Crown

MODEL IM-8

OPERATION
AND
SERVICE MANUAL

SERIES
PRO - 800
RECORDER/REPRODUCER

THREE YEAR
RECORDER WARRANTY

CROWN Warranty Statement:

(a) CROWN warrants to the original using purchaser that all new CROWN equipment shall be free from defects of workmanship and material under normal and proper use and service for a period of three years from date of delivery to original using purchaser.

(b) CROWN guarantees to repair or replace all parts thereof showing such defects subject to use of the provision stated herein.

CROWN Warranty Obligation:

(a) Equipment returned within 0-90 days from date equipment delivered to the original using purchaser. All defective parts will be repaired or replaced at no charge for labor or materials.

(b) Equipment returned within 91-1095 days from date equipment delivered to the original using purchaser, all defective parts will be replaced or repaired at no charge for materials.

(c) In all cases, the responsibility of CROWN will be limited to making a new or factory reconditioned replacement part available to the dealer; it is the responsibility of the dealer to repair or replace defective parts either by his own service personnel, through a CROWN Warranty Service Station, or the Factory Service Department.

CROWN Warranty Conditions:

(a) Defective equipment shall be returned, transportation prepaid, to the CROWN dealer from whom the equipment was originally purchased or to a CROWN Warranty Service Station, or to the CROWN factory upon receipt of authorization. Under no circumstances will CROWN accept a returned machine or component without having given written authorization.

(b) Purchaser, for warranty service, must present his CROWN Warranty Service Identification card to a CROWN dealer, CROWN Service Station, or the CROWN factory before parts are repaired or replaced.

(c) Purchaser shall not have used or allowed to have been used in the equipment any part not supplied by CROWN through its dealers or Warranty Service Station.

(d) Inspection shall disclose to the satisfaction of the CROWN factory the defects are as above specified and that the equipment has not been altered or repaired by other than the factory accepted procedures, subjected to negligence, misuse or accident, or damaged by excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Normal wear of any parts or material are in no way covered or implied by this Warranty.

(e) Replacement parts supplied by this warranty carry only the unexpired portion of the original warranty.

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This warranty is effective only when the warranty-registration card is fully and properly filled in and returned to the factory within ten (10) days of delivery of CROWN Equipment.

A factory-validated warranty identification card will then be returned to the purchaser to be used when in-warranty service is necessary. This card must be presented to obtain warranty service.

CROWN reserves the right to modify or change the equipment in whole or in part at any time prior to delivery thereof, in order to include therein electrical or mechanical improvements deemed appropriate by CROWN, but without incurring any liability to modify or change any equipment previously delivered, or to supply new equipment in accordance with any earlier specifications.

CROWN INTERNATIONAL
DIVISION OF INTERNATIONAL RADIO AND ELECTRONICS CORP.
1718 WEST MISHAWAKA ROAD ELKHART, INDIANA 46514
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(cont.)

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DESCRIPTION

1.1 GENERAL

The purpose of the transport, or as it is sometimes called, "tape deck," is to mechanically position and move magnetic tape over the heads.

CROWN Pro-800 transports accomplish this with optimum ease and simplicity, dependability, and long trouble-free life. Materials and design are keyed to the highest professional requirements. A high-mass capstan drive system assures rock-steady tape motion. Rugged, oversize reel motors provide tape-handling capabilities seldom found at any price. Tape can be reeled from one end to the other; and it can immediately be brought to a soft and gentle stop. The patented braking system never needs adjusting —there is nothing to adjust, nothing to wear out. There are no brake shoes, or other friction devices—no mechanical linkages or gadgets in the braking system. Braking tension is determined entirely be electrical factors. This same design philosophy has been carried throughout the entire transport; a minimum of moving parts, a maximum of dependability.

The belt-driven capstan is powered by a hysteresis-synchronous drive motor. The capstan rotates constantly so long as power is applied to the drive motor. The drive motor also serves to power the forced-air ventilating system of the machine, which draws cold air in over the drive motor and expels it out the ends of the enclosed machine.

The two reel motors (torque motors) perform the duties of take-up and pay-off tension, fast forward and rewind, and braking. In the play mode, the take-up tension is controlled by the AC voltage applied to the take-up motor, while pay-off tension is controlled by an AC voltage applied to the pay-off motor. In fast forward or rewind, the pulling motor is powered with a full 117 VAC while the opposite motor has 35 VAC applied for a slight holdback tension.

A large variety of record-reproduce electronics and heads are available. Fig. 1-1 is a typical combination.

FIG. 1 - 1

1.2 SPECIFICATIONS

1.2.1 Performance Specifications

Definition	Three-speed, three-motor professional tape transport
Tape Width	¼ inch, 1.5 and 1.0 Mil (NAB Std.)
Tape Speeds	3-¾, 7-½, 15 ips. Front panel change 3-¾, 7-½. Other speeds available on request
Speed Regulation	±0.2% with ±10% voltage variation from 117 VAC
Wow and Flutter	15 ips - 0.06% 7-½ ips - 0.09% 3-¾ ips - 0.18% These figures are guaranteed maximum values for complete record and reproduce cycle.
Reel Size	10-½ inch NAB maximum, 5 inch minimum
Start Time	Less than 0.1 seconds. Meets wow specifications within 2 seconds
Fast Forward or Fast Rewind Time	1200 ft. 7 inch reel in 45 seconds 2400 ft. 10-½ inch reel in 58 seconds
Controls	Four momentary contact lighted pushbuttons (Rewind, Forward, Stop, and Play) control tape motion. Photocell tape sensor gives automatic stop command at end of tape or on transparent leader.
Operating Performance	Completely smooth tape-handling because tape deck is controlled by Solid State IC computer logic. The memory stores the last command given it; and, by continuous knowledge of the operating state of the tape (motion and direction), takes all the necessary measures and executes the commands.

1.2.2 Mechanical Specifications

Construction	All exterior aluminum parts are anodized and all steel parts are plated. Precision components, precision craftsmanship, and individual inspection and adjustment ensure the finest quality throughout.
Deck Plate	3/16 inch-thick anodized aluminum with overlay aluminum extrusion across the bottom
Electronic Assembly	All Solid State circuity, all sub-assemblies completely plug-in. Transport can be disassembled and re-assembled in 15 minutes.
Relays (3)	Gold-plated silver contacts (P-B KHP Series)
Capstan Drive Motor	Hysteresis-synchronous type. Employs ball bearings for long maintenance-free operation. Starting Torque: 16 inch-ounce Running Torque: 13 inch-ounce Running Current: 0.55 amp at 117 VAC
Capstan Shaft	The stainless-steel micro-finished capstan shaft is centerless ground, and is housed in self-aligning oilite bearings in a 5 inch cast housing.
Flywheel Assembly	Weight 4 lbs. The flywheel is nickel-plated steel, with one thousandth of an inch maximum eccentricity.
Reel Motors	Torque motors with self-aligning oilite bearings, 1250 RPM, 0.6 amp at 117 VAC. Special high-torque circuit used for starting in Play mode.
Drive Belt	Ground-neoprene drive belt over flywheel and three-step drive pulley (or speed reducers.)

Braking System	Electro-dynamic brakes which never grab, or need adjusting, ensure optimum smoothness in bringing the tape to a gentle stop. A positive-temperature-coefficient resistance is used to provide the braking differential.
Cooling System	Ducted forced-air flows in over the drive motor and is forced out the sides of the machine.
Head Assembly	Erase, record, and reproduce heads are independently tripod-mounted. Azimuth and tracking are independently adjustable and are factory aligned.
Tape Guides	Chrome-plated hardened steel.
Pressure–Roller Solenoid	Actuates pressure roller and tape lifter in Play mode. Solid State circuitry applies extra voltage on pull-in.
Pressure Roller	Neoprene with oilite bearings.
Tape Lifters	Glass-rod lifters lift tape into heads in the Play mode; release and thereby remove tape from heads during Fast Forward, Fast Rewind, and Stop modes.
Tape Reel Holders	Screw-on, positive locking.
Head Covers	Clip on for ease in cleaning of magnetic heads.
Overall Dimensions (no reels)	10-½ in. H x 19 in. W x 9 in. maximum overall depth.

1.2 3 General

Power Requirements	117 VAC, 60 Hz
Power Consumption	230W max. (jockeying mode) 85W min. (standby) 175W (play - large reel) 130W (play - small reel) 155W (fast winding)

J 14
Power Socket

3 +24	6 117 C	9 35
2 INT	5 GND	8 +4
1 H	4 117	7 35

J 15
Remote Socket

3 H	6 J	9 K	12 L
2 INT	5 GND	8 +4	11 +24
1 RWD	4 FWD	7 STOP	10 PLAY

(Rear views, outside of transport)

Command Signals (+ voltages only (2)) available at J15 Remote Socket

	Rewind	Forward	Stop (1)	Play
Max. volt. that will not result in a command	+0.46	+0.46	+0.46	+0.46
Min. volt. that will result in a command	+1.55	+1.55	+0.85	+1.55
Max. command voltage	+4	+4	+4	+4
Typical current at min. voltage for a command	5 ma	5 ma	0.6 ma	2.25 ma

Notes: 1. See Section 5.10 for precautions on the use of externally-powered commands.
2. Negative input commands are not to be applied.

Outputs (+DC) of Computer available at J14 Power Socket, and J15.

	H	J	K	L
Min. Load R	0	510 ohm	700 ohm	510 ohm
Min. I out into load	2.65 ma	1.65 ma	1.7 ma	1.65 ma
Min. open-ckt. voltage	+4	+1.35	+3	+1.35

H = "1" in standby and play
J = "1" in Play
K = "1" without tape
L = "1" rewind direction of motion

1.3 TAPE TRANSPORT

The tape transport (see Fig. 1-2) handles ¼-inch magnetic tape on reels ranging from 5 in. to 10-½ in. diameter.

Three speeds are standard, 3-¾, 7-½, and 15 ips. Special speeds are available on request.

Tape motion is controlled by the four lighted pushbuttons on the lower right hand area of the panel. Power, reel size, and drive motor power are controlled by the slide switches on the lower left hand area of the panel. The speed shift is located directly above the head assembly. Below the lower head cover beneath the pressure roller is located the cue bar. Inside the lower head cover on the panel is located the edit switch.

FIG. 1 - 2

1.4 ELECTRONIC ASSEMBLY

A typical record-reproduce electronics is shown in Fig. 1-3. A typical reproduce electronics is shown in Fig. 1-4. A number of other electronics are available; and for more specific information refer to Section 7. Electronics' assemblies should usually be mounted directly beneath the transport to keep head leads to a minimum of length.

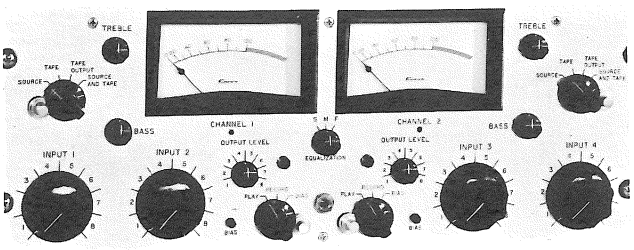


FIG. 1 - 3

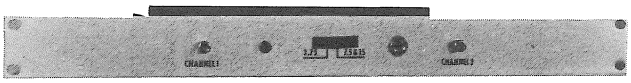


FIG. 1 - 4

1.5 HEAD ASSEMBLIES

The head assembly allows for a maximum of three stacks of heads (See Fig. 1-5). In a typical record-reproduce unit, the heads from left to right would be Erase, Record, and Playback. For a minimum of wow and flutter, the reproduce head is placed as close to the capstan as possible; therefore, in a multi-headed reproduce assembly, the head nearest the capstan is the preferred head. Depending on requirements, a large variety of head arrangements are available.

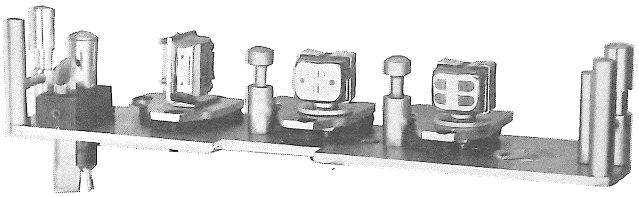


FIG. 1 - 5 2-TRACK STEREO HEAD ASSY.

1.6 ACCESSORY EQUIPMENT

1.6.1 Remote Control Box (RC-40) See Fig. 1-6a

Operation of the tape transport can be remotely controlled by an optional remote control unit. The unit contains lights which indicate the state of the transport command memory; i.e. either the operation in process or the one about to be in process. Commands are given by a series of four pushbuttons.

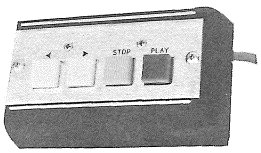


FIG. 1 - 6a

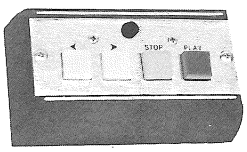


FIG. 1 - 6b

1.6.2 Remote-Record and Control Box (RC-50) See Fig. 1-6b

The remote record is actually an accessory to the record-reproducing electronics. Since it is interlocked with the transport to avoid accidental erasures and such, it is listed here. A Remote-Record control Box which incorporates companion circuitry and a "Record" button, must be utilized. The Remote Record is so devised that the machine can go in and out of record without the transport being taken out of the Play mode. The act of giving any operating command to the transport will shut off the record. Thereby, if the machine is recording, it is only necessary to again push the Play button to shut off the record and continue reproducing.

It is impossible to be recording when either the machine is fast winding or has high brakes applied.

Each record channel (on a multi-channel unit) must be independently activated on the Electronics. A single 'Record' indicator is on the remote box. To get into record, the transport must be in either the standby or play mode and the record button must be depressed or have been released after the last operating command was given to the transport. If there is no tape in the slot, the record will be only so long as the Record button is depressed. This is because "no tape" is equivalent to a continuous stop command.

1.6.3 Repeat-O-Matic (R-O-M)

The Repeat-O-Matic is an accessory to provide the automatic re-play of a tape. The unit has provision for remote start—where the machine automatically cues; and, with a remote start-command, will reproduce the tape and again cue up. When not set for remote start, the re-play is provided automatically and the machine simply plays the tape over and over.

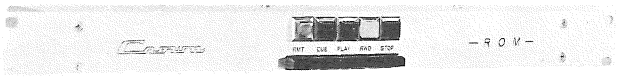


FIG. 1 - 7 ROM ACCESSORY

Every mode of operation (Remote, Cue, Play, Rewind, and Stop) has an indicating lamp which shows the R-O-M's mode of operation.

1.6.4 Track Sync

The Track Sync attachment allows the record head to be used for reproduce—for precise recording and editing applications. It may be installed with a CX or CI electronics.

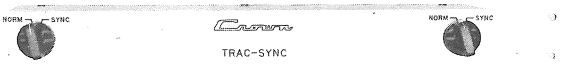


FIG. 1 - 8 TRAC-SYNC ACCESSORY

1.6.5 220 Volt Adapter

Line-voltage conversion from 200 V, 200 V, or 240 VAC down to the 117 VAC required by the PRO-800 is the function of a special 220 Volt Adapter. Mounted above the transport, and adding 1¾ in, in height, the adapter is rated at 285 VA—thus a D-40 or DC 300 amplifier should be separately wired for direct 200, 220 or 240 VAC operation. Color-coded jumper-plugs enable quick-selection of desired input-voltage.

INSTALLATION

2.1 AFTER UNPACKING

Please inspect the unit for any damage incurred in transit. Since the unit was carefully inspected and tested, it left the factory unmarred. If damage is found, notify the transportation company at once. Only the consignee may institute a claim with the carrier for shipping damage; however, CROWN will cooperate fully in such an event. All packing material must be saved as evidence of damage for carrier's inspection.

1. Wrap Machine in Polethylene Package.

*2. Pack Machine in Carton as Shown, Being Sure Machine is Upside Down.**

Even if the unit arrived in perfect condition, as most do, the packing should be saved. It will prove valuable in preventing damage should transport be necessary. Fig. 2-1a shows a preferred form of packing of a typical uncased machine. The machine should never be shipped rigidly mounted to the shipping container, as this provides no shock absorption. Fig. 2-1b applies to a cased unit.

In shipping, the machine should always be top side down, as this places the heavy motors at the bottom of the pack. Also, the machine should be totally sealed inside the carton by a plastic bag. This protects the machine from moisture and sulfur contaminants in the cardboard packing. (Sulfur corrodes electrical contacts).

3. Pack Cased Machine Upside Down as Shown:

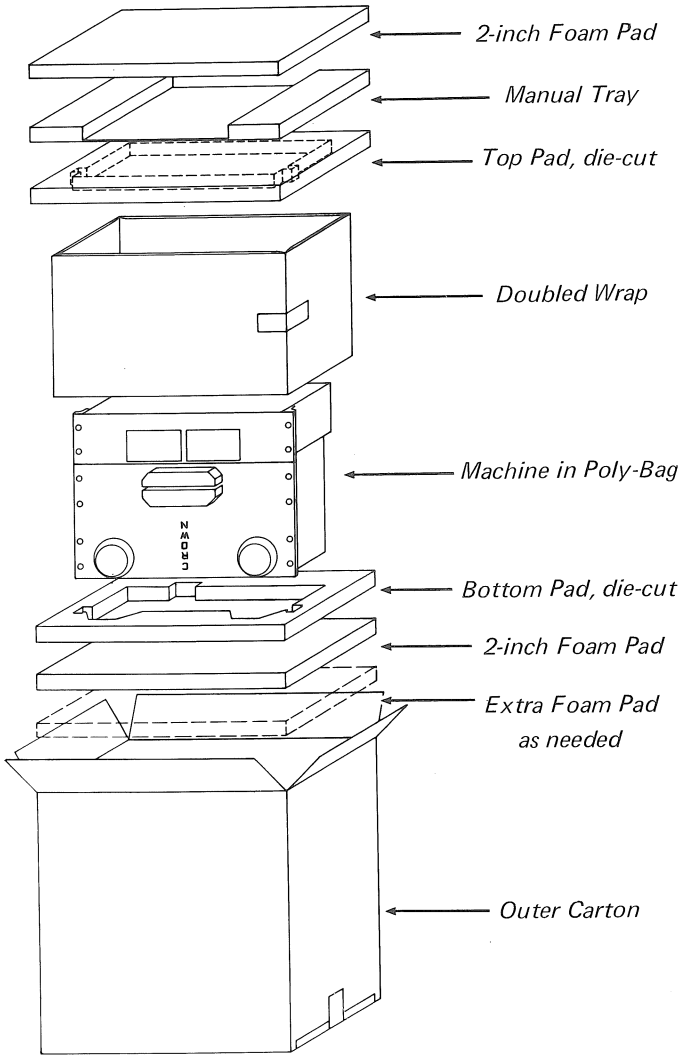


FIG. 2 - 1a

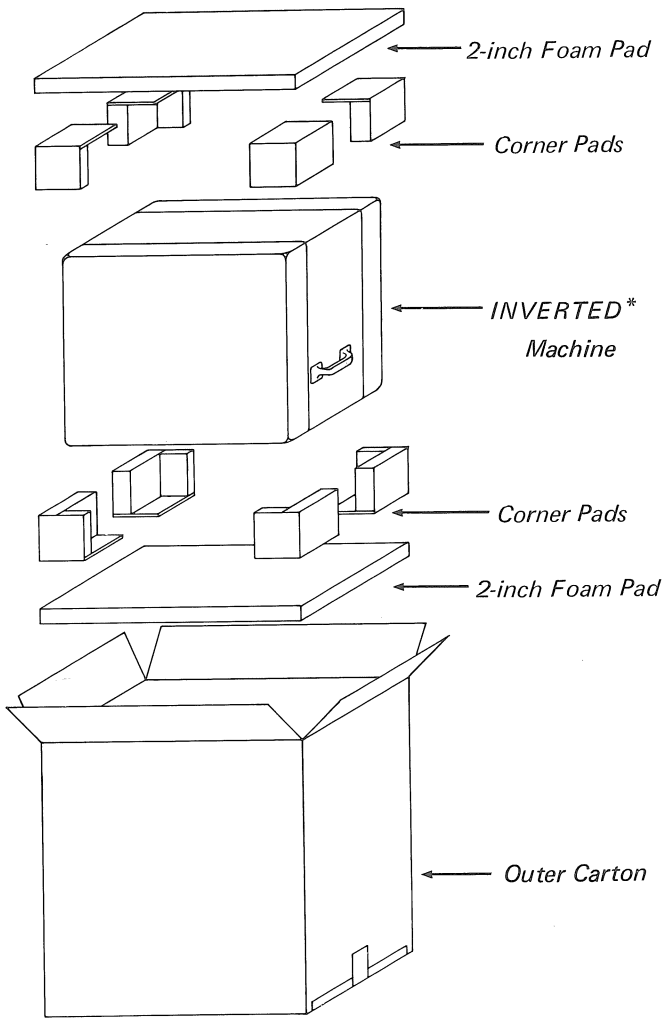


FIG. 2 - 1b

TYPICAL SHIPPING PACK

2.2 MOUNTING and ENVIRONMENT

The recorder should *not* be mounted in an area where: the tape would be exposed to high temperatures, high magnetic fields would be encountered, proper ventilation is not allowed, or high vibration would be encountered while playing. The machine is sufficiently shielded to operate in areas where a reasonable amount of RF is present, such as a radio station.

When the machine is ordered with the portable case, all assemblies are mounted in place at the factory.

The transport and electronics are designed to be mounted in standard 19 in. racks, with the transport situated directly above the electronics for the shortest head leads.

Provisions should be made for obtaining a source of clean cool air for the air inlet at the drive motor. The air outlets at the ends of the machine must not be blocked.

Care must be taken, on units with more than one set of electronics, to insure that electronics and head leads are not permuted upon mounting. To assign a head to an electronics other than the one it was equalized with may result in an equalization error.

Note: The Transport and Electronics must be electrically connected together (grounded). This connection is usually provided by the ¾ x ¾ angles, or by mounting in a metal rack-cabinet. In custom installations on non-metallic panels, a separate ground wire must be provided between the sections.

Fig. 2-2 and 2-3 show the clearances to be observed when mounting the machine.

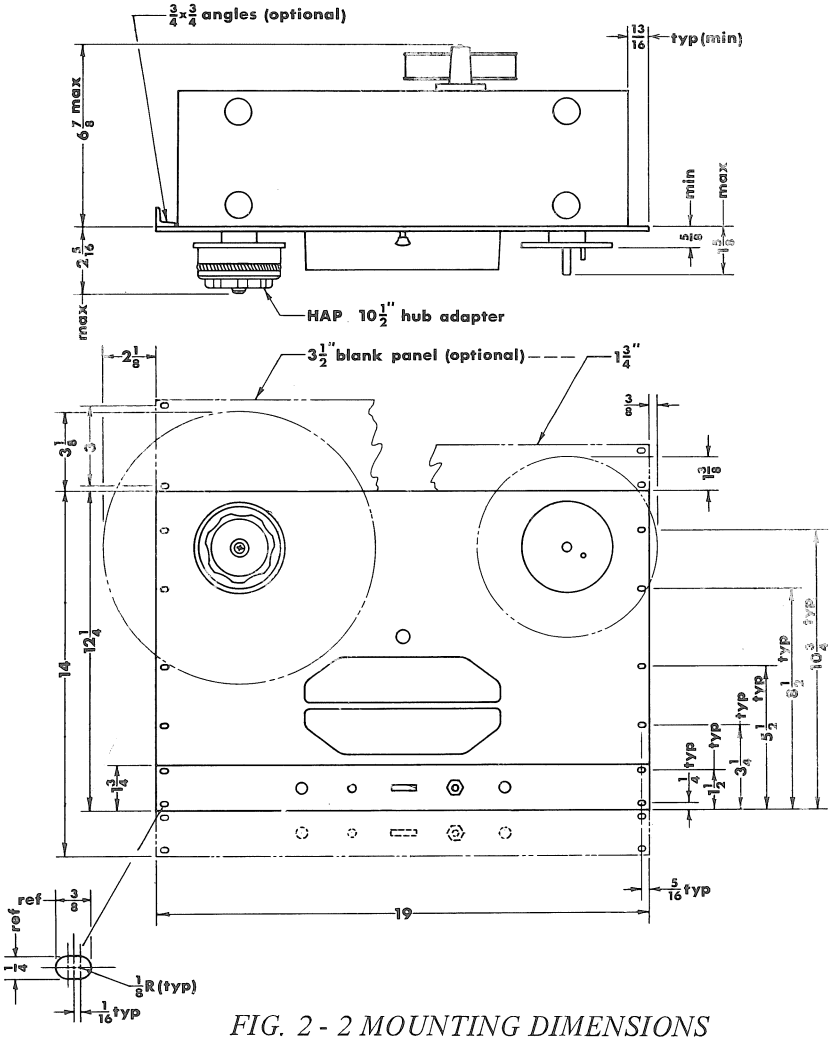


FIG. 2 - 2 MOUNTING DIMENSIONS (REPRODUCERS)

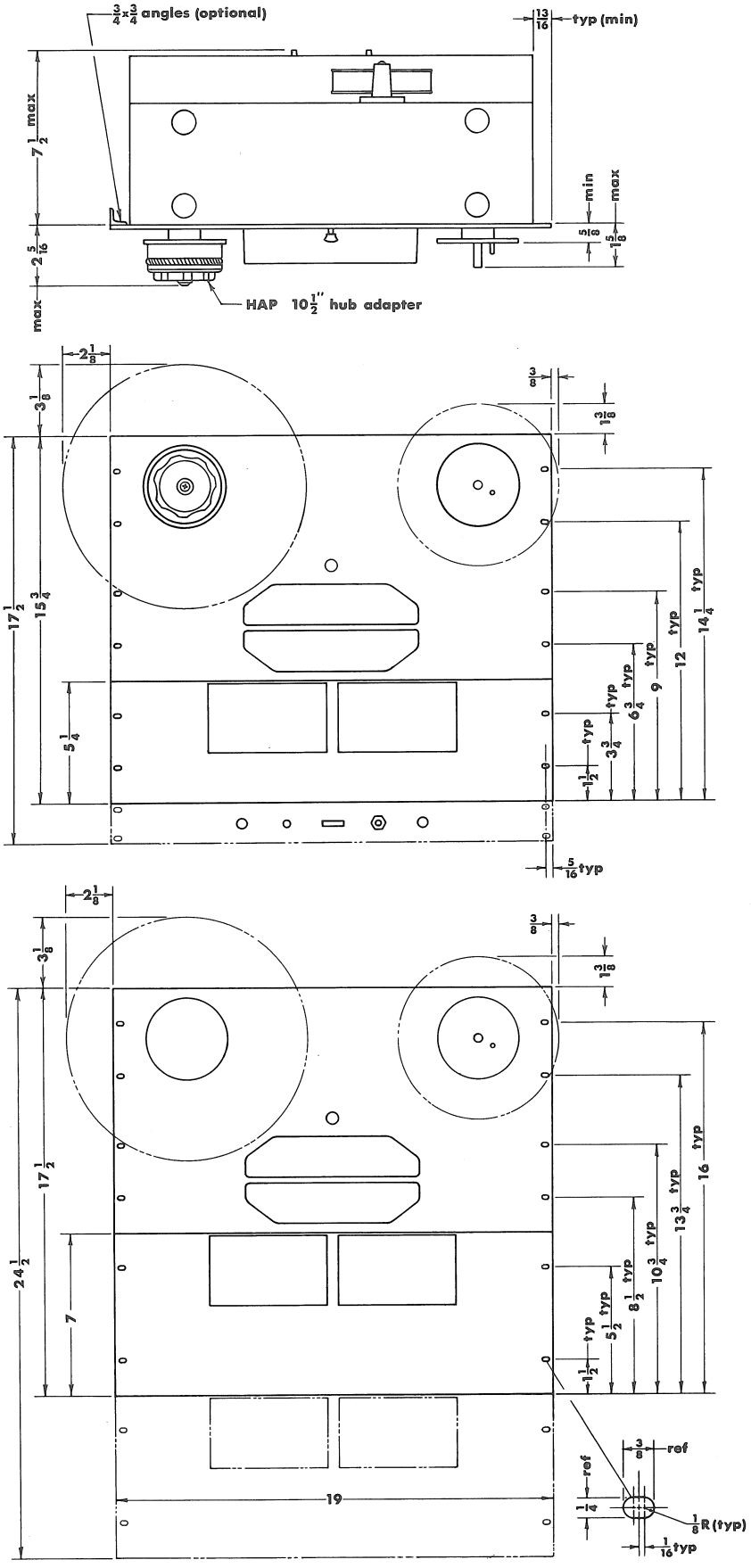


FIG. 2 - 3 MOUNTING DIMENSIONS (RECORDERS)

2.3 ASSEMBLY INTERCONNECTIONS

The basic assembly interconnections or cabling between transport and electronics is composed of one power cable to each electronics and head leads, one for each record channel and one for each reproduce channel. Power cables must join to the power output jack on the rear of the transport (Figs. 2-1, 2-5, 2-6, or 2-7). Each head lead is tagged with its respective channel number which must go to the electronics associated with that channel. In units with more than one set of electronics, care must be used not to interchange them or serious equalization errors may appear. Four-channel recorders will have a special cable passing between electronics to interconnect the bias oscillator and bias amplifier. On the rear chassis is an unfused auxilliary AC outlet which is switched by the transport power switch. For more specific information refer to Section 7.2.

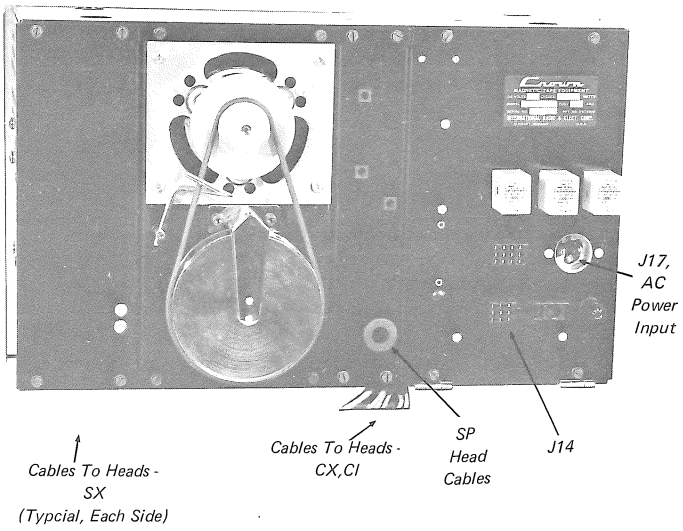


FIG. 2 - 4 'PRO-800' TRANSPORT

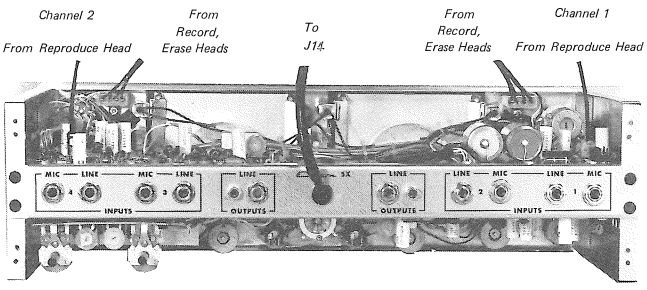


FIG. 2 - 5 'SX' STEREO CHASSIS

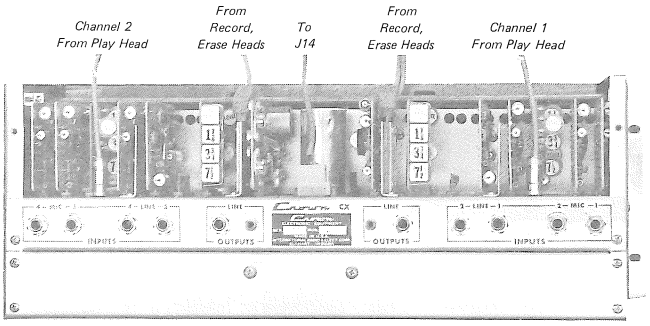


FIG. 2 - 6 'CX' STEREO CHASSIS

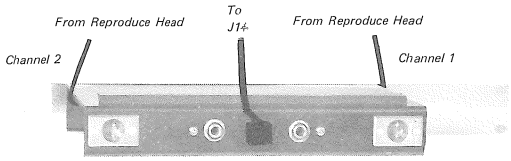


FIG. 2 - 7 'SP' REPRODUCE CHASSIS

2.4 CONNECTING SIGNAL LINES

All inputs and outputs use ¼ in. phone plugs. Machines with Lo-Z input hardware and balanced outputs also have XL connectors (female inputs and male outputs). Some electronics also have a pin-jack line output.

Where XL connectors are used, pins 2 and 3 are the signal leads and pin 1 is ground.

Front-panel monitor or earphone jacks on all stereo electronics, except the CI series, are stereo ¼ in. phone jacks.

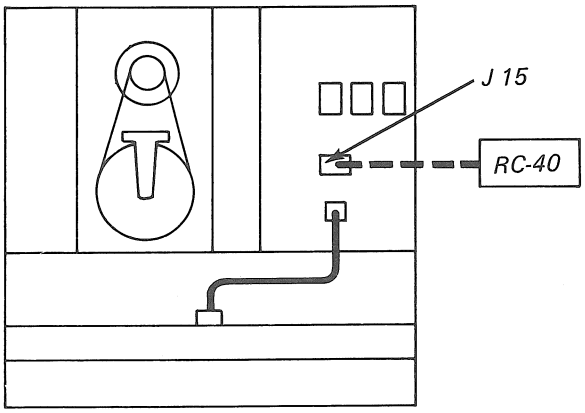
For more specific information on the electrical specifications on inputs and outputs refer to the Electronics' section. AC power cord should be dressed away from all signal leads.

2.5 CONNECTING POWER

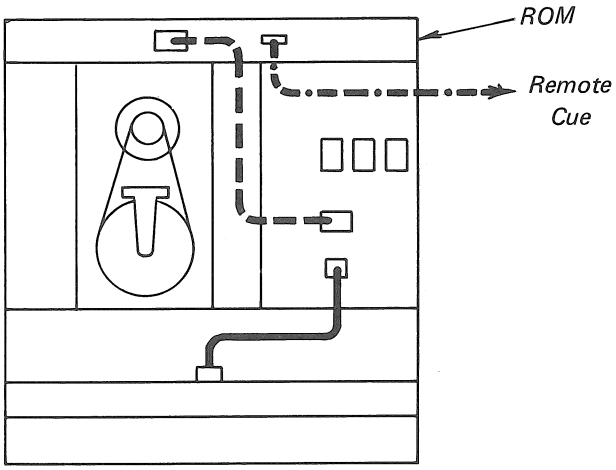
The AC power cord, which is provided, plugs into the male chassis-mount receptacle on the back of the machine (See Fig. 2-4)

2.6 INSTALLING ACCESSORIES

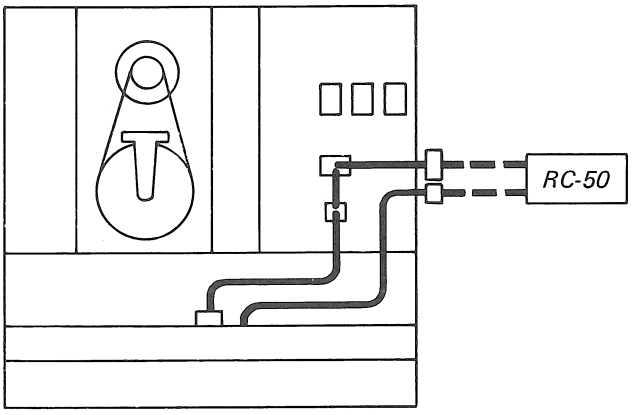
All the accessories mentioned in Section 1.6 can be connected by simply plugging in the furnished cables. Fig. 2-8 shows several accessory connections.



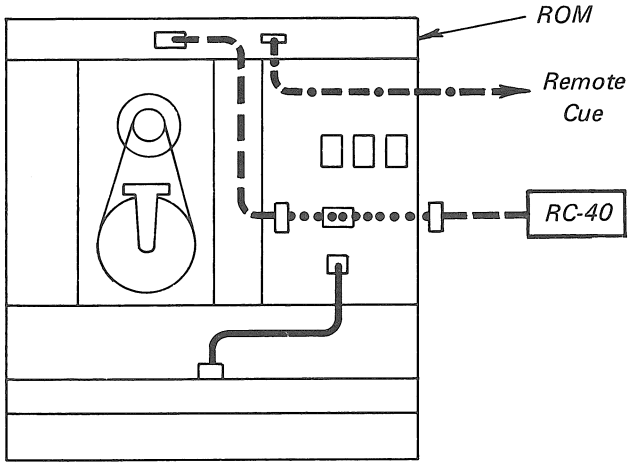
Recorder With RC-40
(Remote Control Box)



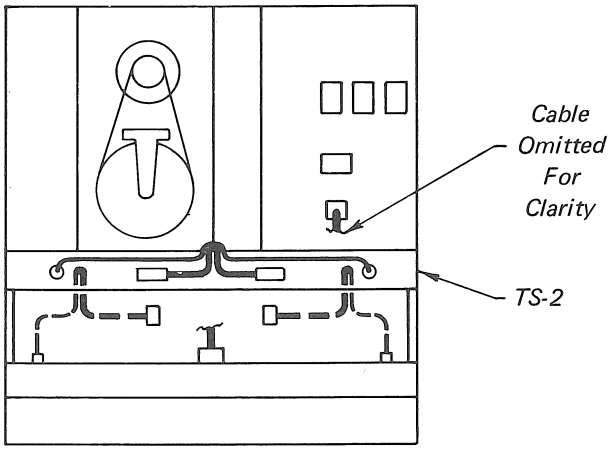
Recorder With ROM
(Repeat-O-Matic Unit)



Recorder With RC-50
(Remote Control Box)



Recorder With RC-40
And ROM Units



Recorder With TS-2
(Trac-Sync Accessory)

CABLE CODES:

- Supplied With Machine
- Supplied With Accessory
- Supplied By Customer
- Accessory Adapter

FIG. 2 - 8 ACCESSORY CONNECTIONS

3.1 OPERATING CONTROLS AND INDICATORS (See Fig. 3-1 and 3-2)

Power	Controls power to the transport and to the record, reproduce electron.
Reel	The REEL switch sets the motor torques for the proper tape tensions depending on . A 10-½ inch diameter reel is considered large and 7-½ inch and 5 inch reels, small. Set the reel size switch accordingly. Both reels (take-up and pay-off) must be the same size. *Do not intermix reel sizes.*
Motor	The MOTOR switch may be used to remove power from the capstan drive motor when using the unit as a control center without transporting tape. When in this mode, the transport relays are de-activated, placing the transport in the standby mode. Since the standby mode is one of mild forward brakes, the drive motor should never be turned off while rewinding a tape.
Photocell Tape Sensor	Provides automatic-stop at tape-motion at end-of-tape, or in event of tape breakage. Sensor will also stop the transport with certain leader and timing tape—useful for cue and edit.
Edit	The EDIT switch is located under the head cover. It removes take-up reel torque for ease in editing.
Speed	The Speed Shift is used to shift the capstan drive belt between two steps on the drive motor pulley and thereby change the play speed. The speed shift should be used only when the drive motor is in operation. A snap-type action should be used, by quickly pushing or pulling the speed shift all the way. On a typical machine, which speed-shifts between 3-¾ and 7-½ ips, the drive motor must be shut off and the belt manually placed on the 15 ips (largest) step. The speed shift should be left in the 7-½ ips position. If special speed reducers are employed, they are also manually shifted (See Fig. 3-4).
Cue	The CUE lever provides a method for precisely locating a specific sound on the tape when moving the tape slowly over the heads (pull knob down to engage). At all other times, this knob should be off (up).
< Rewind Button	Places tape in rapid motion in rewind mode from take-up to pay-off reel. The button lights when in rewind.
> Fast Forward Button	Places tape in rapid motion in Fast Forward mode from pay-off to take-up reel. The button lights when in Fast Forward.
STOP Pushbutton	Stops tape motion from any mode. The button lights when high brakes are being applied. Rewind or Forward button will simultaneously indicate the direction of braking.
PLAY Pushbutton	Places tape in forward motion at pre-selected speed for recording and/or reproducing. The button lights when in Play.

