THE HARVEY BOARD

0 Introduction

My name is Richard Brause. This document is intended as a preliminary manual for a Nagra IV-S modified and equipped with a Time Code Systems, Inc., X4S Time Code/FM Pilot System, hereinafter referred to as the "Harvey Board". I'm one of the early purchasers of a Harvey Board. I prepared this manual with initial cooperation from Harvey Warnke because of the absence of complete and accurate information about using a Nagra IV-S with a Harvey Board conversion. Compared with either a mono Nagra, a Nagra IV-S, or a Nagra IV-STC, a IV-S with a Harvey Board conversion offers many operational modes and hence, many booby traps for the unwary user. With increased experience, we're all learning about this conversion's strengths and weaknesses. Should you encounter the unexpected, either problems with the modification or undocumented features, discuss them first with your dealer and with Time Code Systems. In addition, I'd appreciate getting a report so that I can revise this manual as appropriate. My address and telephone number are listed in the eighth section of this manual.

The first two sections of this manual spell out some terminology, specifications, and technical considerations required to make the necessary decisions involved in setting up the modified machine. The third, fourth, and fifth sections provide specific guidance regarding powering the recorder and using it for record and playback. The sixth section is about special applications. The seventh and eighth sections are about installation and service. The ninth section will contain the flowcharts if the manufacturer ever makes them available.

Every user of a Nagra IV-S modified with a Harvey Board may not need to read this manual from cover to cover, but at a minimum, I urge you to read sections 2.4, 3.2, 4.1, and 4.9 which flag some of the most crucial subjects.

1 Brief Discussion of Synchronization

A manual has to start somewhere and the fundamental concepts relating to synchronization are at the core of many discretionary adjustments on a Nagra offering both center channel time code and FM sync capabilities. I'm assuming that purchasers of the Harvey Board will have a thorough knowledge of synchronization, but it's a rare time code job that doesn't involve some head-scratching.

Because this subject is covered skillfully and in depth elsewhere, and because questions about synchronization are likely to be common amongst those folks to whom a Nagra equipped with a Harvey Board is rented, I suggest that anyone re-renting a Nagra with a Harvey Board accompany it with a copy of Using Time Code in the Reel World by Tanenbaum and Klemme. It's published by Sound Recording Services, Los Angeles, 1987, and was distributed through Nagra Magnetic Recorders, Inc. This should stave off a few panic calls.

After a practical manual specific to the Harvey Board is officially available, I'll work on expanding this brief treatment of the subject as it specifically relates to this conversion.

1.1 Reference Source

Both audio recording tape and videotape lack sprocket holes. Because of slippage, shrinkage, and stretching, (remember: the tape is driven by friction, not sprockets), accurate synchronization of tape with film or other tape requires that a reference signal be recorded on the tape in addition to any program. The reference signal must conform to some known standard. This leads to the single most significant rule with regard to synchronization: *Whatever else you do, label the tape boxes, include detailed sound reports, and verbally slate each tape with information about the sync source you've used so that the folks who subsequently get your tape can properly utilize it.*

Two factors are essential for accurate synchronization. First, it's necessary to identify a moment in time common to all the elements. Clap sticks are the traditional means of providing a sound and image (the simultaneous sound and image of the sticks clapping) for synchronization. Second, it's necessary to provide constant speed control or a continuous signal related to rate or speed. The sprockets on film and the sync signal recorded on tape provide the mechanism for rate or speed control. By numbering each frame, time code combines these two factors in a single signal.

Consider the following rules of thumb when deciding on the appropriate reference source. This section discusses only the reference source, read on for information about frame rate.

If the reference source used by the film, video, or other recording equipment on the job is a *crystal sync*, use your Nagra's crystal reference.

If the reference source is *House Sync* (common on large video jobs), connect a feed from this signal source to your Nagra's Time Code input.

If the reference source is generated either by film or video equipment on the job (common when film cameras are synchronized with video monitors, or, rarely these days, on a job with a constant-speed camera), connect a feed from this sync source to your Nagra's Pilot input.

If the reference source is the *AC power* (60Hz or 50Hz off the wall or from a regulated generator), use an ATN connected to the same power source to provide a 1 Volt sync signal for your Nagra's Pilot input.

