OPERATING INSTRUCTIONS

FOR

CAROUSEL®

Series 800

Models 450-452

Manufactured By

Sono-Mag Corp.

Normal, Illinois U.S.A.

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SMC MODEL 450 SERIES 800 CAROUSELS

SONO-MAG CORPORATION NORMAL, ILLINOIS 61761 USA

January 1984

SECTION I

EQUIPMENT DESCRIPTION

1.1 INSTRUCTION MANUAL: This Instruction Manual covers the Installation, Operation and Maintenance of the following SMC cartridge equipment:

450 Monophonic Carousel Playback
Catalog No. 150-0410-001

452 Stereophonic Carousel Playback
Catalog No. 150-0411-001

1.2 GENERAL DESCRIPTION: The 450/452 Carousel is a magnetic tape playback system which can move mechanically into playing position any of 24 cartridges (NAB Type A or AA) that are stored in its revolving drum. The standard Carousel will, upon returning to the beginning of the endless tape loop where a cue control signal has been recorded, stop the tape drive and automatically remove that cartridge from the playing position and move to the next cartridge and insert it ready for a start command. This sequence procedure is repeated each time a cartridge is played.

Hysteresis-Synchronous capstan motor provide direct tape drive, assuring timing accuracy and low wow and flutter. Circuit boards and integrated circuit components are plug-in. Provision for alphanumeric logging is also standard.

These Carousels are designed to be operated in one of two modes: (a) Random access of Cartridges by BCD signals from an external programmer (as ESP-1) or (b) sequentially.

1.3 SPECIFICATIONS:

1.3.1 ALL UNITS:

Tape speed: 7½ Inches per second (19.05 CM)
Output: 600 Ohms, balanced
12 dBm before clipping
Normally 0 dBm @ NAB Reference
Playback Distortion: Less than 1% @ 0 dBm,
400Hz NAB Reference
Frequency Response: +2dB, 50Hz to 15kHz
Equalization: NAB, adjustable for head wear

Speed Accuracy: 99.8% or better
Aux (Secondary) Cue: 150Hz TTL output,
& open collector output.
Logging Sensor: 4kHz nominal; TTL output
Head configuration: In accordance with
NAB specifications
Cartridge capacity: 24
Time capacity: 40 sec. to 7.5 min. per
cartridge
Shift time (from cue on one cartridge to ready for next cartridge): 4 seconds

Time for 180 degree rotation and insert of cartridge (with Random Selector Control): 11 sec @ 60Hz - 13 sec @ 50Hz
Power: 115V 60Hz 2 Amp
Dimensions: Rack mounts, 20"W x 19¼"H x 18"D
50.7 CM x 49 CM x 45.7CM
Weight: 90 Pounds (41 Kg)

SECTION 2

INSTALLATION & CONNECTIONS

2.1 UNPACKING & INSTALLING:

NOTE: Damage claims should be filed promptly with the carrier. All packing material should be retained until the inspection is complete.

Open crate by removing screws from top and remove two rack-mounting panels and front escutcheon assembly.

Remove any packing around mechanism being careful not to bend cartridge tray holders.

FOR RACKS WITH FRONT RAILS ONLY: (SPECIAL ORDER)

1. Use 8½" tall carrier panel and fasten to inside of rack rail with #10 screws, washers, lockwashers and nuts. Panels fit at top of 19¼" opening with installed Carousel mounting angles at the bottom of the panels and facing toward center of rack.

2. Install four escutcheon mounting clips with #10 screws through slots and tapped holes in clips facing center of rack. Center of clips will be 1½" from 19¼" required opening.

FOR RACKS WITH FRONT AND REAR RAILS:

1. Use 4" wide carrier rail with adjustable rear mounting flange.

2. Measure down 6-3/4" from 19½" required opening. Bolt carrier rail at front and rear with #10 screws. Installed Carousel mounting angle will be near upper edge of carrier rail and facing center of rack.

3. Install four escutcheon mounting clips with #10 screws through slot into front rails. Center of clip will be 1½" from top and bottom of 19¼" opening.

   A. Remove all cables from Carousel electronic chassis.

   B. Remove three screws in top lip of chassis and lift chassis straight up and set aside.

   C. Remove crate clip nearest capstan motor and remove 5/16 bolts at that end of Carousel frame.

D. Carefully lift Carousel by grasping main frame assembly straight up and out of crate. Lift into rack through rear door and rest left hand end of channel on support angle which is bolted to rack panel. Unit can then be moved into position on the right. This unit weighs about 90 lbs. Assistance from the front of the rack to support the weight at the rim of the drum is helpful.

E. Fasten the channel to the angles with the 5/16" bolts and tighten when the drum is centered in the opening of the rack.

F. Install electronic chassis with #8 screws to the channel frame so that the chassis is horizontal and with transformer unit at your left. Plug into chassis sockets the appropriate cable plugs. Double check. Install head cables into proper chassis jacks at right hand end. Refer to Fig. 2, Section 7.

2.2 ESCUTCHEON MOUNTING:

Four right angle clips are bolted to front side of rack rails with #10 screws so that the tapped holes in the clips face toward center of rack.

Feed cables and plugs over top of drum and install escutcheon with four #8 screws to clips just installed.

Be certain to match plugs and sockets in electronic chassis.

Carousel drum must be centered in escutcheon so that no rubbing will occur. DO NOT ATTEMPT TO ROTATE DRUM MANUALLY!!!!!

2.3 EXTERNAL CONNECTIONS:

2.3.1 CONNECTOR SO-1: Connector SO-1 is used on all units. Connections are as follows:

Terminal 1: Left (or mono) Audio out +
2: Left (or mono) Audio out -
3: Audio Ground

4: Stereo, Right Audio out +
5: Stereo, Right Audio out -
9: 5.1 vdc, plus
10: 150-3900 Hz Sensor Enable
11: Remote Start
12: Ground
13: Secondary (Auxiliary) Cue out
14: Secondary (Auxiliary) out, Open Collector
15: Logging out

NOTES:

1. In Stereophonic use, Terminals 1-4 and 2-5 are in phase.

2. Outputs at Terminals 13 and 15 are active only when these circuits are enabled by logic 1 (+5v) applied to Terminal 10. In automation systems these circuits are usually enabled by a "now playing" signal from the system. If this signal is not available, connect #9 to #10 in the plug to SO-1.

3. Outputs at Terminals 13 and 15 are high (logic) with signal detection.

4. Application of a "ground" to Terminal 11 will cause the unit to start. This can be a relay contact or a signal of +5 going to 0-.7v momentarily.

5. Terminal 14 connects directly to the open collector of an NPN transistor which has a grounded emitter. This transistor conducts when a 150 Hz tone is detected. This will furnish a "ground going" circuit which may be used as a "start switch" for other equipment. NOTE: This circuit is intended ONLY for switching 24 vdc, or less, and is limited to a 40 milliampere load. If used to switch a relay or other inductive devices a transient suppressor, such as a diode, should be used across the load to protect the transistor.

2.3.2 ARMING CONNECTOR SO-2: (BCD ARM INPUT)

Terminal 1: No connection
2: Ground
3: "1" tray bit
4: "2" tray bit
5: "4" tray bit
6: "8" tray bit
7: "10" tray bit
8: "20" tray bit
9: No connection
10: Arm Strobe (active low)
11: Reset (active high)
12-13: No connection
14: EOM (AUX) active low
15: +28v DC. CAUTION!

SECTION 3

OPERATING CONTROLS

3.1.1 POWER SWITCH: On all units the main Ac switch is on the front panel. This switch is push-on/push-off. Its signal lite will show when power is ON.

Operator controls are located on the front escutcheon of the unit and their functions are as follows: Refer to Figure 3.1 for details of signal light operation.

MANUAL — This switch is push-on/push-off. When its signal lite is ON, the Carousel is in the MANUAL mode. In this mode, the operator can use the TRAY and ROTATE push buttons.

ROTATE — The two ROTATE buttons control the direction of rotation if the cartridge tray is in the out position. The Carousel drum will rotate as long as a button is pressed and will stop at the next index point after release.

TRAY — This momentary button will cause the tray to move into play position or to move out from play position. If there is no cartridge in the tray, it will back out automatically.

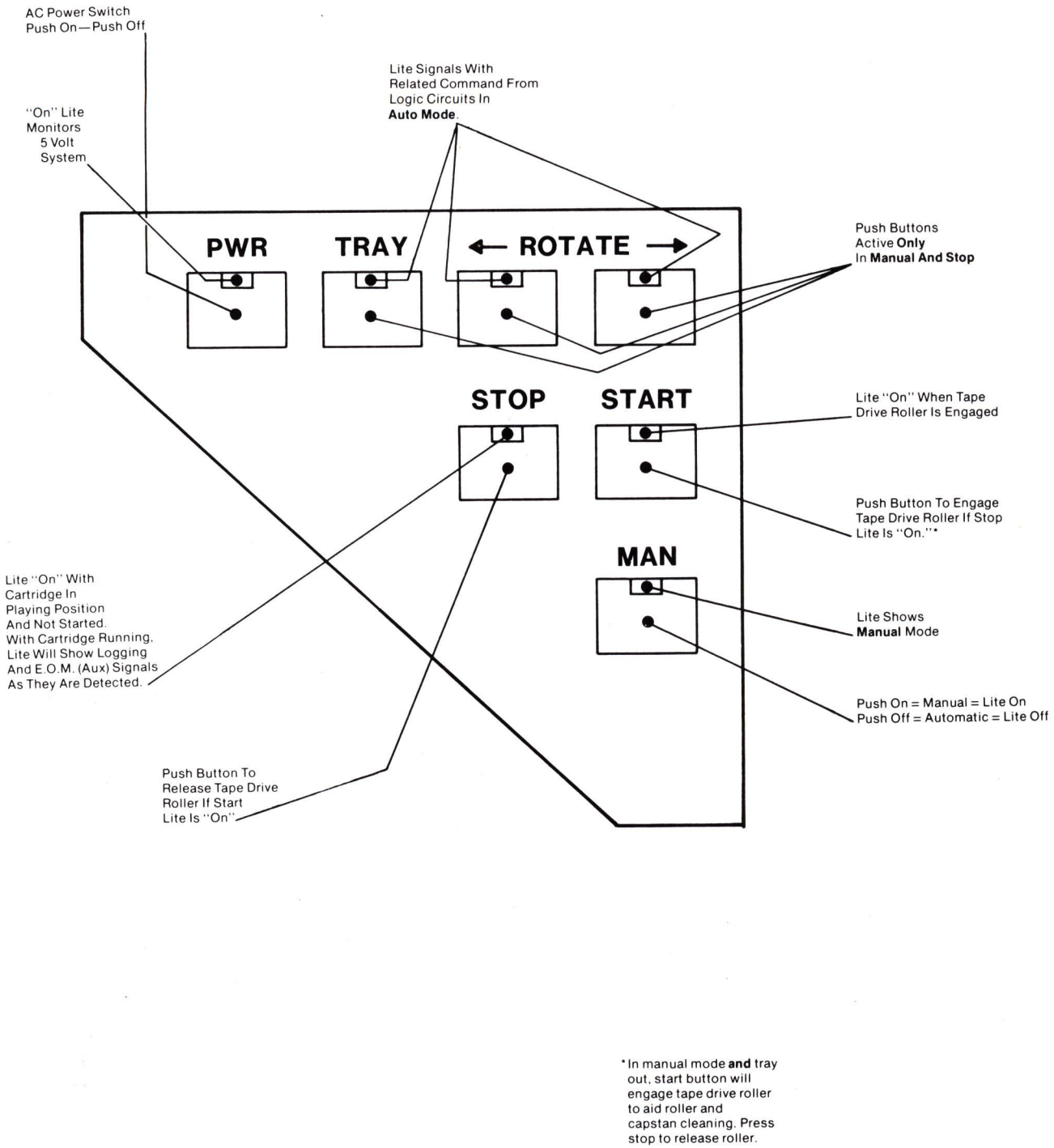
START — This momentary button will play a cartridge trayed into playing position.

STOP — This momentary button will stop a playing cartridge (causing pinch roller to drop back.)

3.1.2 RANDOM/SEQUENCE SWITCH:

The sequential mode or random select mode of the Carousel can be selected with the toggle switch on the right rear of the chassis. In the Seq. position, the Carousel will operate in the sequential mode. When in the Random position, the Carousel will rotate after the tray ejects until external equipment programs the next tray to be selected.

Control Functions
for
Carousel® Models 450 (Mono) 452 (Stereo)



*In manual mode **and** tray out, start button will engage tape drive roller to aid roller and capstan cleaning. Press stop to release roller.

Figure 3.1

FACTS ABOUT TAPE CARTRIDGES

1. Cartridges that are acceptable in a manual operator situation may not be satisfactory in AUTOMATION. Every Automation System operates with switching tones from the tapes and such tones are not normally used in Manual operation. Cartridges and the tape itself must be in first-class condition.

2. "Can I use any brand of Cartridge?" MAYBE!
In the past 20 years, more than a dozen brands and variations of cartridges and tape have come and gone. Each new inovation to correct one weakness often gave rise to another.

3. Cartridges MUST WRAP THE TAPE around the pole area of the head(s). Cartridges need guide posts before and after each head and/or pressure pads. If these conditions are not present, you will have "drop outs", and Automation Switching problems.

4. All tape loaded into cartridges is not satisfactory. Avoid tape that is not lubricated, has poor bonding of the oxide (heads get "dirty" prematurely.).

5. "How do I pick the right combination?" Test in your equipment representative samples before buying a large quantity Look at the samples as they relate to the above facts.

SECTION 4

THEORY OF OPERATION

4.1 GENERAL:

4.1.1 SCHEMATICS: Schematics of all equipment to be described in this section will be found in Section 8. Refer to the appropriate diagram for details of each circuit.

4.1.2 LOGIC DEFINITIONS: To simplify the explanation of the 450 series cartridge equipment, certain basic logic terms will be used. These are defined below:

1. Logic 1: The high voltage state, typically in the order of 3.3 to 5.1 volts.

2. Logic 0: The low voltage state, typically in the order of 0.0 to 0.8 volts.

4

4.1.3 PRINTED CIRCUIT ASSEMBLIES: Printed circuit board assemblies furnished are as follow: Refer to drawing #030-1076-001.

ALL UNITS:	PR-2	Playback Amplifier
	CSC-1A	Control Sensor-Cue, Aux, Log
	CLC-1	Logic Control
	LS-1	Limit Sensor
		Solenoid Control
		Code Reader
		Tray Number Display

4.2 POWER SUPPLIES

4.2.1 24V SUPPLY: The 24 volts supply consists of a bridge rectifier and filter configuration. The output is regulated by an integrated circuit voltage regulator VR-2.

4.2.2 VCC LOGIC SUPPLY: The logic power supply consists of an integrated circuit bridge rectifier and associated filter furnishing approximately 13 volts to an integrated circuit voltage regulator, VR-1. Output of the regulator is 5.1 volts.

4.2.3 SOLENOID POWER CONTROL ASSEMBLY: The solenoid power is derived from the 24 volt rectifier system.

The Solenoid Control board is located inside the main chassis and it has a plug-on edge connector. The circuit consists of two solenoid current switching transistors Q2 and Q3 and a time control circuit with Q1, C1 and R6.

An "on" signal (active high) from the CLC-1 causes Q1 to turn Q2 on for about 0.1 Sec. and energize the Solenoid at full voltage (28 volts) after this time, Q3 passes solenoid current at a reduced voltage, approximately 22 volts.

4.3 PR-2 PROGRAM AMPLIFIER: The PR-2 Program amplifier consists of IC-1, a dual low noise integrated circuit preamplifier, followed by output transistors 1Q1 for the left channel (or monophonic) and 2Q1 for the right channel. Gain controls 1R2 and 2R2 are for left and right channels respectively. Variable resistors 1R15 and 2R15 are high frequency compensators for the left and right channels.

NOTE: The input to the right channel preamplifier is grounded in monophonic units.

Connections to this board are as follow

Terminal	1:	Left preamplifier out
	2:	Left output amplifier in
	3:	24 volts +
	4:	Left amplifier out
	8:	IC Ground
	9:	Left preamplifier in
	11:	Ground
	12:	Power Ground
	13:	IC Ground
	15:	Right preamplifier in
	17:	24 volts +
	19:	Right amplifier out
	20:	24 volts +
	21:	Right output amplifier in
	22:	Right preamplifier out

4.4 INDEX SENSE SYSTEM: In the 450 Carousel the tray index system senses the metal flag attached to the rear edge of the Carousel drum casting.

A printed circuit board, which also has the code disc sensors, is mounted at left of the drum bearing block. This assembly has an infra-red (invisible) sensor and amplifier transistor. An LED indicator is on this board to show the sensing of the edge of the flag. It will be "ON" when the tray is at index and flashs on and off as the drum turns.

The index signal from the sensor is given at the edge of the flag that is approaching the sensor. Since the true index point is at the physical center of the flag, the rotate motor is allowed to run until the center point is reached. This is controlled by an adjustable circuit on the logic board, CLC-1.

For details of adjustment, see Section 5.

4.5 CSC-1A CONTROL SENSE CIRCUIT

4.5.1 GENERAL: The CSC-1A Control Sense Circuit assembly amplifies all control signal information recorded on a cartridge cue track, converts this information to digital form and controls the resulting signals.

The CSC assembly provides switching circuits which enable, or inhibit, transmission of logging and secondary (auxiliary) signals as reguired. In routine operation these signals are enabled at all times; however, in automation systems the outputs are usually inhibited except when the program source is actually on the air. This permits auditioning of cartridges but prevents transmission of switching information.

IC-1 is a single Integrated Circuit package containing two identical high gain amplifiers. The output of the cue playback head feeds the input of both amplifiers. Section A of IC-1 is used as an amplifier for 1000 Hz cue and 3900 Hz logging signals. Section B is a 150 Hz secondary cue selective amplifier in a "twin T" configuration.

4.5.2 1000 HERTZ CUE SECTION: The output of the 1000-3900 Hz amplifier, IC-1 section A, is clipped by diodes D3 and D4 and fed to the input of IC-3, and NE567 phase-locked loop tone decoder. The center frequency of the decoder detection band is set at 1000 Hz by variable resistor R26. Detection of a 1000 Hz cue signal causes the decoder output (board terminal 21) to change from high (logic 1) to low (logic 0) for the duration of the tone.

4.5.3 3900 HERTZ SECTION: The clipped output of the 1000-3900 Hz amplifier is fed to the input of tone decoder IC-4. The center frequency of the decoder detection band is set at 3850-3890 Hz by variable resistor R29. Detection of 4000 Hz causes a low (logic 0) signal to appear at board terminal 20.

3900 HERTZ ENABLING CIRCUIT: The 3900 Hz logic 0 signal appearing at board terminal 20 re-enters the CSC assembly on terminal 5 where it is routed to pin 6 of IC-2 section D. Section D is a two input NOR gate; both inputs must be at logic 0 to produce a logic 1 output. The second input is controlled by transistor Q3. When a logic 1 is applied to the base of Q1, via board terminal 6, a logic 0 appears at IC-2, pin 5. Therefore, when the circuit enabling logic 1 is applied to board terminal 6 AND a 3900 Hz signal is detected, a logic 1 appears at output board terminal 4.

4.5.4 150 HERTZ SECONDARY CUE SECTION: The center frequency of the 150 Hz detection band is set by variable resistor R5. The output of the 150Hz amplifier, IC-1 section B, is rectified by diodes D1 and D2 and thus controls switching transistor Q1. The output of Q1 is properly shaped by sections A and B of IC-2. A logic 0 appears at the output of section B during detection of a 150 Hz tone.

150 HERTZ ENABLING CIRCUIT: The two inputs of IC-1 section C, must be at logic 0 to produce a logic 1 output. It can be seen that this condition exists when a 150 Hz tone is detected AND the enabling logic is applied to board terminal 6.

4.5.5 150 HERTZ SWITCHING CIRCUITS: The CSC assembly provides three output switching circuits which are activated by the 150 Hz tones. As previously described, IC-2 provides a signal at logic level. This same signal controls transistor Q4 which provides an open collector, general purpose

switching circuit. Both of these circuits are controlled by the board inhibit-enable system. A third output is provided by transistor Q2 and is used as a switch for the secondary cue lamp indicators; this circuit is enabled at all times.

4.5.6 BOARD TERMINALS: Functions of the CSC-1A board terminals are as follows:

Terminal	1:	VCC, plus 5 volts
	2:	Ground
	3:	To 150 Hz indicator in Record centers
	4:	3900 Hz logging output
	5:	3900 Hz logging from Terminal 20
	6:	150-3900 Hz enable
	7:	150 Hz logic out
	8:	Ground
	9:	150 Hz switch, open collector
	11:	Ground
	14:	24 volts +
	15:	Cue Head input
	17:	Ground
	19:	VCC, +5 volts
	20:	3900 Hz logic signal to pin 5
	21:	1000 Hz logic signal out
	22:	Ground

4.6 CAROUSEL LOGIC CONTROL: CLC-1 The CLC-1 board (see schematic #020-0635-001) has complete control over the operation of the Carousel. The CLC-1 circuit has two major sections: the microprocessor control section and the interface section. The microprocessor section has the actual control of the Carousel while the interface section ties the microprocessor to the rest of the Carousel and to the remote controlling device.

4.6.1 MICROPROCESSOR CONTROL: The on board microporcessor, following instructions stored in an EPROM (Erasable Programmable Read Only Memory), monitors the input signals from the remote controlling device, the switch pod, the "in" and "out" limit sensors, the index sensor, the cartridge in place sensor, and the tray number sensors. It then issues the signals necessary to arm and to make ready to play the Carousel according to the signals received.

The components that make up the microprocessor control section are: IC-1, a 2716 EPROM that stores the Carousel's executive program, or operating instructions; IC-2, a Motorola MC6802 microprocessor; IC-9, a 74LS42 responsible for address decoding; IC-11, a 555 that resets the microprocessor when power is first applied.

4.6.2 INTERFACES: The interface section consists of the arming interface IC-5, Switch Pod and Remote Interface IC-4 and IC-8, and the Motor Control Interface, which is made up of IC-3, IC-6, parts of IC-7 and 8, and Q1.

ARMING INTERFACE Carousel arming is done through IC-5, a Motorola 6821. The BCD Arming Data, ARM RESET and CAROUSEL SELECT signals from the automation controller or other controlling device are input here, as are the BINARY TRAY POSITION DATA from the CODE READER BOARD on the Carousel.