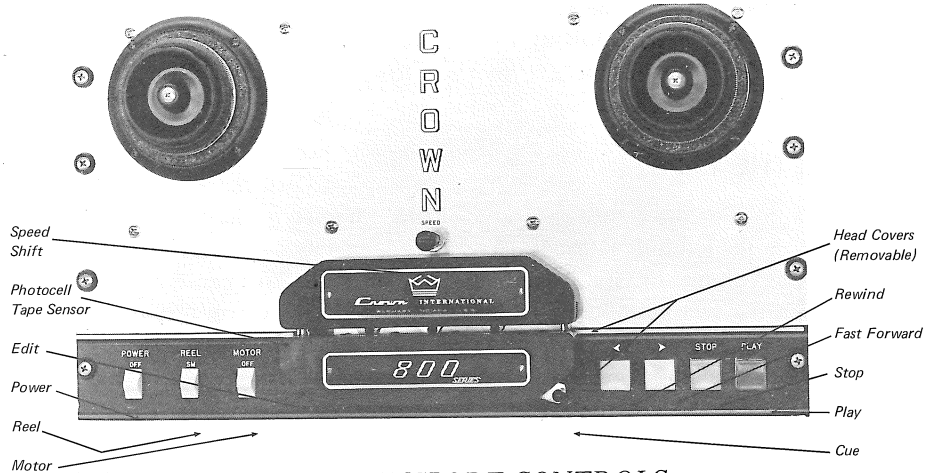


FIG. 3 - 1 PRO-800 TRANSPORT CONTROLS

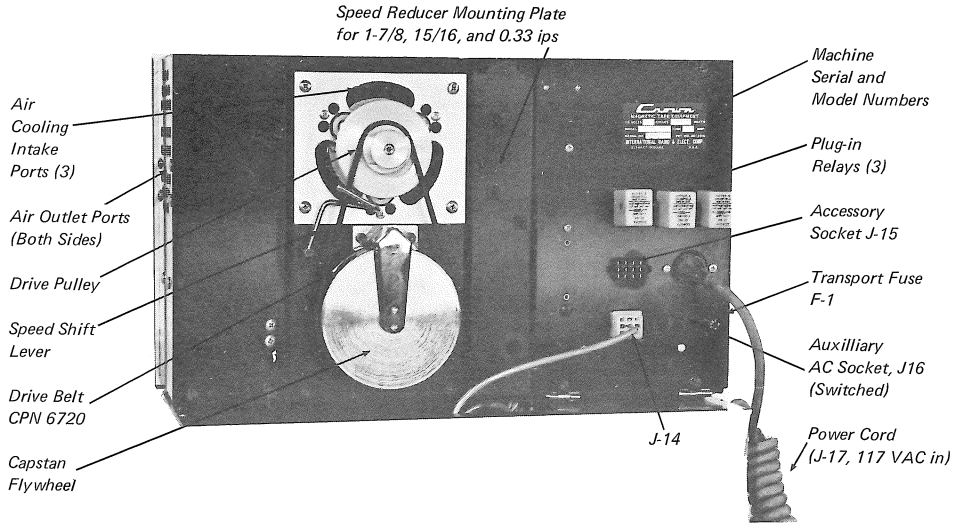


FIG. 3 - 2 'PRO-800' TRANSPORT (REAR VIEW)

The pushbutton handling commands are stored in the transport computer's memory. The memory remembers only the last command given it, and will execute that command in the safest and most efficient way. Any command or combination of commands may be safely given at any time. If multiple commands are given to the machine, it will obey the following priority rules:

1st - (<) Rewind or (>) Fast Forward
2nd - Play
3rd - Stop

Another useful command is to press rewind and fast forward simultaneously, thus allowing one to "jockey" the tape.

An automatic tape sensor (automatic stop) is provided in the form of photocell and lamp assembly on the left end of the head assembly. This gives a continuous stop command whenever tape runs out, or a transparent "window" in the tape is sensed. Because of the priority on commands, the stop command may be overridden by holding down any other command. To enable a precise "cue" to a selection on a tape during PLAY, a 3/8-inch window at 7½ IPS will suffice. For fast-wind cue to this selection, increase to ½-inch (see also Par. 5.2).

3.2 THREADING THE TAPE

Mount reels on the hubs. Put the empty reel on the right hub, and the full reel on the left hub. (Use the same size of reels on both).Pull about two feet of tape from the full reel, insert the tape between the two head covers, and wrap the end of the tape around the empty hub two or three times. Be sure the tape is not twisted. The dull (oxide) side of the tape *must* be on *top* as it goes through the slot.

Normally the 5-, 7- and small-hole, plastic 10½-inch reels are mounted using the reel-lock knob (RK). Special HAP's (hub-adapter, professional) are utilized, together with the RK's, for NAB 3-inch-hole reels: Tighten the RK into the HAP until the reel just slips over the radial spring. Then, while holding reel against flange, turn RK clockwise one revolution—two half-turns of the wrist is convenient. Loosen RK one turn to release reel when desired.

3.3 APPLYING POWER

To apply power to the transport and record-reproduce electronics, switch on the transport POWER switch.

3.4 SELECTING REEL SIZE

If 10-½ inch reels are used, place in the LarGe position. For 7 or 5 inch reels, place the REEL switch in the SMall position. Both reels would be the same diameter.

3.5 SELECTING TAPE SPEED

In order to use the front-panel speed shift, the capstan drive motor must be running. On a standard machine having speeds of 15, 7-½, and 3-¾ ips: for 7-½ ips, quickly pull the speed-shift rod out to its full extension, and release; for 3-¾ ips, quickly push the rod fully inward, and release. For 15 ips: stop the drive motor, move the speed-shift rod to 7-½ position, and manually place the belt on the largest step of the pulley.

Similar operation will be noted when using a machine with 15-7-½ front-panel speed shift; however, a separate small motor pulley must be installed for 3-¾ ips (in place of large pulley).

Special speeds using speed reducers will require manual belt shifts and the use of additional special drive belts (See Fig. 3-3).

3.6 TRANSPORTING TAPE

Once tape is threaded, and POWER and MOTOR switches turned on, the machine is ready to be given its handling commands. To transport the tape, it is only necessary to push the Play button. For instruction on how to record and reproduce the tape refer to Section 7.3.

3.7 RAPID SERVICE GUIDE

If abnormal operation of the transport is suspected, several double-checks and tests may be performed. A chart (see Fig. 3-3) showing symptom test, reason(s), and cure, is shown below. Reference is also provided to the specific theory and service paragraphs where applicable.

SYMPTOM	TEST	REASON(S)	CURE	REF.
No power	Meters' and photocell's lamps should light	Defective power cord, or fuse FI Power switch OFF Fuse-cap of FI loose	Replace power cord, or correct fuse Tighten cap till snug	Par. 3.3
Drive Motor and push-buttons inoperative	No rotation of motor, and no lights or relay clicks when moving tape.	Motor switch OFF	Motor switch must be ON for normal transport function	Par. 3.1
Take-up Motor inoperative in PLAY mode.	Motor does not take up the tape	Edit switch (under lower head cover, left) down	Edit switch must be up for normal tape motion	Par. 3.1
Tape tension in PLAY mode excessive or slack (or) Excessive tape 'bobble' at start of PLAY mode	Tape stretches or squeaks in guides, slack loop formed with possible drop-outs Loop forms, may pull inside of reel flange	Reel switch in wrong position Sticky tape, or heads and guides contaminated Defect in High-Torque action	Reel switch must be up (LG revealed) for 10½ in reels, down for 7 in, 5 in. reels (SM) Clean heads, guides; Use good tape Repair or replace High-Torque Module	Par. 3.4 Par. 4.1 Par. 5.6
Tape playback sounds slow or fast	Reproduction 'tinny' or 'bassy'	Incorrect tape speed, or equalization (see section 7)	Speed shift (or manual shift of belt) required	Par. 3.1, 3.5 or 7
No STOP at predetermined windows in tape, or end-of-reel tape runout	STOP Button does perform properly	Window in photocell tape-sensor housing clogged with oxide Lamp I7 intermittent or defective Sensitivity of tape-sensor mis-adjusted	Clean window with HC and soft toothpick Replace lamp I7 Adjust sensitivity of tape-sensor	Fig. 1-5, 3-1a Fig. 3-1b and 6.3 Par. 5-2
Sluggish tape movement in Fast-wind modes	Listen for loud cue signal Rotate motor shafts with power OFF	Cue lever engaged Reeling motor shaft binding	Release lever Realign motor bearings	Par. 3.1 Par. 4.5
High Wow and/or Flutter	Certain music sounds unsteady, wavers Slow tape start-up in play mode Random pulses in tape at Take-up motor	Sticky or wide tape, or capstan, heads or guides contaminated Low capstan-to-roller pressure Defect in drive system Defect in High-Torque circuit	Use first-quality tape; Clean heads, guides Re-adjust pressure-roller pressure Service drive system Repair or replace High-Torque module	Par. 4.1 Par. 5.4.3 Par. 4.6 Par. 5.6
Erratic or Sudden Stop from Fast-wind modes to STOP (large 10½ in reels)	High-brakes engaged, tape stretches or slips down inside large reel flange Differential lamps should light at beginning of high-braking mode	Wide or weak flanges of 10½ in. metal reels with 1 mil tape Differential lamp defective	Use true reels, or semi-precision type Use good-grade 1 mil or thicker tape Replace lamp I5 or I6 Crown part No. 2611 (No. 304)	Par. 5.7.3
No Brakes (or) Tape breaks with PLAY command from both Fast-wind modes	Tape spillage from fast-wind modes	Motion Sensor lamp intermittent or defective Defect in Motion sensor circuit of Logic Module	Replace lamp I8 Repair or replace Logic Module	Par. 5.3 Par. 5.7.3
Tape breaks upon PLAY command (while in one fast-wind mode only) (or) No brakes (one direction only) (or) FWD, RWD, or STOP Button lights remain 'on' with NO tape motion	While holding PLAY button on, push FWD or RWD button –high brakes must energize until reel motors stops, then to PLAY Remove tape, rotate supply reel by hand–RWD and STOP buttons should light with C-W motion. Repeat C-C-W with similar results in FWD and STOP lights	Motion and Direction Sensor lamp socket tilted Problem in Motion and Dir. Sensor circuit, or Computer Defective relay or contacts	Straighten socket–lamp I8 must illuminate both photocells of motion sensor Repair or replace Logic Module Clean or replace relay	Par. 5.3 Par. 5.11 Par. 5.9

FIG. 3 - 3 RAPID SERVICE GUIDE

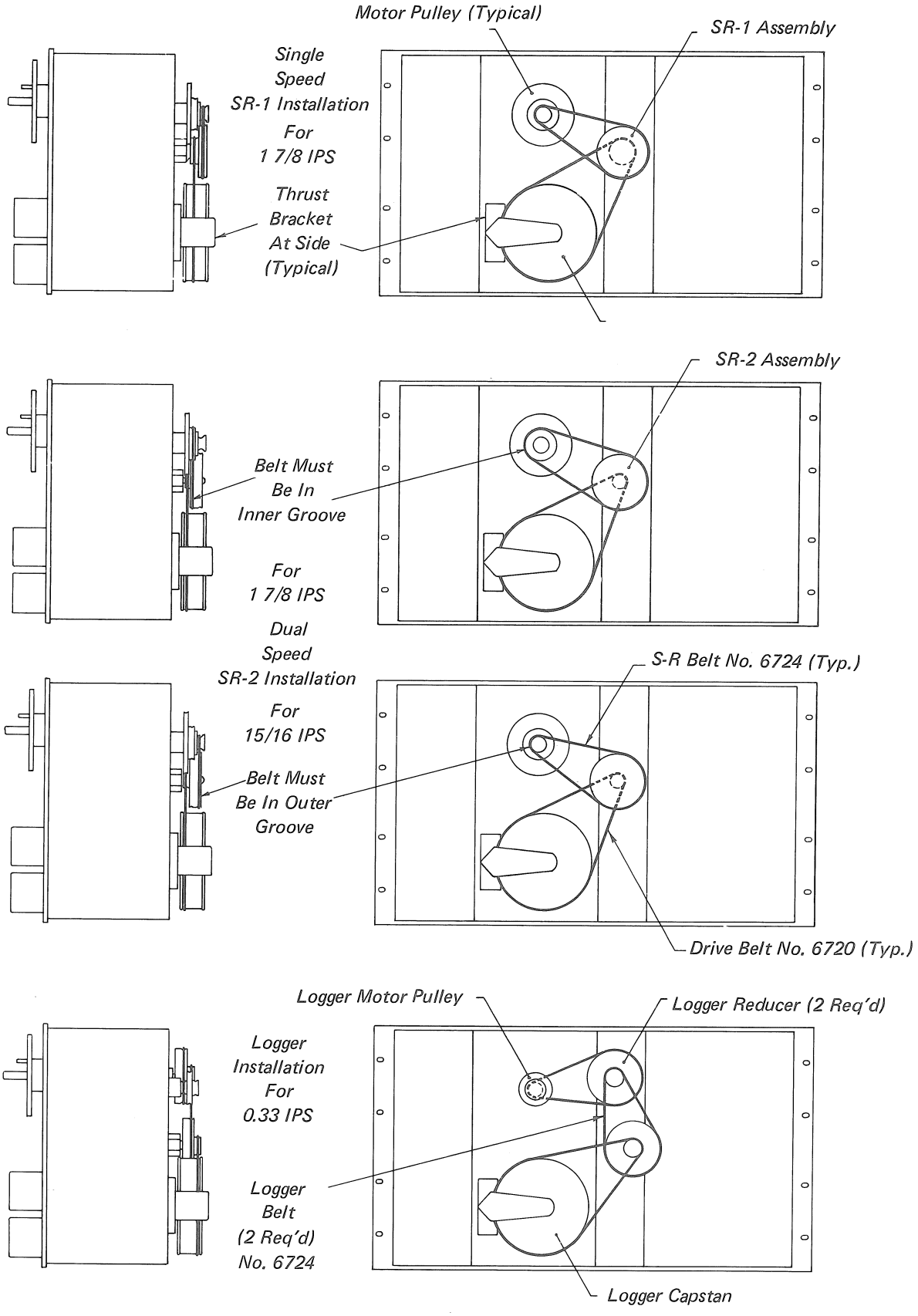


FIG. 3 - 4 SPEED REDUCERS

ROUTINE MAINTENANCE

4.1 CLEANING

In Fig. 4-1 are shown the parts which need periodic cleaning for optimum performance and life of the machine. Metalic tools should not be used on the heads or guides when cleaning as serious damage could result. Use CROWN Head Cleaner (CROWN HC) or isopropyl alcohol. Some solvents are also solvents for plastics used in potting the head, the pressure roller, and other plastic parts of the machine. Care should always be used to keep the solvent confined to the objects being cleaned and out of all lubricated moving parts where it would destroy the lubricant. Avoid contacting photocell lucite with solvent.

Different types of tape will cause different amounts of oxide and dirt to accumulate on the heads at different rates. Check the heads often. When a build-up is noticed, they should be carefully and thoroughly cleaned. A match or wooden toothpick may be used to loosen the dirt if necessary. Low or distorted record and reproduce level or incomplete erasures are also evidences of dirty heads. Clean heads are less likely to show signs of uneven or rapid wear.

Tape guides, lifters, and pressure brushes are additional parts which come in contact with the tape. Like the heads, they should be kept clean and free of oxide particles and build-up. Brush out any large particles and use a solvent to remove any remaining build-up. Do not allow oxide particles to fill up space between vertical fibers in the brushes.

Occasional cleaning of the pressure roller is advisable, especially if large amounts of oxide build-up or any sign of oil appears on the surface of the pressure roller. It is also good practice to clean the capstan as removal of oxide particles and other foreign matter will aid in keeping wow and flutter to a minimum. Excess oil from the capstan bearing may at times appear on the capstan shaft itself. This is especially true in hot environments or after oiling. Make sure that any oil is carefully removed.

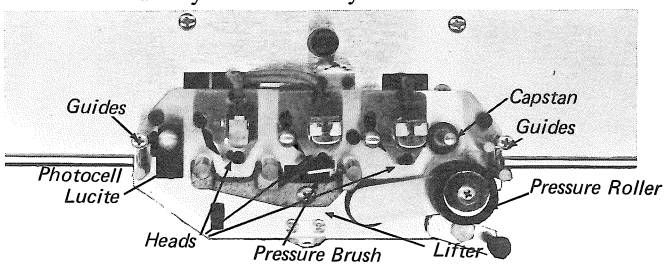


FIG. 4 - 1 TAPE PATH (HEADS, GUIDES, ETC.)

4.2 DEMAGNETIZATION

The heads and guides of the transport should be demagnetized at any time there is a suspicion that the heads may have become magnetized, or when there is any evidence of magnetization. Magnetization will cause an increase in the tape noise level, degrade a recorded tape, and cause even-order harmonic distortion when recording a tape.

In any case, it is a good practice to demagnetize the head assembly on a regular basis. Perhaps every 300 to 500 hours of normal use would justify average needs. This is accomplished by removing the head cover, and bringing a bulk eraser or head demagnetizer into close proximity with the heads. The eraser or demagnetizer should be turned on and off at a distance of at least three feet, and should be moved slowly while near the heads.

Sometimes the capstan shaft, capstan tip, or the capstan flywheel will become magnetized. This will induce a sinusoidal low frequency (subaudio) noise into the playback head. If the shaft is to be demagnetized, the flywheel and shaft must be removed from the back of the machine for the operation.

4.3 HEADS

Wear must be expected in the heads, due to the abrasive nature of the tape. However, some tape is much more abrasive than other tapes. It is best and actually cheaper in the long run to use a good grade of tape on your recorder. Be careful of dirt and foreign particles in the tape deck.

Always use regular splicing tape for splicing. *Never* use household cellophane tape or any other kind of tape not designed specifically for tape splicing. It will gum up the heads and pressure brushes.

The life expectancy of the heads is 4,000 hours or more. The real and only true test of how much is too much wear is the manner in which it affects the performance of the machine.

Further information on the heads and their alignment is given in Section 5.1.

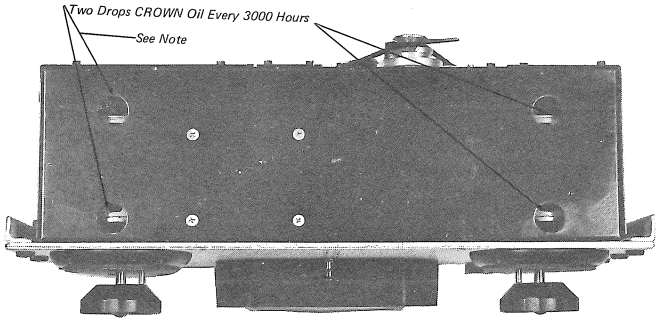
4.4 LUBRICATION

Most moving parts in the mechanism are operating in lubricated oilite bearings (see Fig. 4-2). Therefore, very little oil is required. The reel motors and pressure roller bearings should be oiled after 1,000 hours of operation or one year, whichever comes first. The drive shaft housing should be oiled after 3,000 hours of operation. CROWN lubricant (CROWN CO) is recommended.

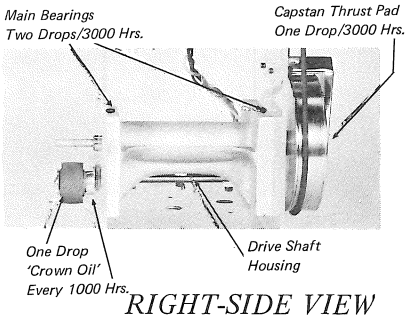
If any excess oil seeps to the outer edges of the moving parts, causing slippage in the drive mechanism, clean off all parts thus affected. See Section 4.1 on cleaning.

Do not over-oil! Two drops of oil on each bearing is usually sufficient. Too much oil on capstan bearing or pressure-roller bearings could cause the oil to go to parts that contact the tape and cause serious trouble.

Note: The rear bearing of the rewind motor cannot be oiled without removing the motion-sensor housing (Fig. 5-5).



TOP VIEW



RIGHT-SIDE VIEW

FIG. 4 - 2 LUBRICATION DIAGRAMS

4.5 REEL MOTORS

When reel motors are new and bearings are tight, it is possible that bearings might stick occasionally. If this happens, it indicates that a bearing is slightly cocked. This may happen during shipment or rough handling. The motor shaft should be tapped lightly in all four directions and at both ends of the motor where possible. This will usually align the bearings. Do not dis-assemble the motor unless absolutely necessary. It may be very difficult to restore it to the original alignment.

4.6 WOW and FLUTTER

There are many factors which may contribute to wow and flutter. Items listed should serve as a guide and may also suggest further checks to make:

1. Dirty capstan
2. Dirty or rough capstan-shaft bearings
3. Shaft too loose in bearings
4. Excessive tape wrap on heads
5. Bad test tape
6. Dirt on test tape
7. Improper pressure-roller pressure
8. Bad pressure roller
9. Pressure roller binding on side
10. Pressure roller with dry or dirty bearings
11. Reel flanges wobbly causing tape to touch reel
12. Flange adjustment causing tape to drag on one side of guide
13. Head-cover guides cramping tape
14. Oily Tape, capstan, or pressure roller
15. Bent capstan tip
16. Irregular belts
17. Mis-aligned motor
18. Oily belt

NOTES ON PERMALUBE

In early 1969 CROWN introduced permanent lubrication in some or all bearings described above. All machines thus equipped were assigned a "K" prefix in serial no. e.g. K4595.

DO NOT USE ANY OIL on any reel motor bearings of "K" series machines. Additionally, some early "K" series units incorporated Permalube capstan bearings and/or pressure-roller bearings. A yellow label on the pressure bar identifies these bearings.

5.1 HEAD ALIGNMENT

Before you begin, all tools which are likely to come in contact with the head assembly should be demagnetized to avoid magnetizing the head assembly. Do not attempt to service the heads unless you have a professional alignment tape, necessary tools, and experience to do so.

5.1.1 Reproduce Head Azimuth

Make sure the Record switch is in the Play position; then thread an alignment tape. Standard alignment tapes provide tones for azimuth alignment, reference level, and frequency response. With the azimuth section playing, adjust the output control until clear indication is seen on the meter. For slight adjustments, turn the azimuth screw slightly to the right and left and leave it at the point where the highest level is indicated on the meter. The two other screws have to do with tipping the head; and, by very careful adjustment, fluctuations of playback level may be reduced (see fig. 4-1).

5.1.2 Record Head Azimuth

After the reproduce head has been aligned, the record head may be aligned in the following manner:

1. Remove the alignment tape, and thread a tape that can be used for recording.
2. Plug an audio oscillator into the high level input and record a 10KHz note on the tape. Record at a level of -10 VU at 7-½ ips.
3. With the Meter switch in "B" or "Tape" position, adjust the record head in the same manner as the play head, using the designated screws.

Adjustments made to the record head must be made slowly, since there is a time delay between recording and playback.

5.1.3 Tracking

The 'tracking' of the tape is very important to obtain consistently good results, especially when using multi-track recorders, such as two-track and four-track stereo. 'Tracking' refers to the tape moving across the heads exactly where it should. (See Fig. 5-1)

Notes:

(1) All views are toward head-faces, with panel at bottom of each configuration.
(2) Tape Travel is from left to right.
(3) Standard tape width is 0.246 ±.002 inches.
(4) RECORDED-TRACK data per NAB STANDARD, ¼-inch Magnetic tape equipment (reel-to-reel), April 1965.

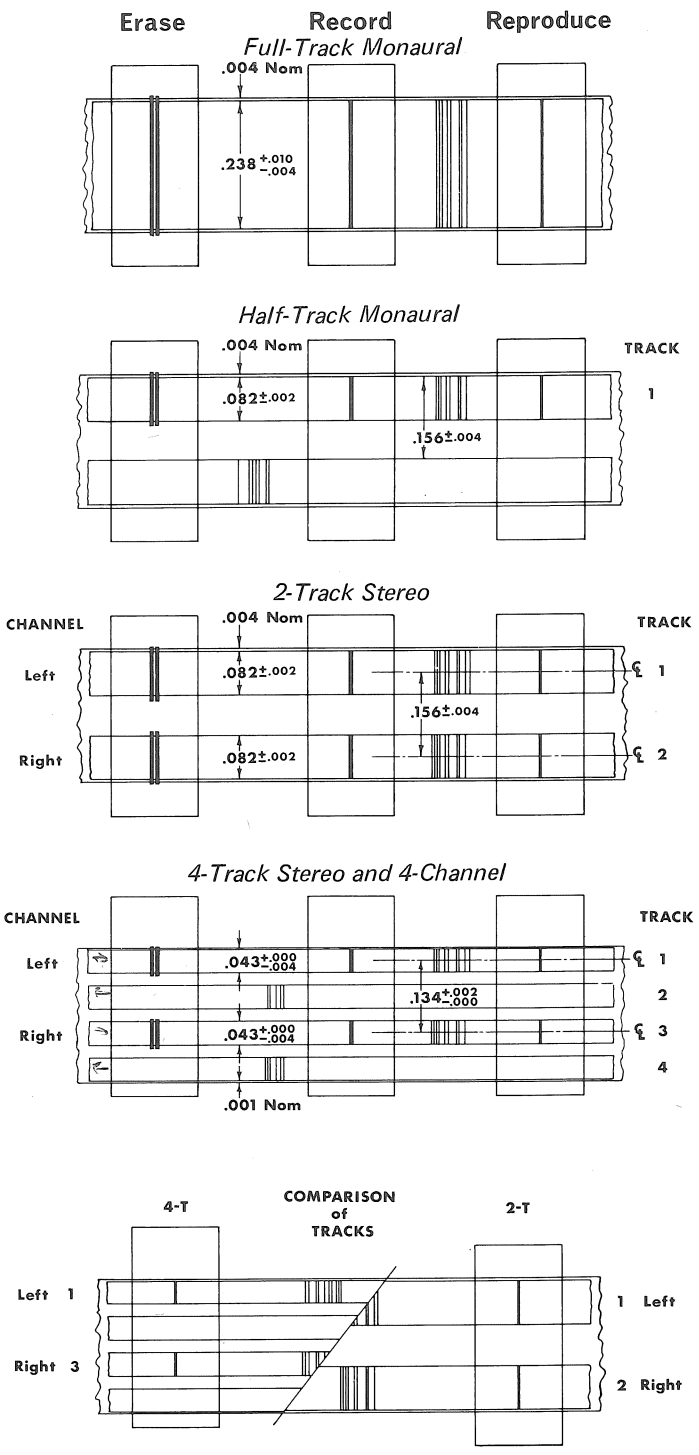


FIG. 5 - 1 POSITIONS OF HEADS AND TRACKS

In order to determine if the tape is running exactly where it should, the use of a colloidal iron suspension is recommended, such as Soundcraft's Magna-See. In using this solution, a 1000-cycle tone from the oscillator should be recorded at full level (0 db) on all tracks of your recorder. Note that this requires the tape to be recorded in both directions (except full-track or two-track stereo). Then a portion of the tape is developed in the colloidal iron suspension and examined. A pattern will clearly indicate the exact position of the recorded tracks on the tape. If the record head needs adjustment, it can be moved forward or backward by adjusting all three record head screws. When moving the head, these three screws should all be turned the same amount, or else serious mis-alignment or head tilt will result. A small adjustment should be made first and then rechecked by making a test with iron suspension again.

The reproduce head can be tracked by recording a steady tone (1.5 V @ 1 KHz) from an audio oscillator directly into the reproduce head leads (after disconnection from electronics). All three screws should be turned the same amount to avoid azimuth error. When the point of maximum output is reached (on both channels if machine is stereo), the heads are properly tracking. The azimuth should be rechecked as a final adjustment.

To check for inaccurate erase head alignment, record the signal as before and then erase the signal and again develop. If the tape is not properly tracking by the erase head, a small sliver of the signal will still be visible on the tape. The erase head may be moved in a manner similar to that used for adjusting the record and play heads, using the screws designated erase head. Normally, the erase head will not cause trouble since the erase gap is longer and tends to overlap on both sides on the recorded track. A small amount of misalignment is therefore tolerable. If severe mistracking is noticed, check to see if the tape is running properly in the guides. If the tape is pulled severely toward the front or the back, the tape is skewing (See Section 3.1.5).

Note: Poor erasure may also be encountered if the erase head current is low or if the circuit is open or shorted. If an examination of the plug, the cable, and the head connections show no abnormality, check the oscillator circuit itself.

5.1.4 Pressure Brushes

In order to reduce dropouts, lower scrape flutter, improve high-frequency response (with better tape-to-head contact), and minimize I M distortion, CROWN equipment incorporates a pressure brush. Normally the brush is applied to the record head—where tape-to-head pressure is lower, and above problems are more likely to occur.

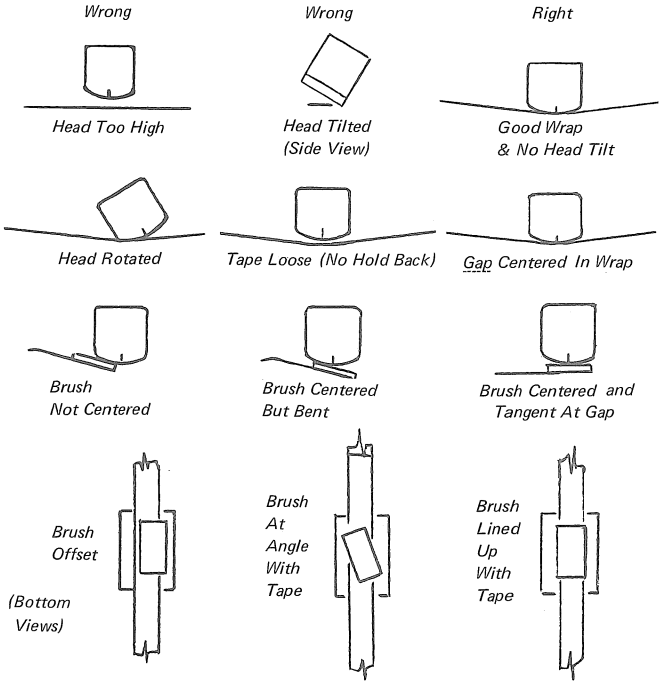


FIG. 5 - 2

Proper adjustment must be maintained, as a misadjusted pressure brush may result in poor-quality sound and/or permanent damage to the head (in the form of excessive or uneven wear. Adjustment should be checked as follows: (see fig. 5-2).

1. Check Head Position: The head position should be such that tape contact is maintained even if the pressure brush is held away from the tape. A 10 KHz tone should not decrease more than 1 or 2 db when the pressure brush is held back. Make certain that the tape is not skewed by whatever object (must be non-magnetic) is used to hold back the pressure brush. If an abnormal decrease is noted, one of several things may be at fault.
   a. Worn heads.
   b. The head position may be too high, or the head may be tilted.
   c. The head may be rotated so that the gap is not centered in the area of "wrap."
   d. Reel holdback tension may be too low, causing the tape to be loose as it moves over the head.

On multi-track recorders, all tracks should be checked.

2. Adjust the Pressure Brush: After conditions causing the drop in level have been corrected, the pressure brush should be released and checked for alignment.
   a. The edges should be parallel to tape travel and centered on the tape.
   b. It should be tangent to the head at the gap.
   c. Pressure against the head should not be excessive or the head will wear rapidly.

5.1.5 Tape Skew

Unwanted tape movement of an irregular nature at right angles to normal tape movement is called skew. Very slight amounts of skew will probably always be present, and will cause no trouble. If skew becomes excessive, several factors should be checked.

1. The tape itself may be at fault: Tape which has been stretched or creased can hardly be expected to follow a straight line. This is especially true with ½ mil tapes.
2. Misalignment may cause skew: The tape should be the same distance from the panel at all guiding points along its travel. (Use the tape guides as a reference.)
   a. Reel flanges should be the proper distance from the panel and motor shafts should be exactly perpendicular to the panel surface.
   b. The capstan should be exactly perpendicular to the front panel.
   c. The pressure roller should also exert pressure evenly across the entire area of contact with the capstan. A slight crowning however, is permissible in the center of the pressure roller.
3. Holdback Tension: Lack of holdback tension in the payoff reel will aggravate any tendency for tape skew.
4. Take-Up Tension: When excessive will aggravate any tendency for the tape to skew.
5. Uneven pressure across the pressure brush may cause the tape to skew.

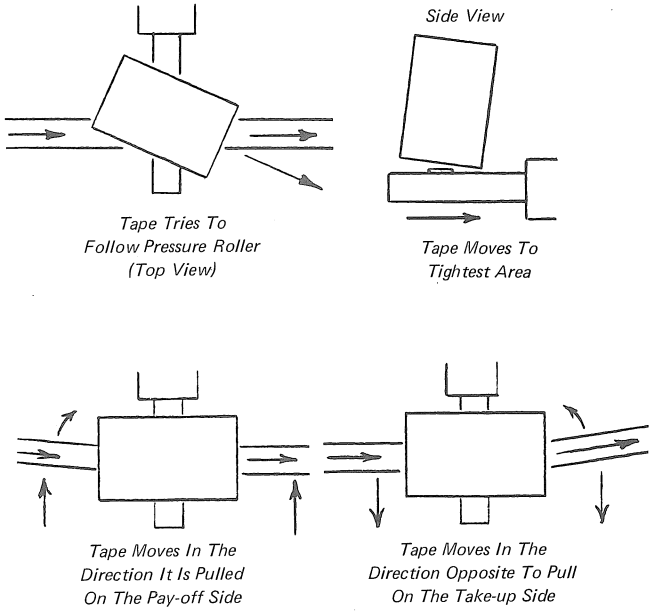
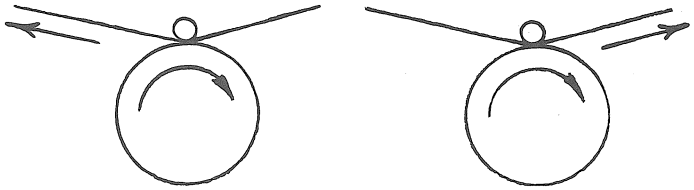


FIG. 5 - 3 FACTORS AFFECTING SKEW



FRONT VIEWS

FIG. 5 - 3 (concl.)

If the machine has been running for an extended period in a misaligned condition, sharp grooves may be worn into the guides, head covers, etc. These grooves may then tend to guide the tape improperly, even after the misalignment has been corrected. Such parts should be replaced.

5.2 THE TAPE SENSOR (See Schematic Fig. 6-1)

The tape sensor is designed to apply a stop command to the computer whenever tape runs out, or a window) transparent region in the tape) is sighted.

This is accomplished by placing a photocell on one side of the tape path and a lamp on the other. Shining light on the photocell causes its conductance to increase. This effect is used to turn on Q 11 which places a "O" (voltage low) at the input of the following inverter. In this state the output of the inverter is a "1" (voltage high) which gives the stop command thru Q 12.

A short stop command is derived from this circuitry at turn-on to insure that the machine comes on in the standby state.

The tape sensor incorporates a dual-speed function; i.e. a longer window is required when in play condition than when in a fast-winding mode. When in the play mode Q 10 is turned on placing C 19 in the photocell circuit lengthening its time constant. For instance the circuit will sense a window only 1-3 msec long when in any mode other than play. In the play mode it will not sense a 10 msec window. This protects the user against a stop command from faulty splices and pinholes in the tape. The control signal that turns on Q 10 is the same signal as pt. J (see schematic and section on remote control).

To functionally test the tape sensor the machine:

1. Should operate in FWD and RWD on Scotch 111 tape.
2. Should pass over 1/16 in. window while playing at 7-½ ips.
3. Should stop on ½ in. window while fast winding (full speed) in middle of 7 in. reel.

Adjustment of Tape Sensor: (see Fig. 5-4, 4-1) To desensitize the photocell move the lucite forward (away from the lamp) by loosening setscrew. If the photocell is found to be too insensitive, the cause may be any of the following:

Note: Do not overtighten setscrew.

1. Oxide in photocell window
2. Lucite rod too far forward
3. Lucite rod not oriented rotationally to photocell
4. Filament of lamp not in line with end of lucite rod
5. Dirty tape windows
6. Low line voltage
7. Defective lamp (silvered bulb, etc.)

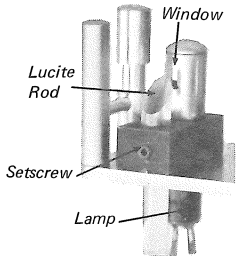


FIG. 5 - 4

It is possible to set the sensor so that it will detect white leader but not red tape if this is desired. Factory adjustment encompasses only the three tests listed for testing the sensor. Whenever the unit is desensitized, the response speed will be somewhat slower. Maximum speed is obtained with the highest illumination level.

5.3 THE MOTION AND DIRECTION SENSOR

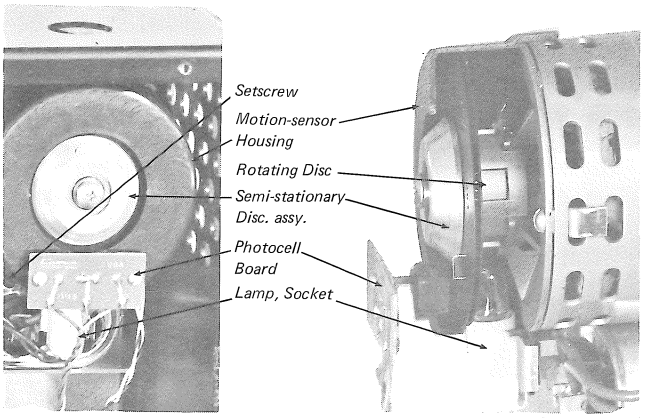
5.3.1 Mechanical (See Fig. 5-5)

The motion sensor uses a pair of slotted discs which modulate a light beam in front of one of two photocells. The first disc rotates with the pay-off motor shaft and causes the light to flash on the photocell whenever the shaft is rotating. The second disc forms an aperture between the first wheel and the photocells, and masks one cell while revealing the other. This disc, being fastened to a ball bearing which rides the rotating shaft, is free to turn with the shaft until it bumps a stop where it will expose either the forward or rewind photocell, depending on the direction of motor rotation.

The operation of the semi-stationary disc (direction sensing disc) is observable from the back of the motor. Sticking or any other irregular behavior of this disc is readily apparent.

To determine if the stops on the sensing disc are properly aligned, the photocell circuit board should be removed (two screws). With the power on, and thus the internally-housed lamp I8 in the motion-sensor housing on, the stops on the direction-sensing disc should be set such that the slots on the disc stop directly in line between each photocell and the centrally located lamp. The lamp should be so positioned that it is central to the two photocells. When a photocell is masked by the direction-sensing disc, light should not be visible thru the cell aperture.

The entire assembly is easily removable by first pulling the lamp down out of the housing and loosening the set screw in the bottom of the housing. After pulling the housing the disc may be removed by taking out the single screw in the end of the motor shaft.



Rear View *FIG. 5 - 5* Left Side (cutaway)

5.3.2 Electrical (See schematic Fig. 6-1)

The photocells have one lead in common which supplies power to the cells. Each cell goes in turn to an input of the R-S direction sense flip flop. This flip flop stores the direction information given it by the last light pulse seen by the photocells. If the last cell to be illuminated were the forward cell then the flip flop would remain in the forward state. Storing of the direction information makes direction information available even during the dark half of the light flashing cycle.

When the light flashes on a photocell its conductance changes which impresses an AC voltage on the supply resistor. R 17. This AC voltage is coupled via C 14 to Q 6 where it is amplified. The voltage to the supply resistor R 17 must be filtered well or power supply hum would be confused with motion thus C 13 and R 21 are necessary.

