NAGRA-D REGISTRATION FORM

Please carefully fill in this page (IN CAPITAL LETTERS) and return it to us upon receipt of your NAGRA-D. We will then be able to send you upgrade pages for your manual, as well as inform you of future developments in software.

Please return this page to:

Kudelski SA
Route de Genève, 22
1033 CHESEAUX

SWITZERLAND

ATTN: Support Technique

NAGRA-D Serial Number : _____

Purchase date   : _____

Your Name / dept.   : _____

Company name   : _____

Street Name / n°   : _____

Town / City   : _____

Zip / Postal code   : _____

Country   : _____

NAGRA DIGITAL

GUARANTEE

NAGRA/KUDELSKI certifies that this instrument was thoroughly inspected and tested prior to leaving our factory and is in accordance with the data given in the accompanying test sheet.

We guarantee the products of our own manufacture against any defect arising from faulty manufacture for a period of one year from the date of delivery.

This guarantee covers the repair of confirmed defects or, if necessary, the replacement of the faulty parts, excluding all other indemnities.

All freight costs, as well as customs duty and other possible charges, are at the customer's expense.

Our guarantee remains valid in the event of emergency repairs or modification being made by the user. However we reserve the right to invoice the customer for any damage caused by an unqualified person or a false manoeuver by the operator.

We decline any responsibility for any and all damages resulting, directly or indirectly, from the use of our products.

Other products sold by KUDELSKI S.A. are covered by the guarantee clauses of their respective manufacturers.

We decline any responsibility for damages resulting from the use of these products.

We reserve the right to modify the product, and / or the specifications without notice.

CHAPTER 1

INTRODUCTION

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INTRODUCTION

USING THIS MANUAL

This instruction manual is designed to enable the operator to understand, and use the NAGRA-D. The basic principles of audio recording or digital technology are not covered, except where the concept within the NAGRA-D is different from that normally applied. The manual is broken down into chapters covering different aspects of the machine. At the end of the manual there is a comprehensive index, which should guide the operator to the correct page quickly. The pages are numbered from 1 to N for each chapter. If in the future there is a page to be added in the middle of a chapter, then the new page to be added will have a page number followed by a decimal point and then 1, 2 or 3 etc. For example if a page is to be added between pages 5 and 6 of a particular chapter then the new page will be numbered 5.1

GENERAL DESCRIPTION

The concept of the NAGRA-D was to build a truly professional machine based on a format that is reliable and lends itself well to archiving. The arguments regarding the format, choice of tape etc. are not covered here.

The NAGRA-D is a four channel digital audio recorder having 24 bits per sample recording on 6.35mm metal oxide tape. It accommodates the sampling frequencies of 32 kHz, 44.1 kHz and 48 kHz rendering it suitable for all types of professional recording applications. The NAGRA-D is transparent to the AES bus giving connection possibilities to a wide range of external digital equipment. The format of the NAGRA-D records 4.608×10^6 bits per second, meaning that on a 5" reel of tape contains 16.03×10^9 bits (16 giga bits) of data. The combination of selected tape speed and number of channels to be recorded gives tape durations to satisfy almost all applications.

Apart from the two AES digital inputs, four analog inputs are available for either line or microphone input sources. When in microphone operation each of the four inputs is switchable between "T" powering, +12V phantom and +48V phantom. The signal levels are adjusted using the input sensitivity potentiometers, and the levels are indicated on the four microprocessor controlled meters.

The four head scanner (2 for recording and 2 for playback) allows read after write (off tape monitoring) which can be heard through the two, level adjustable, headphone outputs.
The three longitudinal tracks (Control, CUE and Time Code) give flexibility of operation and additional features never before seen in a professional recorder.

Microprocessor control of the entire machine gives almost limitless possibilities, not only as far as the digital recording is concerned, but also for external control, fault diagnosis, tape directory management etc., from a PC equipped with the NADCOM software.

This is a brief outline of the machine, all the points mentioned here will be covered in more detail later.

NOTE: The NAGRA-D has few user selections / switches inside (except the type of CUE microphone to be used - factory selection is for the ND-CM and one bank of DIL switches on the direct amplifier, the use of which is covered under the relavent chapter). All other mode selections etc. are made via an external PC or by the MENU mode.

IMPORTANT NOTES

ELECTROSTATIC DISCHARGE

The NAGRA-D's electronic circuits are all SMD devices using CMOS and MECL technology, which renders them very susceptible to electrostatic discharge. These circuits are fully protected while installed in the machine, however if any of the circuits are to be disconnected and removed from the machine then the operator must at all times be connected to ground via a wrist bracelet and the circuits must only be placed on a conductive mat also connected to ground. If circuits are to be transported for any reason then they must be kept in anti-static plastc bags at all times. All the circuits are printed with the international sign indicating the danger.
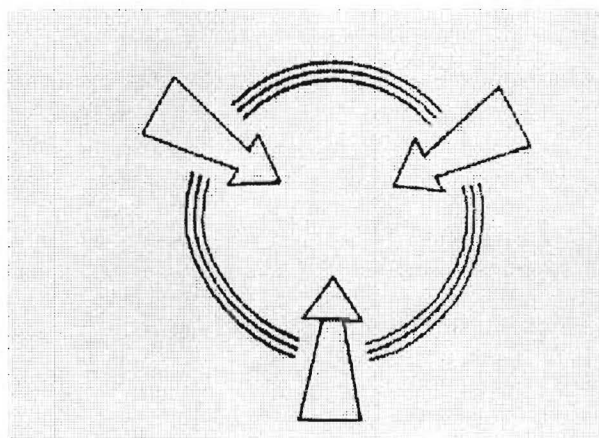
TAPE CARE / HANDLING

Although scissor editing is technically possible on the NAGRA-D, it is not recommended to touch the tape unless absolutely necessary. Cotton gloves are recommended for this, in order to prevent moisture (finger prints) from the skin affecting the tape or clogging of the heads. When certain tapes are rewound, the air trapped between the windings during rewinding can cause the tape to wind unevenly on the reel, meaning that the edges of the tape stand proud. If the plastic reel is then handled, there is a risk of physically damaging the edges of the

tape. On the lower edge of the tape in the format of the NAGRA-D are the time code and Control track (see FORMAT) which will cause problems for playing back the tape if the edges of the tape are damaged. Slower rewinding can be selected in the MENU mode, or there is a special guide available to prevent this problem for those people who have presistent problems with a certain tape type.

OUTPUT CONNECTIONS TO A MIXER

The NAGRA-D does not have transformers on its analog audio outputs. This means that if the outputs are to be connected to the inputs of a mixing console so that the four channels can be mixed down to two, then be sure that the inputs to the mixer are set to the LINE position before the connection to the NAGRA-D is made. If they are set to the Phantom +48 position then the output OP-Amps of the NAGRA-D may be damaged.

HEAD CLEANING

The NAGRA-D, like any tape recorder requires that the user cleans the heads and other parts of the tape transport periodically. The frequency of this depends on many factors, such as the operating environment, the tape type, mechanical alignment of the machine's transport etc. as with any recorder. It is therefore difficult to give a specific time frame. As a guide, we suggest that the heads are cleaned once per day if the machine is being heavily used. However if the cloth does not appear to be dirty after cleaning, and no apparant problems have occurred then more time can be left before cleaning. If however the scanner etc has been touched, and there are finger marks on it then the heads need to be cleaned immediately.

To clean the heads etc, firstly remove the tape and carefully clean the entry and exit guides of the scanner along with the longitudinal erase head and the longitudinal cue / control / TC head, using a soft cloth which has been dipped in ISOPROPYL ALCOHOL. Once this has been done the rotary heads in the scanner can be cleaned. There are two different methods for doing this. The first is to hold the Alcohol soaked cloth against the surface of the scanner using your thumb, then gently rotating the scanner with the other hand while keeping the cloth still. The other is to lace a tape, put the machine in STOP, press RDY and then gently press the alcohol soaked cloth against the rotating scanner.

NEVER MOVE VERTICALLY UP AND DOWN ON THE SCANNER AS THIS CAN BREAK THE HEADS. ALWAYS CLEAN THE SCANNER IN A HORIZONTAL MANNER.