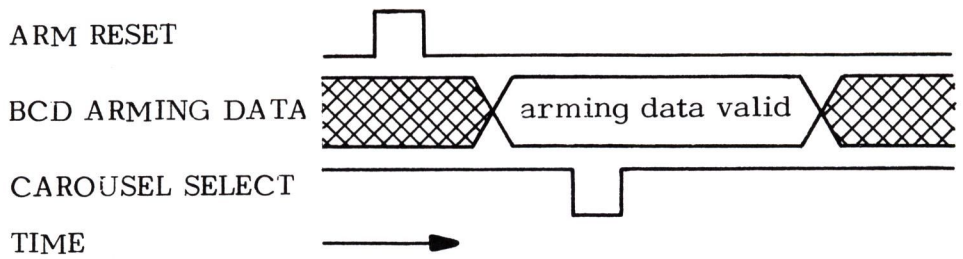
ARMING SIGNALS ARM RESET- The low-to-high going edge of this input enables the CAROUSEL SELECT input line. This signal must be received on or before the CAROUSEL SELECT signal.

CAROUSEL SELECT The high-to-low going edge of this input signals the microporcessor that new arming data is present on the BCD ARMING DATA lines. The CAROUSEL SELECT signal must occur on or after the ARM RESET signal or it will be ignored.

BCD ARMING DATA These six input lines carry tray information from the automation programmer or other controlling device. Tray information is input in an active high, BCD (Binary Coded Decimal) format. This data must be valid on or before the active transition of the CAROUSEL SELECT signal.

Figure 4.1

ARMING SIGNALS TIMING DIAGRAM



BINARY TRAY POSITION DATA These five input lines tell the microprocessor the number of the tray positioned at the playback deck. This data comes from the CODE READER BOARD on the Carousel.

ARMING SEQUENCE There are three different ways the 450 Carousel can be remotely armed. The method used is determined by the type of equipment the Carousel is attached to and the position of jumper J1.

JUMPER J1 This jumper, (located in a corner of the CLC-1 board next to IC-5), is used to configure the Carousel for operation with various pieces of equipment. For operation with a RSC-100 install the jumper from point A to point B. For operation with a CCI jumper point B to point C. All jumpers are removed for operation with a DP-2, ESP-1,MSP-1 or other equipment with compatible arming signals. J1 is removed for operation with an SMC DP-2, ESP-1, MSP-1 or other equipment with compatible arming signals. This arming sequence begins with the receipt of an ARM RESET signal. The low-to-high going edge of the ARM RESET signal sets (places high) a "hardware" flag internal to IC-5, enabling the CAROUSEL SELECT input. The high-to-low going edge of the CAROUSEL SELECT signal causes IC-5 to place the microprocessos's NMI (non-maskable interrupt) line low, initiating the interrupt service routine (part of the programming in IC-1). The ARM RESET flag in IC-5 is checked. If it is clear (low) the interrupt service routing is exited and no further arming action takes place. If the ARM RESET flag is set (high), the data on the BCD ARMING DATA lines are read and stored. The ARM RESET flag is cleared (placed low) and the interrupt service routine is exited. Program instructions in the executive program's main program loop direct the microporcessor to read the tray number from the BINARY TRAY POSITION DATA lines and compare it to the arming data most recently received. If the numbers don't match the Carousel arms itself to the new tray.

J1 is installed from A to B when the Carousel is used with a RSC-100. Arming data from the RSC-100 is held in a steady state until new arming data is issued. When J1 is jumped from A to B the Carousel continually scans the incoming BCD ARMING DATA lines. When a change is detected the Carousel arms itself to the new tray. The ARM RESET and CAROUSEL SELECT signals are not used iwth RSC-100 operation since each Carousel has its own data from the RSC-100.

J1 is installed from B to C when the Carousel is attached to a CCI, used with some DP-1 systems. The high-to-low going edge of the CAROUSEL SELECT signal causes IC-5 to place the microprossor's NMI line low, initiating the interrupt service routine. The data on the BCD ARMING DATA lines is read and stored, and the interrupt service routine is exited. Part of the executive program's main program loop compares the tray positioned at the playback deck to the tray number just received. If they don't match the Carousel arms itself to the new tray. The ARM RESET signal is not used with CCI operation.

When the Carousel is in the manual or sequential modes (switch selectable) it continues to read and store arming data but no arming takes place. When returned to the auto mode the Carousel will arm itself according to the most recent arming data received.

Switch Pod Interface. Signals to and from the Carousel's control switch pod pass through IC-4, a Motorola MC6821. This chip also handles the tray number display signals and the REMOTE START and PLAY ENABLE signals from the controlling programmer. See Section 3 for description of the switch actions.

All signals input from the switch pod are active low, and all expect the MANUAL SW signal remain low as long as its respective button is pushed in. The manual button's push on-push off action alternates the MANUAL SW signal between steady high and low states. The microprocessor continually scans the switch pod inputs. When one goes low it determines which button was pressed then takes the appropriate action.

The signals from the CLC-1 to the switch pod are also active low. These output signals light the various LEDs in the switch pod's buttons. The LED signals, active high out of IC-4, are inverted by IC-8, a 7404, before being sent to the switch pod.

SIGNAL DESCRIPTIONS: TRAY SW. When this input goes low the Carousel's tray will shift out if it is in, or in if it is out. If the signal is held low the tray will continually shift in and out. The TRAY SW signal is ignored when the pinch roller is engaged or when the Carousel is in the Auto mode.

ROTATE CCW SW. When this input goes low the Carousel starts rotating counterclockwise. Rotation continues as long as ROTATE CCW SW is low. This signal is ignored when the tray shift mechanism is not at its outer limit or when the Carousel is in the Auto mode.

ROTATE CW SW. Same as ROTATE CCW SW expect the direction of rotation is clockwise.

START SW. The pinch roller engages when this inputs goes low. This signal is ignored unless the tray is at "in" limit. An exception is when MAN Mode is selected. See Section 3.

STOP SW. When this input goes low the pinch roller disengages.

MANUAL SW. When this input goes low the Carousel is put in the Manual mode. The Carousel remains in Manual as long as the MANUAL SW signal is low. (and its light is on.)

ROTATE CW LED. This output signal goes low, lighting the LED in the Rotate Clockwise button, whenever the Carousel is rotating clockwise.

ROTATE CCW LED. This output goes low, lighting the LED in the Rotate Counterclockwise button, when the Carousel is rotating counterclockwise.

START LED. This output goes low to light the LED in the Start button when the pinch roller is engaged.

STOP LED. The STOP LED signal is derived by ORing the START LED and AUX/LOG SENSOR signals. This signal lights the Stop button LED whenever the pinch roller is disengaged or AUX or LOGGING tones are detected.

MANUAL LED. This output is low, lighting the LED in the MAN button, whenever the Carousel is in the Manual mode.

TRAY LED. This output signal goes low, lighting the Tray button LED, whenever a tray is being shifted in or out of the playback deck. The TRAY LED signal is derived from the TRAY in and TRAY OUT signals, which control the shift motor, and originate from IC-3, the motor control interface. TRAY IN and TRAY OUT are diode OR'ed by D1 and D2 so that if either one goes low the TRAY LED signal will go low.

REMOTE START. On the high to low going edge of the REMOTE START signal the pinch roller will engage if the play enable signal is high and a cartridge is in the playback deck. If the PLAY ENABLE signal is low the REMOTE START signal will be ignored. If the PLAY ENABLE signal is high and a cartridge is not in the playback deck, the Carousel will issue a BUSY/EOM signal on receipt of a REMOTE START signal.

PLAY ENABLE. Placing this input high enables the REMOTE START input. PLAY ENABLE must go high on or before the active edge of the REMOTE START signal or REMOTE START is ignored.

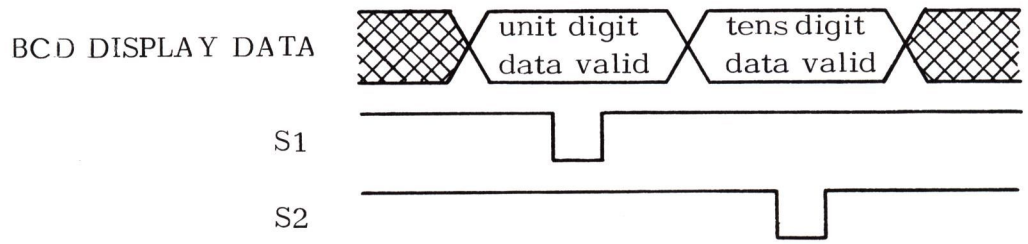
TRAY NUMBER DISPLAY SIGNALS. These signals control the tray number display. This two-digit display shows the number of the tray that is "trayed in" to the playback deck. The display is blank if no tray is "trayed in".

BCD TRAY NUMBER. These four output lines carry the tray number, in BCD form, to the display. Placing all four lines high blanks the display.

S1, S2 - Tray number digit strobes. These two output signals latch the data on the BCD TRAY NUMBER lines into the display circuit. S1 goes low to latch up the units digit, S2 go low to latch up the tens digit.

Figure 4.2

TRAY NUMBER DISPLAY SIGNALS TIMING DIAGRAM



MOTOR CONTROL INTERFACE. The motor control signals originate from IC-3, a Motorola MC6821, as do the SOLENOID ENERGIZE and BUSY/EOM signals. IC-3 also receives inputs from various detector and position sensor circuits. These inputs are used to determine which motor control signals are issued.

MOTOR CONTROL SIGNALS. Rotate CCW and ROTATE CW - These two output signals control the operation of the rotate motor. ROTATE CCW goes low to rotate the Carousel counterclockwise, ROTATE CW goes low for clockwise rotation. Both signals go low for approximately a tenth of a second to halt rotation. The rotate signals exit IC-3 active high, then pass through IC-6 where they are NANAed with an inverted TRAY OUT LIMIT signal. This prevents the Carousel from rotating unless they tray mechanism is completely withdrawn from the playback deck.

TRAY IN AND TRAY OUT. These two output signals control the operation of the tray shift motor. TRAY IN goes low to shift a tray into the playback deck, TRAY OUT goes low to shift a tray out. TRAY IN and TRAY OUT exit IC-3 active high, then pass through IC-6 where they are NANDed with the TRAY IN LIMIT and TRAY OUT LIMIT signals, respectively. This prevents the tray shift mechanism from moving beyond the inner and outer limits by shutting off the motor when the limits are reached. TRAY IN and TRAY OUT are also diode OR'ed and the resulting signal used to light the LED in the "tray" button on the switch pod.

SOLENOID ENERGIZE. This open collector output controls the pinch roller solenoid. The solenoid is de-energized when pin 14 of IC-3 is low. This low signal is inverted by part of IC-8, a 7404, and applied to the base of transistor Q1, (on Solenoid Power Control Board) turning it on. See Section 4.2.3.

BUSY/EOM. This output goes high if a REMOTE START signal is received when the Carousel does not have a cartridge in the playback deck. It signals the controlling device that the Carousel is not ready to play. BUSY/EOM originates from IC-3 pin 17 as an active low signal. It is inverted by part of IC-9, then diode OR'ed to the Carousel's EOM line.

INPUTS FROM SENSOR CIRCUITS---1KHz STOP. This input goes low when the CSC-1A card detects a 1KHz cue tone. This causes the pinch roller solenoid to de-energize, disengaging the pinch roller.

TRAY IN LIMIT. This signal is low when the tray shift mechanism is at its inner limit. By "reading" this signal line, the microprocessor can determine the position of the tray shift mechanism. This signal is also used, at IC-6, to disable the TRAY IN output signal to the tray shift motor. This prevents the tray shift mechanism from moving beyond its inner limit by shutting off the motor when the limit is reached.

TRAY OUT LIMIT. This signal is low when the tray shift mechanism is at its outer most limit. By "reading" this signal, the microprocessor can determine the position of the tray shift mechanism. This signal is used at IC-6 to disable TRAY OUT and, after its inverted, the ROTATE CW and ROTATE CCW output signals. When TRAY OUT LIMIT is low the TRAY OUT signal is disabled to prevent the tray shift mechanism from moving beyond its outer limit. The inverted TRAY OUT LIMIT signal is used to disable the ROTATE CW and CCW signals when the tray shift mechanism is not at its outer limit. This prevents the Carousel from rotating when the tray is in.

CART SW. This input signal goes high to indicate a cartridge is in the playback deck. If this signal is low when the Carousel receives a REMOTE START signal, a BUSY/EOM signal will be issued. This line is also checked after a tray has been shifted into the playback deck. If the tray is empty it shifts backout.

TRAY INDEX. This input goes low when a tray index tab is detected by the tray index sensor, i.e., everytime a tray approaches alignment with the playback deck while the Carousel is rotating. The TRAY INDEX signal is used to determine when a tray is in exact alignment with the playback deck, and thus when the Carousel should stop rotating.

The TRAY INDEX signal, as it enters the CLC-1 board, has slow use and fall times. It is conditioned by IC-7, a 74LS14 schmitt trigger which "squares up the signals" edges. The signal is then coupled through C4 to pin 2 of IC-10, a 555 configured as a single shot. When pin 2 of IC-10 goes low, the output, pin 3, goes high for a time period determined by R26 and C7. R26 is adjusted so the output of IC-10 drops back to the low state as the passing tray comes into exact alignment with the playback deck. This signal from the 555 goes to IC-3 pin 19 where it is "read" by the microprocessor. The microprocessor then determines if the Carousel is to stop rotating at the tray or continues on. See Figure 4.3.

R/S SW. This input comes from the Randon/Sequential switch. Placing this signal high puts the Carousel in the Random mode. Placing it low puts the Carousel in the Sequential mode. This input is ignored when the Carousel is in Manual.

TRAY INDEXING TIMING DIAGRAM

t_1 - index tab enters tab sensor.
t_2 - index tab exactly halfway through tab sensor. Decision is made if Carousel is to stop rotating or not. This point is adjusted by R26.
t_3 - index tab exits tab sensor.

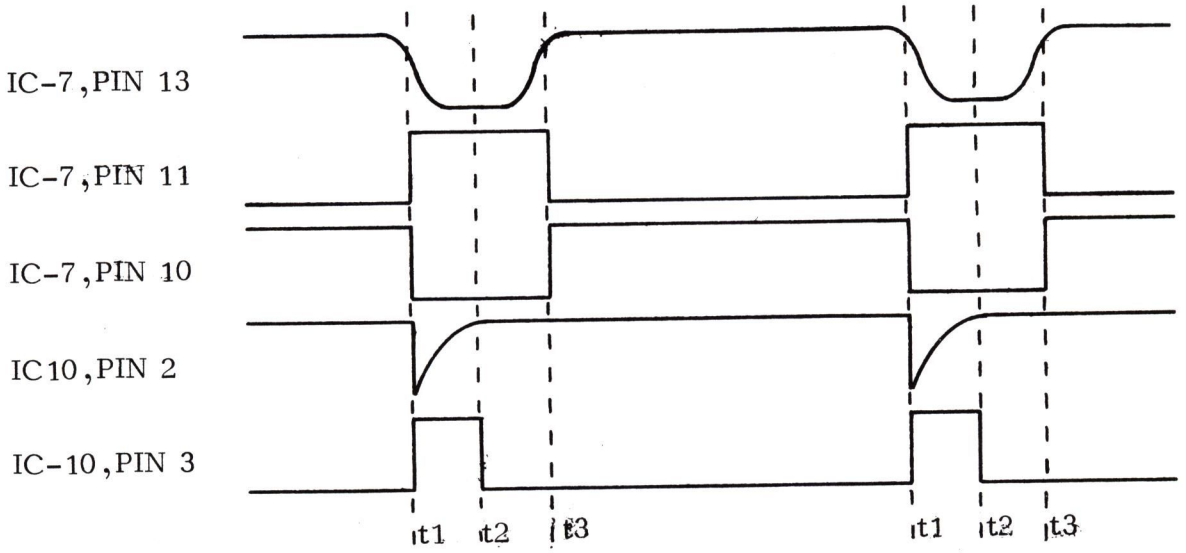


Figure 4.3

4.6.3 CLC-1 BOARD CONNECTIONS:

Pin No.	Function	Active Signal
1-A	+5V. Vcc (425MA)	-
2	ROTATE CCW Command	Low
B	ROTATE CW Command	Low
3	TRAY OUT Command	Low
C	TRAY IN Command	Low
4	TRAY IN LIMIT	Low
D	TRAY OUT LIMIT	Low
5	E.O.M (From CSC-1A)	High
E	Solenoid Control	High=ON
6	MAN Lite	Low
F	INDEX Sensor	Low
7	CCW Lite	Low
H	START Lite	Low
8	STOP Lite	Low

Con't/ CLC-1 BOARD CONNECTIONS:

Pin No.	Function	Active Signal
J	CW Lite	Low
9	Aux/Log (from CSC-1A)	Low
K	TRAY Lite	Low
10	RAN./SEQ. SW	Low=SEQ.
L	CART. SENSOR	Low=CART. IN
11	ENABLE	High
M	STOP (from CSC-1A)	Low
12	START SW	Low
N	MANUAL SW	Low
13	ROTATE CW SW	Low
P	STOP SW	Low
14	TRAY SW	Low
R	ROTATE CCW SW	Low
15	DISPLAY-BIT 2	High
S	DISPLAY-BIT 1	High
16	DISPLAY-BIT 8	High
T	DISPLAY-BIT 4	High
17	DISPLAY Tens Strobe	Low
U	START (REMOTE)	Low
18	EXTERNAL ARM BIT8	High
V	DISPLAY, UNITS STROBE	Low
19	EXTERNAL ARM BIT 2	High
W	EXTERNAL ARM BIT 4	High
20	EXTERNAL ARM BIT 10	High
X	EXTERNAL ARM BIT 1	High
21	CODE READER BIT 1	Low
Y	EXTERNAL ARM BIT 20	High
22	CODE READER BIT 4	Low
Z	CODE READER BIT 2	Low
23	CODE READER BIT 16	Low
AA	CODE READER BIT 8	Low
25	GROUND-POWER	
CC	GROUND-POWER	

4.7 SHIFT AND ROTATE MOTOR CONTROL: Refer to schematic 040-1065-001.
The shift and Rotate motor power control as well as the in limit and out limit sensor electronics are located on a panel within the housing at the center rear of the Carousel. The housing may be removed to access these circuits.

CAUTION: LINE VOLTAGE IS PRESENT ON THIS PANEL.

4.7.1 MOTOR DIRECTION SELECTION: Both the shift in-out motor and the drum rotate motor will run in either direction upon command from the CLC-1 logic board.

The rotation direction of these motors is determined by which leads are connected to power line. The switching of leads is accomplished with solid-state relays SS-1 to SS4. These devices use a 5 volt logic signal from the CLC-1 to turn on a photo triac that switches power to the appropriate motor lead.

The logic signal to activate these solid state relays is ground going (active low). In the case of the rotate motor, dynamic stopping is accomplished by briefly turning on both SS-3 and SS-4 from the CLC-1 logic.

4.7.2 SHIFT MOTOR IN-OUT LIMITS: When the CLC-1 instructs the shift motor to run toward the IN position, it will continue until a flag on the shift rod breaks the infrared beam on an optical sensor, SPX1874-003. This sensor turns on Q1 and returns an active low signal to the CCL-1 and it will turn off SS-2.

When the command is to back out, SS-1 will run the motor until the out limit sensor is interrupted by the flag and SS-1 is switched off by the CLC-1.

Each sensor has an LED signal lite that monitors the action of the sensor. These lites will be on when the sensor has been activated by the flag.

One or the other LED should be lighted at all times and both off when the motor is shifting the tray.

4.8 CODE READER AND INDEX SYSTEM: Refer to Schematic 040-1064-001.
The identification of each cartridge on the Carousel is determined by a code disc attached to the back side of the drum

There are five rings on this disc arranged in a 1-2-4-8-16 binary code. Ring 1 is the outer most and 16 is nearest the center.

An optic code reader for these rings is located on the rear left side of the main bearing block. It consists of five infra-red emitters and reflective photo transistors. Each sensor is the SPX-2498-03 and has a focal distance of ½".

When the infra-red lite is reflected off of the polished ring, the associated transistor (Q2-Q6) will switch low, light a related LED and signal the CLC-1 of its number.

As the drum turns the LED's will flash on and off as they are activated by the code rings.

The actual tray number is determined by adding the weighted value of the LED's that are on. For example it lite 1, 3 and 6 are on, the tray number is 1+4+16=21.

When the number from the code reader matches the number given to the CLC-1 by an external programmer, the stop rotate sequence is started.

When a different tray number is presented to the CLC-1, the start rotate sequence is initiated and the CLC-1 will make the decision as to the shortest direction of rotation.

4.9 TRANSPORT DECK SYSTEM: Refer to Schematic 040-1066-001. On the transport deck, SO-5 carries line AC for the capstan motor, 24v DC for the solenoid and a cartridge sensor SPX-1874-03. This sensor is activated by a flag which is depressed by the bottom of a cartridge.

4.10 TRAY NUMBER DISPLAY: A digital tray number display shows the tray (cartridge) that is in playing position. The display is blank while the drum is rotating and until a cartridge is in place.

A dual digit display (6740) and two decoder drivers (4511) are mounted on a small circuit board located in upper left corner of the trim escutcheon. The control signals are from the CLC-1 board via plug 7.

This unit may be un plugged without affecting any other operations.

SECTION 5

ELECTRICAL MAINTENANCE AND ADJUSTMENT

NOTE: Refer to illustrations and diagrams for more details.

5.1 GENERAL: Use extreme care in removing circuit boards or integrated circuit packages from their sockets. Power should be OFF prior to removal. When replacing integrated circuits be absolutely certain they are returned to the proper socket and in the correct direction with IC pin 1 in socket pin 1: reversal will invariably result in immediate destruction of the IC.

5.2 PR-2 PROGRAM AMPLIFIER: Two sets of controls are located on the PR-2 Program Amplifier Board; these are explained below.

5.2.1 GAIN CONTROLS: The left (or monophonic) output level is set by 1R2. Stereophonic right channel output is set by 2R2. The output level is set at 0 dBm while playing the Standard Level portion of an NAB Primary Reference Tape. The output of the unit must be connected to a 600 ohm load during this adjustment. NOTE: This adjustment calibrates the gain of the playback amplifier for several adjustments which will follow.

5.2.2 HIGH FREQUENCY COMPENSATION: The left channel (or monophonic) high frequency response is set by variable resistor 1R15 and the right channel of 2R25. These controls should be adjusted ONLY after playback head azimuth has been carefully checked. An NAB Primary Reference Tape should be used for both azimuth and frequency checks. The program amplifier should be properly loaded with 600 ohms. These controls are to be adjusted at 12KHz and at a level of -10dBm.

5.2.3 IEC COMPENSATION: The PR-2 can be adjusted to I E C characteristics by changing 1R6 and 2R6 to 220 ohms.

NOTE: Some machines use M975 output transformers. See master chassis schematic, 030-1076-001, for connections to PR-2 socket.

