

# NAGRA T-AUDIO

## T-AUDIO Time Code

### transportable studio recorder

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**NAGRA T-AUDIO      INSTRUCTION MANUAL**

**KUDELSKI S.A.**

June 1984 Edition

Nagra Tape Recorders Manufacture

code no. 20.09012.161

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# USER MANUAL

## TAPE TRANSPORT AND AUDIO ELECTRONICS 1

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## 1.1 FIRST TIME OPERATION

Before connecting the T-Audio to the mains power supply for the first time, ensure that the voltage selector is correctly set. It is located behind the front cover of the machine and may be set to 110 or 220 volts (+ 15% - 10%). The mains cable may then be connected and the power switched on.

### THREADING THE TAPE

Quick release adaptors permit the use of tape reels having NAB, AEG or cinema-type hubs. Each of the hub adaptors is fitted with diametrically-opposed spring-loaded retaining catches which must be fully compressed before the adaptor can be fitted to the recorder. The supply and take-up reels have two alternative spindle positions, to accommodate small reels of up to 20 cm (8") diameter, or large reels of up to 30 cm (11.8") diameter. The outer spindles should only be used with large reels.

Always check that the hub retaining catches have latched correctly before using the recorder.

Having fitted the tape reels, press one of the "Loading" buttons (see page I.1.2-3) and thread the tape as illustrated. The tape passes inside the guide rollers when using large tape reels, and outside the guide rollers when the reel size is less than 20 cm (8").

### KEYBOARD

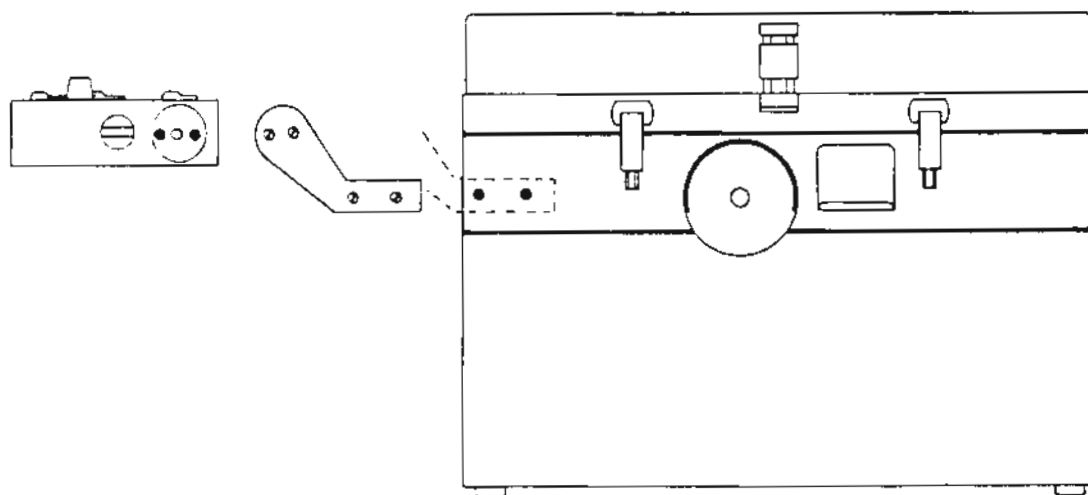
The NAGRA T-Audio can be controlled by two separate standard keyboards connected to either of the two sockets on the side of the machine as well as through the "Remote control Input/output" rear socket (see chapter 1.7) to which any appropriate control device may be connected (additional keyboard, computer, etc.).

### CONNECTION OF THE KEYBOARD

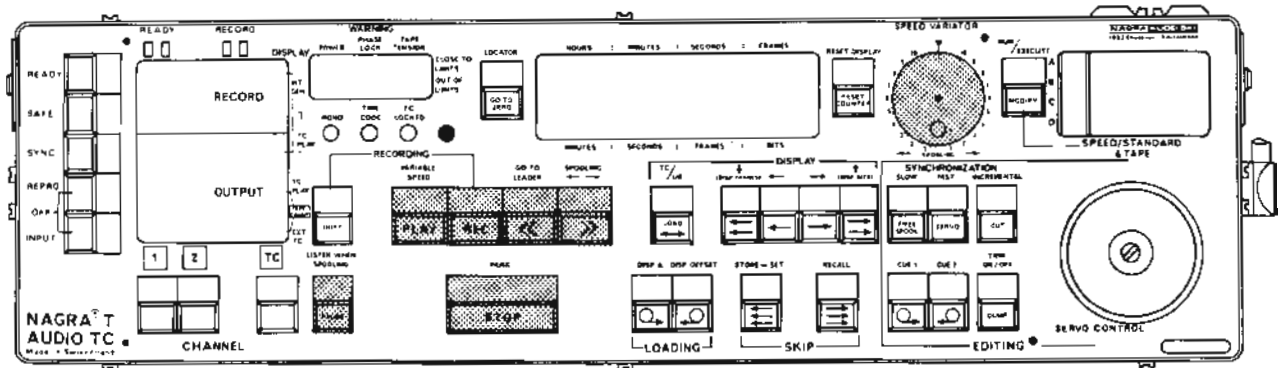
To use the keyboard on the NAGRA T-Audio, connect the cable to the socket on the right-hand side.

To use the keyboard as a remote control, connect the cable to either socket. It must be noted that the left socket is not wired to allow playback or spooling speed variation. A 5 meter extension cable (TAC-5 code no. 09498) is available. The two connectors linking the keyboard cable to the extension cable can be fixed on the upper side of the keyboard by their screws.

**NOTE:** The length of the remote control cable should not exceed 50 meters (with low noise cable).



## 1.2 KEYBOARD DESCRIPTION



Each of the five main keys has two different functions, the direct access function marked on the key itself and the shifted function marked above it. The shifted functions can be selected by first pressing the "SHIFT" key and then, the desired main key while still holding down the "SHIFT" key.

**NOTE:** The LED's inside the keys indicate the direct access function selected. The LED lighting ensures that the selected function is correctly received and decoded.  
No function will be accepted if either tensiometers are at end-stop position, except "LOADING" function.

**PLAY** The PLAY button starts playback in the twin capstan mode at the speed selected by the SPEED and STD SELECTOR.  
The output signal is muted during the start up time. (see page I.2.1-2).

**VARIABLE SPEED** When selected, it offers up to  $\pm 6\%$  variation by means of the speed variator control.  
**SHIFT+PLAY**

**NOTE:** This is operative only if the toggle switch on the speed stabilizer is in its timing variator position (see page I.2.1-5).

**RECORD** When the desired channels to be recorded have been set to READY; press SHIFT + REC to start recording, according to the SPEED STANDARD & TAPE setting.

**NOTE:** See also I.2.1-2 "Record delay".


**NOTE:** THE functions LOADING - SKIP - EDITING - SPEED/ /STD/TAPE modify and GO TO ZERO are inhibited.  
To prevent accidental recording the record function can be inhibited by means of the red switch "Rec. Inhibit" on the right-hand side of the Logic PC board A 02 (see page I.2.1-4).




**FAST REWIND**

By pressing this key the tape will rewind until another key is pressed or until the tape is fully rewound. The value displayed on the counter will be frozen as soon as the tape is fully rewound.

**GO TO LEADER**

SHIFT + 

This function uses the clear tape detector to stop the recorder when light passes through the tape. For example, leader tape.


When SHIFT +  is pressed, the tape will reverse at the preselected speed until this occurs.

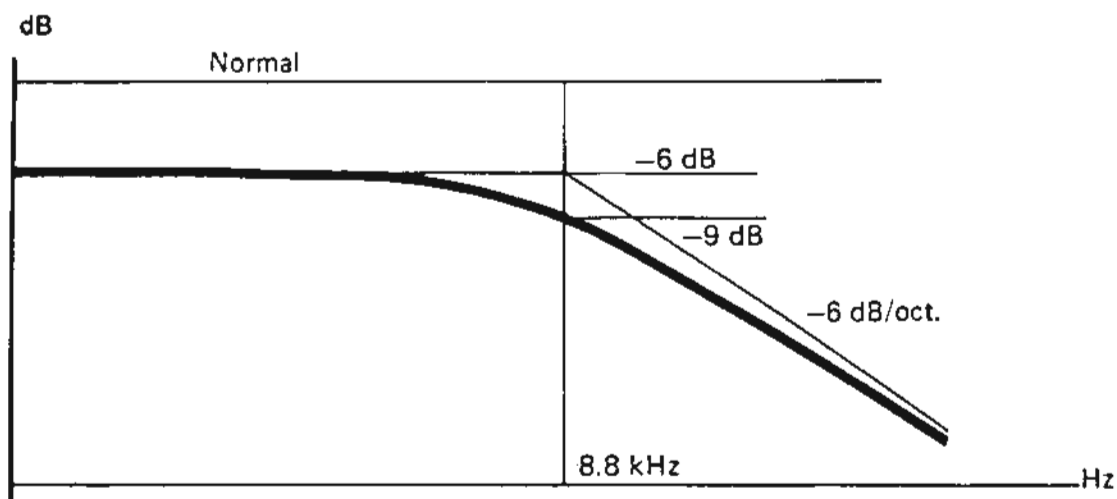
**FAST FORWARD**

This key operates in the same way as Fast rewind but in the opposite direction.

**SPOOLING**

SHIFT + 

Variable speed spooling in either direction may be selected by pressing SHIFT and the  key. The tape direction and speed is now controlled by the speed variator potentiometer. To monitor the tape while in variable spooling mode, hold down the PAUSE key. The monitored signal is automatically filtered and attenuated by -6 dB at low frequencies and is increased by a low pass filters having a -3 dB point at 8.8 kHz for comfort.

**STOP**

Pressing the STOP key overrides any function. The machine will stop. This is the recommended start position prior to RECORD or PLAY.

**PARK**

SHIFT+STOP

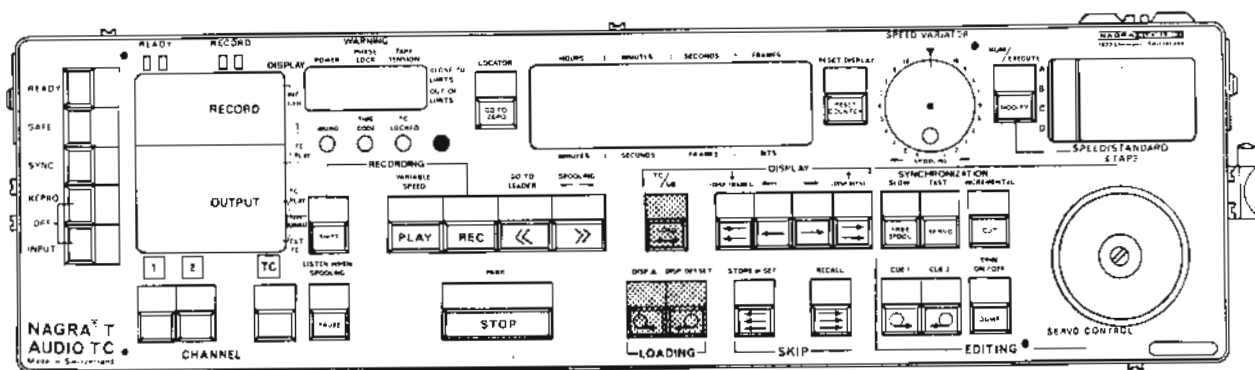
This is the mode automatically selected on power up. This is a standby position with minimal current drain, and should be selected before handling the tape or before power down.

## PAUSE

The PAUSE key is non-latching and may be activated in PLAY, RECORD or PLAY with variable speed. Pressing this immediately stops (followed by a small backward movement) the tape until it is released when it continues in the previous mode.

If "SPOOLING" is selected, pressing "PAUSE" will cause the pinch-wheel assembly to move forward bringing the tape into contact with the record head (except on machines without the TASIM option). (See "Spooling").

## LOADING FUNCTIONS




Threading a reel of tape on the NAGRA T-AUDIO can be done in three ways either:



A light brake is applied to the reel motors and both tensiometers are inhibited thus permitting easy threading of the tape. When the tape is threaded, rotate the take-up reel until both tensiometers leave their end-stop position and select STOP or PARK.


OR



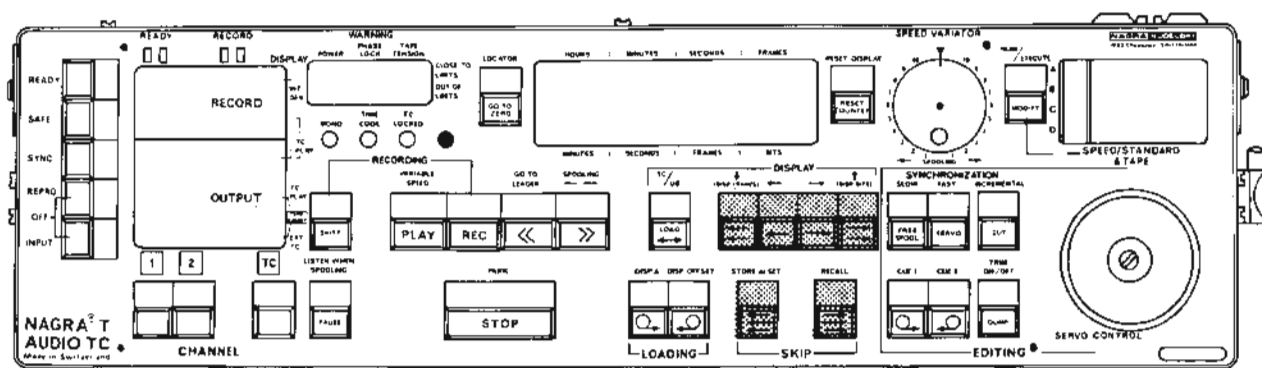
When loading a full left-hand tape reel and an empty right-hand reel, press the  button. The brakes on both tape reel hubs are released, permitting easy threading of the tape and attachment of the tape end to the right-hand take-up reel. When the right-hand reel is rotated a few turns to take up the slack, the left-hand tape tensioning arm leaves its end stop. This provides tension to the tape, then press "STOP" or "PARK"

OR



When loading a full right-hand tape reel and an empty left-hand reel, press the  button. The tape may be then threaded in a similar manner as previously described above but this time from right-to-left.

## SKIP FUNCTIONS



The SKIP functions on the NAGRA T-Audio are divided into three groups each driving the tape at a different speed. These functions stop as soon as the key is released, and the recorder returns automatically to the previous mode.

← or →

The tape is always driven by the right capstan only, in either direction at the selected A B C D speed. Monitoring is only active if "REPRO" is selected.

← or →

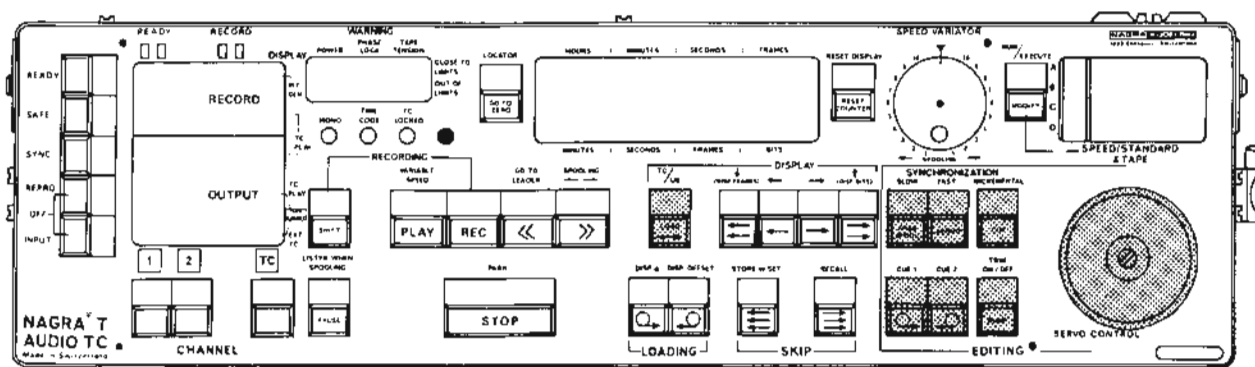
The tape is driven in either direction by the right capstan at 30 ips. Monitoring is active only if "REPRO" is selected with 6 dB attenuation. The 30 ips speed can be internally modified (see page I.2.1-4).

← or →

The tape is driven in either direction at approx. 10 m/s. The pinch-wheel assembly is completely disengaged.

**NOTE:** "Listen" function can be activated in this mode by putting Dil switch S201 in "ON" position.

## EDITING FUNCTIONS (for keyboards fitted with editing facilities)



In all editing functions monitoring is enabled if REPRO is selected on the matrix.

## FREE SPOOL

Function for manual editing of the tape. Pressing the Free Spool button closes the pinch-wheel assembly thereby bringing the tape into contact with the heads. The brakes on both tape reels are released and the tensiometers blocked enabling the reels to be turned by hand.

## SERVO

Optional servo-controlled editing function (built-in accessory TASC). If the keyboard is not fitted with TASC, pressing the Servo key will only allow the right pinch-wheel to come into contact with its capstan. Pressing the SERVO key closes the pinch-wheel assembly. The reel motors, the tensiometers and right-hand capstan motor are energized. The tape movement is activated by the control-wheel both in direction and in speed. The tape speed is constantly proportional to the rotary speed of the wheel. However, the tape speed cannot exceed 15 ips.

## CUT

The CUT button moves the tape from directly in front of the replay head to directly above the scissors mounted on the deck.

To operate the scissors, rotate the black button to unlock them.

The tape will then be cut at an angle of 30°.

Remember to relock the scissors after use.

**NOTE:** Assuming the TASC SERVO option is fitted if not, the tape will just advance.

After cutting, there are two possibilities for further editing:

### A. Servo editing facilities.

Hold the tape with your right hand and locate the second edit point using the servo-control. Press the CUT button while keeping the tape taught over the scissors and cut the tape with the built-in cutter. Select LOADING, the pinch-wheel assembly moves backwards disengaging the tape from the head unit and permits easy splicing of the tape.

**NOTE:** If the tape length to be removed is long, make use of the "TAPE DUMP" button to find the approximate position and then finely locate the exact position with the servo control.

**CAUTION:** Be careful not to touch the right tensiometer to avoid unwanted fast winding of the right reel.

### B. Manual editing facilities:

Hold the tape with your right hand, select  $\mathcal{O}$  and pull the tape until the second edit point is found. Press SERVO then CUT to align the tape with the cutter and cut the tape. Then select LOADING to disengage the pinch-wheel assembly.



Handpull to the right. This function can be used for manual editing, using only one hand to hold the right reel. If the right reel is released, the tape will move backwards, accelerate and the recorder will automatically go to the PARK position. This function is to be used after the tape has been cut to locate the second edit point.



Same function as above but to the left.

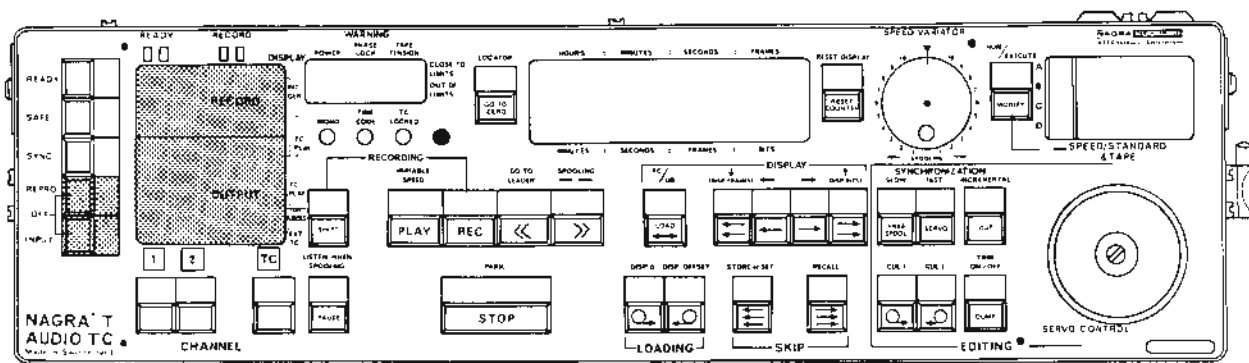
"TAPE DUMP" function. When pressing this key the tape will move from left to right, driven by the right capstan only. The take-up reel motor is not powered causing the tape to fall off recorder. The tape counter value is frozen during this operation.

**NOTE:** This key is non-latching and when released the recorder returns to the SERVO function.

### 1.3 CHANNEL STATUS MATRIX

The LED's on the matrix display clearly show the status of the machine. On power up the status indicated, will depend on position of initialization switches on control logic board (see page I.2.1-1).

#### STEREO MACHINES



#### RECORD

The two LED's are illuminated when SHIFT+REC is selected and indicate that bias is applied to the head.

#### OUTPUT

##### REPRO

The LED indicates that the line output is connected directly to the playback amplifier.

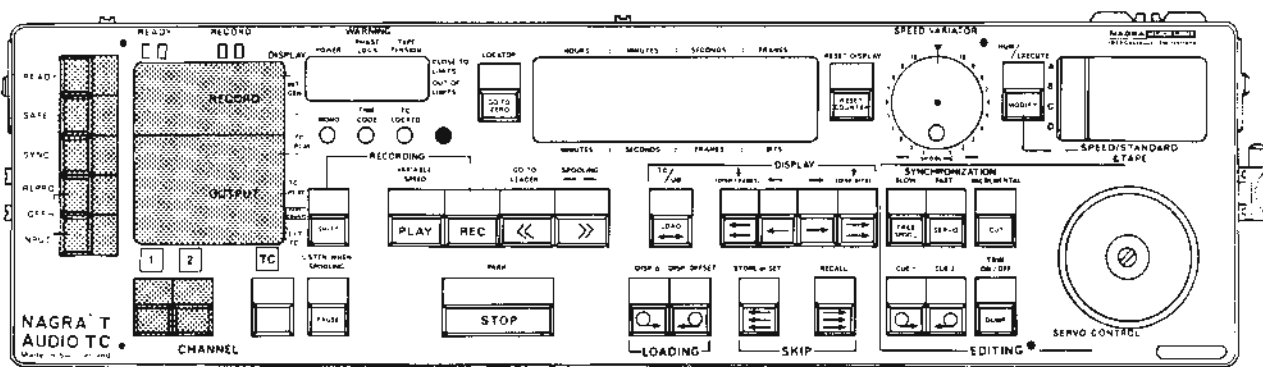
##### INPUT

The LED indicates that the line output is connected to the line input amplifier.

##### OFF

When pressing simultaneously REPRO and INPUT the line output is switched OFF.

#### TWO TRACK MACHINES



On multitrack machines channel status can be selected for each channel independently. Therefore depress the desired channel key and the status key simultaneously.

## RECORD

READY                      The LED indicates that the corresponding channel is ready for recording.

SAFE                      The LED indicates that the recording is inhibited on the corresponding channel. (See also page I.2.1-4 "REC. INH").

**NOTE:** Recording is active only if the two LED's marked "Ready" are on. To start recording either:

- Select Ready on matrix and press "SHIFT + RECORD"

or

- Select "SHIFT + RECORD" (the LED inside the REC button lights up) then press READY.

## OUTPUT

SYNC                      To be used on machines fitted with "Sync" facilities (TASIM optional circuit). The LED indicates that the corresponding channel line output is directly connected to the record head.

REPRO                    The LED indicates that the corresponding channel line output is connected directly to the playback amplifier.

INPUT                    The LED indicates that the corresponding channel line output is connected to the line input amplifier.

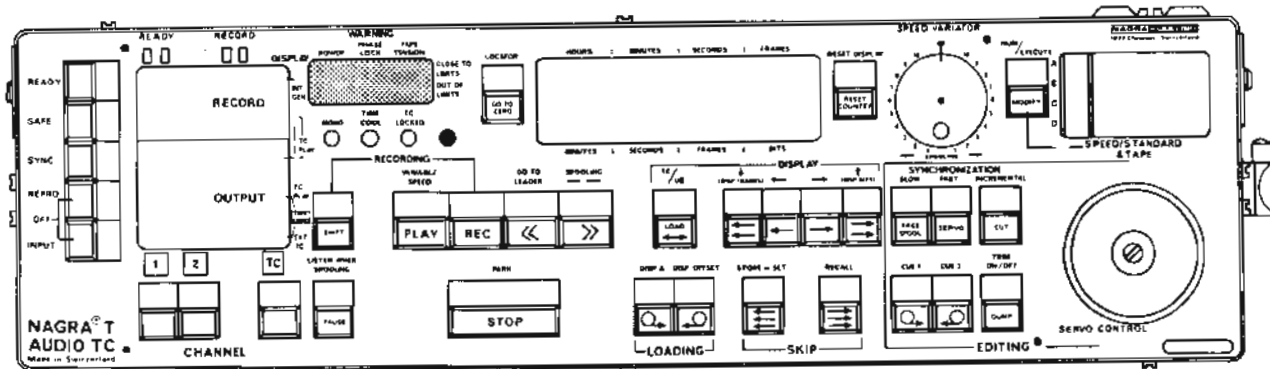
OFF                      When pressing simultaneously REPRO and INPUT the corresponding channel line output is switched OFF.

**NOTE:** Depending on the selected function, the line output is automatically switched to SYNC, INPUT or OFF without LED indication.

REPRO is switched to OFF during starting up time of "RECORD", "PLAY" and "Variable Speed". It can be programmed to be switched to "INPUT" for "STOP", "FAST FORWARD", "FAST REWIND", loading functions and "PARK" and/or to SYNC during listen operation.

SYNC can be programmed to switch automatically to INPUT or OFF if the channel concerned is in RECORD (see page I.2.1-5 "Sync switch-over").

## 1.4 WARNING DISPLAY



The warning display indicates two levels of alarm. Close to limits (the upper LED) indicates that there is an error, however the recorder can continue to operate, but should be checked. Out of limits (the upper and lower LED simultaneously) indicates that the error requires immediate attention as the recorder can no longer operate correctly.

**POWER** Warning indicator for the internal power supply.

**PHASE LOCK** Warning indicator for a phase shift between the right capstan motor and internal X-tal generator.

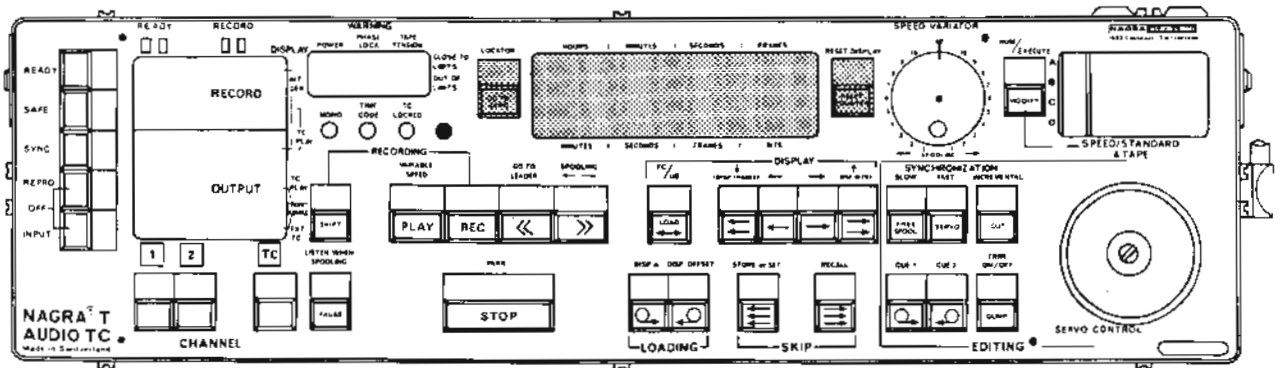
**NOTE:** The phase-lock LED will always light up during Variable Speed play.

**TAPE TENSION** Warning indicator for faulty inter capstan tape tension.

**MONO LED** Light up when the MONO/Multitrack/stereo switch on board A02 is in Mono position (see page I.2.1-1).



## 1.5 COUNTER FUNCTIONS



The NAGRA T-Audio has a time counter indicating the time in hours, minutes and seconds at all speeds thus allowing exact location of the same "0" point even at a different tape speeds.

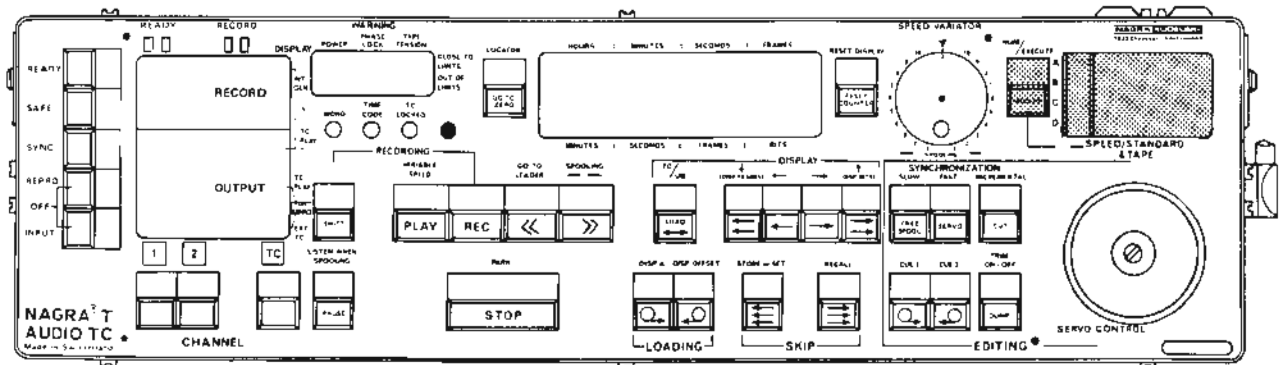
The T-Audio TC uses the same display for time code applications (hours - minutes - seconds - frames).

**RESET COUNTER** Resets the counter display to zero and starts the count again at any desired point on the tape.  
 " \_ " indicates time before the zero point.

**GO TO ZERO** This function returns the tape to zero point, in all modes except record.

**SHIFT+SKIP** Holding down the SHIFT key and pressing on the SKIP keys permits entry of any desired time value onto the counter display.  
 Triple arrow key changes the hours, double arrow key the minutes and single arrow key the seconds.

## 1.6 RECORDING CALIBRATION SWITCHING



The NAGRA T-AUDIO recording circuits are factory preadjusted to allow the use of up to four recording calibrations for any combination of speed, standard and type of tape. For recording calibration modification or optimization refer to calibration manual.

