

# CARE AND REPAIR OF MCI JH-SERIES TRANSPORTS

By Greg Hanks

Over the last 10 years MCI (now MCI/Sony) has established itself as a leading figure in the manufacture of professional multitrack tape recorders. This has been accomplished (in this author's opinion) through technical innovation and budget pricing. A number of MCI/Sony features have set the trend for modern day recording, including:

- Monitoring logic of the JH-100, -114, and JH-24 Series
- Autolocator systems
- Constant tension reel servos
- Wrap and azimuth adjustable heads
- Ceramic Capstans
- One button punch-in and -out, etc.

MCI/Sony machines are modestly priced and provide very impressive results, in addition to being a service person's dream in terms of accessibility. The number of hits made on MCI machines is very large but, due to the price structure, and, I think, technical "intimidation," MCI equipment has been somewhat maligned much of its life. As a maintenance person, this writer has cursed the company many times myself. (But, there again, I would be sorely pressed to name a brand that has not at one time or another been blistered by my frustrated ravings.) Having been involved in the care and feeding of MCI machines for more years than I care to count, I have been able to watch the designs evolve and mature. The following article details some of the modifications, set-up procedures, and repair practices that I have gleaned.

Before launching off into technobabble, however, I feel you should be warned — all machines created equally are actually different! In pragmatic terms, while the basic theories of mag-

netic recording are applicable to all tape machines, each and every one, of whatever make, is distinctly individual. The information presented herein is intended to assist you in case your problems are similar to those described, or for intellectual perusal. This is not intended to be a how-to modification manual.

## Getting Started

A good starting point is to assure that you have the proper documentation for your machine. MCI in Fort Lauderdale has most of the schematics applicable to your recorder (unless you own one of the original JH-10 prototypes). To see if your manual is complete, match your PCBs to the schematics by assembly number. When all the boards, including power supplies and chimneys, have corresponding prints add an "Interconnect Harness Diagram" (the transport wiring) and a "Wiring Diagram" (the audio wiring), and you are complete. Once this is done the next step is to acquire a full set of service bulletins for your machine. These can be obtained through your local MCI dealer, or from MCI directly. Always include your machine's date of manufacture when communicating with

MCI.

It is my belief that the proper approach to tape recorder optimization begins with obtaining tape position in travel that is perpendicular to the plane of tape travel. Tape travel will be at a fixed and uniform height in a series of parallel planes, and should be accomplished with minimum tension sufficient to provide intimate tape-to-head contact. This tension should not exceed 9 ounces, and the tape reference to the bottom of the tape guides. Hard contact should not be maintained. However, the "low-side skew" of the tape (as induced by slitting tolerance) will be bounded by the bottom guiding edge.

The center line(s) of the bottom tracks of all heads should be the same height above the reference surface of the deck, and parallel to tape travel. Once these characteristics are obtained, the heads should then be adjusted for optimum wrap, followed by a rough azimuth alignment. The playback system should then be conformed to the studio's slowest speed test tape. The bias system should then be optimized for erase and bias, at which point standard playback and record alignments can be performed.

At this time it might be wise to tell you a little about the material this article is supposed to cover. The best arrangement is to break the topics down to sub-systems, and discuss each. So here goes.

## Transport Systems

The MCI Transport System is comprised of the following components:

- 1) Take Up and Supply Motors, with their associated Motor Drive Amplifiers (located in the Transport power supply)

— The Author —  
Greg Hanks, formerly service manager at Audiotechniques, Inc., recently formed New York Technical Support Ltd., which will specialize in studio installation and service. Previously chief engineer at Wally Heider Studios in Hollywood, Hanks is currently consulting on several film production and editing suites, as well as recording studios.

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- 2) Capstan Motor and Tach Assembly
- 3) Analog Torque Board
- 4) Control Logic Board
- 5) Phase Lock Loop Board
- 6) Interface/Lampdriver Board
- 7) Solenoid Driver Boards
- 8) Transport Mother Board
- 9) Autolocator and Remote Control Assembly
- 10) Associated Whirling Widgets and other Gizmos that help the machine work, and further confuse the issue.

Before discussing the transport system, a brief overview of the operating theory is in order.

Reeling tensions (in all operating modes) are controlled by the Analog Torque Board, and are selected in the various operating modes by the FET packs (IH 5011): on older JH-100s designated IC21, 22, and 23; on newer JH-114s these are IC16,19, and 25. The output of the analog torque board drives the associated motor drive amplifier(s) located in the transport power supply. The FET packs are driven by the control logic card by levels that go high for an **on** condition. Inputs to the analog torque board are:

A) The supply and take-up motor DC tachometers, which provide a DC output directly proportional to the rotational velocity of their respective shafts, and which are directly coupled to the motor shafts.