NEVER USE Q-TIPS OR OTHER COTTON BUDS AS THEY WILL LEAVE HAIRS ON THE HEADS OF THE SCANNER.
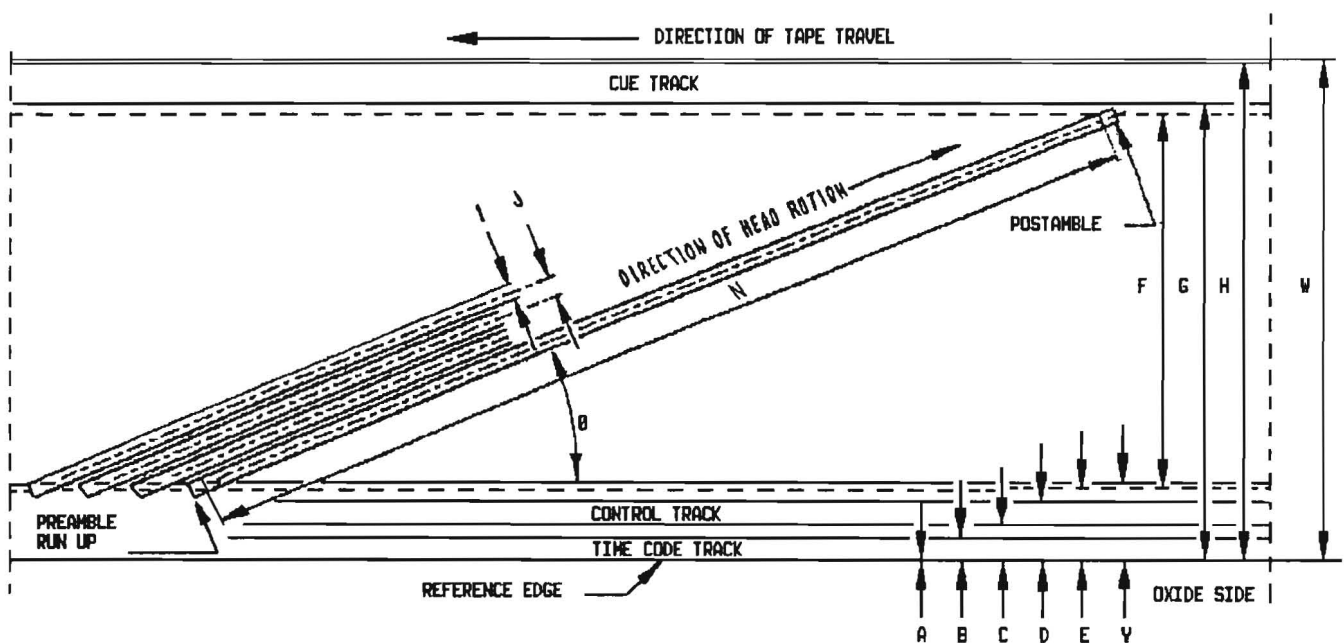
THE "FOOTPRINT"

Diagram of the track layout on the tape.

The NAGRA-D records information on the tape not only using the rotary heads in the scanner but also using longitudinal heads. The "footprint" above shows the positioning of these various tracks on the tape. (diagram is not to scale).

A.	Time code track lower edge	Reference edge
B.	Time code track upper edge	0.300
C.	Control track lower edge	0.500
D.	Control track upper edge	0.800
E.	Digital data area lower edge (ref.point)	0.900
F.	Digital data area width	4.650
G.	Cue track lower edge	5.700
H.	Cue track upper edge	6.200
I.	Helical track width	0.07
J.	Helical track pitch	$80.70 \ \mu m$
N.	Helical track data length	44.20
ϕ.	Track angle	5.835°
W.	Overall tape width	6.250 ($\pm$ 0.05)
Y.	Beginning of data	0.971

All measurements are in mm (unless otherwise specified) taken from the reference edge of the tape.

LONGITUDINAL TRACKS.

As shown in the diagram above there are three longitudinal tracks which are:

TIME CODE TRACK

This is a longitudinal SMPTE/EBU 80 bits time code track recorded using Manchester Bi-phase which allows the reading of time code at very high speeds. The internal time code system of the NAGRA-D includes a time code generator corresponding to all the presently used formats (including drop frame). Time code can be recorded from the internal generator or an external source. Both the time and user information can be set from the keyboard or a PC. Although time code "Pre-striping" is permitted, recording of time code after the event (Post Striping) is not allowed as doing this will disturb the control track of the machine and will make the tape unreadable.

CONTROL TRACK

This track is similar to the control track of a video recorder. Data is recorded along the tape which serves as "markers" indicating the start point of each helical scan. The purpose of these "markers" is to enable the servo system to synchronize the position of the heads of the scanner with respect to the position of the helical scan on the tape, ensuring that the heads track the helical scans accurately and do not read between the scans.

CUE TRACK

The CUE track of the NAGRA-D has two main functions:

1.   It can record a mix of the 4 digital channels, from either the analog or digital inputs, allowing rapid audible searching on the tape of a particular point in the recording. A cue microphone can also be recorded at the same time if desired. This is the normal mode and will operate as described whenever the machine is put into recording mode and the cue channel "lock out" switch is in the READY position, and also when no cue microphone is connected to the external input. The output of the CUE track can only be monitored on the headphone outputs, if searching is being done at speeds other than nominal then the analog and digital outputs of the NAGRA-D are muted. The Cue track output is automatically switched to the headphone outputs whenever the tape is not at nominal speed.

2.   It can be used to record Cue information by means of a commentary microphone (ND-CM), connected to the EXTENSION socket on the left-hand side of the machine.

Synoptic diagram of the cue track
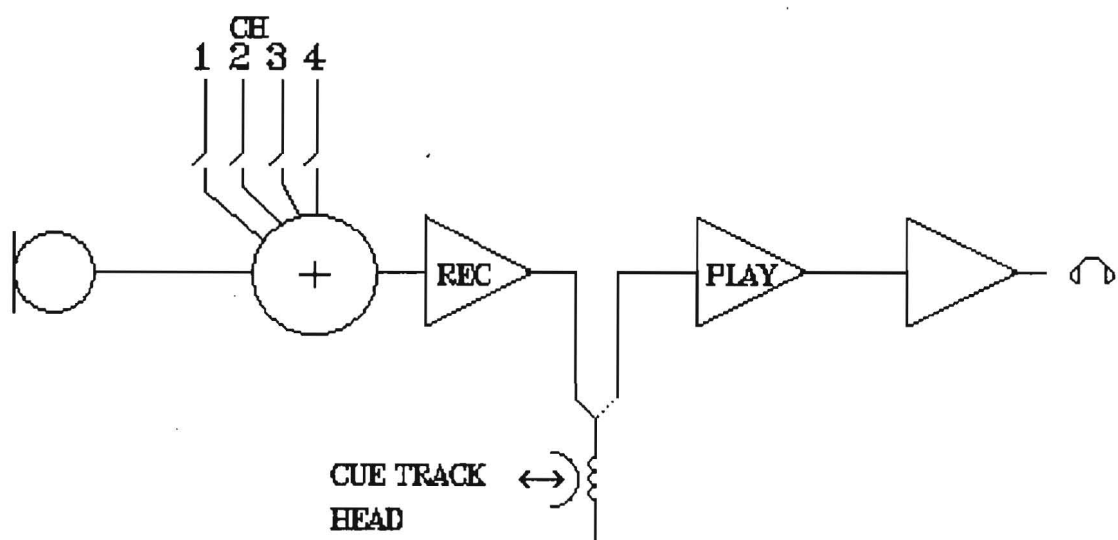
HELICAL TRACKS

Each helical track on the tape contains the information coming from a pair of inputs (either 1 + 2 or 3 + 4). These tracks are made up of 192 sectors of digital information sent from the ECC.
This shuffling means that it is perfectly possible to record channels 1 + 2 initially and then at a later date record channels 3 + 4 (or vice-versa) providing that the machine is in the high speed four channel mode. However it is not possible to record channels 1 + 3 and later 2 + 4 as this requires read before write.

The helical tracks of the NAGRA-D are recorded by a rotating scanner equipped with VHS heads, which rotates at 62.5 revolutions per second (3'750 r.p.m. at a sampling frequency of 48 kHz.) and the track width of each scan is of 70μm.