5.3 CSC CONTROL SENSE CIRCUIT

5.3.1 GENERAL: Three frequency discriminating networks, 150, 1000 and 3850 Hertz, are located on this board. The frequency determining resistors, all located on the CSC board are set at the factory. Should adjustments become necessary, proceed as described below.

To make these adjustements, an accurately calibrated signal generator is necessary. The output of the generator will be connected directly to the input of the cue amplifier; therefore, very low signal levels (-10dBm) will be used. A shilded connecting cord must be used with a phono-type connector at the cue input jack on the chassis.

5.3.2 150 HERTZ SENSOR: Detection of a 150 Hertz tone is indicated by illumination of the lamp in the Stop switch lamp. The center frequency is set at 150 Hz by resistor R5. Adjustments is as follows:

1. Disconnect the Cue head by pulling the phono connector at the chassis.

2. Set the Signal Generator to exactly 150Hz at approximately 1.0 millivolt output. Using the shielded test lead, connect the cue amplifier to the Generator.

3. Adjust R5 until the lamp indicator is ON. Reduce the signal input until the lamp dims slightly. Re-adjust R5 for maximum lamp intensity. Continue reducing the input and adjusting R5 for maximum lamp intensity.

NOTE: The optimum adjustment is at the point of least signal input which will give a lamp indication as R5 is varied. At this point the lamp will be quite dim and the "swing" of R5 very small and will occur with an input of approximately 0.2 millivolt.

5.3.3 1000 HERTZ SENSOR: Detection of the 1000 Hz primary cue tone, and conversion of this signal to digital form, is by means of phase-locked-loop IC-3. An integral part of this integrated circuit is a continuously running oscillator. Calibration of the detector consists simply of accurately setting this internal oscillator to 1000 Hz. NOTE: Rejection of out-of-band signals by this system is extremely high; therefore the oscillator should be set at exactly 1000 Hz since this will establish the lower frequency of the pass-band.

CALIBRATION METHOD 1: The most easy and accurate method of setting the internal oscillator is by means of a frequency counter connected to IC-3 pin 6, or more conveniently, to board test point A (See 030-0095-003). Adjust R26 for 1000 Hz.

METHOD 2: Using a calibrated oscilloscope, observe the triangular wave form at test point A. Adjust R26 for a complete cycle of 1 millisecond.

METHOD 3: Connect a voltmeter to board terminal 21. It will measure 5.1 volts with no cue signal input. Proceed as follows.

1. Using the same set-up as the 150 Hertz, set the signal generator to exactly 1000 Hz and connect to the cue amplifier input. Raise the output to approximately 3 millvolts and adjust R26 until the voltmeter reads zero.

2. Decrease the signal input until the voltmeter reading starts to rise but does not indicate the full 5.1 volts. This indicates the threshold of the cue signal "capture" point. Adjust R26 for the lowest reading. Continue lowering the signal in put and readjusting R26 for the lowest voltmeter reading.

3. As the signal input is decreased, the more narrow the pass-band becomes and the more accurately the center frequency can be set. Therefore, the optimun adjustment point occurs with the lease signal input which will give the least voltmeter downward deflection as R26 is adjusted.

NOTE: Not all cart recorders apply 1000Hz tones to tapes. Some are lower by 100Hz and others by 50Hz. For complete compatibility with these tapes, it may be necessary to adjust R26 to a frequency about 10 to 15Hz below the cue frequency on the tapes.

5.3.4 3850 HERTZ SENSOR ADJUSTMENT: The adjustments for the 3850Hz Sensor are identical to the 1000Hz with the following execptions:

1. Signal Generator is set at 3560 - 3890Hz
2. 3890Hz Center frequency is set by R29.
3. If Calibration Method 1 is used, connect to Test Point B.
4. If Calibration Method 2 is used, the time perios for one cycle is 257 microseconds.
5. If Calibration Method 3 is used, the readings are taken at board terminal 20.

5.4 ROTATION INDEX TIMING: The correct stopping position for the Carousel drum is determined by metal flag on the rear rim of the drum, the edge of which is detected by the flag sensor. See 040-1064-001.

These 24 flags are factory adjusted to be at the center line of its respective tray.

Since the drum rotation is bi-directional it is necessary to provide a timing circuit to give an exact signal at the Mechanical Center of each flag in order to correctly align the cartridge at the play deck. This is done on the CLC-1 control board, 030-0635-002, by IC-10 and adjustment R26.

R26 is the only adjustment on the CLC-1. This timing control is to be adjusted only if every tray is slightly high or slightly low when sliding into the deck.

See timing diagram Figure 4.3, page 4-14.

NOTE: The flag that controls the index of a particular tray is located on the opposite side of the drum.

From the rear, the cartridge at 3 0'clock is indexed by the flag at 9:30 0'clock.

SECTION 6

MECHANICAL ADJUSTMENT AND MAINTENANCE

6.1 MECHANICAL ADJUSTMENTS: The majority of mechanical adjustments that may be required will concern themselves with the tape deck mechanism.

Refer to Drawing 010-0109-001 for all references in the following information.

6.2 SOLENOID OPERATIONS: The solenoid (50) unit is a precision device and its parts should be handled with care to prevent damage.

The plunger, and the bore of the solenoid coil must not be dented or bent. When handling these pieces, keep free of dirt, etc. and do not oil plunger.

6.2.1 SOLENOID DISASSEMBLY: To remove the plunger from the coil, loosen the set screws in the outer end of the plunger to release the tension band clamp segments and pull out the tension band. Remove the screws holding the idler roller assembly, Figure 1 and 010-0109-001, pull the plunger straight up.

Re-assemble in the reverse order making certain the idler roller assembly is square with the edge of the deck. This is to insure the tension band pulling in a straight line.

To remove the entire solenoid unit, remove its leads from socket (54), and remove the two screws holding the solenoid to the deck plate.

When re-assembling, be certain the solenoid leads are clear of the plunger.

The nylon screw at the bottom of the solenoid is adjusted ¼ turn clockwise from the position that the plunger bottoms out in the coil.

6.3 PINCH ROLLER ADJUSTMENTS: The purpose of the pinch (pressure) roller (43) on a tape deck is to hold the tape against the rotating capstan shaft with sufficient pressure to pull the tape. Pressure alone does not guarantee satisfactory tape pulling. The surface of the capstan shaft, if too smooth, will reduce the pulling power, particularly if the shaft has become coated with the lubricant used on cartridge tape. Some of these lubricants cannot be removed with typical head cleaning compounds.

Before making any pressure roller adjustments, the capstan should be throughly cleaned of tape lubricants. Use a fine abrasive such as "crocus cloth" held lightly against the revolving shaft. Follow this with head cleaning compound and wipe dry.

6.3.1 NORMAL ROLLER CONDITIONS: Properly adjusted, the new pinch roller will touch the capstan shaft first at its bottom edge as it swings into a position parallel with the capstan. A new roller will be indented approximately 0.030 inches at point where it contacts the shaft.

As the pinch roller ages with time and use, its hardness factor increases and the indentation will become less. This hardened roller may still pull tape, but its reduced ability to flex off dirt and oxide particles will contribute to a greater wow and flutter factor.

6.3.2 SETTING ROLLER PRESSURE: The pressure of the pinch roller is adjusted by moving the tension band (44) in or out of the clamp on the cross shaft cam.

The cam is located on the end of the cross shaft opposite the capstan end. A small clamp bar is attached to the cam with a screw and this clamp locks the tension band to the cam. By releasing the clamp slightly, the tension band can be pulled forward to increase pressure roller tension, and sliding the band toward the back will reduce pressure.

For the initial adjustment, loosen the clamp, and while pulling on the tension band, rotate the cam until the edge of the pinch roller is just flush with the top of the cartridge plate. Tighten the clamp.

6.3.3 PINCH ROLLER REPLACEMENT: To replace the pinch roller, first remove cover (55), the snap ring on top of the roller shaft, then lift off the nylon washer and the old roller. Clean the shaft throughly with solvent and, if the shaft shows any trace of copper-colored deposits, use crocus cloth to polish.

Oil the shaft with a drop of non-gumming lubricant. Install the new roller with the bearing projection down. Put top nylon washer and snap ring in place. Test for free rolling action with no evidence of binding. Move roller up and down on its shaft to seat the nylon washers.

Pinch rollers should be replaced when they have become hard, grooved, or cupped from excessive use. Also, replace those rollers that do not spin freely on the shaft due to excessive cleaning fluid removing the lubrication in the bearing.

6.4 CROSS SHAFT ADJUSTMENTS: The cross shaft (42) translates the linear motion of the solenoid to the rotary motion necessary to bring the pinch roller in contact with the capstan. The position of this shaft in relation to the capstan is essential to correct operation.

While this shaft rarely requires adjustment, it should be checked at the time a pinch roller is replaced. Test the shaft for end play by grasping the pinch roller and seeing if there is any "play" along the axis of the cross shaft.

Being field adjustable, excessive end play can be eliminated by slightly loosening one of the end bearing blocks (40) and lightly tapping it toward the shaft. Do not over tighten to the extent that the cross shaft return spring will not freely return it to its rest position.

If the cross shaft is to be removed for any reason, take the bearing block opposite the solenoid end off, disconnect the tension band and lift out.

Correctly adjusted, the pinch roller shaft will be directly in line with the capstan shaft and spaced (for 60Hz Motors) 0.503 inches (center to center) from a standard 0.238 inch diameter capstan. This spacing is equal to 0.290 inches between facing shafts.

For 50H motors, the center to center spacing is .527 and the distance between shafts is .290.

6.5 REMOVAL OF TRANSPORT DECK ASSEMBLY: To remove the tape transport assembly refer to exploded view #010-0109-001.

Before removing transport, carefully mark with a pencil, the location of deck plate (item 37) with the angle plate on the main bearing block.

1. unplug all cables to transport assembly.

2. remove two #10 socket head screws, holding pillar (38) at the right hand end of the mainframe.

3. remove two #10 screws, holding deck to angle mounting plate.

4. protect motor cup and capstan shaft from any damage.

Preform necessary service on transport and re-install making sure transport is lined up with pencil marks.

6.6 TAPE HEAD ADJUSTMENTS: Each of the following head adjustments is vitally important to optimum operation.

a. Location of head to capstan.

b. Penetration of head into cartridge.

c. Height of pole faces above deck surface.

d. Zenith, or head face to deck relation.

e. Azimuth, or pole gap to deck relation.

The HB-10 head assembly (Figure 1) can be accurately located in relation to the capstan by using a standard cartridge such a AudioPac A-2.

a) Place the cartridge in the machine until it touches the capstan shaft in the center of the notch in the bottom of the cartridge, then pull the cartridge back 1/16 inch.

b) Hold the cartridge in position (a) and adjust head assembly until it touches the front edge of the cartridge and the tape guides have equal clearance in the cartridge windows.

Properly adjusted head assembly will allow the pinch roller to operate through the cartridge keyhole and when the tape is playing, the cartridge should have freedom to be moved in and out or right and left by about 1/32 inch. In no case should the cartridge be held by the machine without this freedom.

6.6.1 ZENITH ADJUSTMENT: The Zenith adjustment is "factory set" with the HB-10 head assembly, and also the track heights (6.6.2).

6.6.2 TRACK HEIGHTS: Since the tape is held at a fixed location by the tape guides on the head assembly, it is very important to adjust the heads so that their pole tracks are uniformly related to the edges of the tape. In stereo, where the tracks are narrow, an error of 0.010 inches can result in about 2dB loss of output. Track height is factory set by the HB-10 head holder.

6.6.3 AZIMUTH ADJUSTMENT: This adjustment is to align the pole gap at exact right angle to the path of tape travel. The side of the head should be square with the deck before using an alignment tape. Do this by loosening the azimuth lock screws (with 0.050 Allen Key) and turning the azimuth screw.

Use a standard 10-12KHz alighment tape and observe the output meter while turning the azimuth adjust screws. The peak output reading should be obtained within 1 turn of this screw if the head was mechanically azimuthed as described above. It is possible to observe "false" azimuth peaks on either side of the true azimuth. These will be less pronounced than the true one.

After aligning the play head, tighten the lock screws enough to hold the setting but not reduce the peak reading. For stereo systems, connect L and R outputs in series to output meter. Adjust azimuth for maximum output at 10 KHz.

6.7 CAPSTAN MOTOR: The capstan motor is a hystereis synchronous outside rotor design. The rotor is mounted with precision, sealed ball bearings. No lubrication is required. The running speed at 60Hz is 600 RPM and the shaft is ground to provide tape speed of 7.5 IPS. An AC capacitor of the size specified on the motor name plate runs in series with one motor winding.

The motor is mounted to the main deck with three screws and is not adjustable. When removing or installing motors, be extremely careful not to bump either the shaft or the rotor as this will ruin performance. Use only the correct length screws to mount the motor.

6.8 LUBRICATION AND CLEANING: Lubrication is required only at the ball item 41) on each end of the cross shaft, and the pinch roller shaft. Use a light, non-gumming oil, one drop at each point approximately each 3 months use. Keep oil from the rubber pinch roller.

Use only approved cleaners on heads, capstan and pinch roller. Be particularly careful that the cleaner does not attack the pinch roller.

Keep cleaner from running into motor and pinch roller bearings. Always wipe part dry rather than allowing cleaner to evaporate.

6.9 TRAY INDEX ADJUSTMENT: This important adjustment is necessary to insure the cartridge being inserted into the playing transport at the proper relation to the capstan and heads. If the cartridge tray is too high relative to the head support plate, the pinch roller may not be able to enter the hole in the cartridge and drive the tape. If the tray is too low, the cartridge will be forced up at an angle with similar improper results. The correct adjustment is the one that allows each tray to slide smoothly onto the cartridge deck plate without being spaced above it.

To make adjustment:

a) Determine if all trays are shifting into play position too high above cartridge deck plate when rotation is clockwise.
NOTE: They will shift in too low in counter clockwise rotation.

b) Refer to Section 5.4 and Figure 4.3 for timing control R26 adjustment.

If index condition of trays is satisfactory except for one or two trays it is possible that they have become bent or loose on the drum. If this is true, loosen the tray braces on either side of the questionable tray. If the tray holder is loose on the drum, or has been forced up or down, it will be necessary to remove the screw holding the tray pin (grip the pin with smooth-jaw pliers and loosen the #8 screw). A chemical locking compound (Loctite) is used on these screws and they will require some force to remove. When the tray pin is out, the tray may be pulled out to expose the #8 screws holding the tray holder. Loosen these screws and move the tray holder in the required direction. The use of a straight edge from the head support plate is recommended. Check at both the inside and outside edges of the holder, bending the holder slightly if necessary to make surfaces coincide. When this situation is realized, carefully tighten all screws and replace tray holder braces so that they just touch but do not exert force on adjacent tray holder. Replace tray and pin.

A second possibility for one or two trays that do not align with the deck is that their index flag has been moved. Twentyfour of these flags are mounted to the rear edge of the drum, each with a #4 screw.

The flags all point toward the center of the drum and must be tangent to the drum circle.

NOTE: The flag for a particular tray is located on the opposite side of the drum from the tray it controls. It will be the flag, that is passing through the optical sensor.

As an initial adjustment, set the flag with its mounting screw in the center of the slot in the flag. Test that tray for correct index with deck and readjust its flag slightly if required.

DO NOT readjust R26 on CLC-1 for only one tray. R26 is a master adjustment for all trays when testing in both direction of rotation.

6.10 TRAY STROKE ADJUSTMENT: NOTE: Improper tray stroke can cause cartridge to stop short of capstan so far that pinch roller cannot press tape against it. The stroke can be too much and the cartridge will be jammed against capstan causing a "squeek" and slow speed.

1. The length of the tray stroke from full "in" position to full "out" position is regulated by the position of the "in" and "out" sensors. See drawing #101-0107-001. The tray shift motor will run until switched off by the limit sensor signal.
The "in" sensor is at the rear of the motor control panel and the "out" limit is nearest the front.

Each limit sensor is separately adjustable by loosening two #4 screws and sliding the sensor plate to left or right.

The most important limit is the "IN" sensor. It should be adjusted so that the cartridge stops just at the head assembly.

2. When the cartridges are going too far into the transport (there should be 1/32" between front edge of cartridge and capstan for proper operation) some straining of the shift motor will be observed and also loosening of pin fork. If the cartridge is not going into the transport far enough, the pressure roller may not be able to come up through the keyhole or may not drive the cartridge properly.

3. NOTE: Before making any adjustment in the shift bar check the clearance of the pin fork to the shift ring (9/32" maximum). If the shift fork is bent or loose, the cartridge will not be moved far enough into the transport fro correct operation.

4. The tray position relative to the capstan and heads should be corrected by moving the shift ring in or out on the shift rod as required. The shift ring is clamped to the rod by a socket head cap screw located in the side of the aluminum block at the center. Loosen this screw and move the ring in or out as required. Be certain to keep bar in its same horizontal position. Twisting the bar back and forth slightly will aid in moving it on the shift rod. Reclamp screw securely.

6.11 TRAY SHIFT AND ROTATE MOTORS:

1. These motors are induction type with a phase shift capacitor and have internal brake to stop rotation when power is off.

2. The two motors are interchangeable, but the gear reduction units have di erent output speeds and should not be be interchanged.

    a. The drum rotate drive uses a 150H gear head.

    b. The shift drive uses a 60H gear head.

Both motors are direction reversable to give shift-in or out and bi-directional rotation.

3. The brake system used with these motors consists of a set of carbon-type brushes running on a metal disc driven by the armature. These brushes are replaceable by removing the metal disc at the end of the motor opposite the shaft. Two screws hold this cover to the end of the motor. The brushes are removed by carefully pulling the small springs that are exposed when the cover is taken off.

    Brushes should be changed when the motor does not stop immediately when power is off.

NOTE: The brushes do no carry electric current. They are friction devices only. High-pitch squeeking when the motor is running is usually caused by brush-chatter. Take the brushes out and blow out any dust in the brush holes: reassemble.

6.12 DRUM DRIVE MOTOR:

1. The gear reduction motor has a rubber-tire drive wheel on its shaft which is pushed into contact with the inside rim of the drum by a pressure spring. Power is fed to this assembly through the motor control solid state relays, see 040-1065-001, each time the tray reaches its retracted position.

2. Keep the rubber tire drive wheel tight on the shaft. It is held by a set screw under the tires.

   If this wheel is loose, the index will be erratic and a jam may occur.

6.13:

The drum drive motor and the shift motor are protected by a $\frac{1}{4}$ ampere fuse F1. In the event of control failure such that both motors would run at the same time, this fuse will blow.

SYMPTON AND SERVICE NOTES

The following symptoms and solutions do not represent every possible situation or condition. Other factors may be involved. It is assumed that all power supplies are within range. Test these separately if suspect. Check both fuses.

Read section 4 to understand operation.

> CAUTION: Do not remove or plug in the circuit boards when power is turned on. Line voltage is present, when power is on, at the shift/rotate motor control plate and in the tape transport. Use care to avoid injury.

INDEX TO SYMPTOMS

> Note: For electronic problems, particularly intermittant ones, always clean card fingers and sockets with non-silicone approved cleaning fluid.

SYMPTOM	CAUSE - SOLUTION
1. Drum won't rotate- either direction. NOTE: Rotate Push Buttons work only in "MANUAL" mode.	a. Tray not all the way out. See "OUT" Sensor lite in "On". Fig.3
	b. If lite is "ON", check for 0.7v. DC on SS-3 or SS4 pin shown in Fig. 3. If SS-3 or SS4 not low, check IC-3 on CLC-1. If SS-3 or SS-4 is low, check AC to Rotate Motor. CAUTION: 117v. If no AC, replace SS-3 or SS-4.
	c. Rotate Motor or its capacitor defective.
2. Motor runs, but drum turns erraticaly or not at all.	a. See 010-0108. Drive Wheel loose on gear shaft. Drive tires worn out or covered with oil. See Fig.4. Pressure spring broken or missing.
3. Drum turns part way and stalls.	a. Mechanical obstruction check index flags hitting index Sensor,etc.
4. Tray won"t move in or out. NOTE: Tray Push Button not active in AUTO MODE or if Deck Pinch Roller is engaged.	a. Press MAN push button LED "ON". Press STOP if pinch roller is up. SEE Fig. 3. If tray is already "in" check for "low" on SS-1 when TRAY button is pressed. If low is present, check SS-1 & shift motor/capacitor. To replace motor, refer to Fig. 2.
	b. If tray is "out", repeat a. and check SS-2.
	c. If switching signal to SS-1 or SS-2 does not go "low", check LED in TRAY button. It will be "on" if IC-3 on CLC-1 is working. If no light change IC-3.

	SYMPTON	CAUSE - SOLUTION
5.	Tray Motor runs, but tray does not shift moves in jerks.	a. See Fig.2b. Gear loose on shift motor shaft. To service gear, follow instructions for removing shift motor.
6.	Shift System does not place cartridge up against head block on transport deck. (Item 57 on 010-0109-001). NOTE: Proper travel is when shift motor stops just as a cartridge reaches front of head block. Cartridge hold-down spring (item 62 on 010-0109-001) must not exert excess pressure on top of cartridge---just touch top surface.	a. Refer to #010-0111-001. Shift tray out. Remove logo disc (74). Shift good cartridge in. If cartridge stops short of head block, loosen set screw holding hub of shift ring (75) to shift rod. Carefully slide shift ring toward drum until cartridge just touches head block. Be sure to keep pin fork (76) centered on shift pin (82). Tighten hub set screw securely. Replace logo disc. b. If cartridge hits head block before motor stops, repeat a, but pull shift ring forward slightly.
7.	Shift ring tries to rotate when cartridge shifts in & out.	a. See 010-0107-001. Shift rod guide (11) not properly positioned. Remove shift motor assembly (See Fig. 2) & slide shift rod (5) all the way in. Adjust (11) to just touch flat on rod. Reinstall shift motor assembly. Be sure to get shim (16) in place. b. Shift ring loose on shift rod.

SYMPTON	CAUSE - SOLUTION
8. Cartridge will shift in & back right out.	a. See #010-0109-001. Cartridge Sensor Switch (located below item 59) is not operating. Refer to schematic #040-1066-001. b. IC-3 on CLC-1.
9. Won't arm any tray from programmer. Other Carousels are OK. NOTE: Check CLC-1 Board for proper position of jumper J1. See notes on Schematic 020-0635-002 for type of memory programmer being used.	a. Carousel in Manual. b. Carousel in Sequential. See Section 4. c. Cable from SO-2 to Junction Box missing. d. Code signals from code reader board (see Fig.4) must be present. If no LED lighted, check for 5v. power to board. See schematic 040-1064-001. Every tray number must light those LED's whose code adds to that number, ie 13=Bit 8+4+1. Index LED must be "on". e. Replace IC-5 on CLC-1 board. f. Replace CLC-1 board.
10. Won't arm trays #8 thru #15, & #24. Ditto similar groups as #4 thru 7.	a. 8 bit sensor must give solid LED signal at all numbers 8 thru 15. Check that code disc polished ares are clean. Use soft cloth & alcohol. Do not use caustics. Reflecting sensors must aim directly at polished stripes.