1.2 Time Base, Frame Rate, Sync Signal, Time Code, Drop-Frame and Non-Drop-Frame

A *Time Base* is a stable repetitive signal on which the operation of a system is based. A *Sync Signal* may be simply a signal containing the time base. The frequency of the time base is a convenient multiple of the *Frame Rate*. For picture shot at 24 frames per second (fps), the conventional time base is 60Hz; for picture shot at 30fps (commonly used when the film is to be transferred to videotape), the time base is also 60Hz. For picture shot at 25fps, the time base is 50Hz. Finally, for picture shot at 29.97fps (the US standard for color TV -- film is frequently shot at this speed when broadcast monitors are in the scene), the time base is 59.94Hz.

Note that none of these time base - frame rate relationships is mandatory. It *is* mandatory to discuss the decision with the post-production facility handling the job and to let them know what you're doing. Read Using Time Code in the Reel World for a further discussion of selecting the proper time base and cross-standard resolving. Once again, it's necessary to emphasize the importance of documenting what you've done. For example, without documentation, much time would be lost in post production if you failed to specify whether you used 59.94Hz or 60Hz.

There are various standards that combine and include additional information with the sync signal. *Time Code* is an overall term that includes various standards. These signals, at a minimum, include both the time base and a number for each frame.

Last, with respect to *Drop-Frame* and *Non-Drop-Frame* time code (DF and NDF), remember that this characteristic relates to frame numbering and not to frame rate. Unless you're sure that what you're recording is to be broadcast with no intervening processing or post-production, use non-drop-frame time code.

1.3 FM Pilot

A conventional Nagra IV-S (stereo Nagra) uses a frequency-modulated (FM) sync signal recorded between the two program tracks. Typically, the signal contains only time base information: 60Hz, 50Hz, 59.97Hz, etc. It's possible to simultaneously record a commentary track of mediocre quality. This method of synchronization is only achieved on a Nagra IV-STC (time code Nagra) by physically changing (involves soldering!!!) internal circuit boards.

1.4 Center Channel Time Code

On both the Nagra IV-STC and a IV-S equipped with a Harvey Board, the time code signal is directly recorded between the two program tracks. Note that there's no acknowledged standard for track width. By convention or coincidence, Nagra and Studer use the same track widths; some other manufacturers do not. This can lead to compatibility problems.

2 Comparing The Harvey Board, Nagra IV-S, and Nagra IV-STC

2.1 Physical Changes

The new LED display mounted between the REW. <<< O >>> switch and the lid latch requires use of lids with pinch latches. Any standard cases may need surgery on the right side to allow access to the new switch panel which mounts over the old speaker port. Additionally, attaching the right-side carrying lug may be difficult. Securing the new panel to the Nagra case can cause some knob binding problems. Removing / replacing the main function selector will now require at least an additional hour or so. The silk screening (paint and clear coat) on the new control panel is less than permanent. You may choose to make a reference card. The top switches on the new control panel (FRAME RATE and REFERENCE) require either a large tweaker or a small screwdriver to adjust.

2.2 Power Requirements / Power Consumption

IV-STC specs:
STOP with "keep alive" on: 2.8mA

	TEST	RECORD
wild	100mA	250mA
FM pilot	110mA	270mA
time code	140mA	270mA

The meter light adds another 90mA.

Harvey Board:

Operation with display on adds 90mA to IV-STC specs.
Operation with display off adds 40mA to IV-STC specs.
"Keep-alive" circuit draws 13mA from a 24 volt power supply.

Based on practical experience, this means that, with new alkaline batteries, on warm days, at 7½ips, powering one Schoeps microphone with a CUT 1 filter, you'll probably get two to three days intermittent recording. With no other use, the "keep-alive" circuit will drain the freshest of alkaline batteries in about three weeks.

2.3 Recording Tape Requirements

Although no specific tape is required for a stereo Nagra with a Harvey Board, *any* Nagra recording or playing back center-channel time code is going to be intolerant of tape with slitting problems. The tape guides will tend to lift the center of any tape that is slightly overwidth away from the heads, making recording or playing back time code highly problematic. It may be appropriate to increase the tape tension to improve time code recording and playback.

2.4 New Functions / Lost Capabilities

Switching between FM Pilot and Time Code requires just that: switching. No more circuit board changes.

