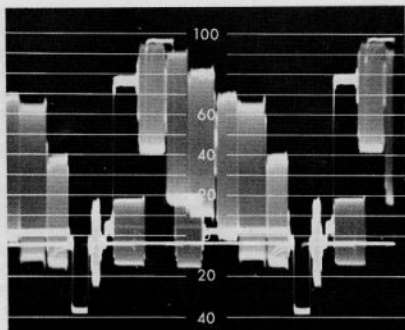


Figure 43—CT REC

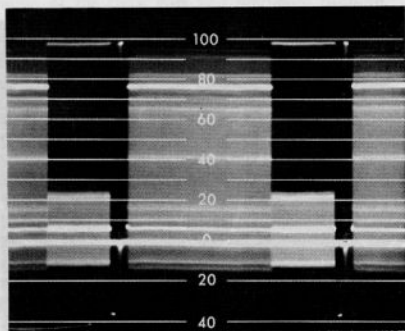




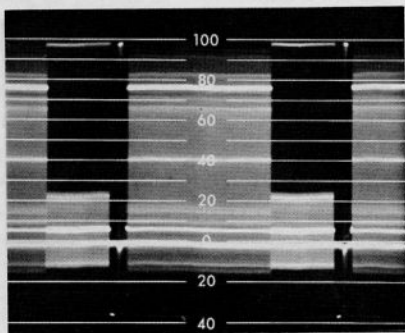
**Figure 44—Video IN**



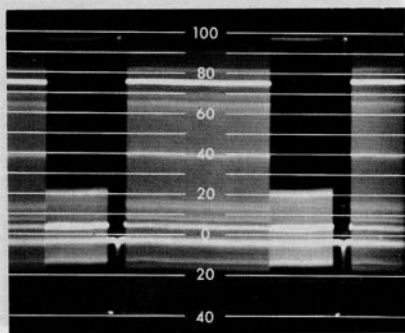
**Figure 45—DEMOD OUT,  
(Horizontal rate)**



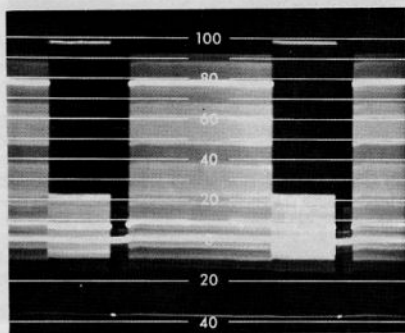
**Figure 46—DEMOD OUT  
FM Reference (Vertical rate)**



**Figure 47—ATC Video**



**Figure 48—CATC Video**



**Figure 49—Video OUT**

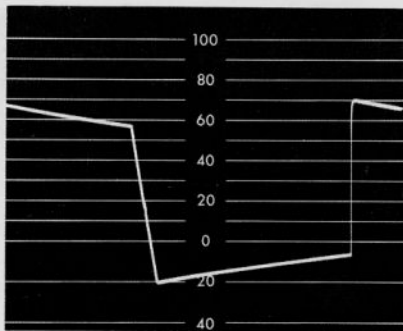


Figure 50—CAP Servo  
(Playback)