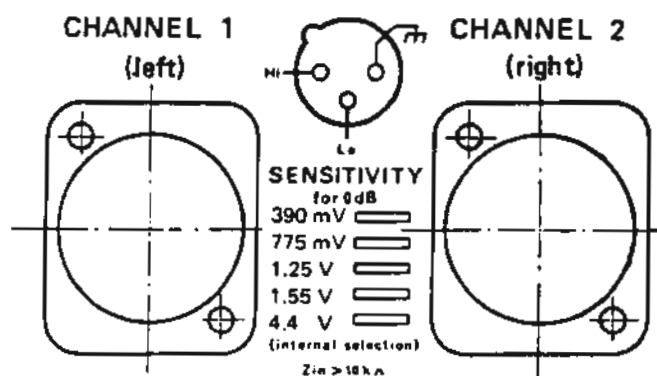
### MODIFY

Any of the 4 pre-set recording calibrations can be selected by means of the "MODIFY" key which is marked by a LED. Switching goes from A through D, then repeats itself. When switching ON the recorder, the preset calibration A is automatically selected.

**NOTE:** This function is also used for selecting the playback speed (see page 1.2.1-3 REPRO SPEED-STD SELECT).

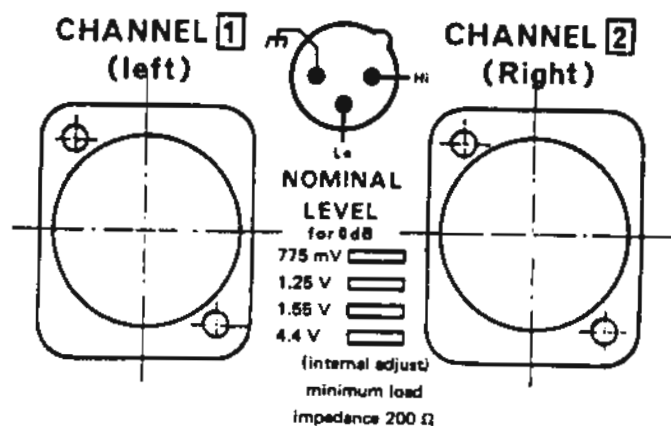
## 1.7 CONNECTIONS

### BALANCED LINE INPUT



For modification of input sensitivity see page I.2.1-5.

### BALANCED LINE OUTPUT



For modification of nominal output level see page I.2.1-6.

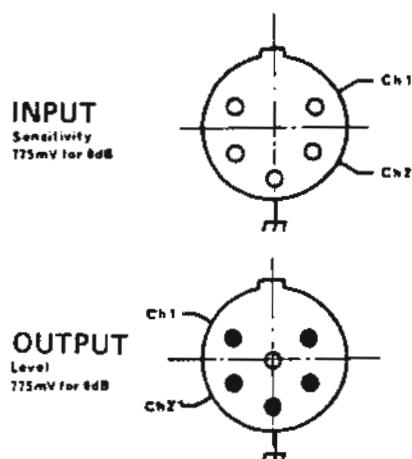
## HIGH SPEED COPY INPUT AND OUTPUT (Optional TA-PCR)

See also page I.2.1-6.

These sockets allow high speed copying (2 or 4 times nominal speed) between two NAGRA T-Audio machines

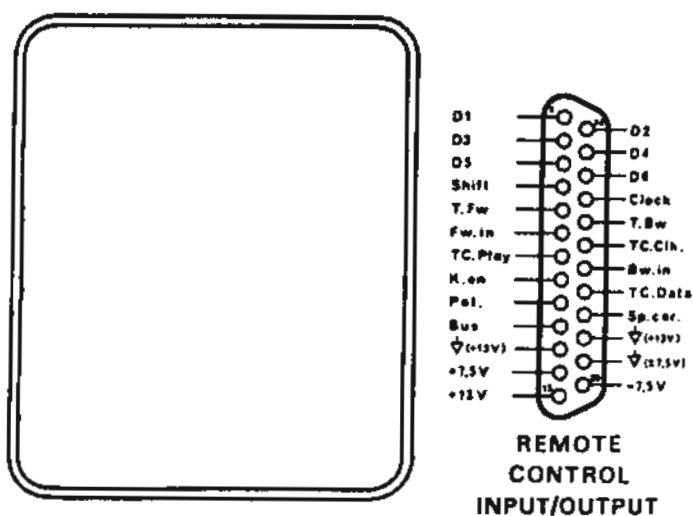
The input sensitivity and output level are fixed at 775 mV for 0 dB.

The frequency response is 50 Hz - 60 kHz  $\pm$  2 dB.



## REMOTE CONTROL INPUT/OUTPUT

This socket permits full remote control of the NAGRA T-Audio with an external control device via an appropriate interface (TAERP) or with a supplementary standard keyboard.



Other special remote facilities are also provided. They are:

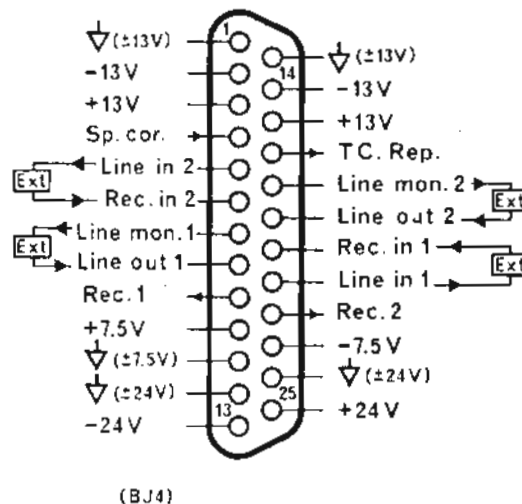
- T Fw** (tape forward and T Bw (tape backward) indicates the tape direction.
- Fw in** (forward) Bw in (backward) when the NAGRA T-Audio is fitted with optional servo-controlled editing, enables the same functions as the servo editing control knob (see page I.1.5-1).
- Pot** (speed variator pot. pin 9) speed correction value corresponding to the setting of the speed variator control (OV to + 5V)
- Sp.cor.** (speed correction, pin 22) input of a playback or spooling speed correction signal (- 7.5 V to + 7.5 V).
- K en** (keyboard inhibit, pin 8) inhibits the use of the keyboard connected to the recorder when grounded.
- TC play** (pin 7) playback or monitoring of the reference signal recorded on the tape.
- TC data** (pin 21) TC Clk (time code clock, pin 19) output signals from the internal reference generator.

Pin 11 to 13 and 23 to 25 stabilized supply outputs except pin 13 (+ 13 V) which is unstabilized.

#### AUDIO MONITORING OUTPUT

This socket provides connection for external monitoring console, and external time code devices.

The following connections are possible:



In 1 and In 2 monitoring of the input signal on balanced line input, after input preamplifier.

Rec 1 and Rec 2 monitoring of the input signal before being recorded on the tape.

Rep 1 and Rep 2 monitoring of the signal recorded on the tape

Li 1 and Li 2 monitoring of the output signal before the output transformer.

**NOTE:** The signals present at the above outputs are analogue, the nominal level is 775 mV for = 0 dB.

TC In external reference signal input.

TC Rep monitoring of the reference signal recorded on the tape.

Au Rec (Audio Record). The information present at this output can be used to switch on an external indicator to indicate that the NAGRA T-Audio is in Record mode.

Bus serial digital bits input and output. Identical to the one used by the keyboard.

Pin 10 to 13 and 23 to 25 stabilized supply outputs to feed the monitoring console.

The upper six pins of this connector are in view of the TACO-M1 monitoring unit wired as follows as from machine number 195:

1 and 14	↓ 13 V	
2 and 13	- 13 V	unregulated power supply
3 and 12	+ 13 V	unregulated power supply

## 2.1 INTERNAL SWITCHINGS

The bridges and other adjusting devices not mentioned in this chapter are reserved either for servicing or adjustment to be carried out at the factory.

### ACCESS TO THE PC BOARD

Turn the two quick-release screws located at both upper corners of the front panel.

### PC BOARD LOCATION

(Refer to NAGRA T-Audio Set of Schematics code number 2009012 263)

#### From top to bottom

1. Channel 1 Audio Record/Reproduce circuit + provision for Noise Reduction System
2. Channel 2 Audio Record/Reproduce circuit (empty space in mono machines) + provision for NRS
3. Main Control Logic
4. Speed stabilizer and Tape Transport (servo control of motors)
5. Tape Counter and servo-controlled editing (TASC option)  
Provision for 3rd track record/reproduce circuits
6. Time Code and synchronizer

**NOTE:** In order to avoid possible damage to the circuits, switch off the recorder before removing any PC Board.

### CONTROL LOGIC BOARD

(The switches are listed from left to right)

#### MONO/MULTITRACK/STEREO switch

##### Stereo machine

<u>MONO</u>	Input signal on channel 1 recorded on both tracks. Input on channel 2 not taken into account. The mono LED on the keyboard lights up
<u>MULTITRACK</u>	Inoperative in stereo machines
<u>STEREO</u>	Stereo recording

## **Two-track machine**

### MONO

Input signal on channel 1 recorded on both tracks. Input on channel 2 not taken into account. The mono LED on the keyboard lights up.

### MULTITRACK

Multitrack recording (on channel status matrix)

### STEREO

Stereo recording (channel selection keys on the keyboard are coupled)



## REPRO SPEED-STD SELECT

Playback speed selector permitting playback of a tape recorded at a speed and standard differing from those preadjusted for recording.

For example, if the preset combinations are 15 ips CCIR, 15 ips NAGRA master, 7.5 ips CCIR and 30 ips AES and the tape you wish to play back was recorded at 7.5 ips NAB.

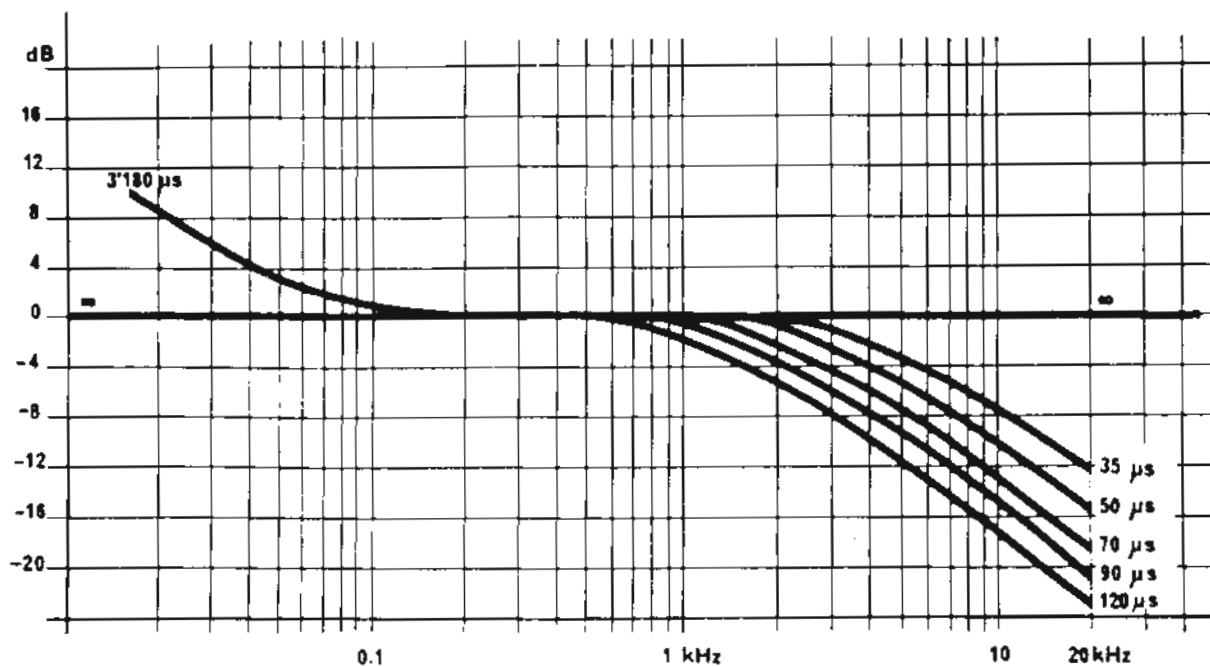
Each switch corresponds to the A B C D positions marked on the keyboard. The numbered position of the switches corresponds to:

Position	Speed cm/s ips	Standard	IEC designation	Time HF	Constant (us) BF
0	9.5 (3.75)	NAB/CCIR	-	90	3180
1	19 (7.5)	CCIR	IEC 1	70	∞
2	38 (15)	CCIR	IEC 1	35	∞
3	76 (30)	CCIR	IEC 1	35	∞
4	19 (7.5)	NAB	IEC 2	50	3180
5	38 (15)	NAB	IEC 2	50	3180
6	38 (15)	Nagmaster	-	13.5	3180
7	76 (30)	AES	IEC 2	17.5	∞

In the above example, the position of the switches would be:

A	B	C	D
2	6	1	7
15 ips	15 ips	7.5 ips	30 ips
CCIR	Nagmaster	CCIR	AES

whereas to play the 7.5 ips NAB recording on of the switches should be set to position 4.



**NOTE:** As the switch settings also correspond to preset recording speeds, switch back to the original position before recording.

## INITIALIZATION

Switches located on the main logic board A02 control the initial matrix-selected function when the recorder is switched on.

To select the function, set the switch to ON.

**NOTE:** These switches have no effect in the time code version.

- |                   |  |
|-------------------|--|
| <b>1 Ready</b>    | Initialization to be used only with multitrack machines.   |
| <b>2 Safe</b>     | For stereo and mono machines set Ready ON and Safe OFF.<br>If Safe is switched ON the recording is inhibited.<br><br><b>NOTE:</b> If both switches are in the ON position, the Safe function will be active. |
| <b>3 Repro</b>    | Line output initialization.  |
| <b>4 Input</b>    |  |
| <b>5 Off</b>      | If more than one switch is in ON position, the further right will be taken into account i.e. Input or Off.   |
| <b>6 Inh Sync</b> | To be used on machines fitted with "Sync" playback facility.<br>Set to ON position, it inhibits the selection of "Sync" on matrix display.   |
| <b>7</b>          | Slows down the maximum speed in fast forward or fast rewind.   |
| <b>8</b>          | Listen function when using skip (three arrows) function.   |

## CLEAR TAPE FUNCTION

Selects the automatic function when a transparent/translucent portion of tape is detected during Play or Record.

**Stop** The recorder selects the STOP mode

**Off** The clear tape detector is inhibited

**Rewind** The recorder rewinds the tape at high speed until another function is selected or the tape is fully rewound.

**Stop, Off and Rewind:** the recorder selects "Stop" if "Go to leader" is selected.

## REC INH

Inhibits the recording function independently from Ready or Safe initialization. If SHIFT + REC is selected the recorder goes into PARK mode.

## SKIP SPEED MODIFICATION

As mentioned in the Keyboard Function chapter the speed corresponding to the skip key can be modified. The skip speed modification depends on the playback speed selected on the control unit (see below).

First switch off the recorder and remove the control logic PC Board. Locate the two diodes CR205 and CR 204 in the line of components labeled "G" (fifth line from the front of the PC board)

	Playback speed (ips)			
CR205 and CR204 in place (ex works preset)	3.75	7.5	15	30
CR205 removed	30	30	30	30
CR204 removed	15	30	15	30
Both CR205 and CR204 removed	7.5	7.5	30	30

## SYNC SWITCH OVER

The switches are located in the upper left-hand corner of the board (B line).

On machines fitted with TASIM option (playback through record head) automatically switches the sync playback output to the input or to OFF when Ready is selected on channel status matrix. In machines not fitted with TASIM option, set to Input position.

## SPEED STABILIZER BOARD

### SYNCHRONIZER/TIMING VARIATOR

Synchronizer	Automatic playback speed variation when an internal or external synchronizer or an external speed variator is used. The external device must be connected to pin 22 (speed correction) of Remote control Input/output connector. Control signal level must be between + and - 7.5 V.
Timing Variator	Manual playback speed variation using the speed variator of the keyboard or control through external device with low output impedance connected to pin 9 Pot. of Remote Control Input/Output connector. Control signal level must be between 0 and 5V.

## AUDIO BOARDS

**CAUTION:** On stereo machines do not interchange audio boards 1 and 2, as only board 1 has active erase circuitry.

### REPRO/INPUT

Switches the LED modulometer display either to Input signal or Playback signal

### INPUT Sensitivity Selection

The input sensitivity is modified by moving a bridge located to the right of the two transformers.

The following connections may be established:

- 1 input sensitivity = 4.4 V for 0 dB (+15 dBm)
- 2 input sensitivity = 3.1 V for 0 dB (+12 dBm)
- 3 input sensitivity = 1.55 V for 0 dB (+ 6 dBm)
- 4 input sensitivity = 1.25 V for 0 dB (+ 4 dBm)
- 5 input sensitivity = 0.775 V for = dB ( 0 dBm)

if the bridge is removed input sensitivity = 0.390 V for 0 dB (-6 dBm).

## OUTPUT Sensitivity Modification

The output sensitivity is factory set to 4.4 V for 0 dB. It can be modified by altering the position of the jumper on the output amplifier. The level adjustment RPl trimmer is located in the right-hand corner of the board behind the modulometer circuit.

ST-1	0.775 V
ST-2	1.25 V
ST-3	1.55 V
Without bridge	4.4 V

**NOTE:** A soldering bridge is used for this selection on machines with serial numbers up to 0900190.

## HIGH SPEED COPY (30 ips) Switchings

(If option is fitted)

Switch one is located on the left-hand side of the board, behind a trimmer and switch two in the middle, near two IC's. Both must be set in the same way: either NORM or COPY

NORM Normal configuration

COPY Configuration for 30 ips high speed duplication

The High Speed Copy facility permits duplication of a tape at high speed with a frequency response of up to 60 kHz if the recorder is fitted with a preset recording circuit for the 30 ips speed (position D on SPEED/STANDARD & TAPE display).

This position allows either normal recording of a tape at 30 ips or tape duplication at 30 ips.

- signals are injected into the two balanced inputs on the back of the machine.
- both red switches on the audio board(s) are set to the NORM position.

**NOTE:** The frequency response is limited to 20 kHz and the HIGH SPEED COPY input is disconnected.

For high speed copying (30 ips):

- signals are injected into the HIGH SPEED COPY input on the back of the machine.
- both red switches of the audio board(s) are set to the COPY position.

**NOTE:** The frequency response is extended to 60 kHz and the BALANCED LINE INPUTS are not connected.

The position of the switches must be taken into account only for the 30 ips speed. It does not affect recording at other speeds.

## 2.2 STANDARD EX FACTORY SETTING

### STEREO MACHINES (NTA-S)

#### Control logic board Stereo

Rec delay: tape length

Initialization:       1 on  
                          2 off  
                          3 on  
                          4 off  
                          5 off  
                          6 off

Clear tape function: off

Rec Inh:               off

#### Speed Stabilizer       Timing Variator

#### Audio board           Input

Input sensitivity: 1.55 V

Output sensitivity: 4.4 V

High speed copy: Copy if  
fitted with 30 ips AES/Copy  
preset calibration

### TWO TRACK MACHINES (NTA-2)

#### Control logic board Multi track

Rec delay: tape length

Initialization:       1 on  
                          2 off  
                          3 on  
                          4 off  
                          5 off  
                          6 off

Clear tape function: off

Rec Inh:               off

#### Speed Stabilizer       Timing Variator

#### Audio board           Input

Input sensitivity: 1.55 V

Output sensitivity: 4.4 V

High speed copy: Copy if  
fitted with 30 ips AES/Copy  
preset calibration

## **OPTIONS**

### **3.1 TAHP Phones output**

This optional circuit allows monitoring of the recorded signal using either headphones or the built-in loudspeakers.

The controls on the right side of the machine permit monitored channel selection, phones or loudspeaker output selection and volume adjustment. A standard stereo jack is provided on the same side as well as two monitoring speakers located on the front of the machine.

The last position of the monitored channel selector has two possibilities (stereo or mixed). The desired possibility is selected using the blue micro switch on the TAHP board inside the machine.

**NOTE:** The signal can also be monitored using an external amplifier connected to pin 7 Li. 1 and pin 18 Li.2 of the rear Audio Monitoring Output connector.

### **3.2 TASIM Self-Sync amplifier**

The TASIM optional circuit permits monitoring of the recorded signal directly through record head. This function is mainly used for simultaneous recording purposes on two track machines. To operate a simultaneous recording simply select SYNC output and SAFE for the channel to be monitored, on the keyboard and select Ready on the channel to be recorded.

The signal of the monitored channel is present on TAHP phones output or loudspeaker, on balanced line output of on pin 7 Li.1 or pin 18 Li.2 of the Audio Monitoring Output rear connector.

**NOTE:** The TASIM circuit is only a monitoring facility consequently its bandwidth is limited to about 60 Hz-12 kHz  $\pm$  3 dB at 15 ips.

### 3.3 TASIM-2 Self-Sync amplifier

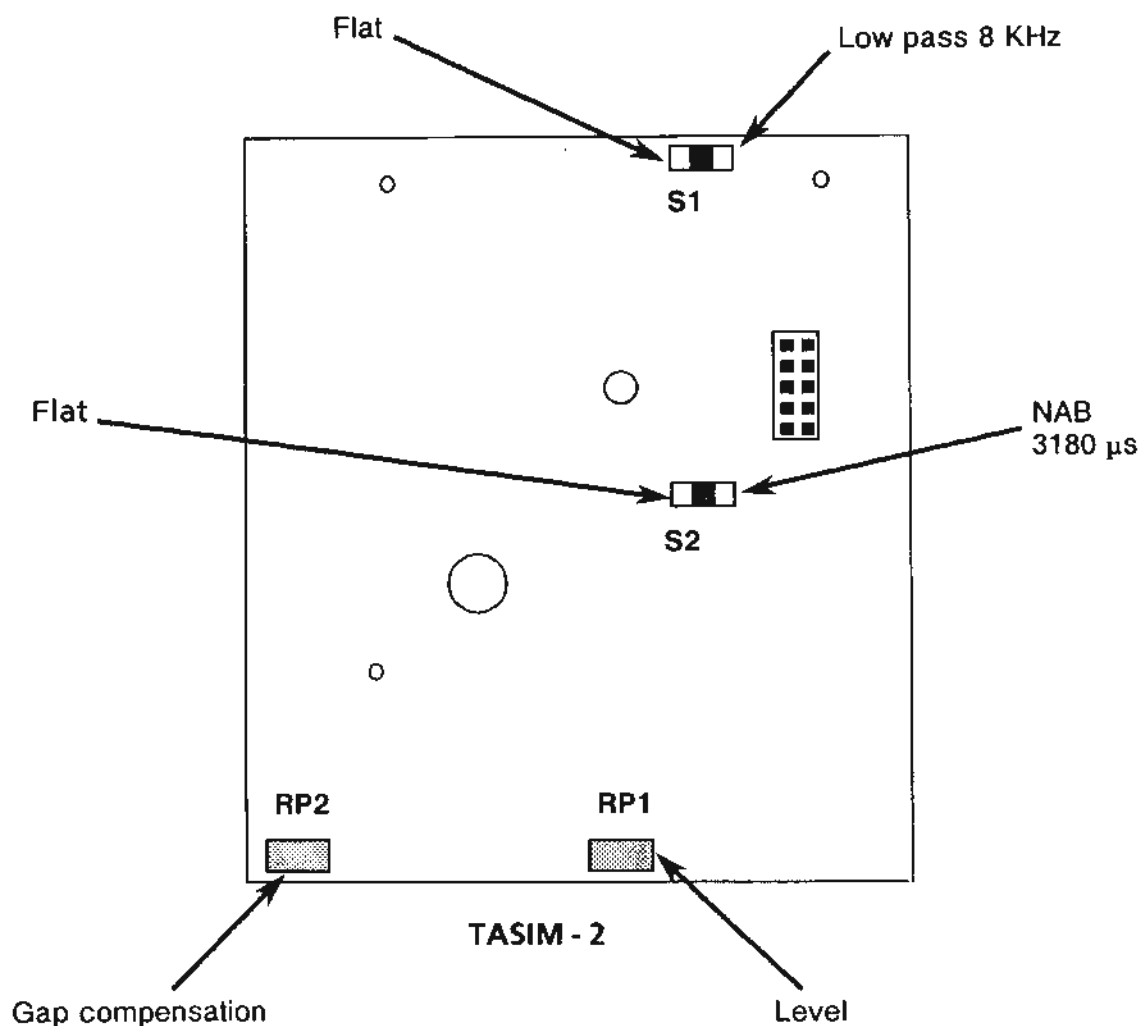
The TASIM-2 is a new and considerably improved version of the TASIM which it replaces.

The main areas of improvement are a more than 25 dB better signal-to-noise ratio and an extended bandwidth (provided the new 10 micron gap record head is used).

The TASIM-2 is functionally identical to the TASIM and its operation is the same except for two new internal switches.

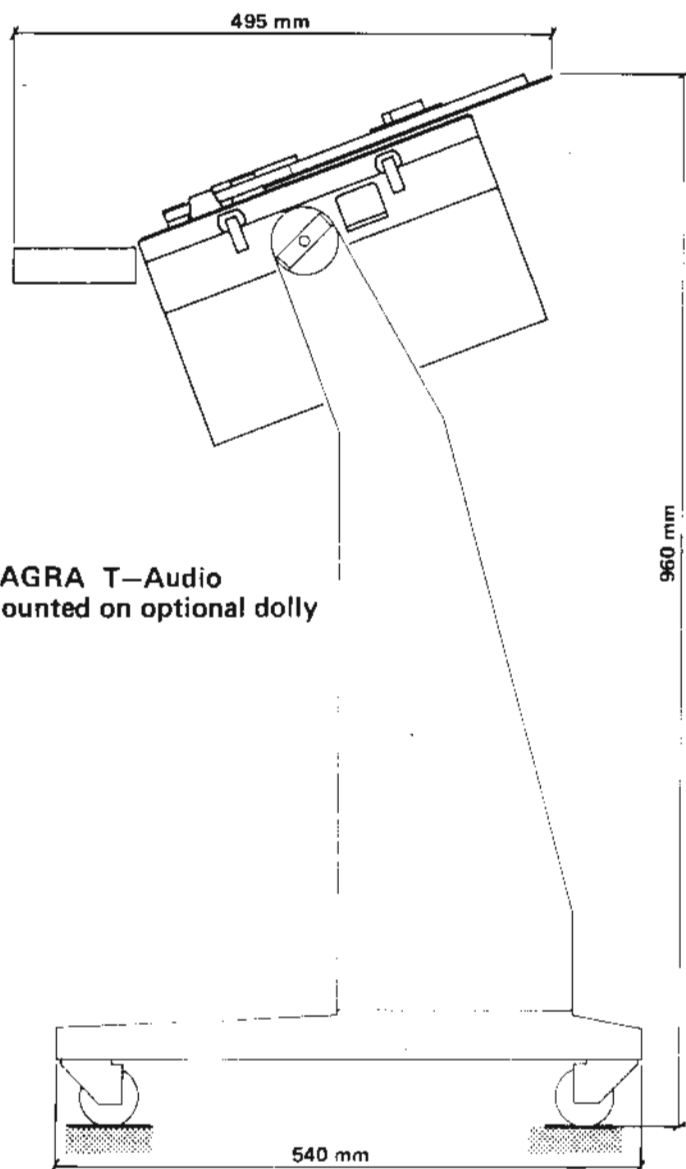
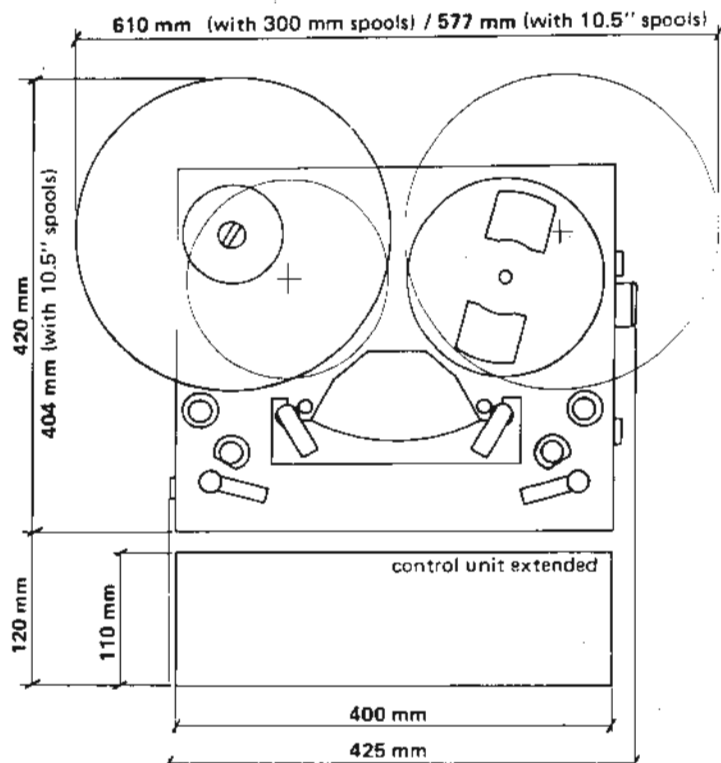
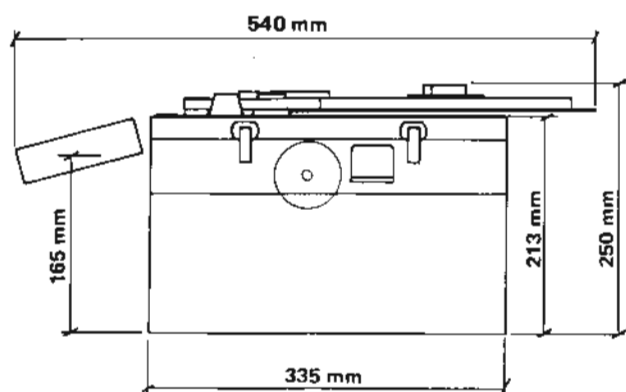
Switch or bridge S1 (on the edge of the board) connects a low-pass filter at 8 kHz (low-pass position) or leaves the upper end of the band flat.

Switch or bridge S2 (in the middle of the board) enables a low-frequency 3180 microsecond equalization for the NAB standard (NAB position) in any speed or standard, or disables it (flat).