TAPE SPEED

Two different tape speeds are available, either 49.6 mm/s (approx 2 i.p.s) for two channel operation, giving approximately 2 hrs of continuous recording with a 13 cm (5") reel, or 99.2 mm/s (approx. 4 i.p.s) for 4 channel operation giving approximately 1 hr of recording using a 13 cm (5") reel. Tape speed selection is made in the MENU mode, and the default setting is the high speed four channel mode. The NAGRA-D will equally well operate with 18 cm (7") reels respectively doubling these recording times. The reel motors need to be rotated and a special cover (ND-SET) needs to be fitted to the machine in order to use 7" reels.

PUTTING THE MACHINE INTO THE 7" REEL POSITION

The NAGRA-D is delivered in the 5" reel configuration, but it can easily be moved to the 7" position.

The machine must be switched ON (without tape) in order to ensure that the parking brakes are released. Loosen the two screws on the front of the main control panel so that the deck plate of the machine can be lifted. Open the plexi-glass cover of the transport and remove the tape and the empty reel. Insert a 1.5mm Allen Key (for machines with 1000325 or lower) (a 2mm Allen key for machines with serial number higher than 1000325) into each of the three holes, in turn, around the reel motor to be moved. Loosen each screw in turn by MAXIMUM HALF A REVOLUTION then remove the key. Lift the deck plate of the machine, and gently rotate the motor to the 7" position by turnung the grey plastic cover of the reel motor. Once the motor is fully turned, and the marks on the deck plate are aligned with the 7" position indications then re-insert the allen key and re-tighten the three screws.

NOTE: If the screws are loosened more than half a turn it is possible that they will fall inside the machine. Secondly if the key is not removed when rotating the motor the brakes will be damaged.

It should also be noted that when in the 7" reel position, the slowing down of the reel motors during fast winding, as it reaches the end of the tape does not operate. This is because the diameter of the central hub of a 7" reel is not the same as that of a 5" reel.

POWERING THE NAGRA-D

The NAGRA-D is fitted with and internal battery pack, of the BETACAM ™ style. This internal battery pack must be fitted to the machine at all times, as without the internal battery the machine will not operate even if connected to the external charger unit, or supply. A fully charged battery pack under normal circumstances will give approximately 2 hrs of continuous 4 channel recording. The NAGRA-D runs permanently off this internal battery pack, which acts as a buffer, even when connected to the charging unit.

The NAGRA-D's charger unit supplies a 40 mA trickle charge permanently to avoid reverse-polarization of the cells in the battery pack. When the battery needs charging the charger is instructed to supply the 400 mA charge current. The internal battery will only be charged when the machine is in LOAD or PARK position. The NAGRA-D communicates with this charger and instructs it on the amount of current to supply, at any particular time. The status of the internal battery, in terms of residue etc, can be seen at any time on the LCD display in the MENU mode (see MENU's in chapter 3). The internal battery pack can be removed from the machine and charged on a normal BETACAM ™ charger if desired. However if the internal battery is removed from the machine, then the memory and settings will be lost. A large capacitor will keep the internal settings for a couple of minutes. The machine will use default modes when powered up again. If settings have been saved in a "Template" (see menus) then these settings will not be lost and can be restored once a new battery is put in the machine.

NOTE :   When the internal battery is replaced then the battery management system assumes that the new battery installed is already full and will indicate 100 % in the battery reserve menu. If however the operator knows that the new battery is only charged to 25, 50, or 75 % this can be stored in the memory of the machine in the menu mode and the machine will take this preset value into account from the start.

WARNING: The battery pack in the NAGRA-D is of the Betacam ™ type fitted with a 2mm DC two pole connector (positive pole on the external connector) WITHOUT any form of internal electronic protection or control. Battery packs fitted with this type of internal surveillance are fitted with a 3 pole connector that is physically too large to be connected inside the NAGRA-D. The internal circuits of such batteries also cause a slight drop in voltage on the output and this causes problems within the NAGRA-D.

It is recommended to run the internal battery completely flat from time to time to avoid any memory effect accumulating in the Ni Cad.

NOTE: As the internal battery is always inside the machine the life of the battery is shortened as it is charged at a temperature of about +40 °C. Meaning that if a full 2 hrs of recording time is needed on the internal battery then the battery must be replaced with one that has been externally charged. The effective life of the internal battery is reduced to about 1 h 20 min if left in the machine.

EXTERNAL DC POWERING

USING THE ND-AP OPTION

Apart from the use of the ND-EPC external DC/DC converter, direct powering of the NAGRA-D from an external battery is possible, assuming that the ND-AP auto power option is installed in the machine.

As mentioned above, the machine must always have an internal battery fitted. However if the machine is to be powered all the time externally, then it is possible to install a very small (1 Ah) internal battery which makes the machine lighter to carry. If the ND-AP option is installed in the machine then external batteries having a voltage between 11 and 14V (MAX) can be connected to the cable supplied with the option. The ND-AP option will automatically select the external if it has a voltage greater than 11V. The indication of the battery reserve in the menu display will increase while the external battery is being used but infact this is meaningless as the actual state of the internal battery is not changing. In this mode of operation, the external battery will not charge the internal battery, meaning that the internal battery of the machine will need to be periodically charged using an external charger.

IMPORTANT: Please note that the external bettery must be connected to the GROUND and the CONTROL connections of the external power connector NOT THE POSITIVE terminal. If is not connected in this manner then the internal fuse of the NAGRA-D will blow.

THE ND-EPC OPTION

The NAGRA-D may be powered with the external DC to DC converter ND-EPC (10505). This external accessory is fitted with a 4 pole XLR (male) socket, to which an external DC supply from 11 to 30 volts can be applied in either polarity.

Dimensions   150mm x 120mm x 55mm (L x W x H).
Weight   1.1 kg.
Supply voltage   11 - 30 V dc.

NOTE: *The NAGRA-D must be switched ON for this accessory to work. The internal battery of the machine will not charge if the machine is turned OFF.*

CONNECTION:

The three pole LEMO type connector connects to the "POWER" connector on the right-hand rear side of the NAGRA-D (where the normal mains charger ND-CCC is usually connected). The 4 pole XLR connector allows the ND-EPC to be connected to the external source which must be an external battery between 12 and 24 V, or an external DC supply with a voltage between 11V and 30V DC. It is recommended that connection of the LEMO connector to the NAGRA-D be made before the external supply / battery is connected to the 4 pole XLR connector.

OPERATION:

The external converter, once connected to the DC supply, supplies the internal battery of the NAGRA-D with the power necessary to run the NAGRA-D as well as the charging current required to charge the internal battery. The output current of the ND-EPC is controlled by the CPU inside the NAGRA-D, which also manages the charge current of the internal battery, according to its state of charge.
Throughout the time when the internal battery is at less than 100% charge, a charging current of 0.42A is sent to the internal battery of the machine, providing the NAGRA-D is switched ON.

Automatic charging of the internal battery will start as soon as the external converter is connected to the machine and the voltage of the internal battery is lower than 12V. This is a minimal initial charge necessary to bring the battery up to a level which will allow the NAGRA-D to be switched ON. It is not necessary for the NAGRA-D to be switched ON for this to occur. A security circuit will stop the converter when the external power source voltage drops to less than 10.5V

LED INDICATIONS ON THE ND-EPC

The LED "Input Voltage" indicates that the ND-EPC is ON and is connected to the external source and that the NAGRA-D is switched ON. It will flash if the NAGRA-D is not connected.