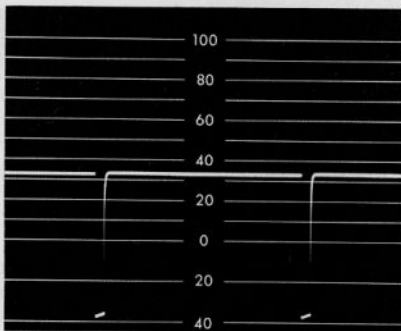


Figure 51—REF Pulse

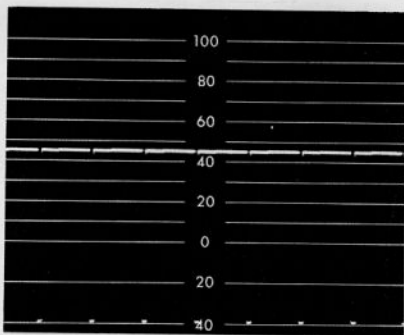


Figure 52—TW Pulse

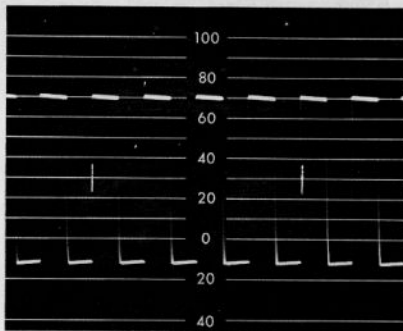


Figure 53—HW Servo

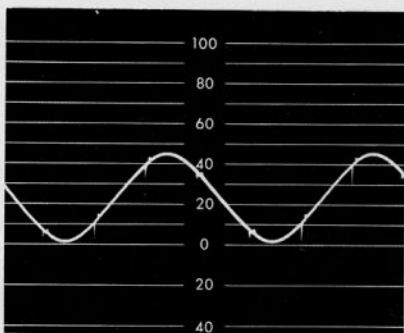


Figure 54—CAP Servo  
(Record)

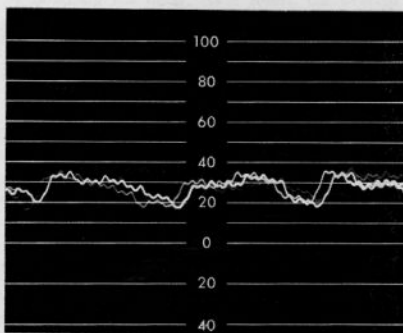


Figure 55—LL Error

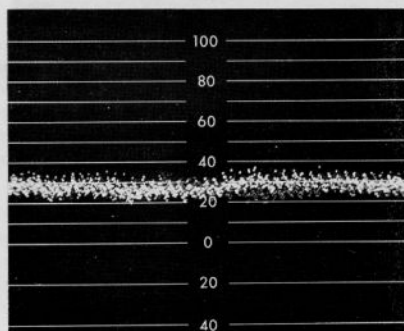


Figure 56—ATC Error

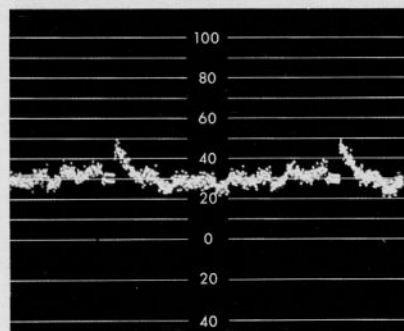


Figure 57—CATC Error

TOP: TP-1 (Module 524)  
 TP-1 (Module 615)

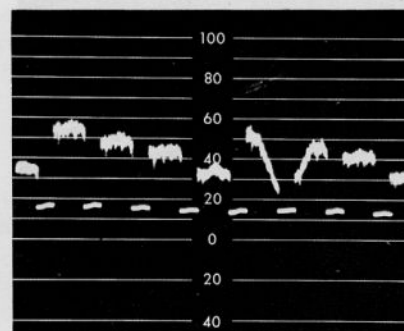


Figure 58—Erase Delay Test  
 (Press FM LEVEL on CRO Switcher)

### Audio Spot Erasure Procedure

To use the audio spot erase feature of the machine proceed as follows:

1. Place the machine in the STOP mode.
2. Mark the segment of audio recording which is to be erased, with a felt "flow pen" on the back side of the tape near the audio erase head. (The tape may have to be monitored in Playback for this purpose.)
3. Place the beginning of this segment over the audio erase head. The tape may be moved manually by releasing the reel brakes with the foot switch and turning the reels by hand.
4. Press the red SPOT ERASE button on the front panel of the Erase Oscillator module 601. The red SPOT ERASE indicator should light.
5. Move the segment of tape which is to be erased, over the audio erase head.
6. To end erasure, press the SPOT ERASURE button. The SPOT ERASE indicator should then go off.

NOTE: With a little practice this facility will serve very well to accurately eliminate unwanted passages.

### Electronic Splicing

Two modules make up the electronic splicer system,

Splice Timing Module 502  
 Splice Logic Module 503

These two *optional accessory* modules are mounted in the TR-70, top row, module series 500.