Because photocell outputs diminish with an increase in frequency, emitter resistor R 20 is bypassed by C 16 to increase the high-frequency amplification.

The amplifier drives an AC detector circuit which outputs a "O" (voltage low) when AC is detected. Q 8, Q 9, R 23, R 24, and R 25 make up a sensitive threshold detector which measures the voltage stored on C 17. As motion occurs Q 7 is intermittently turned on by AC from the amplifier. This causes C 17 to be discharged at a rate higher than it is being charged by R 22, turning off the threshold detector. The time constant is so constructed that motion can be sensed almost immediately; but to sense stop a short delay formed by R 22 and C 17 must elapse. This allows high braking to continue and bring the reels to a halt even after rotation has dropped to a rate too low to be sensed by the motion sensor.

5.4 TAPE LIFTER AND PRESSURE ROLLER SOLENOID AND PULL-IN CIRCUITRY.

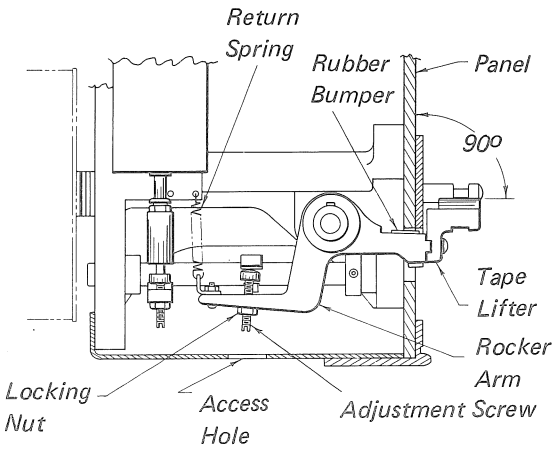
5.4.1 General

The pressure roller solenoid is used to pull-in the pressure roller in the play position and to operate simultaneously the tape lifter.

5.4 2 Tape Lifter

The guides and heads have been positioned in such a way that the tape will not contact the heads except in the play mode. Therefore, a tape lifter assembly is required. The basic consideration is that the lifting surface be perpendicular to the panel, and lift the lifter enough to provide sufficient tape wrap across the head surfaces when the transport is in the play mode. The rubber between the lifter rocker arm and the panel should not be compressed as this may jam the entire solenoid mechanism. (see Fig. 5-6).

FIG. 5 - 6 TAPE LIFTER



5.4 3 Pressure Roller

In order to obtain the best wow performance and good timing characteristics, the pressure roller tension must be set from 10 to 12 lbs. This indicates the pressure between the pressure roller and the capstan, and can be measured by pulling straight down on the right hand end of the pressure bar with a spring balance until the tape just stops moving while the machine is in the play mode of operation. This adjustment also affects the timing of the machine (see section 5.13).

To set the pressure roller pressure turn the adjustment screw shown in Fig. 5-7. The locking nut must be loosened before attempting adjustment. The solenoid has two adjustments which interact. Ordinarily it should not be necessary to adjust the upper one. The assembly on the solenoid plunger is adjustable to control the amount of travel or drop of the pressure roller. Whenever this is adjusted, the lower adjustment (pressure) must be readjusted to compensate for the movement of the former.

With solenoid de-energized, all moving parts must return freely to rest positions (via return springs). Major bearings are Oilite, with lubrication rarely required.

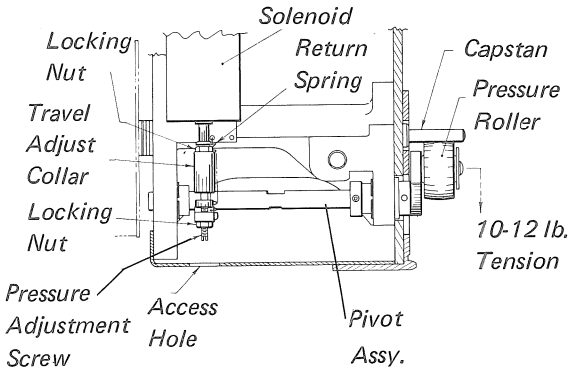


FIG. 5 - 7
PRESSURE ROLLER ADJUSTMENT

5.4.4 Electrical: (See Schematic Fig. 6-1)

Powered from the brake supply thru the relays, the pressure roller solenoid relaxes after pull-in due to an electronic circuit in series with the coil. The relaxing circuit is made up of Q 1, Q 2, C 9, R 6, and R 7. (See schematic). The voltage dropped in Q 1, the power controlling element, is essentially the same as the voltage on C 9. C 9 at turn-on is at zero volts and begins slowly charging towards its final value as determined by the voltage divider R 6 and R 7 across the DC supply. During the beginning of this charging interval, the solenoid becomes seated. Once the solenoid is seated its power requirements are greatly reduced. Since the solenoid is an intermittent-duty type at the pull-in voltage, its power input must be reduced.

The lamp I 1 in the play button is placed in parallel with Q 1. The play lamp is therefore a good indicator of proper operation of the solenoid relaxing circuit.

5.5 REEL MOTORS

The reel motors are AC torque motors having oilite bearings The oil holes are accessible through the transport top.

The reel motors (pay-off and take-up) are part of a self-contained assembly composed of the mounting plate, motor, motor capacitor, and power plug. Pay-off and take-up motors are identical except that the motion sensor is placed on the pay-off. The direction of rotation is determined by the wiring of the power connector on the wiring harness (see schematic Fig. 6-2). Should a motor capacitor fail, the motor will have very little torque.

During RWD or FWD wind modes, full 117V AC power is applied to the pulling reel motor, and approximately 35 VAC applied to the trailing reel motor. (See Fig. 5-8)

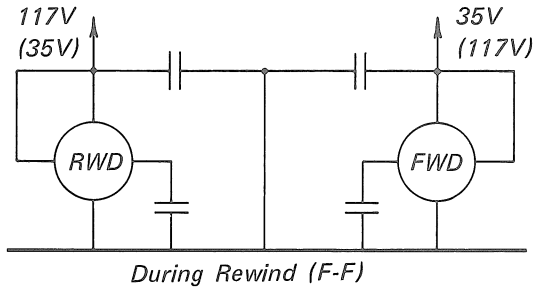


FIG. 5 - 8

5.6 HIGH TORQUE REEL STARTING

To obtain a fast and smooth start when going into play, it is necessary to supply extra power to the reel motors to allow them to overcome inertia. Once the reels are moving properly this extra torque must gently fade away to leave only the proper reel tension. If the torque is not dropped back gradually, a bobble will result in the tape motion. To provide this drop-back, a specially-designed two-terminal network is placed in series with the reel motors. The effective AC resistance of this network is very low for a second or so, and gradually increases to its maximum value after about three seconds.

This network is composed of (see schematic Fig. 6-1) a resistor R 2 shunted by a SCR circuit which is placed in a full-wave bridge CR 9 thru 12. The SCR is fired during the starting interval thereby shorting out R 1. As C 11 charges, Q 3 and Q 4 are reducing the triggering rate of Q 5 (which fires the SCR). This has the effect of reducing the SCR's duty cycle. Ultimately Q 5 ceases to trigger the SCR at all as the collector current of Q 4 becomes zero. In other words, the SCR has a duty cycle of zero.

The voltage waveforms seen at the output go through a progression (as shown in Fig. 5-9) of three to five-second duration. The final waveform is a sinusoid which results in the smoothest motor operation.

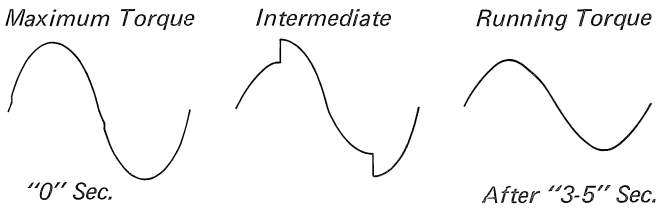


FIG. 5 - 9 HIGH TORQUE WAVEFORMS

With play mode thus initiated, constant tape drive is effected by the capstan-pressure roller pinch action. Take-up of the metered tape is via the take-up motor, with reduced AC voltage (depending on reel size). Holdback tension is similarly applied via the Rewind Motor (see Fig. 5-10). The use of AC holdback results in smooth tape feed.

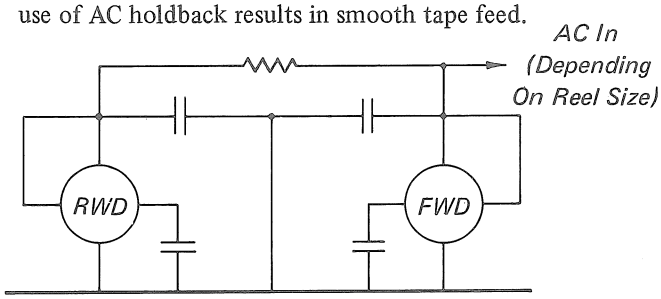


FIG. 5 - 10

5.7 ELECTRICAL BRAKING

5.7.1 Braking Systems Theory

When bringing the reels to a stop, a differential braking action must be used. Differential action means that the reel which is paying out the tape must have a greater braking action applied to it. The take-up reel should have less braking.

See Figure 5-11a. This is the situation that would exist if the tape was stopped shortly after starting the fast winding mode. Here, we have a heavily loaded pay-off reel on the left. Due to its momentum, it tends to continue turning after the brakes are applied. The take-up reel (right) has very little momentum after the right reel stops almost immediately and the left reel continues to run, a loop will form and tape will be spilled unless differential braking is used. (i.e., applying more braking to the pay-off reel and/or less braking to the take-up reel.)

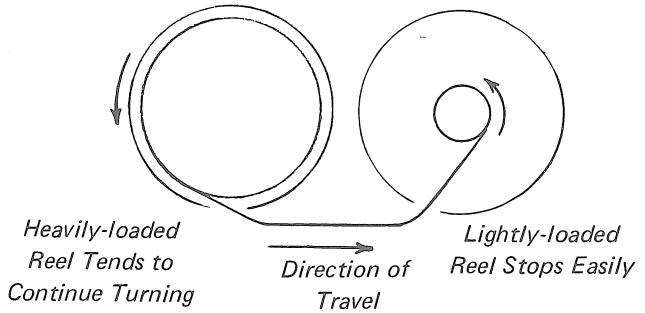


FIG. 5 - 11a

Some manufactures of tape recorders have solved this problem by eliminating the braking completely from the take-up reel. However, this produces a great amount of tension on the tape unless very soft braking only is applied and reel size is limited to 7 inches.

The tendency to stretch tape is increased as the end of the reel is approached. See Figure 5-11b. Since heavier braking must be applied to the pay-off reel as seen above, this reel will now tend to stop very quickly. The take-up reel which is now heavily loaded, will not stop immediately. The tape may be stretched; and if the differential is too great, the tape will even break under tension. Here then, we have the limits for differential braking:

1. The differential must be great enough to prevent a loop from forming under the conditions in Figure 5-11a.
2. The differential must not be so great that the tape is stretched or broken under the conditions in Figure 5-11b.

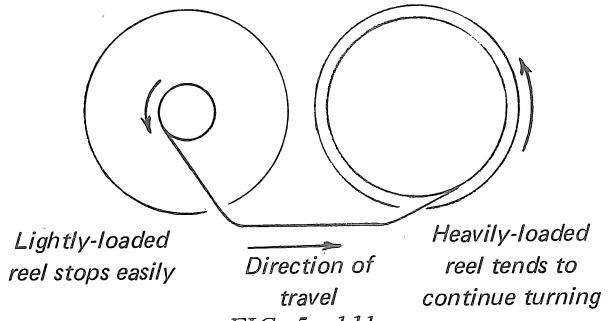


FIG. 5 - 11b

Because fast winding is desired in both directions, the function of pay-off and take-up must be reversible. In Figure 5-11c, tape is traveling from left to right. The left reel is the pay-off reel and should have the higher braking.

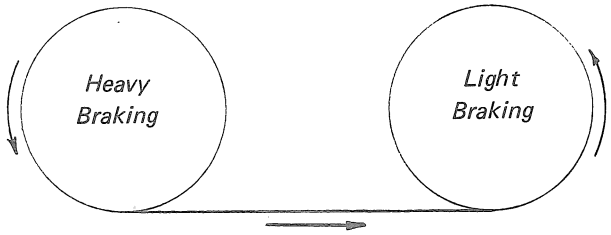


FIG. 5 - 11c

In Figure 5-11d, the tape is running from right to left. Here the right reel is the pay-off and should have the higher braking.

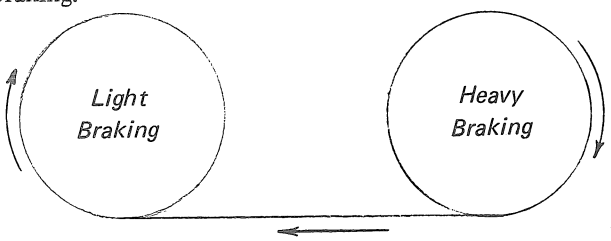


FIG. 5 - 11d

Summary:

1. Differential must be provided to prevent a tape loop from forming (too much slack).
2. Differential must not be so great that there is undue tension on the tape (tape too tight).
3. Function of brakes must be reversed when direction of travel is reversed. (pay-off reel should always have heavier brakes regardless of which reel is the pay-off reel).

5.7.2 Electrical Braking System

The electrical braking system operates by feeding direct current through the reel motors (alternating current causes the motors to turn and direct current causes the motors to "freeze"). D. C. is provided for the motors in both the stop and the standby modes. However, the stop (or hi brakes) current is higher. This is done by shorting out a series resistor. The differential action is provided by placing a lesser voltage on the "taking-up" motor than on the "paying-out" motor. (See Figure 5-12).

Since the stopping torque of such a motor with DC applied is proportional to its rate of rotation, the stopping tape tension due to the electrical differential will tend to be greater at the start of the braking interval than when the tape is nearly stopped. This requires that the amount of electrical differential be less just after brakes have been applied, than a fraction of a second later; i.e., that the ohmic value of the differential resistor increase with time as the tape is halting. To provide this effect, a device with a strong positive temperature coefficient is used—an incandescent lamp assembly.

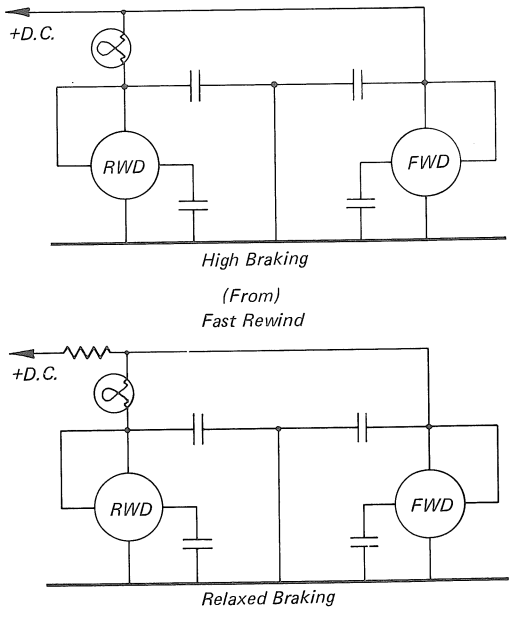


FIG. 5 - 12

5.7.3 Checking the Braking (See Schematic Fig. 6-1)

To check the braking first manually engage the modes of braking in question and then check the relative braking of each motor. This can be done very simply by twisting each motor's reel flange by hand and noting the amount of opposing torque. The paying-off reel for a respective mode should always have the more braking. If the taking-up reel is found to have no braking, the differential lamps have probably opened. Otherwise, check switching, brake supply, wiring, and motors.

The braking of this machine is directed by its internal computer which uses an optical motion and direction sensor to dictate both the need for and direction of braking.

To check the braking, turn the shaft of the pay-off reel motor (left motor when facing front of machine). When the shaft is turned CW, the rewind and stop buttons should light and some opposition to turning should be observed. When motion ceases, the lights should go out.

During the period in which the lights were on, the right hand or take-up motor should now be found to have the greater braking. Once again, when motion has stopped the lights should go out. During the period in which the lights were on, the right hand or take-up motor should have had a high amount of braking. This can be sensed with one hand while turning the pay-off motor with the other.

Turning the pay-off motor CCW should light the forward and stop buttons and provide a high amount of braking to this motor. The take-up motor should now be found to have the lesser braking. Once again, when motion has stopped the lights should go out.

The standby state has a small amount of forward brakes. Normally functioning lights are good indicators of normal brakes. The rewind and forward buttons indicate that power is being supplied to the correct relays (see section on relays) and the stop button indicates that a differential potential exists between the motors. If a differential lamp were to open, the stop button lamp would become overly bright and most likely burn out.

The following trouble shooting list is provided for servicing braking problems:

Problem	Check
1. Hi-brakes refuse to come on	a. I 8 lamp in motion sensor burnt out, intermittent, or leads broken b. Motion sensor stationary disc stuck c. Leads to motion sensor photocells broken d. Motion sensor electronics or computer defective e. Open brake supply (solenoid does not pull in) f. Supply to relays dead (RWD and FWD inoperative) g. Motion sensor has insufficient light-to-dark ratio
2. Hi-brakes fail if reels are in rapid motion	a. I 8 darkening b. +24 low or very low line voltage c. I 8 not centered for optimum brightness on both photocells d. Stationary disc not aligned for proper stop positions e. Amplifier in motion sensor electronics has open emitter bypass, C 16
3. Hi-brakes will not turn off	a. Stray electrical signals in motion sensor leads b. Vibrating pay-off motor, C 4 open c. Motion sensor electronics on computer defective d. Sticky relay (only stop button would be lit) e. +24 filter capacitor C 7 open f. +4 filtering defective, C 13 or C 8 open
4. No brakes whatsoever	a. Brake supply dead (solenoid will not pull in) b. Defective relays

5.8 POWER SUPPLY (See Schematic Fig. 6-1)

The power supply is used to supply power to the electronics, relays, brakes, solenoid, lamps, motors, and accessories.

The computer electronics are powered by approximately +4 volts DC, and relays and motion-sensor lamp by +24 VDC. These supplies are of capacitor-input type—mounted on the power-supply board. The tape-sensor lamp is powered by the 6.3 VAC transformer winding of the +4 VDC full-wave supply. The transformer also provides AC voltage for the small-reel size of the Play mode, AC for the pay-off motor in RWD and FWD, and full-wave common-to-ground AC for external electronics. The brake and solenoid supply (approx. 50 VDC) is well-filtered by C4 —resulting in smooth braking and low external AC fields from motors and solenoid.

When testing the machine in various modes (see Fig. 5-13), the +50 VDC supply voltage may vary ±8% (from a nominal 55V in STBY mode); with a +0, -8% loading on the +24 VDC supply (29V in STBY). The +4 VDC supply is stable at approximately 4.2V. Use 117 VAC line input to machine for proper voltage readings. The +4 VDC and +24 VDC supplies are common to chassis ground when joined thru a tape electronics. These voltages are available at J 14 and J 15. The full-wave, common-to-ground AC is out-put thru the power receptacle.

5.9 RELAYS

Three relays are used to control the high-level, common-to-AC-line voltages used in the reel motors and pressure-roller solenoid. The relays are powered by the computer by common-to-ground +24 VDC signals.

If a problem in the relays is suspected, remove the relay cases by gently squeezing top and bottom of covers. Then, all modes of machine operation can be simulated by manually engaging the proper relays. Beware of potentials on the contacts! If relay coils are good, one can also visually test to see that the computer is actuating the proper relays for each mode.

Failure in relays is usually confined to dirty or pitted contacts. Pitting of contacts and arcing should not be a problem unless there are shorts in the system, or the transient-suppression capacitors (C 5a and C 5b) across the reel motors are defective. To clean relay contacts, it is advisable to use a special contact-cleaning file. Be careful to avoid bending or distorting the contactors as this may cause improper pressure and loss of contact.

Fig. 5-13 shows how each of the various machine modes (states) is effected by the relays, and voltages at each reeling motor and the solenoid (see also schematic 6-1).

MACHINE MODE	RELAYS			TYPICAL VOLTAGES		
	Op (K1)	FWD (K2)	(RWD (K3)	TU Motor (B2)	PO Motor (B3)	Sol. (K4)
STANDBY	0	0	0	+6 VDC	+16.5 VDC	0
PLAY (LG reel)	1	0	0	112 VAC 80 VAC	100 VAC 71 VAC	54 VDC 34.5 VDC
PLAY (SM reel)	1	0	0	78 VAC 55 VAC	69 VAC 49 VAC	54 VDC 34.5 VDC
F-RWD	1	0	1	37 VAC	117 VAC	0
F-FWD	1	1	0	117 VAC	37 VAC	0
RWD BRAKES	0	0	1	+52 VDC	+13 VDC	0
FWD BRAKES	0	1	0	+13 VDC	+52 VDC	0
RWD & FWD (Jockeying)	1	1	1	117 VAC	117 VAC	0

"0" = Relaxed State
"1" = Pulled-in State

Test Conditions:
Line Voltage = 117 VAC
Reels unloaded and free
No accessories being powered
Meter - 20,000 Ω/volt VOM

FIG. 5 - 13

The operate relay is pulled in for all tape-moving modes. This relay is used to select whether the reel motors are powered by AC (moving) or DC (braking), and switch on the pressure-roller solenoid when the other interlocking relays are relaxed.

The rewind relay chooses the proper braking differential and reel voltages for rewind, interlocks the solenoid power, and activates the high-rewind-braking mode.

The forward relay chooses the proper voltages for F-F, interlocks the solenoid power, and activates the high-forward-braking mode.

5.10 PUSHBUTTONS (COMMANDS)

The pushbuttons should require no maintenance other than bulb replacement. The bulbs are easily replaced by pulling on the appropriate button and removing it from the machine. The bulb is located in the button and should be easily removable with the fingernails. On replacing the button, note its internal keying.

The switching of the push buttons is of the normally-open, single-pole, momentary-contact type (see Fig. 6-1). The voltage on these contacts is from the +4 VDC supply (common-to-ground). The power to the fast modes is interrupted, in the "record" position, by the electronics—to prevent accidental erasure of a recorded tape (by rewinding it before turning off the record oscillator). In remote-record electronics this interlock is in special logic circuitry.

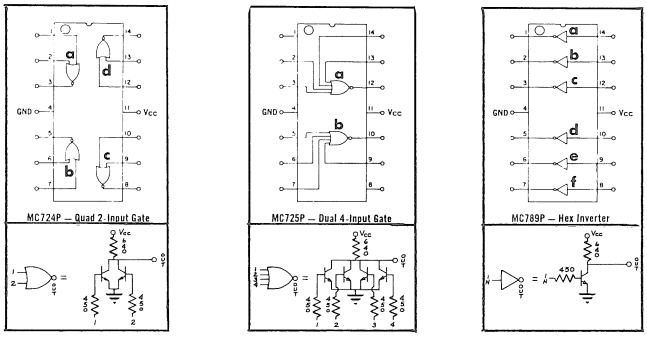
If commands are supplied from an external power supply or device, the stop command must be protected from the possibility of a large outgoing current, as this could destroy Q 12. It is suggested that in such circumstances a series diode (cathode to transport) be placed in the stop signal line. If the diode is not used outgoing current must be held to less than 20 ma when the stop buss is at +4 VDC.

5.11 COMPUTER

5.11.1 General

The computer is the plug-in circuit board located on the front of the hinge-out electronics chassis. On this board are located the electronics of the previously discussed motion-direction sensor and the tape sensor.

The computer uses six of Motorola's MC 700P series integrated circuits (or equivalent), ten transistors, and eight diodes. This results in effectively 56 transistors on this board alone. Figure 5-14 shows the block diagrams and schematics of these units.



SCHEMATICS OF INTEGRATED CIRCUITS
FIG. 5 - 14

5.11.2 Machine Behavior

Figure 5-15 shows a block diagram of the controlling elements of the machine.

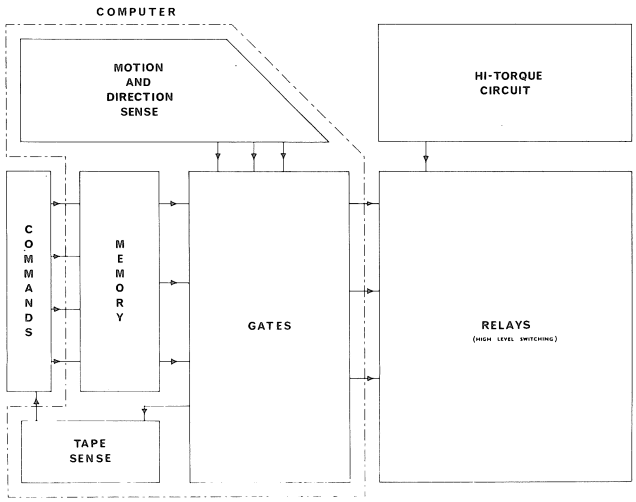
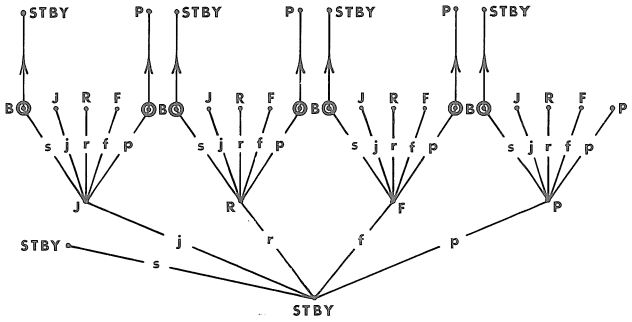


FIG. 5 - 15

To evaluate if the machine is behaving properly, the following "right tree" Fig. 5-16 may be used. A right tree is a graphic method of indicating the behavior of a sequential machine to any given input for any given state. Every vertex represents a state and every branch represents a command. To interpret the tree one must begin at the bottom (initial state) and proceed upwards through the tree. Whenever a permanent state is reached that is found at a lower point in the tree, one should drop down to the lowest such point and proceed from there. In this way, machine behavior can be determined for any arbitrary chain of commands.

States:		Commands:
STBY	– Standby	s – Stop
J	– Jockeying	j – Rewind & Forward
R	– Rewind	r – Rewind
F	– Forward	f – Forward
P	– Play	p – Play
B	– Brakes, Direction depends on tape motion (temporary state)	



Note: If a command is input while in a temporary state, the machine will proceed as if the temporary state had not existed–and proceed from the previous state.

FIG. 5 - 16
RIGHT TREE OF TRANSPORT BEHAVIOR

To interpret simultaneous commands, the following priority rule should be used.

$$j \text{ or } r \text{ or } f > p > s$$

Example: A command such as r with p = r, j with s = j, p with s = p, etc.

The braking state B is temporary in that it exists only so long as motion exists and the machine is either attempting to get into standby or play. As a temporary state it has an automatic transition indicated by the arrowed line which will occur once the machine has stopped.

5.11.3 The Memory (See Schematic)

The memory section of the computer takes and stores, by means of three flip-flops the last command given it while erasing all previous commands. Erasure of past commands is effected by the stop buss which resets all three (rewind, forward, and play) flip-flops to their standby state.

R-S (set-reset) flip-flops are made of the Mc724P two-input gates, by simply cross coupling inputs and outputs as shown in Fig. 5-17.

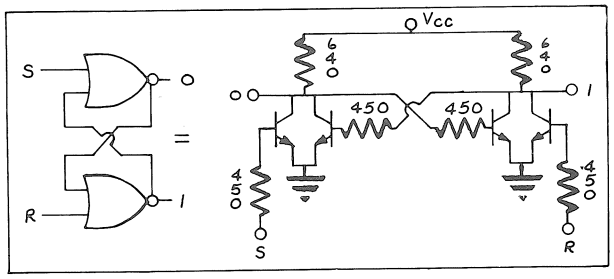


FIG. 5 - 17 R-S FLIP-FLOP SCHEMATIC

A diode (CR 17, CR 18, or CR 19) coupled from the rewind, forward, and play commands respectively provides a signal to the stop buss for each of these commands. This diode not only furnishes the resetting (erasure) signal, but also causes the flip-flop to go to the desired state upon removal of the command because the stop (resetting) command extinguishes before the input command, due to the forward voltage drop of the diode.

The "on" state of the rewind and forward flip-flops gives a "1" (voltage high) for an output while the operate flip-flop gives a "0" (voltage low) when on. During the application of a command other than stop, because both set and reset inputs of the associated flip-flop are activated, one by the command and the other by the stop buss, both output terminals of the flip-flop are "0". Therefore, in the case of the rewind and forward flip-flops where a "1" output is necessary, diode OR gates are used to feed the commands around the flip-flops during the command (reset) interval (diodes CR 20, CR 21, and CR 22, CR 23).

Each of the command inputs to the memory has a capacitor to ground placed across it to protect the input from stray pulse pick-up, and assure that sufficient time was allowed for proper flip-flop setting upon removal of the command. Resistors to ground are also present to shunt any external leakage currents to ground and hold each input's stray positive-pulse immunity at a maximum.

5.11.4 Gates (See Schematic 6-1)

Each relay (see relays) is controlled by a transistor which is in turn controlled by the gates. The 12 IC gates are the very heart of the computer's coordinating and interlocking system. The following tables should furnish all the necessary information to troubleshoot the gates under static conditions.

Each gate on the schematic is identified by a number. (If that gate is on in a given mode its output is called "0" (low), if off "1" (high). Whenever a gate output is "0" the set of numbers or letters following the "0" indicate which gates or control sources had supplied a "1" output to its input to cause it to be "0" (see Fig. 5-18). The letters of the control sources correspond to:

R = Rewind flip-flop in the memory (1 RWD)
F = Forward flip-flop in the memory (1 FWD)
P = Play flip-flop in the memory (0 = FWD)
$\overline{X}$ = Direction Sense (1 = RWD, 0 = FWD)
X = Direction Sense (1 = FWD, 0 = RWD)
S = Motion Sense (1 = Stop, 0 = Motion)

MODE OF MACHINE	GATES											
	1	2	3	4	5	6	7	8	9	10	11	12
STANDBY	0_S, Possibly $\overline{x}$	0_S, Possibly x	1	1	1	0_P	1	0_3	0_4	0_3	0_4	0_5
PLAY	$0_{6\overline{x}}$	0_6	1	1	0_6	1	1	0_3	0_4	0_3	0_4	1
REWIND	1	0_{Rx}	0_{IR}	1	0_5	0_{P8}	0_8	1	0_4	1	0_4	1
FORWARD	$0_{F\overline{x}}$	1	1	0_{2F}	0_F	0_{P9}	0_9	0_3	1	0_3	1	1
REWIND BRAKES	1	0_x	0_1	1	1	0_{P8}	0_8	1	0_4	1	0_4	0_5
FORWARD BRAKES	$0_{\overline{x}}$	1	1	0_2	1	0_{P9}	0_9	0_3	1	0_3	1	0_5
RWD & FWD (JOCKEYING)	0_F, Possibly $\overline{x}$ and/or s	0_R, Possibly x and/or s	0_R	0_F	0_{RF}	0_{P89}	0_{89}	1	1	1	1	1

Mode vs. State-of-Gates Table

FIG. 5 - 18

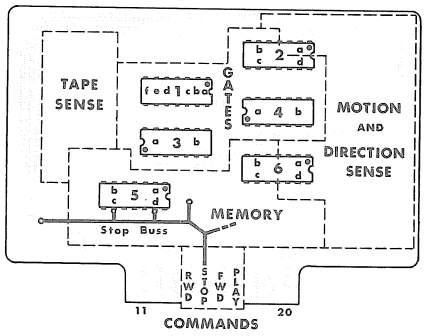
Because the last direction of machine motion is not unique in the standby and jockeying states, gates 1 and 2 have X or $\overline{X}$ possible. Also, since there may not be motion in jockeying, S is possible.

A number of points are labled on the schematic which give information for remote control, interlocking and testing purposes. They are:

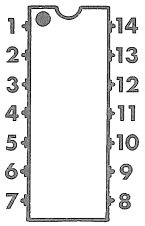
H Tape motion other than playing ("0") (interlock signal for remote record)
J Play condition ("1")
K Stop command given by tape sense ("1")
L Direction ("0" in FWD)

These points are all available in the remote control jack (see Fig. 6-1, 6-2). These points actually are a good place for beginning probing of the gates.

The following pictoral and table shows the physical location of the IC's and their various inputs and outputs on the plug-in logic module. (Fig. 5-19a, b).



"Logic" Module (Component Side)



"IC" Pin Numbers (Top View)

FIG. 5 - 19a
I-C IDENTIFICATION and BLOCK LAYOUT

GATES	1	2	3	4	5	6	7	8	9	10	11	12
IC's followed by Pin Number	4-10 2-10	4-12 2-12	2-8 1-13 1-14	2-14 1-10 1-12	1-9 3-12	3-10 3-13 4-2 4-6	2-5	1-1 2-1 3-7 3-8	1-3 2-6 3-9	1-2	1-5	1-6

SENSE	R	F	P	X	$\overline{X}$	S
IC's followed by Pin Number	2-9 4-14 3-14	2-13 4-7 4-8 3-2	6-5 6-10 3-6	6-3 6-12 4-3	6-1 6-14 4-5	4-9 4-13

FIG. 5 - 19b OUTPUT vs PIN NUMBER TABLES

The following tables (Fig. 5-20) apply for testing each state vs 1C voltages (no commands being given except in RWD and FWD).

A "0" is any voltage below +0.46 VDC and a "1" is any voltage above +0.85 VDC. A (–) indicates "not important."

STBY STATE (W-O Tape)
x = State of Pt. x
$\overline{x}$ = State of Pt. $\overline{x}$

		Pin No.													
	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	2	–	–	–	0	1	0	0	1	0	0	1	0	0	1
	3	–	0	0	0	0	1	0	0	0	0	1	1	0	0
	4	–	0	x	0	$\overline{x}$	0	0	0	1	0	1	0	1	0
	5	0	0	1	0	1	0	0	0	1	1	1	1	1	0
	6	x	–	x	0	1	0	0	0	1	1	1	x	–	$\overline{x}$

PLAY STATE
S = State of Motion
Output–May = "1" if Tape Moves Slowly.

	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0	0	0	0	0	1	0	1	0	1	1	1	1	1
	2	–	–	–	0	1	0	0	1	0	0	1	0	0	1
	3	–	0	0	0	0	0	0	0	0	1	1	0	1	0
	4	–	1	0	0	1	1	0	0	S	0	1	0	S	0
	5	0	0	1	0	1	0	0	0	1	1	1	1	0	0
	6	1	–	0	0	0	0	1	1	0	0	1	0	–	1

FIG. 5 - 20
MODE vs IC CIRCUIT PIN LEVEL TABLES

		Pin No.													
	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	1	1	0	0	0	1	0	1	0	1	1	1	0	0
	2	–	–	–	0	0	0	1	0	1	1	1	0	0	1
RWD STATE (W-Tape) In RWD Motion	3	–	0	0	0	0	1	1	1	0	0	1	0	0	1
	4	–	0	1	0	0	0	0	0	0	1	1	0	0	1
	5	0	0	1	0	0	0	1	1	0	0	1	1	0	0
	6	0	–	1	0	1	0	0	0	0	1	1	1	–	0

	"IC" No	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0	0	1	0	1	1	0	1	0	0	1	0	1	1
	2	–	–	–	0	0	0	1	0	0	1	1	1	1	0
FWD STATE (W-Tape) In FWD Motion	3	–	1	0	0	0	1	0	0	1	0	1	0	0	0
	4	–	0	0	0	1	0	1	1	0	0	1	1	0	0
	5	1	0	0	0	1	0	0	0	0	1	1	0	0	1
	6	1	–	0	0	1	0	0	0	0	1	1	0	–	1

	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0
	2	–	–	–	0	0	0	1	0	0	1	1	0	0	1
RWD BRAKES (With Tape)	3	–	0	0	0	0	1	1	1	0	0	1	1	0	0
	4	–	0	1	0	0	0	0	0	0	1	1	0	0	0
	5	0	0	1	0	1	0	0	0	0	1	1	1	0	0
	6	0	–	1	0	1	0	0	0	0	1	1	1	–	0

	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	0	0	1	0	1	0	0	1	1	0	1	0	1	1
	2	–	–	–	0	0	1	0	1	0	0	1	1	0	0
FWD BRAKES (With Tape)	3	–	0	0	0	0	1	0	0	1	0	1	1	0	0
	4	–	0	0	0	1	0	0	0	0	0	1	1	0	0
	5	0	0	1	0	1	0	0	0	0	1	1	1	0	0
	6	1	–	0	0	1	0	0	0	0	1	1	0	–	1

	"IC" No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	1	1	1	1	0	1	1	0	1	0	0	1	0	0	0
	2	–	–	–	0	0	1	1	0	1	0	1	0	1	0
RWD & FWD Commands ON (W-Tape)	3	–	1	0	0	0	1	1	1	1	0	1	0	0	1
	4	–	0	x	0	$\overline{x}$	0	1	1	S	0	1	0	S	1
	5	0	1	0	0	0	1	0	0	1	0	1	0	1	0
	6	$\overline{x}$	–	x	0	1	0	0	0	1	1	1	x	–	$\overline{x}$

FIG. 5 - 20 (concl.)

As is characteristic of all sequential machines, feedback of information occurs. Whenever feedback is employed, the question of stability arises. The closed loop under question is in the gates 1 and 2 to 4 and 4 to 7 and 8 to 6 back to 1 and 2.

One circumstance leading to possible instability would be when the machine is rewinding rapidly and then being quickly given the command "Forward" followed by the "Play" command all before the tape has stopped. The saturation storage time of gate 1, following the forward-command erasure by the play command, gives rise momentarily to a condition in gates 1 and 2 which is equivalent to the motion sensor having a "1" on line S. In this short period, the output of gate 6 may become "1" causing the machine to hold gates 1 and 2 at "0" output and go into play. The result would most likely be broken tape if the pressure roller were to pull in on rapidly-rewinding tape.

To cure this instability a "timing capacitor" (C 25) is placed on the output of gate 6 which holds its output at "0" for long enough to cover the short storage time at gate 1.

A symmetrically-equivalent condition would be if one were in forward and then quickly punched rewind followed by play. The same solution is also effective in this circumstance.

5.12 SPEED SHIFT

5.12.1 Operation Principles

Changing capstan speeds is accomplished by changing the drive belt to a different groove in the motor pulley. One of two speeds may be selected from the front panel. Operation is as follows:

Shifting to the slow speed: (See Fig. 5-21a)

1. Assume the capstan to be running and the belt to be in the center groove (7-½ ips.) Under these conditions, the speed shift control rod will be pulled forward.
2. To change speed, the speed shift knob is pushed in as far as possible. This causes the shift loop to be pushed to the rear, pushing against the drive belt and forcing it to the lower groove.
3. At the same time, the detent snaps to its rearward position. (See Fig. 5-21).
4. When the speed shift knob is released, the control rod will be pushed forward by a control rod spring, until it is stopped by the detent. This will allow the shift loop to move away from the belt slightly so that it will not rub.

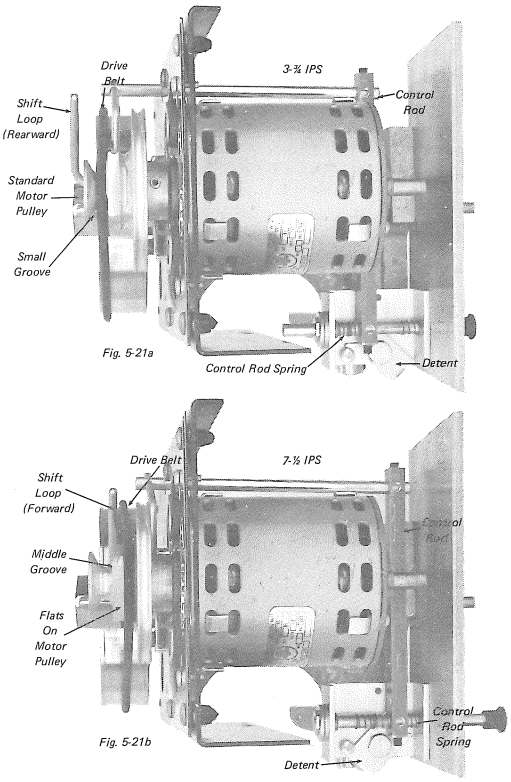
Shifting to the Fast Speed: (See Fig. 5-21b)

1. The speed shift knob is pulled all the way forward.
2. This will cause the shift loop to move to its extreme forward position. This will force the belt forward slightly—just far enough for it to catch on the two flats between the 3-¾ ips and the 7-½ groove.
3. As the motor continues to turn, the belt will be lifted by the flat and then ride into the 7-½ ips groove.
4. At the same time, the detent will snap into its forward position (illustrated).
5. When the speed shift knob is released, the control rod will be pulled back by a control rod spring, until it is stopped by the detent. This will allow the shift loop to move away from the belt slightly so that it will not rub.