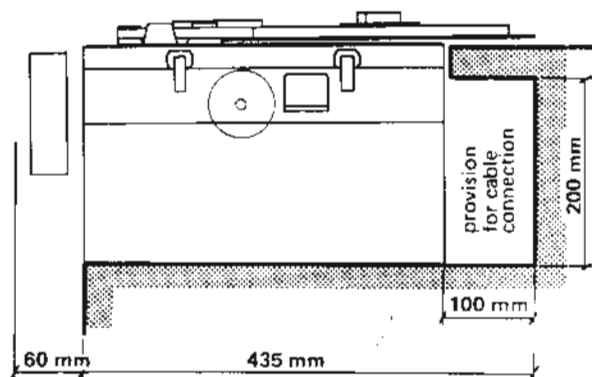




# **NAGRA T—Audio DIMENSIONS**



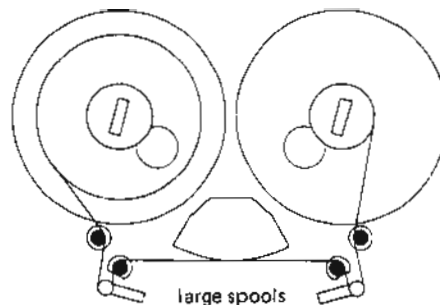
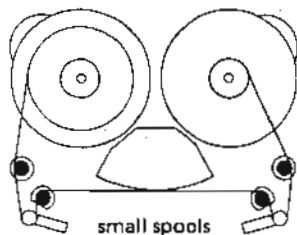
**NAGRA T—Audio**  
mounted on optional dolly



**Installation dimensions**  
for fixed or semi-fixed  
applications  
(control unit folded)

# TAPE THREADING

OXIDE IN

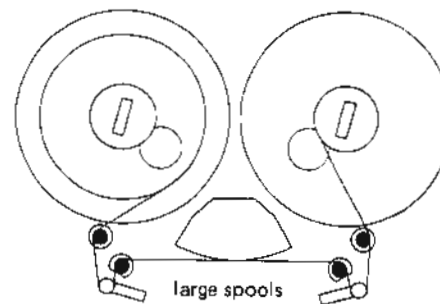
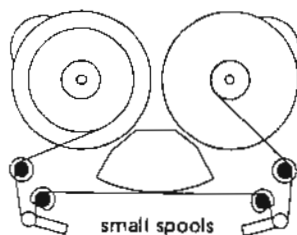


TAPE OXIDE POSITION



# TAPE THREADING

OXIDE OUT

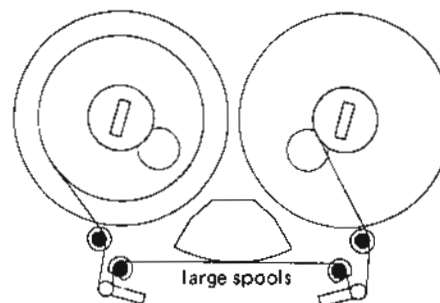
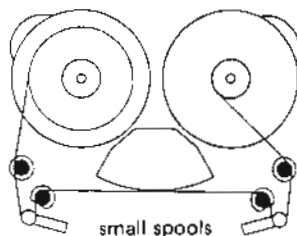


TAPE OXIDE POSITION



# TAPE THREADING

OXIDE IN  
OXIDE OUT

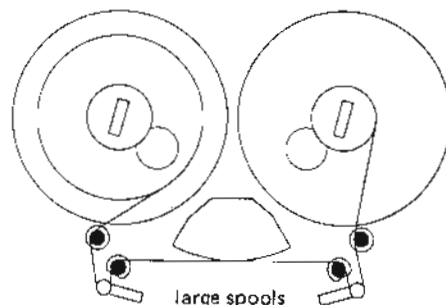
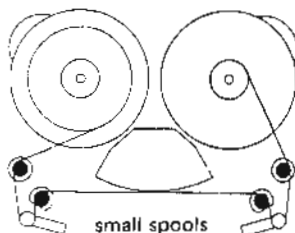


TAPE OXIDE POSITION

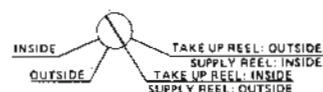


# TAPE THREADING

OXIDE OUT  
OXIDE IN



TAPE OXIDE POSITION



**USER MANUAL**  
**TIME CODE SECTION AND PILOT OPTIONS**

**2**

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	SMPTE/EBU Standards

## **1.0 INTRODUCTION**

The NAGRA T-Audio exists in three mechanically identical versions.

The only feature which differentiates the T-Audio Timecode from the other versions is a center track for time code recording and the necessary electronics to generate, record and read time code signals according to the SMPTE/EBU standard. This section only describes the time code and pilot functions of the NTA.2.TC. For information concerning the tape transport and audio electronics refer to section 1 of this manual. Consequently anyone not yet familiar with the characteristics of the machine should read that section first.

### **CONFIGURATION**

The NAGRA T-Audio TC is equipped with two time code readers, a time code generator, and optionally with a time code synchronizer and insert editor. One microprocessor performs all these tasks.

As a result, most functions are in software, which makes the system very flexible with respect to any future improvements. A number of sheets to add or to replace in this manual will follow every software upgrade. Each page is therefore marked with the date of its issue or last important modification.

Appendix C describes the operational differences between the software versions and the date of their issue.

### **PERMANENT MEMORY**

The time code board is fitted with a back-up battery (Lithium). It powers a permanent memory in which all stored data is preserved when power is switched off. The time code generator's real time clock also continues to run, even when the board is removed from the machine.

### **AUTOMATIC PHASE SHIFT OF TIME CODE SIGNALS**

Timecode and audio signals are recorded and read through separate heads in the T-Audio TC headblock. The standard prescribes that both time code and audio must be recorded on tape in accurate phase (max. allowed error 0.5 ms) and, for ease of operation, time code and audio must be available in phase at the output connectors. In both record and playback modes the microprocessor therefore shifts the time code signal (by calculation) in order to obtain the proper phase correlation obviously taking into account the selected tape speed.

### **SYNCHRONIZER**

The optional time code synchronizer is remarkably rapid due to the fact that T-Audio TC has a low inertia tape transport and also that the synchronizer is not a separate device but integrated in the control logic system of the machine.

The synchronizer can synchronize on the audio record or playback head depending on the mode of operation.

OFFSET is automatically calculated in the INCREMENTAL mode which allows rolling back from a scene into the preceding one, and play forward again to the selected take with immediate synchronization at the very first frame.

See page II.4.0-1.

## **AUTOMATIC EDITING**

Edit entry and edit exit memories are provided for automatic editing. These features allow integration of the machine in an automated post-production system through the use of the optional RS-422 remote control port. See pages II.5.0-1 and II.7.0-1.

## **CUSTOMIZING**

A number of switches for the selection of operating modes are located mainly on the front edge of the T-Audio time code board. As most of these selectors are taken into consideration only during power up of the machine, make sure to push the "CPU-RESET" key after any modification, in order to have their position read by the microprocessor. (From software version 1.6 up, this "CPU-RESET" is done automatically).

Some operational modes are software selected through the execution of numerical commands. See page II.8.0-1.

Switching mains power on or manually resetting the microprocessor will automatically result in display of the status display menu. See page II.1.4-1.

For further details on the customizing selectors see page II.1.3-1.

## **PILOT OPTIONS**

The NAGRA T-Audio time code is the first machine designed as a time code chasing audio tape recorder, specifically intended for video post-production. In order to maintain compatibility with existing pilot systems, optional hardware is available for playback of pilot tapes. This makes the NAGRA T-Audio TC a universal transfer recorder.

A unique combination of features provides the possibility to stripe synchronously a NEOPILOT tape with time code.

For further details see page II.6.0-1.

## 1.1 SPECIFICATIONS

This chapter only describes the specifications related to the time code and pilot sections of the T-Audio. For audio and tape transport specifications refer to the first section of this manual.

### TIME CODE GENERATOR

Frame rates	24 fps, 25 fps and 30 fps 29.97 fps (with or without drop frame) with optional TAHSX
Stability	50 ppm from -10°C to +70°C with optional TAHSX: 1 ppm from +10°C to +40°C 2 ppm from -10°C to +60°C

The internal time code generator permits the use of an external time reference. See page II.3.2-1.

### TIME CODE RECORDING

Trackwidth:	0.35 mm
Track position:	middle of tape
Recording level:	700 nWb/m peak-peak (rms equivalent 250 nWb/m)
Rise and fall time:	65 microseconds $\pm$ 10 microseconds
Audio/TC coincidence:	better than 0.5 ms (approx. 1 bit)

### TIME CODE PLAYBACK

Lowest speed:	0.25 x Nominal speed
Highest speed:	60 x Nominal speed for frame rates of 24 fps and 25 fps 50 x Nominal speed for 29.97 fps and 30 fps

The actual maximum shuttle speed depends on the reel size and hub diameter. At any speed automatic dropout compensation occurs with the use of pulses from the high resolution tape counter roller.

### CROSSTALK

Residual time code signal on the Audio outputs, with 2 mm audio tracks, when measured with 1/3 octave filter set at 1 kHz and 2 kHz must have a signal to noise "deterioration" better than 1 dB with the Time code.

### TIME CODE DECODING

With a tape machine as an external time code source, the limits of decoding its output depend entirely on the quality of the tape transport and the bandwidth of the playback head and amplifiers of the machine. Below, concerns only the limits of the T-audio TC electronics.

Lowest speed:	0.02 (1/50)x Nominal speed
Highest speed:	70 x Nominal speed for frame rates 24 and 25 fps 60 x Nominal speed for 29.97 and 30 fps



## **SYNCHRONIZER**

Accuracy at nominal speed	better than $\pm 25$ microseconds
Manual phase tuning	$\pm 6$ time code bits (approx. $\pm 3$ ms)
Possible offset programming:	1/80 th frame steps to maximum 23:59:59:29
Acceleration/stabilization time	from STOP to nominal speed and LOCKED with a
19 cm/s tape:	typically 2.5 sec
Dropout and wow protection:	user programmable integration time (factory calibrated at 15 frames)

## **EDITOR**

Duration of insert crossfade: 20 ms  
Two memories are available for automatic editing.  
Accuracy of auto-editor:  $\pm 5$  ms  
For more details see page II.5.0-1.

## **TAPE COUNTER**

Accuracy: better than  $\pm 0.2$  % (using 50  $\mu$ m back coated tape)

## **POWER CONSUMPTION**

Timecode board in operation: 120 mA on + 13 V unregulated  
Draft from back-up battery in standby (idle) mode: 0.015 mA

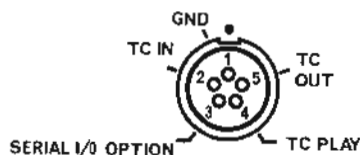
## 1.2 CONNECTORS

### Front side of machine:

TC INPUT/OUTPUT LEMO size A, 5 pin, female

- 1 Ground
- 2 TC IN, input of time code, parallel to pin 2 of main time code input
- 3 SERIAL I/O OPTION, used only when TAIRS option is fitted.
- 4 TC PLAY, direct output of off-tape time code, paralleled to pin 17 of the "AUDIO MONITORING OUTPUT" connector.
- 5 TC OUT, output of time code, paralleled to pin 2 of main time code output and pin 13 of the "THIRD TRACK INPUT/OUTPUT" connector.

Fig 1a



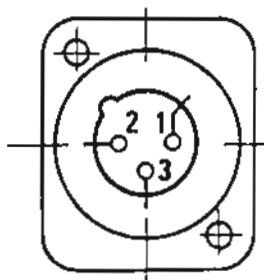
### Rear of machine:

TC INPUT XLR, 3 pin, female

- 1 earth
- 2 time code input, high
- 3 time code input, low

Sensitivity: 100 mVpp to 24 Vpp  
Impedance: 5 kOhm

Fig 1b

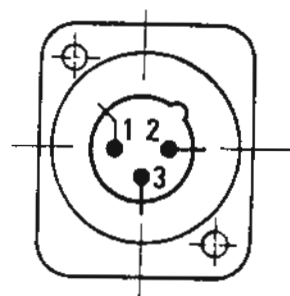


TC OUTPUT XLR, 3 pin, male

- 1 earth
- 2 time code out, high
- 3 time code out, low

Level: 2 Vpp  
Impedance: 300 Ohm

Fig 1c



### THIRD TRACK INPUT/OUTPUT



(BJ 11)

Fig 1d

Cannon D-type, 15 pin, female  
(mating plug, order No 40.25.015.000)

- 1 **Cue out**, output from optional TAPFM pilot circuit.  
Filtered approximately 200 Hz - 3 kHz.  
Level: 1.2V rms for  $\pm 20\%$  modulation at 1kHz  
Impedance: Z-load minimal 1 kOhm.
- 2 **Ext.ref.**, input of external reference signal for optional TAPFM pilot circuit and/or time code generator/synchronizer.  
With TAPFM installed:  
Sensitivity: 0.8 V to 14 Vpp  
Impedance: 47 kOhm  
Without TAPFM, with bridging jumper between pins 1 & 8 of XA25 P-2 on A-05 board: 5 V logic square wave
- 3 **BWD Ext.rol.**, used by TACO-R bi-phase interface
- 4 **Sp.1**, Spare remote input/output, see page II.7.4-1.
- 5 **TC/Pilot**, logic signal indicating the position of the TC/Pilot switch on the TC board, used in the TACO-D Time code & Pilot monitoring module  
+ 5 V = Time code  
0 V = Pilot
- 6 + 5 V, stabilized power supply output.
- 7 **50/60 Hz pilot output** signal derived from off-tape time code during playback.  
Level: + 5 V logic square wave  
Impedance: 1 kOhm (Zload min. 5 kOhm)
- 8 **Direct TC in**, input of external time code, to be recorded without going through the microprocessor first. Only in use when the time code record source switch is set to "EXT UNPROCESSED". (See page II.1.3-1)  
Sensitivity: 500 mV  
Impedance: 100 kOhm
- 9 **Pil.out**, output from TAPFM optional pilot circuit.  
Level: 1.7 Vrms  
Impedance: Z-load min.1 kOhm
- 10 **FWD Ext.rol.**, Used by TACO-R bi-phase interface.
- 11 **Sp.2**, Spare remote input/output, see page II.7.4-1.
- 12 **TC out unprocessed**, output of time code from playback chain, reshaped but without any time shift applied. Available at all speeds including fast shuttle.  
Level: 5 V logic square wave  
Impedance: 1 kOhm
- 13 **TC out**, parallel to main time code output ( XLR ) and thus dependent on position of the status matrix.  
The bit rate of this output is always nominal, independent of tape speed.  
Level: 5 V logic square wave  
Impedance: 1 kOhm
- 14 **↓ (+5v)**, Logic ground

## SERIAL REMOTE CONNECTORS

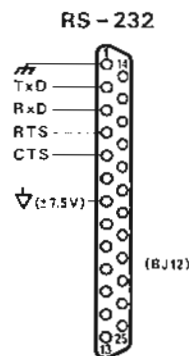
These connectors are used only when the optional serial remote interface TAIRS is installed. All specifications conform to the existing standards for computer communication lines.

For further details see pages II.7.2-1 and II.7.3-1 and section VI of this manual.

### RS-232 Canon D-type, 25 pin, female

- 1 Ground (chassis)
- 2 TxD
- 3 RxD
- 4 RTS
- 5 CTS
- 7 Ground (logic)

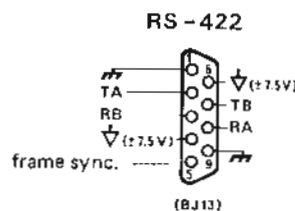
Fig 1e



### RS-422 Canon D-type, 9 pin, female

- 1 Ground (chassis)
- 2 TA
- 3 RB
- 4 Ground (logic)
- 5 External reference input, paralleled to pin 2 of the THIRD TRACK connector (See page II.1.2-2)
- 6 Ground (logic)
- 7 TB
- 8 RA
- 9 Ground (chassis)

Fig1f





### 1.3 CUSTOMIZING SELECTORS

The switches to set the machine to the desired operating mode, are located inside the NAGRA T-Audio TC. To reach these, rotate the keyboard upwards and remove the front panel by loosening its two screws half a turn counterclockwise.

The setting of the operational status of the T-Audio TC is partially made by the execution of numerical commands. See page II.8.0-1.

The switch functions on boards A-01.1, A-01.2 and A-02 are explained in the section: "SERVICE MANUAL, tape transport and control logics." (Section III).

Tape transport speed stabilizer board A 03 :

Synchronizer/speed variator: selects the speed correction input of the speed stabilizer to the manual speed variator control on the keyboard or to the output of the time code synchronizer or TAPFM pilot resolver.

In order to prevent mistakes, always return to "synchronizer" after use of the manual speed variator.

Time code board A 05 :

All switches are located on the leading edge of the electronics, with one exception:

#### S 1, INTERNAL/EXTERNAL REFERENCE.

In order to reach this switch, the time code board must be removed from the machine. Proceed as follows:

- Make sure that the power is switched OFF;
- Remove the colored flat cable from its socket by pushing the two black levers on the connector.
- Remove the circuitry from the body of the machine by pulling gently the two black levers on the front edge of the board.

S1 is the red switch located approximately in the center of the board. See Fig.1g. Slide the switch towards the rear of the machine for internal reference or towards the front of the machine if an external reference for both time code synchronizer and pilot resolver must be applied.

In the last case the external reference should be fed to pin 2 of the THIRD TRACK INPUT/OUTPUT connector, or to pin 5 of B3-13 (RS-422).

For details see pages II.1.2-2 and II.3.2-1.

Before switching the power on again, make sure that the board is completely inserted in its place, the two catches should fold over the front panel of the circuitry. It might be easier to reinstall the flat cable before completely reinserting the circuit into the machine.

**NOTE:** Ex factory setting of S1 switch is in "external" and should remain like that if a TACO-D (TC/PILOT DISPLAY MODULE) is connected to the T-Audio T.C.

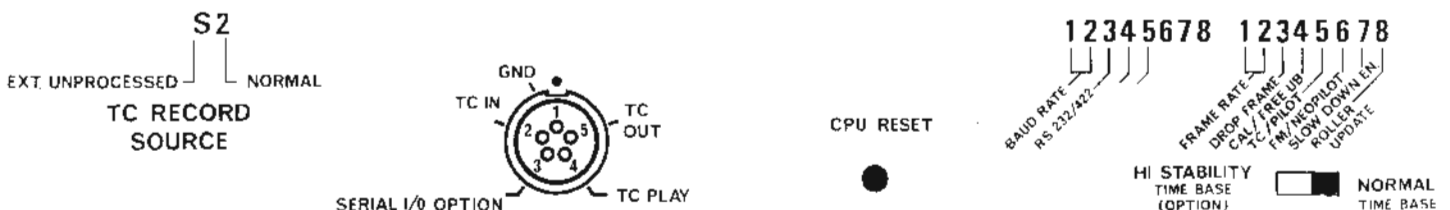


Fig 1h

Timecode board A 05, from left to right:

## S2 TC RECORD SOURCE

When set to NORMAL, the time code recorded, will be the signal generated by the internal generator. In order to obtain proper phase coincidence between audio and timecode on tape, an external time code will be regenerated and thus shifted in time (and cleaned from any dropouts).

When set to EXT UNPROCESSED, an external signal may be applied to pin 8 of the THIRD TRACK INPUT/OUTPUT connector and this signal will be fed directly into the record amplifier without any correction or compensation.

About 5 cm behind this switch a soldered jumper is provided through which it is possible to use the standard TC INPUT connector (XLR) for such a direct feed.

This input may also be used to record digital information other than time code.

The baudrate of such a signal should not exceed 4000 bits/sec.

Playback signal will be available at pin 12 of BJ-11 (Third track in/out) only.

## CPU RESET

This is not a mode selector but a key which, when pressed, makes the microprocessor perform a total reset, as if mains power has just been switched on.

With the software version older than 1.6, push this key when one of the following switches has been altered:

## S3 SELECTOR FOR OPTIONAL SERIAL REMOTE INTERFACE

(left-hand block of 8 )

These switches are used only when the optional serial remote interface TAIRS is installed.

**Switch 1 & 2:** Determine the baud rate of the RS-232 input/output according to the table below:

switch 1	switch 2	Baud rate
OFF	OFF	2400
ON	OFF	4800
OFF	ON	9600
ON	ON	19200 (+4%)

**Switch 3** OFF: RS-422 input/output activated  
Baudrate: always 19.200 (+ 4%)  
ON: RS-232 input/output activated

**Switch 4 to 8** Not used

For more details see page II.7.2-1.

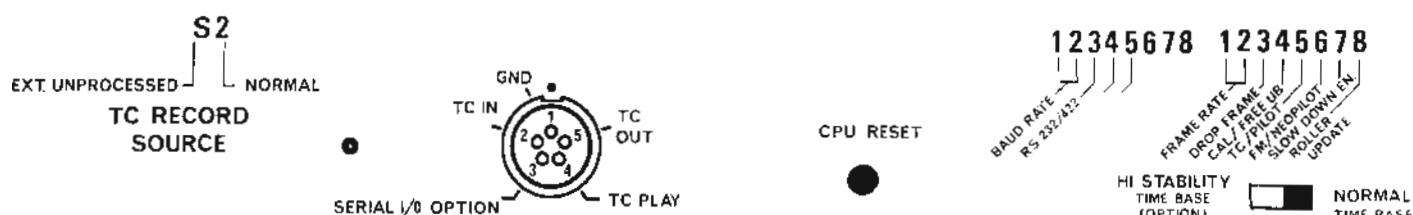


Fig 1i

## S4 TIME CODE SYSTEM MODE SELECTOR

(right-hand block of 8)

Note that a number of mode selections are made through the execution of numerical commands as described on page II.8.0-1.

The position of most of the switches below is only read by the microprocessor during power up; alternatively push CPU RESET after modification with Eprom version older than 1.6. The first line of the status menu will then appear on the display. Use SHIFT+↓ or ↑ to scroll through the various lines.

The indications between [ ] relate to the abbreviations used in the status display.

**Switch 1 & 2:** The position of these switches determines the frame rate for which the T-Audio TC is set. This does not only influence the generator but also the reader and synchronizer. Therefore, always verify the proper setting of these selectors. Since the internal generator may also be used as a reference to resolve pilot tapes, these switches also determine the pilot reference frequency:

switch 1	switch 2	Frame rate	Reference frequency
OFF	OFF	24 fps.	48 Hz
ON	OFF	25 fps.	50 Hz
OFF	ON	29.97 fps. [ 29 ]	59.94 Hz * [ 59 ]
ON	ON	30 fps.	60 Hz

\* Exact figures: 29.97002617 59.95005234

\* **NOTE:** This frame rate can only be obtained with the use of the optional TAHSX high stability time base. In this case the time base selector should be put in "HI STABILITY" position.

**Switch 3 :** This switch only relates to the frame rates 29.97 and 30 fr/s  
ON: Drop frame mode [ dF ]  
OFF: Normal frame count [ FF ]

For further explanation on Drop frame time code, refer to Appendix B.

**Switch 4 :** Selects the user bits to be used in the DATE format or not.  
OFF: Free use of user bits. [FrEE\_Ub\_]   
ON: User bits in calendar mode. [dAtE\_Ub\_]   
In this mode the T-Audio TC while setting its generator will only accept user bits that conform to the date format:  
DD : MM : YY : xx  
The automatic incrementation is also executed whenever the time code generator passes over midnight.

**Switch 5:** This switch puts the system in pilot operation.  
OFF: Pilot operation. [ Pilot ] or [ FM\_Pi ]  
ON: Timecode operation. [ tc ]  
Do not select OFF when no TAPFM pilot resolver board (optional) is installed.



**Switch 6:** Once in pilot mode, this selector determines the choice between neo-pilot or center track pilot (NAGRA SYNC or STELLA-pilot).

OFF: NEO-pilot [ PiLot ]  
ON: Center track pilot. [ FM Pi ]

Do not select OFF when the machine is not equipped with the optional TAONP NEO-pilot head. When in center track mode, the choice between NAGRA FM-pilot or STELLA-pilot is made with a switch on the TAPFM circuit directly. See page II.6.3-1.

**Switch 7:** The NAGRA T-Audio TC tape transport can shuttle at speeds higher than a time code can be read. In order to assure reliable time code reading, the time code system automatically limits the highest spooling speed to 60 x nominal for 24 fps and 25 fps frame rates, or to 50 x nominal for 29.97 fps and 30 fps. This function may be inhibited:

ON: Normal operation. [ SLo\_on ]  
OFF: Shuttle speed unlimited. [ SLo\_off ]

**Switch 8:** Normally, the off-tape time code reader is updated with pulses from the tape counter roller. In order to enable, for example, checks on dropouts, this function can be inhibited:

OFF: Automatic updating inhibited. [ UPdA.off ]  
ON: Normal operation. [ UPdAtE\_\_ ]

## TIMEBASE SELECTOR

The T-Audio TC is factory fitted with a low power consumption crystal time base for the real time clock, having a stability of approximately 50 ppm. This standard time base provides the necessary time information for normal operation on 24 fps, 25 fps and 30 fps. If a higher stability and/or the 29.97 fps frame rate are desired, the system may be equipped with the TAHSX option. This is an additional board with two 1 ppm crystals which also provides the necessary reference frequency to generate 29.97 fps. time code.

1 ppm stability is considered to be sufficient for cable free synchronization of picture and sound. (Typical maximum error of 1 frame over 8 hours of operation).

Set the switch to HIGH STABILITY to activate the TAHSX.

**NOTE:** The TAHSX is only powered from the mains power supply. If power is switched off, the standard crystal takes over.

See page II.3.1-1.

## TC BOARD customizing selectors

### EX FACTORY CONFIGURATION

#### S1 INTERNAL / EXTERNAL REFERENCE



S1 set in external position

#### S2 TC RECORD SOURCE

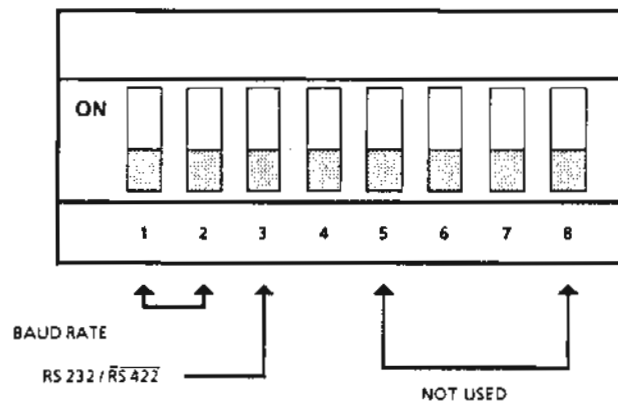


S2 set in normal position

EXT UNPROCESSED NORMAL

#### S3 SERIAL REMOTE INTERFACE

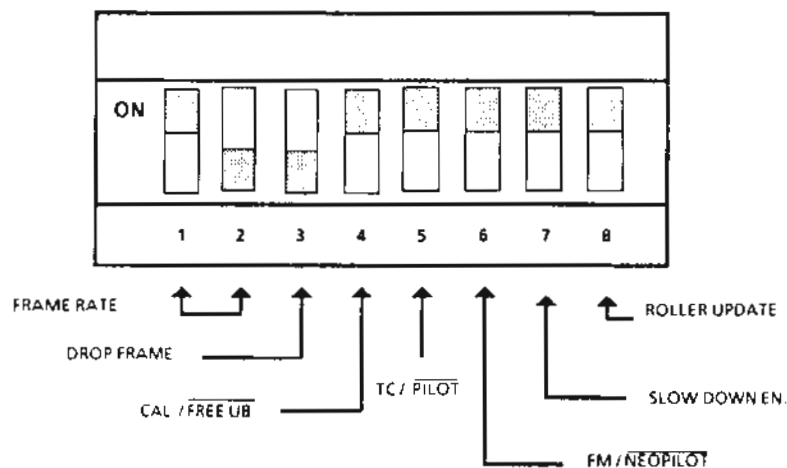
S3.1	S3.2	S3.3	S3.4	S3.5	S3.6	S3.7	S3.8
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF



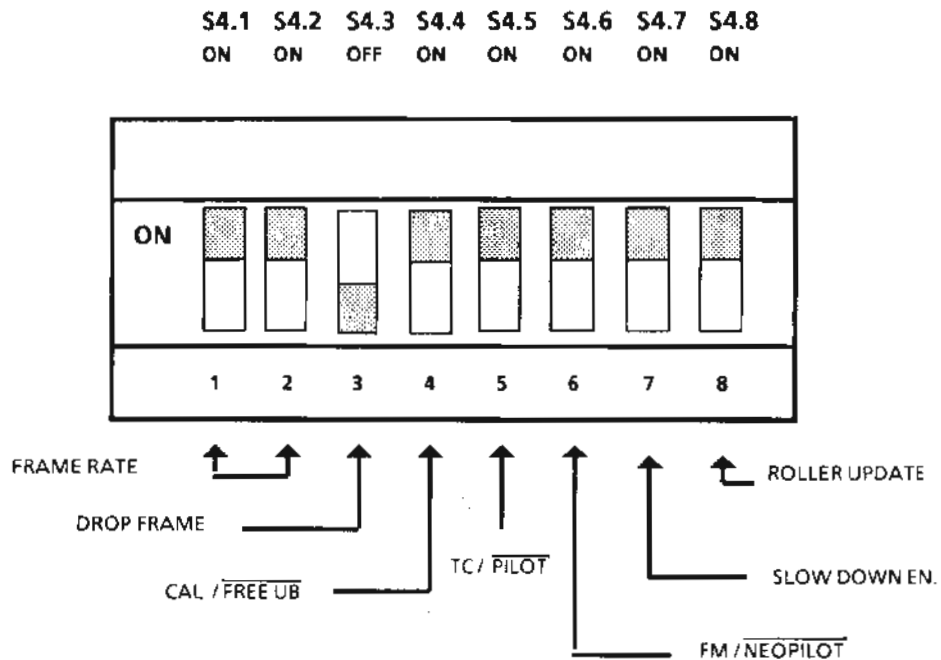
#### S4 TIME CODE SYSTEM MODE

CCIR CONFIGURATION : 25 frames / second

S4.1	S4.2	S4.3	S4.4	S4.5	S4.6	S4.7	S4.8
ON	OFF	OFF	ON	ON	ON	ON	ON



## NAB CONFIGURATION : 30 frames/seconds non drop frame



**NOTE :** Selectors with blue color have the ON position inverted (ON is downwards)

### S1 TIME BASE SELECTOR



**NORMAL :** if no TAHSX (high stability time base option ) is installed



**HIGH STABILITY :** if TAHSX ( high stability time base option ) is installed

## 1.4 STATUS DISPLAY MENU

A special display menu is provided to monitor the setting of the operational mode of the T-Audio TC.