B) Analog capstan speed, which is a DC signal directly proportional to the rotational speed of the capstan, whether it is a fixed, variable or external drive.

C) A/L analog velocity, which is the signal generated by the Autolocator to drive the tape to the desired position.

D) 15 Volts, which provides "hard" drive to the reel motors for Fast Forward and Rewind.

Together these input signals are conditional, modified and adjusted to provide the proper operating tensions for the mode selected.

Older analog torque boards, such as that used in the JH-100 and JH-110, utilize a voltage-controlled oscillator, chopper, and active filter to provide for the tension controls, rather than the quad multiplier found in the newer units. The documentation shows ripple voltage for the analog capstan speed line, rather than the DC voltage actually necessary. The DC voltage determines the time for which control of empty reel is active. The shown ripple should be the **maximum** ripple on this line.

The PLL or Phase Lock Loop board controls the capstan speed. This system is composed of

A) Crystal-controlled Oscillator and Divider

B) Voltage-controlled Oscillator and Control Voltage Scaling Amplifier

C) Digital Reference Selector (applicable to new style PLLs only -crystal on lower left of PCB)

D) Tape Velocity Generator, which provides the DC voltage proportional to capstan speed

E) Phase Comparator

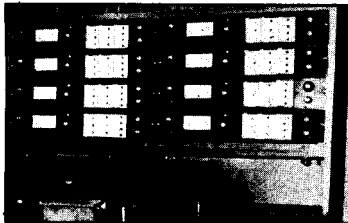
F) Motor Starting Circuit and Output Amplifier.

The system in the fixed-speed mode works very much like any PLL, *i.e.* the reference is divided down, and the speed selected via different dividers feeding one side of the phase comparator, the other side of the phase comparator being driven by the motor tachometer. The time difference between the two signals varies the duty cycle of the signal being fed to the active filter, which in turn provides a DC signal to control the drive circuit that powers the motor; the Tachometer Buffer also feeds the tape velocity generator. When the variable speed mode is selected, the voltage-controlled oscillator is selected through the digital reference selector. The VCO's frequency is determined by a DC voltage, varied by a potentiometer applied through the "Vari/Fixed/External" selector switch.

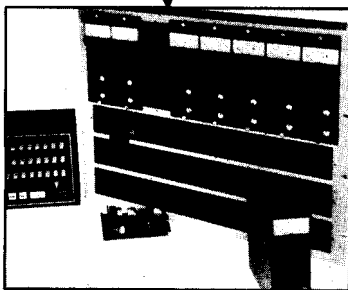
When in "Ext" mode the source of the reference may be either a DC voltage, or a nominal 19.2 kHz external signal. The digital reference selector will select the appropriate line through the use of the

## MCI JH-SERIES MULTITRACK FAMILY TREE

### ELECTRONICS

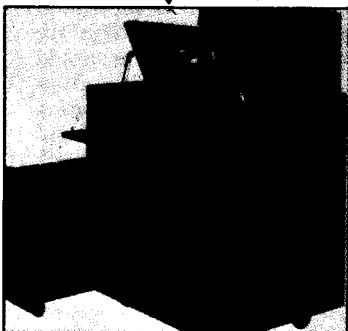


JH-5 Electronics  
(For Ampex Transports)



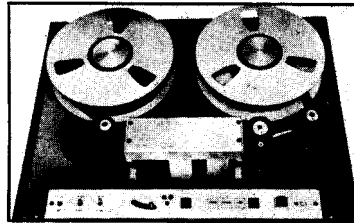
JH-9 Electronics

JH-16 Electronics  
(Advent of Stripboard Concept)

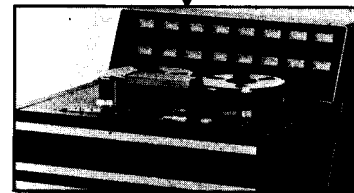


JH-24 Electronics  
(Transformerless Circuits)

### MULTITRACK TRANSPORTS



JH-10 Transport — 1970/71  
(All AC Motors and Synchronous Motors)



JH-10 in JH-16 System  
+ Autolocator I

JH-100 Multitrack Transport — 1973  
(AC Reeling Motors, DC Capstan & Impedance Roller)  
+ Autolocator II

JH-114 Transport  
(Dancer Arm & DC Reeling Motors)



JH-110B-2-VP  
STEREO MACHINE

THE PRESENT GENERATION... d~~~~%?%~

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re-triggerable one shot, IC18, and NOR gates, IC16,17, and 19. When an external frequency source is applied it is selected through the one shot; in the absence of this signal the VCO is selected. When there is a DC control signal applied, it varies the voltage that controls the frequency of the VCO; in the absence of a DC voltage, the VCO runs at a frequency determined by the "Cal" pot located on the PLL board.