Note: that there are actually four positions of operation for the mechanism.

1. Extreme forward position
2. Forward resting position
3. Rear resting position
4. Extreme rear position

In the two extreme positions, the actual belt shifting is accomplished while the resting positions allow the rod to move away so that no rubbing will occur.



SPEED SHIFT OPERATION (TOP VIEWS)

FIG. 5 - 21

Proper operation requires that the knob be pulled all the way to the rear or all the way forward. If this is not done, the belt may only rub and not shift. The same condition will exist if a speed change is attempted while the belt is not in motion.

Similar operation of the special 15 - 7½ ips shift may be noted, although the motor pulley is larger.

5.12.2 Adjusting

The shift should be adjusted (See Fig. 5-21a,b so that:

1. The speed shift loop does not strike the chassis back panel, or trap the belt against the motor pulley, when slipped to the "fast" position.
2. The speed shift loop must not rub on the belt in the operating positions.
3. The speed shift loop should be as close to the motor pulley as possible for more efficient shifting.
4. Overtravel must be such as to ensure shifting.

Speed Reducers require manual shifting of belts (see Section 3.5 and Fig. 3-4).

5.13 TIMING

Timing is individually factory adjusted for each speed and should not need further attention for the life of the machine. However, upon changing the pressure roller, capstan, or drive motor, the timing should be checked.

One satisfactory method of checking the timing is to measure off a length of tape, preferably of several minutes duration, and use a stop watch to accurately time the rate of tape movement. In the manufacture of CROWN recorders, a tape is used which has been very accurately adjusted to speed compatible with the industry and a 60 cycle tone from the power line recorded on the tape. This tape is then played on the machine being tested and the output is compared on the oscilloscope with the actual power line frequency. If the timing is perfect, the interaction between the recorded signal and the power line signal will be very slight. The rate of interaction between the two signals or beat can be counted. If there is one beat per second, the recorder is one second off per minute or one minute per hour.

The factory method of timing adjustment is to accurately machine the motor pulley grooves until the timing is exact. If timing is slow or erratic, the trouble may be caused by a faulty motor, a loose drive belt, a highly-polished capstan, improper pressure-roller tension, or extremely-high holdback tension. If timing is too fast, it is possible the pressure-roller pressure is too low and the tape is being pulled by the take-up reel instead of the capstan. If is suggested that, if poor timing is not due to these causes, the recorder be returned to the factory for complete retiming.

5.14 FACTORY SERVICE

5.14.1 Parts

Many of the parts are standard items stocked by most supply houses. However, there are several which appear to be standard parts but are actually different. Although standard parts may be used in an emergency, best results will be with factory parts. Some of the parts are available only from CROWN.

When ordering parts, be sure to give both the model number and serial number (stamped on the back chassis near the flywheel) in addition to the part number. Rated firms will be billed, otherwise shipments will be C.O.D.

5.14.2 Factory Repair

For major repairs, such as head replacement, repairs which might involve timing, or any other repairs requiring special equipment, it is suggested that the recorder be returned to the factory. An efficient service department is maintained at the factory. Address all requests for this service to the service manager, giving full details. He will promptly advise you concerning the necessary steps to take.

Under no circumstances should a recorder be returned to the factory for service without first obtaining the consent of the service manager. The factory reserve the right to refuse shipments which are not authorized by us. All authorized shipments must be sent to us by Railway Express or truck freight, prepaid and insured at total value. The factory will return your serviced machine by Railway Express or truck freight, collect, and will add C.O.D. charges in the event that the cost is not covered by registered warranty.

Emergency repair information may be supplied by direct contact with the service manager.
Direct Dial (219) ~~523-4919~~ 294-3571 (Elkhart, Indiana U.S.A.).

PRO-800 PARTS LIST

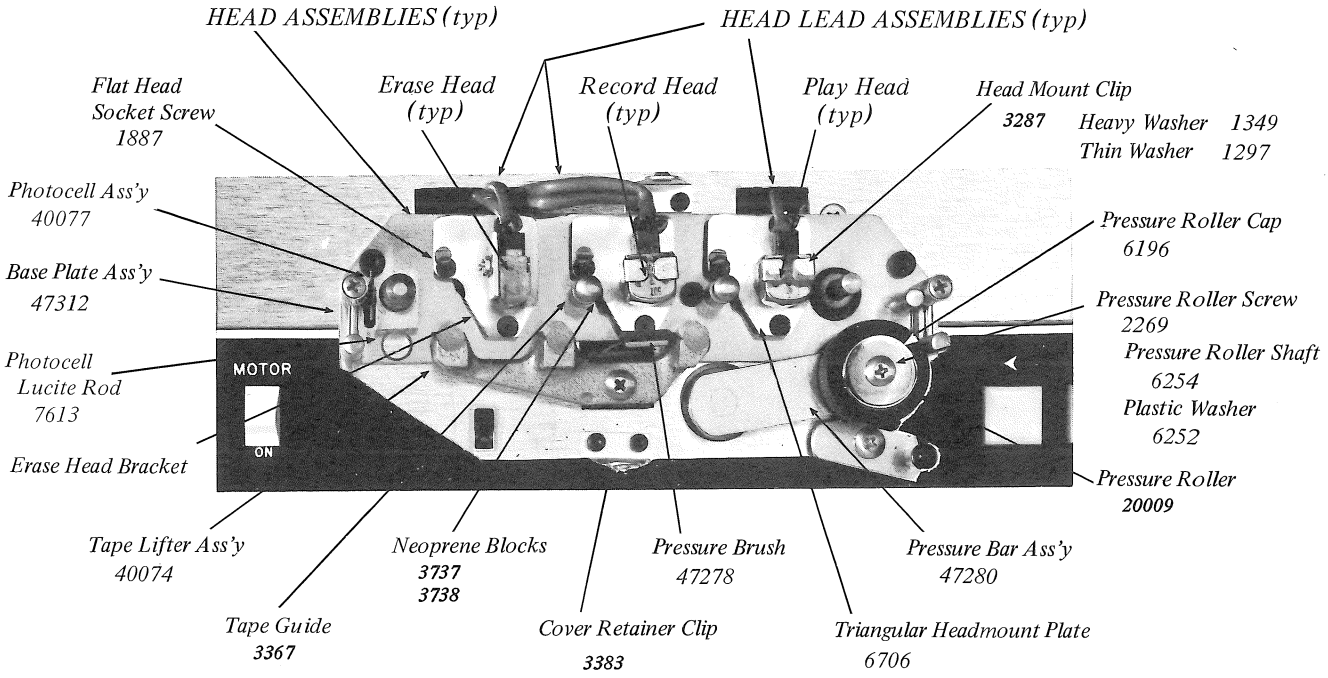
PRO-800 PARTS LIST

Ckt No.	CROWN NO.	DESCRIPTION	NOTES
CAPACITORS			
C1, C3	2523	4.0 mfd 270VAC OIL	
C2	2460	2.75 mfd 330VAC OIL	
C4	2573	1000 mfd 60V ELEC.	
C5	2529	2X.5 mfd 600V OIL	
C6	3729	100 mfd 16V ELEC.	
C7	1679	225 mfd 30V ELEC.	
C8	2615	4000 mfd 6V ELEC.	
CONNECTORS			
J1M, J3M, J4M, J7M	2052	4-way cap	On amp connectors J-1, J2, J3, J4, J7 plug connector is identified as F, cap connector is identified as M.
J1F, J3F, J4F, J7F	2051	4-way plug	
J2M	7769	9-way cap	
J2F, J14	7770	9-way plug	J14 is power socket
Connector Pins	2444	Amp Terminals	Used for all plugs & caps above.
J5, J6, J8, J9, J10		18-way connector	
J11, J12, J13	3469	relay socket	Lock ring included
J15	7786	12-way plug	Remote socket. Mating plug (for remote control) is CPN 7811; pins are CPN 2444.
J16	2432	Flush AC panel recept	Accessory socket
J17	2950	Flush AC plug, male	AC power socket
J18	3757	6 pin precision connector	
J19	3758	10 pin precision connector	
FUSES			
F1	1748	3AG, 3AMP	
INTEGRATED CIRCUITS			
IC1	2624	MC789P	
IC2, IC5, IC6	2622	MC724P	
IC3, IC4	2623	MC724P	
LAMPS			
I1, I2, I3, I4	2639	Incandescent No. 327	
I5, I6	2611	Incandescent No. 304	
I7	2899	Incandescent No. 1866	
I8	2900	Incandescent No. 1822	
MOTORS			
B1	20012	DRIVE MOTOR	With terminals
B2, B3	20011	REEL MOTORS	With terminals

PHOTOCELLS			
V1	1619	CL-403AS	
V2, V3	3376	VT-732	
RECTIFIERS			
D1, D24, D25	3181	1N4148	
D2, D3	2941	1N5402	
D4, D5, D6, D7	2851	1N4003	
RELAYS-SOLENOIDS			
K1, K2, K3	3468	4PDT Relay	24vdc.
K4	3571	MAIN SOLENOID	
RESISTORS			
R1	2506	50 Ohm 30W	
R1	2507	75 Ohm 30W	SZ tarts at S/N J3270
R2	2590	65 Ohm 55W	
R3	2713	30 Ohm 10W	
R4	2656	33 Ohm 2W	
R5	2609	390 Ohm 1/2W 10%	
R34	2355	5.6 Ohm 1W 5%	
SWITCHES			
SW1, SW2, SW3, SW4	2614	DIALCO pushbutton Switch contains indication lamps	
SW5, SW6, SW7, Sw8	2612	DPDT SLIDE	
TRANSFORMER			
T1	2746	POWER	
TRANSISTORS			
Q1	2976	2N3054	
PLUG-IN MODULES			
	L-2	COMPUTOR LOGIC CKT.	
	HT-2	HI TORQUE CKT.	

MECHANICAL PARTS	CROWN PART NO.	NOTES
Power Reel Motor Switch Ass'y	40044	
Control Switch Ass'y	40045	
Power Supply Ass'y	40211	
Capstan-Flywheel Ass'y	20002	
Capstan Bearing	3329	
Speed Shift Loop	3357	
Solenoid Ass'y	40051	
Solenoid Spring Housing Ass'y	47248	
Solenoid Adjust Screw	3430	
Reel Motor Ass'y	40054	
Reel Flange Ass'y	47288	
Reel Flange Pin	1667	
Reel Flange Cover	25711	
Reel Flange Ring	2566	
Ring Mounting Cap Screw	1904	
Reel Knob	7001	

Drive Motor Ass'y	40055	
Drive Motor Fan	2652	
Drive Motor Mount Screw	2280	
Drive Motor Depressed Washer	1295	
Drive Motor Grommet	1605	
Drive Motor Pulley (7½ - 3¾) shift, 15 IPS dia.)	7766	Average time, 3-speed
Drive Motor Pulley (15-7½ shift)	7866	Average time, 3 speed
Drive Belt	6720	
Speed Reducer Ass'y 1 7/8 1PS	40107	
Speed Reducer Pulley	6115	
Speed Reducer Ass'y 1 7/8 - 15/16 1PS	40108	
Speed Reducer Pulley 1 7/8 - 15/16 1PS	7059	
Speed Reducer Belt	6724	
Direction Sensor Disc Ass'y	40057	
Motion Sensor Wheel	2502	
Motion Sensor Centering Spacer	2619	
Motion Sensor Housing	3764	
Motion Sensor Lock Screw	1828	
Motion Sensor P.C. Board	7585	
Head Cover Ass'y	47377	
Lower Cover Ass'y	40076	
Cover Retainer Clip	3383	
Tape Lifter Ass'y	40074	
Pressure Brush Ass'y	47278	
Pressure Brush Ass'y-Velvet only	7677	
Pressure Roller	20009	
Pressure Roller Cap	6196	
Pressure Roller Shaft	6254	
Pressure Roller Plastic Washer	6252	
Pressure Roller Screw	2269	
Speed Shift Knob	1583	
Cue Lever Handle	1728	
White Lens Cap	2636	
Red Lens Cap	2638	
Green Lens Cap	2637	
Front Panel	7509	
Front Panel Extrusion	3433	
Transport Chassis Bottom	7511	
Transport Chassis Top	3714	
Power Resistor Chassis	3715	
Power Resistor Heat Shield	7524	
Speed Reducer Rear Panel	40072	
AC 2-Wire Cord	1387	
AC 3-Wire Cord	2321	
8 X 3/8 Slotted Hex Chassis Screw	2708	
10-32 X 5/8 Oval Head Panel Screw	2120	
Nylon Panel Washer	2119	
P.C. Board for Power-Reel Switch	7583	
P.C. Board for Control Switch	7787	
P.C. Board for Mother Board	7864	
P.C. Board for Power Supply	7582	
White Toggle Cap	2613	


HEAD ASSEMBLIES (typ)
HEAD LEAD ASSEMBLIES (typ)
Flat Head Socket Screw 1887
Erase Head (typ)
Record Head (typ)
Play Head (typ)
Head Mount Clip 3287
Heavy Washer 1349
Thin Washer 1297
Photocell Ass'y 40077
Base Plate Ass'y 47312
Photocell Lucite Rod 7613
Erase Head Bracket
Pressure Roller Cap 6196
Pressure Roller Screw 2269
Pressure Roller Shaft 6254
Plastic Washer 6252
Pressure Roller 20009
MOTOR
ON
Tape Lifter Ass'y 40074
Neoprene Blocks 3737 3738
Pressure Brush 47278
Pressure Bar Ass'y 47280
Tape Guide 3367
Cover Retainer Clip 3383
Triangular Headmount Plate 6706

REPLACEMENT HEADS

Model	SX811, CX811		
	Play Head	3184	Also used on SP811
	Record Head	2267	
	Erase Head	3183	
Model	SX812, CX812		
	Play Head	2418	Also used on SP812
	Record Head	2485	
	Erase Head	3167	
Model	SX822, CX822		
	Play Head	2901	Also used on SP822
	Record Head	2173	
	Erase Head	3058	
Model	SX824, CX824		
	Play Head	2171	Also used on SP824
	Record Head	2172	
	Erase Head	3602	
Model	SX844, CX844		
	Play Head	3328	Also used on SP844
	Record Head	1205	
	Erase Head	3166 (2)	
Model	SX822-P4C		
	Play Head	3328	4-Channel playhead
	Record Head	2173	
	Erase Head	3058	
Model	SX824-P4C		
	Play Head	3328	4-Channel playhead
	Record Head	2172	
	Erase Head	3602	

HEAD ASSEMBLY HARDWARE

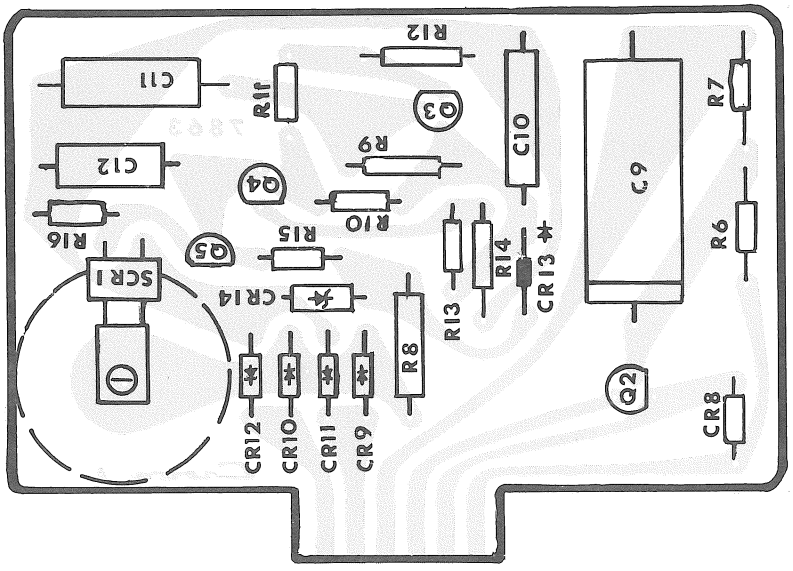
Base Plate Ass'y (includes guides & goal posts)	47312
Tape Guide	3367
Triangular Headmount Plate	6706

NOTE: THIS PLATE IS USED FOR ALL HEADS EXCEPT 4-CHANNEL ERASE.

Erase Head Bracket (4-channel)	7853
Neoprene Blocks	3737, 3738
Flat Head Socket Screw	1887
Head Mount Clip	3287
Heavy Spacer Washer	1349
Thin Spacer Washer	1297
No. 6 Star Washer	1823
6-32 Hex Nut	1889
Photo Cell Ass'y	40077
Photo Cell Lucite Rod	7613

HT-2 PARTS LIST

Schematic Ref.	CROWN Part No.	Description	Notes
CAPACITORS			
C9	1679	225 mfd, 30V. Elec.	
C10	1678	5mfd, 70V. Elec.	
C11	3008	1 mfd, 100V. Mylar	
C12	2938	.1 mfd, 200V. Mylar	
RECTIFIERS			
CR8, CR9, CR10, CR11, CR12	2851	1N4003	
CR13	3181	1N4148	
CR14	3277	1N968B	20V. Zener
SCR-1	2540	C106B32	SCR (GE)
RESISTORS			
R6	1059	3.9 K, ½w	
R7, R13	2628	2.2K, ¼w	
R8	2555	1 K, 2w	
R9	1032	820 K, ½w	
R10	2632	15K, ¼w	
R11	2631	10K, ¼w	
R12, R14	2082	22 K, ½w	
R15	2626	470 ohm, ¼w	
R16	2872	100 ohm, ¼w	
TRANSISTORS			
Q2, Q4	3786	PN4250A	Selected for 60V. BVceo
Q3	2962	TZ-81 Sprague	Selected for 35V. BVceo
Q5	2784	2N4870	Formerly TI S43



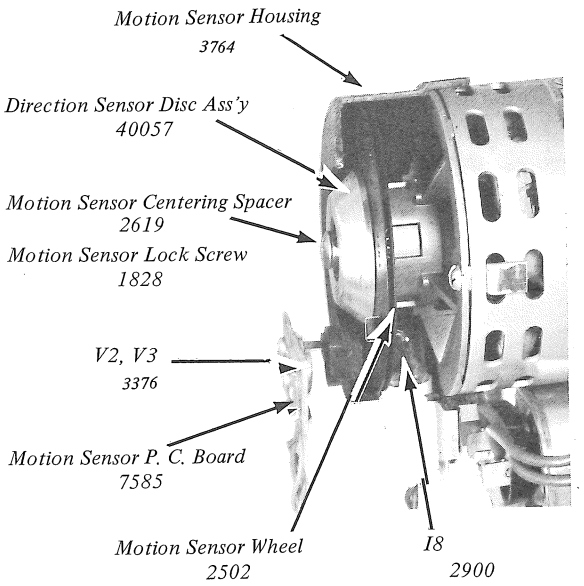
(Bottom Views)

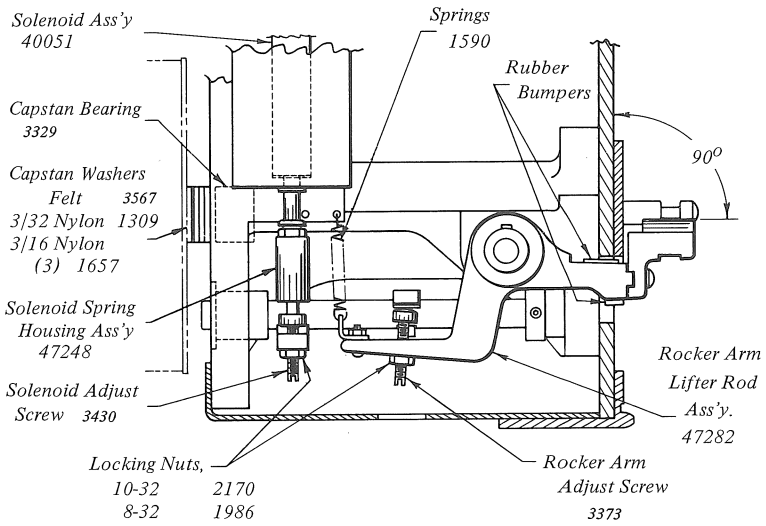
HT - 2 HI-TORQUE CKT. ASSY.

State of Machine	T. U. Motor B2	P. O. Motor B3	Solenoid K4	+50 Supply	+24 Supply	+4 Supply
STANDBY	+6VDC	+16.5VDC	0	+55VDC	+29VDC	+4.2VDC
PLAY (LG Reel)	112VAC at start 80VAC	100VAC at start 71VAC	54VDC at start 34.5VDC	+56VDC	+28.5VDC	+4.2VDC
PLAY (SM Reel)	78VAC at start 55VAC	69VAC at start 49VAC	54VDC at start 34.5VDC	+56VDC	+28.5VDC	+4.2VDC
Hi RWD Brk	+52VDC	+13VDC	0	+52VDC	+27.5VDC	+4.2VDC
Hi FWD Brk	+13VDC	+52VDC	0	+52VDC	+27.5VDC	+4.2VDC
RWD	37VAC	117VAC	0	+59VDC	+27.5VDC	+4.2VDC
FWD	117VAC	37VAC	0	+59VDC	+27.5VDC	+4.2VDC
Jockeying	117VAC	117VAC	0	+59VDC	+27VDC	+4.2VDC

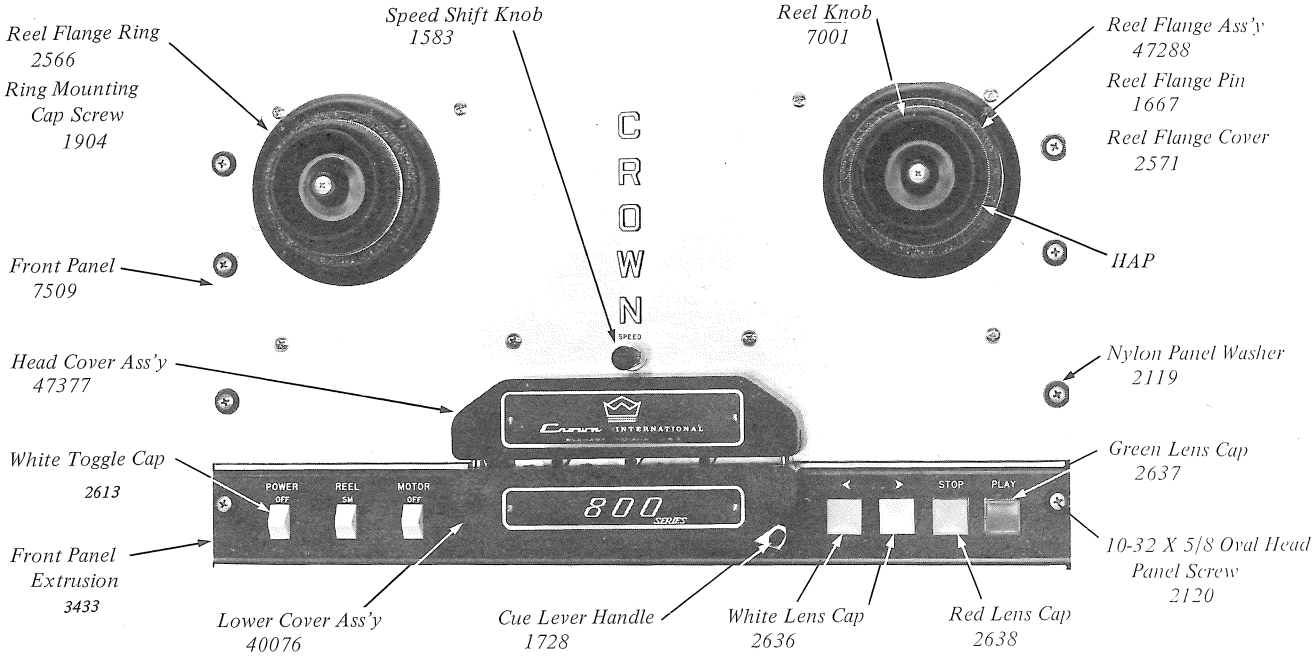
Test Conditions:
Line Voltage = 117VAC
Reels unloaded and free
No accessories being powered
Meter - 20,000 Ω /volt VOM

VOLTAGE CHART

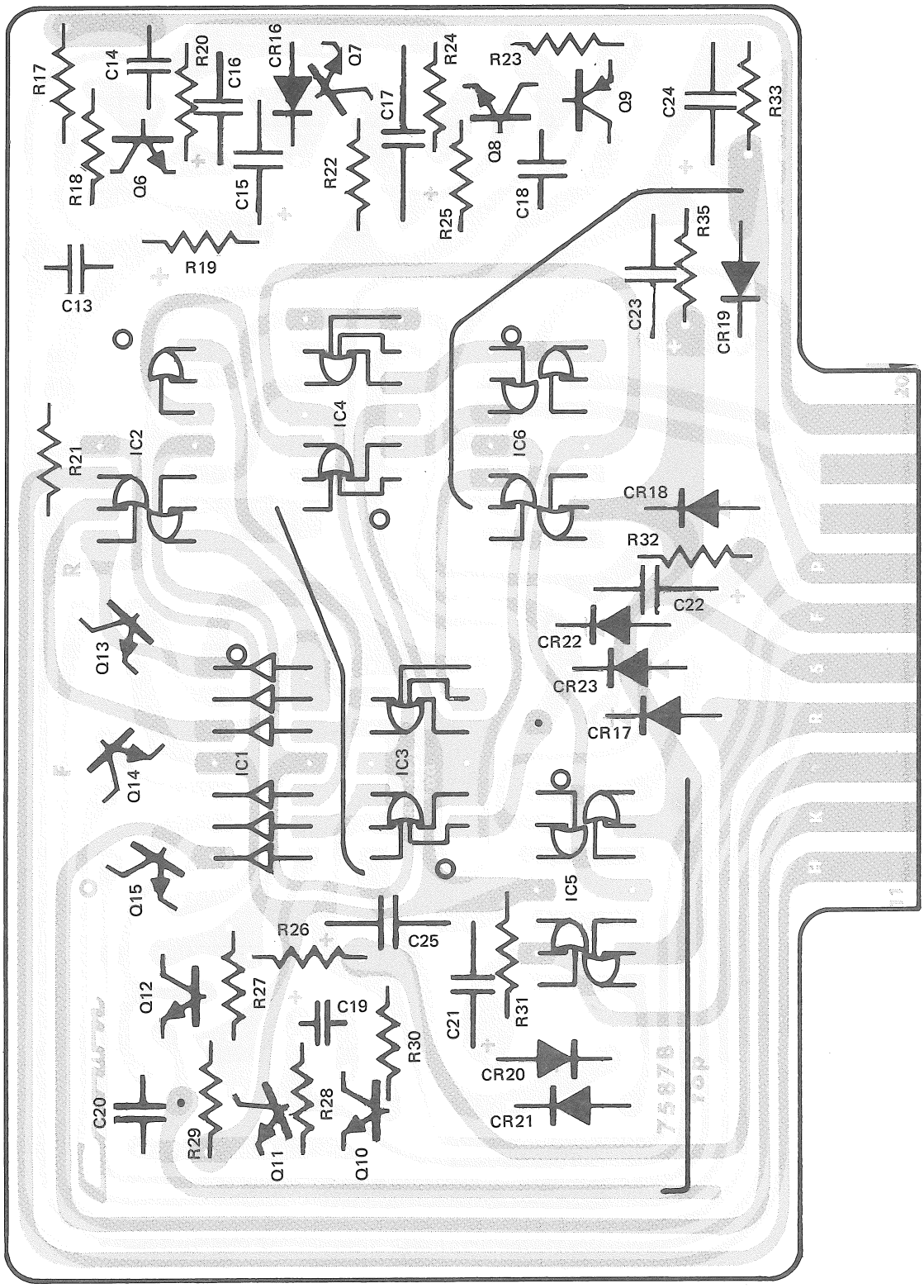




Capstan Housing Ass'y 40043

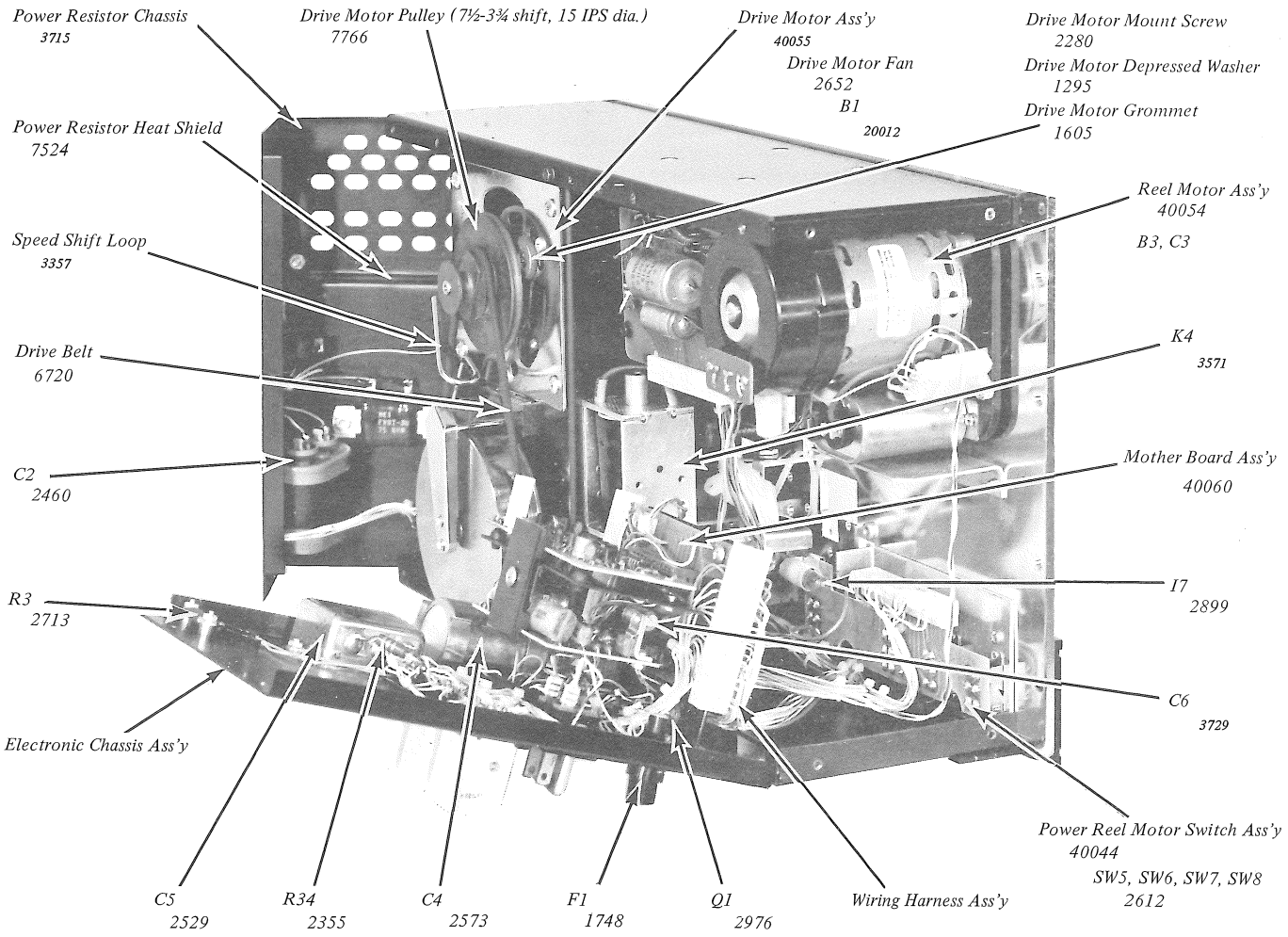


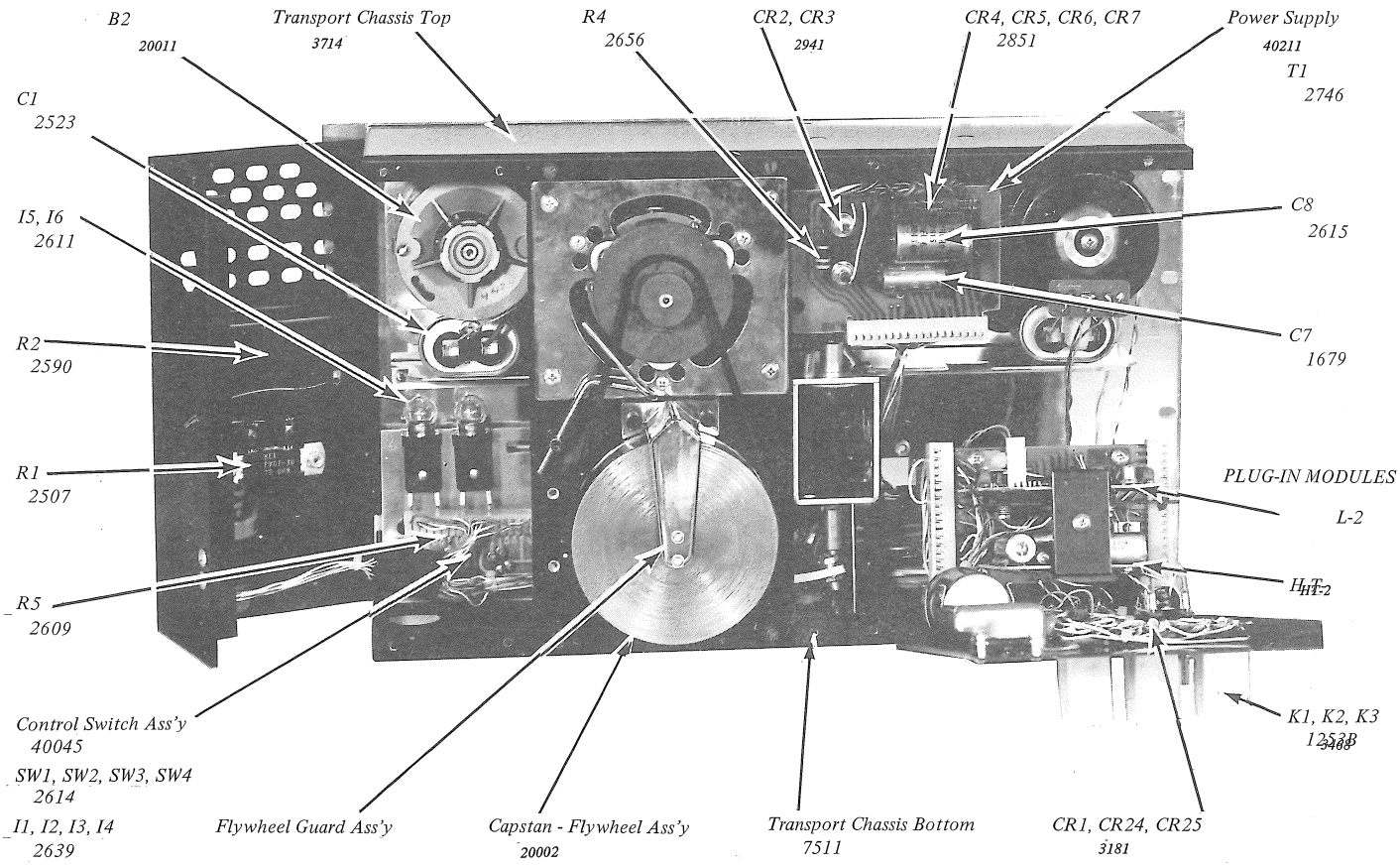
L - 2 COMPUTER LOGIC CKT.