All time code signals appear on the **CUE** connector.

The Harvey Board introduces no time code offset in **RECORD** modes other than in the signal fed to the sync head. In other words, assuming any device used for displaying the time code (e.g.: a slate) doesn't introduce its own delay, no offset need be established in post production.

A Harvey Board-modified Nagra IV-S includes an internal resolver.

The pilot frequency metering function (available on an unmodified IV-S) is lost, so next time you're in the field with a camera equipped with a constant-speed motor and you're relying on cable sync....

The capability of recording a commentary on the cue track along with the FM signal is completely lost.

Because of mechanical constraints inherent in the installation of the new control panel overlaying the old monitor speaker port, the volume and quality of the speaker playback is severely limited as compared to the stock Nagra IV-S.

2.5 Input / Output Characteristics, Requirements, and Tolerances

4-pin **PILOT** socket

Same pin functions; **Xtal** is now a 4 volt square wave and will not drive the display of a POM. With the **REFERENCE** switch in **FM PILOT**, the output from this socket *will* drive a VARK Audio, Inc. CC101 Crystal Checker. **PILOT IN** signal should be greater than 1 volt p-p (0.4 volts rms) and less than 30 volts continuous.

7-pin **CUE** socket

pin	old	new
1	cue signal in	external time code input
2	-10 volts	unchanged
3	pilot output	time base of center track
4	speed correction	unchanged
5	modulator on	time code output (low)
6	cue signal out	time code output (high)
7	chassis	chassis

Pin 1 (unbalanced time code input); input load impedance: 20kΩ; no min/max levels specified.
Pin 3 (time base of center track); 4 volt square wave
Pin 4 (speed correction); not isolated; dc connected to board.
Pins 5 and 6 (balanced time code output); source impedance: 10kΩ 4 volt square wave (greater than +8 VU)

2.6 Compatibility of Recorded Tape

One of the notable strengths of a Harvey Board-modified Nagra is that it builds on a Nagra IV-S. The IV-S's sync head lays down (and reads) a significantly wider sync track than is the case with the Nagra IV-STC. Consequently, tapes recorded or played on a machine modified with a Harvey Board will be much less susceptible to vertical alignment problems with the center-channel time code track.

3 Powering Considerations

"Hot switching" is okay, other than as noted below in "Window of Vulnerability". The Nagra needn't be powered down with the function switch in the **STOP** position to: select power source; select **REFERENCE**; select **FRAME RATE**; adjust **PRESET TIMECODE / PRESET USER BITS DISPLAY**. The "keep-alive" circuit, which maintains timekeeping functions while the recorder is in **STOP**, relies on *continuous* power either from the internal batteries or from the external power supply (ATN or equivalent). If you want the recorder to remember time code information while it's off, either switch the **POWER** selector to **Batt** before switching the main function selector to **STOP** or make sure that the power source to which the ATN is connected remains hot while you're away from the machine. If the ATN's power source is hot and the power selector is switched to external power, the "keep-alive" circuit will be powered through the ATN even if the main function selector is in **STOP**. If you've any reason to doubt the reliability of the AC power source (somebody pulls the bull switch while you're on lunch), leave the power selector in **Batt**.

3.1 Fuses, Failure Modes

looking at the trace side of the Harvey Board:

2 Amp on right edge / rear: replaces Nagra main fuse - everything fails

¼ Amp between Molex connectors: analog electronics and display fail

¼ Amp on right edge / front: timekeeping and counter circuitry lose continuous power. If this fuse blows, the CMOS circuitry providing the timekeeping functions will continue to draw enough current through sneak paths from other parts of the board to function so long as the Harvey Board remains powered, i.e., external or battery power supplied and the main function switch in other than **STOP**. If power to the Harvey Board is lost, the clock will lose time and stop. This is the only indication that this fuse has blown.

3.2 "Window of Vulnerability"

Never disconnect power from the recorder with the main function switch in other than **STOP**.

If, while in **STOP**, the Nagra loses all power (no batteries, no external power), the timebase will lose accuracy immediately. Therefore, after *any* power loss, it's necessary to re-jam the Nagra if it is receiving time code or re-jam any downstream equipment that's using the Nagra as a time code source.