### Operating Features

#### Mode Selection

Three self-illuminating pushbuttons on the record panel labelled NORMAL, ADD ON, and INSERT, allow selection of the two operative modes for splicing.

As a special feature of the equipment, the selector buttons may be left in either ADD ON or INSERT and the machine will still make a normal recording if the RECORDING button is pressed before the PLAY button. This feature is obtained by use of a splice mode circuit which is similar to the mode memory circuits of the control system.

*The three sequence modes are as follows:*

1. NORMAL — In this operational condition the recorder splicing circuitry is in use in part but the recorder will behave as though the splicer had no function.

2. **ADD ON** — This is the simplest form of splice in which the new video and audio are simply continued at some point in the tape or near the end. The machine makes a new control track in phase with the original. An ingoing splice is made and any previous material that might be on the tape is erased.

With the machine in **NORMAL** and in the **STOP** mode, if the **ADD ON** button is pressed it will glow dimly and activate circuits in a preparation for this mode. When the **PLAY** button is pressed the **ADD ON** light will brighten and the machine enters the **Splice Play** mode in readiness for an actual splice.

3. **INSERT** — In this splicing mode the original control track is maintained and new video is inserted. The audio may or may not be replaced as desired. Both an ingoing and outgoing splice are made.

As with the **ADD ON** button when the machine is in **NORMAL** and **STOP** mode, if the **INSERT** button is pressed it will glow dimly and activate circuits in preparation for the **Insert** mode. When the **PLAY** button is pressed the **INSERT** light will brighten and the machine enters the **Splice Play** mode in readiness for an actual splice.

There are two conditions of operation requiring explanation at this time.

1. **SPLICE PLAY** — This mode is a readiness condition for splicing. The desired splicing mode has to be selected and the **Switchlock** servo mode selected. When the regular **PLAY** button is pressed the machine should go to **switchlock** and the machine is then in **SPLICE PLAY**. (The white **SWITCHLOCK** light should light up and the picture should frame vertically.

2. **SPLICE RECORD** — Splice record is accomplished only after the machine selections have been made as follows:

- a. Select either **ADD ON** or **INSERT** on the record panel.
- b. Select the **Switchlock** mode of operation by means of the knob on the **Tape Sync Processor** module 622.
- c. Press the **PLAY** button and allow the machine to become **Switchlocked**.
- d. Press the **RECORD** button at the time the splice is to be made, at which point the machine is then in **Splice Record**.

**NOTE:** The rotary switch on the **Splice Logic** module 503 is not used in the **TR-70** since the controls are operated by the sequence buttons on the **Record Control Panel**.

### *Erase Test*

The operating controls for this circuit consist of two red buttons marked **ERASE TEST**, and a potentiometer marked **ERASE DELAY**, on the front panel of the splice timing module. The two buttons are momentary and are connected in series. This arrangement prevents undesired erasure of the tape, if one of the buttons is accidentally pressed.

When the machine is in the **Splice Play** mode, and the two buttons are held down, the erase test circuit causes the tape to be erased in pulses of 200 microseconds duration, and the timing of these pulses, with respect to the recorded sync is the same as if a series of ingoing splices were being made.

This test should be made only while playing back a tape containing an unwanted recording, since the tape will be erased. Once the adjustment is made it will require no further attention until the headwheel is changed.

### *Changes in Timing to Accommodate Different Speeds*

When a tape recorded at half tape speed is being spliced, the number of frames between the master erase head and headwheel is doubled (30 frames for 60-field standards, or 24 frames for 50-field standards). Consequently the number of counts between the start of erase delay and the end of the cycle must be doubled. Also, since twice as much time is required for a given point in the tape to reach the erase head, the erase delay period must be doubled.

The two-speed circuit also causes the monostable delay multivibrators in the erase delay circuit to cycle twice, before the video erase switch is actuated, thereby doubling the delay. As a result, the overlap for an ingoing splice is increased from  $1\frac{1}{2}$  to 3 tracks, and the overlap for an outgoing splice is increased from  $2\frac{1}{2}$  to 5 tracks.

For more detail on the erase delay and timing functions of the splicer refer to **IB-31872, Electronic Splicer Accessory Manual**.