L-2 LOGIC BOARD PARTS LIST

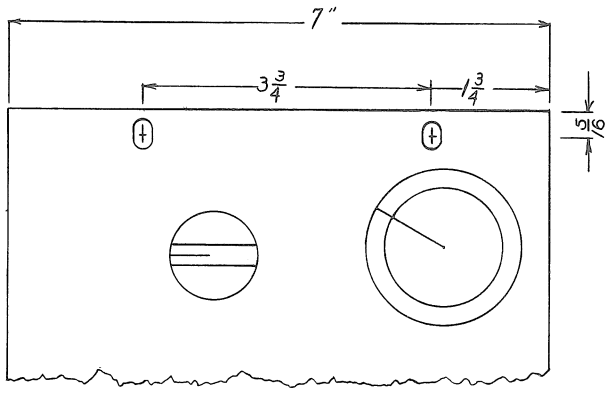
Schematic Ref.	CROWN Part No.	Description	Notes
CAPACITORS			
C13, C25	3729	100 mfd/16V	ELEC
C14, C18, C20	2599	.05 mfd/12V	DISC
C15, C16, C23	1750	1 mfd/30V	TANTALUM
C17	3677	27 mfd/15V	TANTALUM
C19	3022	22 mfd/6V	ELEC
C21, C22, C24	3337	4.7 mfd/20V	TANTALUM
CIRCUIT BOARD	7587	L-2	P-C
INTEGRATED CIRCUITS			
IC1	2624	MC789 P	Motorola
IC2, IC5, IC6	2622	MC724 P	Motorola
IC3, IC4	2623	MC725 P	Motorola
RECTIFIERS			
CR16, CR20, CR21, CR22, CR23	3447	1N270	
CR17, CR18, CR19	3181	1N4148	
RESISTORS			
R17, R27, R29	2630	3.9 K, ¼w	
R18	2634	2.7 M, ¼w	
R19, R31, R32, R33	2633	18 K, ¼w	
R20	2629	3.3 K, ¼w	
R21	2626	470 ohm, ¼w	
R22	2632	15K, ¼w	
R23, R28, R30, R35	2631	10 K, ¼w	
R24, R26	2627	1 K, ¼w	
R25	2628	2.2 K, ¼w	
TRANSISTORS			
Q6, Q7, Q11	2962	TZ-81 Sprague	(Selected for BVceo 35V)
Q8, Q10, Q13, Q14, Q15	2961	2N3859A Sprague	
Q9	3786	PN4250A	(Selected for BVceo 60V)
Q12	2721	2N1304 T-I	

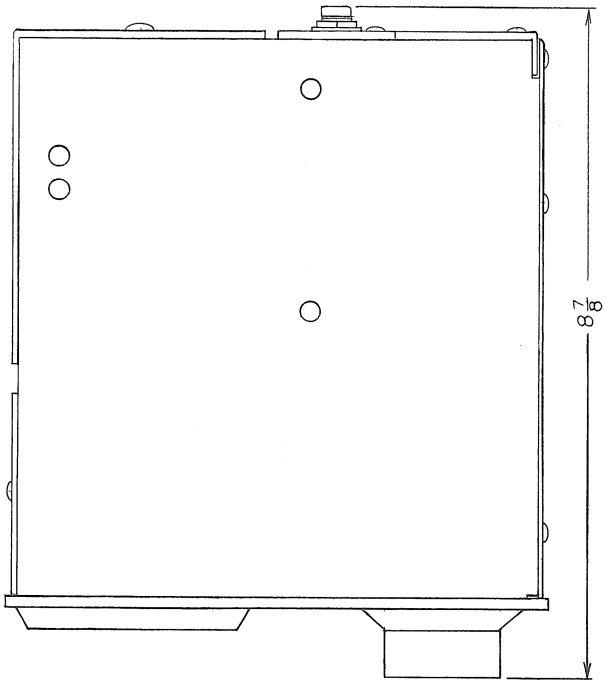

Power Resistor Chassis
3715
Drive Motor Pulley (7½-3¾ shift, 15 IPS dia.)
7766
Drive Motor Ass'y
40055
Drive Motor Fan
2652
B1
20012
Drive Motor Mount Screw
2280
Drive Motor Depressed Washer
1295
Drive Motor Grommet
1605
Power Resistor Heat Shield
7524
Reel Motor Ass'y
40054
B3, C3
Speed Shift Loop
3357
K4
3571
Drive Belt
6720
C2
2460
Mother Board Ass'y
40060
I7
2899
R3
2713
C6
3729
Electronic Chassis Ass'y
Power Reel Motor Switch Ass'y
40044
SW5, SW6, SW7, SW8
2612
C5
2529
R34
2355
C4
2573
F1
1748
Q1
2976
Wiring Harness Ass'y

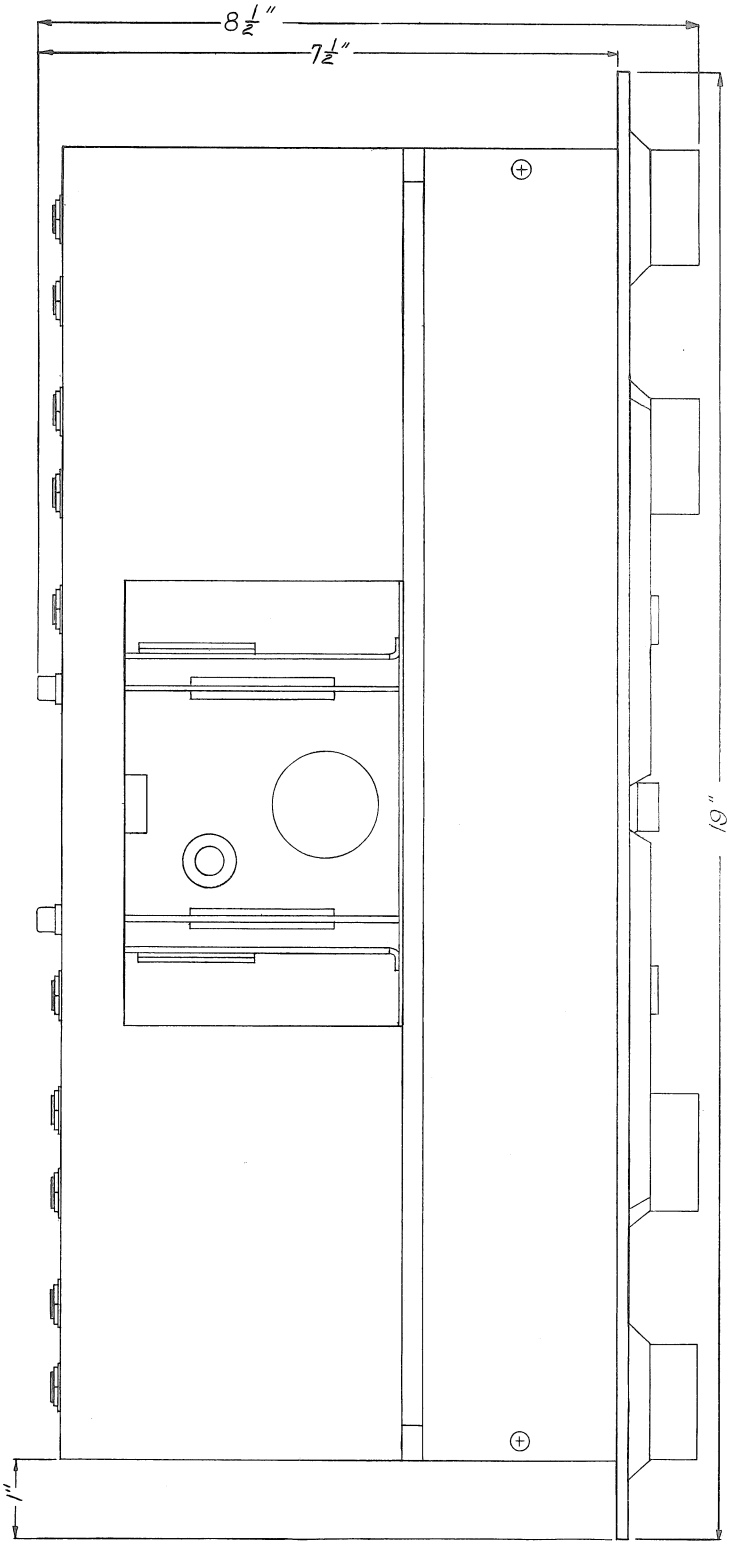

B2
20011
Transport Chassis Top
3714
R4
2656
CR2, CR3
2941
CR4, CR5, CR6, CR7
2851
Power Supply
40211
T1
2746
C1
2523
C8
2615
I5, I6
2611
C7
1679
R2
2590
PLUG-IN MODULES
L-2
R1
2507
H.T.
H1-2
R5
2609
K1, K2, K3
1253B
3468
Control Switch Ass'y
40045
SW1, SW2, SW3, SW4
2614
I1, I2, I3, I4
2639
Flywheel Guard Ass'y
Capstan - Flywheel Ass'y
20002
Transport Chassis Bottom
7511
CR1, CR24, CR25
3181

"CROWN" TECHNICAL MANUAL

CX Electronics


7"
3 3/4
1 3/4
5/16


8 7/8


8 1/2"
7 1/2"
19"
1"

GENERAL CHARACTERISTICS

The CX electronics is a dual Solid State modular record/reproduce amplifier. Its purpose is to accept and condition input signals to properly drive magnetic tape recording heads and to provide reproduce facilities with proper equalization.

The CX record/reproduce amplifier uses all silicon Solid State transistors and the highest quality construction throughout.

SPECIFICATIONS

Audio Inputs: Two inputs per channel. Either input will accomodate high impedance mic or line level.

Tone Controls: Both controls in center detent position provide flat response.

Rotating bass control provides up to 15 db attenuation (full CCW) or boost (fully CW) at 30 cps.

Rotating treble control provides up to 15 db attenuation (fully CCW) or boost (fully CW) at 15 KC.

Audio Output: Low impedance high level output -- +8dBm, 600 Ω

Power Source: 115 VAC. This supply is normally derived from the associated transport.

Power Drain: Approximately 10 watts

Bias Frequency: 100 KHz

Preamplifier Response: Essentially flat 10 Hz to over 100 KHz exclusive of required equalization and bias traps.

FEATURES

Record function interlocked mechanically, electrically, and visually
Highly regulated DC power supplies
Glass epoxy circuit boards
Illuminated 5" VU meter

CONSTRUCTION

Anodized aluminum chassis
Anodized aluminum front panel with silk screened markings
Weight: 12 lbs.
Dimensions: 7" H x 19" W x 8 11/16" D

OPERATING INSTRUCTIONS

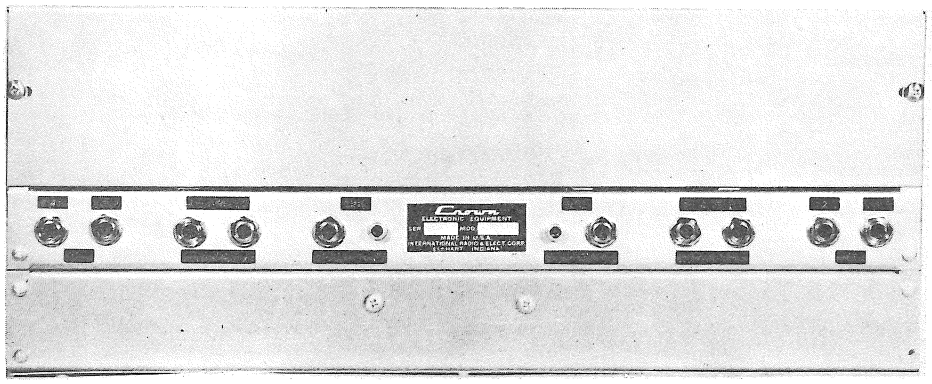
Connecting the Inputs: Note that the controls on the CX electronics are symmetrical on each side of the center line. Controls on the left, control the left channel (Channel 1) while the controls on the right control the right channel (Channel 2). The only exception is the equalization control which is common to both channels. The following instructions apply to one channel only. It should be understood that inputs, outputs, and controls for the other channel are identical.

Input #1: Either a microphone or a high level line type signal may be plugged into Input #1. When a plug is plugged into the Line input for Input #1, it will automatically disconnect the Mic 1 jack.

Input #2: The inputs for #2 are identical to those for Input #1.

RIAA Inputs: Either (or both) Input 1 or Input 2 becomes an RIAA equalized input by replacing the CX-2D board with a CX-RIAA board.

Note: Low impedance microphones may be used by employing the matching input transformer SMIT available as an accessory, or by installing the LOZ-4 input transformer accessory.



Connecting the Outputs: Two jacks are provided for the output of each channel of the CX electronics. One jack is of the standard phone type and the other is of the RCA pin jack type. These two jacks are connected in parallel and are driven directly from the output of the Output amp. On units supplied with CX-6 boards, the output signal level will be approximately +12 dbm when the VU meter reads "0" VU. On units without the CX-6 board, the output will be 8 db lower.

SETTING THE CONTROLS FOR RECORDING

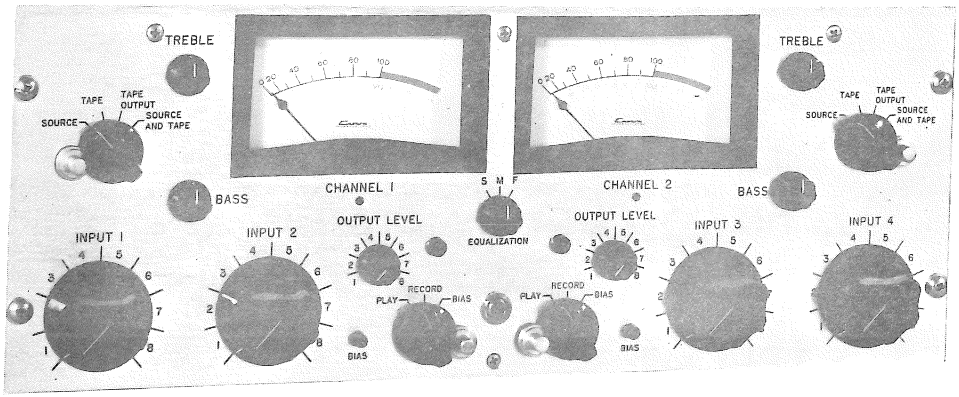
Source-Tape-Output: Place the switch in the Source position.

Input #1 and Input #2: Adjust Inputs 1 and/or 2 for the proper recording level as indicated on the meter. With the proper setting the meter will read near "0" VU and go into the red only occasionally on the very loudest peaks.

Monitor Jack: If you desire to monitor the signal to be recorded, head phones may be plugged into the front panel phone jack. The tip of the jack is connected to Channel 2 and the ring is connected to Channel 1.

Output Level: This control should be set for convenient listening level and/or proper output to auxiliary equipment.

Bass and Treble: These controls may be adjusted as desired for bass boost and/or treble boost or attenuation. They can be used during recording. (They can also be used during playback when function switch is in Source plus Tape). If no change in compensation is desired, the controls should be at the detent, in their mid-rotation point.



Equalization: This switch should be set according to the speed being used. "S" refers to the slowest of the recording speeds, "M" to medium, and "F" to the fastest.

Record Switch: Depress the record lock button and rotate the record switch all the way to the Bias position.

The Bias is adjustable on the front of the machine. The two small plastic shafts next to the record switches allow approximately ±3 db of bias adjustment range. Bias should be adjusted to the settings recommended for the tape and speed being used. A general rule to use is to adjust for the highest possible setting that does not noticeably attenuate the highest frequency. This will normally result in the least amount of distortion and the widest dynamic range. Critical adjustment may be made for flatest response if proper test equipment is available. After setting the bias, the record switch should be

rotated to the record position. This allows the incoming signal to be monitored. Note that recording will still take place with the switch in the "Read Bias" position. The only difference being in the signal fed to the meter.

To begin recording, momentarily press the Operate button on the transport.

AB Test: To check the recording process, the Source-Tape switch may be switched from Source to Tape. When this switch is in the Tape position, the actual recording will be played back (delayed slightly due to the spacing between record and play heads.) Normally no noticeable change in volume or quality should occur when switched from the Source to Tape position except at very low tape speeds. Note that the Output Level control has no effect on the meter reading or the recording level in either of the switch positions. Its only effect will be to adjust the level at the monitor and output jacks.

Tape Output Position: By placing the switch in the Tape Output position, the line output level may be monitored on the meter. This level may be adjusted by means of the Output level control.

Source and Tape Position: In this position, a signal from the tape playback amplifier is combined with the source signal and recorded. Since the tape signal is exactly like the source signal, except that it is delayed slightly, an echo will be recorded. The amount of echo may be adjusted by means of the Output Level control. (In the Source plus Tape position, the Output Level control has no effect on Inputs #1 and #2.) Various echo effects can be produced by varying the Input levels, the Output level controls and by changing tape speeds. CAUTION: Too much echo produces delayed distortion and undesirable feedback effects.

SETTING THE CONTROLS FOR PLAYBACK

Equalization: Set according to the speed being used.

Record Switch: Place in the Play position. Be sure that both record switches are in the Play position to prevent possible damage to a valuable recording.

Note: It will be impossible to fast forward or rewind the tape if either channel is in the record mode.

Tape Output: Place the A-B-Output switch in the "B" tape or the tape output position.

Note: Start the tape in motion by pressing the Operate button on the transport.

Output Level: Adjust the volume to desired level at the head phones or to the auxiliary equipment.

Tone Controls: Tone controls may be used during playback if the A-B-Output switch is placed in the Source plus Tape position. In any other position, play back response will be flat. When in the Source plus Tape position, the

response may be adjusted as desired. For flat response in this position, place controls in the detent at mid-rotation point.

Meter Function: During playback, the meter may be used to monitor the line output level by placing the A-B-Output switch in the tape output position. By placing this switch in the "B" tape position, the original recording level can be determined.

ADDITIONAL FUNCTIONS

With the input sources connected as described under the section on recording, the control center may be used as a mixer. The line output may then be fed to public address systems, broadcast consoles, etc. Program material fed to the line output will then depend upon the position of the A-B-Output switch.

a. "A" Source -- In this position, material fed into Input #1 and Input #2 will be combined and fed to the output. Mixing levels may be adjusted by means of the controls Input #1 and Input #2. Master gain may be adjusted by means of the output level control.

b. "B" Tape and Tape Output Positions -- The output will be the same for these two positions, the only difference being in the meter function as described previously. In these two positions, tape output only will be heard. The level may be adjusted by means of the output level control.

c. Source and Tape -- In this position, both the source material and the tape output will be heard. Inputs #1 and #2 will be controlled by their respective controls. In this position, however, the output level control is no longer a master gain control, but rather, it now becomes a tape playback gain control.

Due to the highly flexible nature of the control center, many other applications will suggest themselves. It will be impossible to list all these applications because of space consideration. The foregoing has been an attempt to list the more conventional uses and at the same time point the way toward the more specialized uses.

SLOW SPEED OPERATION

Normally, units are supplied with three standard speeds: 15, 7½, and 3¾ ips. For equalized operation at slower speeds, see transport section for special instructions for SR-1 and SR-2.

CIRCUIT DESCRIPTION

CX-2D Mic Stages: Mic input stages consist of a direct coupled pair of very high gain silicon transistors. This pair employes heavy negative feedback for linearity and control along with bootstrapped input for a high input impedance. The output impedance is very low and capable of driving to a clipping level in excess of +14db. The outputs are fed by way of the line input jack to the top of the input level controls.

The microphone input stages are designed to accomodate a wide range of input levels. A dual gain feature is employed so that the operator automatically selects the amount of gain to suit his particular needs.

CX-2L: Same as CX-2D, but lower gain; 25db gain.

CX-7B Buss Amp: The Buss amp is employed to isolate inputs and provide approximately 24db of gain for the line inputs. It consists of four direct coupled silicon transistors with DC feedback for gain stability and linearity. The tone control circuit is connected across pins 2, 6, and 7. The output of this amplifier is fed to both the record amp and the A-B-Output switch.

CX-6C Output Amp: The Output amp employs a quasi-complimentary pair of transistors to provide high level, distortion free, transformerless output. The output impedance is under 4 Ω. This unit will adequately drive a 600 Ω line without noticeable loading effects at levels up to +26dbm. Normal output is +12dbm for "0" VU, depending on setting of CX-6C.

CX-5C Record Amp: The Record amp is a three-stage amplifier providing necessary gain, impedance match, and pre-emphasis equalization for the recording process. High frequency pre-emphasis is provided by an RLC network in the emitter circuit of Q501. Low frequency equalization is provided by an RC network in the feedback loop from Q503 to the emitter of Q501. The record level is adjusted by means of a constant current resistor in the output of the amp. Voltage drive is provided and then converted to current drive so that at no time will the amplifier be current limited within the dynamic range of any known recording tape.

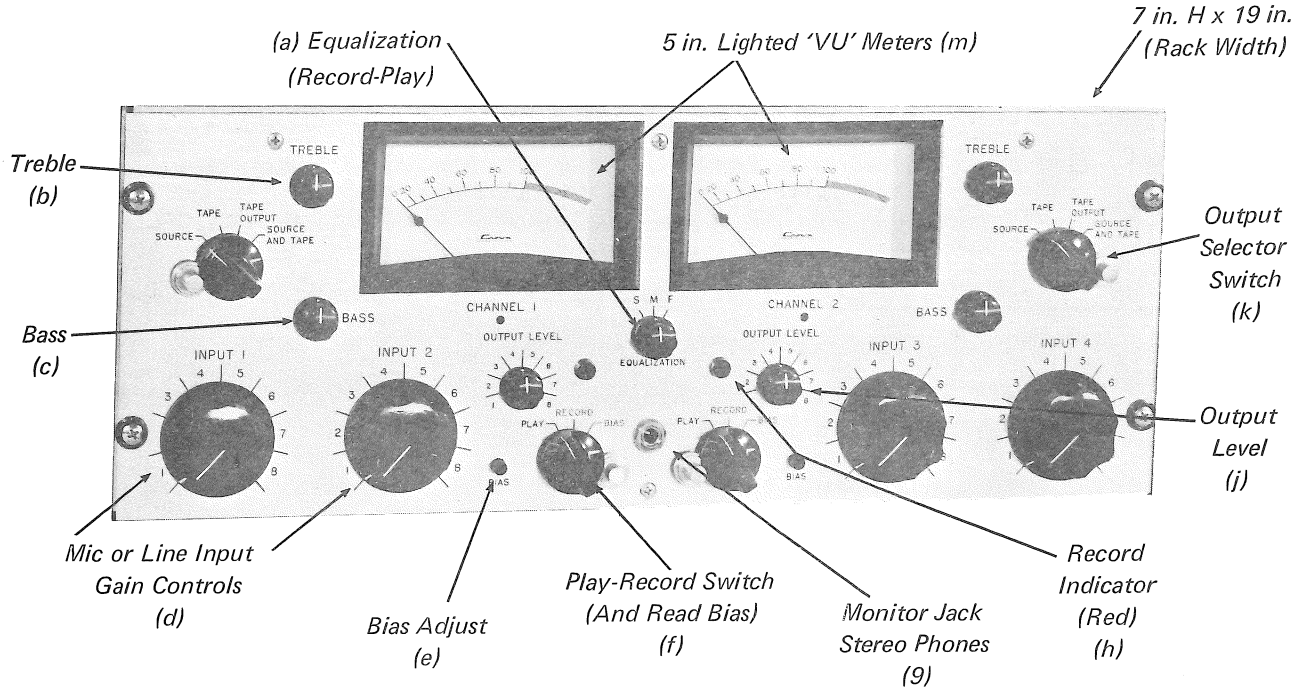
CX-2D and CX-8E Playback Amp: The playback amplifier consists of a proven circuit of five high gain low noise silicon transistors. Feedback equalization is employed around the first three direct coupled stages and degenerative gain control is utilized in the last two stages. Circuitry is such that the equalization, gain, and distortion performance are almost entirely independent of device characteristics. NAB equalization is provided by the RC network in the feedback loop to the emitter of Q201. Bass roll-off is adjustable by means of R805, R806, or R807. L801, and C801 provide a notch filter at the bias frequency. The output of the playback amp is fed directly to the source-tape switch.

CX-9D Bias Oscillator: The bias oscillator consists of a pair of push-pull connected power transistors operating into a highly efficient ferrite cup core assembly. The circuit produces a very clean low distortion 100KHz signal for bias and erase. This results in lowest possible erase noise. Bias is coupled to the heads by means of the internal bias adjust (on CX-5) and the front panel bias adjust and mixed with the audio signal at the output of the bias trap on CX-5 consisting of L504 and C507. Erase voltage is coupled to the erase head by way of C905 and C906 which are adjustable trimmers.

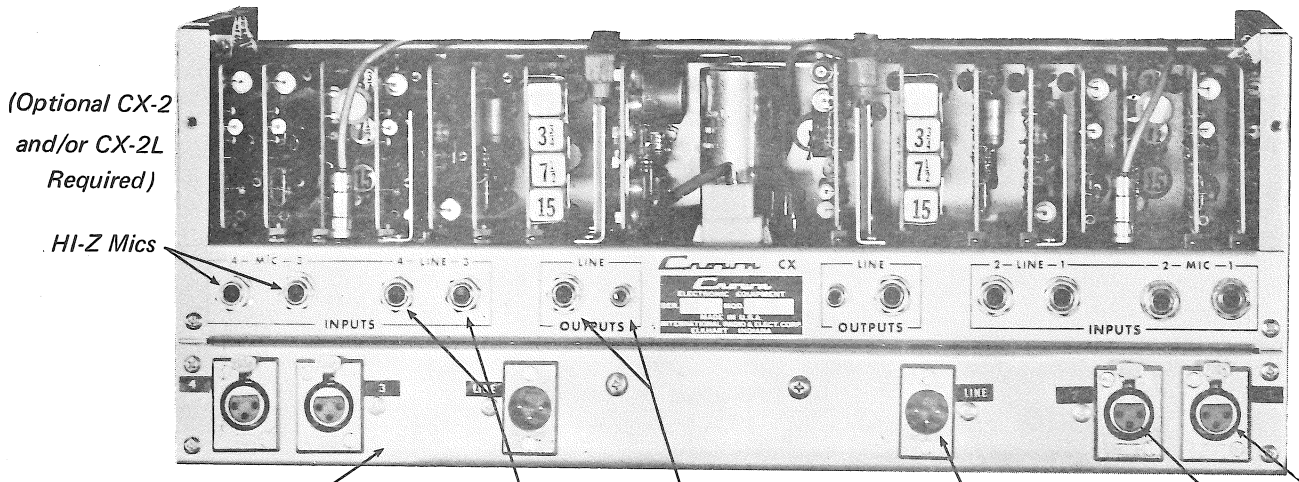
CX-3 Power Supply: A regulated power supply is employed to make the CX electronics nearly independent of line voltage variations and to insure stable operation in all modes. The power supply board contains all the components to rectify and control the necessary supply voltages to the rest of the circuitry. The +30 supply is adjustable by means of R305. The output of the +30 supply is highly regulated and very well filtered. The negative supply is referenced to the positive and is adjusted with it. Additional filtering and de-coupling of the power supply lines are employed within the various circuits where needed.

'CX'

DUAL-CHANNEL, RECORD-PLAY ELECTRONICS



Front Panel



Rear Panel

The CX electronics is the sophisticated "nerve center" of a typical CX-700 or CX-800 series stereo recorder. Highly accurate three-speed equalization and custom-calibration to all tapeheads assure unequaled record-reproduce performance.

A "basic" CX-700 or CX-800 recorder includes only two mixed Hi-Z line inputs, and a 600 ohm (CX-6) output, per channel.

(A). One or two Hi-Z mic inputs per channel require one or two CX-2 (and/or CX-2L) plug-in modules as options -- depending on gain required. Most dynamic, condenser and ribbon mics will require the CX-2, with close-miked condensers and a few dynamics (at very close range) requiring only CX-2L.

(B). Equalized magnetic-phono inputs require the CX-2R modules in lieu of CX-2 mic modules.

(C), Hi-Z mic (or line) inputs may be converted to Lo-Z balanced inputs using optional plug-in transformers SMIT (or SBIT). The factory-installed Lo-Z-4 (or 600 Z-4) offers four similar transformers of SMIT (or 600 ohm line) type as "built-ins."

(D). The 600 ohm unbalanced line outputs may be converted to balanced with the optional SLOT. On electronics with Lo-Z-4 (or 600 Z-4) strips, these transformers are integral.

INPUT CHARACTERISTICS

INPUT	NOTES	INPUT Z	RECOMMENDED INPUT LEVELS	
			Min.dbm	Max.dbm
Line-Hi-Z	1,2,3	100-K	-24*	+25*
Line-bridging SBIT	1	20-K	-18	+25
Line-Lo-Z bal. (600 Z-4)	1	600 ohm	-23	+25
Mic.-Hi-Z CX-2 (phone jacks)	4	350-K	-88*	-10*
CX-2L	4		-64*	+14*
Mic.-Lo-Z CX-2 (cannonXLR)	4,5	50 ohm 250 ohm	-104 -98	-26 -20
CX-2L	4,5	50 ohm 250 ohm	-80 -74	-2 +4

All levels are such that VU can be zeroed.
0 dbm = 1 mw into 600 ohms.
*Voltage equalivalent to 0 dbm, or 0.778 volts.

OUTPUT CHARACTERISTICS

OUTPUTS	NOTES	MAX. OUTPUT Z	MIN. LOAD Z	OUTPUT* LEVEL
Line Out (with CX-6)	6,8	25 ohm	600 ohm	+8 dbm
Front Panel Monitor Jack (with CX-6)	9	600 ohm	4-16 ohm	+8db into Hi-Z
Balanced Out (cannon XLR male)	8	150 ohm	600 ohm	+8 dbm

* 0 db is 0.778 volts.

0 dbm = 1 mw into 600 ohms.

NOTES:

1. Maximum input level limited only because gain setting becomes difficult at extremely high levels due to the very small amount of rotation required. If levels over +25 db are encountered, an external divider is recommended.

2. Plugging into Hi-Z line disconnects the corresponding mic input.

3. Input Z becomes 50-K ohms at maximum CW position of input control.

4. In general, low-quality microphones (most crystal, ceramic, and low-cost dynamic units) are not recommended for professional sound recording. For professional results use a professional microphone.

5. On units equipped with LoZ-4 (or 600 Z-4), a mic-input (or line-input) channel (in use) can be either phone jack, or cannon connector, but not both.

6. The line output pin jack has 560 ohms in series from the line-out phone jack.

7. 600 ohm output Z in Source-and Tape position or in Source position with output control full CW.

8. CX-6 output level is normally set to +8 dbm at the factory, but can be reset to any level up to +18 dbm. CX-6 must be installed with LOZ-4 strip for balanced output.

9. High or Lo-Z dynamic headphones may be used; however, electrostatic headphones are not recommended since they require 2-30 watts (e.g. a D60) for proper levels and flat frequency response.

TWO - CHANNEL CX ELECTRONICS

I. Description of Front-Panel Facilities:

(a). EQUALIZATION (3-position switch) adjusts reproduce and record circuits for proper equalization for a given tape speed.

(b). TREBLE (variable control) adjusts amount of high-frequency boost (or cut) during record (reproduce). Mechanical detent assures flat response when not used. Maximum boost, 20 db and cut, 14 db @ 15 KHz.

(c). BASS (variable control) adjusts amount of low-frequency boost (or cut) during record (reproduce). Mechanical detent assures flat response when not used. Maximum boost, 18 db and cut, 13 db @ 30 Hz. All circuitry is low-distortion feedback type.

(d). INPUTS (variable controls) adjust MIC or LINE volume (either Hi or Lo-Z) with dual mixing, and echo, if desired. Dual-element controls enable wide dynamic range thru MIC preamps (CX-2).

(e). BIAS (variable control) sets record bias for optimum results for a given tape. Visual indication of bias current is available on VU meter with PLAY-RECORD switch in BIAS position.

(f). PLAY-RECORD (3-position switch, with mechanical interlock) sets electronics for PLAY, RECORD, or BIAS-read functions.

(g). MONITOR (3-way phone jack) enables stereo monitoring.

(h). RECORD INDICATOR (red neon) for visual indication of RECORD mode.

(j). OUTPUT LEVEL (variable control) adjusts output signal through all connectors on both front and rear of chassis.

(k). OUTPUT SELECTOR SWITCH (4-position)

(1). SOURCE: meter reads source mixer-buss level.
(2). TAPE: meter reads calibrated tape reproduce level.
(3). TAPE OUTPUT: meter reads tape reproduce level at output connector.
(4). SOURCE and TAPE: TREBLE (b) and BASS (c) controls become operative for reproduce, meter reads source mixed with tape reproduce. In RECORD this provides echo via output level control (j).

(m). VU METER: 5 inch edge-lighted meter features a decibel and 0-100% modulation scale, with true VU damping per standards.

II. Electronic Specifications:

(1). Minimum frequency response $\pm$0.5db, 10Hz-50KHz, thru Hi-Z LINE INPUTS to OUTPUTS.

(2). Total distortion throughout ELECTRONICS less than 0.2% (not including tape).

(3). Equivalent noise thru MIC INPUT (CX-2), with input shortened, better than -115 dbm.

MODEL T C TAPE COUNTER

8.3.1 DESCRIPTION

The model TC Tape Counter accessory serves as a convenient tape-location reference device. A 4-digit, push-to-reset, indicator counts the number of revolutions of the Take-up Motor, and is there by linked to the tape in all modes of transport operation (see fig. 8-3-1). Rapid return to "0" reference is possible with the push-to-reset button.

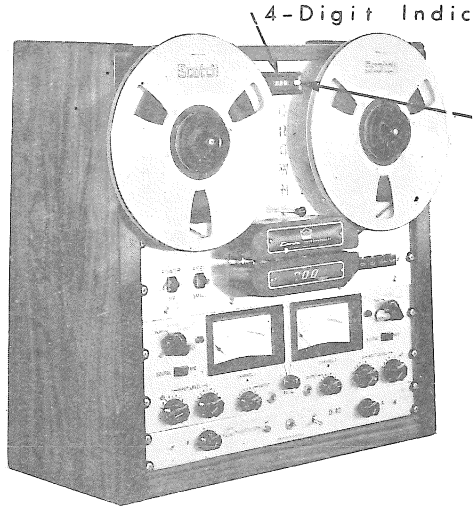


FIG 8-3-1

8.3.2 INSTALLATION

Normally, the TC will be installed at the factory, with no user-installation required.(See other side) Since the counter mechanism occupies a separate rack-mounted chasses, the height of a typical machine increases by 1 3/4".
Field-installation of the TC may be effected on all PRO Transports, and many older units having 3/8" of T.U. Motor Shaft (at the rear).

8.3.2.1 All PRO700 and PRO800

The T.U. Motor Shaft will accept the threaded end of the small drive-pulley supplied with the TC kit.

Although a clearance hole is normally provided for this pulley, earlier transports may require modification of the corner cover (see fig. 8-3-2).

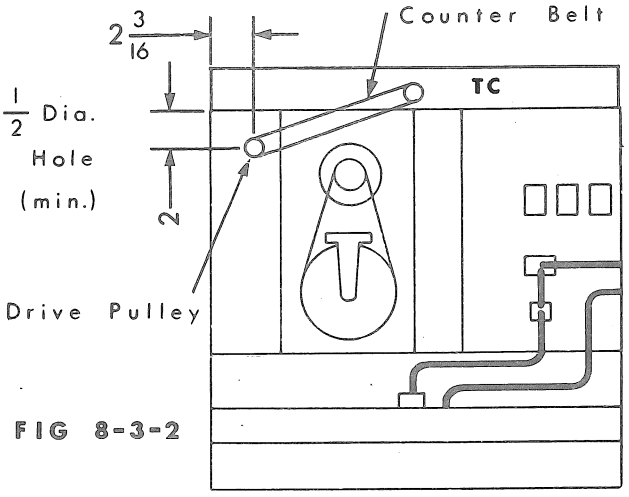


FIG 8-3-2

The drive pulley is then carefully threaded into the rear-end thread shaft of the motor -- tightening by holding reel flange. Stringing the drive belt between pulleys completes the TC installation.

8.3.3.3 T-series 700, G-series 800

A special drive-pulley with 5/16 bore must be supplied with the kit -- specified when ordered by model and S/N of your machine. A modification of motor cover may be necessary on some transports as well.

8.3.3 OPERATION

Usually, the white reset-button is depressed at the beginning of a given tape -- establishing a "0" reference. Thereafter, desired locations on the tape must be noted as a convenient means of returning to a taped selection.

8.3.4 MAINTENANCE

Occasional cleaning of the small counter drive--belt and pulley grooves comprises the major maintenance for smooth operation. All bearings in the TC mechanism are lubricated for life -- no oiling required.

8.3.5 THEORY AND PARTS LIST

The numbered wheels of the counter mechanism are driven by a stepped-gear arrangement to provide decade operation. The input motion is bi-rotational -- being a one-to-one drive from the T.U. Motor Shaft through a flexible belt. Special cogs within the counter enable a zero-reset action with a push of a button. All counter parts are of low-friction, non-wearing plastic with oilite bearings and stainless shafts.

8.3.5.1 User-Replaceable Parts

7194A	Counter Ass'y
3024	Spring Coupling
3016	Heyco bushing
40398	Drive pulley ass'y
40395	Driven shaft ass'y
7833	Counter belt, thin

NOTE: For shipping purposes, the TC is mounted at the bottom of the recorder. To prepare for operation, place the recorder on its back and remove all the front panel screws. Remove the TC, slide the recorder down, and re-locate the TC at the top of the transport. The drive pulley (located with the manual) must be installed on the shaft of the take-up motor. Finally, install the TC drive belt.

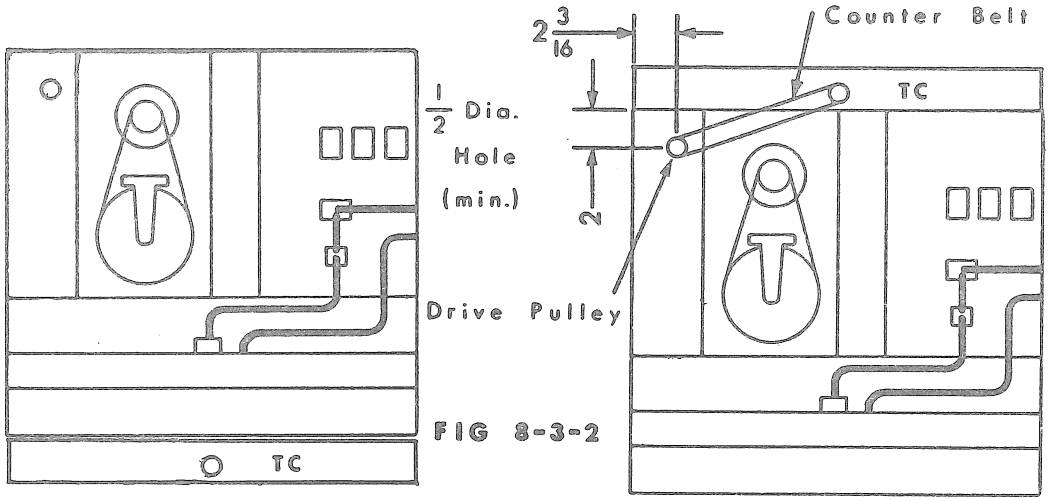


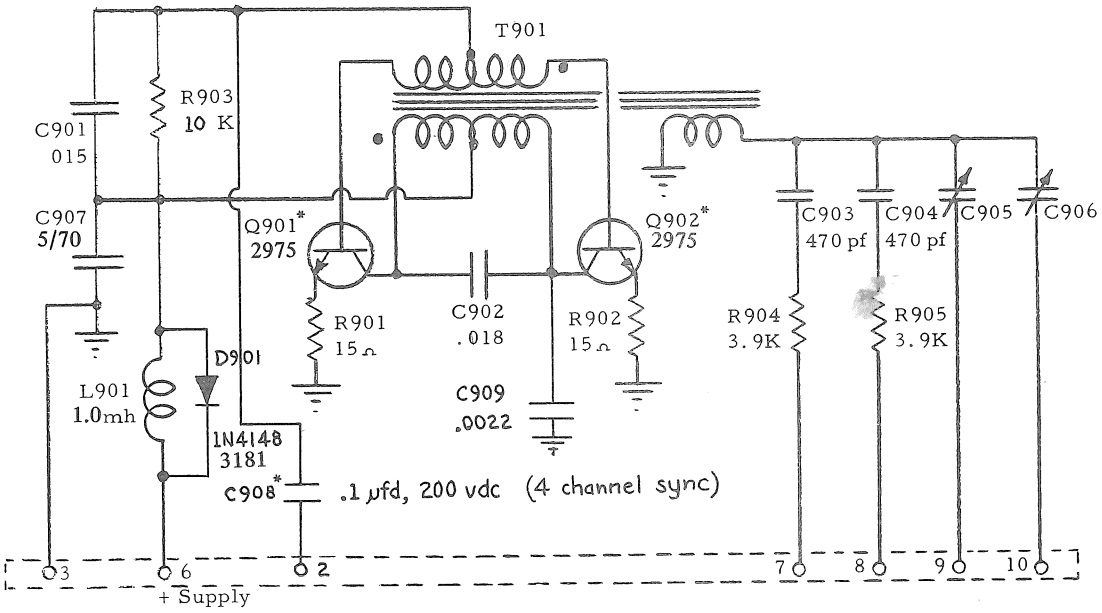
FIG 8-3-2

SHIPPING NORMAL OPERATION

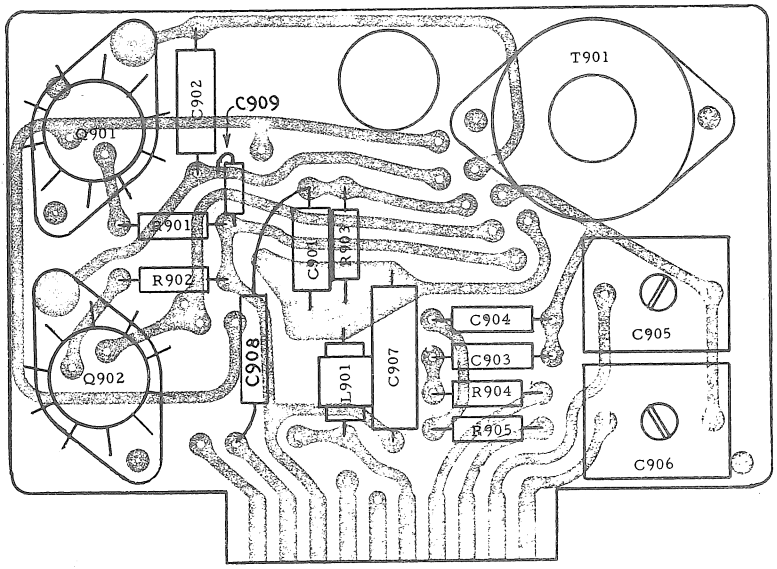
Crown INTERNATIONAL

SOLID STATE SERIES

CX—9D BIAS OSCILLATOR



*if 4-channel sym is difficult to obtain, use CPN3348 (RCA40327) transistors for Q901, Q902.
*C908 4-channel only



CX-9D PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
2	R901, R902	15 ohm ½ Watt	1013
2	R904, R905	3.9K ½ Watt	1059
1	R903	10K ½ Watt	1035
Capacitors:			
2	C903, C904	470 pf	2511
2	C901, C902	.015 Pacer	3288
1	C907	5 mfd 70 volt	1678
1	C908	.1 mfd, 200 volt (4 chan. only)	2938
1	C909	.0022 Pacer (use with 2N2102's)	3285
Transistors:			
2	Q901, Q902	2N2102 or RCA 40327	2975 3348
Miscellaneous:			
2	C905, C906	PC-467 Trimmers	1256
1	L901	1.0 Choke	2441
1	T901	Bias Oscillator Coil	3331
1		BA-04-R Bracket	1781
1 pr		TC 6-04-160 Ferramic Core	1779
1		TA-04-B Screw Type Trimmer	1782
1		Trimmer Cover for TA-04-B	1782
2		4/40 x ¼ Round Head Screw	1827
2		4/40 Hex Nut	1938
4		6/32 x ¼ Binding Head Phillips Screw	1954
4		6/32 Hex Nuts	1889
1	CX-9D	Printed Circuit Board (Unwired)	7596U
1	D901	1N4148 diode	3181

Crown
INTERNATIONAL

SOLID STATE SERIES

CX-9
Bias
Oscillator

SPECIFICATIONS

Frequency: 100KHz sinusoidal of low harmonic content. (adjustable by slug in oscillator core)

Power Output: Sufficient for two record heads plus two tracks of a stereo erase head or one full-track erase head

Voltage Output: Approximately 60 VAC at secondary of T901

Power Required: +30 VDC (Current dependent on heads employed)

Erase Head Voltage: Adjustable by trimmer on board

PURPOSE

The CX-9 is designed to provide the necessary high frequency bias required for professional quality magnetic tape recording and erasing.