Furthermore, if power is restored after approximately 2 minutes but within 3 minutes after loss, *all* sync circuitry may lock up. Evidence of this lockup is: no LED display in any time code mode; no **PILOT** indicator (Maltese cross); no time code or sync output. The sync circuitry then requires at least 2 minutes and, perhaps, up to 5 minutes with no power (no batteries, no external power) to re-set.

WHAT TO DO IF ALL POWER TO THE NAGRA IS LOST: either restore a power source within 2 minutes or wait at least 3 minutes. Turn the main function switch to TEST. With the REFERENCE switch, select INT. TIMECODE. A blank or abnormal LED display indicates a lock up and requires at least 3 minutes with no power for a capacitive discharge to occur, allowing normal operation to resume. If the LED display is functioning normally, re-set the internal time code and user bits if neccessary, re-set the REFERENCE switch as appropriate, and resume normal operation. Additionally, unless the Nagra is receiving external timecode or sync by cable or radio, or is sending timecode or sync by cable or radio, **after any power loss, you must re-jam either the Nagra or any downstream reader-generator.**

4 Record Set-up and Operation

4.1 Use of and Need for the Sync Jumper Plug

Removing the sync jumper plug while recording will only turn off the PILOT indicator (Maltese cross) but not the pilot track. I've observed that the sync jumper plug need not be connected to generate either an FM Pilot or a time code signal from the internal time base generator. Repeating: the sync jumper plug merely toggles the PILOT indicator (Maltese cross) but not the pilot track. A new version of the PROM may correct this.

4.2 Recording without a Sync Signal (Wild Track)

In FM PILOT, select No Ref. on the FRAME RATE switch to turn off the sync track and the LED display. At present, if the REFERENCE selector is in any position other than FM PILOT (any of the TIMECODE positions), with No Ref. selected on the FRAME RATE switch, a residual signal is recorded on the pilot track in either RECORD mode whether or not the sync jumper plug is installed. This is *not* a sync signal. One last caution: in the FM PILOT mode, with No Ref. selected on the FRAME RATE switch, if you feed a valid time base signal (1 volt from your ATN, etc.) to the PILOT connector, you will turn on the PILOT indicator (Maltese cross) but not the sync track.

4.3 Recording with FM Pilot Sync Signal

Select FM PILOT with the REFERENCE switch and the FRAME RATE that's appropriate. The frequency of the sync signal is double the FRAME RATE selected.

For example, to record a 60Hz FM Pilot Signal, select FM PILOT with the REFERENCE switch and 30 with the FRAME RATE switch.

In FM PILOT, the LED display is turned off.

4.4 Recording with a Time Code Sync Signal: Selecting REFERENCE and FRAME RATE

Use the REFERENCE switch to select the appropriate sync mode. INT. TIMECODE is the continuous, free-run, or time-of-day mode. These terms all mean the same thing: the internal clock continues to advance frame numbers. Note that using the time-of-day mode doesn't mandate that the time code actually be the same as the actual time-of-day. TIMECODE ADVANCE on RECORD is the record-run mode. The time code generator only advances the frame numbers while the Nagra is in one of the RECORD modes.

In TEST or in RECORD, the LED display shows the output of the time code generator. Using the TIMECODE ADVANCE on RECORD mode may result in some confusion because of the way the display works. If you turn the main function switch to STOP and then back to TEST, you'll see garbage on the display. *Don't panic!* In the TIMECODE ADVANCE on RECORD mode, the internal time code generator doesn't generate time code unless you're in RECORD. Therefore, the display is only updated while the Nagra is in one of the RECORD modes.

For a further discussion of FRAME RATE selection, re-read section 1.2 of this manual and Using Time Code in the Reel World.

4.5 PRESET TIMECODE / PRESET USER BITS DISPLAY Switch

This switch (the lower right-hand switch on the control panel) is divided into three sectors: use the positions from 12:30 to 2:30 to set time code; use the positions from 3:30 to 5:30 to set user bits.