Some of the modes are selected by switches, see page II.1.3-1 and others are set by the execution of numerical commands as explained on page II.8.0-1.

The first line of this display menu will be shown when power is switched on, or when the manual CPU RESET key is pressed, or when numerical command 000 is executed. The line relating to the last modification will be shown after execution of any other numerical command.

Use SHIFT+↑ or ↓ to scroll through the consecutive lines of the menu.

The display returns to time when one of the main tape transport keys is used or when SHIFT + DISP TC or DELTA or OFFSET is pushed.

LINE	EXAMPLE	MEANING	SEE PAGE
1	t c _ _ _ _ 2 5	general mode, time code or pilot, and frame rate or pilot frequency	II.1.3-3
2	F r E E _ U b _	operating mode of user bits section, free use or automatic date incrementation	II.3.5-1
3	S L o . _ o n _	automatic shuttle speed limitation	II.1.3-4
4	U P d A t E _ _	updating of time code reader with the use of tape counter pulses	II.1.3-4
5	M U t E _ o n _	automatic muting of audio outputs during synchronizer operation when the tape transport is not LOCKED	II.4.0-1
6	r E F . _ t c _	setting of the time code synchronizer's reference (time code, square wave or bi-phase)	II.6.6-1
7	r E H . r E P .	edit rehearsal being executed with audio channels in REPRO or alternatively SYNC	II.5.3-1
8	t c _ r u n _ _	state of internal time code generator	II.3.0-1
9	P r o t . o F F	modification of internal generator allowed or inhibited	II.3.3-1
10	S P 2 _ o F F _	effect of SPARE-2 remote input	II.7.4-1
11	1.5 SYNC	version of software installed	Appendix C

## 2.0 KEYBOARD DESCRIPTION

Two keyboards can be used simultaneously on one T-Audio TC with the TA-PPA option (supplementary keyboard input). Extension cables up to 10 meters may be used between the keyboard and the machine (50 meters with low resistance cable).

Most of the time code related functions have been added to the standard T-audio by using shifted functions on the already existing keys. These functions are printed in yellow above each key while the direct functions are marked in white on the keys themselves.

Shifted functions are activated by pressing first the yellow "SHIFT" key and then the desired key while holding the "SHIFT" key down.

The channel status matrix keys don't have any shifted functions.

Some functions have no direct access but can be executed through numerical commands.

See page II.8.0-1.

On the top side of the keyboard, close to the speed/standard selector, there is a rotary switch which inhibits or enables the keyboard and/or the parallel remote bus.

An external device connected to one of the serial remote inputs always has access.

See page II.7.0-1.

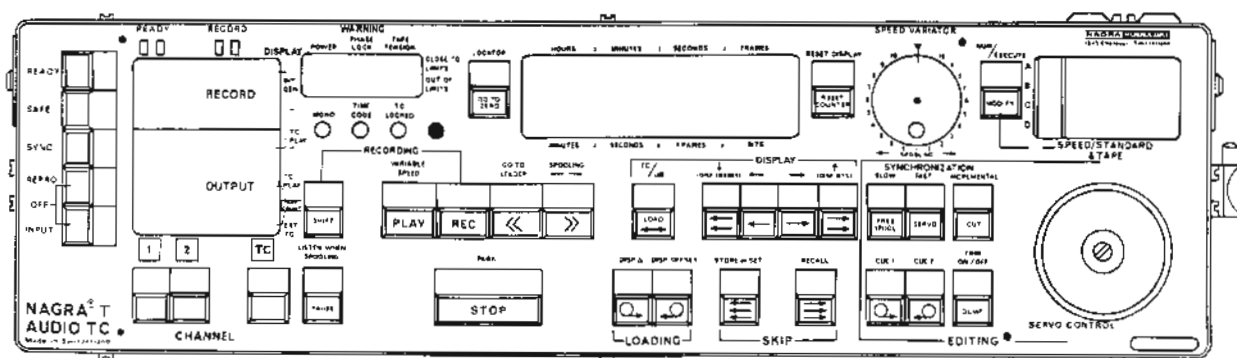


Fig 2a

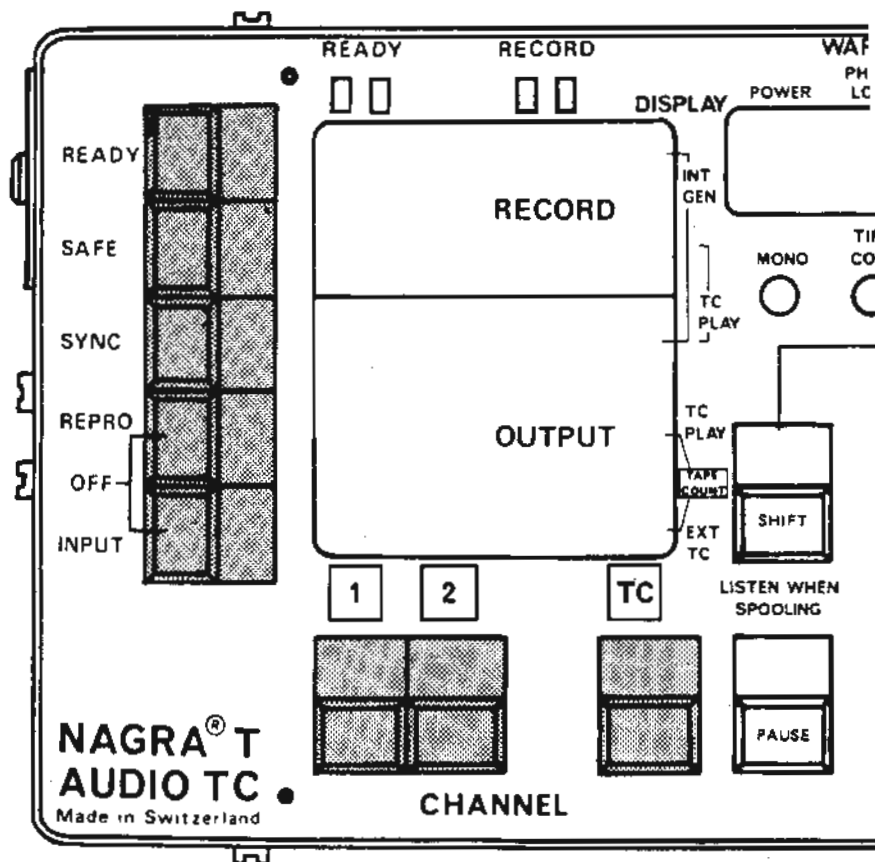


Fig 2b

## 2.1 CHANNEL STATUS MATRIX

The third position of the matrix is reserved for the time code channel. It functions as similarly as possible to the switching of the audio channels. However, since the time code channel serves different purposes to the audio channels, it is obvious that there are some significant differences. For instance, during record the position of the output section of an audio channel does not influence the current recording. For the time code channel, however, it is the output part of the matrix that determines the time code source to be recorded.

The table below shows how the matrix influences the time code track:

SAFE		READY	
	DISPLAY	TC-OUTPUT	TC-OUTPUT
OFF	Tape-counter	Off-tape TC REP.head (shifted)	Tape-counter NO signal
INPUT	External TC	Off-tape TC REP.head (shifted)	External TC External TC
REPRO	Off-tape TC REP.head (shifted)	Off-tape TC REP.head (shifted)	Off-tape TC REPRO (shifted)
SYNC	Off-tape TC REC.head (shifted)	Off-tape TC REC.head (shifted)	Internal GEN. Internal GEN.

**NOTE:** The above shows clearly that the difference between REPRO and SYNC during time code playback is similar to the audio channels. This means that the synchronizer will phase the tape to the audio playback head when the matrix is in REPRO or INPUT, but it will synchronize to the record head when the matrix is set to SYNC. Refer to section 5 of this manual for the timing involved in automatic time code displacement.

**NOTE:** Switching between REPRO and SYNC, while the machine is parked, does not show any change on the display because the head phase computation is made only when the tape is in motion.

## 2.2 TAPE TRANSPORT KEYS

STOP is the NAGRA T-Audio TC EMERGENCY BRAKE:

It will not only bring the tape transport to a stop from whatever mode, but it will also interrupt any data modification operation and recover the original values.

The only other keys in this section of the keyboard that are related to time code and/or pilot operation are SHIFT+PLAY and SHIFT+REC:

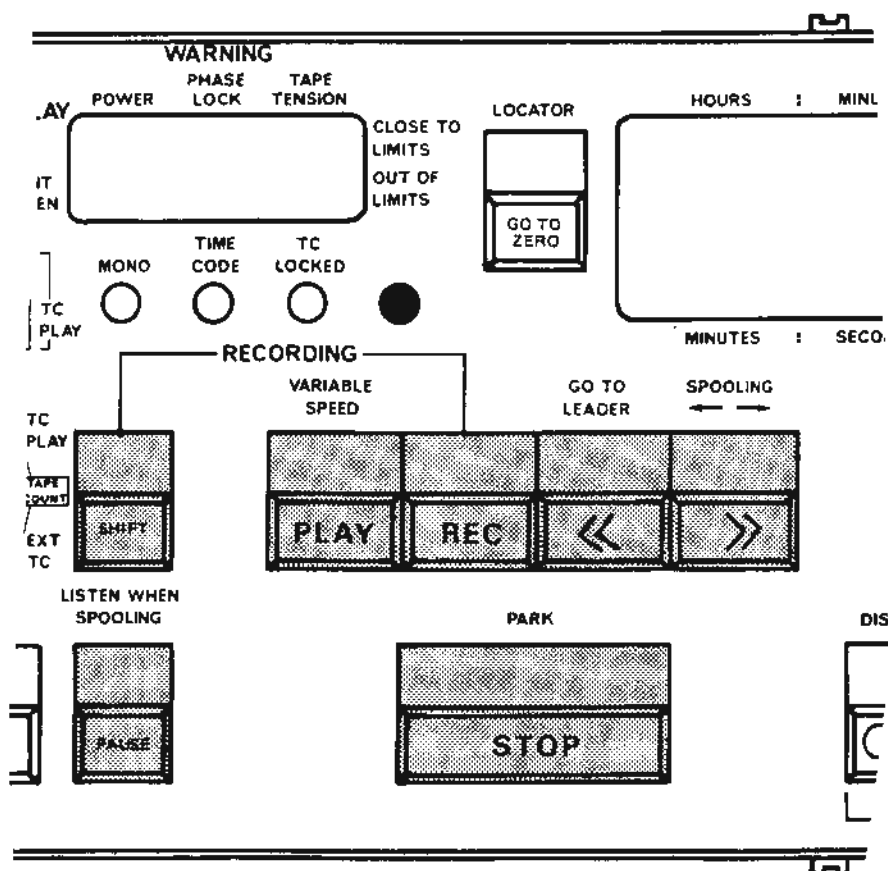
The T-Audio TC is able to record audio during playback of time code. Obviously the synchronizer can lock the tape transport using this time code. Record will only be accepted in this mode when the tape transport is in the LOCKED status (See pages II.4.0-1 and II.5.1-1).

SHIFT+REC will activate the record and erase amplifiers of the audio channel(s) previously selected to READY, without interrupting the synchronizer.

SHIFT+PLAY will switch the audio electronics to playback again, without interfering with the synchronizer.

In pilot mode SHIFT+ PLAY is used to start the tape transport with the optional resolver TAPFM activated. See pages II.6.5-1 and II.6.6-1.

Fig 2c





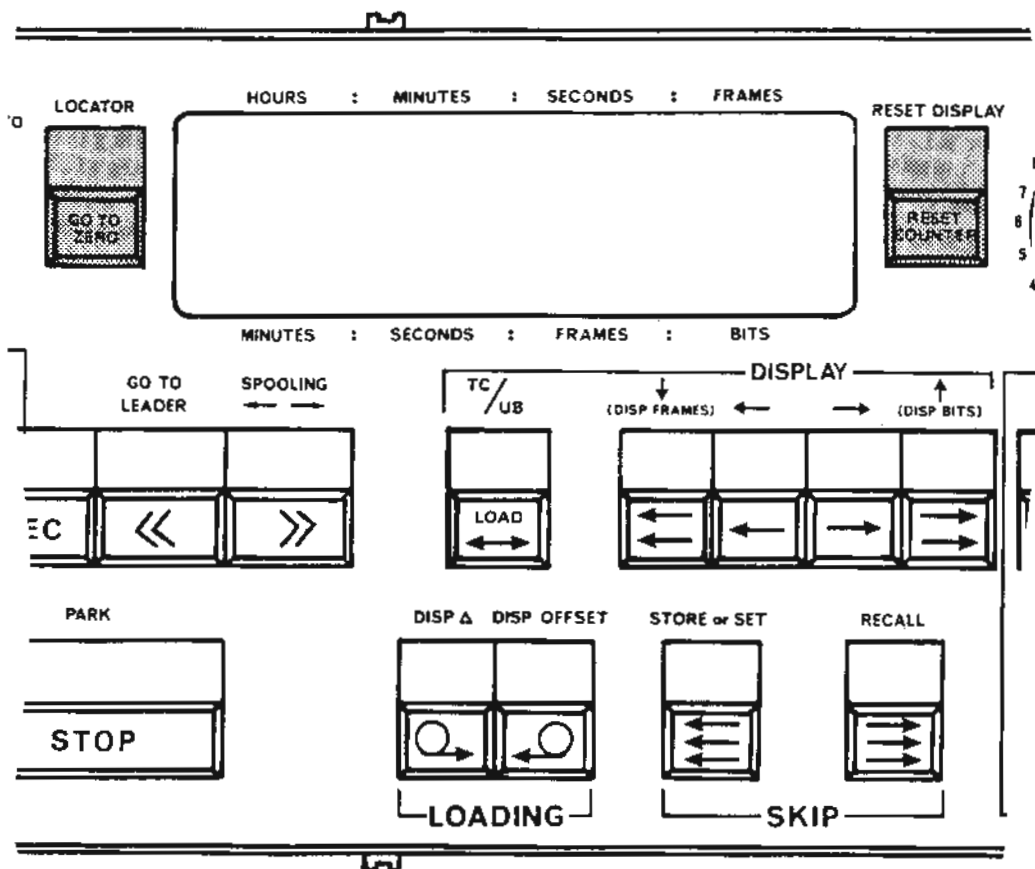


Fig 2d

## 2.3 LOCATOR

The locator enables automatic searching for any position on the tape using the tape time code as a reference. SHIFT + GO-TO-ZERO will make the T-Audio TC shuttle to the time code value which is shown on the display at the moment the keys are pressed. This time code value may be from any source, except of course time code from the T-Audio TC's own tape. There are 5 memories available in which CUEs can be stored. See pages II.2.6-1 and II.5.2-1.

Numerical command 010 gives access to a pre-programmable preroll time to CUE 1. This value is initially set to 5 seconds but may be modified through the blinking mode as described on page II.2.5-1. When the locator is sent to find CUE 1, the tape will be parked at a point which is located this preroll time before CUE 1.

It is possible that the calculated preroll position before CUE 1 is non-existent on the tape because of time code discontinuities. This will cause the locator to malfunction. Reset the preroll time to zero if this occurs.

**NOTE:** The T-Audio TC tape transport is able to shuttle at speeds higher than time code can be read. This occurs especially when operating at frame rates 29.97 and 30 fps. The maximum shuttle speed is therefore automatically limited in both locator and synchronizer modes to maintain reliable time code reading.

This function may be inhibited by putting customizing selector 7 of the right-hand block in the OFF position. Monitor line 3 of the status display menu.

It should read:            S L o . \_ o n \_    for normal operation.

In the case of discontinuous time code on the tape, the T-Audio TC may be sent to locate a time code value which is non-existent on the tape. If this occurs, ERROR 5 will be shown on the display and the tape transport will be parked as close to the interruption of the time code track as possible.

When the DELTA (See page II.2.4-1) appears to be bigger than 12 hours when in locator operation, the T-Audio TC will shuttle in the opposite direction, presuming that the time code recorded on the tape is discontinuous.

**NOTE:** In spite of the fact that the tape counter won't be displayed most of the time during time code operation, it still takes into account all tape movements. Consequently, RESET COUNTER will still set the counter to zero and GO TO ZERO will still make the T-Audio TC shuttle to counter zero, even when time code is displayed.

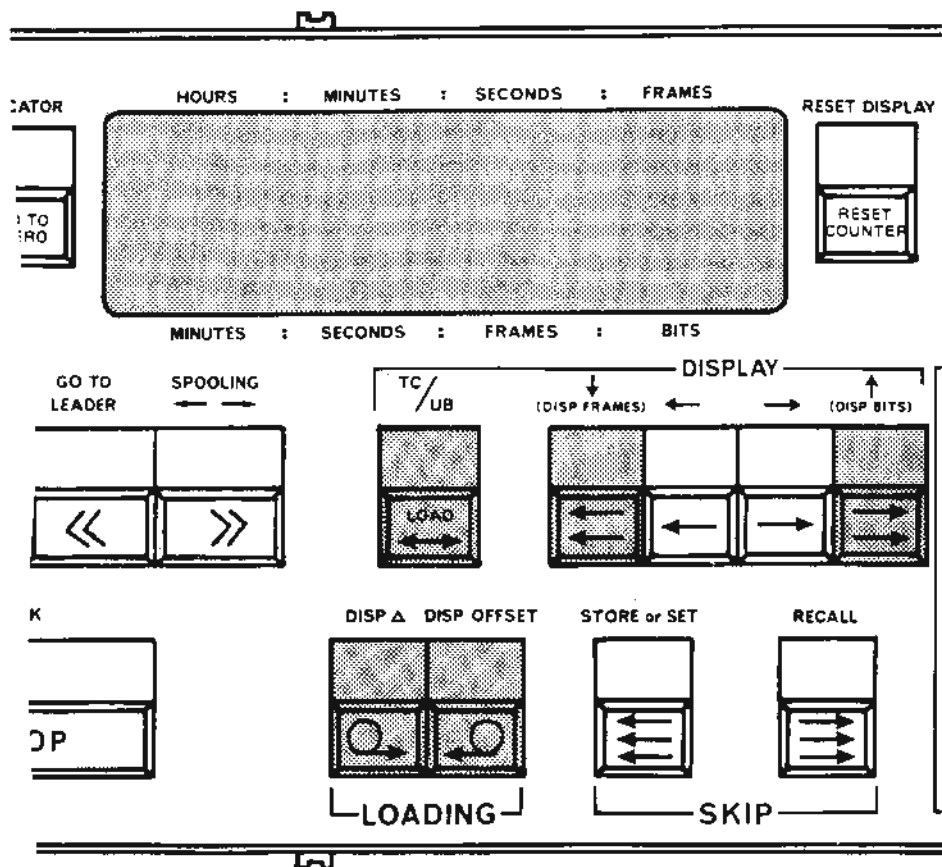


Fig 2e

## 2.4 DISPLAY

The eight digit LED display on the keyboard can be used to display all sorts of information such as time code or user bits to error messages and diagnostic indications.

When power is switched ON, the display shows the first line of the status display menu. Use SHIFT +  $\uparrow$  or  $\downarrow$  to go through the consecutive lines. For details see page II.1.4-1.

The next three keys are used for further selection:

**TC/UB** Shows alternately time code or user bits. The signal source to be monitored is determined by the position of the matrix, see page II.2.1-1. Timecode is displayed with decimal points between hours, minutes, seconds and frames, while user bit values are shown without. One decimal point between the 6th and 7th digit will indicate that the user bits are in the DATE mode.

**DISP DELTA** Shows DELTA, which is the calculated distance between off-tape time code and external time code, taking into account the programmed OFFSET.

**DISP OFFSET** Shows the programmed OFFSET. See page II.4.3-1.

Both DELTA and OFFSET values can be negative. As soon as their values are negative and bigger than 9 : 59 : 59 : 23 (or 24, or 29 ), the minus sign will be replaced by a decimal point below the far left digit.

Both DELTA and OFFSET can be displayed in the "high resolution format": SHIFT + DISP BITS the first time will shift all displayed information two positions to the left. Thus the two last digits on the right show BITS. A time code BIT is 1/80 th of a frame which corresponds to 0.5 msec for 25 fps time code or 0.416 msec for 30 fps. SHIFT + DISP FRAMES a second time will return the display to normal format.

On the left of the numerical display there are three red LEDs two of which give further indications on the functioning of the T-Audio time code system:

**MONO** This LED lights up when the audio channel mode switch located on the control logics board A-02 is set to MONO.

**TIME CODE** When this LED lights up, a readable time code is received by the reader that is selected by the status matrix. (See page II.2.1-1). Dropouts will cause this LED to flicker. This LED reacts in a way that is similar to the above, for off-tape pilot signals and pilot reference when the machine has been set to pilot operation. This LED also lights up when an external frame pulse reference or bi-phase signal is applied and the time code channel has been set to INPUT on the matrix.

**TC LOCKED** In synchronizer mode this LED will light up as soon as both master and T-Audio TC are close to nominal speed and DELTA has decreased below 5 bits.

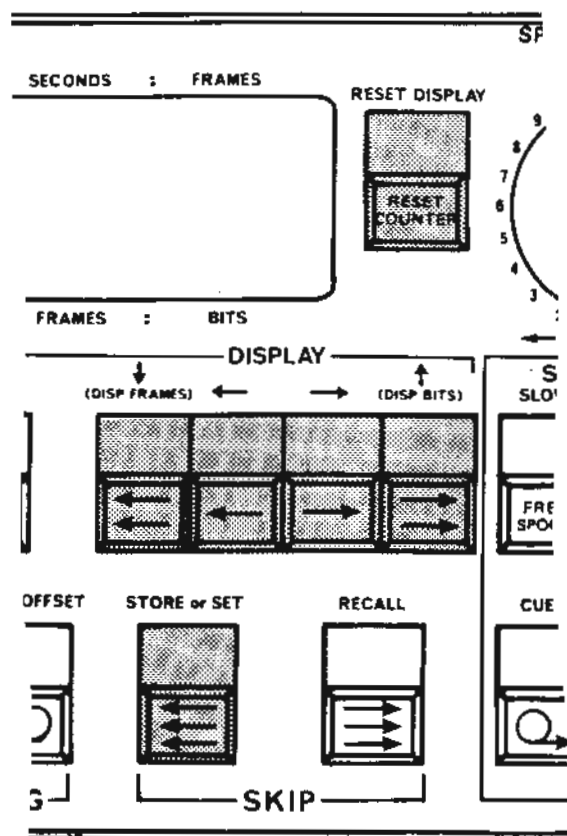


Fig.2f

## 2.5 RESET, DATA MODIFICATION

Any value stored in the T-Audio TC memories can easily be modified by first calling it to the display and then using the following keys:

**RESET DISPLAY** Will set to zero all digits of the memory actually on display. In the case of DELTA or OFFSET also the part not shown on the display (hours or bits) will be reset. The internal generator will not be brought to a stop during reset. This key also serves to deactivate the automatic insert editor when pressed immediately after SHIFT + CUE 1. See page II.5.3-1.

### BLINKING MODE

→ Will start the blinking mode from the left side of the display. Any consecutive pressing will shift the blinking cursor one position to the right. After the extremity of the display has been reached, the blinking cursor jumps back to the opposite end.

← As →, but in the opposite direction.

↑ Once the blinking mode has been started by SHIFT + ← or → each stroke on this key will increase the blinking digit by 1. The maximum value of each position is automatically limited. For instance, frames tens may never exceed 2.

↓ As ↑, but decreasing.

**NOTE:** In order to be able to program a negative value in the offset memory, the first digit on the left may also be put to the -2, -1 or -0 values.

**NOTE:** If a mistake has been made, it is always possible to recover the original value and to stop the blinking mode by simply hitting one of the main tape transport keys.

**STORE:** After the desired value is reached, hit SHIFT + STORE to introduce it into the previously selected memory.

This method is also used to introduce numerical commands.  
See page II.8.0-1.

## 2.6 STORE, RECALL, MEMORIES

The NAGRA T-Audio TC offers 5 independent cue-memories. Two of them, CUE 1 and CUE 2, are reserved for editing purposes and are accessible by their designated keys. For automatic editing see pages II.5.2-1 and II.5.3-1.

The other 3 memories are scratchpad memories that are selected by means of the output section of the time code channel status matrix:

### STORE

Will store the value actually on display in the scratchpad memory of the time code reader in use. This may be either TC-SYNC, TC-REPRO, or TC-INPUT.

Will also confirm a data modification after the blinking procedure has been completed. See page II.2.5-1.

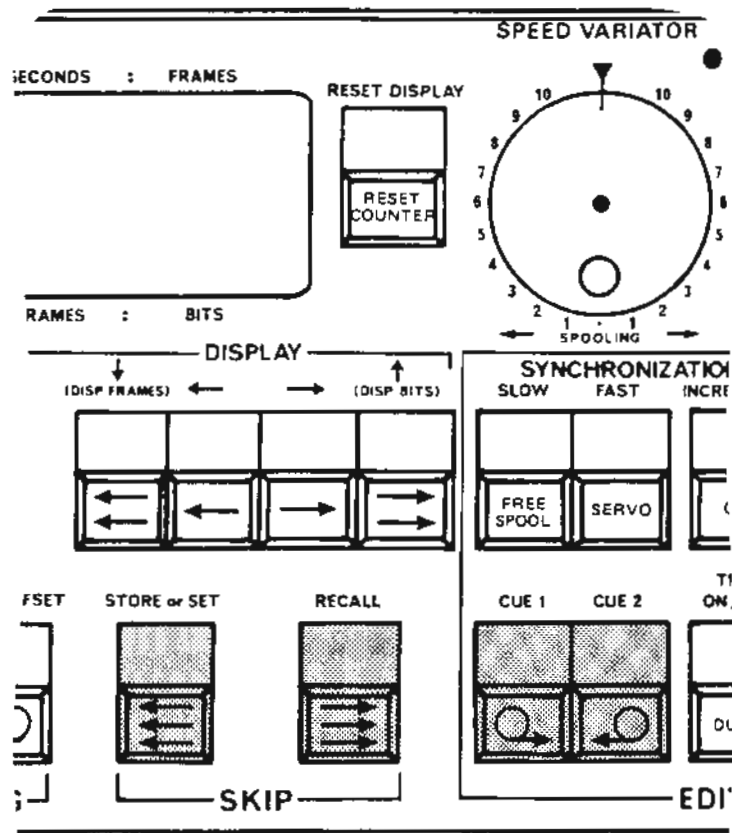
Will also set the internal generator from an external source when the matrix was previously set to READY+INPUT. See page II.3.2-1.

### RECALL

Will display the value of the scratchpad memory of the time code reader actually in use. This function may be followed by LOCATOR, for instance. The memory value will be displayed until DISP.TC or any of the main tape transport keys are pressed.

LOCATOR will also make the display return to off-tape time code.

Will also recall the value of CUE 1 or CUE 2 to the display if either key were previously pressed.



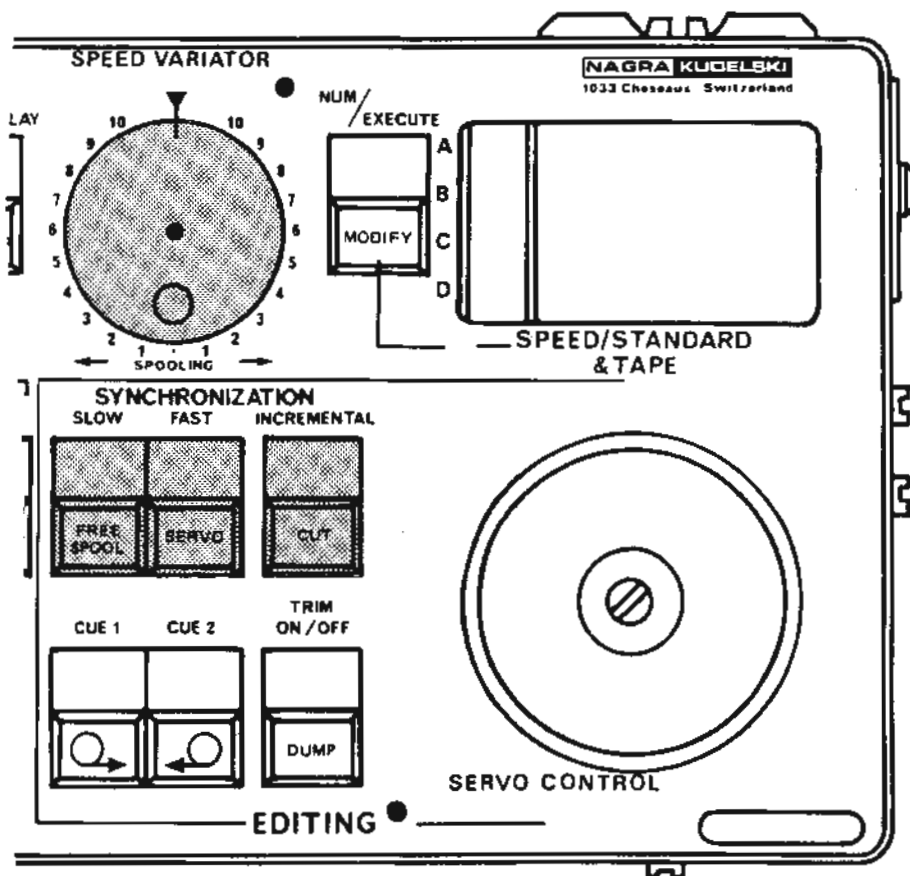


Fig 2h



## 2.7 SYNCHRONIZATION

For details on synchronizer operation see page II.4.0-1.