CIRCUIT DESCRIPTION

The CX-9 consists of two medium power transistors operating as switches. Each transistor conducts for a short period on opposite peaks of the waveform and while conducting is biased to saturation so that there is little collector dissipation. This type of operation results in high efficiency. The collectors operate into a resonant circuit consisting of T901 and C902.

The circuit operates as follows:

As power is applied to the bias oscillator and one transistor begins to conduct a positive pulse appears on the other end of T901 which is applied to the base and drives this transistor to saturation. After saturation is reached, the changing magnetic field of T901 applies a positive pulse to the opposite transistor and it conducts to saturation. Since the positive signal has now disappeared from the first transistor it stops conducting. As soon as the second transistor reaches saturation, a positive pulse is applied to the first transistor. This cycle maintains oscillation.

The regulation is good up to a point very near the maximum power capacity of the CX-9 so that adjusting the erase voltage on one head or even switching one head out of the circuit has a minimum of effect on the other. By using proper values of capacitance for different heads, the erase head and coupling capacitor form a series resonant load on the oscillator.

Resistors R904 and R905 will vary in value and are chosen to give proper bias current and adjustment range to the front panel bias adjust which is in series with these resistors.

The CX-9 may also be adapted for multiple channel use. Two CX-9's are connected together using a "sync" wire between pin 2 of each socket. Each CX-9 must also have C908 added. Be certain that the two oscillators are within 2% of each other (nominally 100 KHz).

Voltages: (Are approximate load dependent, measured with both channels in record)

	AC (RMS, 100 KHz)			DC (VTVM)		
	Emitter	Base	Collector	Emitter	Base	Collector
Q901	.7	3	21	+.5	-1	+29
Q902	.7	3	21	+.5	-1	+29

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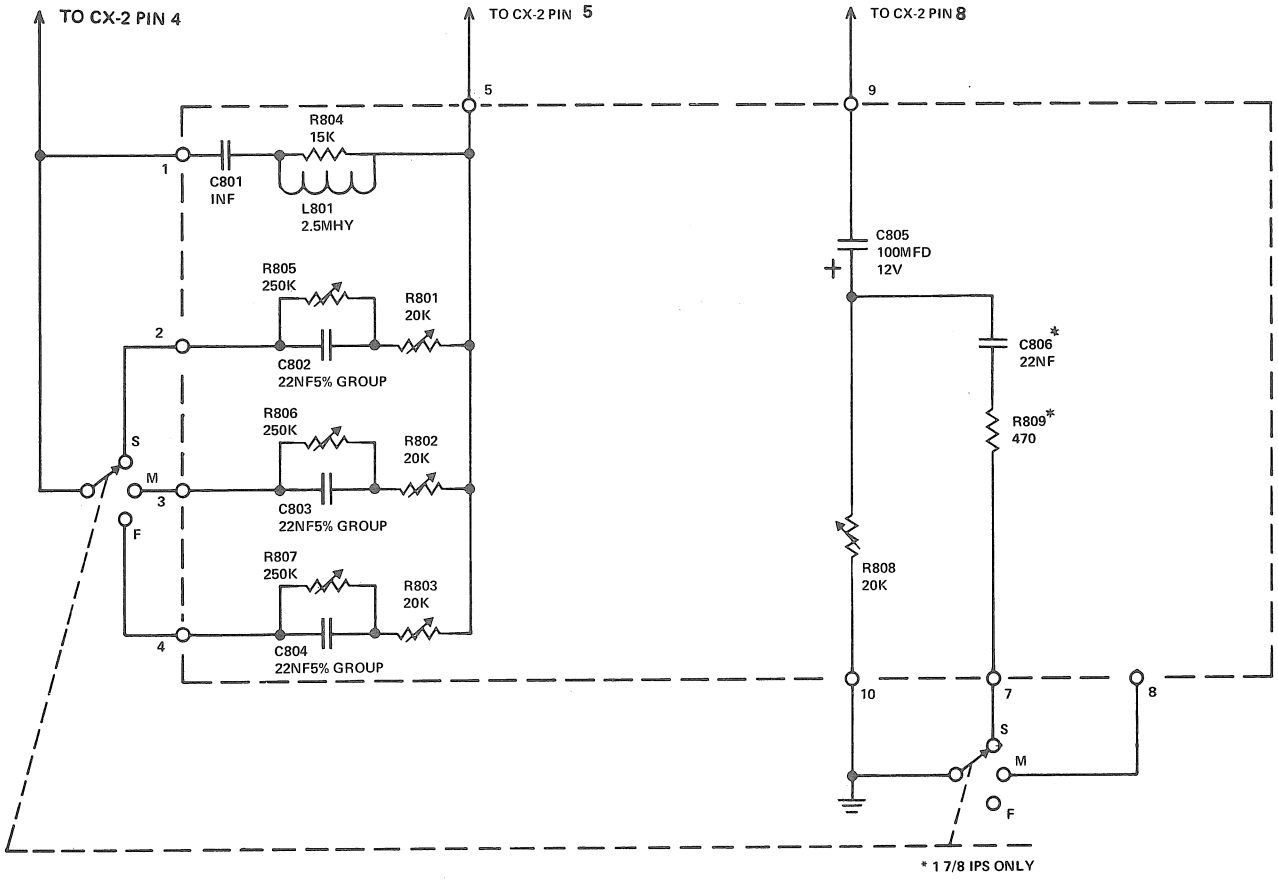
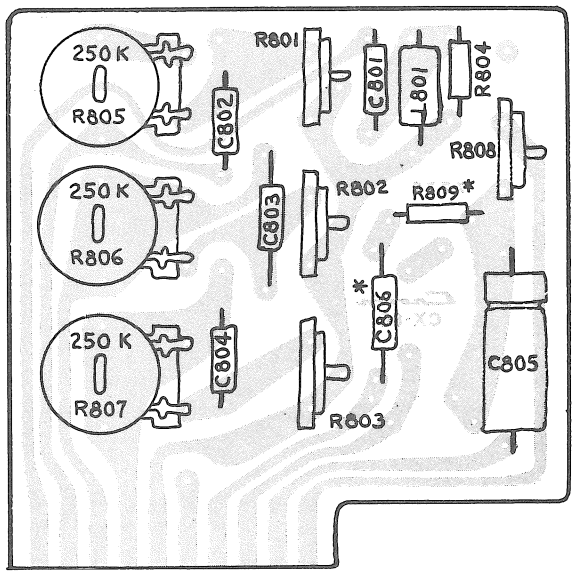
INTERNATIONAL

SOLID STATE SERIES

CX – 8E EQUAL–IZATION

(REVISED)





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CX-8E PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
1	R804	15K ¼ Watt	2632
Capacitors:			
1	C801	.001 mf 200V Filmatic	3480
3	C802, 3, 4	.022 mfd 400 volt Mylar	2963
1	C805	100 mfd 12 volt	1635
Potentiometers:			
3	R805, R806, R807	250K Horiz.	3087
1	R808	20K Vertical	1712
3	R801, R802, R803	20K Vertical	3029
Miscellaneous:			
1	L801	2.5 mh Choke	1510
1	CX-8E	Printed Circuit Board (Unwired)	7772U
For 1 7/8 Equalization Only:			
1	R809	470 Resistor ¼ Watt	2626
1	C806	.022 mf 200V Filmatic	2963

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SOLID STATE SERIES

CX-2L
Pre-amp

SPECIFICATIONS:

Gain: When used as a MIC amp with the CX input level control, minimum of 0 db and maximum of 29 db.

Noise: -115 db (flat -30KHz) reference to input with input shorted.

Output Level: +24 dbm into HiZ
+19 dbm into 5K
+8 dbm into 600 ohm

Input Z: 100K

Response: -.4 db 20 Hz, -1 db at 100 KHz (when used as MIC amp 1 KHz reference).

Distortion: I.M. .15% (MIC 0 dbm out).

Connector Required: 10 pin precision (card edge, contacts one side).

Power Supply: 6 ma at +30V and 6 ma at -30V for normal operation.

PURPOSE:

The CX-2L is a two-stage audio amplifier which is used as a microphone preamplifier. It is a low gain amplifier with facilities for external gain control.

CIRCUIT DESCRIPTION:

The circuit is basically a feedback stabilized amplifier, consisting of Q204 and Q205, a complimentary pair. Voltage feedback is provided via R214 to the emitter of Q204. By adjusting the dynamic resistance between pin 8 and ground, the AC gain may be altered over a wide range. This effect is achieved with part of the tandem input level control when used as a MIC pre-amp. This allows a wide range of microphone levels without overload.

DC Voltages (VTVM)

	Emitter	Base	Collector
Q204	-.5	0	+28.4
Q205	+29	+28.4	-1.3

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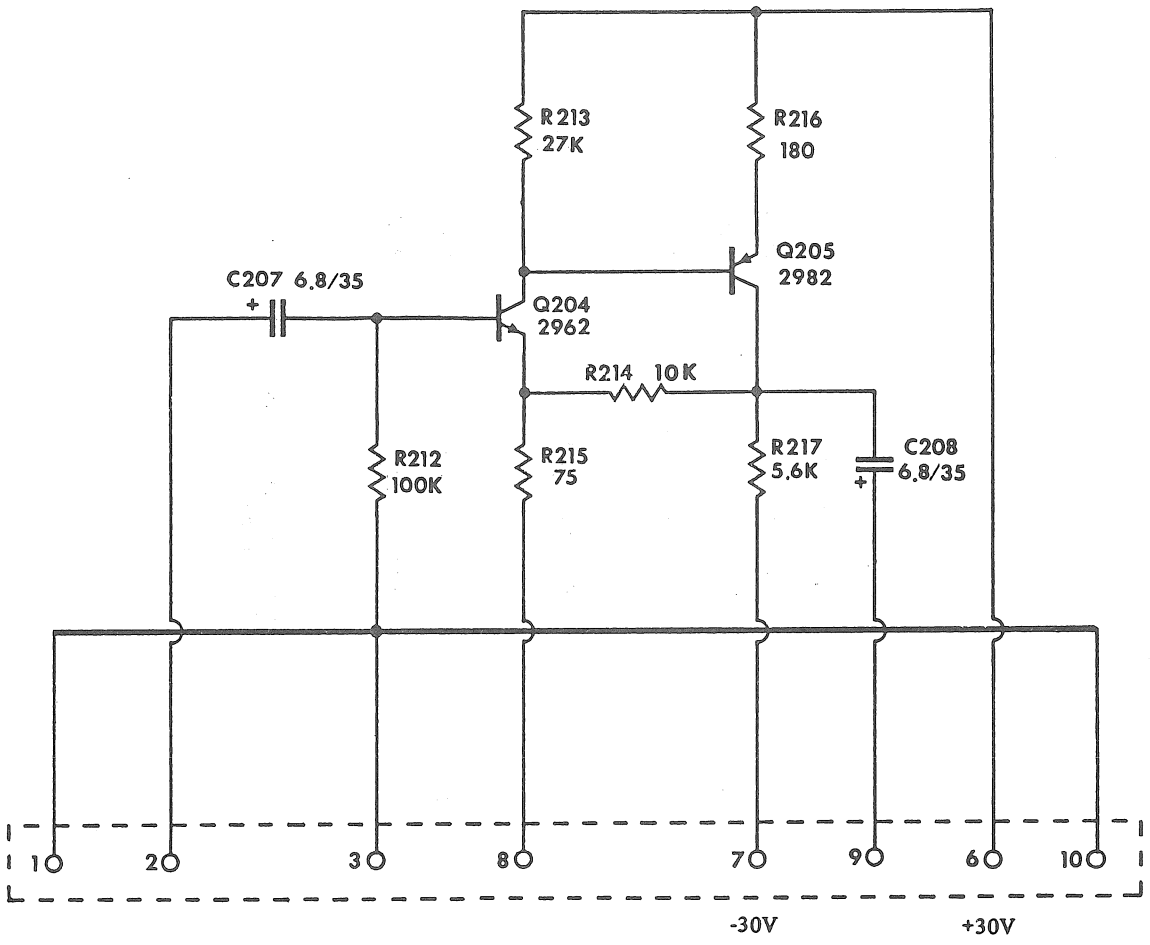
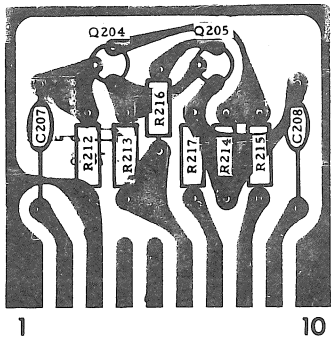
SOLID STATE SERIES

CX—2L PRE—AMP





CX-2L PARTS LIST

QUANTITY	SCHEMATIC NUMBER	DESCRIPTION	CROWN PART NUMBER
Resistors:			
1	R212	100K ½ watt	1056
1	R213	27K ½ watt	1027
1	R214	10K ½ watt	1035
1	R215	75 ohm ½ watt 5%	2423
1	R216	180 ohm ½ watt	1006
1	R217	5.6K ½ watt	1042
Capacitors:			
2	C207,C208	6.8MF 35V Tantalum	3573
Transistors:			
1	Q204	Selected TZ-81	2962
1	Q205	Selected 2N5383	2982
Miscellaneous:			
1	CX-2L	Printed circuit board (unwired)	7843u

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INTERNATIONAL

SOLID STATE SERIES

CX-2
Pre-amp

SPECIFICATIONS

Gain: When used as Mic amp with CROWN level control, minimum of 30 db and maximum of 64 db.

Noise: -115 db (flat - 30 KHz) reference to input with input shorted

Output Level: +24 dbm into Hi Z
+19 dbm into 5K
+8 dbm into 600 Ω

Input Z: 350K (Mic) recommend 50 K source

Response: -.4 db 20Hz, -1 db at 100 KHz
(when used as Mic amp, 1 KHz ref.)

Distortion: I. M. .15% (Mic, 0 dbm out)

Connector Required: 10 pin precision (card edge, contacts one side)

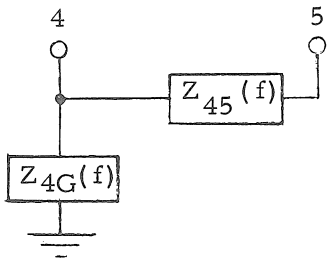
Power Supply: 10 ma at +30 volt and 5 ma at -30 volt for normal operation
Optional may be operated from +30 only (7.5 ma)

PURPOSE

The CX-2 is a five stage audio amplifier which is used as a microphone, magnetic phono, and/or tape playback preamplifier. It is a high gain amplifier with facilities for external equalization and gain control.

CIRCUIT DESCRIPTION

The circuit is basically that of two cascaded feedback stabilized amplifiers. The first consituted of Q201, Q202, and Q203 provides a low noise, high impedance input with feedback equalization. Emitter follower Q203 allows a high open loop gain and a wide dynamic range to be obtained independent of the equalization being used. Because the open loop gain is essentially independent of the equalizer, equalizer synthesis becomes straightforward. The closed loop equalizer network connected between pins 4 and 5 becomes essentially:



$Z_{45}(f)$ = impedance between pins 4 and 5.
(Real part must be greater than 1 K at high frequency if Z_{4G} is small.)

$Z_{4G}(f)$ = total impedance between pins 4 and ground.

$$A(f) \approx \frac{Z_{4G}(f) + Z_{45}(f)}{Z_{4G}(f)}$$

Provision is made on the board for mounting of the RIAA equalization network. When used as a tape playback preamplifier, all equalization and gain controls appear on the CX-8 equalization board.

The second amplifier block consists of Q204 and Q205, a direct coupled complementary pair. Voltage feedback is provided via R214 to the emitter of Q204. By adjusting the dynamic resistance between pin 8 and ground, the AC gain may be altered over a wide range. This effect is used for setting the overall gain when used as a tape playback amplifier and is part of a tandem level control when used as a microphone preamplifier. This allows a large range of microphone levels without overload.

This second block is so fitted that it may be biased for operation from either ±30 VDC (standard) or a single +30 supply. In the latter case, 82K (R221) is inserted between the base of Q204 and the +30, and C208 is reversed.

All transistors are silicon, planar, epitaxial types.

DC Voltages (VTVM)

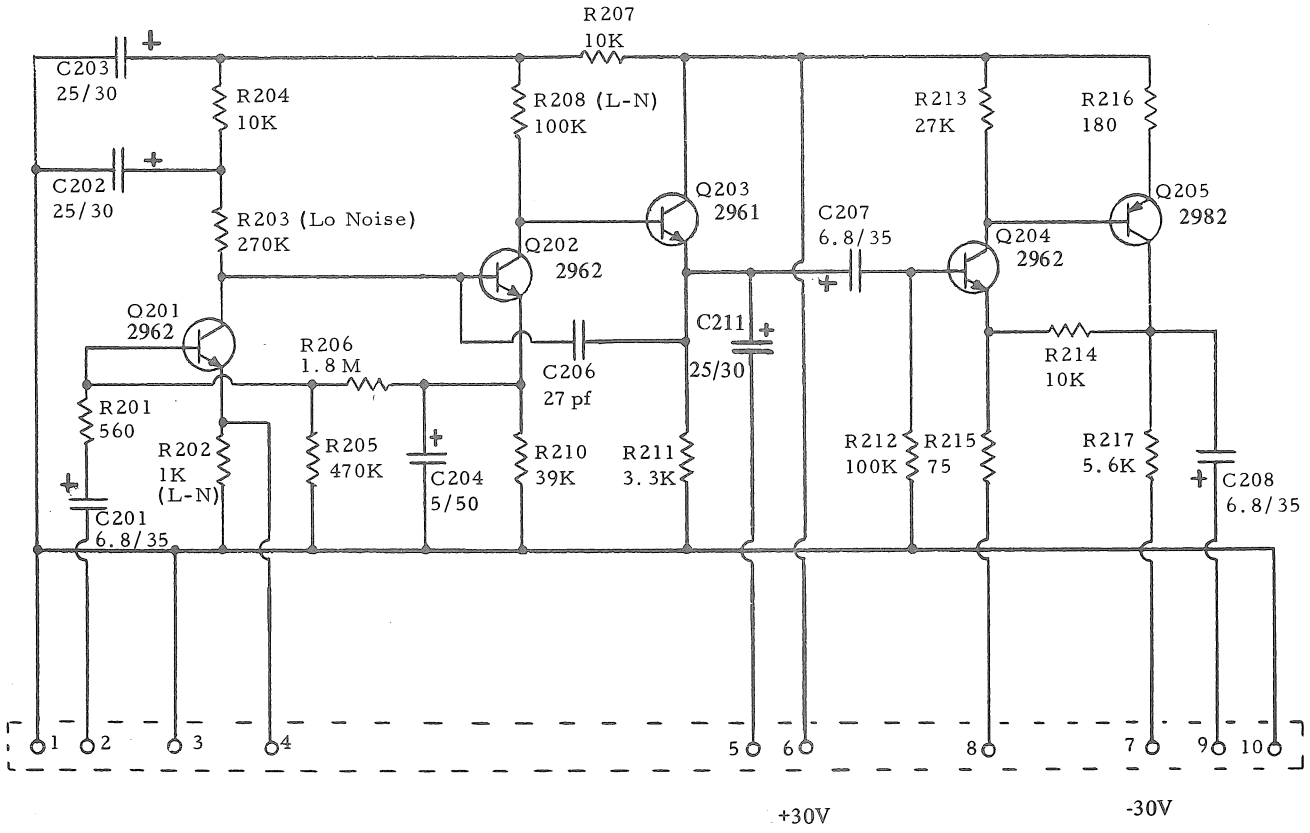
	Emitter	Base	Collector
Q201	0	+.5	+4
Q202	+3.3	+4	+18
Q203	+17.4	+18	+30
Q204	-.5	0	+28.4
Q205	+29	+28.4	-1.3

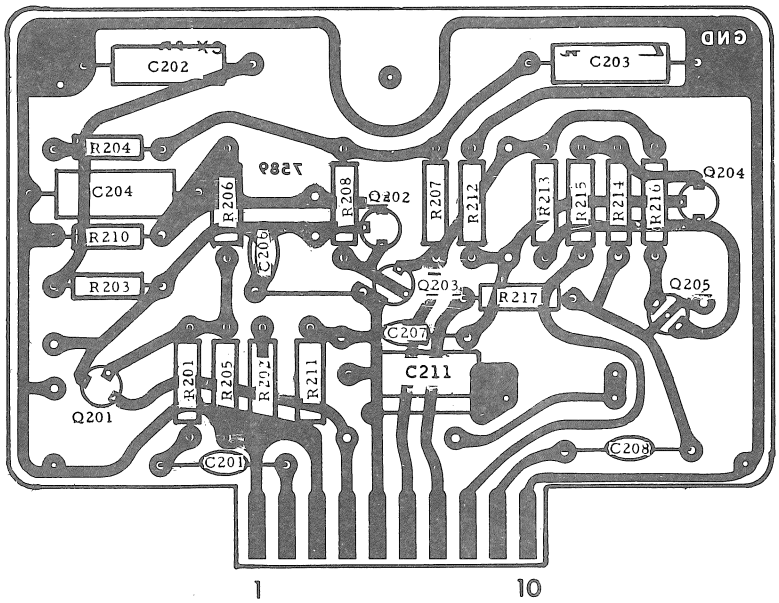
Crown

INTERNATIONAL

SOLID STATE SERIES

CX—2D PRE—AMP





CX-2D PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
1	R215	75 ohm ½ Watt 5%	2423
1	R216	180 ohm ½ Watt	1006
1	R201	560 ohm ½ Watt	1030
1	R202	1K ½ Watt (1% Film)	3194
1	R211	3.3K ½ Watt	1051
1	R217	5.6K ½ Watt	1042
3	R204, R207, R214	10K ½ Watt	1035
1	R213	27K ½ Watt	1056
1	R210	39K ½ Watt	1043
1	R212	100K ½ Watt	1027
1	R208	100K ½ Watt (5% Film)	2324
1	R203	270K ½ Watt (5% Film)	1997
1	R205	470K ½ Watt	1040
1	R206	1.8M ½ Watt	1033
Capacitors:			
1	C206	27 pf	2342
1	C204	5 mfd 70 volt	1678
3	C201, C207, C208	6.8 mfd 35 volt Tantalum	3573
3	C202, C203, C211	25 mfd 30 volt	1087
Transistors:			
1	Q205	Sel 2N5383	2982
3	Q201, Q202, Q204	Sel TZ-81	2962
1	Q203	Sel 2N3859A	2961
Miscellaneous:			
1	CX-2D	Printed Circuit Board (Unwired)	7589U

Crown INTERNATIONAL

SOLID STATE SERIES

CX-3
Power
Supply

SPECIFICATIONS

Output Voltages: ±30 VDC

Maximum Output Current: 300 ma +30, 100 ma -30

Ripple and Noise Voltage: 500 μV (+30), 50 μV (-30)

Line Regulation: ±25 mv for ±10% line deviation from 117 volt with all boards in stereo CX and in record

Load Regulation: -75 mv from 25 ma to 300 ma for +30 supply
-25 mv from 0 to 100 ma for -30 supply

AC Input to Board: 66 VCT

Current measured in stereo control center:

	+30	-30
All boards	147 ma	63 ma
Less 2 Line amps	140 ma	56 ma
Less 2 Line amps and 2 CX-2	120 ma	46 ma
Less 2 Line amps and 4 CX-2	100 ma	36 ma
Short Circuit Current	1 A	600 ma

CIRCUIT DESCRIPTION:

The CX-3 board consists of two power supplies of the full-wave rectifier type each followed by a series voltage regulator. The function of the regulator is to provide ripple free DC voltages (±30) which are independent both of load current and AC line conditions.

In the series regulators, transistors are used as variable series resistance. These resistances are varied by control amplifiers which vary the transistor base currents. The control amplifiers measure the difference between a pre-determined fraction of the output voltage (set by R305) and a stable DC reference voltage (D 308 Zener). The control amplifiers act so as to reduce this difference term (error) to zero.

Consider a supply working normally, say the positive supply. The output voltage is 30 volts. Assume that the load increases causing the output voltage to drop. This will then cause the voltage at the

base of Q301 to be reduced thereby turning off the collector current of Q301, but when the collector current of Q301 is turned off, this current must then flow into the base of Q302 which amplifies this current (as an emitter follower in a Darlington configuration) and feeds it to the base of the series (variable resistance, transistor, Q303). Once this amplified current appears at the base of Q303, it will turn on harder (drop in resistance) causing the output voltage to be restored to 30 volts. This process takes place continuously in the regulator system. This is what is known as a type "0" or "regulator" type of feedback system. In fact, virtually all feedback audio amplifiers may be viewed as a type "0" feedback system, the only difference being that the reference voltage, now the input voltage, is no longer a DC constant.

Since the reference voltage is independent of the supply voltage, the regulators will likewise regulate for line voltage changes.

The regulators feature:

1. High internal (open loop) gain which results in a high degree of regulation.

2. Pre-regulated control amplifiers. This refers to the diode and capacitor networks (D305-7 and C301 in the positive supply and D310-11 and C307 in the negative). These networks serve to pre-regulate the supply voltage to the collectors of C301 and Q304 respectively keeping AC ripple and DC variations due to line voltage changes out of the control amplifiers. The networks are connected so as to form DC "bootstraps" for the collector circuits of Q301 and Q304 thereby also increasing the internal gain of these stages.

3. A single Zener reference which is filtered to eliminate Zener noise (C304) and powered from a regulated voltage (+30) via R309. Powering the zener from a regulated voltage causes the zener voltage to be totally independent of line voltage changes.

4. A single voltage adjustment sets both regulators to ±30 volts respectively. This is acheived by using the +30 supply for reference for the -30 supply. The adjustment of the negative supply is pre-determined by the precision resistors, R311 and R312.

5. Current limiting (short protection) resistors R302 and R310.

6. All semiconductors employed are silicon

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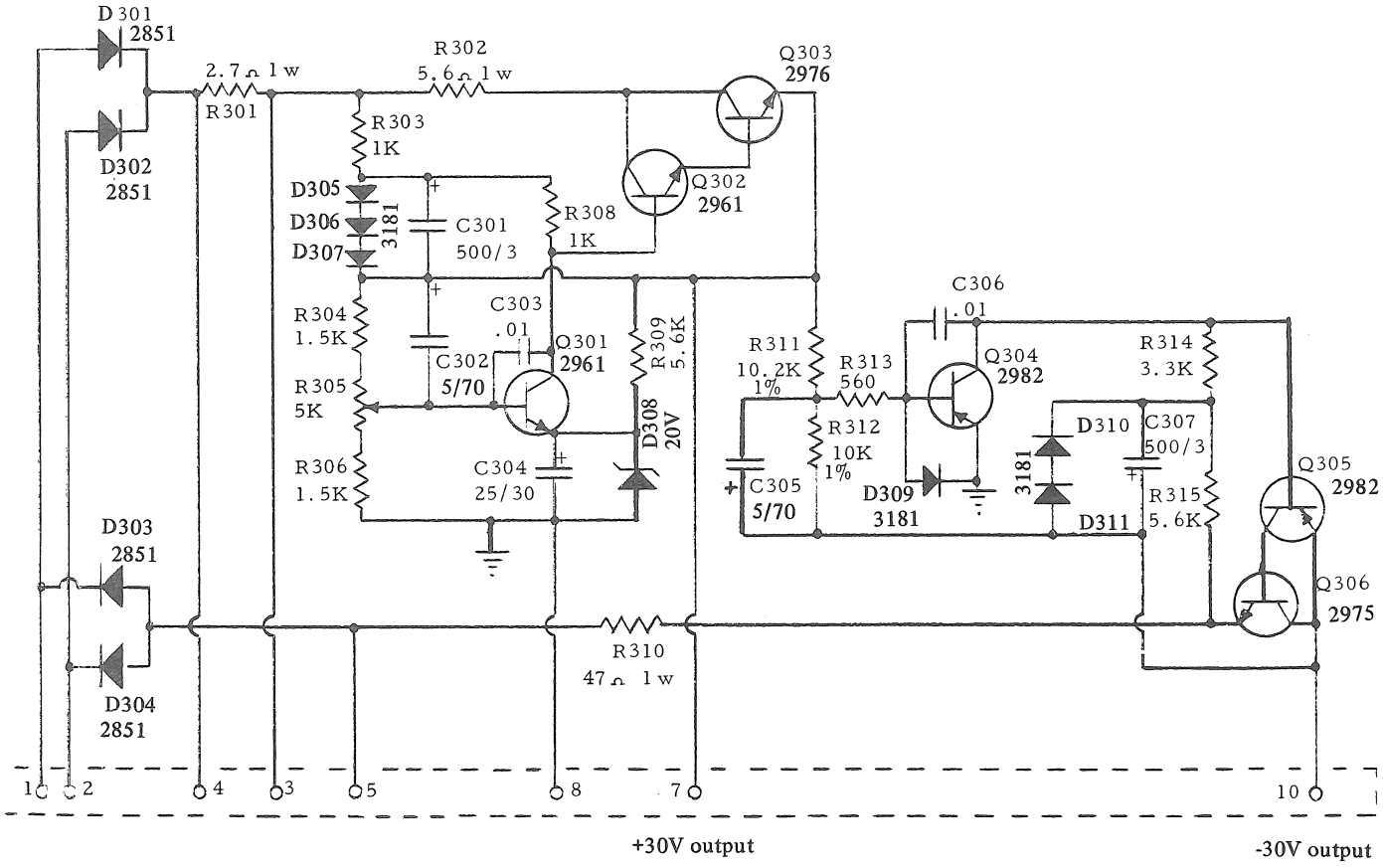
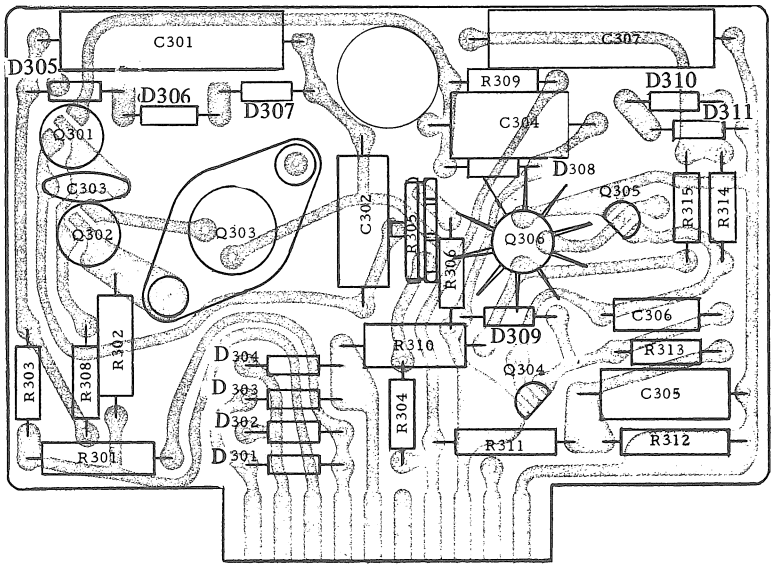
INTERNATIONAL

SOLID STATE SERIES

CX — 3B POWER SUPPLY





CX-3B PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
1	R301	2.7 ohm 1 Watt	1001
1	R302	5.6 ohm 1 Watt	2355
1	R310	47 ohm 1 Watt	1073
1	R313	560 ohm ½ Watt	1030
2	R303, R308	1K ½ Watt	1053
2	R304, R306	1.5K ½ Watt	1076
1	R314	3.3K ½ Watt	1051
2	R309, R315	5.6K ½ Watt	1042
1	R312	10K ½ Watt 1% Film	2343
1	R311	10.2K ½ Watt 1% Film	2344
Capacitors:			
1	C303	.01 Ceramic	1751
1	C306	.01 mfd 200 Filmatic Mylar Cap.	3161
2	C302, C305	5 mfd 70 Volt	1678
1	C304	25 mfd 30 Volt	1087
2	C301, C307	500 mfd 3 Volt	2050
Transistors:			
2	Q304, Q305	Sel 2N5383	2982
2	Q301, Q302	Sel 2N3859A	2961
1	Q306	2N2102	2975
1	Q303	2N3054	2976
Miscellaneous:			
4	D301 thru D203	1N4003	2851
6	D305 thru D307		
	D309 thru D311	1N4148	3181
1	D308	20 Volt Zener 1N968B	3277
1	R305	5K Vertical Potentiometer	1681
1		T0-5 Transistor Cooler	3175
3		T0-5 Transistor Pad	1250
1	CX-3B	Printed Circuit Board (Unwired)	7590U

DC Voltages (Load +147 ma, -63 ma) (VTVM)

Q301	+16	+16.6	+31.2
Q302	+30.6	+31.2	+42
Q303	+30	+30.6	+42
Q304	0	- .6	-40.8
Q305	-30	-40.8	-41.4
Q306	-42	-41.4	-30

SERVICING

When measuring voltages on the CX-3 board, be careful not to short any of the component leads together. A momentary short could damage the zener or transistors. The supply outputs can be shorted to ground without damage to semiconductors. A prolonged short will burn out R302 or R310 as the case may be.

The supply voltages should simultaneously adjust to 30 volts ±4% by means of adjusting R305.

The tolerance of the zener D308 is not critical as variations can be compensated for by adjusting R305.

Crown INTERNATIONAL

SOLID STATE SERIES

SS-4A
Meter
Amp

SPECIFICATIONS

Voltages Required: ±30 volt

Current Required: ±5 ma

Input Signal: Nom. -10 dbm
Min. -15 dbm for "0" VU
Max. - 3 dbm

Input Z: 100K

Frequency Response: $^{+0}_{-1}$ db to 100KHz (Filtered at 50 KHz in control center)

Meter Sensitivity: 200 μamp, critically damped with 3.9K source as provided by SS-4A.

PURPOSE

The SS-4 provides amplification and isolation for functions which are to be measured by the meter. These include input (record) signal levels, playback, output, and bias current voltages. Frequencies thus measured will be audio (30 Hz to 30 KHz) and bias (100 KHz). Each of these functions is reduced by means of voltage dividers to a common level before being fed into the meter circuits.

CIRCUIT DESCRIPTION

The amplifier is a high feedback, two stage, direct coupled complementary pair having an input at ground level (DC-wise) and also an output very nearly at ground. This minimizes meter banging at turn-on due to charging capacitors with large bias potentials.

The gain is adjusted by adjusting the feedback factor via R405.

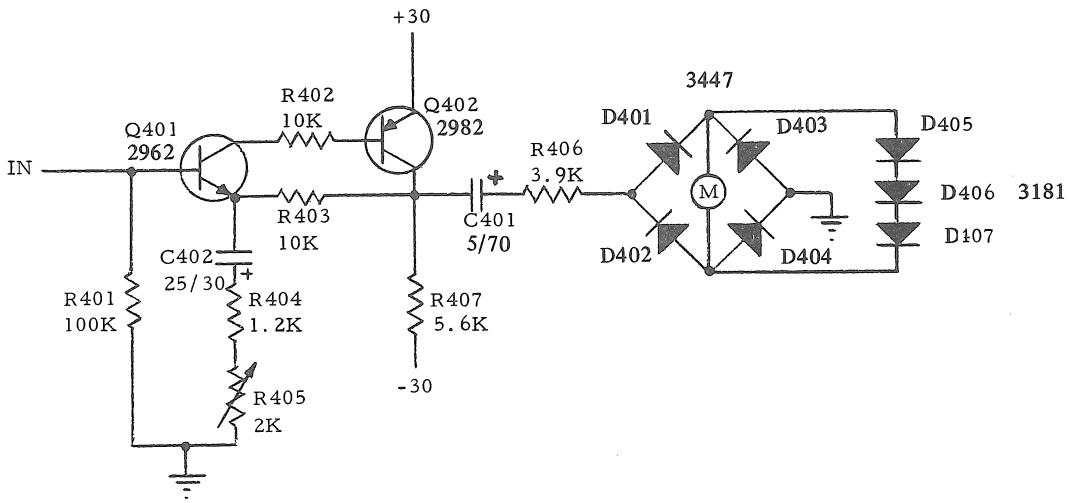
The meter is in a full-wave bridge and is overload protected by diodes (D405-7).

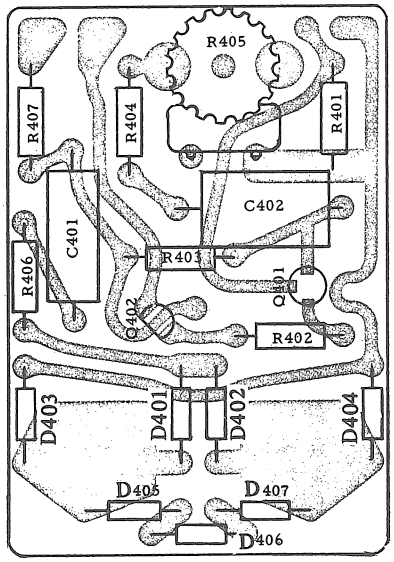
Voltages	AC (dbm for 0 VU)			DC (VTVM)		
	Emitter	Base	Collector	Emitter	Base	Collector
Q401	-10	-10	-35	-.5	0	+29.3
Q402	---	-46	+ 4	+30	+29.4	- .6

Crown
INTERNATIONAL

SOLID STATE SERIES

SS — 4A
METER
AMP.





SS-4A PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.	
Resistors:				
1	R404	1.2K ½ Watt	1045	
1	R406	3.9K ½ Watt	1059	
1	R407	5.6K ½ Watt	1042	
2	R402, R403	10K ½ Watt	1035	
1	R401	100K ½ Watt	1027	
Capacitors:				
1	C401	5 mfd 70 Volt	1678	
1	C402	25 mfd 30 Volt	1087	
Transistors:				
1	Q402	Sel 2N5383	2982	
1	Q401	Sel TZ-81	2962	TZ-81
Miscellaneous:				
1	R405	2K Linear Taper Pot	2067	
3	D405, D406, D407	1N4148	3181	
	D401 thru D404	1N270	3447	
1	SS-4A	Printed Circuit Board (Unwired)	7591U	7591U

Crown INTERNATIONAL

SOLID STATE SERIES

CX – 5C
RECORD
AMP.

SPECIFICATIONS

Input Z: 48K

Standard Input Level: 0 dbm (may be altered to -10 dbm)

Power Required: ±30 VDC at 7 ma

PURPOSE

The CX-5 is designed to provide gain, proper output impedance, record equalization, and bias injection for direct recording (audio) on magnetic tape.

CIRCUIT DESCRIPTION

The record amplifier board consists of a three stage amplifier employing frequency selective negative feedback circuitry.

Q501 and Q502 form a direct coupled complementary pair with Q503 functioning as an emitter follower output.