Starting at the "6:30" position and continuing clockwise:

position	label	present function	proposed function
1	Off	display off	display off
2	Off	display time code one time jam	display off
3	Off	display time code one time jam	display off
4	On	display off	display user bits one time jam
5	On	display off	display time code one time jam
6	Off	display user bits	display off
7	Off	display user bits	display off
8	Off	display off	display off

4.6 Set Internal Time Code

You can only set internal time code with the **REFERENCE** switch in **INT. TIMECODE**. If you're using the **TIMECODE ADVANCE on RECORD** mode, set the needed time code with the **REFERENCE** switch in **INT. TIMECODE** and then rotate the **REFERENCE** switch one position to the left to **TIMECODE ADVANCE on RECORD**.

You can most easily set time code in the following sequence: **Hours, Minutes,** and **Seconds**. Select each of these **DISPLAY** positions, set the **DIGIT x 10** and **DIGIT x 1** switches as needed, and then press the **LOAD** button. By setting the **Seconds** last and holding the **LOAD** button as necessary, you can set the precise time as desired.

4.7 Set Internal User Bits

You can only set internal user bits with the **REFERENCE** switch in **INT. TIMECODE**. **USER BITS** positions are numbered 1 through 8 from *right* to *left* as displayed. Select the desired pair of **USER BITS** with the **PRESET TIMECODE / PRESET USER BITS DISPLAY** switch, set the **DIGIT x 10** and **DIGIT x 1** switches as needed, and then press the **LOAD** button.

4.8 EXT. REF to TIMECODE

In this position, a valid external time base must be connected to the **PILOT** connector; the internal crystal is disconnected and the frame rate can vary wildly anywhere between 22 and 34 fps. Set initial time code numbering in the normal fash-

ion with the REFERENCE switch in the INT. TIMECODE position. The FRAME RATE switch sets the frame numbering sequence: 24 (0-23), 25 (0-24), or 30 (0-29). I'm not sure about drop-frame functions. It follows that in this mode, you must use either a hard-wired slate or a radio to transmit the time code generated in the Nagra to the slate.

4.9 EXT. TIMECODE

This is *not* a continuous jam mode; the Harvey Board does *not* regenerate incoming time code. In this mode, the Harvey Board merely *reshapes* incoming time code. The FRAME RATE switch *only* sets the position of the illuminated decimal point on the display but not the actual frame rate of the recorded time code. The EXT decimal point will not illuminate. The recorded time code is the reshaped incoming time code.

As a practical matter, the Harvey Board's inability to regenerate time code is particularly significant on a job that requires playing back a tape with time code on one machine and re-recording the played back time code on a second machine. Played back, reshaped, unregenerated time code may display properly on a Harvey Board display. If recorded, it may be recoverable on a IV-S with a Harvey Board. However, field experience has demonstrated that time code recorded using this technique is not readable on other equipment. In this scenario, use of a separate reader / generator that truly regenerates (not just reshapes) time code is essential.

In summary, the incoming time code must be nice, clean, fresh, new time code. If it isn't, use a reader / generator to regenerate it before feeding it to the Harvey Board.

4.10 ONE TIME JAM

REFERENCE switch: ONE TIME JAM
FRAME RATE switch: as appropriate
DISPLAY switch: positions #2 or #3 (See "DISPLAY Switch" section 4.5 above.)
time code source: supplied to time code input on cue connector
LOAD button: press once (Note that the LOAD button remains armed and dangerous.)
EXTernal and JAM decimal points: flash on / off at 1Hz
absent valid external code: display will freeze

4.11 FRAME RATE Switch: 30DF (30FPS Drop-Frame) Position

Time Code Systems has alerted us in that frame numbering is erroneous in the 30DF (30FPS drop-frame) position. Don't use 30DF (30FPS drop-frame) until this problem has been fixed.

4.12 Metering, Maltese Cross Indications

PILOT FREQ: in record: green needle = ; red needle = ;
specifications to be supplied by the manufacturer

5 Playback Set-up and Operation

5.1 QSLS No Longer Applicable

The Harvey Board incorporates a resolver; hence, the QSLS isn't needed and probably won't work.

5.2 Playback with Internal Resolver Off; Sync Jumper Plug

The resolver is turned off by eliminating the time base signal. Pull the sync jumper plug or disconnect any external reference to disable the resolver. Otherwise, the resolver is on in both **PLAYBACK** modes. The resolver tries to lock to a sync track even if it's not there. Playing back a tape which lacks a sync track will result in wildly erratic speed unless the resolver is disabled.