	SYMPTON	CAUSE - SOLUTION
11.	All trays shift in low clockwise & high counter clockwise.	a. See section 4, Fig. 2A and Fig. 4. Stop time delay is too short. Adjust R26 on CLC-1 so that index flag (Fig.4) stops drum at center of Index Sensor.
12.	All trays shift in high clockwise & low counter clockwise.	a. Stop delay too long. Set R26 as in (a) above.
13.	Particular tray is too high or too low in both rotation directions.	a. Index flag for that tray requires adjusting. See Fig.4. NOTE: The flag for the subject tray is located on the left rear of the drum. It is the one at the index sensor. b. If tray is "high", move flag counter-clockwise facing rear of drum. c. If tray is "low", move flag clockwise. Keep flags square with drum.

NOTE: For the Following, Read Page 3.3

14.	Won't pull any tape cartridge.	a. See Fig. 1A. Tape cartridge too far from head block & is holding pinch roller away from capstan. Tray shift needs adjustment. Refer to symptom 6. b. Pinch roller not turning. c. Motor not running.

	SYMPTOM	CAUSE - SOLUTION
15.	Some cartridge tapes won't pull.	a. Tape worn out. b. Turntable jammed.
16.	Some tapes jump over top of capstan or "squirt" out of cartridge.	a. Tape wound too loose or worn out.
17.	Some tapes drop below pinch roller & stop.	a. Tape wound too tight. Tape lubrication worn out.
18.	Tapes "sound" slow.	a. Pinch roller & Capstan shaft slick, clean with alcohol or head cleaner. Use crocus cloth on shaft. Pinch roller must turn freely & not be worn out.
19.	"DROP OUTS"- loss of some program or cue track information.	a. Tape not held against heads properly. b. Worn or improper pressure pads. Beware of pads that take a "set" & lose their spring back. c. Tape not pulling smoothly over heads due to improper tensions.
20.	"Flutter"	a. Pinch roller worn out. b. Pinch roller not turning freely. c. Capstan damaged. d. Flutter recorded on tape.
21.	All tapes "ride" above top of pinch roller.	a. See Fig. 1. Tension band needs to be shortened. Refer to Section 6.3. b. Cross shaft out of adjustment. See Section 6.4.

	SYMPTOM	CAUSE - SOLUTION
22.	Pinch roller comes up to slowly.	a. Cross shaft too tight. See Section 6.4. b. Solenoid control board. See 040-1068-001. This board located inside main chassis. c. Probably Q2. Check DC volts to board at 28v. d. Air vent hole in foil on bottom of Solenoid screw plugged.
23.	Solenoid won't operate.	a. Check coil resistance at approximately 25 ohms. See 040-1066-001. b. Check DC volts across solenoid. Should be 22v. When START BUTTON pressed. c. Check for logic high signal at "START" pin of Solenoid Control board when "START" button is pressed. This signal comes from Q1 on CLC-1. d. If no or low DC for Solenoid, replace Solenoid Control board. e. Solenoid plunger jammed dismantle & clean. f. Cross shaft or pinch roller jammed.
24.	Pinch roller won't drop down on STOP.	a. Cross shaft too tight see Section 6.4. b. Return spring weak or missing. See Fig. 1. c. Solenoid plunger dirty. d. Idler roller (47) binding.

	SYMPTOM	CAUSE - SOLUTION
25.	Capstan motor will not run unless spun by hand.	a. Motor capacitor (52). b. Motor winding.
26.	Cue track signals audible in program at normal play volume.	a. Tape running too high on heads. b. Tape guides set too high. c. Head set too low. d. Cue signals recorded above NAB levels.
27.	False cue system operation.	a. Program track signals getting into cue. b. Tape running too low. c. To separate problem from electronic system, run a well-erased taped. If cue system still malfunctions, problem is likly electronic.
28.	Squeek when pinchroller is engaged or disengaged.	a. Put 1 drop oil on lower part of return spring (45) Fig.1.
29.	Hum on program or cue track.	a. Head coil or jack grounded to head block. Remove cable & test. The only ground is at chassis end of cable. c. 24v. Regulator VR-2 or C4. d. Excessive current in 24v. system. Check solenoid resistance @ 25 ohms.
30.	No program output.	a. Check 24v. DC on PR-2. b. Check output cable from SO-1. c. Check LM381 IC on PR-2.

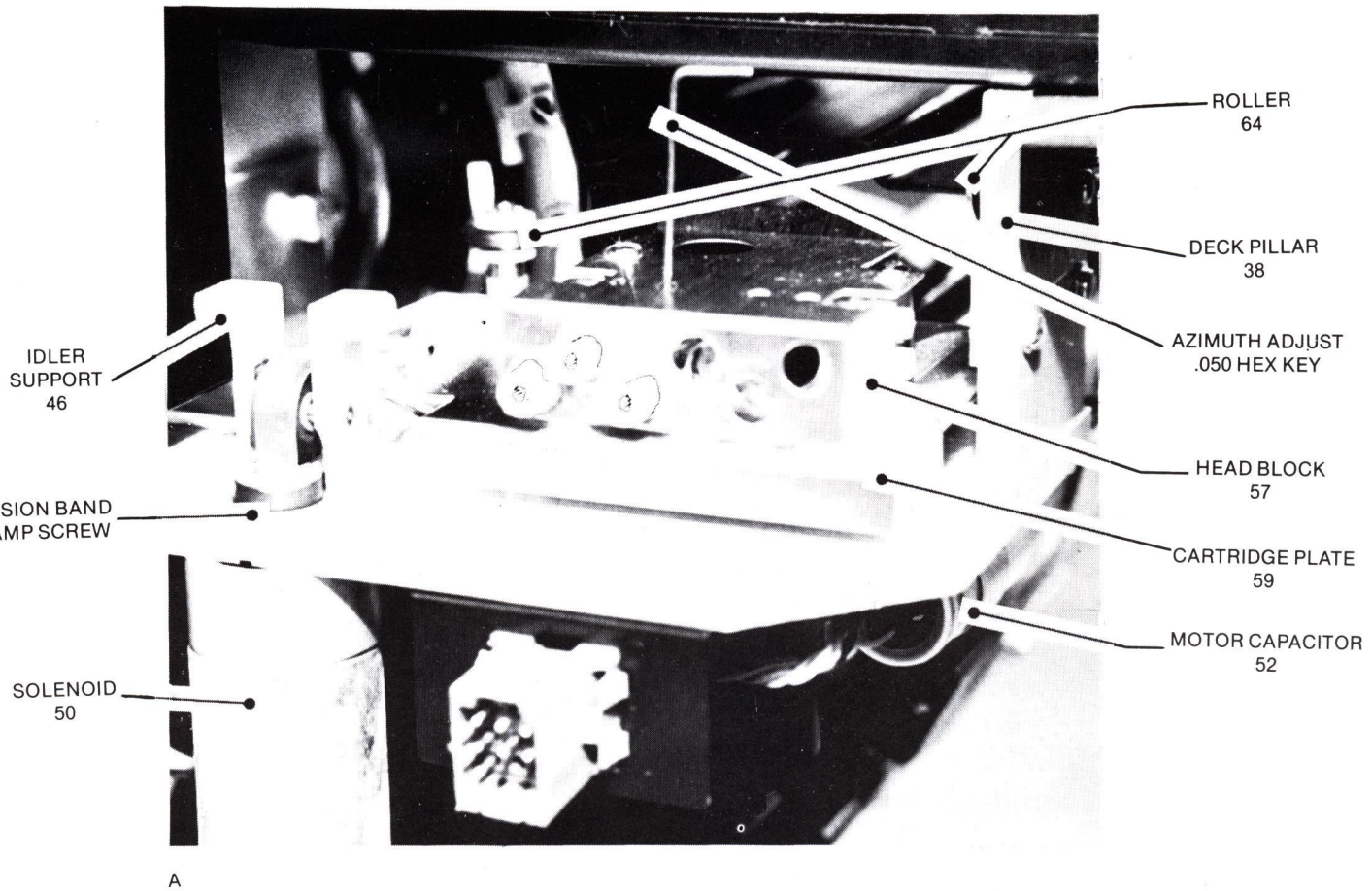
	SYMPTOM	CAUSE - SOLUTION
31.	In stereo, Left & Right channels reversed.	a. See Fig. 2A for cables from heads to chassis. b. Check cable to SO-1.
32.	Cue System "dead"	a. Put cable from cue head into "L" jack on chassis & listen for cue signals, logging etc. If no sounds, check cue head & cable.
33.	High frequency response is deteriorating.	a. This is normal as heads wear. b. Dirty head. c. Poor pressure pads. d. Head is magnetised. NOTE: Do not expect standard calibration tape to last forever. It loses its higher frequency first. Do not keep advancing equalization controls for a worn-out test tape.
34.	Levels don't stay constant.	a. Recording levels not controlled. b. Bad pressure pads.
35.	Tapes sound "muddy".	a. Head azimuth of recorder & player not the same. b. Pressure pads not holding tape against heads. c. Tape travel not smooth. Cartridge jerky.

SYMPTOMS	CAUSE - SOLUTION

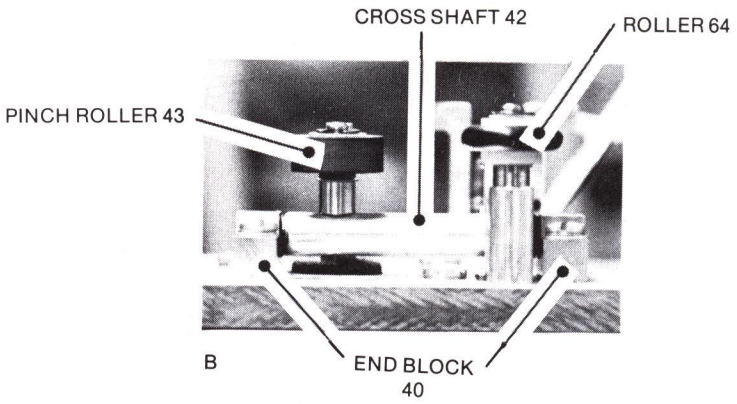
TRANSPORT DECK

Series 800—Model 450 Carousel®

See 010-0109-001

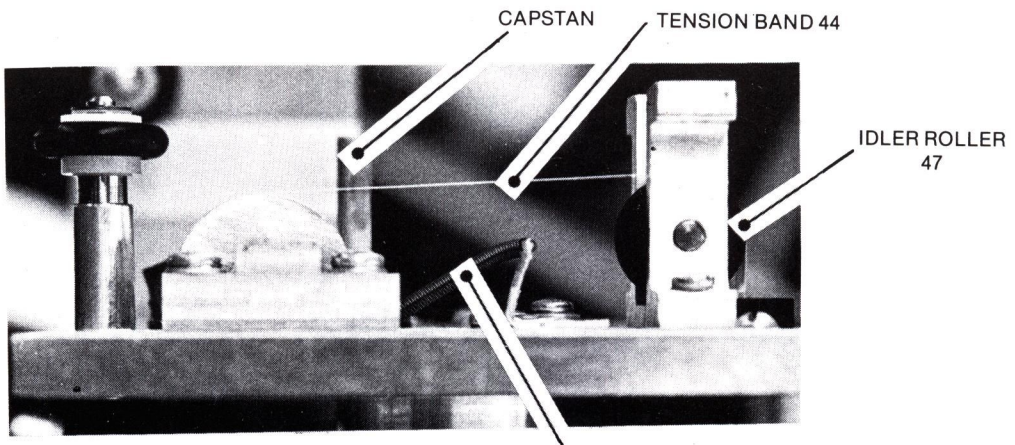


A



B

Fig. 1



C

CHASSIS AND TRAY SHIFTING PARTS

Series 800—Model 450 Carousel®

See Dwg. #010-0107-001

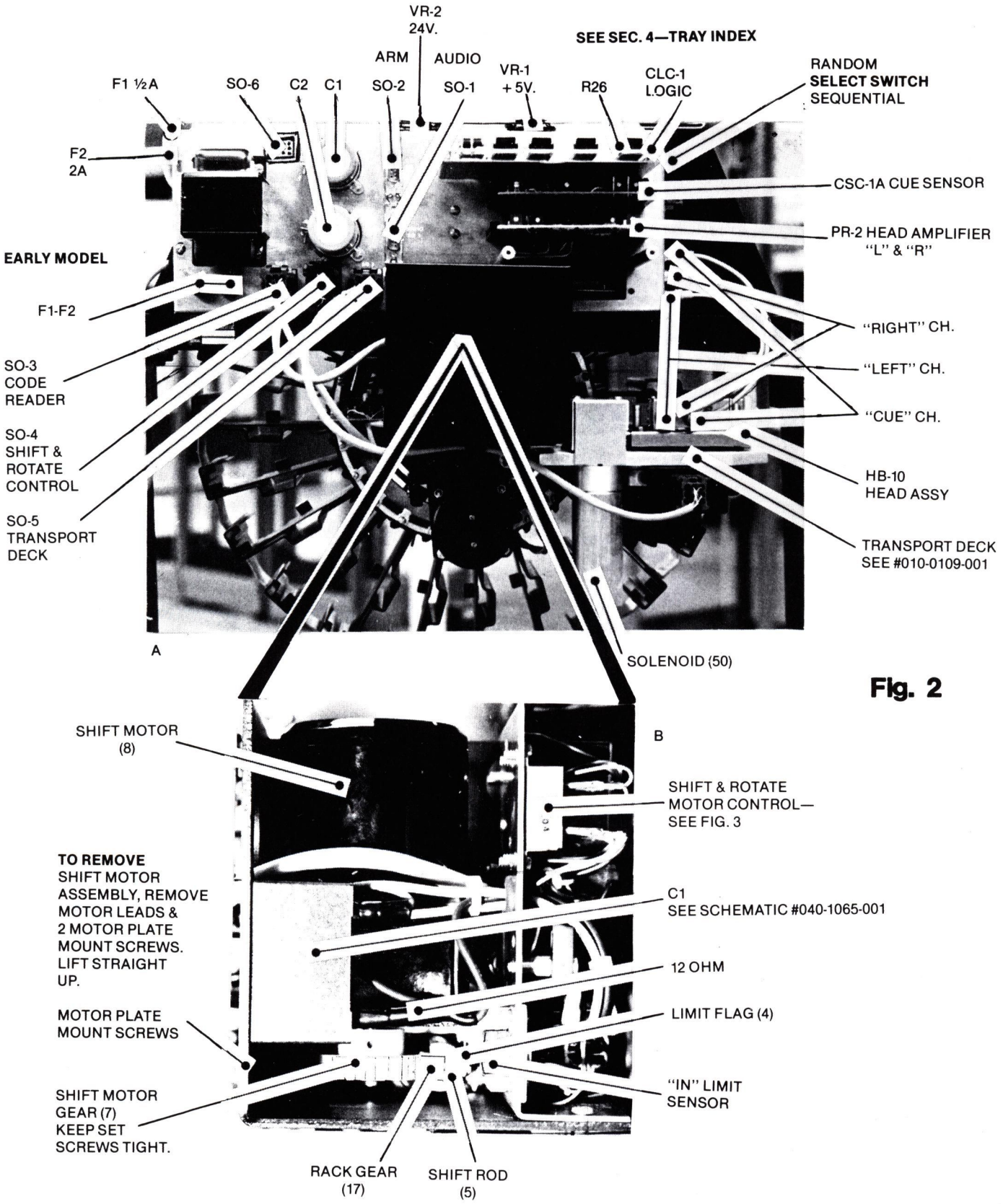


Fig. 2

SHIFT & ROTATE MOTOR CONTROL

Series 800—Model 450 Carousel®
See 040-1065-001 Schematic

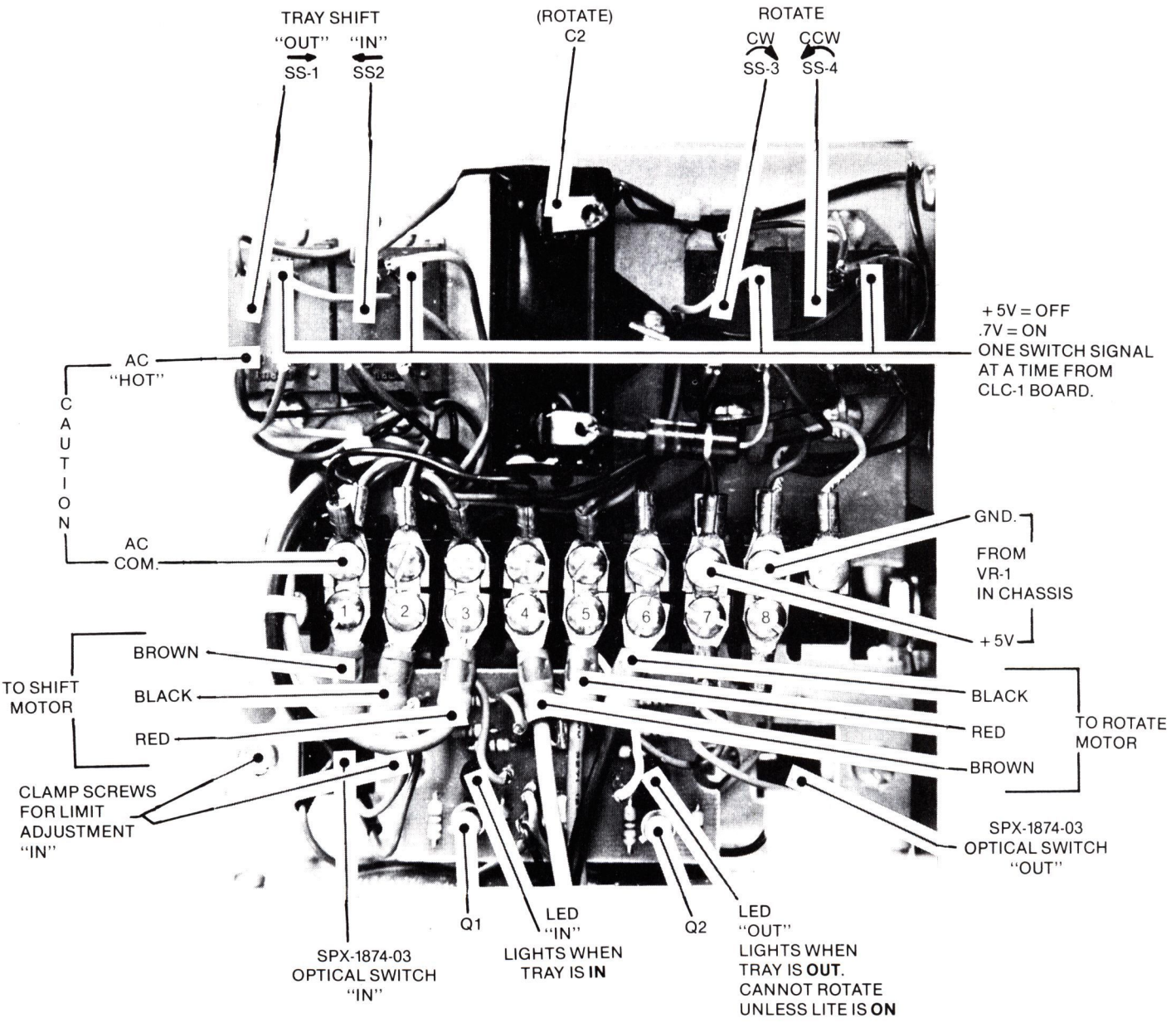


Fig. 3

CODE READER & INDEX SENSOR

Series 800—Model 450 Carousel®
See 040-1064-001 Schematic

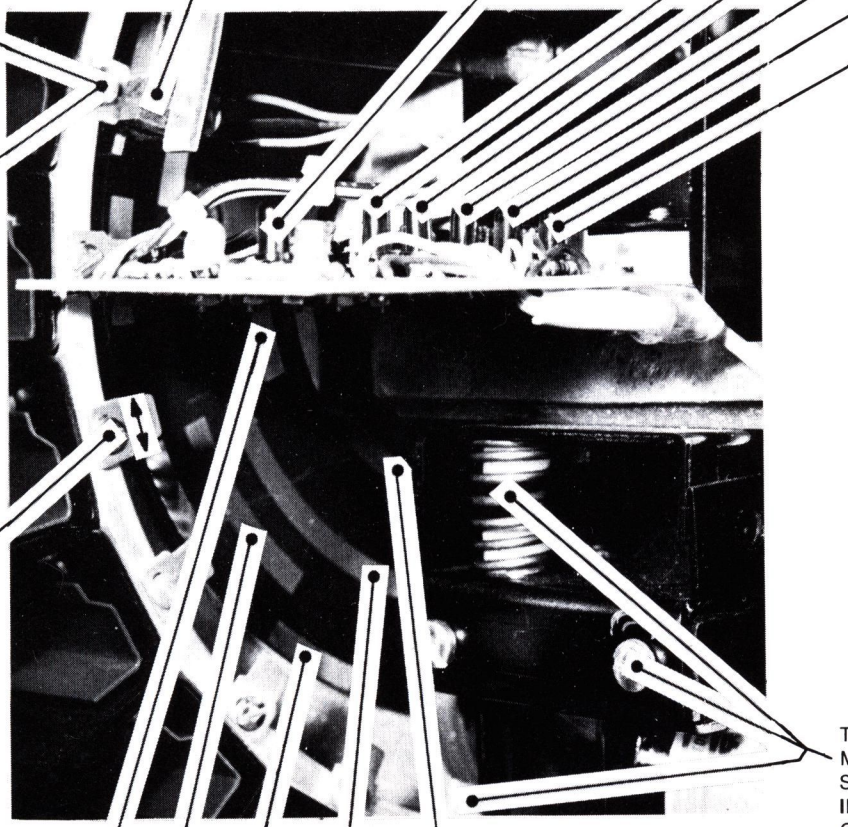


Fig. 4

SECTION 7

MODEL 450 CAROUSEL CHASSIS PARTS

ITEM	STOCK NUMBER	DESCRIPTION
3	030-1084-001	Cover, Cardcage
5	550-0008-000	Transformer, M873B/M874 115v/220v
6	556-0006-000	Transformer, Audio M975/M976
7	356-0002-000	Card Socket, Dual 22 pin
8	356-0013-000	Card Socket, Dual 25 pin
17	477-0026-000	LM309K 5v Regulator
18	477-0236-000	LM317K 24v Regulator
22	296-0001-000	Capacitor, 5600mf @ 25v
23	296-0003-000	Capacitor, 5000/6000 @ 40v
25	482-0012-000	Rectifier, B40-C2000 Fagor
26	150-0406-001	RF-2 Circuit Board
48		Line Filter Board
49	342-0023-000	RCA Phono Jacks

Catalog #150-0284-001

EMI Board RFI Filter

1	292-0014-000	.01uF Disc Capacitor
2	572-0002-000	10 uH Choke

Catalog #155-0149-001

Control Switch Assy.