Feedback for bias stability (sub-audio) is via R510 and C504.

The feedback at audio frequencies is a function of R506, R508, R509, C505, and the associated (switched to ground) series RLC network. Bass pre-emphasis (100 Hz and below) is provided by C505 and limited by R509. The switched series RLC network gives the necessary mid and high frequency pre-emphasis appropriate for each of three different tape speeds. These components may be adjusted for proper equalization on any of the speeds employed on the CROWN recorder.

The peak equalization is determined by the resonant frequency of these elements while the mid equalization is determined by the capacitance relative to R510. Assume for example that the record response is 1 to 2db low in the area between 1 and 10KHz. Adding an .001 capacitor across the existing capacitor would raise the level by approximately the correct amount. It would then be necessary to re-adjust the inductor to restore the desired peak frequency.

The output from Q503 is taken thru R514 (which can be jumpered) and R515.

R515 is the record level adjustment. The resistance in the output circuit is deliberately high so as to present a constant current to the record head independent of head impedance variations as a function of frequency.

Bias injection is achieved via R516 and C508. R516 is a coarse adjustment and is adjusted to allow the proper range of adjustment to the front panel bias control which is in series with pin 2.

A parallel resonant bias trap consisting of L504 and C507 isolates the output of the amplifier from the bias coupling network.

Because of the large supply potential from which the amplifier operates (±30 volt, 60 volt), the amplifier overload is well in excess of the tape saturation level.

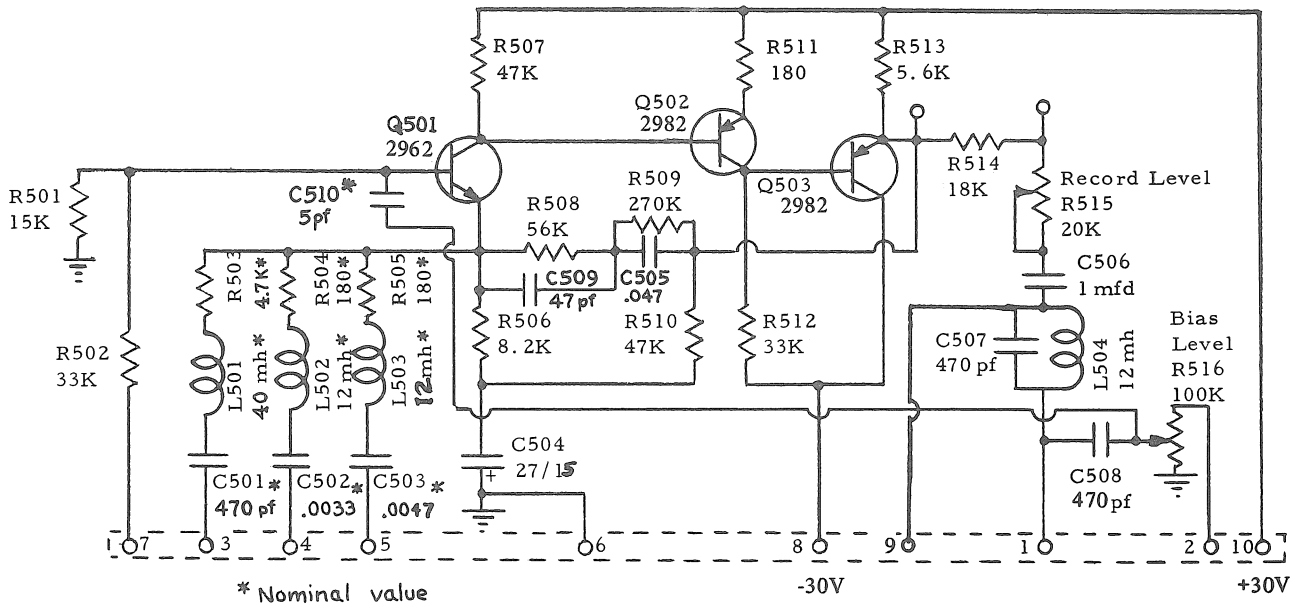
Voltages:	DC (VTVM)			AC (1 KHz, 0 dbm Input)		
	Emitter	Base	Collector	Emitter	Base	Collector
Q501	-.5	0	+29.3	-11	-11	-12.3
Q502	+29.9	+29.3	-2	-13	-12.5	+3
Q503	-1.4	-2	-30	+3	+3	--

Crown

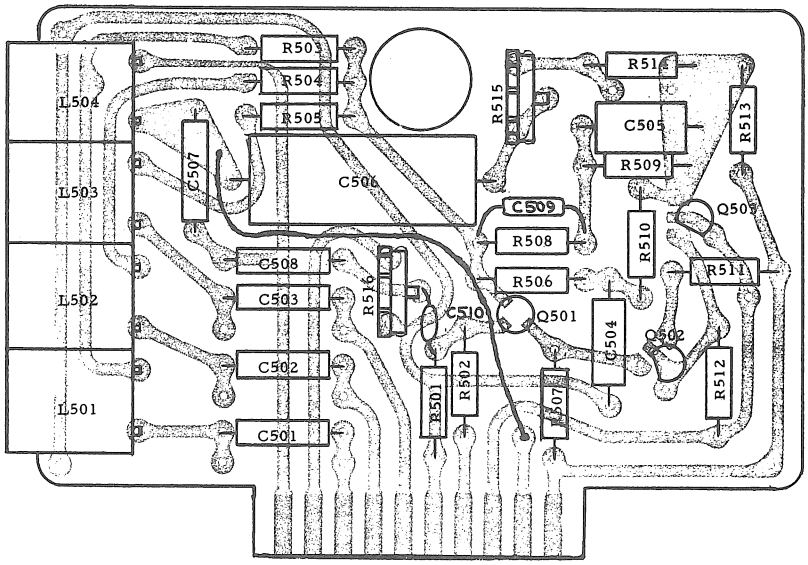
INTERNATIONAL

SOLID STATE SERIES

CX — 5C RECORD AMP.



*C510 removed for Remote Record



CX-5C PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
3	R504, R505, R511	180 Ω ½ Watt	1006
1	R513	5.6K ½ Watt	1042
1	R506	8.2K ½ Watt	1005
1	R501	15K ½ Watt	1064
1	R514	18K ½ Watt	1075
2	R502, R512	33K ½ Watt	1623
2	R507, R510	47K ½ Watt	1058
1	R508	56K ½ Watt	1663
1	R509	270K ½ Watt	1049
Capacitors:			
1	C509	47 pf	3409
3	C507, C508, C501	470 Mica Cap.	2511
1	C502	.0033 Pacer	1682
1	C503	.0047 200V Filmatic	3178
1	C505	.047 mfd 200V Filmatic	2977
1	C506	1.0 mfd 100V Filmatic	3008
1	C504	27 mfd 15V Tant. Cap.	3677
1	C510	5 pf Mica	2820
Transistor:			
2	Q502, Q503	Sel 2N5383	2982
1	Q501	Sel TZ-81	2962
Miscellaneous:			
3	L502, L503, L504	12 mh coil	1661
1	L501	40 mh coil	2440
1	R515	20K Vertical Potentiometer	1712
1	R516	100K Vertical Potentiometer	1713
1	CX-5C	Printed Circuit Board (Unwired)	7592U

Crown INTERNATIONAL

SOLID STATE SERIES

CX-6C
Line
Amp

SPECIFICATIONS

Output: +26 dbm into 600 ohm

Gain: 21 db (attenuated to 8 db standard usage)

Distortion: THD, less than .15% at +12 dbm into 600 ohm

Input Z: 18 K

Output Z: 25ohm (loads less than 600 ohm not recommended)

Noise: -100 db below +24 dbm out (0-30KHz)

Frequency Response: +0 -1 db 10Hz - 250 KHz

Power Required: ±15 ma at ±30 volt for +20 dbm output into 600 ohm

Connector Required: 10 pin precision

PURPOSE

The CX-6 is designed to provide additional voltage amplification and power gain when required for driving remote lines and accessory equipment.

CIRCUIT DESCRIPTION

The CX-6 is a small power amplifier designed especially for 600 ohm lines. The output transistors Q603 and Q604 are used as complementary symmetry emitter followers. They are the output of a direct coupled complementary pair voltage amplifier (Q601 and Q602). Feedback is via R606. The output must exhibit very low DC drift therefore, C602 is employed to give total DC feedback. DC balancing of the output is achieved by adjusting R601 for -.5 DC volts at pin 5.

Resistors R612 and R613 are used to provide the meter with a zero level signal.

The gain (line level) may be altered by changing the value of R615.

If full 21db gain is desired, remove R614 and adjust R618. R612, part of the meter divider should be chosen to give proper meter reading at specific gain settings. See tables below for approximate values:

Table:

Gain (db)	R615	R612
0	68K	0 (may remove R613)
4	39K	1.2K
8	22K	3.9K
12	12K	6.8K
18*	2.7K	18 K

* May give overload problem

Voltages:

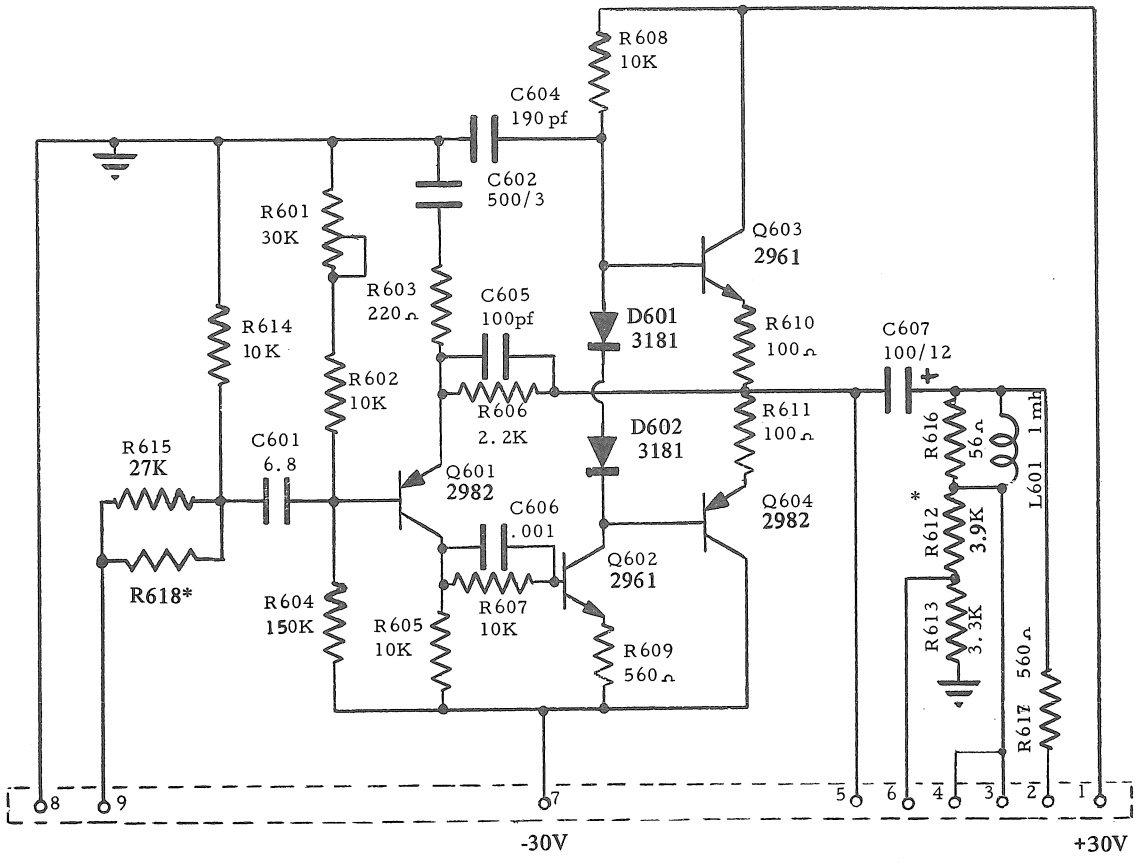
	AC (dbm, +12 dbm into 600Ω)			DC (no signal, VTVM)		
	Emitter	Base	Collector	Emitter	Base	Collector
Q601	-9	-9	-9	-11	-1.7	-27.4
Q602	-10	-10	+13.5	-28.2	-27.6	-.6
Q603	+12.5	+13.5	----	-.5	+.1	+30
Q604	+12.5	+13.5	----	-.5	-1.1	-30

Crown

INTERNATIONAL

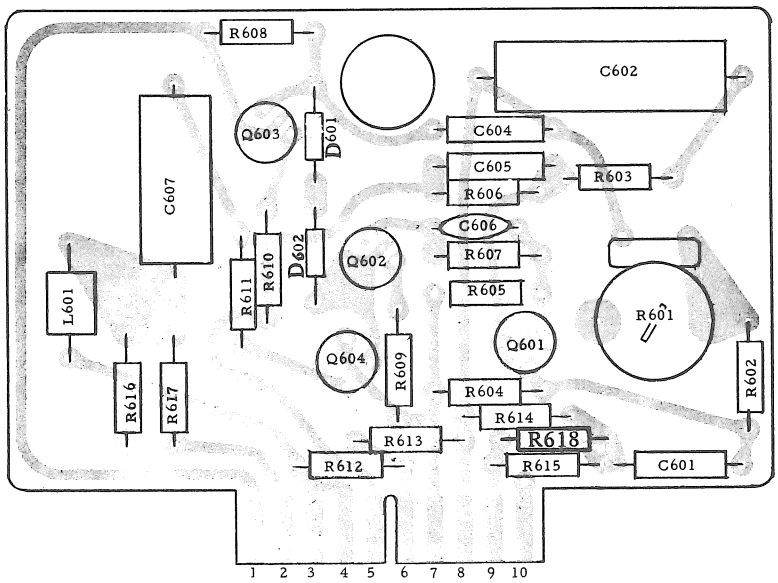
SOLID STATE SERIES

CX—6C LINE AMP.



*R618 selected to give over-all gain of 8-8.5db, typically from 180k to 1m.

*R612 selected for meter reading of -.2 to +.4 VU with zero level in and R618 properly adjusted.



CX-6C PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
1	R616	56 ohm ½ watt	1009
2	R610, R611	100 ohm ½ watt	1007
2	R609, R617	560 ohm ½ watt	1030
1	R606	2.2K ½ watt	1036
1	R613	3.3K ½ watt	1051
1	*R612	3.9K ½ watt	1059
5	R602, R605 R607, R608, R614	10K ½ watt	1035
1	*R615	27K ½ watt	1056
1	R604	150K ½ watt	2786
1	R603	220 ohm ½ watt	1046
1	*R618	560K ohm ½ watt	2352
Capacitors:			
1	C605	100 pf Mica	3410
1	C604	200 Mica	3411
1	C606	.001 Ceramic	2288
1	C601	6.8 mfd 35 volt Tant. Cap.	3573
1	C607	100 mfd 12 volt	1635
1	C602	500 mfd 3 volt	2050
Transistors:			
2	Q601, Q604	Sel 2N5383	2982
2	Q602, Q603	Sel 2N3859A	2961
Miscellaneous:			
1	L601	1 mh Choke	2441
1	R601	30K Horizontal Potentiometer	2318
2	D601, D602	1N4148 diode	3181
1	CX-6C	Printed Circuit Board (Unwired)	7593U

*R615, R618, R612 adjustable - see previous notes

Crown INTERNATIONAL

SOLID STATE SERIES

CX-7B
Buss
Amp

SPECIFICATIONS

Gain: 24 db (calibrated by R705) from line to output

Maximum Out: +26 dbm (Hi Z)
+20 dbm (600 Ω)

Distortion:

I.M.	.1%	0 dbm	
THD	.15%	0 dbm	
THD	.5%	+20 dbm	600 Ω

Noise: -70 dbm at output (0-30 KHz)
-90 db below +20 dbm line pots closed

Input Z: 100K input to mixing resistors R701-2

Response: +0 - 1 db 3Hz - 200KHz (pots full open)
3Hz - 100KHz (worst pot position)

Tone Controls: Bass: Boost 18 db 30Hz
Cut - 13db
Treble: Boost +15 db 15 KHz
Cut - 14 db

Power Supplies: ±15 ma (±30V) at +20 dbm into 600 Ω

CIRCUIT DESCRIPTION

The CX-7 provides gain, mixing, and tone control for the input signals. Feedback tone controls allow bass cut or boost and/or treble cut or boost.

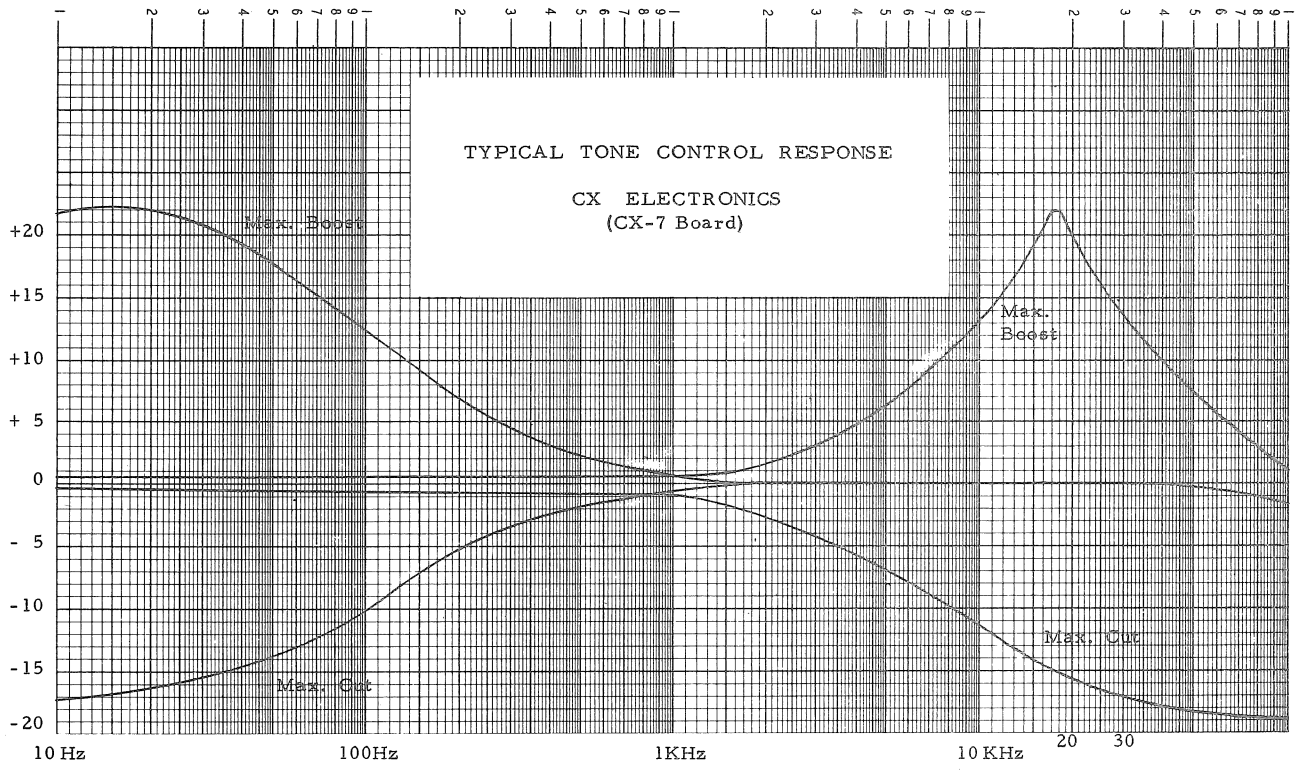
The amplifier is capable of driving a 600 Ω load at high levels with very low distortion. The output is a complementary symmetry emitter follower pair (Q703 and Q704) with feedback taken overall.

The feedback for bias stability is sub-audio thru R713, C704, and R714 to the input. Audio feedback is via the tone controls which are specially tapped and tapered tandem controls. They allow the flat position to be quickly located by means of an internal detent position. The detent position corresponds to the tap position indicated on the controls in the schematic.

Turning the bass control from flat CW (boost) causes the rotor of the boost section (250K) to pass into the resistive region (the cut section remains shorted) forming an RC network with C109 which reduces the amount of feedback at low frequencies thereby boosting the bass. Turning this control CCW does the opposite by not keeping the boost section shorted and forming an RC element with the resistive portion of the curt control (15K) and C106. This RC network increases the degeneracy at low frequencies; i.e. cuts the bass.

The treble controls function in a similar fashion.

Voltages:	AC (dB, "0"dB out into Hi-Z)			DC (no signal, VTVM)		
	E	B	C	E	B	C
Q701	-33	-33	-39	-.6	0	+28.1
Q702	-41	-40.5	0	+28.8	+28.2	-4.4
Q703	0	0dBm	----	-5	-4.4	+30
Q704	0	0 dBm	----	-5	-5.6	-30

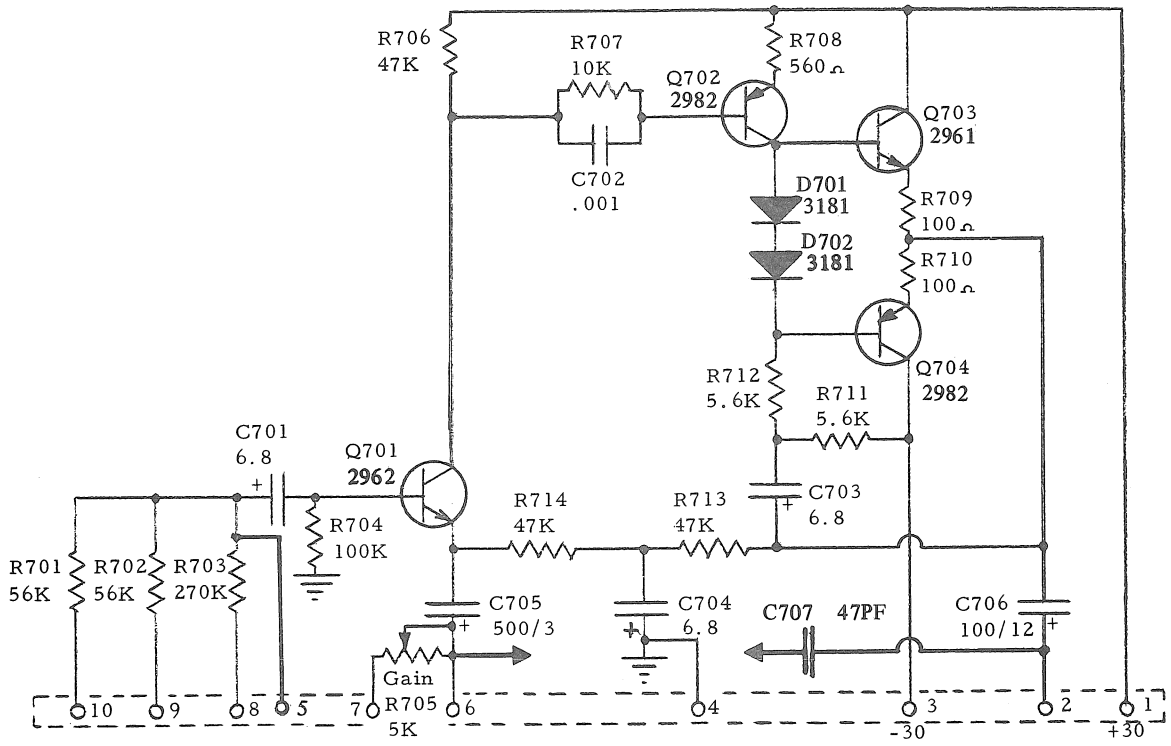


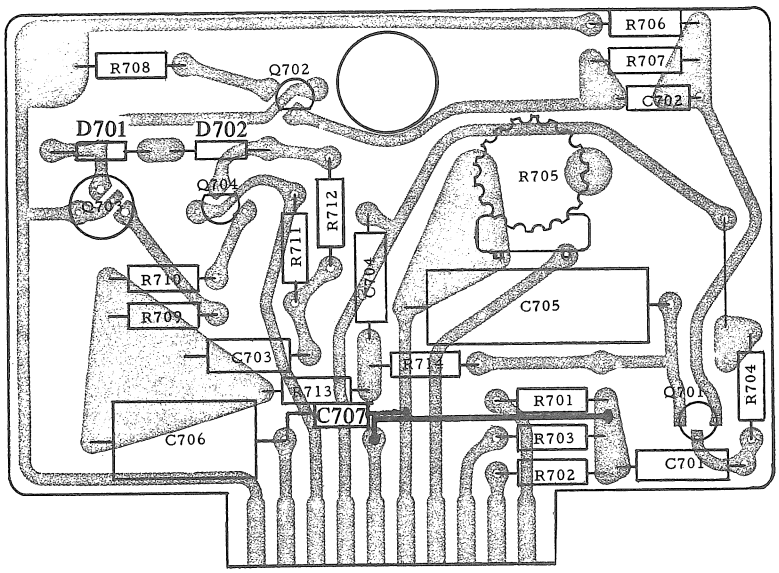
Crown

INTERNATIONAL

SOLID STATE SERIES

CX — 7B BUSS AMP.





CX-7B PARTS LIST

Quantity	Schematic No.	Description	CROWN Part No.
Resistors:			
2	R709, R710	100 ohm ½ Watt	1007
1	R708	560 ohm ½ Watt	1030
2	R711, R712	5.6K ½ Watt	1042
1	R707	10K ½ Watt	1035
3	R706, R713, R714	47K ½ Watt	1058
2	R701, R702	56K ½ Watt	1663
1	R704	100K ½ Watt	1027
1	R703	270K ½ Watt	1049
Capacitors:			
1	C702	.001 Ceramic	2288
3	C703, C704, C701	6.8 mfd 35 volt Tant. Cap.	3573
1	C706	100 mfd 12 volt	1635
1	C705	500 mfd 3 volt	2050
1	C707	47 pf Mica Cap.	3409
Transistors:			
2	Q704, Q702	Sel 2N5383	2982
1	Q701	Sel TZ-81	2962
1	Q703	Sel 2N3859A	2961
Miscellaneous:			
1	R705	5K Horizontal Potentiometer	1613
2	D701, D702	1N4148	3181
1	CX-7B	Printed Circuit Board (Unwired)	7594U

Crown
INTERNATIONAL

SOLID STATE SERIES

CX-8E
Play
Equal.

SPECIFICATIONS

Nature of Circuit: Non-active equalization board for playback amplifier CX-2D

Number of Equalizations: Any three from 15 ips to 15/16 ips tape speed

Adjustments: Three switched high frequency
Three switched bass adjust
One gain adjust (common to all speeds)

Gain: (With CX-2) can be varied from 46 db to 80 db at 1 KHz when equalized for 7 1/2 ips playback

PURPOSE

The CX-8 board is used in the CROWN recorder with the CX-2 board to provide proper playback equalization. It is capable of reproducing the standard NAB curves or the special playback curves used at slow speeds with high resolution tape and narrow gap heads.

The board also provides gain adjustment necessary to handle various outputs of playback heads at various speeds.

CIRCUIT DESCRIPTION

The gain adjust circuit R808 and C805 provides the ground path for the feedback around Q204 and Q205 of the CX-2 board. Decreasing the resistance of R808 decreases the amount of feedback and thereby increases the gain.

The regular NAB equalization curves are realized by the network R801-3 R805-7 and C802-4. R801-3 adjusts the gain of the high frequency plateau and R805-7 adjusts the gain of the low frequency plateau.

The network composed of R804, L801, and C801 is a 100KHz bias-trap used to reduce the high frequency gain of the CX-2 so that the 100KHz signal of the bias oscillator will not be picked up when recording.

At 1 7/8 speeds, it is desirable to add an amount of treble boosting. This is accomplished by C806 and R809 (switch selected). If the machine is set up for the higher tape speeds, these components will be omitted.

(G) Change C508 from 100 pf to 470 pf.

CX-6C:

(A) Change R612 from 6.8K to 3.9K ohms.

(B) Change R615 from 12K to 27K ohms; parallel with padding resistor for 8.0 to 8.5 dbm output with "0" input level.

(C) Set R601 for -0.5 VDC at Point "A" (pin 5).

(D) Replace C601 (silver with red-tip) with CPN 3573.

(E) Change R604 from 560K to 150K.

CX-7B:

(A) Add jumper from junction of R701, 2, 3 and C701 to pin 5.

(B) Replace C701, C703 and C704 (when silver with red-tip) with CPN 3573 (green dipped-epoxy).

(C) Set Gain (R705) to yield "0" db (.78v) at pin 2 with -24 db (.045v) input at pin 9 or 10.

(D) Add 47 pf (C707) from pin 2 to pin 6.

CX-8E:

(A) The CX-8E is an update of CX-8D by addition of individual bass-adjust pots R805, 6 and 7 (3 3/4, 7 1/2 and 15 ips respectively).

(B) R802, R803 and R804 are 20K vertical taper pots, CPN 3029. R 808 is 20K, CPN 1712.

CX-9D:

(A) Q901 and Q902 can be CPN 3348 (TO-5) or CPN 2975 (2N2102). Do not intermix! C909 (0022) must be used with 2N2102's, from one collector to ground!

(B) Change L901 from 2.5 mh to 1.0 mh.

(C) Add D901 (CPN 3181, IN4148) in parallel with L901.

(D) Add C908 (.1 ufd, 200 VDC) for 4-channel bias-sync only. Install from center tap of T901 (at top) to pin 2.

(E) Change C902 from .018 to .015 ufd.

(F) Change R903 from 4.7K to 10K ohms.

CX MODULE UPDATE SHEET

S-1172-JH
Revised 9/5/73

CX-2D:

(A) When Q201,Q202,Q203 and Q204 are CPN 2064(A); C205 (27 pf) and R209 (10K) are used.

(B) When Q201,Q202 and Q204 are CPN 2962 and Q203 is CPN 2961 (permissible); C205 is omitted and R209 is a jumper.

(C) Always replace C201,C207 and C208 (when silver with red-tip) using CPN 3573 (green epoxy-dipped).

(D) Add C211 (CPN 1087) 25 mf 30V from pin 5 to emitter of Q203. This requires cutting the trace from pin 5, and adding a jumper.

CX-3B:

(A) Replace CR301, 2, 3 and 4 with CPN 2851 (IN 4003), upon failure; do not intermix!

(B) Replace CR305, 6, 7 and CR 309, 10, 11 with CPN 3181 (IN 4148).

(C) Replace transistors according to substitution chart #SIH1672.

CX-5C:

(A) C501, C502 and C503 are now 470 pf, 3300 pf and 4700 pf respectively; and are nominal values depending on equalization.

(B) L501, L502 and L503 are 40 mh, 12 mh and 12 mh respectively; and are variable for equalization.

(C) R503, R504 and R505 are 4.7K, 180 and 180 nominal value; depending on equalization.

(D) Add C510 (5 pf) from base of Q501 to wiper of bias level pot, R516. Remove C510 for remote-record!

(E) Add C509 (47 pf) from emitter of Q501 to junction of R509 and C505 (.047).

(F) Add jumper from pin 9 to junction of C506, C507 and L504.

CROWN Solid State Performance Manual

Introduction:

The CROWN tape recorder has three main units

1. Transport
2. Head Assembly
3. Electronics

The transport contains main power supplies, take-up motor, pay-off motor, drive motor, capstan assembly, tape lifter housing, and the head assembly.

Head Assembly: Is made up of the head mounting plate, tape guides, and three heads -- Play, Record, and Erase -- with facilities for adjusting the heads.

The Electronics: Contains the circuitry for electronic operation of the tape recorder in the Play and Record modes.

This discussion will involve the Electronics unit and the Head Assembly in their relationship physically and electronically with each other and the tape.

Part one of this manual will give a brief technical summary of important aspects of Magnetic Tape Recording.

Part two will give a series of performance tests to check the overall operations of the recorder.

PART I

Technical Summary

Playback Equalization and the Playhead:

In an ideal situation, the signal picked up by the play head will double in amplitude if the frequency is doubled. (An increase of 6 db per octave will occur). This is assuming that the record level has been held constant.

This happens because the voltage generated is proportional to the rate-of-change of flux. If the frequency is doubled, the flux changes twice as fast, and the voltage has doubled.

In order to compensate for this 6 db per octave rise, the preamp must include a 6 db per octave drop. The resultant output would then be flat.

However, other factors affect the curve, and must be taken into account. Such factors as gap losses and spacing losses tend to decrease the high frequency response. The final curve will, then, follow a 6 db drop at the low frequency end, and then begin to level off in the area where high frequency losses begin to become effective. (Some modification to the curve is required at the extreme low end of the response, also).

The Electronics:

CROWN "CX" recorders are equalized for speeds of 15, 7 1/2, and 3 3/4, 1 7/8 and 15/16 ips are available on special order.

The electronics unit, whether stereo or mono, is equipped with playback equalization controls for electronically setting a prescribed play curve (or response) in the electronics to compensate for the characteristics of the head (deviations from ideal) conditions.

The following curves show the steps of playback equalization:

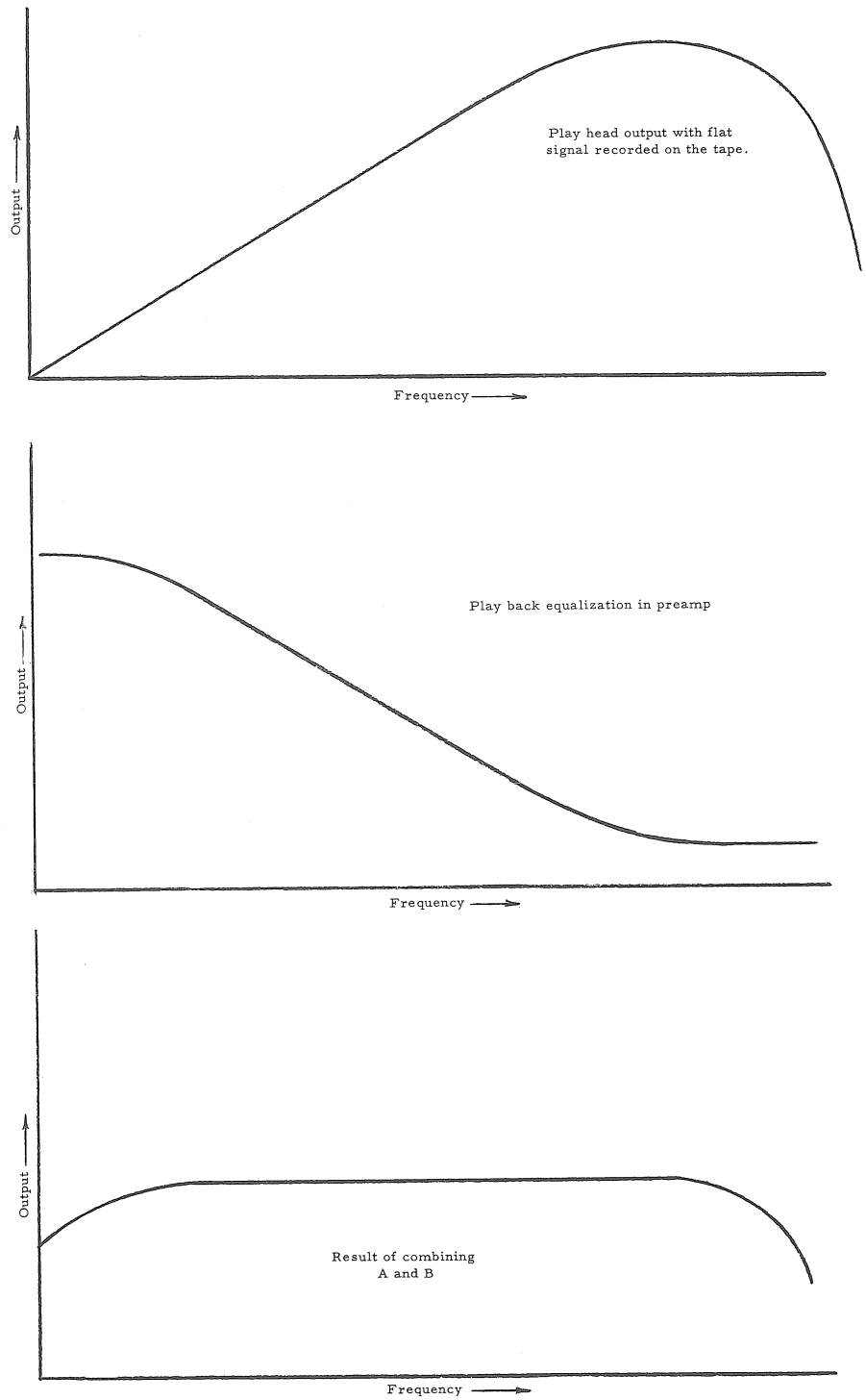


FIGURE I

Record Equalization:

In order to realize the best possible high frequency response, equalization must be used in the record circuit to offset certain losses. Losses might include the erasing effect of bias, penetration losses due to the thickness of the oxide coating, self-demagnetization losses due to the magnetic nature of the medium, head losses through the gap, and eddy current losses.

Record equalization in CROWN recordings is accomplished by providing additional gain in the frequencies subject to recording losses.

In order to obtain the desired composite curve, two separate correction curves are considered. The mid equalization provides a gradual rise beginning at a point slightly beyond 1 KHz. The peak equalization provides a sharp rise at the upper response limit.

Sometimes the peak frequency can be adjusted slightly higher thus giving a slightly better frequency response. If the peak is adjusted too far out, serious roll-off will occur at the high frequency end. If the peak frequency is set too low, there will be an unusually high boost somewhere below the maximum frequency and serious roll-off following this peak. We have chosen the specification on our recorders so that the highest frequency we specify as flat is very nearly the proper setting for the peak frequency adjustment. IT MUST BE REMEMBERED, HOWEVER, THAT IN RUNNING A FREQUENCY RESPONSE CURVE, THE LEVEL SHOULD BE KEPT 15 to 30 db BELOW THE ZERO LEVEL AT 1 KHz. If this is not done, tape saturation will be experienced at the frequencies where high frequency boost has been used. This will result in distortion and erroneous results.

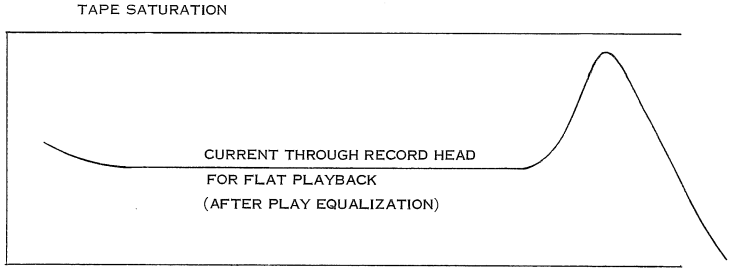
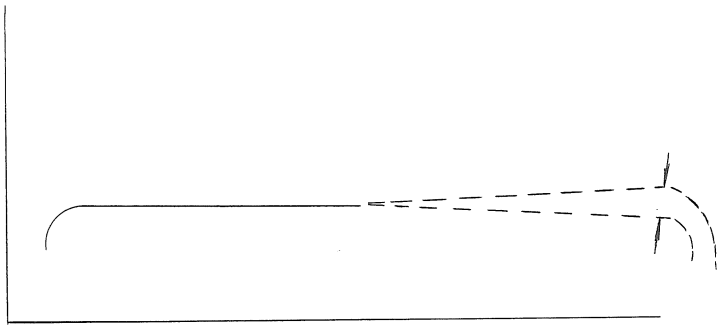
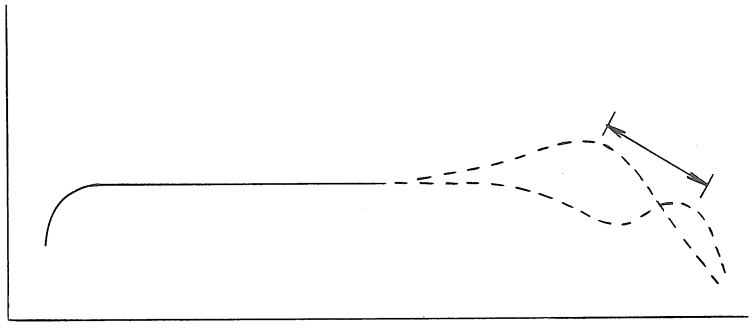


FIGURE 2A



MID EQUALIZATION



PEAK EQUALIZATION

FIGURE 2B

The Need for Bias in the Magnetic Recording Process:

Magnetic tape is basically a non-linear medium; that is, the magnetism left on the tape is not always proportional to the current in the recording head. This non-linearity (or distortion) appears mainly as the signal passes through the zero axis. The appearance is much the same as that which occurs in an overbiased class "B" amplifier.