The "Output Current" LED indicates inversely with respect to the output current of the ND-EPC. It will be dimly lit if the drain by the NAGRA-D is large (max current supply) (while the internal battery is less than 12 V as well as when the NAGRA-D is switched OFF)
It will be lit brightly when the NAGRA-D is fully charged and hence the current being supplied by the ND-EPC is less important.
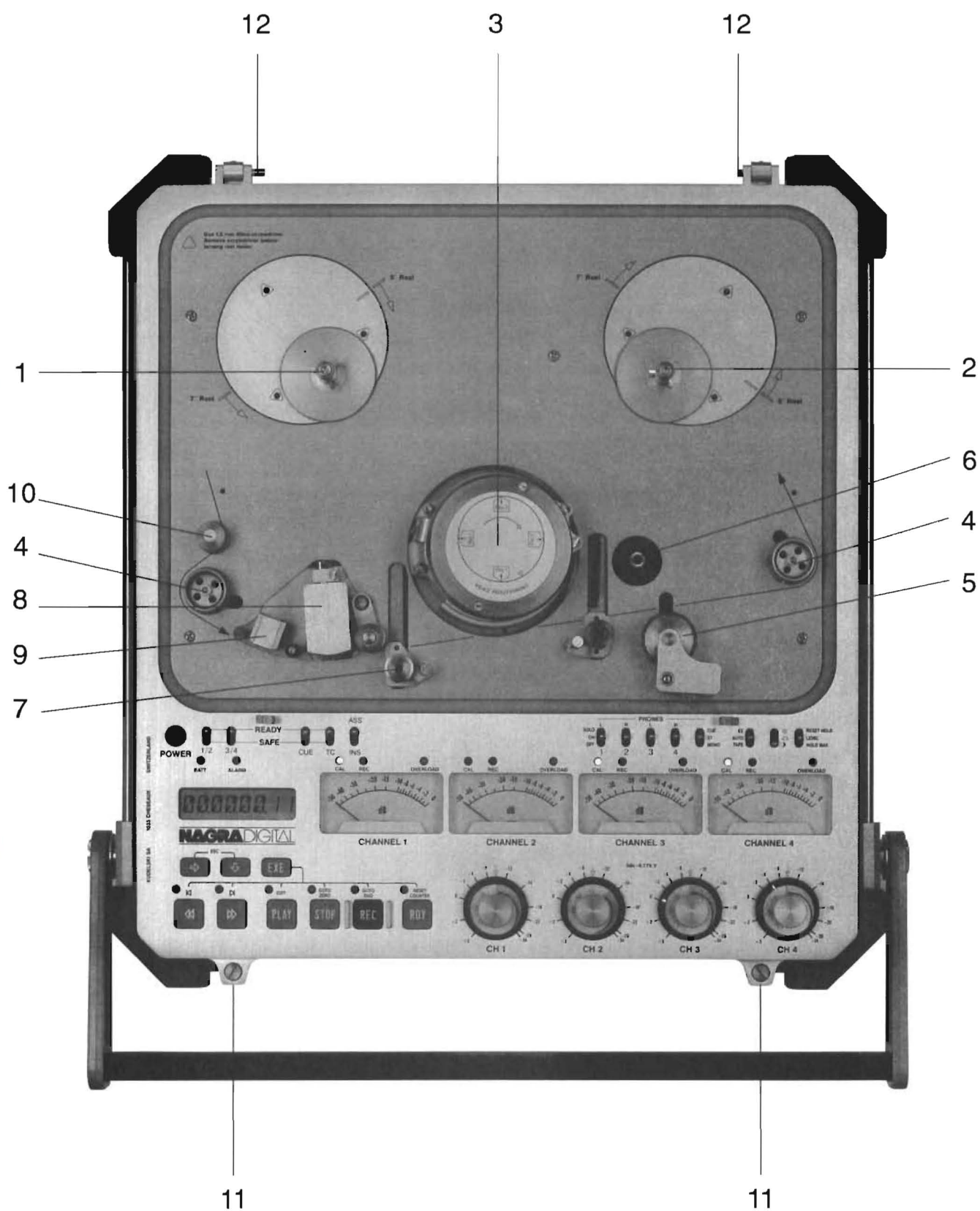
The " ' " on the display of the machine will indicate whenever the internal battery of the machine is being charged. (see display indications in the time code section of this manual).

CHAPTER 2

LOCATION OF KEYS / CONNECTORS / FUNCTIONS

Description of parts located on:

Deck plate
Main control panel
Front face
Left-hand side panel
Right-hand side panel

TAPE DECK

(Refer to photograph number 1) This shows the location of various mechanical parts referred to elsewhere in the manual.

Pos	Description
1	Supply reel holder
2	Take-up reel holder
3	Scanner (for recording helical tracks)
4	Tape tension roller and tape counter roller
5	Pinchroller
6	Capstan shaft
7	Tape engagement carriage
8	Longitudinal head (Cue, TC and Control track)
9	Full track erase head
10	Tape guide
11	Deck fastening screws
12	Hermetically sealed plexi-glass cover fixations

MAIN CONTROL PANEL

This section describes the operation of all the elements of the main control panel of the machine. (please refer to photograph)

Pos	Description

1.   HEADPHONE SELECTION SWITCHES

The 4 headphone selection switches function in conjunction with the mode selector switch 2 and the direct switch 3. There are four switches (each corresponding to one channel) each having three positions. These positions are SOLO / ON / OFF. The SOLO position is a snap switch and must be held in the SOLO position. When held in the SOLO position the signal from the selected channel is centered on the headphone outputs, and the other channels are inhibited while the switch is held there. The four (1, 2, 3, 4) headphone switches are also labelled L, R, L, R respectively. This means that if selector 1 is ON then the signal will be fed to the left channel of the headphone outputs. If selector 2 is ON then it will be fed to the right channel and so on. Thus having stereo monitoring between two channels is possible between the following combinations: 1+2, 1+4, 2+3 and 3+4. The combination of 1+3 is not possible as they would both be on the same channel superimposed.

21 23 22 24 25 26   27 6 28   1 2 3 4 5

20

19

18

17

16

POWER

READY
SAFE

1/2 3/4

BATT   ALARM

CUE TC INS

ASS

PHONES

SOLO L R L R CUE EE
ON   ST AUTO
OFF   MONO TAPE

RESET HOLD
LEVEL
HOLD MAX.

1 2 3 4

CAL REC   OVERLOAD   CAL REC   OVERLOAD   CAL REC   OVERLOAD   CAL REC   OVERLOAD

7

1535.1800

-50 -40 -30 -20 -15 -10 -8 -6 -4 -3 -2 0
dB
CHANNEL 1

dB
CHANNEL 2

dB
CHANNEL 3

dB
CHANNEL 4

8

9

NAGRADIGITAL

ESC

EXE

GOTO   GOTO   RESET
ZERO   END   COUNTER
EDIT

0dB=0.775 V

PLAY STOP REC RDY

CH 1   CH 2   CH 3   CH 4

SWITZERLAND   1003 CHESEAUX   KUDELSKI SA

15 14 13 12 11 10

2.   HEADPHONE MODE SELECTOR

      This three position switch selects the mode of the headphone outputs. The
      three positions correspond to MONO / STEREO / CUE. In the MONO or
      STEREO positions the audio signals are monitored in the respective format.
      In the CUE position the headphone outputs monitor the longitudinal CUE
      track (see CUE TRACK). Whenever the machine is not at nominal speed then
      the headphone output is automatically switched to the CUE track, if the EE
      / AUTO / TAPE switch is not in the EE position, in which case it will not be
      switched.

3.   EE / AUTO / TAPE SELECTOR

      This three position switch is the EE / AUTO / TAPE selector. When the
      machine is the RECORD mode in 2 channel operation (half speed) then the
      signal fed to the headphones is the EE signal irrespective whether the switch
      is in the AUTO or TAPE position unless the machine is fitted with a specially
      aligned scanner allowing read after write at half speed.. In the EE position the
      signal on the headphone outputs is the INPUT (DIRECT) signal. When in the
      EE position there is no delay (caused by the DSP). In the AUTO position a
      delay will be heard if the tape is not moving. In the EE position it is not
      possible to monitor the AES inputs. In order to do this switch must be in the
      AUTO position.

4.   DISPLAY ILLUMINATION SWITCH

      The brightness switch is used to change the intensity of the back lit display,
      the meters and the leds on the main control panel. It is a three position switch
      showing a sun, a cloud and a moon. The brightness of the leds and the back
      lit LCD display can hence be adjusted. The only position of this switch where
      the meters and the LCD display are illuminated is in the "moon" (night)
      position.

5.   METER SWITCH

      This is a three position switch, marked RESET HOLD / LEVEL / HOLD
      MAX. This is the selection for the operation and indication of the level
      meters. When set to the LEVEL position, the meters indicate the normal
      signal levels, either "off tape" or "input" depending upon whether the machine
      is in REPLAY or RECORD.
      When in the HOLD MAX position, the meters and the ECC display will rise
      and stop at the maximum level reached and will hold.. They will then increase
      as higher levels are detected. These max values are kept in memory and can
      be looked at when needed, by switching from LEVEL to HOLD MAX, on the
      main keyboard..