1	040-1046-001	Switch Plate - Marked Legend
2	334-0043-000	Switch: C&K 8168J862Q-2-2-03
3	334-0044-000	Switch: C&K 8161J862Q-2-2-03
4	342-0052-000	Receptacle: AMP 207443-1-18
5	346-0028-000	Pins, Male: AMP 66103-2

Catalog # 150-0405-001

Solenoid Control Board

ITEM	STOCK NUMBER	DESCRIPTION
1		
2	474-0001-000	2N3053 Transistor
3	474-0024-000	2n6288 Transistor
4	482-0001-000	1N4003/4 Diode
5	252-0023-000	7.5 OHM 5W Resistor
6	250-0097-000	1000 OHM ¼W Resistor
7	250-0101-000	2200 OHM ¼W Resistor
8	250-0109-000	10K OHM ¼W Resistor
9	250-0121-000	100K OHM ¼W Resistor
10	294-0002-000	330Mf@35volt Capacitor
11	342-0054-000	Plug, 5 pin Right Angle Molex (Male)

Catalog # 150-0145-002

CSC-1A Cue/Sensor Board

ITEM	STOCK NUMBER	DESCRIPTION
2	250-0075-000	Resistor, 15 OHM ¼W
3	250-0085-000	Resistor, 100 OHM ¼W
4	250-0089-000	Resistor, 220 OHM ¼W
5	250-0091-000	Resistor, 330 OHM ¼W
6	250-0097-000	Resistor, 1000 OHM ¼W
7	250-0101-000	Resistor, 2200 OHM ¼W
8	250-0105-000	Resistor, 4700 OHM ¼W
9	250-0109-000	Resistor, 10K OHM ¼W
10	250-0111-000	Resistor, 15K OHM ¼W
11	250-0113-000	Resistor, 22K OHM ¼W
12	250-0115-000	Resistor, 33K OHM ¼W
13	250-0120-000	Resistor, 82K OHM ¼W
14	250-0125-000	Resistor, 220K OHM ¼W
15	260-0001-000	Pot., 10K
17	288-0005-000	Cap. 0.033mf Mylar
18	288-0018-000	Cap. 0.1mf Mylar
19	292-0001-000	Cap. 0.1mf Disc
20	292-0003-000	Cap. 0.01mf Disc
21	292-0004-000	Cap. 0.22mf Disc
22	292-0007-000	Cap. 270pf Disc
23	292-0012-000	Cap. 0.001mf Disc
24	298-0005-000	Cap. 2.2mf Tant.
25	294-0006-000	Cap. 8-10mf. Electro.
26	294-0007-000	Cap. 15mf Electro.
27	294-0022-000	Cap. 50mf Electro.
28	298-0003-000	Cap. 0.47mf Tant.
30	288-0013-000	Cap. 0.022mf Mylar
31	292-0006-000	Cap. 50pf Disc.
35	477-0002-000	IC NE567/LM567
36	477-0004-000	IC 7402
37	477-0025-000	IC LM381
38	474-0016-000	Transistor 2N2222
39	482-0002-000	Diode 1N914
40	348-0001-000	Socket IC 14 pin Dip
41	348-0002-000	Socket IC 16 pin Dip
42	496-0001-000	Insulator, Transistor Pad

Catalog # 150-0146-001

PR-2 Program Amplifier Board

ITEM	STOCK NUMBER	DESCRIPTION
1	288-0018-000	.1mf Cap. plastic
2	294-0031-000	250uF Electro. Cap.
3	288-0013-000	.022mf Cap.plastic
4	294-0006-000	8mf Electro. Cap
5	292-0006-000	50pf Disc Cap.
6	477-0025-000	LM381 IC
7	474-0001-000	2N3053
8	260-0001-000	10K Pot
9	250-0105-000	4700 OHM ¼W Resistor
10	250-0111-000	15K OHM ¼W Resistor
11	250-0099-000	1500 OHM ¼W Resistor
12	250-0097-000	1000 OHM ¼W Resistor
13	250-0093-000	470 OHM ¼W Resistor
14	250-0075-000	15 OHM ¼W Resistor
15	250-0021-000	2700 OHM ¼W Resistor
16	250-0113-000	22K OHM ¼W Resistor
17	250-0109-000	10K OHM ¼W Resistor
18	250-0002-000	22 OHM ½W Resistor
19	250-0013-000	470 OHM ½W Resistor
20	250-0123-000	150K OHM ¼W Resistor

NOTE: For IEC Compensation:
2 pieces
250-0089-000 220 OHM ¼W Resistor

Catalog # 150-0402-001

CLC-1 Carousel Logic Control Board

ITEM	STOCK NUMBER	DESCRIPTION
2	348-0001-000	14 Pin IC Socket
3	348-0002-000	16 Pin IC Socket
4	348-0015-000	8 Pin IC Socket
5	348-0003-000	24 Pin IC Socket
6	348-0016-000	40 Pin IC Socket
7	474-0016-000	2N2222 Transistor
8	477-0020-000	555 IC
9	477-0006-000	7404 IC
10	477-0001-000	7400 IC
11	477-0136-000	74LS42 IC
12	477-0166-000	6802 IC
13	477-0171-000	6821 IC
14	477-0207-000	2716 IC
15	496-0001-000	Transistor Pad
16	292-0005-000	0.1 Cap.
17	292-0015-000	27pf Cap.
18	294-0005-000	4.7mf Cap
19	294-0021-000	100mf Cap.
20	294-0022-000	47mf Cap.
21	298-0006-000	3.9mf Cap.
22	288-0004-000	0.01mf Cap.
23	250-0089-000	220 OHM ¼W Resistor
24	250-0091-000	330 OHM ¼W Resistor
25	250-0097-000	1000 OHM ¼W Resistor
26	250-0103-000	3.3K OHM ¼W Resistor
27	250-0105-000	4.7K OHM ¼W Resistor
28	250-0101-000	2.2K OHM ¼W Resistor
29	250-0121-000	100K OHM ¼W Resistor
30	260-0002-000	100K POT.
31	325-0006-000	3.579545MHz Crystal
32	482-0002-000	1N914 Diode
33	482-0001-000	1N4001/2 Diode
34	270-0004-000	Transient Suppressor V8ZA-1
35	477-0132-000	74LS14

Catalog # 155-0148-001

Shift/Rotate Control Assy.

ITEM	STOCK NUMBER	DESCRIPTION
1	030-1060-001	Switch/Sensor Bracket
2		
3	250-0105-000	4700 OHM ¼W Resistor
4	250-0093-000	470 OHM ¼W Resistor
5	252-0005-000	12 OHM ½W BWH Resistor
6	286-0005-000	2.5 mf @ 330V Capacitor
7	310-0010-000	SS Relay-Sigma 226R-4-5A1
8	342-0050-000	Socket (Recp) AMP 20718-1
9	346-0028-000	Pins-Male-AMP 66103-2
10	490-0002-000	Indicator/LED
11	490-0009-000	Limit Sw. SPX-1874-03
12	474-0016-000	2N2222 Transistor
13	496-0001-000	Transistor Pad
14	040-1041-001	Guide: Flag
15	358-0015-000	Barrier Strip 140-8 Terminal
16		Spacer ½"x¼" #6 Tapped
17	837-0025-000	Spacer Insulated 5/8"x#6 Tapped
18		Spade Terms. #6 Screw
19	345-0054-000	Pins Molex 02-06-1103
20	717-0005-000	Cable, 12 Cond.
21	030-1060-002	Sensor Bracket

Catalog # 155-0146-001

Code-Flag Sensor Assy.

ITEM	STOCK NUMBER	DESCRIPTION
1	040-1062-001	Mount Bracket
2	040-1063-001	Switch Bracket
3		
4	250-0089-000	220 OHM ¼W Resistor
5	250-0093-000	470 OHM ¼W Resistor
6	250-0097-000	1000 OHM ¼W Resistor
7	250-0105-000	4700 OHM ¼W Resistor
8	342-0053-000	Socket (Recp.) AMP 207440-1
9	346-0028-000	Pins Male AMP 66103-2
10	490-0008-000	Reflect Sensor, SPX-2498-3
11	490-0009-000	Switch Optic SPX-1874-3
12	474-0016-000	2N2222 Transistor
13	496-0001-000	Transistor Pad
14	490-0002-000	Indicator LED
15	040-0753-001	Spacer ¼"

Catalog # 155-0147-001

Display-Tray No. Assy. for 450

ITEM	STOCK NUMBER	DESCRIPTION
1		
2	250-0990-000	270 OHM ¼W Resistor
3	292-0001-000	0.1 disc. Capacitor
4	342-0053-000	Socket/Recptacle AMP 207440-1
5	346-0028-000	Pin Male AMP 66103-2
6	348-0002-000	Socket, IC 16 pin
7	348-0003-000	Socket, IC 24 pin
8	477-0156-000	4511 IC
9	502-0002-000	6740 IC
10	837-0025-000	Spacer Insulated 5/8 #6 Tapped
11		
12	717-0011-000	Cable, 9 Cond.

Refer to Drawing Numbers
010-0107-001 thru 010-0111-001

MECHANICAL PARTS MODEL 450

ITEM	STOCK NUMBER	DESCRIPTION
1	020-0634-001	Shift Housing
2	030-1060-001	Motor Switch Bracket
3	040-1041-001	Limit Flag Guide
4	040-1078-001	Limit Flag
5	040-1047-001	Shift Rod
6	020-0634-002	Shift Motor Plate
7	040-1075-001	Shift Motor Gear
8	155-0155-001	Shift Motor/Gearhead Assy.
9	030-1087-001	Motor Box Cover
10	040-1042-001	Housing Spacer
11	040-1044-001/2	Shift Rod Guide
12	030-1060-002	Limit Switch Plate
13	490-0009-000	Optic Switch
14	310-0010-000	Triac Relay
15	286-0003-000	2.5 Mfd Motor Capacitor
16	040-1054-001	Motor Plate Shim
17	040-1048-001	Rack Gear
18	020-0654-002	Main Bearing Block
19	020-0652-002	Hinge Bracket
20	020-0652-003	Swing Bracket
21	020-0652-001	Motor Mount
22	155-0156-001	Rotate Motor/Gearhead Assy.
23	040-1045-001	Drive Pulley
24	762-0021-001	Drive Tire (set of 2)
25	791-0005-000	Tray Rotate Spring
26	040-1043-001	Spring Retainer
27	040-0466-001	Hinge Pin
28	837-0031-000	Hinge Pin Retainer (Palnut type)
29	Standard Hardware	
30	Standard Hardware	
31	Standard Hardware	
32	Standard Hardware	
33	Standard Hardware	
34		Motor Mounting Screw
35	Standard Hardware	
36	Standard Hardware	
37	030-1075-001	Deck Plate
38	040-1052-001	Deck Pillar
39	040-1077-001	Nylon Guide
40	040-0420-001	End Bearing Block
41	837-0002-000	End Bearing
42	040-1053-001	Cross Shaft
43	155-0058-001	Pinch Roller Assy.
44	040-0295-001	Deck Drive Band
45	791-0006-000	Crosshaft Return Spring
46	040-1051-001	Idler Bracket

Refer to Drawing Numbers
010-0107-001 thru 010-0111-001

MECHANICAL PARTS MODEL 450

Continued

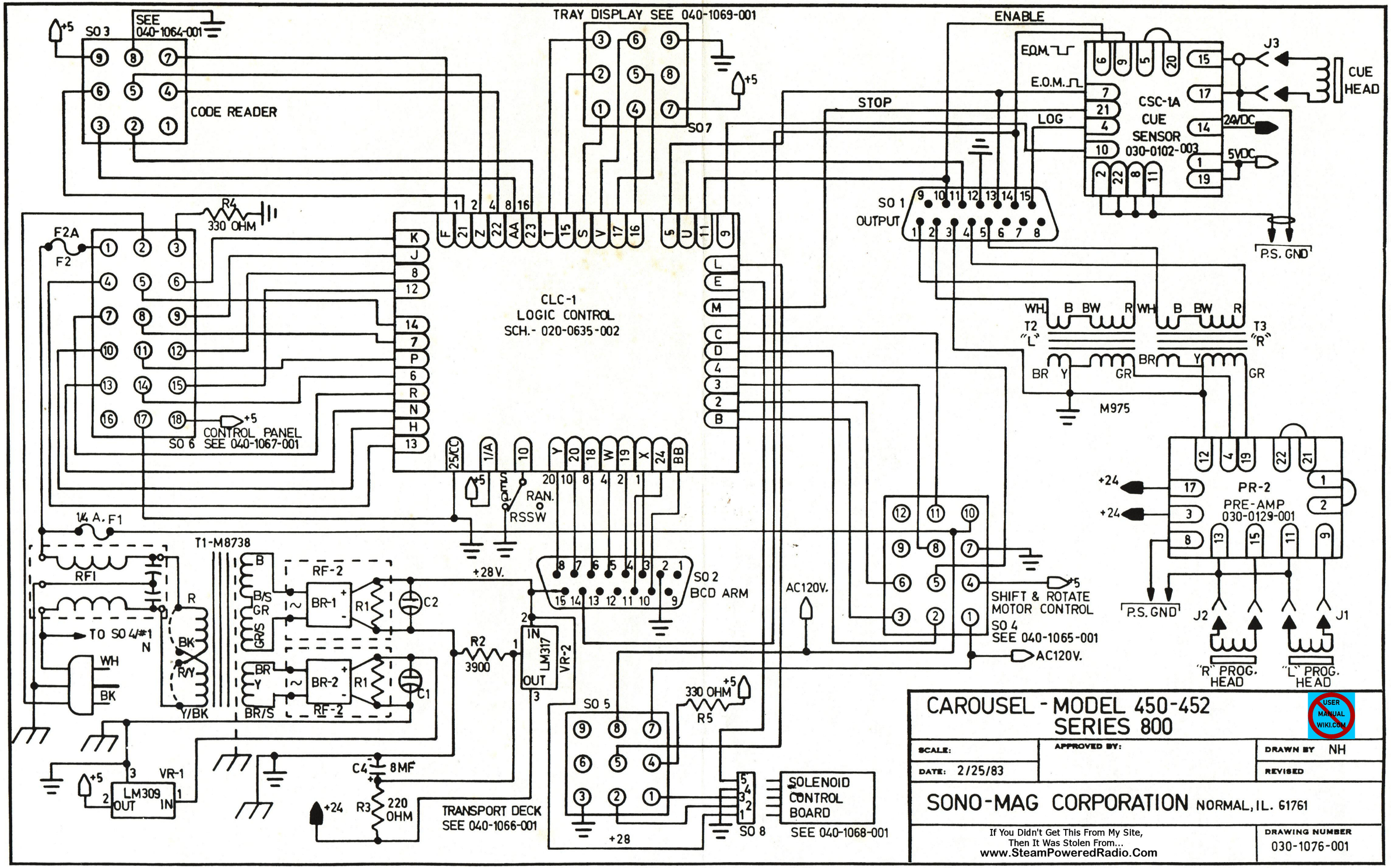
ITEM	STOCK NUMBER	DESCRIPTION
47	155-0150-001	Idler Roller
48	040-1079-001	Axel
49	040-1076-001	Spacer (Solenoid)
50	155-0151-001	Solenoid - 24 volt
50A	040-1084-001	Shell
50B	040-1084-002	End Washer-Tapped
50B	040-1084-003	End Washer-Plain
50C	040-0241-001	Butt Piece Plated
50D	040-0262-001	Plunger-Teflon
50E	040-0272-001	Clamp Bar-Brass
50F	040-0240-001	Butt Screw-Nylon
50G	854-0003-000	Tube-Coil-Brass
50H	040-1084-004	Washer-Insulate
51	775-0010-002	Capstan Motor
52	286-0008-000	.7Mfd Motor Capacitor w/Clip
53	040-1070-001	Socket Plate
54	342-0053-000	9 Pin AMP Socket/Male
55	040-1082-001	Idler Support Cover
56	030-0619-001	Spindle
57	030-0168-001	Head Block
58	574-0005/6-000	Tape Head
59	040-1071-001	Cartridge Plate
60	040-0781-002	Spacer (Cart. Plate)
61	490-0009-000	Optic Switch
62	030-0803-001A	Spring Cover
63	040-0415-00	Roller Shaft (Carostat)
64	040-1061-001	Roller
65	040-1061-002	Spacer
66	040-1050-001	Clamp
67	040-1050-002	Anchor (Spring)
68	030-1074-001	CAM-Cross Shaft
69	040-0298-001	Roller Shaft (Cross Shaft)
70	040-1046-001	Switch Panel
71	030-1077-001	Escutcheon
72	040-1046-002	Display Panel
73	030-0344-001	Escutcheon Mounting Clip
74	385-0002-000	Disc, Trim Logo
75	030-0062-001	Shift Ring
76	040-1073-001	Pin Fork
77	030-1090-001	Shift Rod Assy.
78	020-0089-003	Drum
79	020-0650-001	Tray, Inner (Teflon)
80	020-0049-001	Tray, Outer-Enamel
81	040-0463-001	Tray Brace (Plate)
82	837-0047-000	Tray Pin
83	040-1040-001	Index Flag (Mylin)

Refer to Drawing Numbers
010-0107-001 thru 010-0111-001

MECHANICAL PARTS MODEL 450

Continued

ITEM	STOCK NUMBER	DESCRIPTION
84	030-1073-001	Code Disc (Mylin)
85	140-0448-001	Main Shift
86		
87	020-0654-002	Bearing Block
88	040-1042-000	Spacer, Housing
89		See Dwg. 010-0107-001
90	040-1062/1063	Code Reader & Sensor Bracket
91	020-0651-	Main Frame
92	040-1049-001	Deck Support
93	010-0109-001	Deck Assy.
94		See Dwg. 010-0108-001
95	155-0125-001	Mount Rail Assy. (1R/1L)
96	020-0628-001	Electronic Chassis Assy.
97	010-0111-001	Drum Assy. W/Inner/Outer Trays/ Tray Spacers/Pins/Code Disc.
98	030-1086-002	Bearing Block Assy. w/Bearings and Shaft
99		

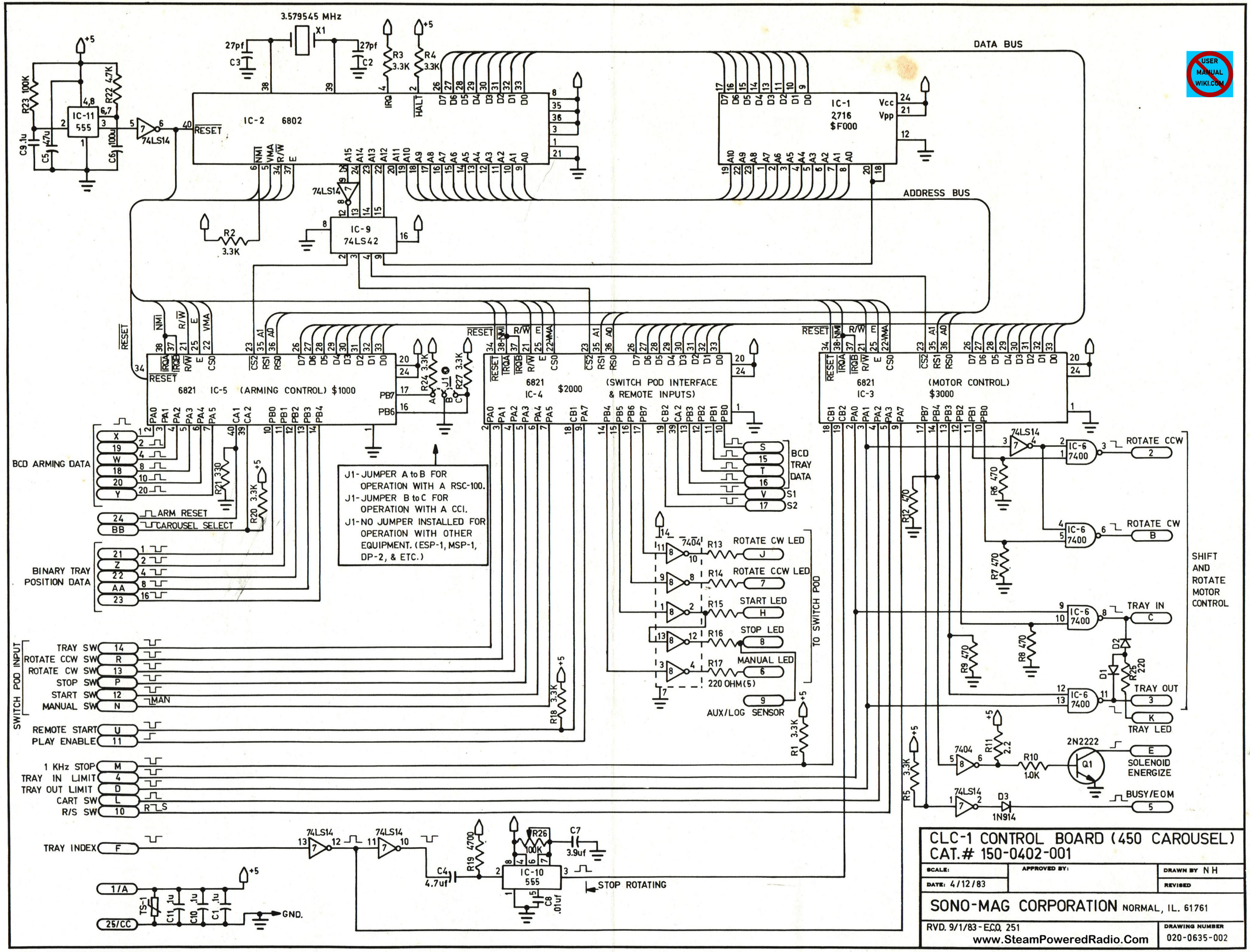


CAROUSEL - MODEL 450-452
SERIES 800

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 2/25/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 030-1076-001