The NAGRA T-Audio TC synchronizer has three different operating modes:

- SLOW** This is the standard mode of the synchronizer. The T-Audio will try to stay as close as possible to the connected master at any speed. When the master is at nominal speed, the T-Audio will synchronize itself very accurately, and the TC LOCKED indicator will come on as soon as DELTA has decreased to 5 bits.  
From this state the T-Audio TC will not react immediately on speed variations of the master. An integration time (which is initially set to 15 frames) is applied, thus preventing wow & flutter from the master to be copied by the T-Audio TC and providing protection against dropouts.  
Numerical command 012 allows access to the integration time. See page II.4.2-1.
- FAST** As SLOW but without integration in LOCKED state. The T-Audio TC will react instantaneously on any speed variation from the master.
- INCREMENTAL** This mode is identical to SLOW as far as tape transport behaviour is concerned. Additionally, automatic adjustment of OFFSET is made at the moment the key is pressed. When a discontinuity is detected in either master or off-tape time code, with the T-audio at nominal speed and LOCKED, the same will be provided spontaneously.  
For more details see page II.4.4-1.

### SYNCHRONIZER PHASE ADJUSTMENT

When synchronizing audio to audio, exact phase control between machines may be required. This adjustment can be made in any synchronizer mode by means of the SPEED VARIATOR control. Monitor the applied correction by displaying DELTA in the "high resolution format" (DISP-BITS) with the tape transport at nominal speed and LOCKED.

See chapter page II.4.5-1.

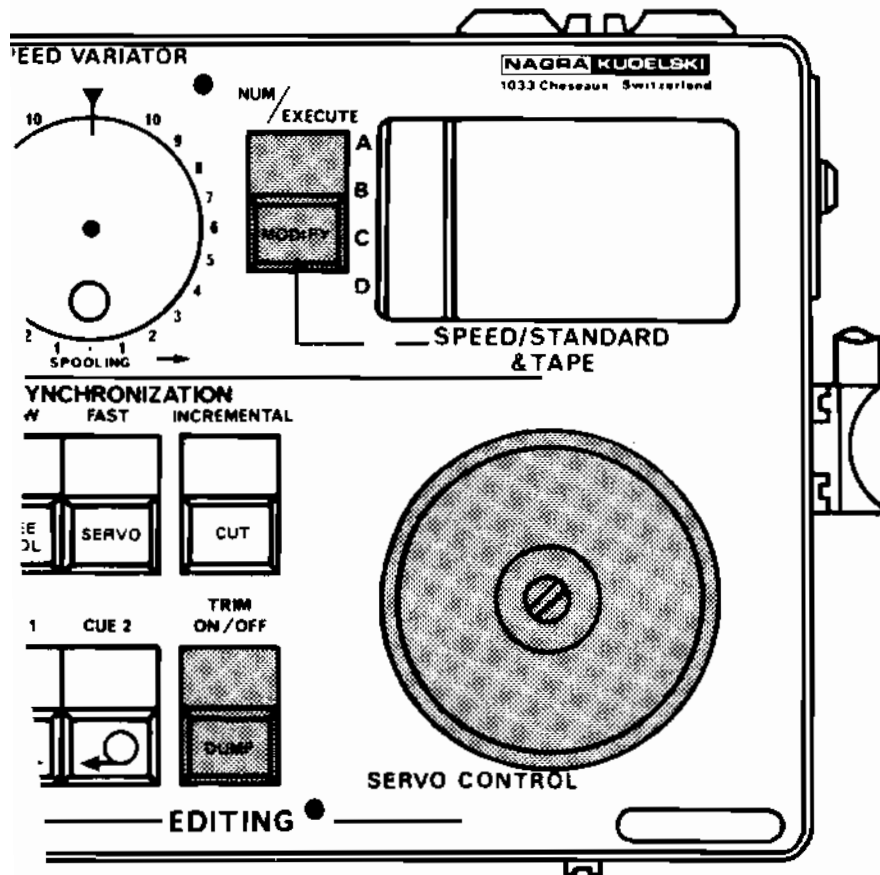


Fig 2i

## 2.8 OFFSET TRIMMER

The synchronizer OFFSET can be stored automatically using the INCREMENTAL key or manually by means of the BLINKING mode (page II.2.5-1) or dynamically with the:

**TRIM CONTROL** This rotary control gives direct access to the OFFSET-memory in steps of only 1 bit. Turn to the right to advance the T-Audio TC, or to the left to delay the T-Audio with respect to the master. This adjustment may also be made when the T-Audio is LOCKED to its master.

This control is only active when OFFSET is on the display and activated by:

**TRIM ON/OFF** Alternately enabling and disabling the OFFSET TRIMMER. When ON, the right-hand digit of the display flashes.

After the desired OFFSET value is reached, select TRIM OFF or anything other than OFFSET on the display to prevent accidental modification.

For details on OFFSET programming see page II.4.3-1.

## 2.9 NUMERICAL/EXECUTE

All normal functions are obviously directly accessible through the keyboard. There are, however, functions that will not be used every day, such as special diagnostic display formats or operational mode selections.

These functions are accessible through NUMERICAL COMMANDS:

**NUM/EXECUTE** When this key is struck for the first time, the display will show three zeros the left of which is blinking. Now a command number may be keyed in by means of the data modification keys ↑, →, ← and ↓ (page II.2.5-1). When the desired number is reached, press SHIFT + NUM/EXECUTE a second time to execute the command.

When power is switched ON, or when CPU-RESET is pressed, numerical command 000 which sets display to the status menu, is automatically executed.  
See page II.1.4-1.

For the available numerical codes see page II.8.0-1.

### 3.0 INTERNAL GENERATOR

The T-Audio TC is fitted with an internal generator for a number of reasons:

- In many cases it will be necessary to use "pre-stripped" tapes, virgin tapes on which only a continuous time code track has been recorded. The T-Audio TC can "stripe" tapes independently, while the rest of the studio equipment is in use for other purposes.
- With the optional high stability time base, TAHSX, the T-Audio TC may also be used as a production recorder without cable link to other equipment on the set.
- Also with the high stability time base the internal generator can be used as a resolver reference for transfer and playback recording applications.
- During the recording of an external time code, the internal generator is used to compensate for dropouts in the source signal. The time code recorded on the T-Audio TC is therefore always completely clean from dropouts and jitter.
- One of the main application fields of the NAGRA T-Audio TC is in video post-production. For integration of a tape machine in a video editing or sound post-production system, the presence of an internal generator is in any case handy, and in many cases an absolute requirement.

The most important features of the T-Audio TC internal generator are:

There is a crystal time base with a very low power consumption, which is powered by a lithium back-up battery when mains power is switched OFF. Real time is maintained even when the time code board is removed from the machine.

Optionally, a high stability time base can be installed to enable synchronous, cable free recording sessions, and accurate self resolving.

Chapter II.3.1-1

Manual setting is provided so as to be able to set the generator at any desired time.

Chapter II.3.3-1

USER BITS can either be used in free mode or in calendar mode which provides automatic date incrementation when the time code generator passes midnight.

Chapter II.3.5-1

JAM-SYNC from an external source is possible in order to synchronize the T-Audio TC generator to a master clock.

Chapter II.3.4-1

Internal switches switch the generator to any existing standard frame rate.

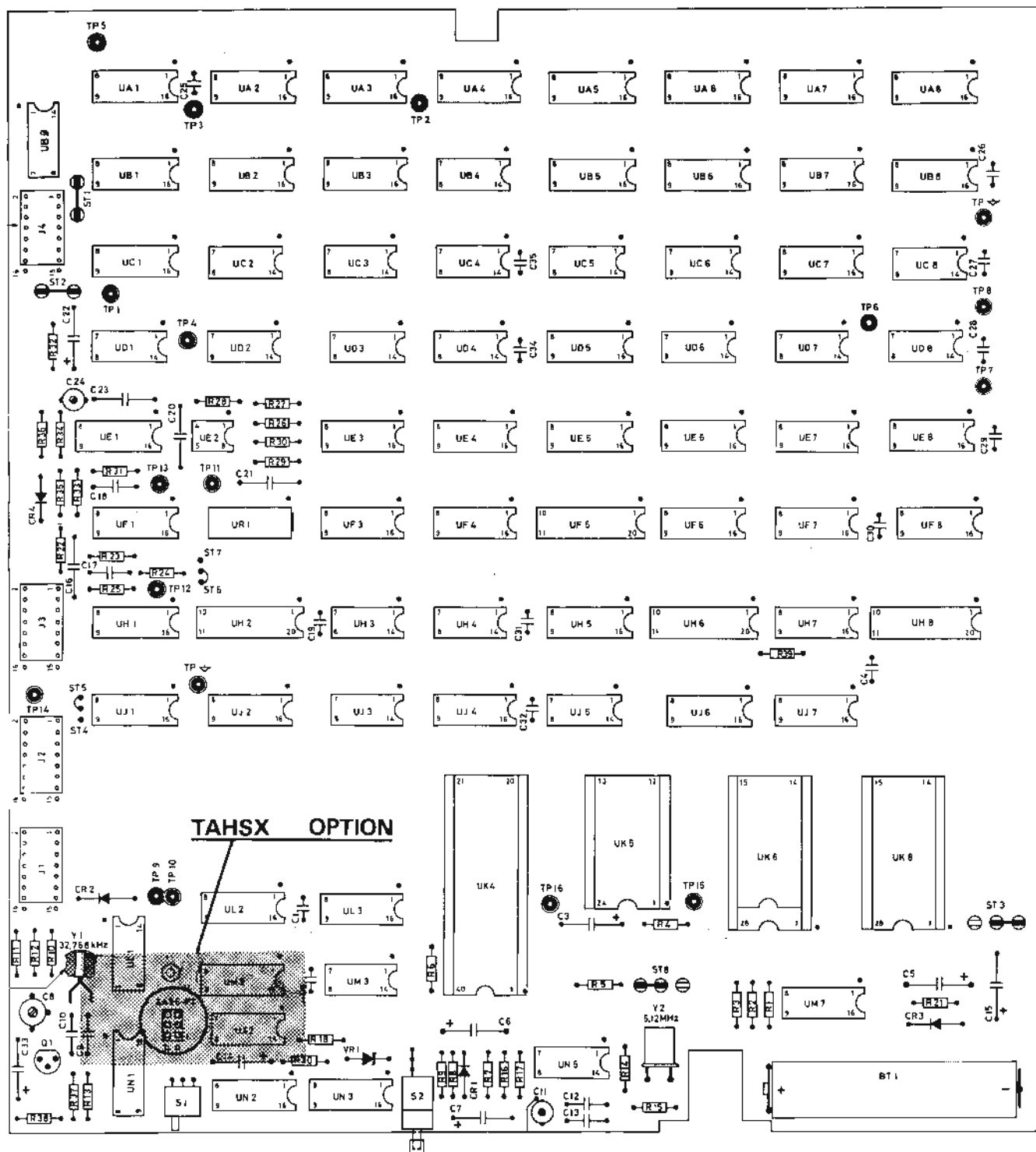
**NOTE:** 29.97 fps only with TAHSX option installed.

Chapter II.1.3-1

An external reference input is provided to run the generator from, for instance, a video studio "house reference".

Chapter II.3.2-1

Numerical command 100 stops the generator. Line 8 of the status display menu will show: `t c _ H O L d _` The output signal is still available at the preset frame rate, but the time does not change; all words contain the same time information. Numerical command 101 restarts the generator from its original time.



### **3.1 TAHSX, OPTIONAL HIGH STABILITY TIME BASE**

The NAGRA T-audio TC is fitted with an internal time code generator that normally runs referenced to a 50 ppm crystal. This timebase consumes very little power and is powered from the back up battery when mains power is switched OFF.

The optional TAHSX board is essentially a double oscillator equipped with two crystals with a stability of 1 ppm. One of these crystals is used for frame rates of 24 fps, 25 fps and 30 fps. The other has an odd frequency as required for generation of 29.97 fps time code.

Thus the presence of the TAHSX option in the T-Audio TC is an absolute necessity when working at 29.97 fps.

It is also strongly recommended to install a TAHSX when the internal generator is used as a resolver reference in transfer or playback shoot applications.

#### **INSTALLATION**

Make sure that power is switched OFF.

Remove the front cover of the T-Audio TC by unscrewing the two screws that are located right under the keyboard. Only half a turn counterclockwise is sufficient to undo them.

Remove the colored ribbon cable by pushing the two plastic catches outwards that hold the connector in place.

Remove the time code board from the T-Audio TC by pulling the two plastic levers on the front corners of the board.

The connector that takes the TAHSX, is located on the lower half of the time code board, as shown in figure 3a. Once the option is in place, secure it with a screw for which a special nut is provided (approximately 1 cm behind the connector on the board).

Now the timebase selector may be put in the HI STABILITY position.

No calibration is required as this accessory is factory set.

Reinstall the time code board in the machine and switch the power ON after making sure that the board is fully inserted in its place. The two black plastic levers should fold over the front rail of the board.

**NOTE:** The TAHSX is powered only when mains power is available. After power down, the standard time base takes over, and the accuracy of the generator is 50 ppm again. And if the machine was in use at 29.97 frame rate, the exact real time relation in the generator may be lost.





### 3.2 EXTERNAL REFERENCE

The internal time code generator, the time code synchronizer and the optional pilot resolver can all be locked to an external reference. In the case of time code resolving this reference should be a frame pulse signal (1 pulse per T.C. frame). For pilot resolving this reference should be a pilot signal.

Such a reference should be fed to pin 2 of BJ-11 (THIRD TRACK INPUT/OUTPUT) as described on page II.1.2-2, or to pin 5 of BJ-13 (RS-422)

If the optional pilot resolver TAPFM is installed, the external signal will go through an automatic level compensation circuit, which allows the input signal to be of any shape and of any level between 0.8 and 14 Vpp. Without the TAPFM the external reference should be a +5 V logic square wave. In this case pins 1 & 8 of connector P-2 on the time code board A 05 must be bridged as shown in figure 3b.

To apply the external reference to the pilot resolver, slide switch S 1 on time code board A-05 towards the front of the machine (See page II.1.3-1).

The relationship between time code frame rate and external reference frequency is shown in the table below.

TC-Frame rate	Pilot/reference	
24 fps	48 Hz	
25 fps	50 Hz	
29.97 fps	59.94 Hz	*
30 fps	60 Hz	
* Exact values:		
29.97002617	59.94005234	

An external reference can also be applied to the internal time code generator and the synchronizer for resolving of time code tapes.

Proceed as described above but additionally, numerical command 004 should be executed. This also sets the synchronizer in the resolver mode, in this case the external reference should have a frequency ratio of 1:1 to the time code frame rate. The status display should show: "r E F . \_ P i L" (in software version up to 1.6) and "rEF.Fr.P" (in software version from 1.6) onwards.

Execute numerical command 005 to return to normal operation.

### 3.3 MANUAL SETTING

To set the T-Audio TC internal generator manually, proceed as follows:

Select the time code channel to READY/SYNC on the channel status matrix in order to activate the generator and to visualize it on the display, use SHIFT+TC/UB to select either user or time information to the display; only the displayed memory can be modified by the following procedure.

Hit ← or → in order to start the blinking modification process.

This will freeze the display but will not interrupt the time code which is actually being generated and is still available on the output.

Now using the blinking mode as described on page II.2.5-1, enter the desired value. During all this the generator is still generating the original time code. At any stage it is possible to return to the original time setting by pressing one of the main tape transport keys. SHIFT+PLAY may be used when the synchronizer is not to be interrupted.

Once the desired value is reached, SHIFT+STORE will introduce the new time to the generator without stopping it.

To restart the generator from zero, select the generator to the display and press SHIFT+RESET. This operation is effective immediately, and does not need to be followed by SHIFT+STORE. SHIFT+RESET may also be used during the blinking mode, in this case only the display is reset and the actual time code generator is not influenced until SHIFT+STORE is pressed.

The generators' USER BITS memory can be set or reset by the same procedure.

**NOTE:** The user bits may be set to hexadecimal numbers when not in calendar mode.

The generator can be protected from accidental modification with numerical command 102. In this case, ERROR 04 will show on the display if an attempt to modify it is made.

Numerical command 103 enables setting.

### 3.4 SET FROM EXTERNAL

The internal generator of the NAGRA T-Audio TC can easily be set (jam-synced) from an external source. Before attempting to apply the following procedure make sure that the frame rate setting of the T-Audio TC generator corresponds to the frame rate of the external source.

For details on the frame rate selector see page II.1.3-3.

#### SETTING PROCEDURE

Connect the external source either to the XLR input at the back of the machine or to the five pin LEMO connector on the front. For details on the connectors see page II.1.2-1. Set the display to time code and the status matrix to READY -INPUT for the time code channel. Check that the external time code is indeed being received by the T-Audio TC; the TIME-CODE LED on the keyboard should be lit without any interruptions. Press SHIFT+STORE. After a maximum of one second the matrix will change to SYNC showing the internal generator on the display now running parallel to the external source. The cable link may then be removed.

Time and user information are considered separately in this procedure, only one value can be set at a time. To set the user-bits, proceed as above but set the display to user-bits first. (SHIFT + TC/UB)

**ERROR-04** will appear on the display when the above procedure is executed while the generator is protected from accidental setting by means of numerical command 102. Execute numerical command 103 to authorize modification.

**ERROR-03** will appear when the user bit section of the T-audio TC generator has been set to the CALENDAR mode and the user bits as contained in the external signal do not conform to the date format. See page II.3.5-1.

**ERROR-09** will appear if the CPU is unable to synchronize the real time clock properly.

### 3.5 USER BITS

The time code that is generated by the NAGRA T-Audio TC conforms to the SMPTE/EBU standards. These standards prescribe the presence of eight groups of four user bits in each and every time code "word". See appendix B.

These positions may be used for the recording of any type of information. Only their presence is standardized, their use is not. (Except in calendar mode).

The T-Audio TC accepts hexadecimal values in the user bit memory of the time code generator. The blinking mode as described on page II.2.5-1 may be used for this programming.

#### SET FROM EXTERNAL

The user bits can be taken from an external time code source. To do so, proceed as follows:

Apply the external signal to either the five pin LEMO connector or to the XLR time code input. Set the display to user-bits and the time code channel to READY and INPUT, the TIME CODE LED on the keyboard should light up without interruption to indicate the presence of a proper signal. Press SHIFT+STORE, after a maximum of one second the matrix changes to SYNC confirming that the setting has been accomplished. The cable may then be removed.

#### CALENDAR MODE

Switch 4 of the frame rate selector on the time code board selects the user bits memory of the generator between FREE or DATE mode.

ON = DATE (calendar mode)

OFF = FREE use of user bits, including hexadecimal information.

Monitor the second line of the status display menu to check this.

If the system has been set in the calendar mode, the user bits will be shown on the display with one decimal point between the sixth and the seventh digit. (Normally they are displayed without any points).

In this mode the first six digits of the eight user bit groups are reserved for the recording of dates in the time code signal, according to the format:

DD : MM : YY : xx

When the generator passes midnight, the date as stored in the user bits memory will be automatically increased. When a setting of the internal generator is attempted and the new user bits do not correspond to the above format, **ERROR-03** will appear on the display and the setting will be refused. This is valid for both manual setting and set from an external source.

Numerical command 102 protects both user bits and time from accidental modification. **ERROR-04** will be shown if an attempt is made to modify this.

Execute numerical command 103 to enable setting.

### 3.6 JAM SYNC ON TAPE

This feature makes it possible to extend a prerecorded time code track without causing numerical discontinuities. Only the time code "word" during which the recording was started will be destroyed, but old and new code will be perfectly sequential. Which means that the distance between the beginning of one time code frame and the beginning of the next one remains constant across the switching point.

It is to be noted, however, that this procedure is non-synchronous. This means that a change of the time code recording speed may occur on the switching point when the tape has been stretched, or if it was recorded on a transport which was not properly calibrated for speed.

#### **Procedure:**

- Make sure the tape is in a position where there is still a few seconds of time code track ahead.

- Set the time code channel to READY/REPRO on the channel status matrix.

- Start the T-Audio TC in PLAY.

- Check that the TIME CODE LED lights up without interruptions (no drop-outs).

- Press SHIFT + REC before the end of the time code track is reached.

The machine will continue to record time code until one of the main tape transport keys is used.

End recording by first pressing PLAY before any other key when it is required to make a record exit as clean as possible. (It will be obvious that the end of such a recording is by no means sequential).

The internal time code generator is only used as a reference for this operation, its real time relation will not be modified.

#### 4.0 SYNCHRONIZER

The optional TASYN time code chaser/synchronizer cannot be recognized as a hardware circuit in the T-Audio TC electronics. The time code board A-05 inside the T-Audio essentially contains a microprocessor with peripheral hardware performing all time code tasks, and partially controls the logic of the machine's tape transport.

The latter allows the microprocessor immediate access to all tape transport functions and detailed status information, which is essential for rapid synchronizer operation. This in combination with the double capstan, low inertia, tape transport, makes the T-audio TC a very fast synchronizing machine.

Typical acceleration time from STOP to nominal speed and LOCKED: 2.5 sec. (with tape recorded at 19 cm/s (7,5 ips.) and with a generator as master).

No complicated wiring or interfacing to the master is required; the T-Audio TC synchronizer only needs a time code signal to be fed to its external TC input.

**NOTE:** Only software versions marked with the letters SY contain the relevant software for synchronization. Inspect the last line of the status display menu (see page II.1.4-1) to check that the correct software is installed in your machine.

Once the synchronizer has been activated, the T-Audio TC will park within an accuracy of one frame when the master is parked. During shuttle, the T-Audio TC will use varispeed shuttle to always stay as close to the master as possible to avoid excessive delay in reaching LOCKED status when the master decelerates and immediately continues at nominal speed.

LOCKED status is indicated by the LED marked TC-LOCKED just above the PLAY key on the keyboard. This light will come on when both master and T-Audio TC are stabilized at nominal speed, and when DELTA is decreased below 5 bits.

The T-Audio TC can also LOCK itself to the master on reversed nominal speed.

Chasing is accomplished using only the numerical values of the two time code tracks until LOCKED state has been reached. Once LOCKED, phase resolving is done between the bit streams of the two signals in order to ensure exact, phase stable synchronization, steady enough for audio-audio synchronization. For this application phase adjustment of the synchronizer is possible, see page II.4.5-1.

DELTA is the numerical difference between off-tape and external time code, minus the preprogrammed OFFSET. DELTA is negative when the T-Audio TC lies behind the master. If DELTA is bigger than 12 hours, the T-Audio TC shuttles in the opposite direction to what normally would be expected, presuming a discontinuity across midnight in the on tape recorded time code track(s).

OFFSET is a programmed numerical difference between master and off-tape time code. Any value up to 24 hours (minus one frame) may be stored, positive or negative. For more details see page II.4.3-1.

It is possible to record audio while playing back the time code track. The synchronizer will not be disturbed by audio channels being in record which enables synchronized insert editing. See page II.5.0-1.

The audio outputs are normally muted when the synchronizer is active and when the machine goes out of LOCKED. This function may be inhibited by execution of numerical command 003. Line 5 of the status display menu will show:

M U t E \_ o F F . Execute numerical command 002 to return to normal operation.

#### 4.1 CONNECTION TO MASTER

As stated in the previous chapter, the only information the T-Audio TC needs from the master tape transport is a time code feed. The decoder of the external time code reader can decode a signal at speeds varying from 0.02 x nominal up to approximately 70 x nominal speed (60 x nominal speed for frame rates 29.97 and 30 fps).

The signal level may be anything from 100 mVpp to 24 Vpp and the signal does not need to be "reshaped" before feeding it to the T-Audio TC. In many cases, it is necessary to avoid regeneration of the time code because generators usually produce only a usable signal at nominal speed. It will be obvious that the T-Audio TC needs to receive the time code signal over a spectrum of speeds as wide as possible. For the same reason the use of audio outputs of a time code channel should be avoided. Normally an audio channel output is filtered at 20 Hz to 20 kHz which limits the maximum speed of a time code feed to only 5 x nominal. For this reason most of the video tape recorders are equipped with two outputs on the channel used for time code recording. One is audio filtered and another one comes from a wideband amplifier which usually also reshapes the signal into a square wave. In many cases, a link has been made between this output amplifier and the tape transport control logics to assure some sort of dropout compensation. For details on specific equipment see the connection sheets in appendix A.

## 4.2 SYNCHRONIZER SLOW MODE

In SLOW mode all characteristics of the synchronizer are essentially the same as in FAST mode except for when the transport is LOCKED. In this state an integration time is applied on the phase lock loop of the synchronizer.

The integration time is initially set to 15 frames but modification is possible through numerical command 012. Execution of this command shows the integration time in the display which may then be modified using the "blinking" mode as described on page II.2.5-1.

This feature does not only prevent the copying of any master tape transport imperfections but also provides powerful dropout protection.

When a time code track interruption needs to be overcome, increase the integration time to a value corresponding to the length of the interruption plus 10 frames.

The T-Audio TC will now run over this interruption using its tape counter information to remain synchronous.

Modification of integration time may be made with the tape in motion. The new integration time, however, will only be taken into consideration by the synchronizer when it is switched ON. Modification of the integration time will not have any influence when this is done during synchronizer operation.

When the master machine stops, the T-Audio TC continues at nominal speed for about the same time as the integration time, and only then returns to the master position. Now synchronizer operation remains FAST until LOCKED state is reached again.

The synchronizer will LOCK just as well as in both FAST and SLOW modes, at nominal speed both forward and reversed.

The SLOW mode is to be considered as the standard operational status of the time code synchronizer.

**NOTE:** The T-Audio TC reacts immediately to all speed variations of the master when the synchronizer is set to the FAST mode. To some extent even wow & flutter from the master may be copied through the synchronizer on the T-Audio TC tape transport.



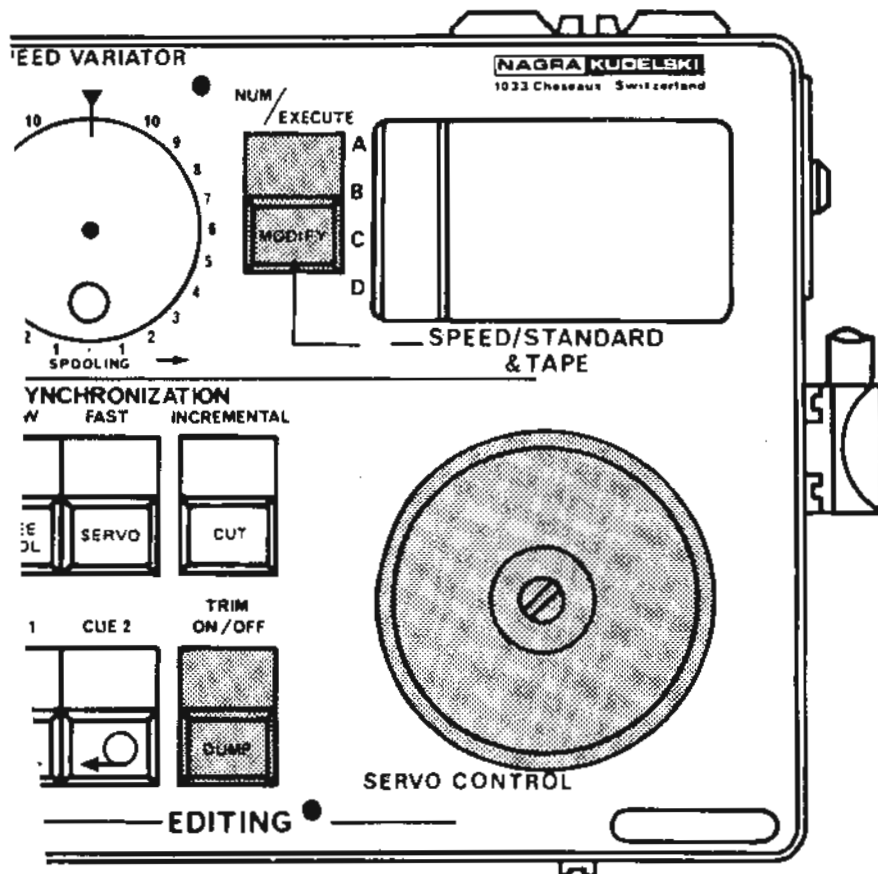


Fig 4a

### 4.3 OFFSET PROGRAMMING

OFFSET is a pre-programmed numerical difference between two time code tracks that are to be synchronized. An OFFSET of any value up to 24 hours (minus one frame), positive or negative, can be stored in the T-Audio TC. A negative OFFSET means that the T-Audio TC is put behind the master.

A stored OFFSET value will be maintained in the memory during power off.

#### MANUAL INTRODUCTION OF AN OFFSET

Display the OFFSET by pressing SHIFT+DISP OFFSET.

Press SHIFT+ ← or → to start the blinking mode as described on page II.2.5-1.

The bit section of the OFFSET register can be modified when the display is set to the high resolution format before the blinking mode is started.

If an error was made during this modification, use STOP to interrupt the modification mode and to recover the originally stored value.

Confirm the modification with SHIFT+STORE when the desired value has been reached.

When an OFFSET modification is performed while the synchronizer is switched on, nothing will happen to the tape transport until the new OFFSET is confirmed by SHIFT+STORE.

#### FINE ADJUSTMENT OF OFFSET

The OFFSET can be trimmed frame by frame as follows:

Select OFFSET on the display by pressing SHIFT+ DISP OFFSET.

Activate the trimmer by SHIFT+TRIM ON/OFF, this key switches the trimmer function alternately ON and OFF. If the trim function is ON, the right-hand digit of the display blinks. Now the adjustment can be made by rotating the servocontrol/offset trimmer wheel on the right-hand side of the keyboard. This adjustment does not need to be confirmed by STORE, it is effective immediately. When the desired value has been reached, press SHIFT+TRIM ON/OFF or set the display to any other mode except OFFSET to avoid accidental modification.

The above function may also be used during synchronizer operation. If the T-Audio TC is LOCKED, for example, exact synchronization of speech can be easily achieved.

Counterclockwise rotation will delay, and clockwise rotation will advance the T-Audio TC with respect to the master.

AUTOMATIC OFFSET PROGRAMMING is available by the use of the INCREMENTAL key, as described on page II.4.4-1.

#### **4.4 INCREMENTAL MODE**

As far as all tape transport reactions are concerned, INCREMENTAL mode is identical to SLOW mode. The INCREMENTAL function essentially provides automatic storing and/or updating of OFFSETs.