The start time of the capstan is determined by the "slew up" amplifier held at a negative voltage, which forward biases CR10, and shuts off the motor. For start up, the left motor play command applies a positive voltage to R39 and C24, driving the output of this amplifier positive, back biasing CR10, and turning the motor over to the motor amp.

The Control Logic Card does exactly as its name implies - it receives commands from the push switches, and logically converts these to control the transport and record functions. The main problem with this card has been dirty IC sockets, so we do not really have to get into this area.

The Interface Lamp Driver provides five different functions that are necessary to the operation of the machine. These are:

- 1) Lamp Drivers that provide a logical low for the lamp to be illuminated.
- 2) Manual Velocity Control sensor,

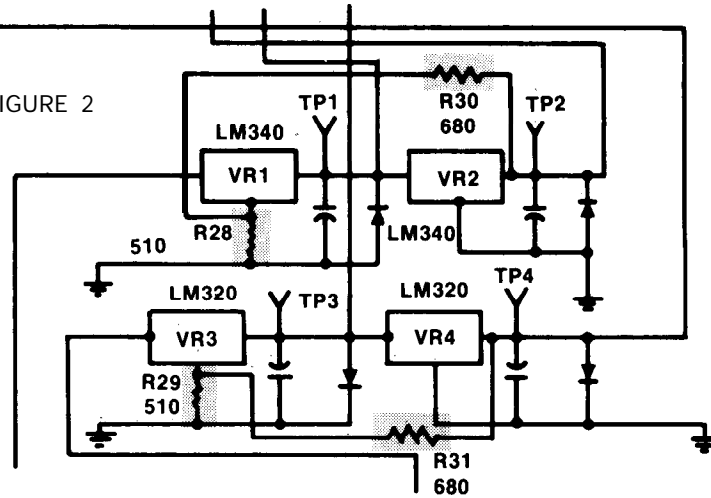
which provides a logical low to the control logic board, when the MVC is engaged.

3) Autolocator enable line that goes to the Autolocator is sent from here; if the "start" button does nothing, check IC6.

4) Tach Generator (or tape counter if you prefer) buffer, is comprised of IC7 and 8. When you begin to lose counts with your locator, the top of R11 is the place to look with your scope to see if the pulse frequency is decreasing.

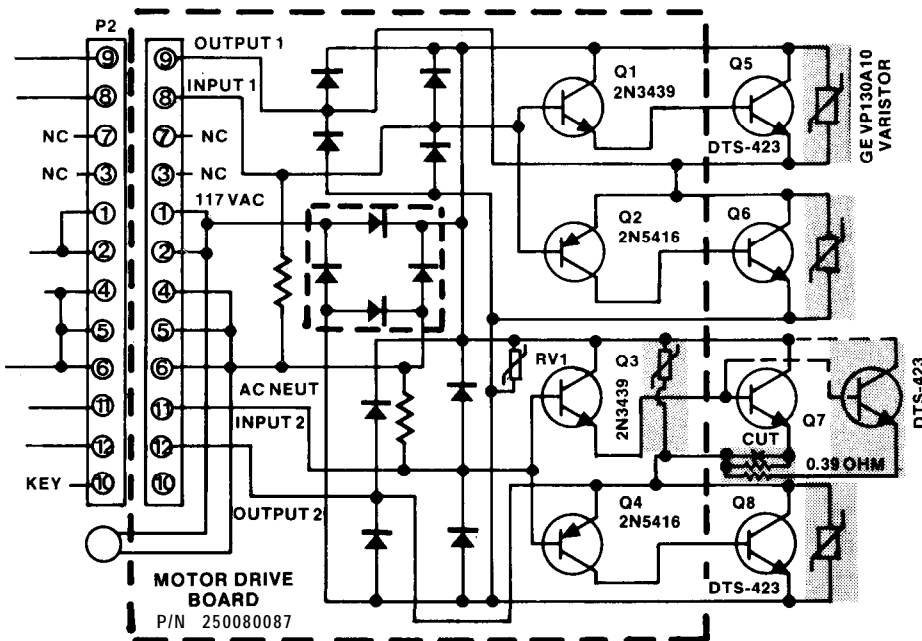
5) Record Momentary Pulse, and the Record Hold lines are both buffered by this board.