5.3 Concerning the Resolver

The resolver functions best (this is true of all Nagras) when powered off the ATN. The Harvey Board circuitry is considerably more efficient on batteries than the Kudelski circuitry. Fresh batteries are adequate at 7½ips; ideally, use the ATN at 15ips, although the Harvey Board is better at 15ips on batteries than is any Kudelski resolver.

The Harvey Board provides metering of resolver phase lock in either playback mode. With the meter select switch in **PILOT PLAYBACK**, the red needle (the old frequency comparator) shows two full frames deviation, one (retard) to the left of the center position and one (advance) to the right of center position.

When the Harvey Board resolves time code, as much as ten seconds may elapse while its slews within one frame to lock the time code signal on the tape to the internal reference. The resolver may take up to ten seconds to completely stabilize. Note that for most of the ten seconds, the resolver is accurate within one frame. To lock up sync more rapidly in time code mode, snap the pinch roller. This makes the internal sample-and-hold counters think there's been a sync dropout; the Harvey Board then looks for two sequential valid time code words and syncs up.

5.4 Playback and Resolve to an Internal Reference

The sync jumper plug must be installed to resolve to an internal reference. Normally, the **FRAME RATE** switch is used to select the same time code frame rate that has been recorded on the tape or, for **FM PILOT**, the frame rate that is one-half the time base of the sync signal on the tape. Let's try that last one again. To resolve a tape with a 60Hz FM Pilot sync signal, select **FM PILOT** with the **REFERENCE** switch, and select **30** frames with the **FRAME RATE** switch. Similarly, to resolve a 50Hz FM Pilot sync signal, select **25** frames with the **FRAME RATE** switch. For an excellent discussion of cross-reference resolving, read the appropriate sections of Using Time Code in the Reel World.

5.5 Resolve Timecode to Mains

At present, the IV-S with the Harvey Board won't accept any external sync reference. This is supposed to be fixed imminently with additional resistors on the Harvey Board. The latest word is that connecting an external sine wave sync source (e.g.: ATN 1 volt sync output) to the time code input (cue socket: pins 1 and 7) may work. Deep breaths, everyone.

5.6 Metering, Maltese Cross Indications

PILOT PLAYBACK: in playback: green needle = pilot level; should be 0dB with a tape recorded on a IV-S with a Harvey Board; will read approximately -10dB @ 15ips or -20dB @ 7½ips with a pre-recorded narrow track tape. This reading is sufficiently accurate so as to show pilot track dropouts. Red needle = resolver phase lock.

6 Special Applications

6.1 Striping (Adding) a Sync Signal

An aspect of the installation of the Harvey Board in a Nagra IV-S can be the inclusion of an internal switch that allows you to stripe tape with time code. Time Code Systems neither recommends nor supports this option, but in its absence, you've got no capability comparable to the "gem clip" option available on an unmodified Nagra IV-S: jumping pins 2 and 5 on the CUE socket to activate the FM sync record circuit. These pins now have new functions. When using this option with a Harvey Board-modified Nagra, the real estate on the tape allocated to the center channel *must* be blank. In other words, you can *not* stripe tape with full track mono program or re-stripe tape with existing FM sync or time code.

In Harvey's own words (6/21/90): "...you can actually record time code rather successfully if there was nothing in the center track before. Ah, it's not biased, and it's not pretty time code, and some T's are going to hate it.... It's not a biased record with that in playback, but it actually, you can actually put a track down that works pretty well, but it's not going to, to go through a lot of houses without tweaking and, and care. It'll play on our machines fine but...."

Note that the labels on early control panels don't match the indexing of the REFERENCE and FRAME RATE Switches: The labeling and the switch positions on these panels only correspond at the "6:00" position. As you rotate the switches clockwise and counterclockwise from that position, you've got to accurately count click stops. By the time you've reached either extreme, the slot is neatly pointed between two marked positions. The sequence of positions is correctly labeled; it's only the positioning that's off. A corrected control panel is available.

Installation and Set-up (from Frank Haber: 6/15/90)

Strip machine out of case and lid, remove batteries!!! Set aside battery compartment lid. On machines with "Euro" (DIN 5mm) fuses as battery contacts, take care that these do not fall out.