If the RESET HOLD switch is pressed a second time while the scrolling is being performed then the scrolling will switch to the time code scroll indicating the present settings of both the internal generator and the internal time code synchronizer (on time code machines only) (see time code chapter for the default settings and their explanations). Pressing any transport key will abort the scrolling menu mode.

6.   REC LEDS

The red record leds will light when the selected channels are in the record mode and not locked out. If the machine is put into record mode, and two channels are in the SAFE position while the edit selector is in the ASS (assemble) position then the record leds of the channels in the SAFE position will flash to indicate to the operator that these two channels are being erased. The REC leds will also come on while the tape DIRECTORY is being recorded even if all four audio channels are in the SAFE position. (In 2 channel operation then only channels 1 + 2 will go into record when the tape directory is being recorded).

7.   METERS

The four meters are microprocessor controlled and indicate the audio levels either during record, or replay depending on the mode of the machine, and they are calibrated in dB. The controlling software gives the meters the almost the same ballistics as a modulometer. The possible indications of these meters is selected by the mode selector 5.

8.   INPUT LEVEL SENSITIVITY ADJUSTMENT * SEE: CH. 2, PAGE 18, PARA 2; CH. 3, PAGE 32;

The outer ring of the coaxial potentiometers is the input level sensitivity adjustment. These potentiometers act directly on the inputs and control the sensitivity of the analog inputs and hence incoming levels. These controls have no effect on the digital inputs.

9.   FADER CONTROL

The fourth fader control potentiometer is used for several different functions, each of which is listed and explained below.   DIGITAL
The inner knob of the coaxial potentiometers is the FADE control and should be left in the center (CAL) position at all times except when making a fade, if the full dynamic range of the machine is to be used. The CAL position is indicated by the green CAL led 26. The fade commands are digital information recorded onto the tape and do not actually fade the incoming source material, which means that this "non-destructive" fading can be changed after the event, if required.

The fader control for the fourth input can be used to control the tape direction and speed when in the SEARCH mode (EXE + PLAY).

If the machine is fitted with the ND-TC time code option, then the fourth fader potentiometer can also be used to change the OFFSET between the time code reference and the time code recorded on the tape. When in this mode (see menus) the pot has a large central stop position, where the offset does not move, then when turning the potentiometer there is initially a position where the offset will increase (or decrease depending on the direction that the pot is turned) at a rate of 2 bits per second. If the pot is turned a little further the offset will start to increase at a rate of 20 bits per second, and if it is turned to its end-stop, then the offset will start to increase at a rate of 200 bits per second, (which corresponds to approx 2.5 frames per second). This modify mode should only be used to find the sync point when very close, larger offset modifications (minutes seconds and frames) should be entered as values in the SET mode.

The fourth potentiometer can also be used as a tracking control, by pressing EXE when in the tracking menu. This allows the operator to change the relative position of the control track pulses with respect to the scanner, which is especially useful at half speed to ensure playback compatibility between machines.

10.   RDY

The RDY (ready) key will switch on the scanner (assuming that a tape is fitted onto the machine and that neither of the tape tension rollers are at their outer extreme positions). This has two main advantages, firstly that once this mode is selected then the machine can be put into playback or record very quickly without the need to wait for the scanner to start up, and secondly that the operation of starting the scanner draws more current from the internal battery and the autonomy of the machine is reduced if the machine is started and stopped all the time. This mode is the same as "scanner on" in a VTR. The scanner will stop automatically if the machine is left in this mode for 1 minute (duration is selectable in the menus) and the transport is in STOP mode. The ready function is automatically selected if the machine is put into PLAY or REC from stop, which means unless it is pressed again after STOP has been selected, then the scanner will continue to turn for 1 minute after the end of the REC or PLAY. If the end of tape is reached then the scanner will stop. If the EXE key is held down while pressing the RDY key then its second function is operated, this is the RESET COUNTER, which will reset the internal tape counter. This can be made during any mode of operation of the machine. It must be noted that the counter is in hours, minutes and seconds and is dependant upon the sampling frequency presently selected on the machine.

11.   RECORD

The REC (recording) key must be pressed in conjunction with the PLAY key to put the NAGRA-D into the recording mode, both the PLAY and REC leds will be alight. The channels that are to be recorded are selected according to the positions of the lockout switches (20). (If no channels are selected to the READY position then the machine will go into the REC mode in order to record the control track only, as long as the edit switch is in the ASS (assemble) position. If all the channels are in SAFE and the ASS/INS is in the INS position then the machine will not move and the REC led will flash to indicate that record has been selected but no channels have been selected. If the EXE key is held down while the REC key is pressed then the GOTO END feature is activated. This will automatically send the tape to the end of the last recorded section of the tape. It will stop slightly before the exact end so as to leave enough time for a correct pre-roll thus being sure that a correct track assemble edit is made when record is pressed. This feature will only operate if the tape is formatted with the directory mode ON. (see DIRECTORIES in chapter 3). The take number will automatically be incremented each time the REC + PLAY keys are pressed. This can also be done without dropping out of record by simply pressing the two buttons again to create a new take number, while the machine is recording.

NOTE: The DIL switch Number 1 on the top left-hand side of the direct amplifier inside the machine is a record inhibit switch and will prevent the machine from recording if it is put into the ON position.
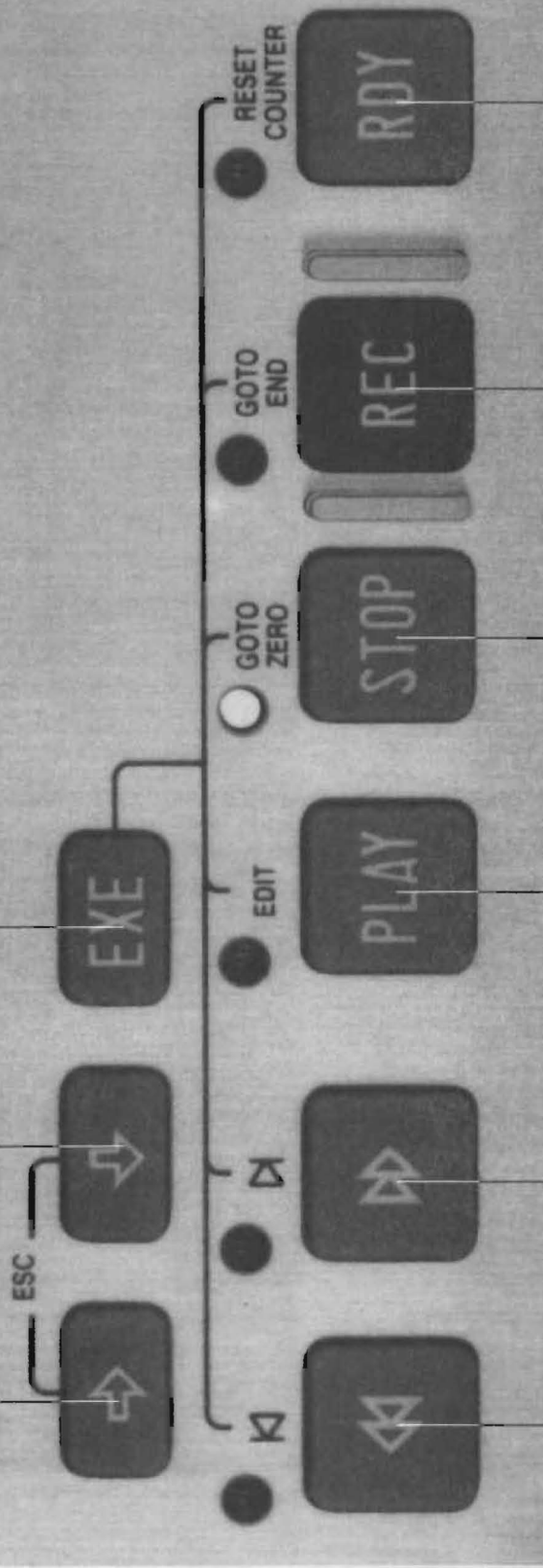
12. STOP

This is the main STOP key and will stop the machine from any transport mode. Once pressed, the tape will be taken away from the scanner which will then stop rotating, unless the RDY (ready) key was pressed previously, then the scanner will continue to turn for 1 minute after the STOP key has been pressed (this duration is selectable in the menu mode). The machine is then in the "standby" mode. When in STOP the audio signal path is EE allowing level adjustment and audio monitoring. Access to all the status menus, and their modification is possible while in the STOP mode via the display keys located below the LCD. If the EXE key is held down while pressing STOP then the GOTO ZERO function is activated. The transport will go to the zero counter position. When a new tape is loaded on to the machine and the STOP key is pressed, then the machine will automatically start to look for the tape directory.