The SHIFT+INCREMENTAL function can be used in two ways:

##### **AUTOMATIC CALCULATION OF OFFSET**

When two tapes with different time code tracks need to be synchronized, proceed as follows:

Park both machines at a clapper or other synchronization reference point. Press SHIFT+INCREMENTAL on the T-Audio TC, this will instantly load the actual numerical offset between the two time code tracks in the OFFSET memory and activate the synchronizer in SLOW mode. This operation may also be done "on the fly", with one, or even both machines at any speed. The stored OFFSET value is now probably only approximate and can be trimmed as described on page II.4.3-1.

##### **INCREMENTAL SYNCHRONIZATION**

During normal synchronizer operation, the T-Audio TC starts chasing as soon as a time code discontinuity occurs in either master or slave time code track. INCREMENTAL mode can be used to prevent this. When the T-Audio TC is in the LOCKED state, a discontinuity in either tape will not cause any audible speed variation. (The integration of the synchronizer provides the necessary safety).

In this case, the difference between the last time code value before, and the first one after the discontinuity is calculated and added to the OFFSET. And the T-Audio TC will remain LOCKED, but with a new OFFSET.

This operation results in a resolving like synchronization, seemingly without the numerical values of the time code track taken into account. In reality however, these values are indeed processed, providing dropout protection and absolute safety when going from PLAY through STOP into PLAY-reversed. Since the T-Audio TC synchronizes just as well in backward motion as in forward, this function allows it to roll backwards out of a scene into the precedent, and to play forward again into the selected scene with immediate synchronization at the very first frame.

In this mode, an unlimited number of discontinuities may be crossed, provided that the tape transport is in LOCKED state when a discontinuity is reached. For this reason be sure not to stop too close to a discontinuity. Practical safety margins are 3 secs for 7.5 ips (19 cm/s) and 5 secs for 15 ips (38 cm/s) tape speed.

**NOTE:** Calculation and introduction of the new offset takes some time. A second discontinuity which occurs during this procedure can not be taken into account by the T-Audio TC. Re-record a new portion of time code if discontinuities happen to be closer than some 10 frames.

If it is necessary to switch between synchronizer INCREMENTAL and SLOW modes during a transfer, do this only when the LOCKED state is indicated, or, when both master and T-Audio TC are parked. Doing so prevents accidental entry of OFFSET or audible tape speed variations at the moment of switching.

#### 4.5 PHASE TUNING

The previous chapters describe how to load and finely adjust an OFFSET in the T-Audio TC memory. These functions are more than accurate enough for sound to picture synchronization. For synchronization of sound to sound, (multitrack operation from more than one machine for example) access to synchronizer phase is required.

Continuous variation of the phase of the synchronizer is offered without any special commands by the use of the SPEED VARIATOR potentiometer. A correction of approximately  $\pm 6$  bits ( $\pm 3$  msecs) is possible and can be made visible by selecting DELTA to the display in the high resolution format (SHIFT+DISP BITS).

The center (zero) position of the rotary control corresponds approximately to phase adjustment 0 as shown by the display. This is due to the fact that this potentiometer also serves as manual speed correction and its center position is calibrated to obtain nominal speed in that mode.

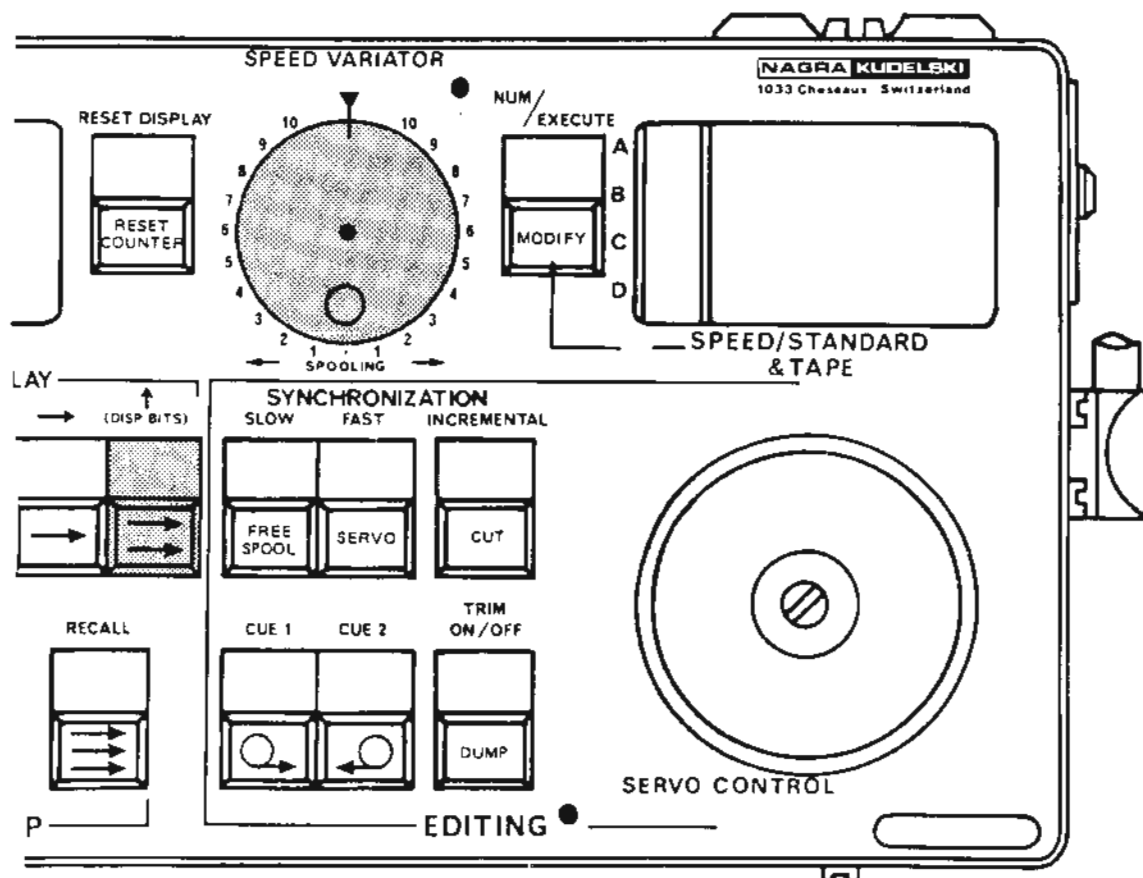


Fig.4b

## 5.0 EDITOR

The three channels of the NAGRA T-Audio TC are completely independent. The channel status matrix as described on page II.2.1-1 shows the functions of the time code channel. Due to this independence it is possible to record a time code on the center track of an audio tape on which sound is already recorded without the risk to damage any of the sound tracks. It is also possible to playback time code during recording, on one or both audio tracks. The synchronizer may very well use this time code to lock the tape transport to a master signal during audio recording.

This is the basis of the editing features of the T-Audio TC. A machine may be locked to any other device and synchronous transfers in either direction are possible. Page II.5.1-1 explains how to switch manually between REC and PLAY, without disturbing the synchronizer, in whatever mode it is activated. Chapters II.5.2 and II.5.3 explain how to perform an automatic insert-EDIT with the use of the CUE 1 and 2 memories as pre-determined EDIT-IN and EDIT-OUT points.

For almost all edit operations the tape needs to be "pre-stripped" with a preferably continuous time code track. This can be done from an external time code source, but it might be easier to set the T-Audio TC up to stripe its own tape independent of other equipment. Page II.3.3-1 describes how the internal generator can be employed for this.

The switching between REC and PLAY during editing operations won't ever result in an audible "click" in the sound track. The bias, erase and record amplifiers are controlled in such a way, that a miniature crossfade occurs during the switching. Timing circuits take account of the relation between the tape speed and the distance between erase and record heads automatically. The drawing 5a shows this feature schematically.

In order to ensure proper timing, the tape needs to move at, or close to, nominal speed. If the T-Audio TC is started in RECORD directly from STOP, or manually stopped when in RECORD, clicks may be recorded on tape. In automatic EDIT mode, RECORD will be switched off as soon as the synchronizer dictates a tape speed other than nominal, which may be audible.

## **5.1 MANUAL EDITING**

When the tape transport is LOCKED or stable in non-synchronized PLAY, manual "punch-in" and "punch-out" may be done on any audio channel previously selected to READY. The switching will result in a click on the audio monitoring outputs, but no audible defect will be recorded on tape. The result of the timing of erase, bias and record amplifiers is shown in drawing 5a.

### **MANUAL EDIT WITHOUT SYNCHRONIZER**

Select the audio channel (-s) to be used to READY.

Park the T-Audio TC with sufficient preroll time before the point where the punch-in should take place. Since the T-Audio TC tape transport has very low inertia this preroll may be very short.

Start the machine in normal PLAY, and execute SHIFT+REC on the desired punch-in point.

To exit the record mode properly, first go from REC to PLAY before stopping the transport.

### **MANUAL EDIT, SYNCHRONIZED**

Select the audio channel(-s) to be used to READY.

Select the time code channel status matrix to SAFE and SYNC: this will make the synchronizer phase the tape on the record head instead of on the reproduce head, on which synchronization normally takes place.

Activate the synchronizer in SLOW or INCREMENTAL mode, and park the machines through manipulation of the master with sufficient preroll time before the edit point. The necessary length of preroll largely depends on the characteristics of the master transport behaviour. A preroll of only 3 secs will be sufficient at tape speed 19 cm/s (7,5 ips) and if a generator is used as master.

Start the master in PLAY and punch the T-Audio TC to record by executing SHIFT+REC. Make sure not to punch-in when the LOCKED state has not already been reached; this may cause improper audio switching.

At the punch-out point, return to synchronous playback by pressing SHIFT+PLAY. This will switch the audio channel(s) back to playback without disturbing the synchronizer and without recording an audible click on the tape.

If the synchronizer detects a speed other than nominal speed during this operation, the T-Audio TC returns automatically to synchronized playback. This switching, however, is not necessarily "clean".

Page II.7.4-1 explains how above described editing can be remote controlled by simple contact closure.

## **5.2 CUE PROGRAMMING**

The NAGRA T-Audio TC provides a total of five cue or "scratchpad" memories. The use of the three "scratchpad" memories is described on page II.2.6-1. The memories CUE 1 and CUE 2 can also be used for cue storing, but essentially reserved for automatic editing as explained in the next chapter. CUE 1 is used as memory for the EDIT-IN point, while CUE 2 will be the EDIT-OUT point.

### **TO STORE A VALUE**

A time code value to be stored in one of the cue memories may either be read from the tape on the T-Audio TC, or from the external time code signal. Selection is effected by first selecting time code on the display, and then INPUT or REPRO on the channel status matrix.

Press SHIFT+CUE. The entire display will flash indicating that a CUE memory has been "opened". At the moment that SHIFT+STORE is pressed, the displayed value is stored in the cue memory. The tape from which the value is taken needs not be parked, it is possible to load values "on the fly", the tape speed may even be maximum shuttle.

Storing a value in CUE 1 automatically activates the editor. This is indicated by a decimal point flashing on the left of the display.

The status of the audio channels is also automatically modified when necessary.

### **MEMORY MODIFICATION**

Press SHIFT+CUE, SHIFT+RECALL to display the stored value. The blinking mode as described on page II.2.5-1 may now be used to modify the contents of the memory.

### **CUE REPLACEMENT**

The value stored in the CUE 2 memory can easily be transferred into the CUE 1 memory by the following key sequence:

SHIFT+CUE 2, SHIFT+RECALL, SHIFT+CUE 1, SHIFT+STORE.

This method can also be used to transfer any of the scratchpad memories into either cue register.

### **LOCATING OF A CUE POSITION**

Press SHIFT+CUE, SHIFT+RECALL to display the stored value. SHIFT+LOCATOR will make the T-Audio TC automatically shuttle to the memorized tape position.

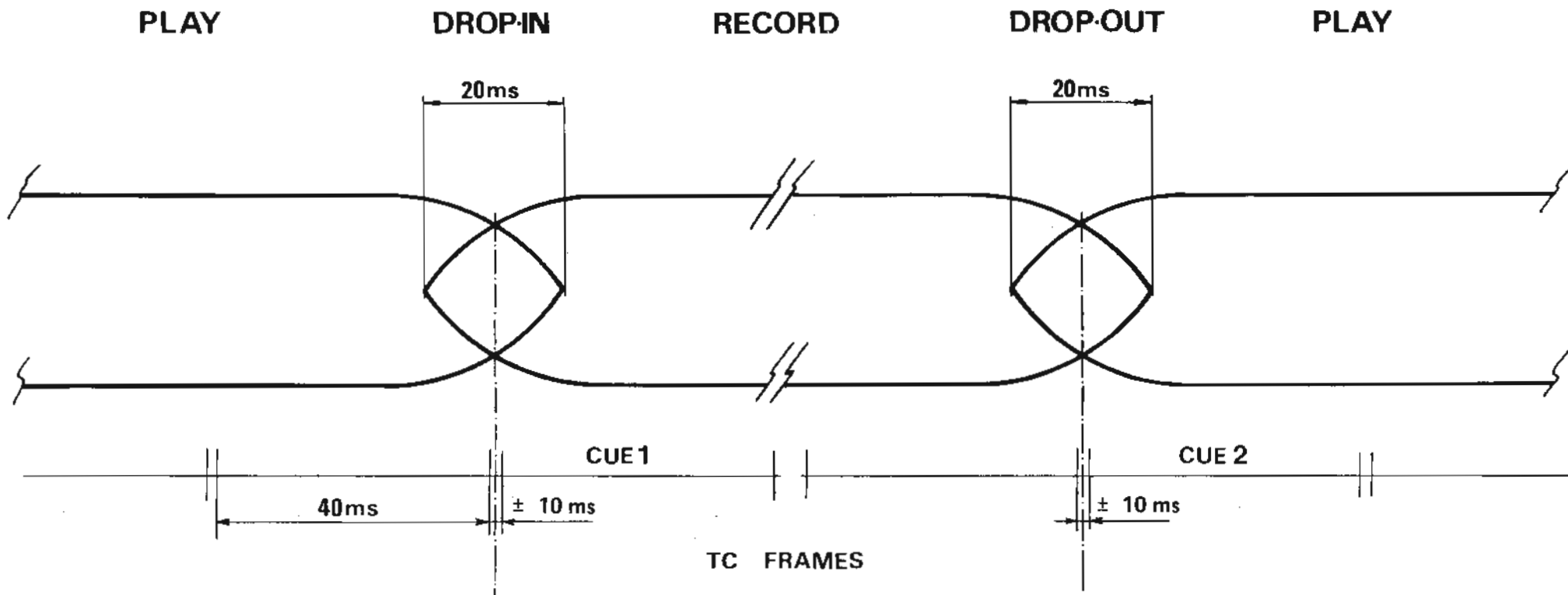
If the locator is sent to CUE 1, the tape will be parked at a preroll distance from the actual CUE 1 value.

Numerical command 010 gives access to the stored preroll time which may be modified in the "blinking" mode as described on page II.2.5-1.

**TO CLEAR A CUE**, simply press SHIFT+CUE directly followed by SHIFT+RESET.

Fig.5a

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### 5.3 AUTOMATIC EDITING

Once the EDIT-IN and EDIT-OUT points are loaded in the CUE 1 and 2 memories as described in the previous chapter, the T-Audio TC is ready for editing.

The channel status matrix is automatically modified when a value is stored in CUE 1. Storing an EDIT-IN point in CUE 1 will also automatically switch ON the editor. This is indicated by a flashing decimal point on the left of the display.

The T-Audio TC editor is essentially developed for sound to picture post production. The editor operation is consequently very similar to the system incorporated in professional video tape recorders. Chapter II.7.2 explains that all functions, including editing, are accessible through the optional serial remote port which makes integration of the T-Audio TC in a post-production system possible.

#### REHEARSAL

A rehearsal (preview) can be made by simply setting all channels to SAFE and rolling the T-Audio TC across the loaded edit points in any synchronizer mode. At CUE 1, the audio channels will be switched to INPUT (EE) and at CUE 2 returned to their initial position.

The rehearsal can be made with all channels in SYNC or in REPRO.

Execute numerical command 008 for REPRO or command 009 for SYNC.

**Status display:**   rEH.rEP.                   rEH.SYnC

The time code channel will be set like the audio channels in order to synchronize the tape on the selected audio head.

Make sure to allow enough preroll time; the editor will only function properly when the cue points are reached at nominal speed in LOCKED state.

The edit-exit point may be loaded "on-the-fly" into the CUE 2 memory: Make sure to reset CUE 2 to zero or to load a value considerably higher than desired. Start a rehearsal as described above and press SHIFT+CUE 2; the display shows the off-tape time code while blinking. Hit SHIFT+STORE at the desired exit point. The audio channels will return to REPRO (or SYNC) and the exit value is loaded in the CUE 2 register.

#### EDIT PASS

An automatic edit will be made when the above procedure is repeated with one or more audio channels set to READY. The machine will drop into record at CUE 1 and will return to playback at CUE 2. The audio switching is timed as shown in drawing 5a. Since the audio switching results in an inaudible, miniature crossfade, there is no objection to fix an EDIT IN or OUT point in the middle of the program material.

**NOTE:** The audio outputs are set to REPRO during the edit to allow an after tape confidence monitoring on the edit switching. Consequently, the output is not in synchronism with the picture because the synchronizer is set to synchronize the tape on the record head during editing.

Also the automatic editor is switched off, when the tape reaches CUE 2 during an edit pass; the blinking decimal point in the display disappears.

The stored values remain available for locating or repetition of the same event.

All channels return to REPRO (or SYNC) when any of the main tape transport keys (or LOCATOR) is used.

## **REPETITION**

When an edit has to be repeated using the same entry and exit values press SHIFT+CUE 1 twice.

This will reactivate the editor, the blinking decimal point reappears, without modifying the present cue values.

## **CUE REPLACEMENT**

When a new edit needs to be assembled "head to tail" to the previous one, proceed as follows to load the present CUE 2 value into CUE 1:

Press SHIFT+CUE 2 , SHIFT+RECALL , SHIFT+CUE 1 , SHIFT+STORE .

Note that now CUE 1 and 2 are identical; modify CUE 2 before attempting a rehearsal or edit.

This sequence may also be used to copy the contents of a scratchpad memory into one of the CUE registers.

## **CANCELLING OF EDIT**

If the editor is switched ON accidentally, cancel CUE 1 by pressing:

SHIFT+CUE 1 , SHIFT+RESET

This will switch OFF the editor and reset the CUE 1 memory to zero.

The CUE 2 value remains in the memory.

**NOTE:** Automatic editing may be performed with the synchronizer in either SLOW or INCREMENTAL mode. Do note however that the OFFSET modification in INCREMENTAL mode takes some time; during which no other functions can be executed. Make sure not to place an EDIT ENTRY or EXIT point closer than 10 frames behind a discontinuity.

**NOTE:** Any time code value may be loaded into a cue memory for editing except 00:00:00:00. Zero is considered as register empty so the editor will not react on this value.

## 6.0 PILOT OPERATION

The NAGRA T-Audio TC accepts two options which make resolved playback of pilot tapes on any existing standard possible:

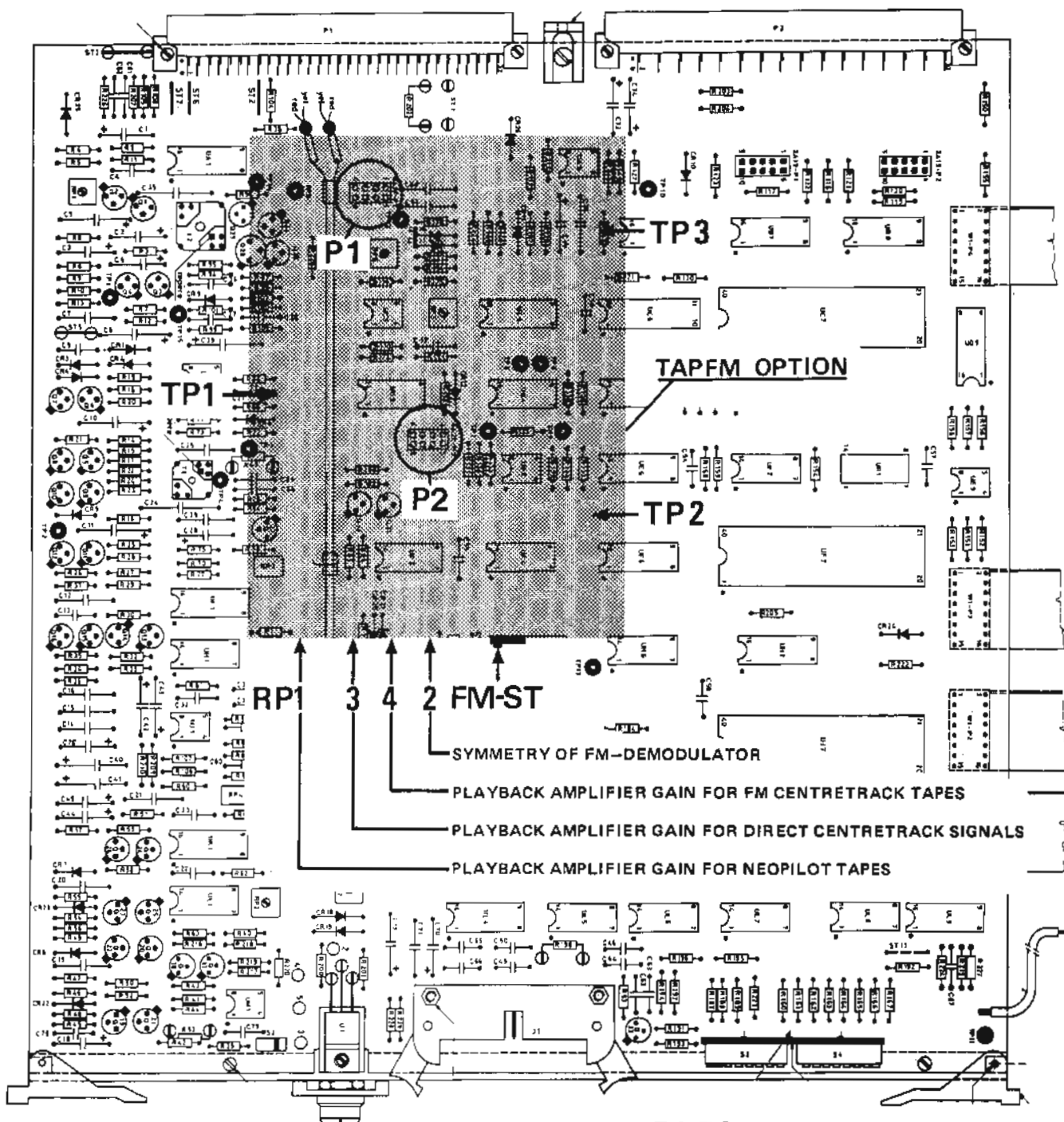
**TAPFM** Is a circuit to be installed in the T-Audio TC which permits resolved playback of tapes with center track pilot using the time code head. The circuit is compatible with both direct recorded pilot tapes (STELLAPILOT) and FM-recorded pilot tapes (NAGRA SYNC). Resolving is possible using either the internal generator (when fitted with the TAHSX, optional high stability timebase) or an external pilot signal as a reference.

If commentary is recorded on the center track of a NAGRA IV-S-L, the signal will be decoded and amplified to an asymmetrical line output.

**TAONP** Is a miniaturized NEOPILOT head which can be fitted to the T-Audio TC headblock to read mono neopilot tapes and to resolve them using the TAPFM electronics.

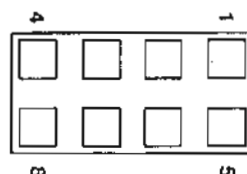
The T-Audio TC is fitted with an output of pilot signal derived from off-tape time code. This output is available in any operating mode.

A second feature, enabling time code versus pilot synchronizations is the possibility of feeding the T-Audio with a frame pulse signal as an external reference. Such a reference can be used to resolve a time code tape against a pilot reference. This resolving is done by the time code synchronizer, the presence of a TAPFM board is not required for this feature.



P1/P2 detail

Fig.6a



## 6.1 INSTALLATION

### INSTALLATION OF TAPFM CIRCUIT

The TAPFM is to be installed on top of the time code circuitry A-05 of the T-Audio TC.

Proceed as follows:

Make sure that power is switched OFF.

Open the front cover of the machine by loosening the two screws located under the keyboard. To gain access, rotate the keyboard upwards. Half a turn counterclockwise should be sufficient to undo these bayonet type screws.

Remove the colored ribbon cable from the front of the time code board by pushing outwards the two black plastic catches that hold its connector in place.

Remove the board from the machine chassis by pulling gently the two black plastic levers on the front corners of the circuit.

Plug the TAPFM board on the two 8 pin connectors as shown in figure 6a.

A screw hole is provided close to each connector to secure the circuit in place.

The shield should be fitted between the special bolts at the corners of the board by slightly bending it and slipping it in the slots.

### INSTALLATION OF TAONP OPTION

This option is essentially a miniaturized neopilot head which is to be added to the head block. It is fixed on the side of the tape tension sensor as indicated in figure 6b. After installation of this head a recalibration of the entire headblock is necessary. Consequently it is strongly advisable to have this option factory installed.

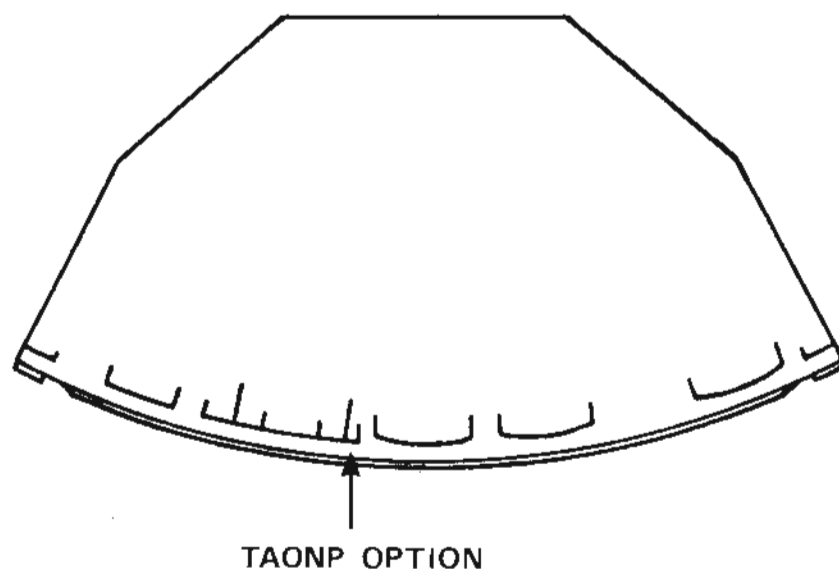


Fig 6b

## 6.2 CONNECTIONS

All connections relative to pilot operation are found on the THIRD TRACK INPUT/OUTPUT SOCKET:

- 1 CUE OUT      Output of commentary or other information decoded from the FM-modulated center track from tapes recorded on a NAGRA IV-S-L. This output is filtered at approximately 200 Hz to 3 kHz in order to separate pilot and cue information when these signals are recorded mixed.  
Level:            1.2 Vrms for  $\pm 20$  % modulation at 1 kHz.  
Impedance:       Z-load minimum 1 kOhm
- 2 EXT.REF.      Input for an external reference signal routed to the TAPFM TAPFM resolver circuit, and to the time code generator and synchronizer. The signal is first routed through the TAPFM for level adjustment and wave shaping.  
Sensitivity:      0.8 to 14 Vpp.  
Waveform:       Anything, only 50% duty cycle is required.  
Impedance:       bigger than 47 kOhm  
If no TAPFM is installed it is still possible to feed an external reference. A jumper has to bridge pins 1 and 8 of TAPFM connector P-2, and the reference needs to be a 5 V logic square wave because no level adjustment is made by the T-AudioTC itself.
- 7 50/60 from TC      Output of the pilot signal derived from off-tape time code. In pilot mode the output of pin 7 is phase lock looped to the T-Audio T.C. internal generator.  
In the time code mode with the time code channel status matrix in SYNC + READY the output of pin 7 is phase lock looped to the internal generator.  
In time code mode with the time code channel status matrix in READY + INPUT the output is phase lock looped to external time code.  
In time code with the time code channel status matrix in REPRO the output is phase lock looped to time code play signal.  
For the relationship between time code frame rates and pilot frequencies see page II.1.3-3.  
Level:            + 5 Volt logic square wave  
Waveform:       Square  
Impedance:       1 kOhm, Z-load should be greater than 5 kOhm
- 9 PILOT OUT      Output of the pilot signal read off tape by the TAPFM decoder circuit. This output is available at all speeds close to nominal, with resolver active or not. A low pass filter is provided, to separate cue information in the case of mixed recordings on an FM modulated center track.  
Level:            approximately 1.7 Vrms  
Waveform:       Sine  
Impedance:       Z-load minimal 1 kOhm.

### 6.3 SET-UP

The switches used to set the pilot electronics to the desired mode are located on the right-hand block of eight switches on the upper surface of the leading edge of the time code board, and on the TAPFM circuit itself.

#### REFERENCE SELECTOR

It is located in the middle of the upper surface of the time code board A-05. For its operation see page II.1.3-1. When an external reference needs to be applied to resolve a time code tape, numerical command 004 should be also executed, and the reference must be a frame pulse not a pilot signal. Execute numerical command 005 to return to normal operation.

#### CENTER TRACK DIRECT / FM

This switch is located on the leading edge of the the TAPFM circuit. See figure 6a. Slide to the left for playback of FM recorded NAGRASYNC tapes. Slide to the right for playback of direct recorded signals (STELLAPILOT). These positions are marked FM and ST on the board itself.

#### PILOT FREQUENCY

The pilot frequency is selected by the same selectors as used for the time code frame rate.

For their setting and for the relation between time code frame rate and pilot frequency see page II.1.3-3.

#### TIME CODE/PILOT SELECTOR

This is the main mode selector. This is switch number 5 of the right-hand block of eight switches on the time code board. Select ON for time code operation and slide to OFF when the TAPFM is to be activated.