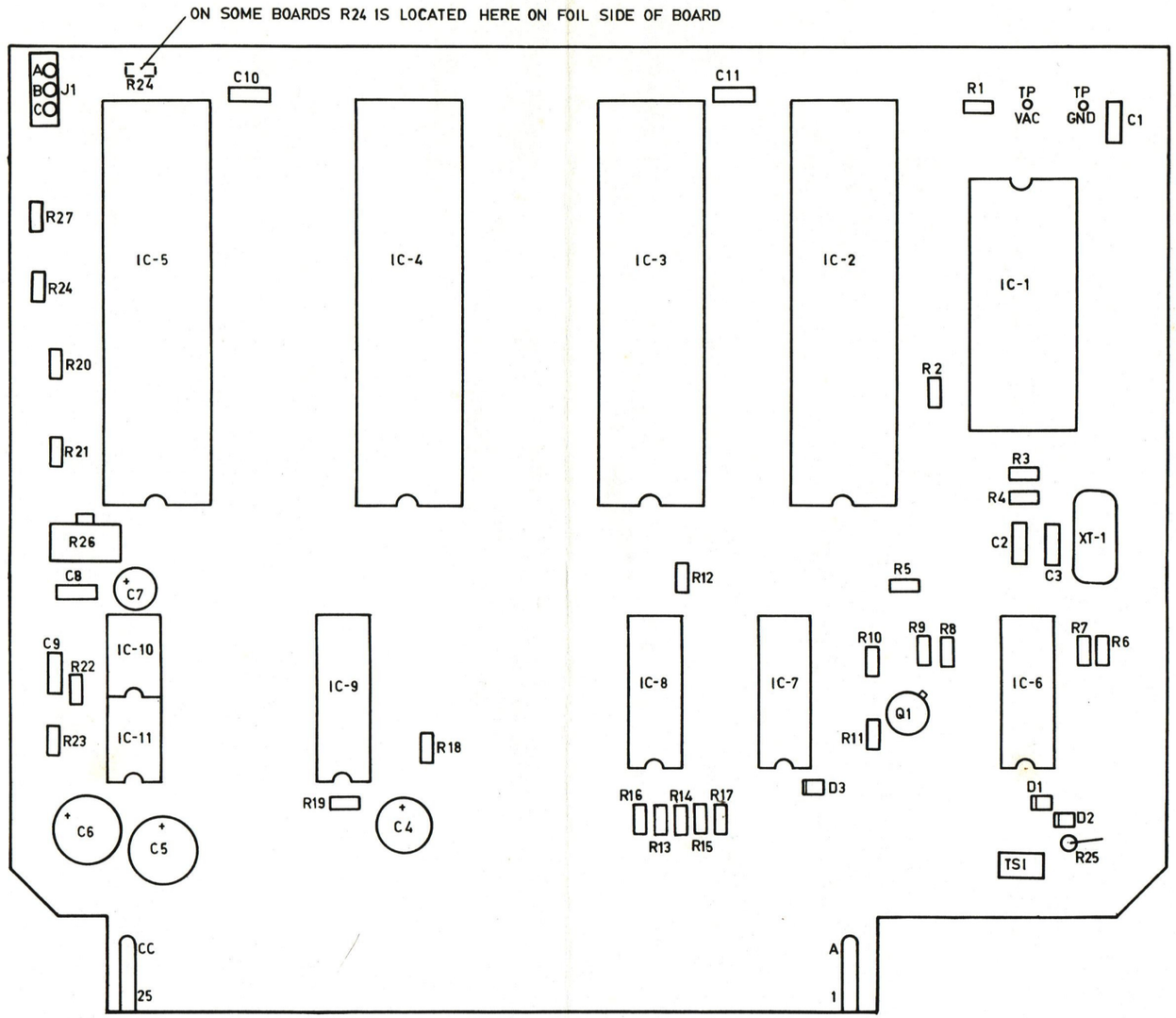
CLC-1 CONTROL BOARD (450 CAROUSEL)
CAT.# 150-0402-001

SCALE:	APPROVED BY:	DRAWN BY N H
DATE: 4/12/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

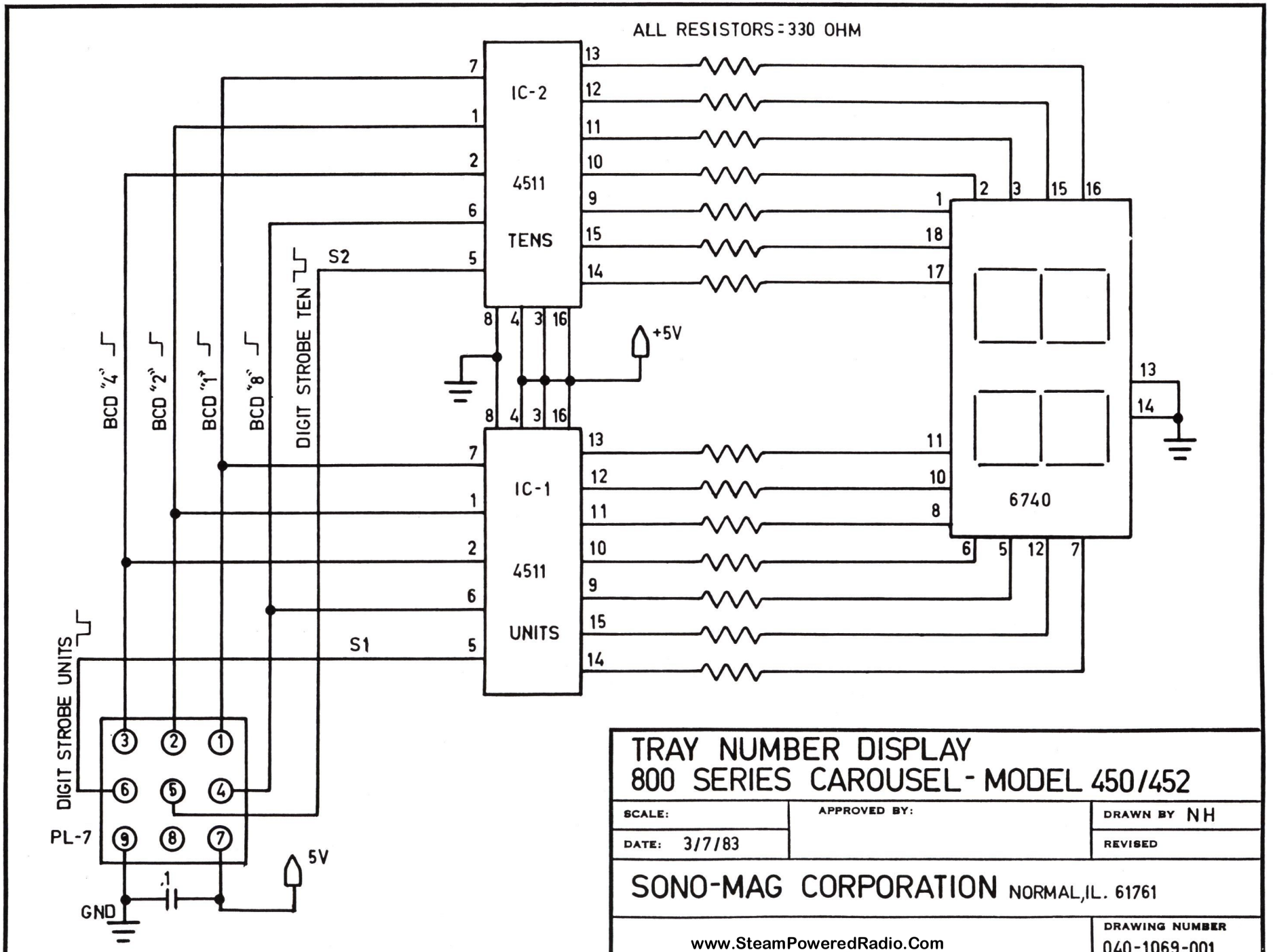
RVD. 9/1/83 - ECO 251

DRAWING NUMBER 020-0635-002



SCH. 020-0635-002

CLC-1 LAYOUT		CAT # 150-0402-001
SCALE: 2:1	APPROVED BY:	DRAWN BY NH
DATE: 2/17/83		REVISED
SONO-MAG CORPORATION NORMAL, IL. 61761		
		DRAWING NUMBER 020-0653-001



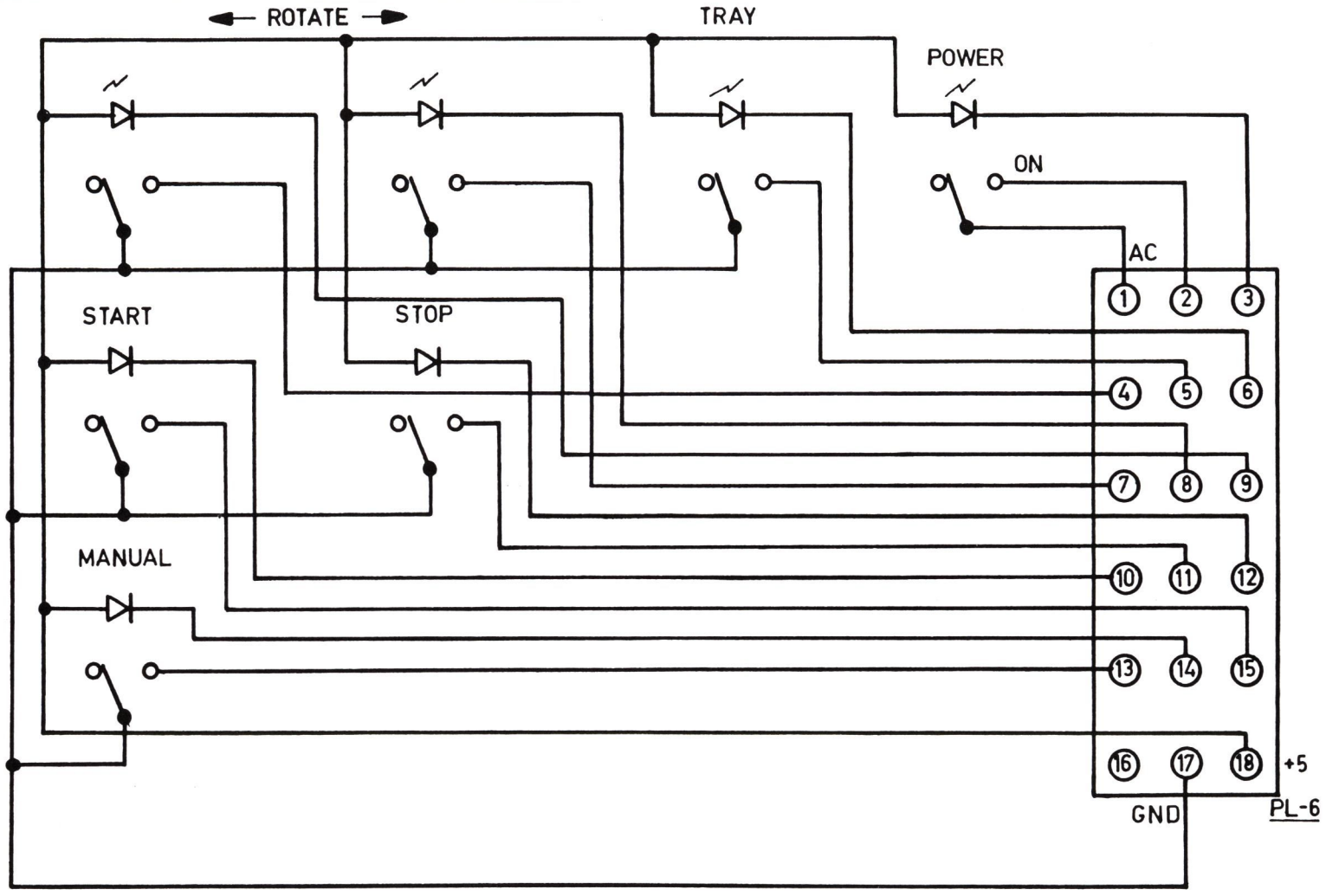
TRAY NUMBER DISPLAY
800 SERIES CAROUSEL - MODEL 450/452

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 3/7/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 040-1069-001

8½ X 11 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT



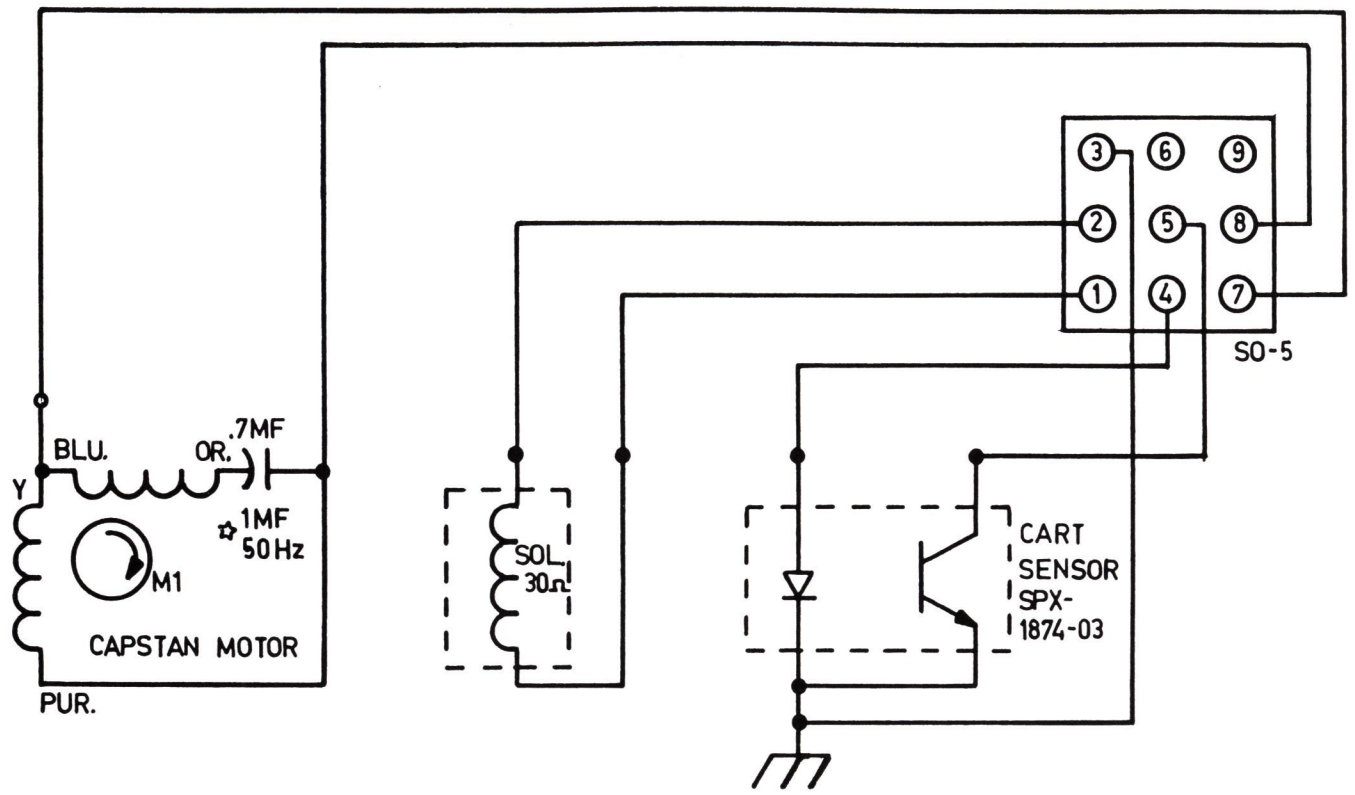
CONTROL & INDICATOR PANEL
800 SERIES CAROUSEL

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 3/2/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

RVD. 7/29/83

DRAWING NUMBER 040-1067-001



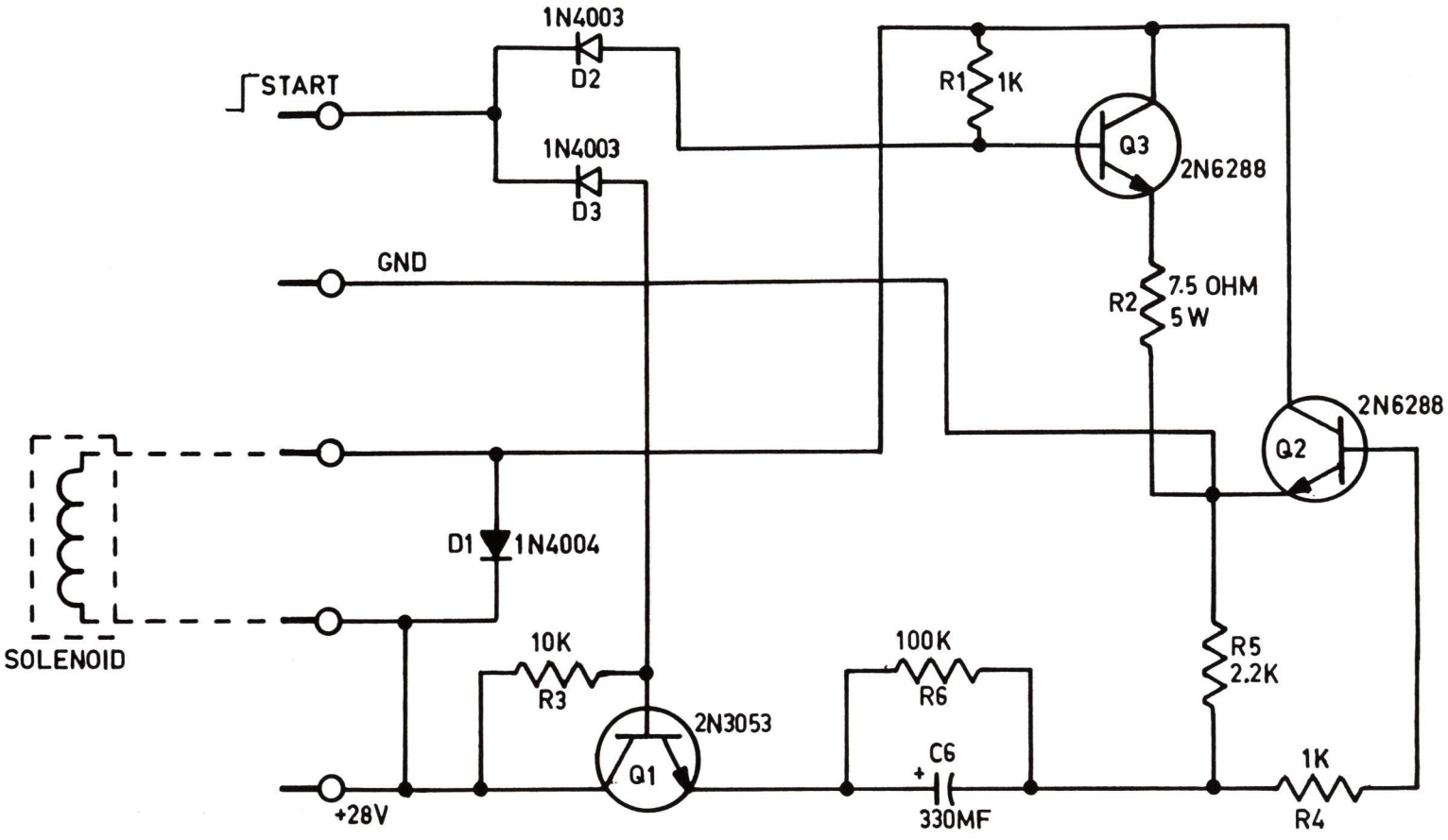
TAPE TRANSPORT DECK
800 SERIES CAROUSEL - MODEL 450/452

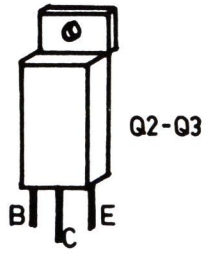
SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 3/2/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER
040-1066-001

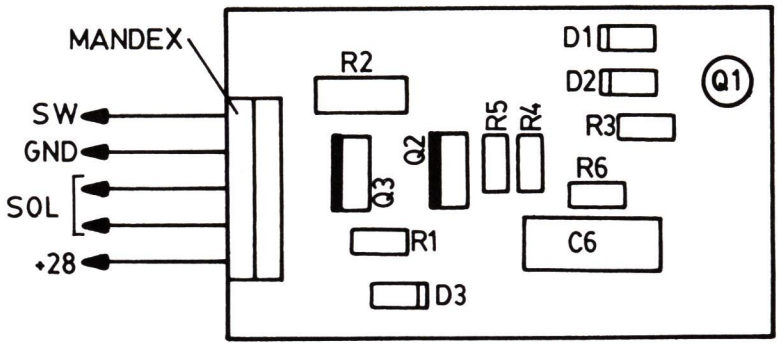
8½ X 11 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT





SOLENOID CONTROL BOARD
800 SERIES CAROUSEL

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 3/2/83		REVISED
SONO-MAG CORPORATION NORMAL, IL 61761		
		DRAWING NUMBER 040-1068-001