### **Setup Adjustments**

#### *Erase Delay*

1. Select a splice mode, on the **Record** panel, **ADD ON** or **INSERT** as desired. Select **SWITCHLOCK** on the **Tape Sync Processor** module 622.
2. Make a 5-minute recording at the beginning of a 1-hour reel of tape.
3. Play back and press the two **ERASE TEST** buttons on module 502.

4. Press FM LEVEL on the CRO switcher.

5. Adjust the ERASE DELAY control until the erase pulse occurs after the band containing the frame pulse, by an interval of approximately  $1\frac{1}{2}$  bands. See figures 59 and 60.

#### Capstan Add On Adjustment

1. Make a normal recording, for test purposes, on the splicing machine.

2. Play back the recording and observe the capstan servo trapezoid.

3. Hold the toggle switch on the splice logic module in the CAP ADJ position.

4. If the sample pulse is not steady on the capstan trapezoid, release the switch and adjust the CAPST ADD ON ADJ screwdriver control.

5. Repeat steps 3 and 4 until the sample pulse remains steady on the trapezoid slope for at least 4 seconds while the toggle switch is held in CAP ADJ, and then drift down the slope of the trapezoid. It may be necessary to make a slight adjustment of the OSC FREQ control on the capstan oscillator module 614 to obtain the desired results.

#### Splice Record Horizontal Phase Adjustment

This adjustment should be made each time a series of splices is to be recorded, if the original recording was made on a different machine, or headwheel panel.

NOTE: The picture monitor using pulse cross display may be used instead of an oscilloscope. Observe the combined signal from the VIDEO IN and DEMOD output and adjust the SPLICE RECORD

HOR PHASE control until the superimposed input and playback pulse crosses are exactly aligned vertically, and aligned horizontally as shown in figure 60. For the method required when using an external oscilloscope, refer to the *Electronic Splicer Manual* IB-31872.

### Operating Procedures

#### Making an Add On Splice

1. Push the ADD ON selector button on the Record panel.

2. Place the selector switch on the tape sync processor module in switchlock position, SL.

3. Make sure that playback reference is HOUSE SYNC and the HEAD SELECT switch on the reference generator module is on HEAD 1.

4. If recording is desired on the audio and cue tracks, make sure that the corresponding toggle switches on the Record control panel are in the NORM (center) position.

5. While playing the tape, check the CAP ADJ setting as directed in steps 2 through 5 under *Capstan Add On Adjustment*, page 66.

6. Unless the original recording was recently made on the same machine, make the SPLICE RECORD HOR PHASE adjustment and leave the toggle switch on the splice logic module on VAR TW. If the recording was recently made on the same machine, omit the adjustment and place the toggle switch on FIXED TW.

7. Rewind tape, press PLAY button, and wait for the SWITCHLOCK indicator to light.

#### Simultaneously press Picture Monitor Switcher IN and DEMOD pushbuttons

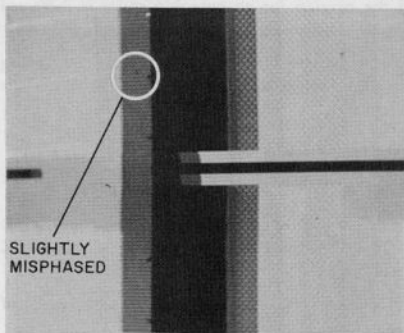


Figure 59—Splice Phasing (Add On) Switchlock (Play)

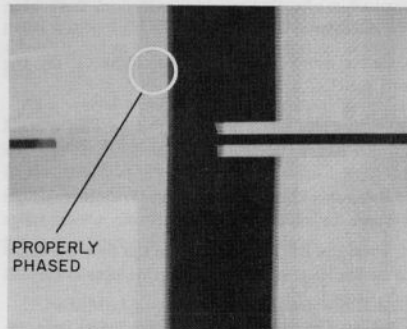


Figure 60—Splice Phasing (Add On) Switchlock (Play)

8. When splicing cue (which may merely be a pre-determined number on the tape timer) arrives, press the RECORD button. The splice is made approximately  $\frac{1}{2}$  second later at a tape speed of 15 in/s, or 1 second later at  $7\frac{1}{2}$  in/s.