FIGURE 2



SHADED AREAS DENOTE MODIFICATIONS TO JH-110 POWER SUPPLY BOARD

FIGURE 1



SHADED AREAS DENOTE AREAS OF MODIFICATION. NOTE THAT FOR CLARITY PARALLEL DEVICE IS ONLY SHOWN ACROSS Q7. MOST NEW MOTOR DRIVE BOARDS HAVE THIS MOD IN SITU

The Solenoid Driver Boards provide the machine's power switching functions, including pinch-roller solenoids, head gate rotary solenoid, brake solenoid, lifters, etc. All of these outputs go low when they are active.

The Mother Board ties these previously mentioned sub-systems together. The interface to and from this board is done with Molex connectors, and they are the only problem this board has. In newer MCI machines there are two buffer amplifiers on this board located under the PLL. Not shown on the interconnect harness drawing, IC2 - the bottom one - buffers the VCO of the PLL, and this signal goes to the capstan servo programming plug, for use in SMPTE time-code systems. The top IC1 provides buffering for the capstan tach pulse, which is also sent to the programming plug for use with SMPTE. Also on the mother board is the Run-Time Indicator, which provides an indication of the amount of time tape has been running across the heads. The timer only works in the play or record modes, and it is also under the PLL. The lifter command is buffered by Q1 on the mother board.

Something to note at this time is how to work your way around the MCI schematics. The easiest way to tie everything together, is to realize that the interconnect harness drawing shows what goes to/from the mother board, and all the connectors that live on the transport. So, to find out what drives what, first find the connector and pin numbers on the board in question, go to the mother board and locate the path, and then see where it goes with the interconnect harness diagram.

At this point in time we should address some of the specific circuit boards and the problems that they possess.

### Power Supplies

#### 1) Older JH-100s:

Problem: Reel motor transistors

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keep blowing up.

**Fix:** Update the circuit to the schematic of Figure 1 and replace the DTS 411 transistors with DTS 423s, made either by Delco or Solitron. Remember not to subject yourself to the circular failure game; meaning, when the output transistors blow they are usually accompanied by the driver and the pre-driver.

2) JH-114s:

**Problem:** Heat is the enemy of any bipolar power circuitry. One of the common failure modes of the JH-14 and -24 is when the "chimney" fan conks out, the motor drive transistors overheat, and one or more of them short. This turns the corresponding motor fully on.

**Fix:** The easiest diagnostic procedure is to remove the chimney, turn the machine on, and unplug the power transistors until you get to the dud. When you pull the plug on the bad device, inspect the insulation for brittleness and cracking. For maximum reliability, this device should be either an RCA 2N3055H or a JAN 2N3055(A). When

changing transistor types, its mate should be changed also.

3) Note: When changing any of the TO-3 type negative regulators, the case is the V- input and not ground. If care is not taken to ensure that the insulating washer and heat compound is used, traces that feed these guys can easily vanish into smoke.

4) Odd: After many hours of chasing an increasing number of erratic and intermittent problems, one of my clients found that the wire that energizes the flywheel solenoid on his JH-100 was rubbed through. A lesson that we relearned was that when there is a problem with the deck, or electronics, check the integrity of the power!

5) Noteworthy: On some older JH-100s, the +15 and +24 volt regulators were both LM320-15V and LM340-15V devices. Not shown on the schematic are additional diodes and resistors on the ground sensing leg of the 24-volt regulators. Those familiar with these devices are aware that the voltage on the output can be increased by removing the ground leg, and re-inserting a portion of the output voltage into this port. This is exactly what MCI has done on these machines. Therefore, if your machine has a 15-volt regulator in the 24-volt socket, measure the voltage before using a 24-volt regulator in this position, or

else you could inadvertently end up with 32+ volts on your 24-volt line!

Figure 2 shows the power supply schematic following modifications detailed in MCI Bulletin #204, dated July 22, 1976, and which was intended to improve reliability of the 24-volt regulator circuit on JH-110 machines; added components are the pair of 680 and 510 ohm resistors connected across the output and reference legs of the four voltage regulators.

7) Problem: Punch in clicks on older JH-100s.