Verify correct tensions, rough audio operation. If you have a scope that can measure 13.5kHz at the millivolt level, azimuth the pilot head against a known standard (a full-track 7-1/2 ips audio alignment tape at 16kHz gives the best adjustment sensitivity for this narrow-track head).

Check that machine records and plays back FM sync. Verify deviations from nominal FM carrier level, if you have a standards tape. Xtal frequency, deviation and carrier level are obviously not important -- the Kudelski cards are now spares.

MAKE FM REFERENCE TAPES AT BOTH 7-1/2 AND 15 IPS. A 3150Hz flutter reference tone is a useful thing to have on the audio channels.

MACHINE STRIPDOWN

Remove FM Pilot card and attached QFM Frequency Meter, if any. If the flesh-colored pilot head coaxial cable is soldered to your FM card, CLIP the cable just beyond the point where any solder-wicking into its braid stops. If you have a connector on your cable, cut it off. Remove crystal card. Remove hex standoff under the crystal. Label all cards with customer name and bag.

Remove bias/record amp (trapezoidal) card and set aside. Unsolder and set aside clad-phenolic shields for FM and bias cards. Clip the pink and gray speaker wires and remove the speaker and its adapter plate as a unit (the four screws on the side of the Nagra).

Clip out the Nagra's main power fuse. This is usually a Picofuse (like a 1/8W resistor), covered by sleeving, wired inline in the purple/white wire along the machine's right side, approximately over the Cue connector. LABEL the wire which comes from the REAR of the machine. On machines which have had an accessory (3AG) "auto" fuseholder installed, remove that. Some early machines may use brown instead of purple-white wire.

BIAS CARD CONNECTOR DISASSEMBLY: Identify the bias card's front connector. It's screwed into front edge of machine top with long 2mm flathead screws, nuts and flat washers. If you've never seen this connector internally, it consists of two Diallyl or white plastic halves, with molded recesses for Nagra's male pins and/or stainless female threaded bushings. There

are several unused blank pins. WARNING -- Disassembly of this connector without insuring that the halves stay together is a minor disaster! The pins will splay out of their recesses and cost you twenty minutes of reassembly time.

Take a moment, and secure the two halves of the connector together with your choice of cyanoacrylic cement, thin tape, clamps, etc. THEN fully remove the two mounting screws, nuts and washers and set aside.

A22 REGULATOR/SERVO CARD CONNECTOR DISASSEMBLY: This is the long card that stands vertical against the back side of the Nagra's "box" (bottom half), nestled behind the battery compartment. We will not remove it now.

Stand the machine on its back, opened like a book. Identify the two connectors at the board's top edge (now facing you as the front edge). The larger cheese-head screws in the center of the connectors secure the (male) harness connector to the "cup" (female) board connector sockets. Remove these, but do not unplug the mating connectors. The small 2mm screws on the ends of each connector clamp the two halves of the male together. We are about to remove these four screws, but first we must deal with the unseen nuts on the other end of the screws. These nestle in a hex recess in the plastic. Either secure them in these recesses with fun-tak, or let them drop to the surface of the servo card, remove and place aside.

The harness connections to the male half of the connector are now visible. If you've never worked on these Kudelski-made connectors before, the tinned wire ends are laid in cross-slots in the pin tops. The slots may not be visible under their solder fillets. A good basic technique is to lay the tinned end of your new wire on top of Nagra's, entering from the same direction. If your Nagra has the older, thick-PVC insulation, the fit will be tight. Reflow all old connections with at least 1/3 new solder and a clean iron, for integrity. You will be soldering to a mating connector pair which will act as a heat sink; use a hot iron, and act quickly. The female ("bell," "cup," "barrel") half of the pair you're working on is a series of cups on the pc board. On older Nagras, these are not staked. Still, soldering one pin at a time should not disturb their alignment. Remember to unmate all connectors before checkout -- later Nagras do not have gold on these parts, only nickel(?), and soldering heat can promote contact problems.

The A22 Harnesses: TC Systems supplies two harnesses to connect the servo board to their installation. These are both 6-pin Bergs. The keys go up on both, if the shrouds are missing on the board pins. These are unfortunately interchangeable.

Start with the short, 5-wire cable. Consult the diagram packet for connections. Note that we use the previously unused pin 10, which is multed to pin 9 on the servo card. One mini cable tie should be sufficient for securing the new harness, as shown.