13. PLAY

The PLAY key puts the machine into normal playback mode. If the EXE key is held down while the PLAY key is pressed then the machine will go into the EDIT mode and the PLAY led will flash. When in the edit mode then the fader pot n° 4 serves as a search control and will vary the speed and direction of the tape according to the rotational position of the pot. Monitoring during this mode is on the CUE track via the headphone outputs. Once the machine is at nominal speed in this mode then the audio outputs are no longer muted and the line outputs can be monitored. If either of the FF or REW transport keys are pressed while in PLAY the machine will advance or reverse at four times nominal speed, and once the FF or REW key is released then the machine will continue in the playback mode at nominal speed. If the ND-TC time code option is fitted to the machine then pressing PLAY+FF+REW simultaneously will switch on the chase synchronizer (according to the selected mode see menus). In this mode all three leds will light when the machine is locked.

14. FAST FORWARD

The FF key will put the transport into the fast forward wind mode, the speed of which is carefully controlled, meaning that the winding speed will slow down before the end of the tape is reached. If EXE + FF key is pressed then the machine will jump to the next take (Skip forward 1 take).This feature will only operate if the tape is formatted with the directory mode ON. (see DIRECTORIES in chapter 3). If the FF key is pressed while in playback mode then the machine will advance at 4 times nominal speed for as long as it is held down. If the ND-TC time code option is fitted to the machine then pressing PLAY + FF + REW together will switch on the synchronizer and all three of the leds will alight when the machine is locked.

15.   REWIND

The REW key will put the machine into the rapid rewind mode, the speed of which is carefully controlled, meaning that the winding speed will slow down before the end of the tape is reached. If the EXE key is held down while the REW key is pressed then the machine will jump back to the previous take (Skip backwards 1 take).This feature will only operate if the tape is formatted with the directory mode ON. (see DIRECTORIES in chapter 3). If the REW key is pressed while in playback mode then the machine will reverse at 4 times nominal speed, for as long as it is held down. If the ND-TC time code option is fitted to the machine then pressing PLAY+FF+REW simultaneously will switch on the chase synchronizer (according to the selected mode see menus). In this mode all three of the leds will alight when the machine is locked.

NOTE: The leds above each of the main function buttons will flash when the key is pressed, until the selected function is actually activated. For example if STOP is pressed during rapid rewind then the STOP led will flash while the machine comes to a complete stand-still.

16.   RIGHT ARROW

This is the key used for moving horizontally to the right through the menus on the LCD display when in the MENU mode. (see MENU's chapter 3). When the end of a horizontal line is reached it returns to the start of the particular line.

17.   DOWN ARROW

This is the "scroll" key and is used for passing vertically through the menus and from one choice to the next in a specified menu on the LCD display. When the last choice is reached when scrolling, then it will return to the first.

NOTE: Pressing the RIGHT and DOWN arrow keys simultaneously activates the ESC (escape) function. This allows the operator to move out of the menu modes. The display will return to the initial counter (ECC, TC, or REMAIN) display.

18.   EXE KEY

The EXE key executes either choices made in the MENU mode (which are written in capital letters on the display) (See menu's) and can also be used to select the second functions written above the main function keys, it acts as a sort of "shift" key. Each of these secondary functions are described along with the description for each specific key.

19.   LCD DISPLAY

This is a 14 segment 8 digit back lit LCD display, permitting alpha-numeric indication of a large quantity of different information and allowing internal settings of the machine to be made in the MENU mode. In normal operation it will indicate either counter roller, time code, take number or remaining tape. It is also used to display the internal STATUS of the machine. The display will be illuminated if the illumination switch 4 is put in the moon (night) position. The sign " ' " is used between some of the digits to indicate various modes of the machine (see time code).

20.   POWER SWITCH

The POWER button is the main power ON/OFF selector for the NAGRA-D. In the OFF mode none of the internal circuits of the machine are powered. When the machine is switched on then all the electronic circuits are powered, level adjustment and monitoring are possible.

NOTE: The machine must be switched ON prior to charging the internal battery, as it is the microprocessor of the machine that controls the charging current to the battery, and it therefore cannot charge the internal battery if the machine is switched OFF.

21.   BATT LED

Under normal operating conditions the BATT led is not alight. This indicates that the internal battery pack has sufficient charge to operate the machine normally. When the charge of the internal battery falls below 11V then the led will light. When the battery reserve indication (see MENU'S) falls below 20% the batt led will start to flash slowly to warn the operator that the reserve is getting low. When the internal battery voltage drops below 10V then the LED will start to flash rapidly. At the same time an audible beep will be heard in both the headphones and from the machine itself, giving the indication that the machine will stop operating in 15 seconds. If the external charger is connected before the machine actually stops, the beep will immediately stop, however the led will continue to flash until the charger has supplied enough power for the battery voltage to climb above 10 V again. More accurate indication of the amount of power reserve left, can be seen in the menu mode. When selected to the display then the display will read batt. XX% and this indicates the % reserve in the battery. (see MENU'S)

22.   ALARM LED

The ALARM led indicates when there is an error either internally within the machine or if the operator tries to operate a function incorrectly. (ie trying to synchronize to the AES input signal when no cable is connected). If it is flashing but the machine appears to be operating normally then check the setting of the reference selection in the menu mode.

23.   AUDIO CHANNEL LOCK OUT SWITCHES

These two switches are the LOCK-OUT selectors for the channels 1+2 and 3+4 respectively and are used to determine which audio channels will be recorded. The audio channels cannot be individually locked-out due to the shuffling and the layout of the information recorded on the tape. If the machine is put into the record mode and all channels (including TC and CUE) are in SAFE and the edit selector is in the INS position then the machine will stay in the stopped mode and the led above the record key will flash.

24.   CUE CHANNEL LOCK OUT

This is the LOCK-OUT for the CUE track, which completely inhibits the recording of the cue track. Playback of previously recorded CUE information is unaffected by this switch. The CUE track should not be recorded in the INSERT mode, as crosstalk within the longitudinal head will disturb the reading of the control track. If INSERT editing is being made on the audio, then the CUE switch must be in the SAFE position.

25.   TIME CODE CHANNEL LOCK OUT

This is the LOCK-OUT for the TC, which inhibits the recording on the time code track. Playback and use of previously recorded time code is not affected by this switch. Time code must not be recorded in the INS position, as cross-talk in the head will disturb the reading of the control track. If INS editing is being made then the time code lock-out switch must be in the SAFE position.

26.   EDIT MODE SELECTOR

This is the INSERT / ASSEMBLE switch used to determine the type of recording being performed. The insert position is used to record on a tape already containing a control track. Assemble mode is to be used on a new tape. (this could be considered as a lock out for the control track recording). If this switch is in the ASS position, and only one pair of audio channels is in the READY mode then when the machine is put into record, then the REC leds of the two channels in SAFE mode will flash to indicate that they are in fact being erased. When the switch is in the ASS position then the full track erase head is activated, and previous recordings will be erased.

27. CAL LED

This led is alight when the fader is in its central calibrated position. This is the only position that the fader should be in order to guarantee that the full dynamic range of the machine is being used.