**Fix:** This problem as it relates to the power supply is rather simple to fix. There are other causes of punch in/out noises on this vintage machine which will be covered a little later in the article. Apparently, some JH-10 power supplies found their way into some of the early JH-100s that had a different grounding scheme. I found a service bulletin, dated August 13, 1975, that covers some additional wiring in the power supply chassis that I will share with you:

*"For JH-16 and JH-24 cabinets using one or more JH-8 supply, the following modification will be needed. Supply is identified by the one 12-pin Cinch Jones sockets on the top of the supply, and three internal relays.*

1) Power off. Remove each JH-8 supply one at a time. Remove bottom panel. [Refer to Figure 3.]

2) Connect jumper between pin #4 and pin #10 of K3. Connect 22 gauge insulated lead from pin #6 to lug of terminal strip, 24V common.

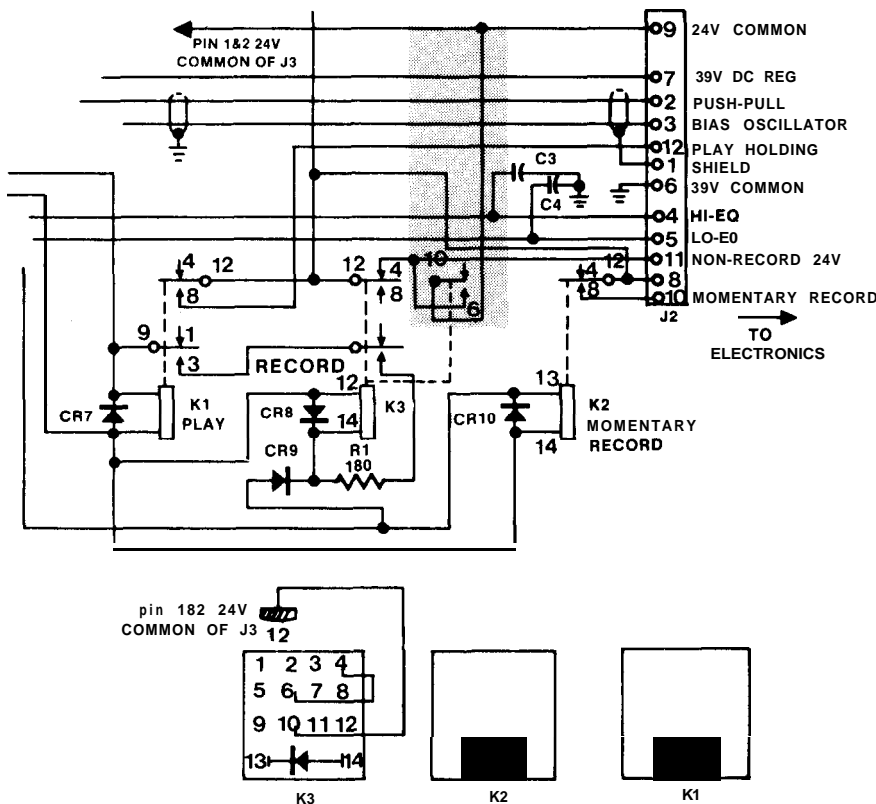
3) Replace bottom cover and return supply to same position."

13) Problem: In some installations, utilizing the Melco "Glide Mount" and a JH-114 with A/L 3, motor noise can appear on all outputs unless the Autolocator case is electrically isolated from the mount. The chassis on the locator is at 5 volt ground, and the console chassis is at Audio ground. If the tape machine is now brought to Audio ground, a big loop is formed that puts digital chatter on the audio.

### Analog Torque Board

Sometimes on the JH-114 and -24 (through rarely), tension inconsistency problems crop up. The supply reel tension can be observed using the centering of the dancer arm; note its position at the beginning, end and middle of the reel at both speeds - it should remain constant at all times. The take-up side is checked by pushing the pinch roller away from the capstan in Play (allowing at least 10 seconds after initiation of Play, to allow the start boost to subside), and observing that the running speed does not change. Again, this test is performed at the beginning, middle and end of the reel in both speeds. If the tensions are deviating, it must be determined if the problem is with the tachometers, the analog capstan velocity, the quad multiplier, or off-sets within the system. These elements are checked as follows, but set the off-set

FIGURE 3



## MODIFICATION TO JH-8 POWER SUPPLY BOARD TO PREVENT PUNCH-IN CLICKS ON OLDER JH-100 TRANSPORTS

nulls first!