The longer two-wire cable is trickier. We will be threading both wires through the transparent vinyl tubing that contains the upper harness along the rear of the machine. On older Nagras using the thicker hookup wire, the fit is quite tight. First, note the length of the cut end of the head coax. This is your guide for the dress of the new coax and thin black wire of the two-wire cable. With a sharp-pointed scissors or dikes, extend the hole in the Nagra cable's clear sleeving 1" toward the hinge side of the machine. This will allow easier entry of the new wires, and will be necessary later on to dress the new connector a bit left of its old position. Now strip back 1/8" of the thin black wire and new coax. Tin the wire and the coax braid.

Procure a 10" piece of 18-24 ga. solid tinned buss wire, and tack the new wire and cable to the buss, a few inches apart. The buss will be your puller. Gently thread the buss wire through the sleeving until it emerges at the hinge side of the machine. As the two new wires enter the sleeving, lubricate them well with hand soap or clear silicone grease.

The thin black wire goes to the other servo-board connector, as shown. The coax goes along the machine hinge (follow the existing harnessing) as shown, cutting inward on the top plate along the microswitch wiring, then lying alongside the bias ribbon cable until it reaches the connector you previously removed. Adjust the cable dress so that as much as possible, the cable is twisted when you open and close the machine, rather than forming a loop. Above all, avoid interference with moving parts!

8 Service / Repairs

Emergency telephone numbers:

Time Code Systems: (415) 574-4458
Peter Bettendorff (Time Code Systems partner): [redacted]
Harvey Warnke (Time Code Systems partner): [redacted]
Andy Wiskes (Time Code Systems partner): [redacted]

The modification doesn't lend itself to component-level field service.

This manual's author's name and telephone number:

Richard Brause
[redacted]

[redacted]

In any comments or observations that you report to me, in addition to a description of the event, please include: mode of operation (REFERENCE switch position); FRAME RATE; tape type; and tape speed.

9 Flow Chart(s) (from Harvey Warnke)

The manufacturer has not made available any flow charts, circuit diagrams, or other technical information.

THE HARVEY BOARD
June 22, 1992 revised version

If this is your first encounter with this manual, I'm sure you'll want to read it from front to back. If you've got one of the earlier versions, this summary highlights the most significant revisions. I'm also considering a 900 telephone number: press 1 for drop frame; press 2 for non-drop frame; select your time base now.... Any comments?

As in the past, feel free to make copies of this manual and make them available to anyone who's interested.

section 0, second paragraph: smarmy disclaimer

section 2.2: ATN-2 modification

section 2.4: voltage; need for regenerated time code

section 2.5: renumbered

section 2.6: entire section

section 3.2, last paragraph: reference to Jim Tanenbaum

section 4.8: entire section

section 4.9, first paragraph: reference to section 5.4 (This one will sneak up and bite you!)

section 4.10: note about user bits

section 4.12: new

section 5.4: new information about time code playback

section 5.6: new / more complete information

section 5.7: new (This is why I ask for your comments.)

section 7, paragraph on page 16 that begins "The A22 Harnesses: TC Systems supplies two harnesses...": note my comment about the missing shrouds on the Harvey board. Mine might be the only installation with this defect, but the cumulative cost to me (and others) has been sizable. The left 6-pin connector only uses five of the six pin positions. I have now jammed some toothpicks into the unused opening in the female connector. These were mighty expensive toothpicks.

section 8: amended information about Time Code Systems; information about Jim Tanenbaum/Sound Recording Services.

June 18, 1992

This is a list of people who, to my knowledge, own Nagras with Harvey Board conversions. If you know other folks whose names and telephone number(s) should be added to this list, please send them to **RICHARD BRAUSE.**

Paul Bang
[redacted]

Felipe Borrero
[redacted]

Richard Brause
[redacted]

Jerry Bruck
[redacted]

Curtis Choy
[redacted]

Frank Haber
[redacted]

Samantha Heilweil
[redacted]

John Hirst
[redacted]

Lawrence Loewinger
[redacted]

Frank Stettner
[redacted]

Douglas Tourtelot
[redacted]

Bernie Zuch
[redacted]

Thanks