28. OVERLOAD LEDS

The overload led will flash when an input level of -1.16 dB is reached. This is due to the 20 bit converters that overload at this level.
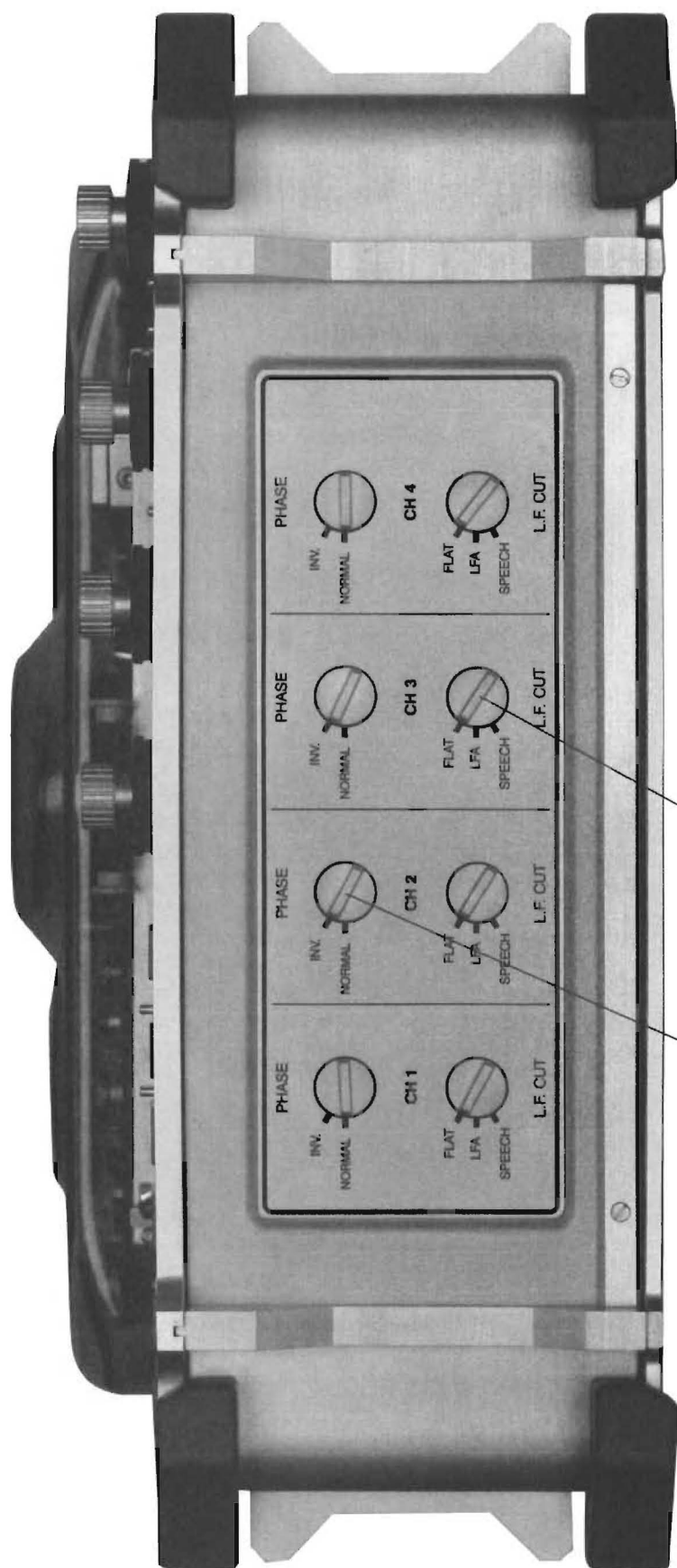
FRONT FACE

1.　PHASE SELECTOR

> The PHASE switch (one for each channel) is a two position selector and allows inversion of the phase for each of the inputs individually. The position of this switch is recorded on the tape and can be altered during playback if desired (see MENU's).

2.　FILTER SWITCH

> The L.F. CUT switch is a three position filter on the direct amplifier, and allows the selection of either FLAT, LFA or Speech filters for each input. (similar to the filters on portable analogue NAGRA's).

Below are the filter curves (audio precision) corresponding to the three positions of the filter
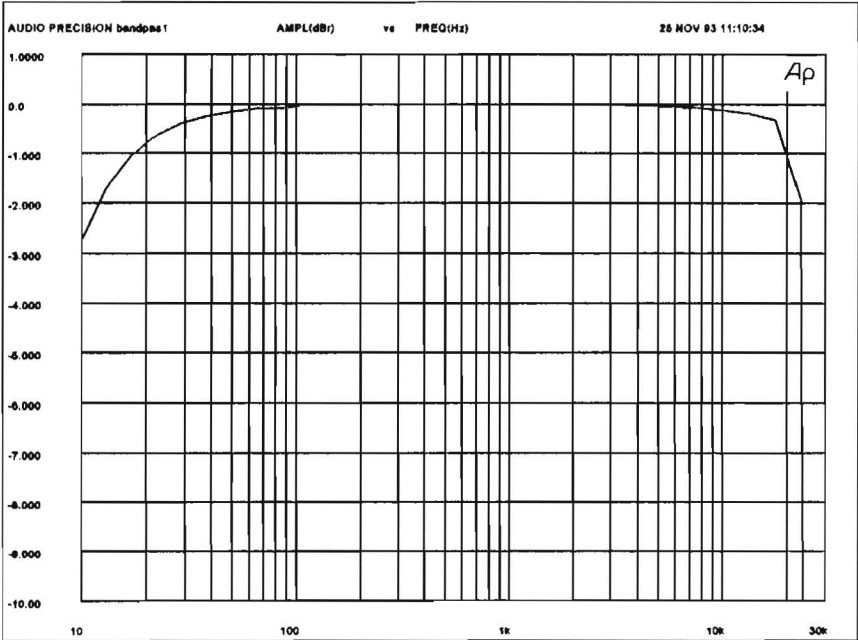
FLAT filter response curve
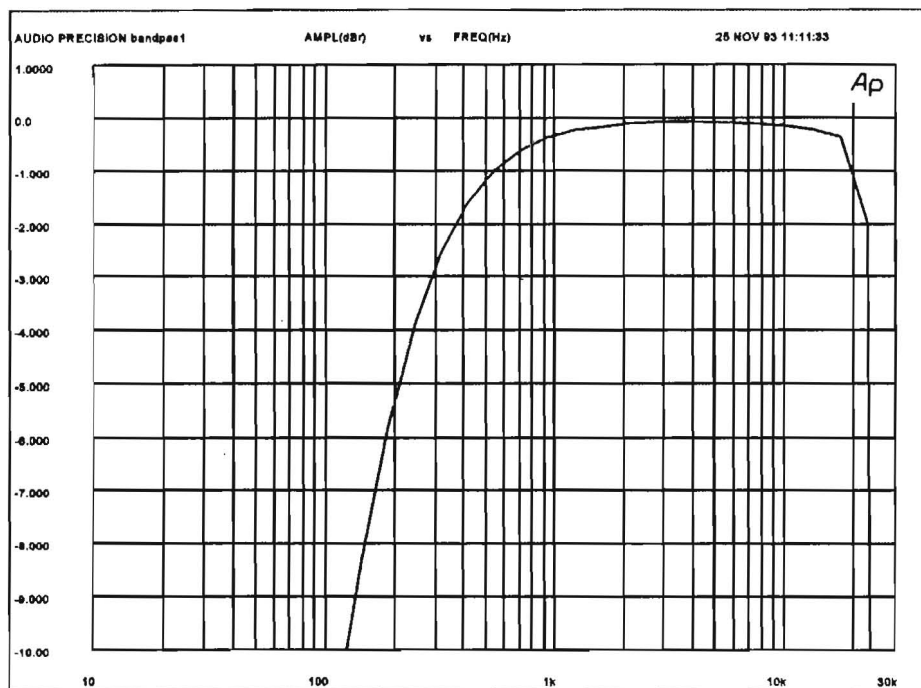
Speech filter curve