**Tachometers:** Measure the offset voltages at test points one and two in low-speed play at a given point in the reel, then switching to high speed. If working properly, the voltages at these points will double.

**Analog Capstan Velocity:** Measure the voltage at PLL pin 2 on the analog torque board in low-speed play. Again, switching to high-speed play should double this voltage.

**Quad Multiplier** (on newer machine): Measure the output voltage in low-speed play, then switch to high-speed play. This voltage, unlike the previous tests, should *not* change. To thoroughly examine this chip for proper operation some math is necessary. The output of the quad multiplier is a percentage of the quotient of the analog capstan voltage divided by the Tach output. These voltages are to be measured and noted from the beginning of the reel. Also measure and note the output of the multiplier. Then perform the same measurements at the end of the reel.

Perform the following calculations:  $\text{Output V}/(\text{Analog Capstan V}/\text{Reel Tach V})=X$ . Beginning of the reel "X" should equal end of reel "X," or be within 10%. If they do not, replace the chip.

**Modulator Circuit** (on some of the older machines, without the multiplier): This circuit is treated much the same way as above, with — for the take-up side — Analog Capstan V measured at pin 6 of EC2, Reel Tach at pin 6 of IC13, and the Output at pin 6 of IC14. For the supply, the tach is measured at pin 6 of IC11, and the output at the junction of R63 and R64. If the tensions cannot be adjusted to provide the same "X" that is given in the above math, then the modulator must also be checked. Between low- and high-speed the duty cycle of the signal at the base of Q3 should change by 50%.

**Pitfall:** When measuring the off-set nulls of the Analog Torque Board with an AC-powered instrument (scope, DVM, etc.) be careful to use one of the capacitor-minus terminals at the test point as ground, and *make sure* the third pin on the AC cord of the instrument is lifted. Otherwise large DC offsets are introduced into the reading! **Repair:** Sometimes at the end of the 30 IPS reel, you hit play and nothing happens. Well folks, it could be one of two things:

- 1) Too high a hold-back tension setting;
- 2) The puck/pinch roller tension isn't high enough.

I have seen a few occasions where replacement was the only cure, but usually a quarter to half a turn on the adjustment nut is enough.

**Troubleshooting:** When chasing down tension aberrations, it is sometimes necessary to look directly at the output of the FET pack. This can only be accomplished by removing the driven op-amp, since the FET pack feeds the summing junction, and without reading

this point with a current probe you just won't see anything. If you do get a reading, however, the op-amp is defective.

Also, if in fast wind modes the machine acts very sluggishly, or throws loops or performs other nasty behavioural things, check the notes on the schematic, and make sure that the board is configured to the required track format. It is very disturbing to discover that your two-inch 15/30 IPS machine is running with a torque board configured for 1/4-inch 7-1/2/15 operation.

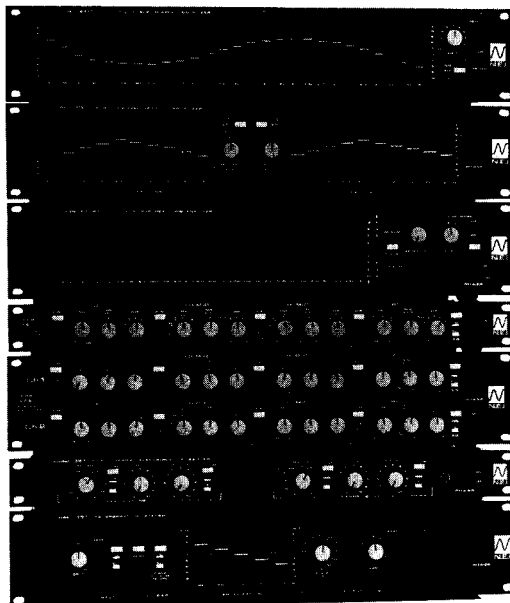
**Repair:** On some of the older JH-100 analog torque boards there were some problems with the plated-through holes. Installing a jumper (or "z" strap) and

soldering both sides of the board has solved many intermittent tension problems on several machines. Another useful tip for these older boards is to install 68X-type top turn, multiturn pots in place of the full-reel/empty-reel pots. At the same time replace the off-set null and 50/60 Hz pots. When you find an older board requiring "z" straps, also perform the same connection confidence modification to the mother board, PLL, and control logic boards.

Part Two of this article, to be published in next month's issue, will cover Phase Lock Loop **Boards**, Interface Lamp Driver, Motherboard, and Autolocator. ■ N=

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to remember about signal processing



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