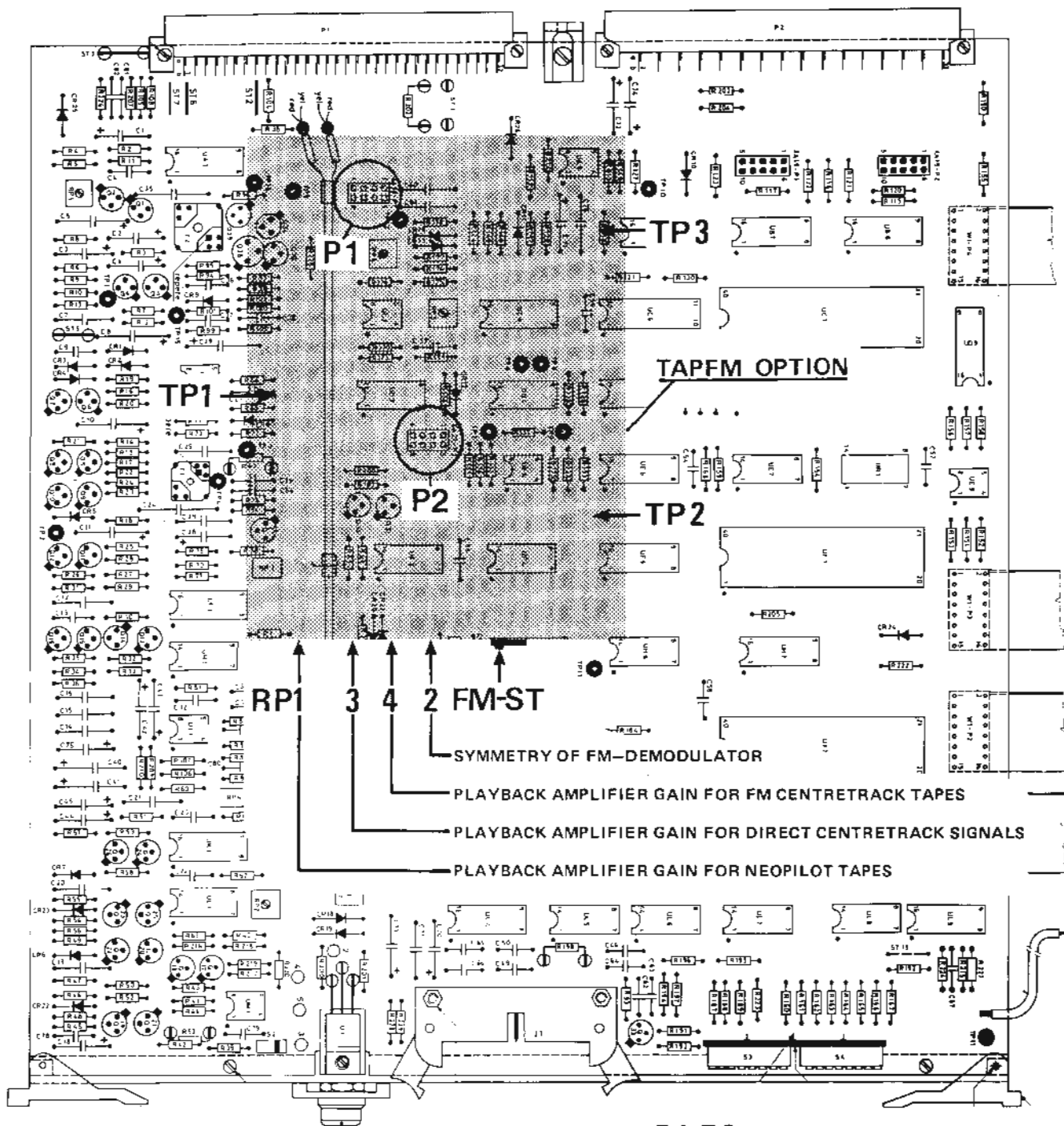
**NOTE:** The LED marked TIME CODE also serves as off-tape signal indicator in pilot mode. It does not light up when the wrong tape speed has been selected.

#### NEOPILOT / CENTERTRACK

This is switch number 6. Select ON for center track pilot, in which case the choice between FM or DIRECT recorded tapes needs to be made with switch FM/ST on the TAPFM board. Set to OFF for NEOPILOT tapes.

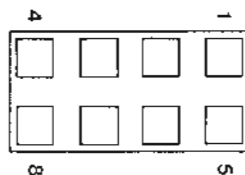
Status display: Centre track: F M \_ P i \_ . .  
NEOpilot: P i L o t \_ . .

To assure proper cancellation of Neopilot signals in the audio output, set switch S-101 on the left of the board A-02 to MONO position.



P1/P2 detail

Fig.6c





## 6.4 CALIBRATION

This is only a condensed description of the calibration procedure of the TAPFM circuit. More details can be found in the "Timecode and pilot options" section of this manual (Section 5).

As test tapes for calibration, use pilot tapes that were recently recorded on a well calibrated pilotone recorder.

Make sure that the machine is properly set for the tape on which a calibration is to be done. Follow the instructions given on page II.6.3-1.

### TEST POINTS

For the location of the test points refer to drawing 6d.

TP-1 Neopilot playback signal before RP-1.

Should show 21 mV rms.

TP-2 Symmetry of FM-demodulator

Should show the FM decoded signal symmetrical with respect to earth.

TP-3 Final output stage of circuit

Should show approximately 450 mV pp from all three tape types.

Equivalent to 1.7 V rms output on pin 9 of third track input/output.

### POTENTIOMETERS

Refer to drawing 6d on the opposite page for their physical location.

RP-1 Playback amplifier gain for neopilot tapes.

RP-2 Symmetry of FM-demodulator, FACTORY ADJUSTED.

RP-3 Playback amplifier gain for direct center track signals.

RP-4 Playback amplifier gain for FM center track tapes.

## 6.5 RESOLVING, PILOT TAPES

First make sure that the operational mode of the T-Audio TC corresponds to the tape to be played back. Refer to page II.6.3-1 for the selector positions.

The TIME CODE LED on the keyboard normally lights up when a proper pilot signal is read off tape. This indication will fail, when the wrong tape speed has been selected.

The T-Audio TC should be in normal synchronizer mode for the procedures mentioned below. (numerical command 005, status display: `r E F . _ t c _`)

### RESOLVING TO AN EXTERNAL REFERENCE

Feed the reference signal to pin 2 of the THIRD TRACK connector as described on page II.6.2-1 and set switch S-1 to EXTERNAL position. (See page II.3.2-1 for further information).

Make sure that the tape signal frequency is identical to the reference.

(Mixed use of 59.94 Hz and 60 Hz is however allowed).

Start resolving by pressing SHIFT+PLAY or SHIFT+INCREMENTAL.

### RESOLVING TO THE INTERNAL GENERATOR

The use of the optional high stability timebase TAHSX is strongly recommended for this operation because of the relatively low stability of the standard timebase. See page II.3.1-1.

Make sure that switch S-1 (See page II.1.3-1) is in INTERNAL position, and that the generator frequency is set to the same value as the signal on tape. (See page II.1.3-3).

(Mixed use of 59.94 Hz and 60 Hz is, however, allowed).

Press SHIFT+PLAY or SHIFT+INCREMENTAL to start resolving.

**NOTE:** It is possible to record on one or both audio channel(s) while resolving the tape transport on a prerecorded center track pilot signal. This may be done against either an internal or an external reference. This is not possible on a NEOPILOT tape because of the width of the audio erase effect; the pilot tracks are also erased (before they reach the neopilot head).

### TIME CODE STRIPING OF NEOPILOT TAPES

A NEOPILOT tape can be striped with time code for postproduction purposes.

This can be done using either an external time code source or the internal generator. It is recommended, however, to use the latter because an accurate synchronization between on-tape pilot and the new recorded time code signals can only be guaranteed by doing so.

Set the mode selectors for neopilot resolving and check that S-1 is in the INTERNAL position. Select the time code channel to SYNC and READY in the status matrix.

Start resolving by pressing SHIFT+INCREMENTAL, and start the recording of time code by pressing SHIFT+REC as soon as the tape transport is stable.

**NOTE:** The erasure of the center track also decreases the NEOPILOT signal level by some 5 to 6 dB. This means this operation can only be performed on tapes having a good pilot level to start with. In case of difficulties increase the pilot playback gain temporarily as described on page II.6.4-1. Also avoid repeating this operation several times on the same tape; the legibility of the pilot signal can not be guaranteed after the second pass.

## 6.6 RESOLVING OF TIME CODE TAPES

In spite of the fact that a time code signal contains a lot more information, it can still be applied as a pilot frequency to execute simple resolving. This resolving is performed by the time code synchronizer TASYN which means that the features mentioned below are available without the optional pilot resolver TAPFM.

The synchronizer is set to resolver mode by executing numerical command 004. Line 6 of the status display menu should show: "r E F . \_ P i L" (in software version up to 1.6) and "rEF.Fr.P" (in software version from 1.6 onwards).

### EXTERNAL TIME CODE REFERENCE

The synchronizer may be left in the normal (chaser) mode for this operation.

Feed the reference time code signal to either the XLR connector at the back, or to the LEMO connector on the front of the machine.

Check receipt of this signal by setting the time code channel to SAFE and INPUT on the status matrix. The values of the signal should now be visible on the display and the indicator light marked TIME CODE should light up without interruption.

Check that the frame rate of reference, off-tape time code and machine setting are identical. (Mixed use of 29,97 fps. and 30 fps. is allowed). For the frame rate selectors see page II.1.3-3.

Start resolving by pressing SHIFT+INCREMENTAL, the LOCKED indicator lights up as soon as resolved play speed is reached.

### EXTERNAL PILOT REFERENCE

Execute numerical command 004 to set the synchronizer in the resolver mode.

Feed the reference signal to pin 2 of the THIRD TRACK connector as described on page II.6.2-1 or to pin 5 of BJ-13 (RS-422) and set the reference selector S-1 (See page II.6.3-1) to external.

Make sure that the reference frequency, and the frame rates from off-tape time code and the machine setting match. The reference signal should provide one pulse per frame. (Mixed use of 29,97 fps. and 30 fps. is allowed).

Start resolving by pressing SHIFT+INCREMENTAL, the LOCKED indicator lights up as soon as resolved play speed is reached.

**NOTE:** It is possible to switch one or both audio channel(s) to RECORD as soon as the LOCKED indicator has come on in any of the above modes. This allows the resolved recording of sound on a tape that was previously "striped" with time code. Automatic insert editing, as described on page II.5.3-1, is also possible. This is **not** true for the last resolver mode; using the internal generator (See page II.6.6-2). To switch to RECORD in this mode would result in the erasure of the time code track since this channel has to be set to READY to make the internal generator signal available.

Return the synchronizer to its normal (chaser-) mode by executing numerical command 005. Line 6 of the status display menu should show: r E F . \_ t c \_

## RESOLVING AGAINST INTERNAL GENERATOR

Execute numerical command 005 to set the synchronizer in the standard mode.

(Line 6 of the status display menu should show: `r E F . _ t c _`)

For this operation check that switch S-1 is set to the internal reference position.

The use of the optional high stability timebase TAHSX is strongly recommended because of the limited accuracy of the standard timebase.

Check that the machine frame rate setting corresponds to the signal recorded on tape. (Mixed use of 29,97 fps. and 30 fps. is allowed).

Provide a loop between the machines time code input and output. Use a standard XLR cable between the connectors at the back or connect pins 2 and 5 of the five pin LEMO connector on the front.

Set the status matrix to READY and SYNC for the time code channel.

Press SHIFT+INCREMENTAL to start resolving. The LOCKED indicator lights up as soon as the resolved playspeed is reached.

**NOTE:** Do not attempt to record audio in this operation. This would result in the erasure of the time code track.

**NOTE:** Recording of audio is however possible by putting the time code channel in the safe position.

## 7.0 REMOTE CONTROL

The NAGRA T-Audio TC keyboard may also be considered as a remote control because it may be separated from the tape transport with an extension cable up to 10 meters (50 meters when low resistance cable is used).

It is equally possible to connect a second keyboard to a machine when the machine is fitted with the TA-PPA option (supplementary keyboard input).

Direct access to the control logic bus is possible through the REMOTE CONTROL INPUT/OUTPUT on connector BJ-3. For details on the control logic bus see page II.7.1-1 of this section and the page III.3.0-1 of this manual.

**NOTE:** The remote control connector is part of TA-RAM option which is not included in the standard configuration of the non-time code versions of the T-Audio.

The optional (TAIRS) RS-232 port allows the T-Audio TC to communicate with a personal computer. The protocol and other details can be found on page II.7.2-2.

The TAERS is an external device specially developed for integration of a T-Audio TC in a computer assisted post-production system. It communicates with the T-Audio TC through the TAIRS option, which is therefore switched to RS-422 format.

For further information on protocols see chapter II.7.3 and section VI "External accessories".

Special remote control features such as fader start are possible through the SPARE inputs on the THIRD TRACK connector. TC machines only. See page II.7.4-1.

## **7.1 PARALLEL REMOTE CONTROL**

The parallel remote control of the T-Audio is only possible through the interface TAERP, of which a description can be found in Section VI.

All internal information exchanges are routed through a 6-bit parallel bus, and a single wire, bi-directional serial bus is used to connect the keyboard(s).

Both buses are accessible through connector BJ-3 "Remote control" of which description can be found in Section III, chapter 3.2. Simple remote control functions such as fader start can be done using the "spare" inputs of the time code system. See chapter II.7.4-1.

## **7.2 SERIAL REMOTE, OPTION TAIRS**

A Nagra TA-TC can be remote controlled from any external computer-like device either through the RS-232, or the RS 422 port, when fitted with option TAIRS. This option is a combination of both hardware and additional software.

The hardware part consists of an IC type NSC-858N which has to be fitted in the socket provided at position UK-4 on board A-05/A-23 (which is the upper half of the TC circuitry).

The necessary software package is present in all software versions marked .....RS. Check the last line of the status display menu to make sure that the right software version is installed in your machine (See page II.1.4-1).

The switches described on page II.1.3-1 select between either the RS-232 or the RS-422 port. The baud rate is variable from 2400 to 19200 the first case, but fixed at 19.2 kBauds (+4%) for use of RS-422. The communication protocol on the following pages is valid for both ports.

An external interface (TAERS) is available to allow the integration of a NAGRA TA-TC in an audio/video edit/production system. A description is found in Section VI of this manual.

**NOTE:** Until software version 1.6 only the RS-422 port can be used.

## RS-422 / RS-232 PROTOCOL OF TAIRS OPTIONS

### GENERAL

The signaling rate is 20.0 kBaud (about 4% higher than the standardized 19.2 kBaud), however this should not be a problem for systems having a 19.2 kB rate.

Each character consists of a START bit, EIGHT DATA bits, a PARITY bit and a STOP bit. The parity bit is such that the sum of the ONES in the data and the parity bit itself is an EVEN number.

The connectors, voltage levels, source impedances, etc., described in the documents are similar to RS 422 and RS 232 standards. See also page II.1.2-3.

**WARNING:** For the time being the RS 232/422 switch on the front pannel of the time code board is not operational. The switching between RS 232 and 422 ports will only be done in software version 1.6. Until the 1.6 version becomes available, use only the RS 422 port.

### MESSAGE STRUCTURE:

to NAGRA T-AUDIO:

STX (Hex 02):	at the start of every message
Byte count of the message:	does not include the STX itself, or the checksum
The message:	variable length, 250 bytes max.
The checksum:	the two's complement of the one-byte sum, without carry, of the message and the byte count.

Several commands may be put onto one message line, as follows:

```
STX
Byte count of all the commands
Command 1
.....
Command N
Checksum
```

From NAGRA T-AUDIO, each frame:

STX (HEX 02)	Hexadecimal value 02
Byte count	Hexadecimal value 17
23 bytes of status	
The checksum, which includes the byte count and the status byte.	

**NOTE:** On power up the T-AUDIO sets itself in standby (idle) mode. It will not accept any command or send back the above mentionned status before having received a break character.

The sending of these status, is in the present software, dependent upon the presence of an external reference signal (whether time code in rEF. tc mode or an external square wave at the frame rate in "rEF. Pil" or "rEF.Fr.P" from Eprom version 1.6 onwards. To transmit these 23 bytes of status, it requires approximately 16 ms (half a NTSC frame) with a signaling rate of 19.2 kBauds therefore a slower signaling rate should not be used.



## TIME CODE FORMAT

Time code values are transmitted as fields of 4 bytes in packed BCD, hours byte first. Most significant nibble (4bits) is tens, least is units.

## COMMANDS

The following are all the commands decoded in the NAGRA T-AUDIO. Numbers are hexadecimal values.

**NOTE:** A + sign in the following text indicates data to follow the command.

### 27 DEFER COMMANDS

- + 4 bytes of time code which is the time of execution.
- + 1 byte which is the byte count of the command(s) to be deferred
- + N bytes of command(s) to be deferred

### 2E TIME LINE STOP

Stops incrementing the software counter

### 2F LOAD TIME LINE

- + 4 bytes of time code data.
- This value must be earlier than the first deferred command.

### 30 TIME LINE CLEAR

All events associated with the time line are cleared.

### 41 STOP

Sets the T-Audio to STOP or PARK according to the READY status (command 48).

### 42 SLOW PLAY

- Play with variable speed from 0 to nominal speed.
- + 2 bytes of data, most significant first:  
-512 = nominal speed backwards / 0 = steady / +512 = nominal speed forward

### 43 PLAY

Sets the T-Audio to PLAY

### 46 SHUTTLE

- Variable speed mode for speeds greater than nominal speed
- + 1 byte of data  
1 full speed backwards / 128 : steady / 254 : full speed forward

**NOTE:** Tape in contact with T,C head.

**NOTE:** Maximum values 0 and 255 produce respectively FAST REWIND and FAST FORWARD where tape is no longer in contact with any head.

- 47 NOMINAL SPEED OVERRIDE**  
Variable speed about nominal speed + 1 byte of data  
0 : 12% / 128 : nominal speed / 225 : +12%
- 48 READY ON/OFF**  
+ 1 byte of data  
0 = off (sets the T-AUDIO in park), 1 = on (sets the T-Audio in stop)
- 4A EDITOR MODE**  
+ 1 byte of data  
0 = off, 1 = insert, 2 = assemble, 3 = rehearse, 4 = crash record.
- 4B RECORD ENTRY**  
+ 1 byte of data.  
This causes the T-Audio to start recording on the specified channels if the editor mode is in INSERT or ASSEMBLE and the synchronizer is locked. If the editor mode is in REHEARSE the specified channels will switch to input.  
Bit 1: Audio channel 1 READY  
Bit 2: Audio channel 2 READY  
Bit 7: Time code channel READY  
  
**NOTE:** This command requires prior sending of RECORD ENABLE (66) on the specified channels.
- 4C RECORD EXIT**  
+ 1 byte of data, same format as in 4B above.  
Inversed process as RECORD ENTRY.  
For a clean audio record exit, for example during an insert, the RECORD EXIT command must be applied to all recording channels. A partial exit, of one channel only will produce audible clicks on the concerned track.
- 4D TCG TIME SOURCE**  
+ 1 byte of data  
0 = Stop time code generator / 1 = Start time code generator.
- 4E TARGET SEARCH (LOCATOR)**  
+ 4 bytes of time code data.  
Causes the T-AUDIO to move to the specified location, ignoring preroll.
- 4F PREROLL SEARCH**  
No byte of data.  
Causes the T-Audio to move to the point specified by the command SET CUE POINT, hexadecimal value 61.
- 50 ROLL**  
Play with synchronization providing the time line has been correctly started in INSERT, ASSEMBLE or REHEARSE mode. In CRASH RECORD mode this command starts the recording.

- 53 CHASE**  
Synchronization depending on syncro-mode set by command  
SYNCHRONIZE SELECT 54
- 54 SYNCHRONIZE SELECT**  
+ 1 byte of data:  
00 : External time code, data dependent = SYNC SLOW  
01 : External time code, data independent = SYNC INCREMENTAL  
02 : External frame pulse reference = SYNC INCREMENTAL  
03 : External time code, data dependent = SYNC FAST
- 55 SET SYNC OFFSET**  
+ 4 bytes of time code data  
Stores synchronization offset
- 5A TAPE / EE**  
+ 1 byte of data  
0 = Audio channels 1 and 2 : REPRO / 1 = Audio channels 1 and 2 : INPUT
- 5C COLOR FRAMER**  
+ 1 byte of data  
Read but not presently used.
- 60 SET PREROLL**  
+ 4 Bytes of time code data  
Suggested minimum for NAGRA T-AUDIO TC is 2 1/2 seconds at  
19 cms/sec and 3 1/2 seconds at 38 cms/sec.
- 61 SET CUE POINTS**  
+ 4 bytes of time code data
- 62 SET SYNC POINT**  
+ 4 bytes of time code data  
Not presently used.
- 63 SET TIME CODE**  
+ 4 bytes of time code data  
Sets the internal time code generator to the specified value.
- 64 SET USER BITS**  
+ 4 bytes of user bits data, most significant byte first.  
Sets the internal user bits generator to the specified value.
- 65 SET TAPE TIMER**  
+ 4 bytes of "time code" data  
Sets the tape timer to the specified value.
- 66 RECORD ENABLE**  
+ 4 bytes of data, same format as in command 4B above.

- 69 JOG FORWARD**  
Causes the T-Audio to advance one frame. The T-Audio automatically sets itself to SERVO mode.
- 6A JOG BACKWARD**  
Causes the T-Audio to reverse one frame. The T-AUDIO automatically sets itself to SERVO mode.
- 6B TIME SOURCE SELECT**  
+ 1 byte of data  
0 : time source = time code / 1 : time source = tape timer.

### Status sent back by the T-Audio .

At each frame, the T-AUDIO sends back 23 bytes of status with a constant format.

- 1 DEVICE IDENTIFICATION:**  
1 byte, T-Audio identification : hexadecimal value 1D.  
**NOTE:** The used identification may also be set to 09 (Ampex VPR-3) by numerical command 205. Numerical command 204 returns the machine to its standard behaviour.
- 2,3,4,5 TIME CODE DATA**  
4 bytes of time code data, hours first.
- 6,7,8,9 USER BITS DATA**  
4 bytes of user bits most significant first
- 10 STANDARD**  
Bit 0 : NTSC / PAL (0 = PAL)  
Bit 1 : Drop frame  
Bit 2 : Time line running  
Bit 3 : Deferred buffer full  
Bit 4 : Current event executing  
Bit 5 : Sense (0 = forward)  
Bit 6 : Still (1 = T-Audio at rest)  
Bit 7 : Error
- 11 TRANSPORT STATUS**  
1 byte of data:  
00 : Stopped  
01 : Stopping  
02 : Playing  
03 : Nominal speed override on  
04 : Shuttle mode  
05 : Fast forward  
06 : Fast rewind  
07 : Synchronizing

08 : Synchronized and is a source  
 09 : Synchronized and is the master recorder  
 0A : Master edit period (not implemented)  
 0B : Record  
 0C : Cueing  
 0D : Cued (parked)  
 0E : Searching  
 0F : Search completed  
 10-12 : Reserved  
 13 : Slow play  
 14 : Power not on (not implemented)  
 15 : Not in remote control (not yet implemented)  
 16 : Unthreaded (from Eprom 1.6 on)

## 12 EXTENDED STATUS

Reserved for signaling error conditions not yet used

## 13 READY STATUS

1 byte of data: 1 = READY / 0 = READY OFF

## 14 TAPE / EE STATUS

1 byte of data : 0 = TAPE (REPRO) / 1 = EE (INPUT)

## 15 TIME CODE STATUS

1 byte of data : 0 = OFF / 1 = ON

## 16 SYNCHRONIZATION MODE

1 byte of data:

00 : External time code, data dependent	= SYNC SLOW
01 : External time code, data independent	= SYNC INCREMENTAL
02 : External frame pulse reference	= SYNC INCREMENTAL
03 : External time code, data dependent	= SYNC FAST

## 17 EDITOR MODE STATUS

1 byte of data

00 :	OFF
01 :	INSERT
02 :	ASSEMBLE
03 :	REHEARSE
04 :	CRASH RECORD

## 18 RECORD ENABLE STATUS

Bit 1 : audio channel 1  
 Bit 2 : audio channel 2  
 Bit 7 : time code

## 19 TC GEN MODE

1 byte of data : 0 : TC hold / 1 : TC run / 2 : TC jam

## 20 TIME SOURCE SELECT

1 byte of data : 0 : time code / 1 : tape timer

**21, 22 RS 422 ADDRESS**

2 bytes of data : selected by use of numerical command 200

**23 SPEED SETTING**

1 byte of data

00 :	9.5 cm/s (3.75 ips)
01 :	19.0 cm/s (7.5 ips)
02 :	38.0 cm/s ( 15 ips)
03 :	76.0 cm/s ( 30 ips)

### **7.3 EXTERNAL INTERFACE TAERS**

This option is an external 19" rack mount interface which allows the T-Audio T.C. (When used in conjunction with the TAIRS OPTION) to communicate with other microprocessors at baud rates of up to 38.4 Kbauds complying to the SMPTE/EBU standard.

In order to make the interface compatible with different protocols it is only necessary to change the software in the TAERS, the hardware remains the same for Sony and Ampex protocols.

The TAERS stores and re-arranges the status answer backs of the T-Audio T.C. according to these protocols. The TAERS can also contain the TAESV option which is a video SYNC stripper. (Video signal black burst extractor) to enable the T-Audio T.C. to be synchronized to the "HOUSE" reference signal normally used in all video applications (PAL, NTSC or SECAM).

For further information on TAERS and TAESV see section VI of this manual "EXTERNAL ACCESSORIES".

## 7.4 SPECIAL REMOTE CONTROL INPUTS

Two software programmable input/outputs are available for special remote control functions: SPARE-1 and SPARE-2 located on the THIRD TRACK connector are always internally connected to the microprocessor system but need to be activated by the execution of numerical commands.

The +5 V from pin 6 may be applied to the input through a normal switch, for example as fitted in a fader to execute the function.

Connected to ground or left open returns the T-Audio TC to its previous status.

### SPARE 1

This pin is programmed in standard software as an output following the logic values of the FM/Neopilot signal (+ 5 V = FM, 0 V = Neopilot). Spare 1 output is used in the TACO-D (TC/PILOT DISPLAY MODULE).

### SPARE 2

#### Fader start:

This pin is programmed in standard software as an input with programmable features:  
Execute numerical command 301.  
The display will show: S P 2 \_ P L A Y .  
Position the tape on the desired cue point and push STOP.  
+5 V to SP-2 results in PLAY.  
0 V returns the T-Audio TC to STOP.

#### Record switching:

Execute numerical command 302.  
The display will show: S P 2 \_ r E C \_ .  
+5 V to SP-2 will drop the T-Audio TC into RECORD.  
(At least one channel should to be in READY on the channel status matrix)  
0 V will return the machine to record-OFF.  
The resulting edit is similar as explained on page II.5.1-1.  
This switching is possible at nominal PLAY-speed as well as in synchronizer mode when the transport is LOCKED.

#### End

Execute numerical command 300 to inhibit SPARE-2.  
The display will show: S P 2 \_ o F F \_ .

#### Pulse PLAY START/STOP

Numerical command 305  
See II.7.4-2. For timing etc.

#### Pulse RECORD START/STOP

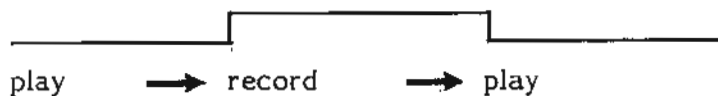
Numerical command 306  
See II.7.4-2. For timing etc.



Spare 2 programmed play (Numerical code 301)

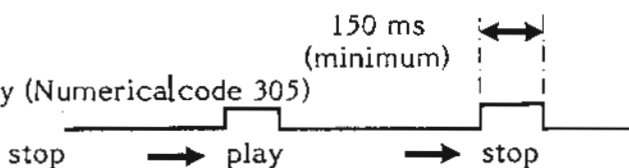


spare 2 programmed play/rec (Numerical code 302)

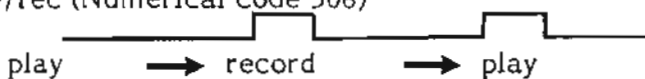


var.play → var.record → var.play

spare 2 programmed toggle play (Numerical code 305)



spare 2 programmed toggle play/rec (Numerical code 306)



var.play → var.record → var.play

## 8.0 NUMERICAL COMMANDS

Special functions and special mode selections are made through the execution of numerical commands.

Chapter II.8.1 lists the available command numbers and a short description of their effect. The underlined commands are the initial status in which the T-Audio TC is factory set or after an EPROM change.

The numerical commands are three digit numbers. The first digit indicates the number of the functional group:

Group 0xx:	Functions in relation to the synchronizer and editor.
Group 1xx:	Internal generator.
Group 2xx:	Serial remote (TAIRS and TAERS options)
Group 3xx:	General set-up and maintainance.

To execute a numerical command proceed as follows:

Push SHIFT + NUM/EXECUTE to start the numerical procedure.

The display will show three zeros the left of which is blinking.

Key in the desired command number using the "blinking" mode as described on page II.2.5-1.

After completion of the number hit SHIFT + NUM/EXECUTE a second time to execute the command.

In the case of status modification, the display will show the status menu on the line relative to the mode that has been just modified.

SHIFT + ↑ or ↓ can be used to check the other status of the T-Audio TC.

Hit any of the main tape transport keys or SHIFT + DISP TC to return to normal display.

## NUMERICAL COMMANDS (Continued)

COMMAND	FUNCTION	SEE PAGE
100	Stops internal generator Display:    t c _ H O L d _	II.3.0-1
<u>101</u>	Starts internal generator Display:    t c _ r u n _ _	II.3.0-1
102	Protection of internal generator from accidental modification of time or user bits information. Display:    P r o t E C t .	II.3.3-1 & II.3.4-1
<u>103</u>	Authorization of modification. Display:    P r o t . o F F	II.3.3-1 & II.3.4-1
200	Access to the machine identification number. Shows the present number which may be modified by the "blinking" method	II.2.5-1
202	Single frame JOG, forward	II.7.2-5
203	Single frame JOG, backward	II.7.2-6
<u>204</u>	T-Audio TC identifies itself as T-Audio, id.code 1D.	II.7.2-6
205	T-Audio TC identifies itself as VPR-3, id.code 09.	II.7.2-6
<u>300</u>	SPARE-2 no function Display:    S P 2 _ o F F _	II.7.4-1
301	SPARE-2 for faderstart Display:    S P 2 _ P L A Y	II.7.4-1
302	SPARE-2 for RECORD switching. Display:    S P 2 _ r E C _	II.7.4-1
303	Inhibition of off-tape time code filter P-1380 (See Tech. information 09-5)	
<u>304</u>	Automatic switching of off-tape time code filter P-1380	
305	Toggle pulse start of play on SPARE 2 Display:    SP2 _ P _ to	
306	Toggle pulse start of record on SPARE 2 Display:    SP2 _ r - to	

## 9.0 ERROR MESSAGES

As soon as something unacceptable happens to the NAGRA T-audio TC, an ERROR message will appear on the display. The list below explains the meaning of the different messages and indicates a possible solution to the problem.