D1,D2,D3=1N4003/4
Q1=2N3053
Q2,Q3=2N6288
R2= 7.5Ω 5W
R1,R4=1K
R5=2.2K
R3=10K
R6=100K
C6=330 MF

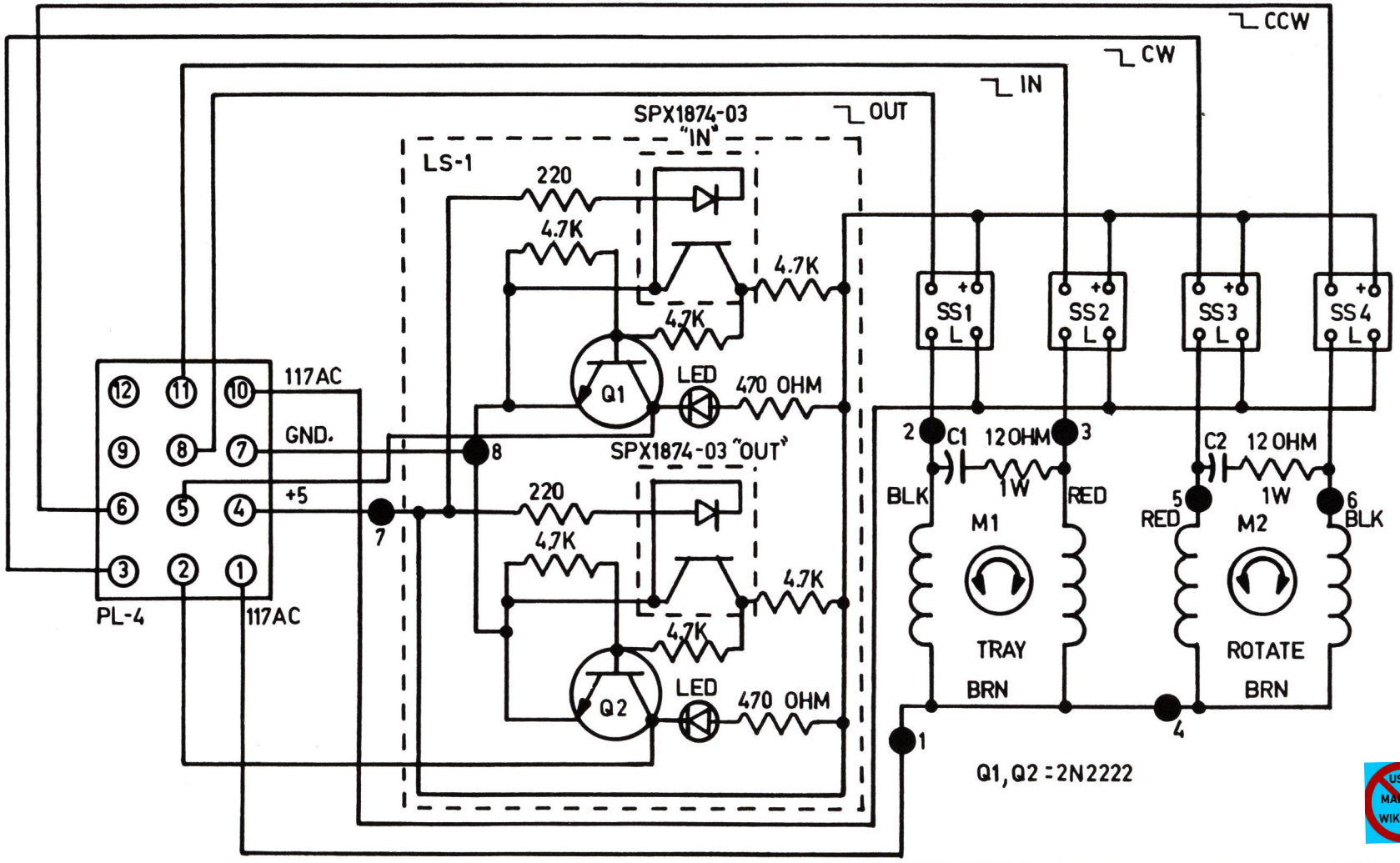
SEE 040-1068-001

SOLENOID CONTROL BOARD SOC-1

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 1/25/84		REVISED

SONO-MAG CORPORATION NORMAL,IL. 61761

DRAWING NUMBER
040-1095-001



● TERMINAL STRIP CONNECTIONS

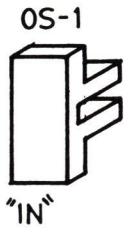
SHIFT & ROTATE MOTOR CONTROL
800 SERIES CAROUSEL - MODEL 450/452

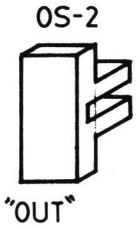
SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 3/1/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

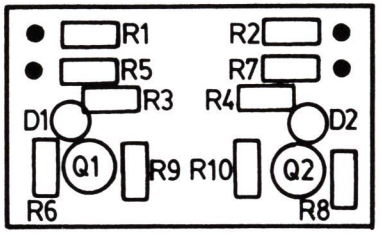
DRAWING NUMBER 040-1065-001

8½X11 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT





OS-1, OS-2 = SPX1874-03
Q1, Q2 = 2N2222
D1, D2 = LED
R1, R2 = 220
R3, R4 = 470
R5 - R10 = 4.7K



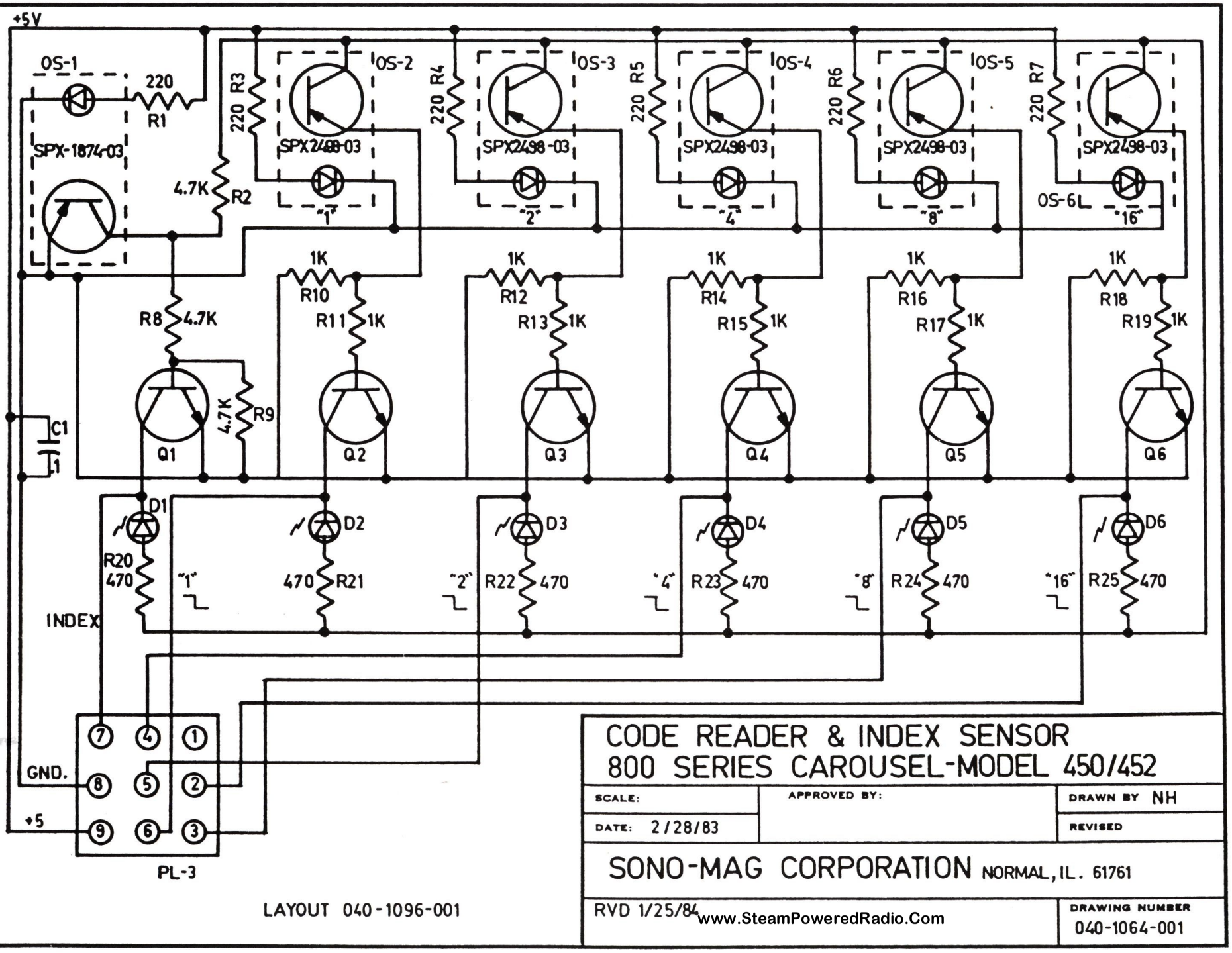
SEE 040-1065-001

LIMIT SENSOR BOARD LS-1

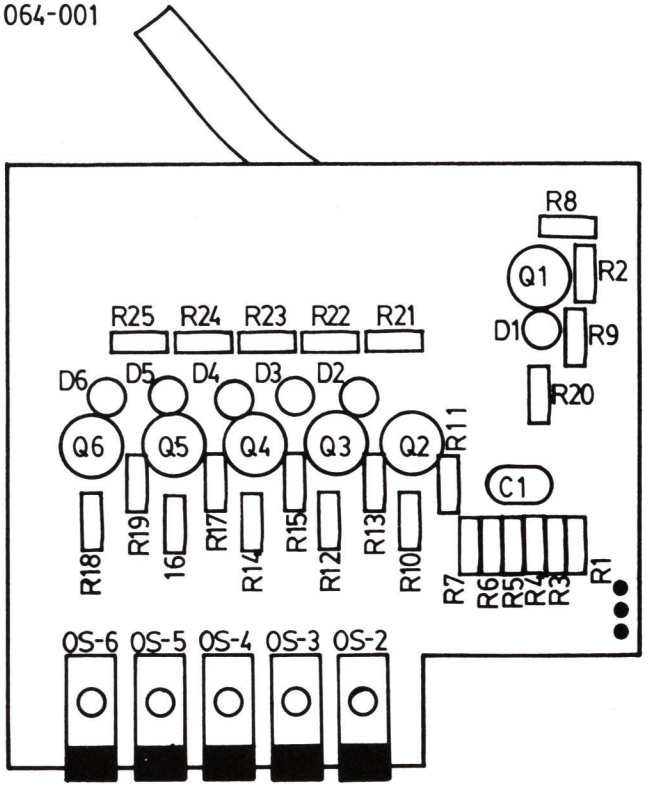
SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 1/26/84		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

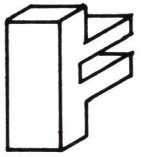
DRAWING NUMBER
040-1097-001



TO SO-3
SEE 040-1064-001



OS-1= SPX1874-03
OS-2/OS-6= SPX2498-03
R1,R3/R7=220
R2,R8,R9=4.7K
R10/R19=1K
R20/R25=470
C1=.1
D1/D6=LED



OS-1
FLAG
SENSOR

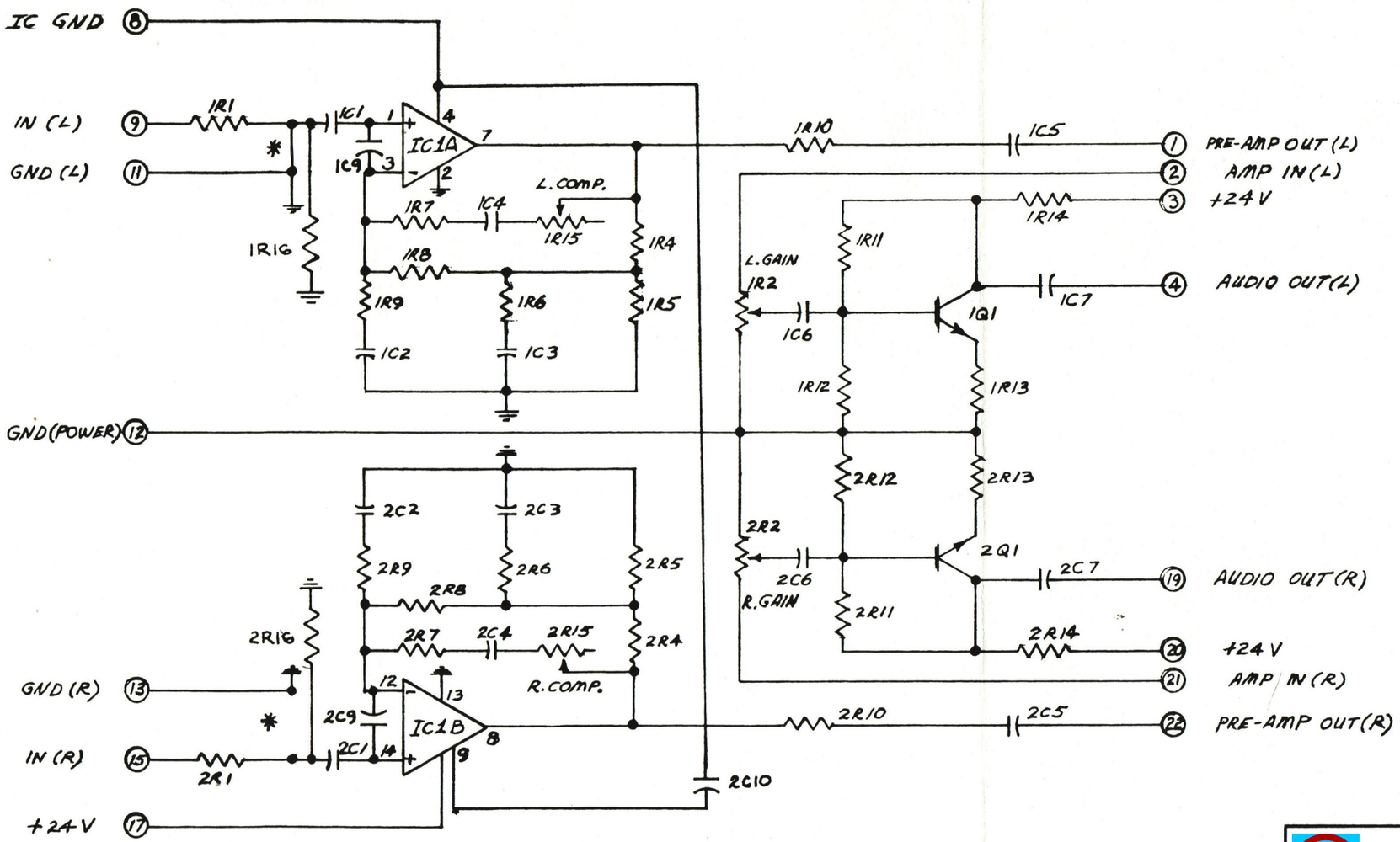
SEE 040-1064-001

CODE SENSOR BOARD CR-1

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 1/25/84		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER
040-1096-001



* Rvd. May, 77
IC8 & 2C8 Removed
C9 & C10 Added

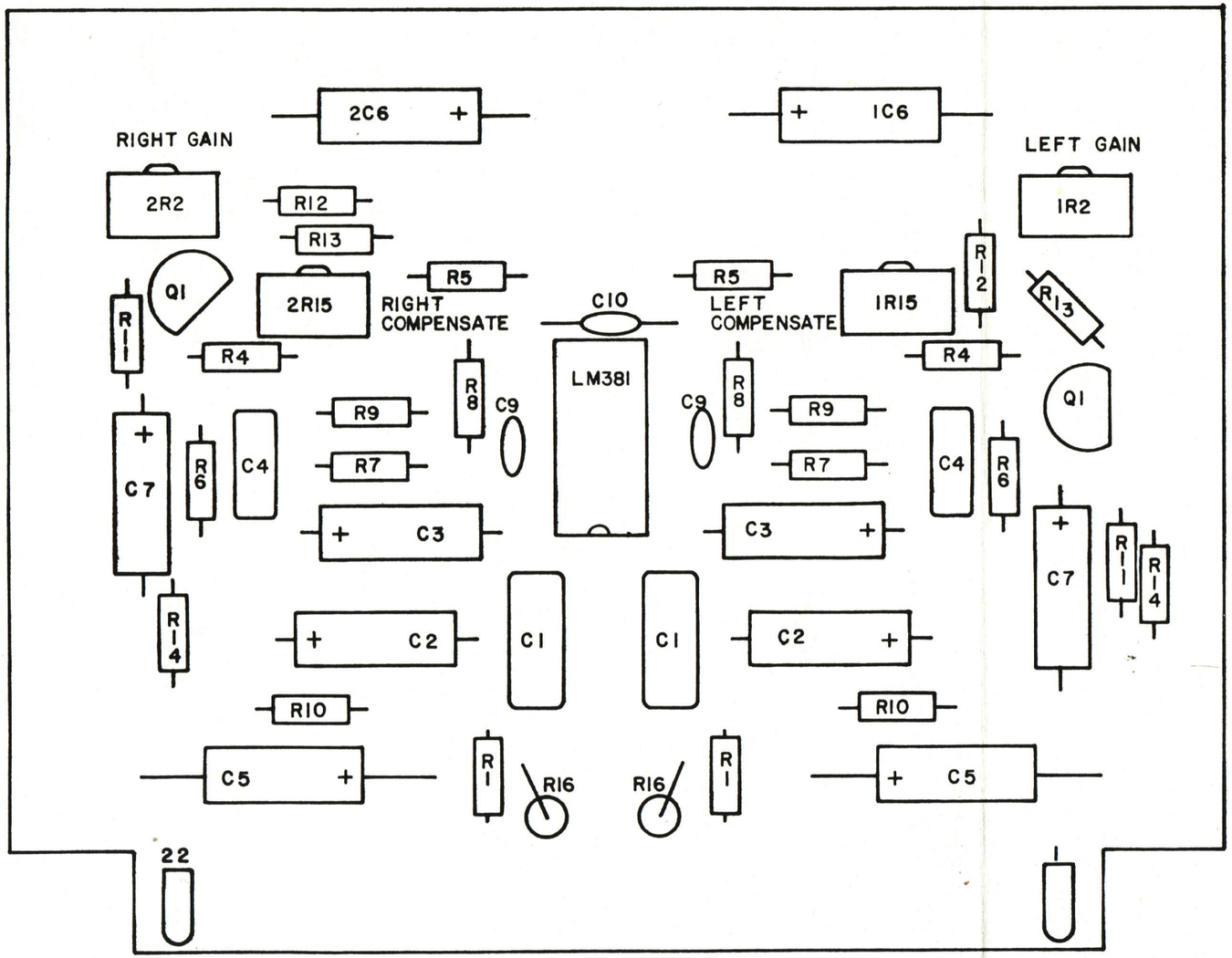
Layout: 030-0175-001

TAPE PRE-AMPLIFIER PR-2

SCALE:	APPROVED BY	DRAWN BY TA
DATE: 26 JAN 73		

SONO-MAG CORP.
BLOOMINGTON, ILLINOIS

18 Jun 75 28 Nov. 77	DRAWING NUMBER 030-0129-002



PROGRAM AMPLIFIER LAYOUT (PR-2)

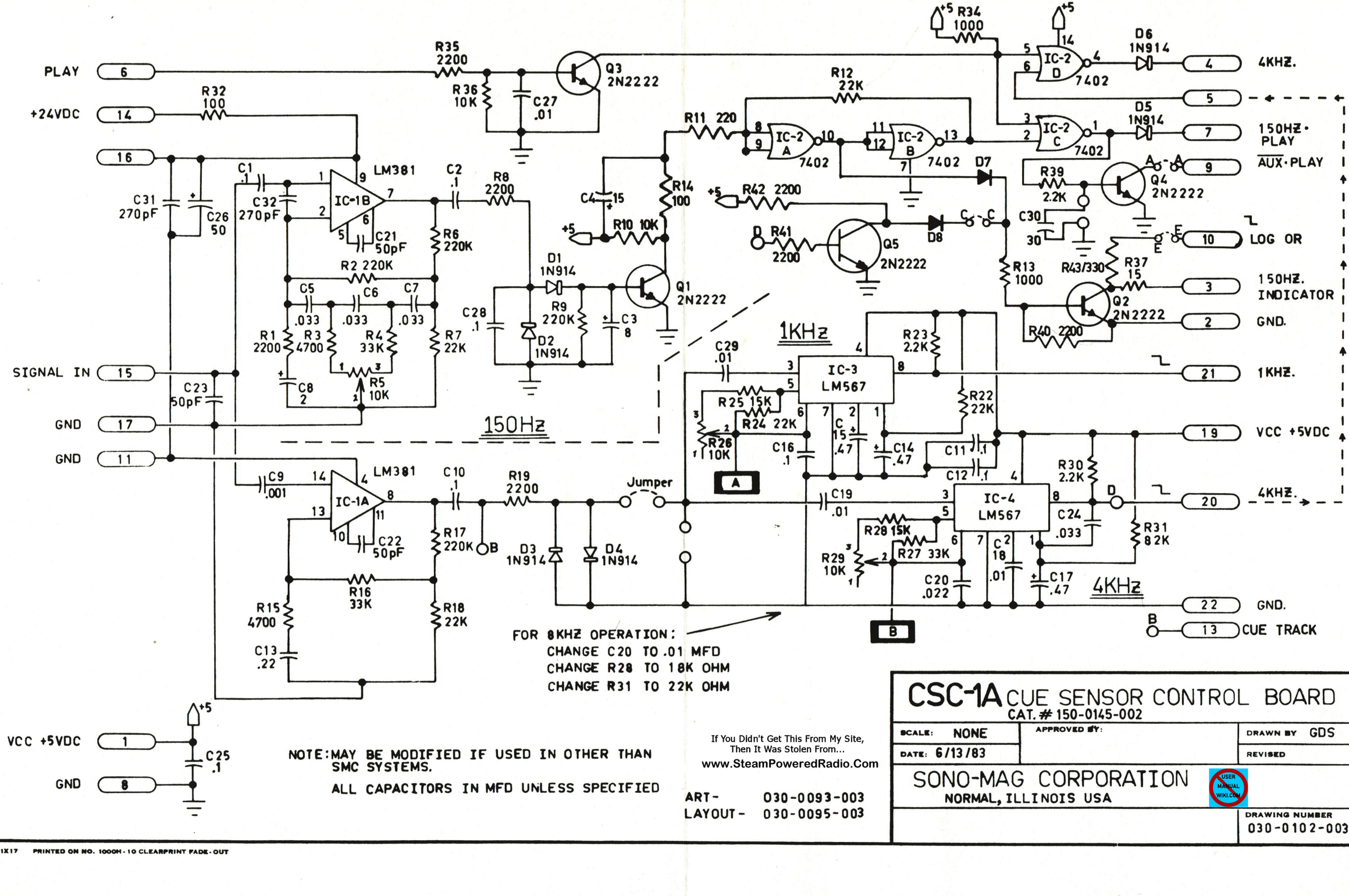
SCALE: ———	APPROVED BY:	DRAWN BY J.A.H.
DATE: 1 MAY 77		REVISED

SONO-MAG CORPORATION

BLOOMINGTON - ILLINOIS - USA

DRAWING NUMBER 030-0175-002

11X17 PRINTED ON NO. 1000H - 10 CLEARPRINT FADE-OUT



NOTE: MAY BE MODIFIED IF USED IN OTHER THAN SMC SYSTEMS.