9. Record at least 10 seconds longer than necessary to permit making more Add On splices if desired.

10. Stop recording by pressing PLAY, WIND, or STOP button (or FAST FORWARD button on remote control panel). The machine will immediately enter the selected mode.

#### *Making an Insert Splice*

1. Push INSERT selector on the Record panel.
2. Place selector switch on the Tape Sync Processor module in the SL (Switchlock) position.
3. Make sure playback reference is HOUSE SYNC and the HEAD SELECT switch on the reference generator module is on HEAD 1.
4. If retention of original audio or cue tracks is

desired, place corresponding toggle switches on Record control panel in OFF position. Otherwise, place switches in NORM position.

5. Play tape and adjust SPLICE RECORD HOR PHASE if original recording was made on a different machine. If recording was made on the same machine, place toggle switch on splice logic module on FIXED TW (See figures 59 and 60).

6. Replay tape and wait for the SWITCHLOCK indicator to light.

7. Press the MASTER RECORD button at the splicing cue. The ingoing splice will be made approximately  $\frac{1}{2}$  second later at 15 in/s or 1 second later at  $7\frac{1}{2}$  in/s.

8. Wait for outgoing splice cue.

9. Press PLAY, WIND, STOP or FAST FORWARD button as desired. The machine will continue recording until the outgoing splice is made and will then enter the selected mode (approximately 1 second later at 15 in/s or 2 seconds later at  $7\frac{1}{2}$  in/s).



## LIST OF ABBREVIATIONS

ACC	Automatic Chroma Corrector	LL	Linelock
AFC	Automatic Frequency Control	MATC	Monochrome ATC
AGC	Automatic Gain Control	MGC	Manual Gain Control
APC	Automatic Phase Control	MSMV	Monostable Multivibrator
ASMV	Astable Multivibrator	MV	Multivibrator
ATC	Automatic Timing Corrector	NEB	Negative Error Bus
B.A.L.L.S.	Bus Asking for Linelock Servo	NIC	Non-Interlaced Color
B.A.L.P.S.	Bus Asking for Linelock or Pixlock Servo	NLA	Non-Linear Amplifier
B.A.P.S.	Bus Asking for Pixlock Servo	NPC	Non-Phased Color
CATC	Color ATC	PB	Playback
CCIR	Comitee Consultatif Internationale Radio	PEB	Positive Error Bus
CM	Capstan Motor	PL	Pixlock
CRO	Cathode Ray Oscilloscope	PLATCH	Pixlock Achieved
CSEF	Complementary Symmetry Emitter Follower	PWFFST BUS	Play/Wind/Fast Forward/Stop Trigger Bus
C. T.	Control Track	REC	Record
DL	Delay Line	RFP	Reference Frame Pulse
DNEB	Delayed Negative Error Bus	S.C.	Sub-Carrier
DOC	Drop Out Compensator	SIMUL	Simultaneous Playback
DPEB	Delayed Positive Error Bus	SL	Switchlock
E-E MODE	Electronics-to-Electronics Mode	SMPTE	Society of Motion Picture and Television Engineers
E.F.	Emitter Follower	SU	Set Up
EVDL	Electronically Variable Delay Line	SW	Switcher
FB	Feedback	TFP	Tape Frame Pulse
FM	Frequency Modulation	THA	Tape Horizontal Alignment
F.L.U.C.	Fast Lock-up Capstan	THAF	Tape Horizontal Alignment, Fine
FP	Frame Pulse	TMV	Time Modulated Vertical (TM VERT)
4XTW	Four Times Tonewheel	TVA	Tape Vertical Alignment
HD	Head	TW	Tonewheel
HI	Horizontal Inverted	2XTW	Two times Tonewheel
HN	Horizontal Normal	2SPN	Two Speed Normal
HM	Headwheel Motor	2SP1	Two-Speed Inverted
HW	Headwheel	VEC	Velocity Error Corrector
HWM	Headwheel Modulator	VEL	Velocity
IC	Interlaced Color	VI	Vertical Inverted
I.C.	Integrated Circuit	VN	Vertical Normal
L.A.S.S.	Lazy Servo Simulator		



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