To return to normal display, push any of the main tape transport keys or SHIFT+DISP TC.

- ERROR 01** Non existent numerical function has been executed. No action will be undertaken.
- ERROR 02** Invalid time code. An unusable time code signal has been fed to the input of the machine for setting. Check frame rates.
- ERROR 03** Invalid date. The T-audio has been brought to the calendar mode for its generator user bits. A set from external or a manual set has been attempted with user bits that do not conform to the date format. The setting has been refused. Modify the user bits to conform to the date format or change the user bits mode to FREE. (See page II.1.3-3).
- ERROR 04** Inhibited entry. In spite of the fact that modification of the internal generator was inhibited, a setting has been attempted. Obviously, this setting has been refused. Execute numerical command 103 to authorize modification.
- ERROR 05** Timecode not found. This message may appear in synchronizer mode or when the locator is used. It means that the time code position to which the T-audio TC was addressed, does not exist on its tape due to a discontinuity. When in synchronizer mode, this message will automatically disappear when the LOCKED state is reached.
- ERROR 06** Non existent function. In some of the operational modes of the T-Audio certain functions are inhibited. For example, synchronizer SLOW and FAST when the machine is set to pilot operation. No action is undertaken.
- ERROR 07** Memory lost. The contents of the continuous memory has been lost. This is probably due to the back-up battery being empty or an EPROM version change.
- ERROR 08** Invalid external reference. May appear when the machine is used in the resolver mode and the reference frame-pulse signal is not present or unstable. Also indicates malfunction in "timeline" synchronization when the T-Audio TC is controlled by an edit-controller through a serial remote port.
- ERROR 09** The processor failed an attempt to synchronize the real time clock during an internal generator setting. Try again if this failure should occur.

## APPENDIX C

# SOFTWARE EVOLUTION

## GENERAL

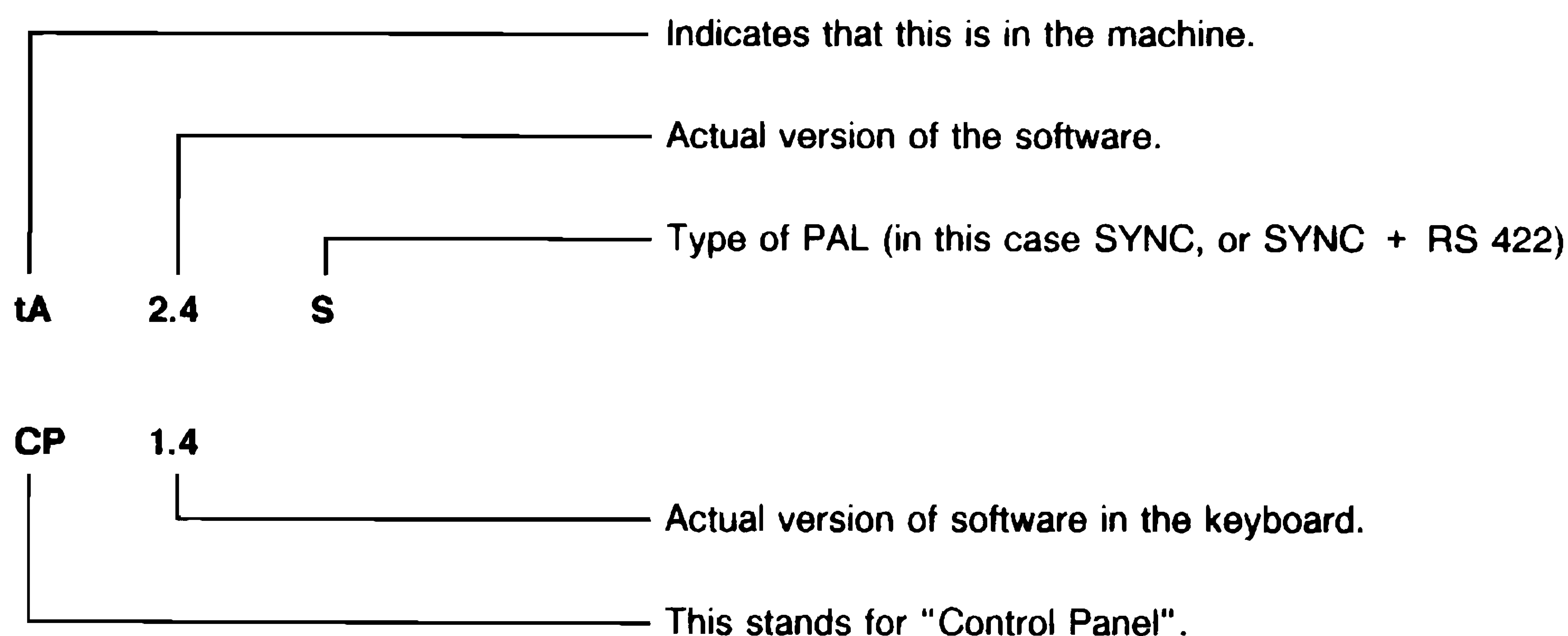
The time code system of the NAGRA T-Audio TC is essentially a software system which performs many functions and controls all parameters of the time code generator.

The system can therefore be regarded as a software based system, making it not only very flexible, but also allowing an update of the software as new features are developed, or as new operations require it. The resulting software updates have been grouped wherever possible in order to minimize the number of eprom changes. However it does mean that all machines throughout the world will not always have the same version of software installed.

This section of the manual is designed to give brief explanation of the differences between the various versions of the software.

It is not necessary to open the machine to see which version of software is fitted as this can be seen in the STATUS DISPLAY MENU. This mode will first show the version of software fitted to the time code circuit of the machine itself, and the following line will show the version of the software installed in the keyboard.

They are displayed as follows :



The first digit of the version indicates the hardware compatibility, thus as this version is 2.4 it cannot be installed in an older T-Audio which presently contains version 1.84 without a hardware modification (fitting of TACA-TC2 keyboard). However the version 1.4 in the keyboard can replace a version 1.3 without any hardware modification.

**NOTE :** It is important that the software in the machine itself remain compatible with the version of software in the keyboard. Thus version 2.4 in the machine requires version 1.4 in the keyboard, and likewise version 2.3 in the machine requires version 1.3 in the keyboard.

This section will give a brief description of the early software versions installed in the NTA.2 TC followed by much fuller descriptions of the software into the NTA.3 TC machines and related accessories.

#### **VERSION 1.0 (JUNE 1985)**

This version was the first version and not released in production machines. It made compensations for the distance between the audio and time code heads, and it initialized the time code channel in the position SAFE and REPRO automatically.

#### **VERSION 1.1 (JUNE 1985)**

This version of software for the NTA.2TC was again for internal factory use only. It contained the basic software for time code generation and reading.

#### **VERSION 1.2 (JULY 1985)**

Addition of the inhibition of the internal automatic editor upon reaching CUE 2. Also PLAY and RECORD functions controllable through the SPARE-2 input on the rear of the machine. It also switched from normal PLAY to VARIABLE PLAY when the SYNC INC mode was activated. This version was used for demonstrations and product evaluation only.

#### **VERSION 1.3 (AUGUST 1985)**

Compatibility with the NTSC frame rate of 29.97 f.p.s. in both DROP frame and NON DROP frame modes. Installation of the SYNC INCREMENTAL mode for synchronizing a time code tape to an external reference with an OFFSET. Installation of the possibility to make an edit pass with the audio channels switched to the SAFE and SYNC positions thus making a REHEARSE EDIT. Finally the introduction of the ERROR 05 message, which means the time code value hunted for does not exist on the tape.

#### **VERSION 1.4 (MAY 1986)**

Improvement of the synchronization when using drop frame time codes. Introduction of the CALENDAR mode to the internal generator for the USER BITS information. Introduction of the ability to set the internal time code and user bits separately by means of a numerical command. Introduction of the ERROR messages 0 through 9 (see ERROR MESSAGES page 52). Introduction of the numerical commands 000-014, 100-103, 200-205 and 300-302 (see numerical commands). Automatic shuttle speed limitation introduced. Display of the STATUS installed. Selection between SYNC and REPRO during edit rehearsal installed. Possibility of re-making an edit using the same CUE values. Automatic muting of the audio outputs when in synchronizer mode but not in the LOCKED state. Possibility to resolve pilot tapes without the time code channel being selected to READY and SYNC. Possibility to resolve time code tapes using the internal generator as the reference. Programmable PRE-ROLL time to locator when searching for CUE 1. Variable integration time when in SYNCHRONIZER SLOW mode. RS-422 compatible with version 1.1 software in the external TAERS interface.

#### **VERSION 1.5 (JULY 1986)**

Operationally identical to version 1.4. Minor correction to synchronization when in drop frame modes. Provisional (non synchronous) jam-sync from tape. Compatible with version 1.2 (AMPEX) in the external TAERS interface.



**VERSION 1.6** (This version is not accurately dated as it was revised several times)

Improvement of synchronization at speeds below nominal speed. Indication of ERROR 09 when the RTC cannot synchronize. Installation of a routine to make a CPU reset after modification of the dil switches on the front edge of time code circuit A 05. Indication of frame pulse reference in place of Pilot Reference.

Installation of the mode 30 frames per second in DROP FRAME. Installation of the reference BI-PHASE allowing use with a TACO-R and a telecine machine. Installation of the command "UNTHREAD" when working with the TAERS.

Improvement of the time line synchronization. Installation of toggle play and toggle record for the SPARE-2 input. Control of the offset with bit accuracy.

Accurate calculation of the delays due to the distance between the heads, depending on tape speed and frame rate.

Installation of the serial communication RS-232.

Improvement of the time code generation in reverse when the tape is moving backwards.

**VERSION 1.7 (SEPTEMBER 1987)**

This version requires the version 1.4 Ampex the TAERS for ACE/MOSAIC editors and the version 1.1 Sony for Sony protocol based editors to be fitted in the TAERS.

**COUNTER :**

Installation of tape timer reset upon reaching the value of 23:59:59:xx (according to frame rate) to 00:00:00:00 instead of 24:00:00:00. The same procedure is applied for negative values below - 23:59:59:xx.

Counting through zero was changed. Until version 1.7 the series of values shown included -0 during part of a frame at the selected speeds of 38 cm/s and 76 cm/s. Now it discards the -0 value at all speeds, therefore the series of values shown are : 3, 2, 1, 0, -1, -2, -3 etc.

**LOCATOR :**

The action of the "PLAY" command pressed during a locator process (GO TO ZERO or LOCATOR) was changed in such a way that it does not interrupt the locator process but is memorized in order to initiate an instant PLAY at the end of the cueing process.

**SPARE 2 REMOTE CONTROL :**

"SKIP" commands no longer inhibit the pre-programmed functions of SPARE-2 (after pressing "STOP" it was necessary to reset the programming of the Spare 2 input).

**SYNCHRONIZER :**

Improvement of synchronizer operation with drop frame. In the previous method a random offset (transparent to the user) of 0, +2, or -2 frames could be added to the actual offset depending on where on tape the synchronizing process was initiated. It now works with de-drop framed time code.

**EDITING :**

Introduction of the possibility to realize "OPEN ENDED EDITS". No longer necessary to pass beyond the CUE 2 before starting a new edit pass (the "End of edit" process is called whenever the T-AUDIO TC detects it is not locked to the master).

## **RS-422 COMMUNICATION :**

Improvement of the "Transport status" handling (Searching, Searched, Cueing, Cued, etc.). Improvement of the "Transport status" handling during a "Video only" insert. This is of particular interest when recording in parallel on a T-Audio and a VTR controlled by an ACE editor. Modification of the communication protocol between the T-Audio and the TAERS. The sending of status from the T-Audio no longer relies on the presence of a valid external reference (square wave or a TC) but is permanent with a period of about 45 ms. A new flag in the "Standard" status signals to the TAERS if a valid reference is present for the "Error led" management. As soon a valid reference is detected again the status sending process is re-synchronized with this reference.

In "SHUTTLE" mode at zero speed the servo loop was reintroduced to compensate for any miscalibrated T-AUDIO so the tape could not deviate too much from the standby position. Re-initialization of the status table when a memory corruption process occurs (due to invalid external high frequency on the external reference signal when the TAERS is powered down and there is no TAPFM installed to filter it). Display of ERROR 07 will occur.

## **MISCELLANEOUS :**

Suppression of the possibility to display memory locations like CUE 1, CUE 2, REPRO, etc. in a "DISPLAY BITS" resolution. Hence only DELTA and OFFSET registers may be displayed in this high resolution mode.



## **VERSION 1.81 (JANUARY 1988)**

This version requires the version 1.5 Ampex for ACE/MOSAIC editors and the version 1.2 Sony for Sony protocol based editors to be fitted in the TAERS.

### **COUNTER :**

Tape timer counting as a time code. This means that negative values have been suppressed and that the displayed value will be 23:59:59:2x instead of -00:00:00:01 when the counter goes below zero. Its resolution has been increased as the software now takes each counter pulse into account (150 pulses/s at 19 cm/s). The tape timer will count correctly at the 24 frame/s rate and at drop frame rates.

On power up, the time code board will set the time code matrix to REPRO or OFF depending of the last status before power down (this means it will retain the time code mode or tape timer mode of operation after a power down or a reset).

### **LOCATOR :**

The tape timer GO TO ZERO function has been merged with the time code LOCATOR function. Thus the GO TO ZERO process will from now on be done in the "Listen tc" mode where tape is in contact with the time code head instead of in "Rewind" or "Fast forward" mode. This allows the user to perform a tape timer based LOCATOR function to any desired tape timer target value present on the display as he hits "LOCATOR" when the time code matrix is in OFF.

### **TIME CODE DISPLAY :**

Both playback and external time code are now direction interpolated (anticipation of one frame depending on the forward or backward direction of the time code). Altogether with the benefits obtained from the improved resolution of time code update by the tape timer (narrower fork of 1.5 frames instead of 2 frames before update) the consequence is a much more precise indication of the parked position of the T-Audio (precise to  $\pm 0.5$  frame instead of  $\pm 1.5$  frame).

### **SYNCHRONIZER :**

Installation of synchronization using the tape timer, which includes the possibility of editing (rehearse, record edit) based on roller information. Creation of a new numerical code 007 for "color frame" synchronization. When this mode is activated any offset computed between playback and external time code upon hitting on "Sync incremental" will have its value rounded to the closest multiple of 4 frames in PAL and 2 frames in NTSC. This mode is indicated on the status menu display by "rEF. CF". This mode is now stored in permanent memory, consequently the machine will stay in the "rEF. CF" mode after a power down or a reset. Modification of the incremental synchronizer mode so as to never store an offset with non zero bits if the previous offset was not already trimmed to hold a non zero bits value. The offset is thus rounded to the closest frame at each discontinuity or upon pressing on the SYNC INC function.

### **EDITING :**

Correction of the time code assembly operation while time code is being recorded during editing. The setting (by Start tc) was carried out incorrectly up to 7 frames 50 bits of offset at the entry point. Now the assembly is made with a precision of 1-3 bits. While editing with the tape timer, an offset (rounded to the closest frame) is added to correct for the distance between the replay head (standard reference for the tape counter) and the record head in insert or assemble mode as well as in rehearse with the "simulation in SYNC" mode on.

The editing process based on CUE 1 and CUE 2 has been modified in order to enable a non synchronous operation. It is no longer necessary to be locked to a master in order to perform a simulation or a real edit.

## RS-422 COMMUNICATION :

Suppression of all possibilities via RS-422 to return the T-Audio to the position "REPRO TC" or "SYNC TC" if it is selected in "OFF TC", except for the command "Time source select".

Suppression of the verification of the timeline buffer temporal values in the event of a "Load timeline" command since the Mosaic editor can start the time line from 23:59:5x:xx when the edit "In point" is just before or after midnight. Values of the data parameter accompanying the "Synchronize select" command have been set back to the original table:

<u>DATA VALUE</u>	<u>REFERENCE</u>
00	External time code
01	Bi-phase
02	Frame pulse (extracted from a video signal)
03	External time code (color framed)

The tape speed override transfer function has been improved to compensate in a more accurate way the non linearity of the capstan speed at various variable speed commands. The actual capstan speed corresponds now to incoming speed commands between -12.8 % and +12.7 % within +/-0.7 %.

## PILOT :

Possibility to check the pilot resolver operation by means of the led "Tc locked" on the keyboard. The precision of the measurement makes it possible to measure differences in speed between the pilot and the reference signal in the order of 0.3 per thousand while filtering out a transition jitter of the pilot or reference signal in the order of +/-100 µ.

## INTERNAL GENERATOR :

For compatibility reasons with the TACA-TC2 keyboard, it is now possible to put the machine in internal generator mode without putting the time code channel in SYNC + READY. This is done by pressing SHIFT + SYNC TC.

## MISCELLANEOUS :

Introduction of two further numerical codes. "Auto park" active or not active. Introduction of two new numerical codes allowing the selection of the operational mode of the time code outputs of the T-Audio TC.

A new feature is foreseen to mute the time code output whenever the machine is not at nominal speed. This mode is designed to improve the interfacing of the T-Audio with external synchronizers such as the Q-Lock or the Adams-Smith which can be affected by a constant bit rate time code as fed out from the T-Audio in shuttle or slow motion modes.

Numerical command 206 = Time code output normal (default setting)  
Numerical command 207 = Time code output muted.

Introduction of a new numerical code giving a new function to the spare 2 input. This code allows the machine to be switched between the STOP and LOAD function via a switch connected to the spare 2 input when the keyboard is being used as a remote control.

Numerical command 303 = Spare 2 : STOP/LOAD



## **VERSION 1.83 / 2.3 (AUGUST 1988)**

Version 1.83 corresponds to machines not fitted with the TACA-TC2 keyboard and 2.3 corresponds to the machines which are fitted with the TACA-TC2.

Version 1.83 requires version 1.6 Ampex for ACE/Mosaic editors and version 1.2 Sony for Sony protocol based editors. The new 2.3 Version replaces the previous 2.2 Version for T-Audio time code machines with the new TACA-TC2 keyboard. Version 2.3 requires Version 1.3 to be installed in the TACA-TC2 keyboard.

### **NEW FUNCTIONS :**

Two new numerical commands to enable or disable a new feature which automatically switches the audio output from "SYNC" to "INPUT" and back to "SYNC" depending on the commands sent to the T-Audio : Stop, Record, Rewind, Fast forward, Load, Park switch audio channels in "SYNC" mode to "INPUT". Play, Free spool, Cut, Skip, Shuttle, Jog, Go to leader, Go to display, Go to zero switch audio channels back from "INPUT" to "SYNC".

Numerical command 016 = Channel switching enabled

Numerical command 017 = Channel switching disabled (default setting)

Two other new numerical codes permit to enable or disable an automatic reset of the offset register at each power up of the T-Audio.

Numerical command 018 = Offset reset at power on

Numerical command 019 = No offset reset at power on (default setting)

These four new numerical codes do not (for the time being) display a status line.

### **EDITING :**

"NON STANDARD SPEED" EDITS with editors using the Ampex protocol (Ampex ACE, AEG-TFK Mosaic) may now be performed. Depending on the variable speed requested by the editor, one of the three following modes is selected :

Speed range from 93.5 % to 106.5 %

True synchronization with a continually skewing offset.

Speed range from 87.5 to 93.5 % and from 106.5 to 112.5.

The T-Audio sets itself in variable speed play roughly at the requested speed (guaranteed speed accuracy  $\pm 0.8\%$ ).

There may also be a slight delay in the entry point due to the start up time of the T-Audio (approx.4 frames at 38 cm/s).

Speed range from -200 % to +200 % and out of the previously described range at 19 cm/s (limited to -112.5% to +112.5 % at 38 cm/s): the T-Audio sets itself in "slow motion" play roughly at the requested speed (speed accuracy is better than in variable speed play but wow and flutter is much greater).

Another improvement with Ampex protocol based editors consists in a better handling of audio to video split edits (previous software showed erroneous behavior with "Audio First" edits). However it should be remembered that the T-Audio is not designed to handle correctly audio 1 to audio 2 split edits. Separate audio 1 and audio 2 entry points may generate audible clicks at the position on the tape where the second channel starts to record.

## RS-422 COMMUNICATION :

Improvement of channel 1 and channel 2 "record" status whenever one channel is switched from READY to SAFE or from SAFE to READY during a record via RS-422.

## INTERNAL GENERATOR :

The internal generator "HOLD" mode has been modified so that the generator starts running as soon as the time code channel starts recording. This allows a presetting of the internal generator value which remains at the preset value until recording is initiated. At the end of the recording the internal generator returns to the "HOLD" mode retaining the last recorded time code value.

The setting of the internal generator by an external time code was one frame too early in version 1.81 / 2.2.

The new eprom version corrects this one frame error and improves the setting precision with the new keyboard when done with the tc matrix in INPUT + SAFE.

## MISCELLANEOUS :

Correction of the control of the "Pot. enable" signal which was left active in some cases after a shuttle mode. This could generate conflicts with the TAERP parallel interface and with the pilot resolver.

Improvement of the timing of the audio channels switching from SYNC to INPUT at the start of a recording. This switching was performed too early (at the record command reception). It is now performed simultaneously with the "record head enable" signal 426 ms later at 19 cm/s). Time code was not recorded in version 2.2 when the tc matrix was switched directly from "OFF" to "INT.GEN". Switching first to "SYNC" or "REPRO" before "INT.GEN" was mandatory before going to record.

At the same time there is no modification of the reference selection when switching from time code to pilot mode and back. The time code output mute mode (when selected by numerical code 207) will now only switch off the time code output if the time code has originated from the tape. No mute is made while the time code circuit outputs the internal generator or external tc.

The checksum of these versions are as follows :

V2.3	eprom is D51E.
V1.83 SYRS	eprom is CFCC.
V1.83 SYNC	eprom is C300.
V1.83 RS	eprom is C291.
V1.83 NOSY	eprom is 0D69.

## **VERSION 1.84 / 2.4 (APRIL 1989)**

Version 1.84 replaces the previous 1.83 Version for T-Audio time code machines which do not have the TACA-TC2 keyboard.

Version 1.84 requires version 1.6 Ampex for ACE/Mosaic editors and version 1.2 Sony for Sony protocol based editors to be fitted into the TAERS.

Version 2.4 replaces the Version 2.3 for T-Audio time code machines fitted with the TACA-TC2 keyboard.

Version 2.4 requires Version 1.4 to be installed in the TACA-TC2 keyboard.

### **NEW FUNCTIONS :**

A new tape analysis system has been implemented by means of a numerical code. This function starts the loaded tape in playback and scrolls through the various signals and frame rates until it discovers the right selection, stopping the tape automatically at that point and displaying the selected mode. If no correct sync information is found on the tape or if the playback speed is incorrect it stops, and displays ERROR 13. Each possibility is analyzed during 5.5 seconds, which makes a maximum test time of 44 seconds (8 x 5.5 secs) so be sure there is enough tape on the machine to complete the entire test. The system scrolls through all possibilities in the following order :

tc 24, tc 25, tc df 29, tc ff 30, fm pi 50, fm pi 60, pilot 50, pilot 60.

**Note :** If the tape analysis system discovers some type of time code on tape it will not attempt to scroll through all the pilot configurations but will limit itself to the four time code varieties.

**Note :** The last two positions can only be analyzed if the FM / Neopilot dil switch has been put to OFF (Neopilot) before starting the test procedure.

**Note :** There is no way for the system of deciding between a tape recorded at 29.97 frames/sec and 30 frames/sec, it is only admitted that if the drop frame flag is set, there are good chances that the original frame rate was 29.97 and if it is not that it probably was 30.

**Note :** The leds showing which mode is selected on the TACO-D2 may not correspond to the mode in which the tape has been found.

As the time code board of the T-Audio has no access to change the playback speed itself, the user should change manually the T-Audio speed (to check all possibilities) as long as the results of the analysis are not positive.

This manual speed scrolling is only necessary with the old keyboard, the new keyboard automatically takes care of changing the speed of the T-Audio as long as the result is negative (ERROR 13) and this up to 4 times (corresponding to positions A, B, C and D).

If the result of the analysis is positive, it indicates which type of tape was loaded and will stay in the displayed mode (even if it is different from the mode selected by the dil switches or the TACO-DRS) as long as the position of these switches is not modified or a power down is not made.

**Note :** However if the result of the test shows an FM PILOT tape, no switch modification will be taken into account until a power down or a reset of the tc board is made.

Two other numerical codes permit to enable or disable a new feature which automatically mutes the audio output during the "GO TO ZERO" and "LOCATE" functions. However in order to mute effectively the audio outputs during the "SHUTTLE" or "SPOOL" part of the locate process, whether a hardware modification is required on the logic board or not (by implementing a priority of



the "Line out off" signal over the "Listen enable" signal) numerical code 022 must also be activated.

Numerical command 020 = Audio mute during locate enabled  
Numerical command 021 = Audio mute during locate disabled (default setting)

Two other numerical commands allow enabling or disabling of the tape lifter during "LOCATE" functions. The main purpose of disabling head to tape contact during the "shuttle" part of the locate process is to reduce wear and tape oxide deposits on machines heavily employed in automatic processing situations where the time code on tape is continuous and where generally interpolation by the tape timer is sufficiently accurate to guarantee correct functioning of the "LOCATE" process.

Numerical command 022 = Tape lifter during locate enabled (no head to tape contact during shuttle time)  
Numerical command 023 = Tape lifter during locate disabled (default setting)

Two other numerical codes permit to enable or disable a new feature which may specially be useful for customers using the Sony-2 mode where the T-Audio synchronizes itself to the time code of a master VTR which may have discontinuities in time code. Or if the tape loaded on the T-Audio has itself discontinuities. If this discontinuity handling mode is enabled the T-Audio switches from "SYNC" to "SYNC INC" mode as soon as the transport is locked and inversely switches back to "SYNC" when the transport is no longer synchronous. On returning to "SYNC" the software begins synchronization to avoid cumulative errors during each rehearse of edit. This new mode also correctly handles a new type of discontinuity (of the type : 10, 11, 12, 13, 13, 13, 14, 15 etc.) which previously did not ask for a new offset value to be computed at the discontinuous point.

024 = Discontinuity handling enabled  
025 = Discontinuity handling disabled (default setting)

These ten new numerical commands as well as the four numerical commands introduced in eeprom version 1.83/2.3 display the following status lines :

Numerical command 016 : "ChAn on "	(Channel switching enabled)
Numerical command 017 : "ChAn oFF"	(Channel switching disabled)
Numerical command 018 : "rESo on "	(Offset reset at power on)
Numerical command 019 : "rESo oFF"	(No offset reset at power on)
Numerical command 020 : "LoCM on "	(Audio mute while locate enabled)
Numerical command 021 : "LoCM oFF"	(Audio mute during locate disabled)
Numerical command 022 : "LIft on	(Tape lifter during locate enabled)
Numerical command 023 : "LIft oFF"	(Tape lifter during locate disabled)

code 024 : "dISC on" (Discontinuity handling enabled)  
code 025 : "dISC oFF" (Discontinuity handling disabled)

Another new numerical command has been included since eeprom version 1.81/2.1 but has not been documented yet. This numerical command permits alteration of the frequency of the internal generator at 24 or 25 frames/sec. When the T-Audio is in the 25 frames/sec mode, this special command slows the generator from its nominal speed of 2000 bits/sec down to 1920 bits/sec (which corresponds to the 24 frames/sec time base). If the T-Audio is in the 24 frames/sec mode, this code will speed up the time base in the reverse manner. This conversion mode may be useful if for a reason or another a tape must be accelerated or slowed down by 4% (at the ratio of 25/24 or 24/25). This may be done in the following manner :

Resolve the original tape on a IV-S or a T-Audio (be it a pilot or a tc tape) while making a copy of the audio on a T-Audio with this code activated, simultaneously recording its internal generator. The new tape will have a time code recorded in such a way that any subsequent synchronized playback of it will be done at the converted speed.

In order to have a nominal speed playback, it may be advantageous to alter the speed during recording in the opposite way by setting the variable speed to + or - 4% and activating the vari-speed key before going to record. The recording will go on at the preset var speed.

Note : This special code will only be cancelled after a reset of the tc board or a power down.

Numerical command 104 = 25/24 frames/sec up-or down conversion

#### SYNCHRONIZER :

The procedure (introduced in eprom version 1.81/2.1) which rounded up or down the new computed offset to the closest frame at each discontinuity in the SYNC INC mode was incorrectly made. This has been corrected. The pilot resolver analysis fork which checked the synchronization in pilot mode (which lights the "LOCKED" led) has been augmented by two to make it less critical. From now on, it will check that the speed of the pilot signal is not more than 0.6 per thousand apart from the reference.

#### EDITING :

Edit timing at the exit point has been advanced by one frame both during preview and insert. Up to now the software included the record exit frame. Now the edit timing is made in such a way as not to record or preview the last frame.

#### RS-422 COMMUNICATION :

To manage the additional status lines described above, some modifications have been made to the RS-422 protocol between the T-Audio TC and the TACA-TC2 keyboard which make it mandatory to use 2.4 with 1.4 in the new keyboard.

#### MISCELLANEOUS :

Variable speed record has been made available (since eprom version 1.81 actually). When entering the record mode, the software checks if the T-Audio TC was previously in the var speed mode playback and at which percentage. It thereafter keeps that preselected speed until the end of the recording (no speed modification during recording is possible).

After reverting from pilot mode to time code mode, previous eproms did not restore the time code channel matrix to the REPRO position. This has been corrected.

Park time (when in auto park mode) has been increased from one minute to three minutes.

When the time code output mode is activated (Numerical command 207) the internal generator could on some occasions also be muted. This has been corrected.

The checksum of these versions is as follows :

V 2.4	eprom is DE7C
V 1.84 SYRS	eprom is EOF2
V 1.84 SYNC	eprom is DF59
V 1.84 RS	eprom is E188
V 1.84 NOSY	eprom is ODBD