ALL CAPACITORS IN MFD UNLESS SPECIFIED

ART- 030-0093-003
LAYOUT- 030-0095-003

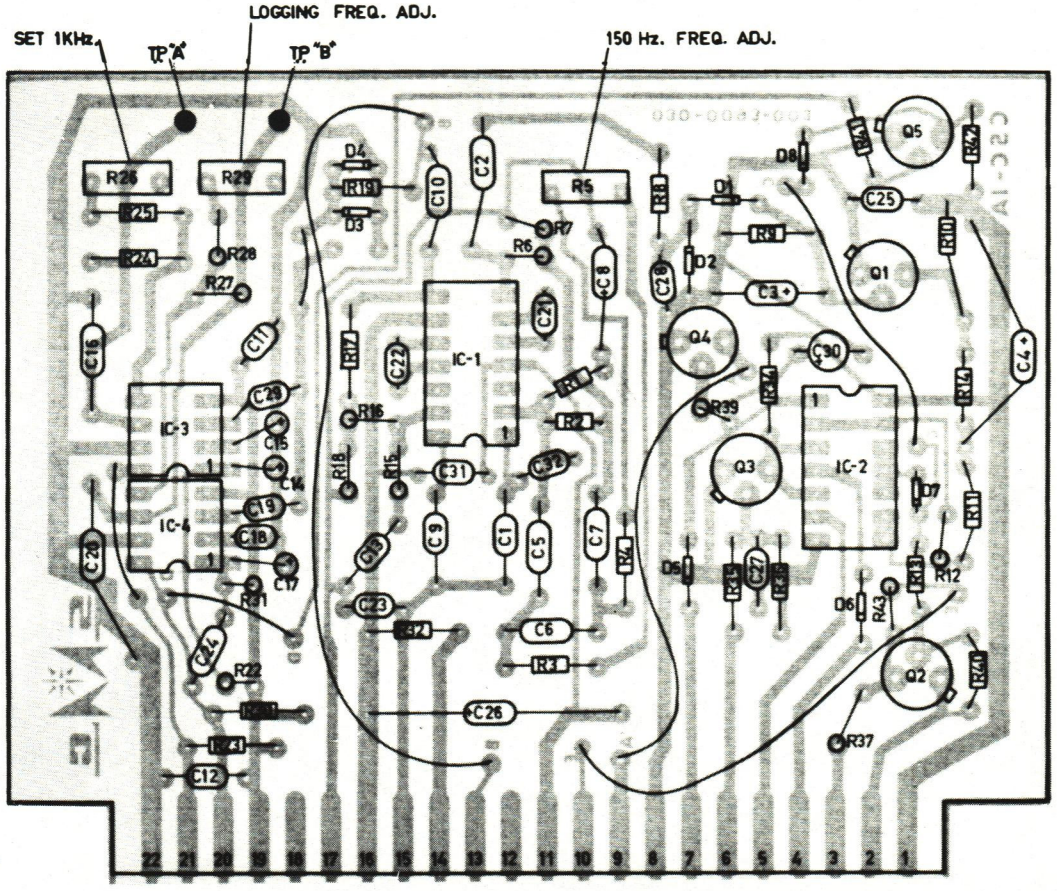
CSC-1A CUE SENSOR CONTROL BOARD

CAT. # 150-0145-002

SCALE: NONE	APPROVED BY:	DRAWN BY GDS
DATE: 6/13/83		REVISED

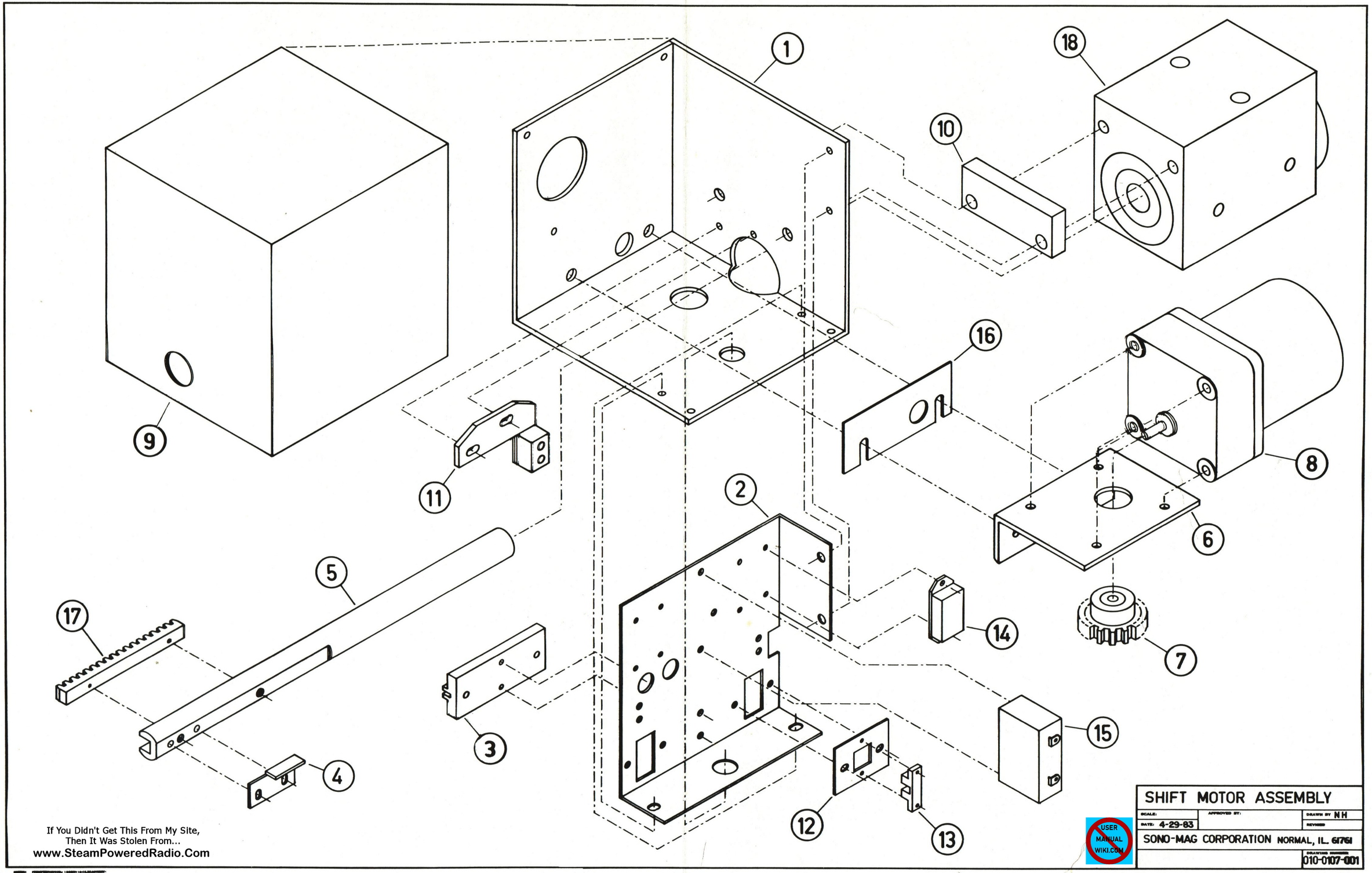
SONO-MAG CORPORATION
NORMAL, ILLINOIS USA

DRAWING NUMBER 030-0102-003



SCH. 030-0102-003

CSC-1A CUE SENSOR CONTROL BOARD		
SCALE: ——	APPROVED BY:	DRAWN BY NH
DATE: 6/22/83		REVISED
SONO-MAG CORPORATION NORMAL, IL. 61761		
		DRAWING NUMBER 030-0095-003

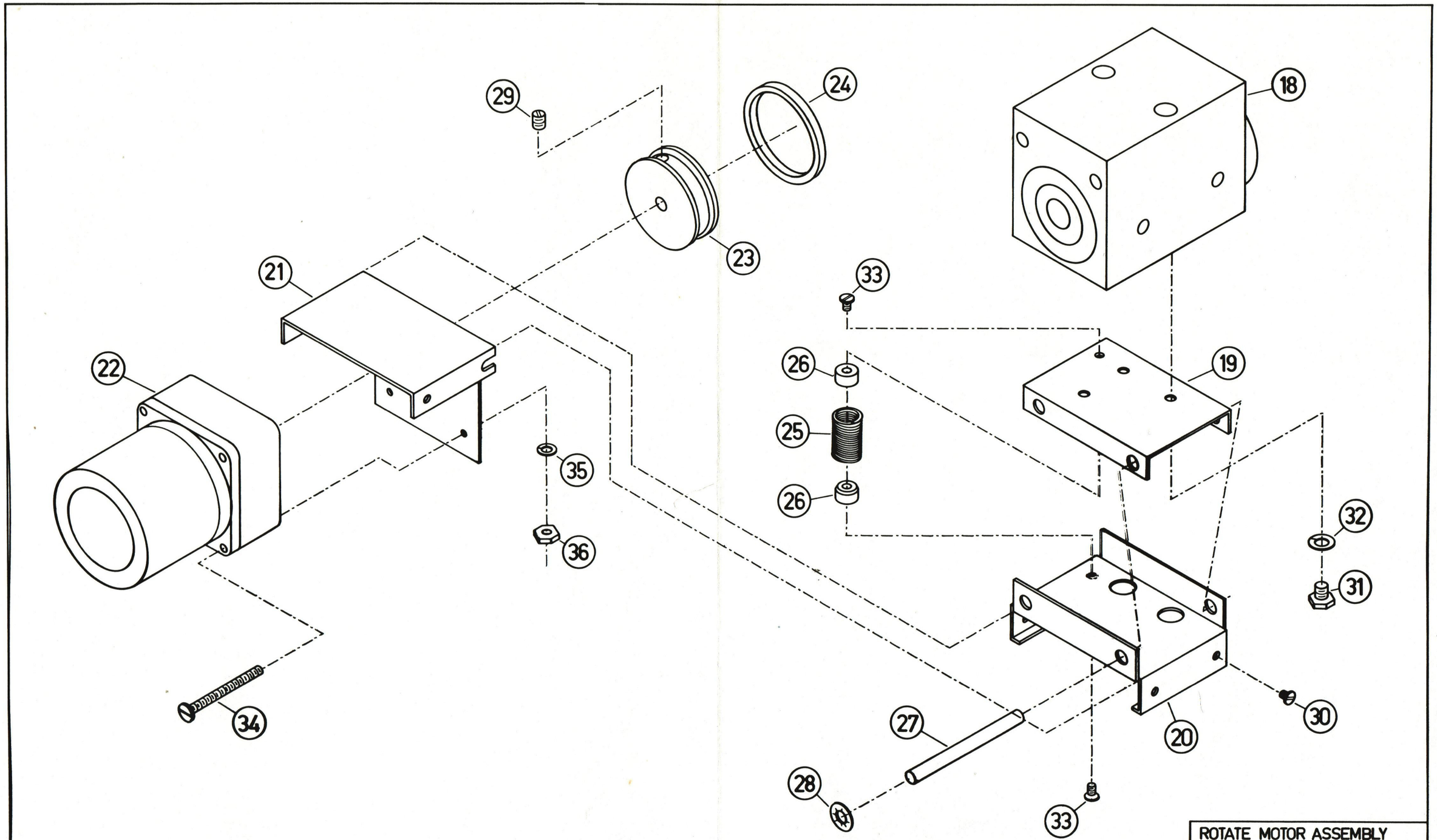


SHIFT MOTOR ASSEMBLY

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 4-29-83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 010-0107-001

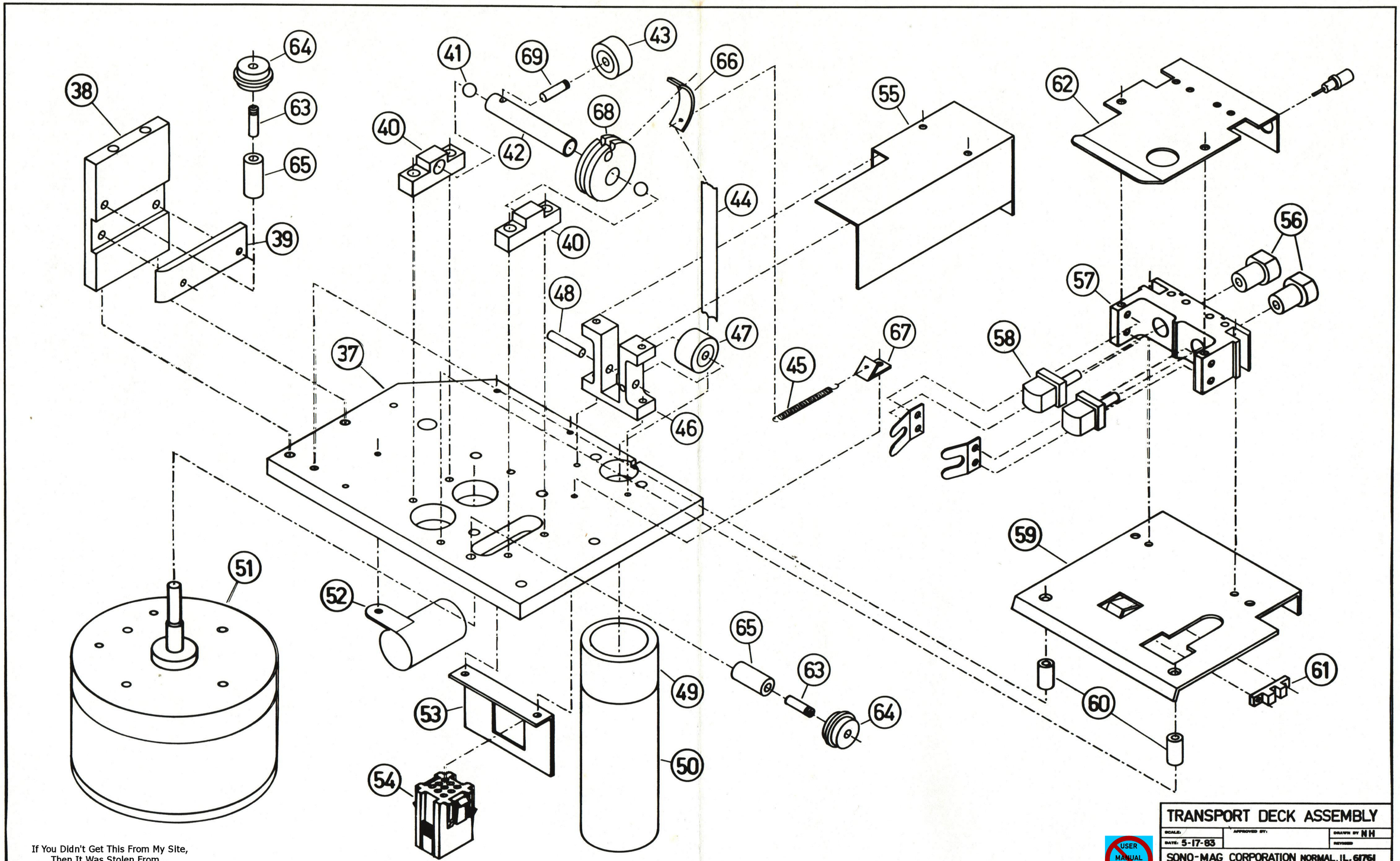


ROTATE MOTOR ASSEMBLY

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 6-15-83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 010-0108-001

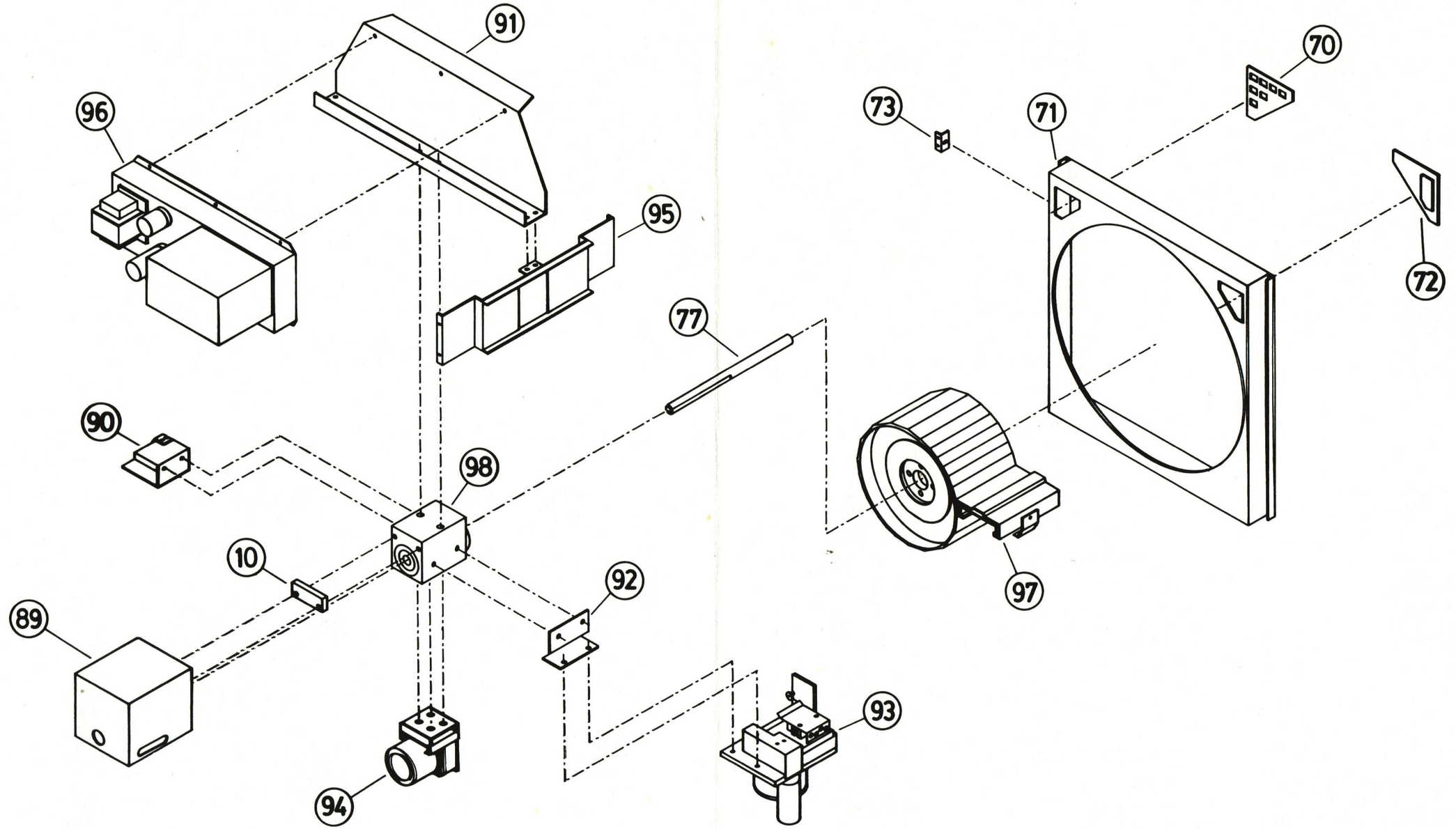


TRANSPORT DECK ASSEMBLY

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 5-17-83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 010-0109-001

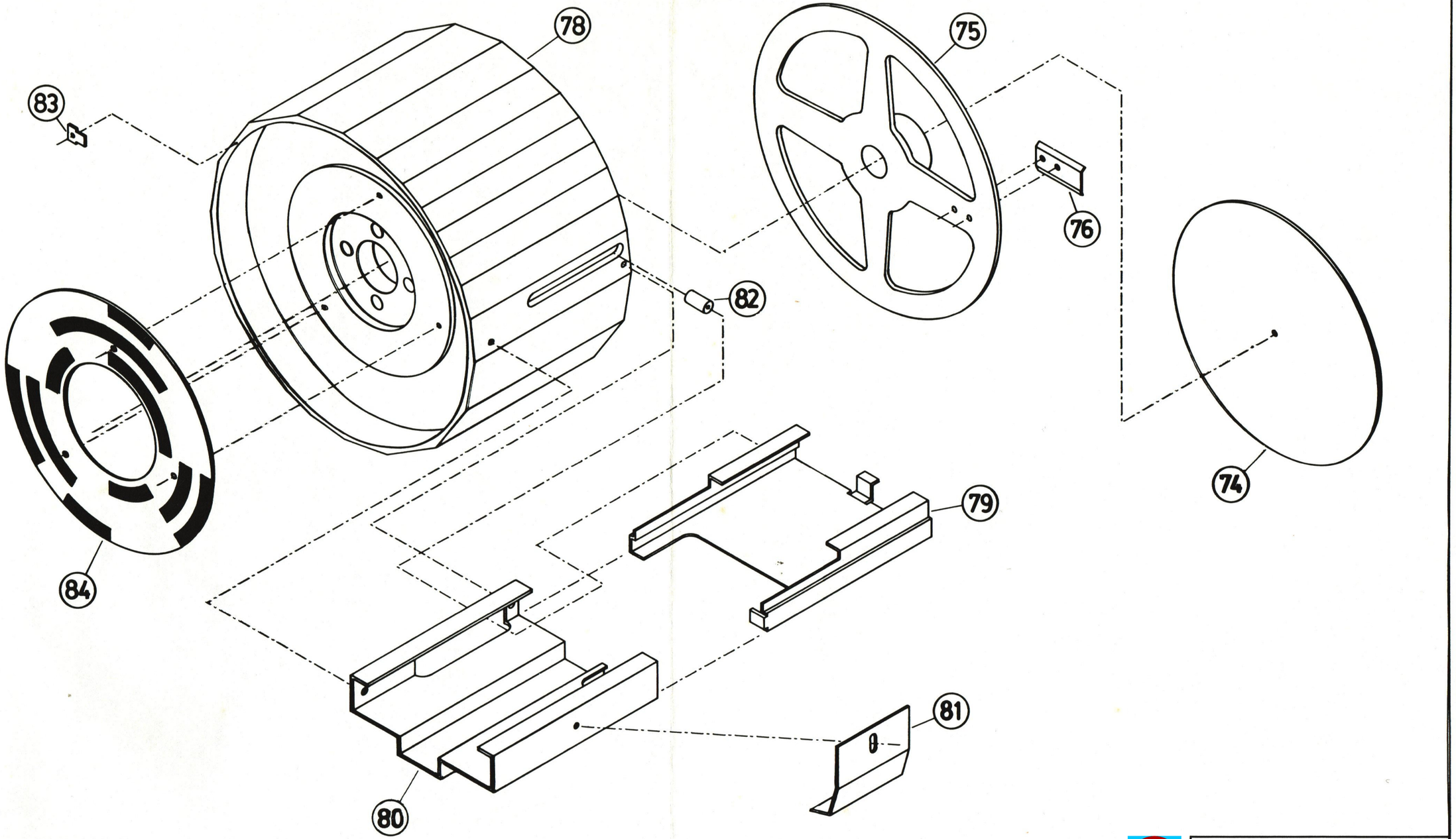


MODEL 450 CAROUSEL ASSEMBLY

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 7/14/83		REVISED

SONO-MAG CORPORATION NORMAL, IL. 61761

DRAWING NUMBER 010-0110-00



DRUM ASSEMBLY

SCALE:	APPROVED BY:	DRAWN BY NH
DATE: 7/6/83		REVISED

SONO-MAG CORPORATION

DRAWING NUMBER 010-0111-001