One simple method of biasing is to add enough direct current to the signal current to prevent it from ever reaching zero. Of course, the maximum signal level used will be less than half since the signal may not be allowed to reach saturation, or zero.

This may be accomplished a second way by previously saturating the tape in one direction. A direct current is then made to flow through the recording head as before. This direct current is then adjusted so that with no signal present, this DC will just overcome the original magnetism and leave the tape de-magnetized. A signal current super-imposed upon this will then magnetize the tape in a fairly symmetrical manner about the zero point. This will be true because in this process the tape is being recorded by de-magnetizing varying amounts rather than by magnetizing it by varying amounts, and the de-magnetizing curve is relatively free of distortion. With this type of bias, signal-to-noise ratios up to 30 db may be realized. However, through the use of ultrasonic bias, signal-to-noise ratios will be obtained which can be made to exceed 60 db.

Ultrasonic bias (which is the type used in all CROWN recorders) uses an alternating bias current which is relatively high in amplitude, and several times the frequency of the signal. The signal is then super-imposed upon the bias. The ultrasonic bias allows the tape to be saturated in each direction as it moves past the record head gap. As it leaves the gap, it is de-magnetized to a level which is dependent upon the signal, therefore utilizing the more linear de-magnetizing curve BC rather than the non-linear curve AB. (See Figure 3).

The main effect of changing bias levels will be changes in distortion. As the bias level is increased, distortion will be decreased. As the bias is increased however, output will be reduced, especially at the higher frequencies. For optimum performance, therefore, the bias should be adjusted carefully. As the bias is increased (starting from zero), distortion will at first decrease rapidly. As the usable bias range is entered, the distortion will decrease more slowly. If this bias is increased much beyond this point, serious losses in high frequency response will result. It will be desirable to keep the bias as high as possible without causing the high-frequency response to drop outside of the specified limits.

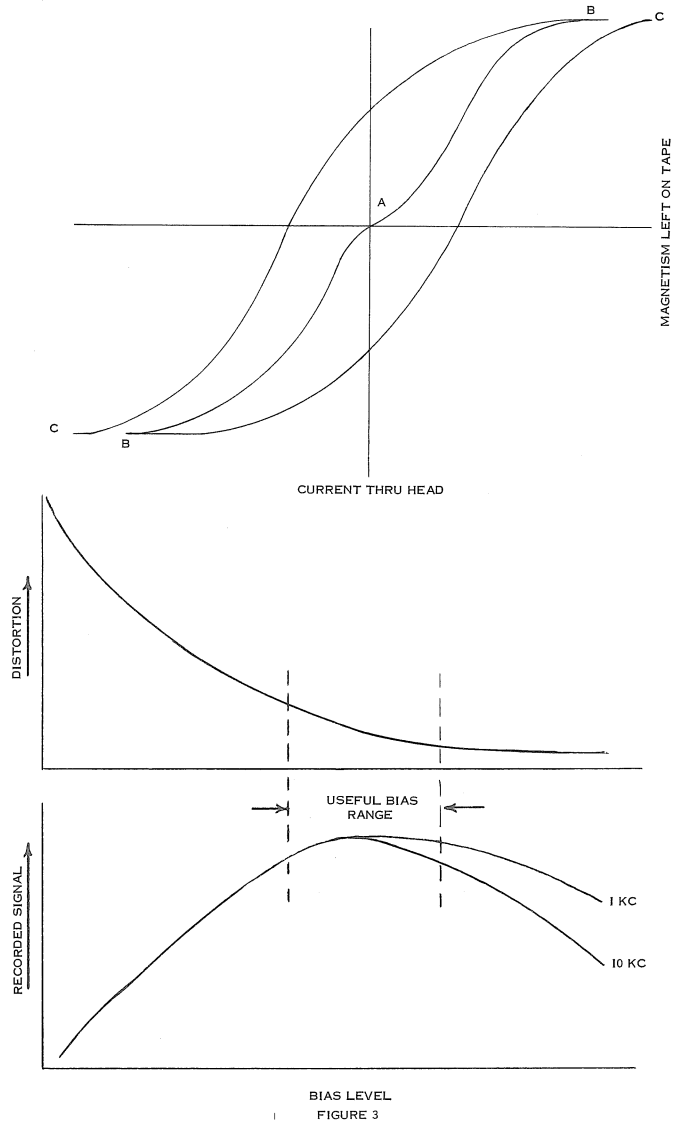


FIGURE 3

Part II

Performance Tests

General

The performance of your recorder can be checked quickly by making some general tests. For example, deterioration of playback and/or record can be determined by playing a pre-recorded tape, or making a simple A-B listening test while recording. By stopping the recorder and turning up the amp gain, excessive hum and noise will be apparent. Meter calibration can be checked by playing a pre-recorded tape and comparing meter readings. In addition, much can be learned by checking headwear and listening for mechanical problems.

Following is a complete step-by-step set-up procedure, in the event that your CX needs servicing. It should be emphasized that only proper test equipment and knowledgable personnel can achieve reliable results. If the results of the adjustments aren't understood, serious degradation of performance is likely to occur.

Before any electronic adjustments are made it is imperative that all mechanical functions of the recorder are normal. This would include pressure roller adjustment, tape lifter and pressure pad alignment, head alignment and any other function which directly affects the tape transporting process. In addition, the wow and timing should be checked. Please refer to the transport section which deals with these adjustments.

Following is a list of recommended equipment with some typical model numbers included.

- Demagnetizing Tool - Robins ME-66
- DC Voltmeter - Simpson Model 260
- Precision AC Voltmeter (capable of accurately measuring 100KHz) - Hewlett-Packard Model 400 E
- Audio Oscillator (low distortion) - General Radio Model 1309 A
- Distortion Analyzer - Hewlett-Packard Model 331 A
- Standard Alignment Tape - Ampex 01-31321-01 or Standard Tape Laboratory Cat. #2
- Resonate Probe - See figure 4
- Noise Filter (20Hz-20KHz bandpass) See figure 5
- 100KHz Bias Trap - See figure 6
- Frequency Meter - Hewlett-Packard 5210A

Optional:

- Flutter Meter - Micom 8100
- Oscilloscope - Telequipment Model S 54 A
- Monitor System

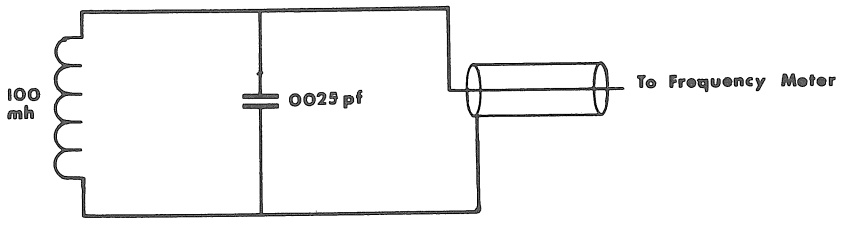


FIG. 4 RESONATE PROBE

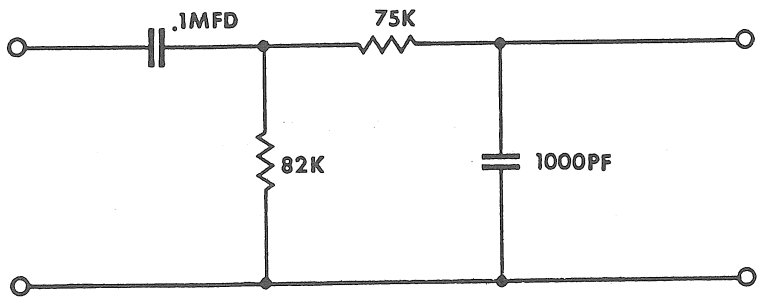


FIG. 5 20Hz-20KHz BANDPASS FILTER

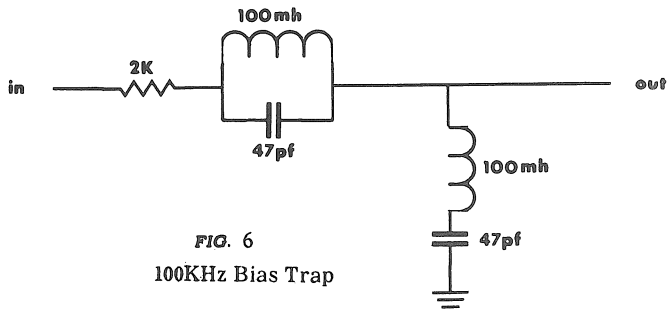


FIG. 6
100KHz Bias Trap

PRECAUTIONS TO OBSERVE BEFORE MAKING ANY ADJUSTMENTS

1. Make sure heads are free of dirt and oxide.
2. Demagnetize heads and all tools that will come into contact with head assembly.
3. Make sure a new tape (of proper type) is being used for record checks.
4. Adjustments must be made in the specified order.
5. If a discrepancy occurs in any step, stop and remedy that problem before proceeding to next step.

Test Set-up

Following is a block diagram of a typical test set-up using the recommended equipment.

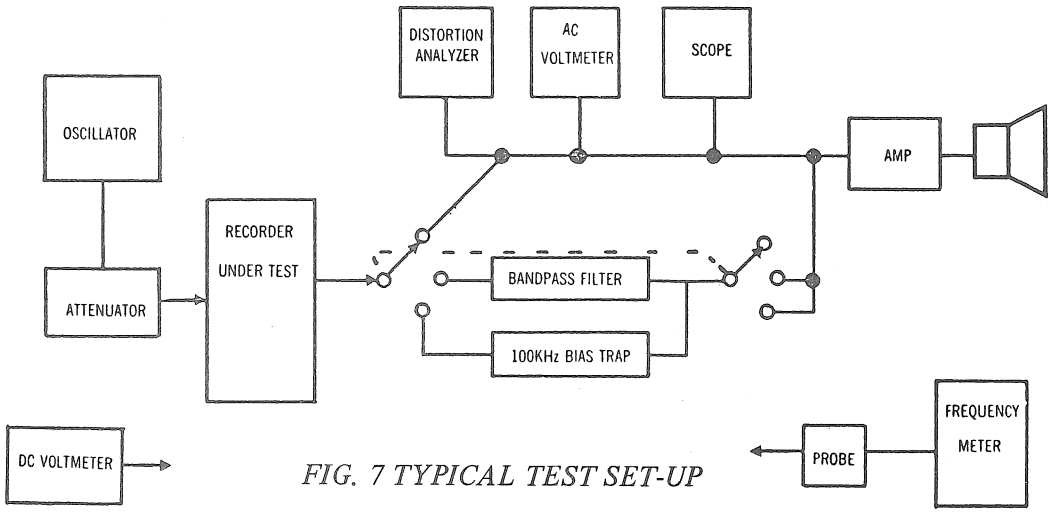


FIG. 7 TYPICAL TEST SET-UP

TEST PROCEDURE

I. Check Power Supply Voltages and Output Balance
   - A. Power Supply
     1. Set to +30V using R305 on CX-3 module, (-30V supply will be adjusted automatically and should be -30V, or slightly higher)
     2. Check regulation under full load
   - B. Output Balance
     1. Adjust dc output (pin 5 CX6) to -.5V using R601 on CX-6 module.

II. Meter Calibration
   - A. Buss Amp Gain (CX-7 board)
     1. Adjust R705 on CX7 board for 24db gain (from input to output.)
   - B. Line Amp Gain (CX-6 board)
     1. Gain is preset at 8db, can be altered - see table in section 9.
   - C. Meter Amp Gain (SS-4A board)
     1. Set output level controls full CW.
     2. Feed in 1KHz signal, monitor output from CX on external audio voltmeter.
     3. Increase input level control until output from CX is +8db (or gain setting of CX6 module) into Hi Z.
     4. Adjust meter gain control (R405 on SS4-A module) for "0VU" reading on front panel meters.

III. Check Electronic Performance

A. Feed in 1KHz "0" level signal, monitor output. (Selector switch in source position) Check frequency response, distortion, and signal-to-noise. This checks the CX7, and CX-6 modules. Any CX-2 mic pre-amps may be checked at this time - reduce input signal to a -60db level.

IV. Play Amp Gain and Equalization

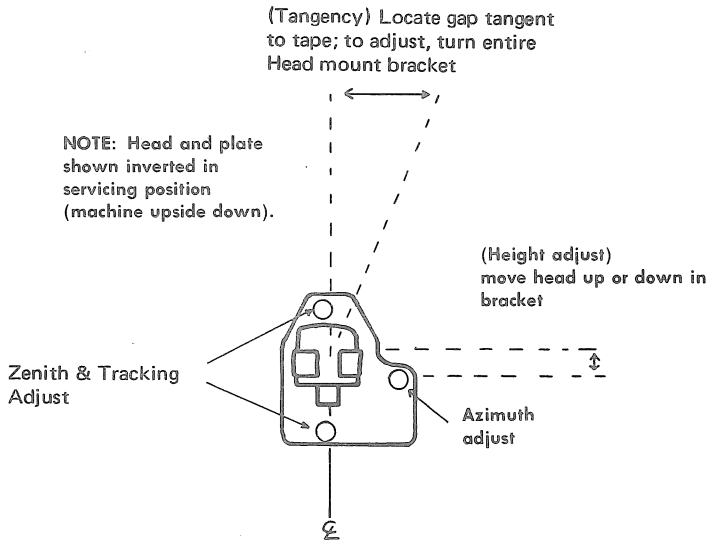
A. Set play head tracking, zenith, height, tangency and approximate azimuth.

B. DEMAGNETIZE heads.

C. Play level - Play a standard "0" level 700Hz tape, adjust play gain control (R807 on CX8D, R808 on CX-8E) for "0" VU on front panel meters.

D. Azimuth Adjust - Play a standard 15KHz Azimuth Adjust Tape. Adjust azimuth screw for maximum output, both channels. Watch for split azimuth, an indication of a defective head. Split azimuth is apparent when all channels don't reach peak output together. Only 1.5db separation between peaks can be tolerated for proper results.

FIG. 8 HEAD ALIGNMENT



E. Play Equalization

1. Play a 700Hz (equalization reference) section of standard alignment tape, set a suitable reference on external audio voltmeter.
2. Switch tape to 10KHz section (equalization adjust).
3. a. (Service method:)
   Use appropriate equalization control (R801, 2 or 3 on CX-8D or CX-8E) to set output as follows: (All adjustments are made with a 7-½ ips standard alignment tape playing at 7-½ ips, switching only the equalization switch):
   - —For 15 ips, set 10KHz -1db from 700Hz reference.
   - —For 7-½ ips, set 10KHz Odb from 700 Hz reference.
   - —For 3-¾ ips, set 10KHz +6db from 700Hz reference.
   - —For 1-7/8 ips, set 10KHz +12db from 700Hz reference (only approximate.)

   b. (Direct method:)
   Using standard alignment tapes for the appropriate speeds, set 10KHz for flat playback using appropriate controls (R801, 2 or 3 on CX-8D or CX-8E). Since there are no standard response curves for 1-7/8, satisfactory alignment can be achieved by disconnecting the playback head and feeding a -50db signal directly into the electronics, and adjusting for a response according to the curves below. (See fig. 9).

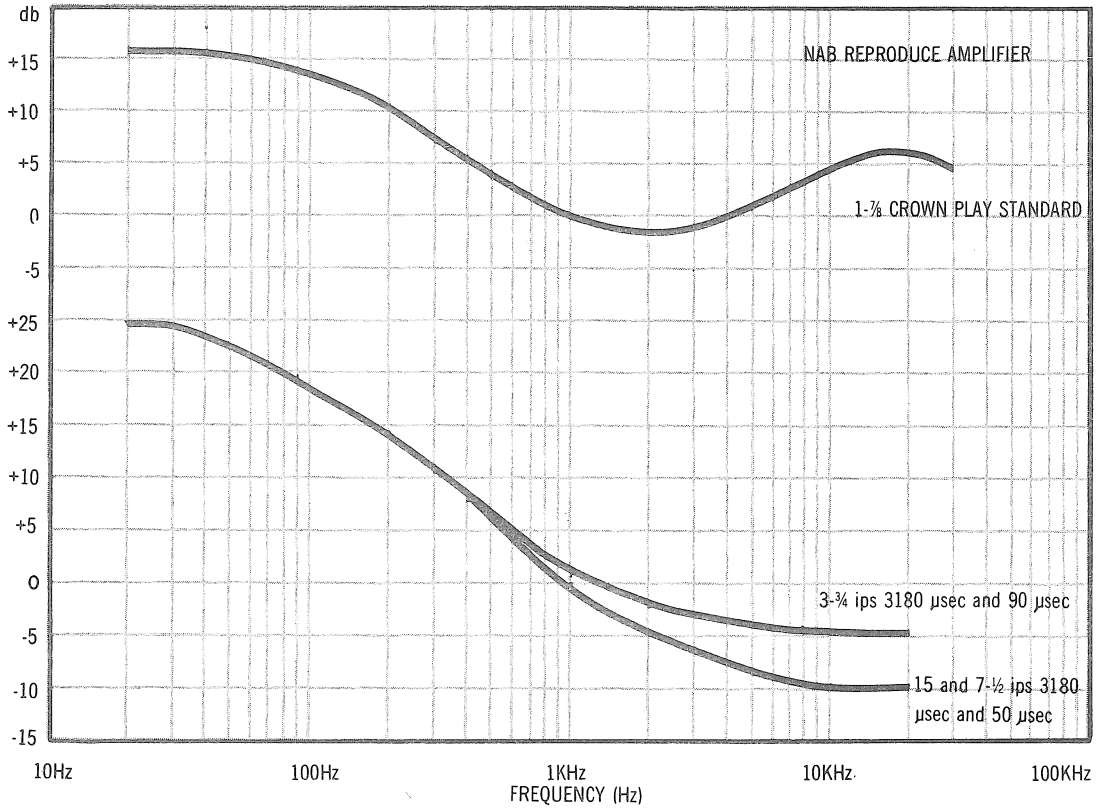


FIG. 9 REPRODUCE EQUALIZATION CURVES

NOTE: When using a full-track alignment tape on multi-track machines, a high output (+2 to +4db) may be noted at the low frequencies. This is due to a "fringing" effect and may be disregarded. Output will be normal when using a multi-track tape. Also, bear in mind that standard tapes frequently are slightly boosted at the highest test frequencies, in an attempt to compensate for self-erasure effects that occur gradually with aging. The relative age of the tape should be taken into consideration when attempting to adjust equalization.

F. Bass End adjust – Play 50Hz (bass end adjust) section, using bass adjust control (R805 on CX-8D; R805, 6 or 7 on CX-8E), set output +.5db to +1db above 700Hz reference. Set bass end for all speeds.

G. Play standard "0" level tape again. Re-check play level as there is some interaction between level and equalization controls.

H. You can verify flat playback and proper equalization by playing standard play tape and noting the response curve. Response should be +2db from 50Hz to 15KHz. If results are out of tolerance, the following possibilities should be considered:
   1. Worn or defective playhead which would require placement.
   2. Defective playamp. This may be checked by feeding a -50db signal into the playhead input and comparing output to standard play curves. Also check signal for distortion. (See fig. 9)
   3. Defective component in equalization circuit.
   4. Bass end out of tolerance – adjust R805, 6 or 7.

V. Set Bias Oscillator, Pre-set Erase Voltage

A. Set oscillator to 100KHz ±5K, (slug of T-1 on CX-9D board)

B. Pre-set erase voltage (setting only approximate).
   –full-track -100V to 175V
   –half-track -50V to 100V
   –quarter-track -40V to 90V
   Refer to Proof of Performance sheets with machine or on permanent file in CROWN Factory Service Dept.

C. Adjust bias traps for a null at 100KHz.
   1. This can be done by connecting the audio voltmeter to pin 9 of the CX-5C board and adjusting the bias traps L504.

VI. Check Erasure and Signal-to-Noise

A. Set tracking, zenith, height, tape wrap, and tangency of erase head.
B. Insert bandpass filter (20Hz to 20KHz) between recorder and audio voltmeter. (See fig. 5)
C. Play pre-recorded erase tape (3% THD, 400Hz*) set reference on audio voltmeter.
D. Switch to record mode (no signal input) and measure output. Should be in the vicinity of -55db below 3% reference.
E. Maximum erase can be achieved by adjusting erase head tracking and erase voltage. Best procedure is to adjust erase voltage just to the point where clean erasure results. This prevents overloading the oscillator.
G. Using same set-up (reference to 3% THD tape*) put on a roll of virgin tape, start recording (inputs full counter-clockwise). Output can be measured as signal-to-noise in db below 3% THD, should be in the vicinity of -60db.

*3% THD occurs with Scotch 202 at approximately +8db, with Scotch 207 at +11db.

VII. Record Response and Level, Bias Meter Calibrate

A. Insert 100KHz bias trap ahead of audio voltmeter. (See fig. 6)
B. Use correct type of tape (Scotch 202 or 207).
C. Adjust record head tracking, height and tape wrap, zenith, and approximate azimuth.
D. Start recording at 700Hz "0" level signal, switch to "tape."
   1. Adjust the front panel bias control (R113) to produce peak in audio output off tape. Set bias right on peak in output.
   2. If clear peak cannot be obtained, adjust the internal bias control (R516 on CX5C) in the same direction through and slightly past the peak in audio. Then the front panel control can be adjusted for a peak in audio.
E. Set the bias meter calibrate control (R117) to read "0" VU with switch in "Bias" position. This is only a preliminary setting. Control R117 is mounted inside the CX electronics near the power transformer, on early units. Later CX electronics R117 is mounted on center rear chassis and is a screwdriver adjust pot.
F. Adjust record level control (R515 on CX-5 board) so that 700Hz "0" level in, reads "0" VU in "tape" position.
G. Record a 1KHz "0" level signal and check distortion. THD should be below 1% typically.
H. Reduce signal level 20db with attenuator and record a 15KHz signal. Adjust record head azimuth for peak output. Again be alert for split azimuth problems.
I. At proper record level (see chart below), set 1KHz reference on external audio voltmeter.
   1. Sweep frequency to confirm only if machine has potential to meet specs at high frequencies.
   2. Switch to slowest speed, set bias to proper setting (see chart below) and check response.
   3. At this point, response can be corrected or adjusted using front panel bias adjust and record equalization.

NOTE: The RLC record equalization network works as follows:
–the capacitor changes the overall amount of boost in the upper mid-range frequencies (2KHz to 10KHz depending on speed). An increase in capacitance increases boost and conversely.
–The coil is adjustable and changes the frequency of the highest frequency to be boosted.
–The resistor changes the amount of the high frequency boost. Increasing the resistance, decreases the boost and conversely.

   4. When all channels are nearly the same and response is within specs, use bias meter calibrate control to set bias meter to proper setting (see chart below).
   5. Now switch to medium speed, change to proper bias setting (front panel control) and equalization position. Correct or adjust response using only equalization. It should be pointed out that the correct setting for the bias is a compromise and not exactly optimum for both speeds.
   6. Now switch to fast speed, change to proper bias setting and equalization position. Repeat above step.
   7. It may be necessary to change speeds several times to find proper bias setting. (Compromise for all three speeds) Also bear in mind, that unless the heads are new, original specs are difficult to obtain.

J. Bias swing—Only after proper bias calibration is obtained should bias swing be set.
   1. Use the internal bias control (R516) to set the range of the front panel bias adjust (R113). Final swing should be at least +2db to -3.5db.

K. Final Record Level.
   1. Record at "0" level 700Hz signal, set record level pot (R515) to read "0" VU in "tape" position.

VIII. Distortion Check

A. Insert bandpass filter between recorder and audio voltmeter. (See fig. 5)
B. Record a "0" level, 1KHz signal, check distortion. Total Harmonic Distortion should be 1% or less.

SOLID STATE SYSTEM CIRCUIT DESCRIPTION

Reference: System Schematic Diagram

Input #1: A signal plugged into the Mic 1 jack will be amplified 60 db, then routed through the Line jack to the Input 1 gain control. A signal plugged into the Line 1 jack is fed directly to the Input 1 gain control. Plugging a jack into the Line 1 jack automatically disconnects the CX-2 output.

Input #2: Identical to Input #1.

Buss Amplifier (CX-7): The output from the gain controls is then fed through 56K resistors for isolation purposes, then mixed. Input signals thus mixed are further amplified in the Buss Amp. BASS and TREBLE boost or attenuation may be added at this point.

Record Amplifier (CX-5): The signal is then passed on to the record amplifier, where record equalization is accomplished, record level is set, and bias is added.

Record Head: From the record amp, the signal goes to the record head, except when the record switch is in the play position.

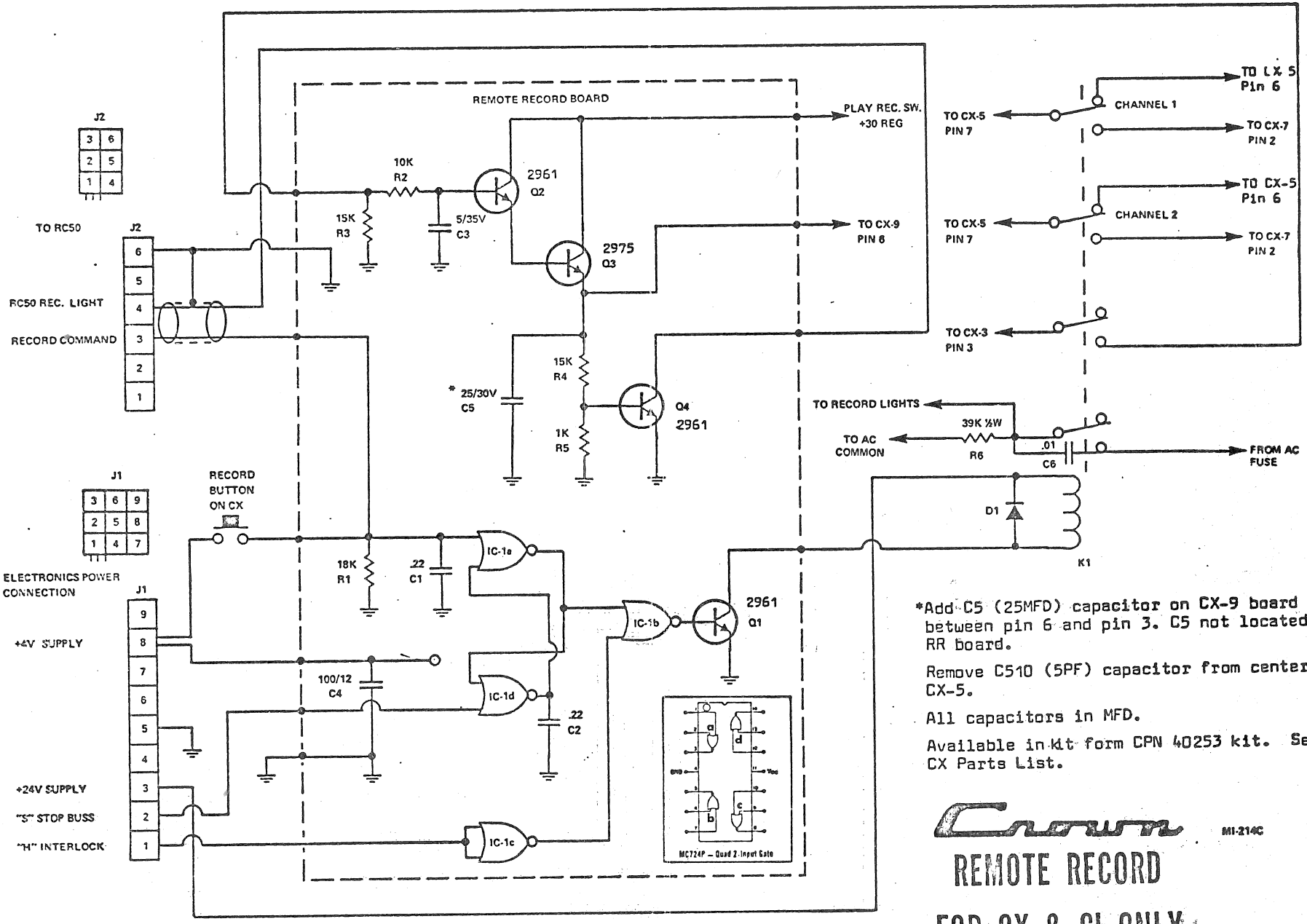
Bias Oscillator (CX-9): The bias oscillator provides ultrasonic bias to one or both channels in the record head (via the record amp) and also to one or both channels in the erase head.

Play Preamplifier (CX-2): The play preamp, CX-2, is identical to the MIC preamps except that the play preamp is used in conjunction with an equalization board, CX-8. This provides equalization for any one of the three equalization curves selected from the front panel. CX-8 boards are labeled, showing the speeds for which they are pre-adjusted. Two boards (per channel) must be used where more than three speeds are required. A level set control is also located on the CX-8 board. This allows the play preamp output to be set to a standard level. This is adjusted so that a standard tape will cause the meter to read "0" VU at 7 1/2 ips.

Meter Circuits: The meter circuits provide a method of measuring the following levels:

a. With SW102 in the play or record mode and SW101 in:

1. The SOURCE (A) Position -- reads the signal level at the output of the buss amp. This is the record level. A signal recorded with the meter reading "0" VU should playback at the same level as the zero level segment of a standard tape.



*Add C5 (25MFD) capacitor on CX-9 board socket, between pin 6 and pin 3. C5 not located on RR board.

Remove C510 (5PF) capacitor from center of CX-5.

All capacitors in MFD.

Available in kit form CPN 40253 kit. See CX Parts List.

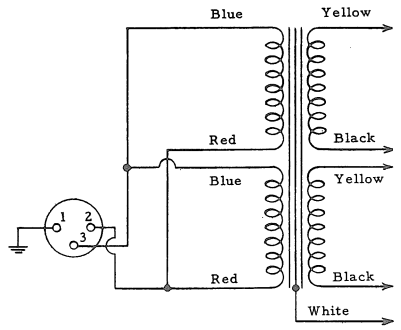
Crown MI-214C

REMOTE RECORD

FOR CX & CI ONLY

INPUT AND OUTPUT CONNECTIONS

(LOZ-4 and 600Z-4)
MI-251

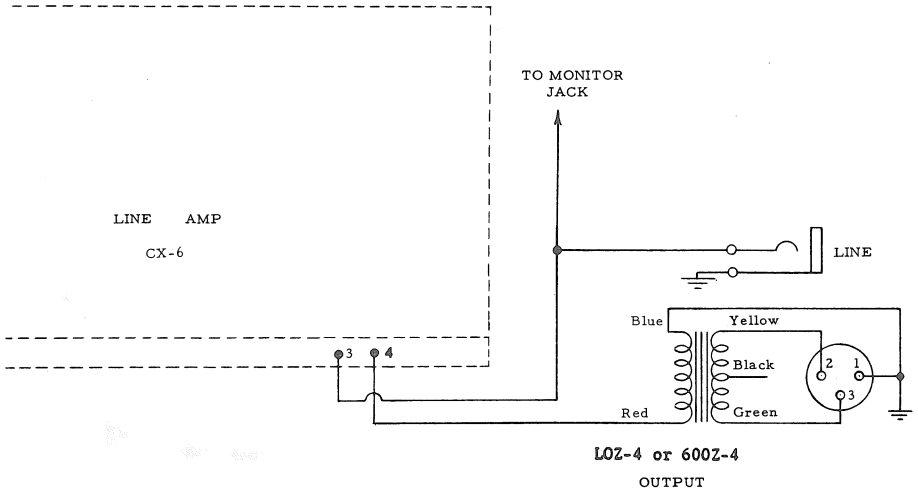


Transformer connections for 50 Ω. Diagram below shows connections for 250 Ω.

CONNECTIONS FOR LOW IMPEDANCE

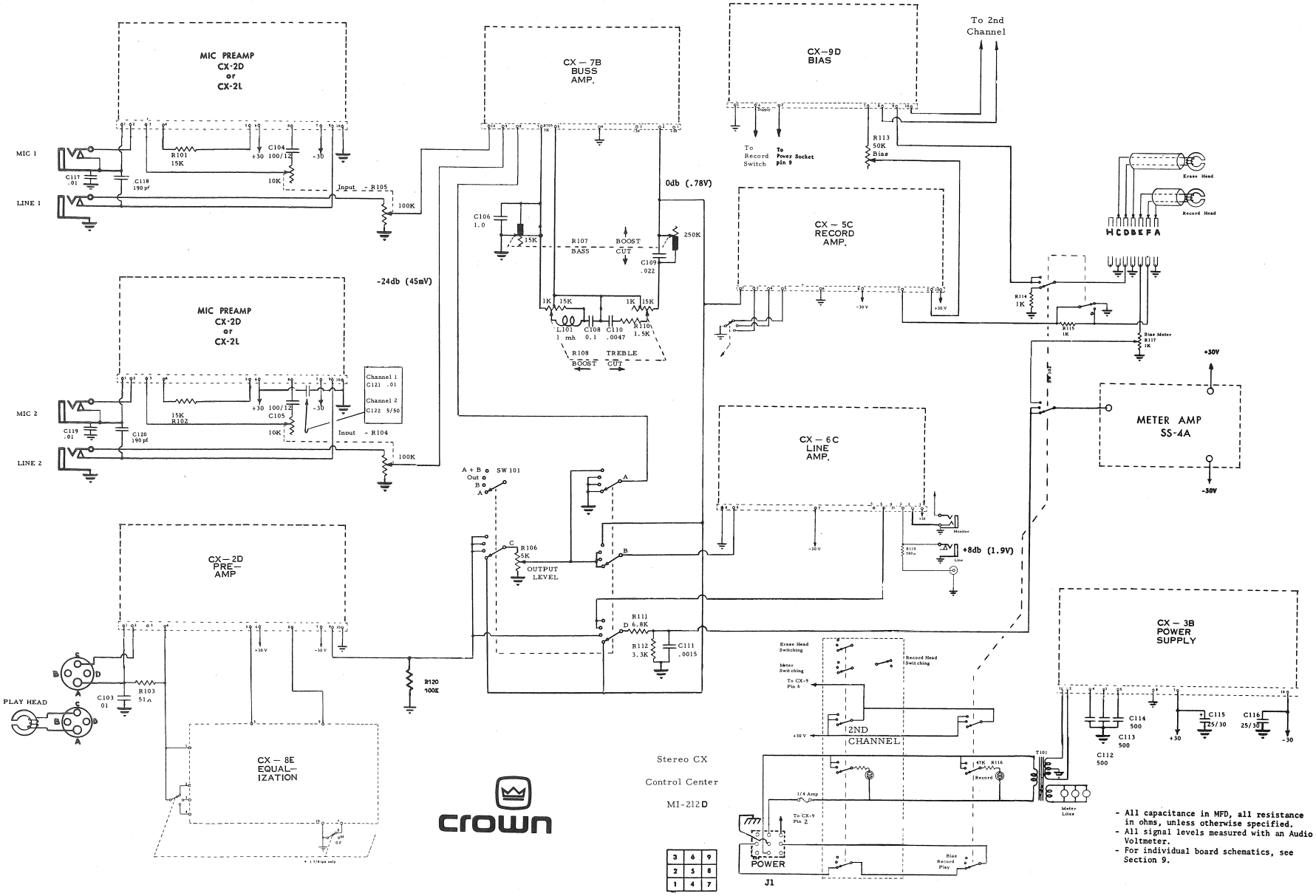
BALANCED LINE RECORDERS

600Z-4

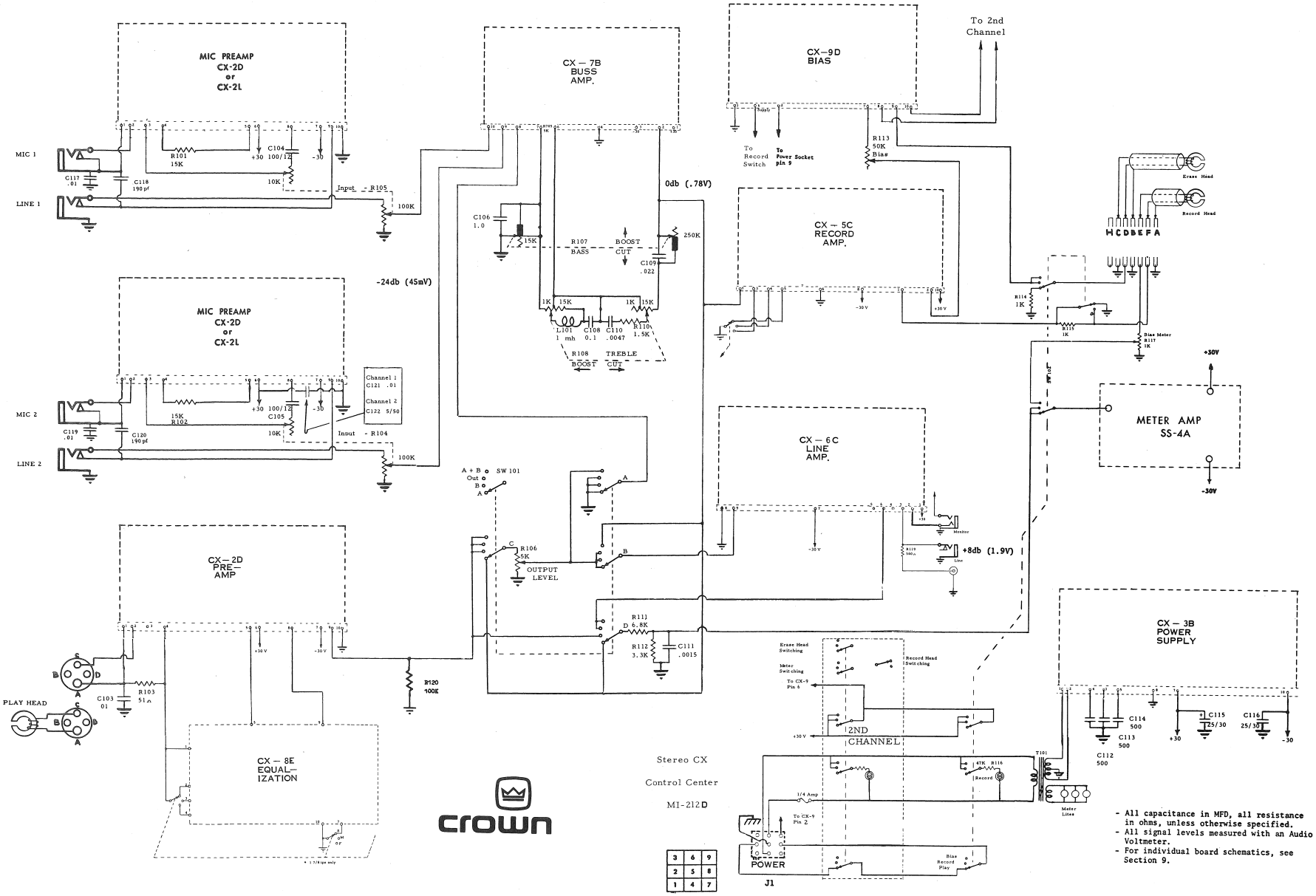


LOZ-4 or 600Z-4

OUTPUT



- All capacitance in MFD, all resistance in ohms, unless otherwise specified.
- All signal levels measured with an Audio Voltmeter.
- For individual board schematics, see Section 9.



crown

- All capacitance in MFD, all resistance in ohms, unless otherwise specified.
- All signal levels measured with an Audio Voltmeter.
- For individual board schematics, see Section 9.