LFA filter curve

Video
sync. IN

1 GND
2 Hi
3 Lo

INPUTS

Time code — Extension — RS 422 — DIG 1 + 2 — DIG 3 + 4 — CH 1 — CH 2 — CH 3 — CH 4
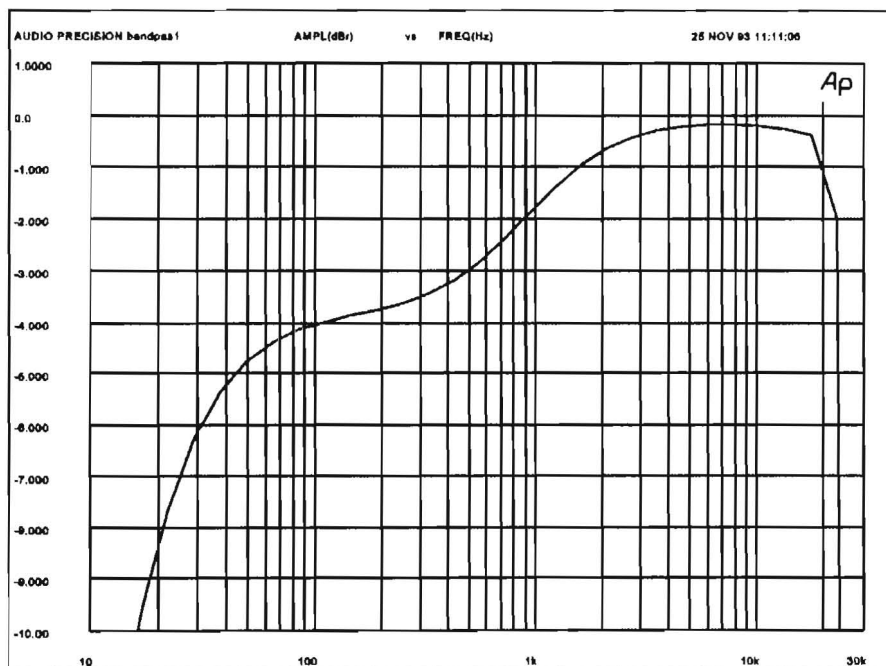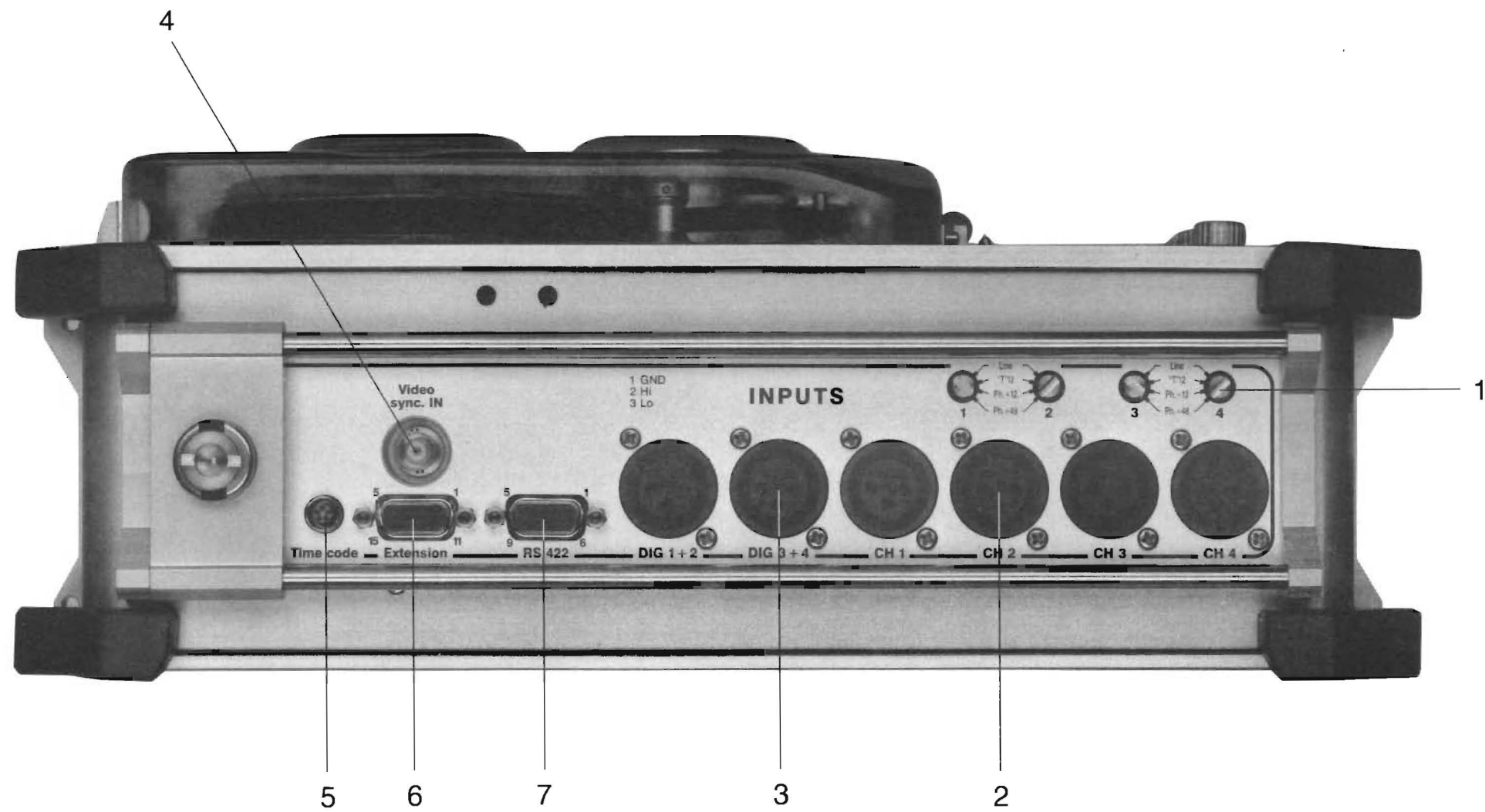
LEFT-HAND SIDE PANEL

1.   MICROPHONE POWERING SELECTORS

These three position input selection switches allow the selection of the microphone powering for each microphone input individually. The possible selections are +12V "T" power, +12V phantom and +48V phantom. The input selector must be in the LINE position if an analogue line input is to be used. The sensitivity of these inputs is made using the outer ring of the co-axial potentiometers on the main control panel.

① 2.   ANALOGUE INPUT CONNECTORS *MAXIMUM INPUT: 0.0 DB FOR "DIGITAL 0.0 dbFS*

These are the four XLR (female) analogue inputs. They are the connectors used both for microphones or line inputs, the sensitivity of these inputs is made using the outer ring of the co-axial potentiometers on the main control panel.

3.   DIGITAL INPUT CONNECTORS

These are the two XLR (female) digital inputs to the NAGRA-D. They are to be used whenever the machine is connected to another piece of equipment communicating on the AES bus. The selection of the inputs to digital mode, as well as the reference frequency is made in the menu mode. (see MENUS)

4.   VIDEO SYNC CONNECTOR

The BNC type connector is the input signal for the video reference. This is a standard "House SYNC" input used for synchronizing the machine. This connector is internally terminated with a 75 Ohm load.

5.   TIME CODE IN / OUT

The 5 pin LEMO connector is the time code IN / OUT connector. (as on the NAGRA T-AUDIO, IV-STC and VPR-5). This is used to feed an external time code to the machine as well as to read the played back time code.

① THESE ANALOG INPUTS SHOULD BE REGARDED AS MICROPHONE INPUTS WITH A LOT OF ATTENUATION WHEN THE INPUT SENSITIVITY IS ADJUSTED FULLY COUNTER-CLOCKWISE

6.   EXTENSION - EXTERNAL CONNECTION PORT

This 15 pole miniature D-type connector has many functions, and is the principle connection point for external accessories. The ND-CM CUE microphone is connected here and allows commentary to be recorded on the cue track. It can also be used to supply an external sync signal to the machine as a reference.

7.   RS 422 CONNECTOR

This is a standard 9-pin RS 422 symmetrical 0 to 5 V RS 422 serial communication port for connection to the external world. This connector can be used to communicate with external interfaces allowing communication with editors etc. It is also used for connection to a PC. When connected to the PC access to all the functions of the machine are available. In order for communication to be made between the NAGRA-D and a PC then the NADCOM software must be installed on the PC.

NOTE:

A "lap-top" style PC is not always fitted with an RS 422 port. A converter RS 232 / RS 422 must in this case be fitted to the cable to allow the communication. (ND-PCA # 10540)

OUT 0dB :
+12 dBm/3,1VRMS

1 GND
2 Hi
3 Lo

OUTPUTS

CH 4   CH 3   CH 2   CH 1   DIG 3 + 4   DIG 1 + 2

MIN

PHONES

NAGRA® D
S/N

Control

GND
POWER PACK

6

5   4   3   2   1
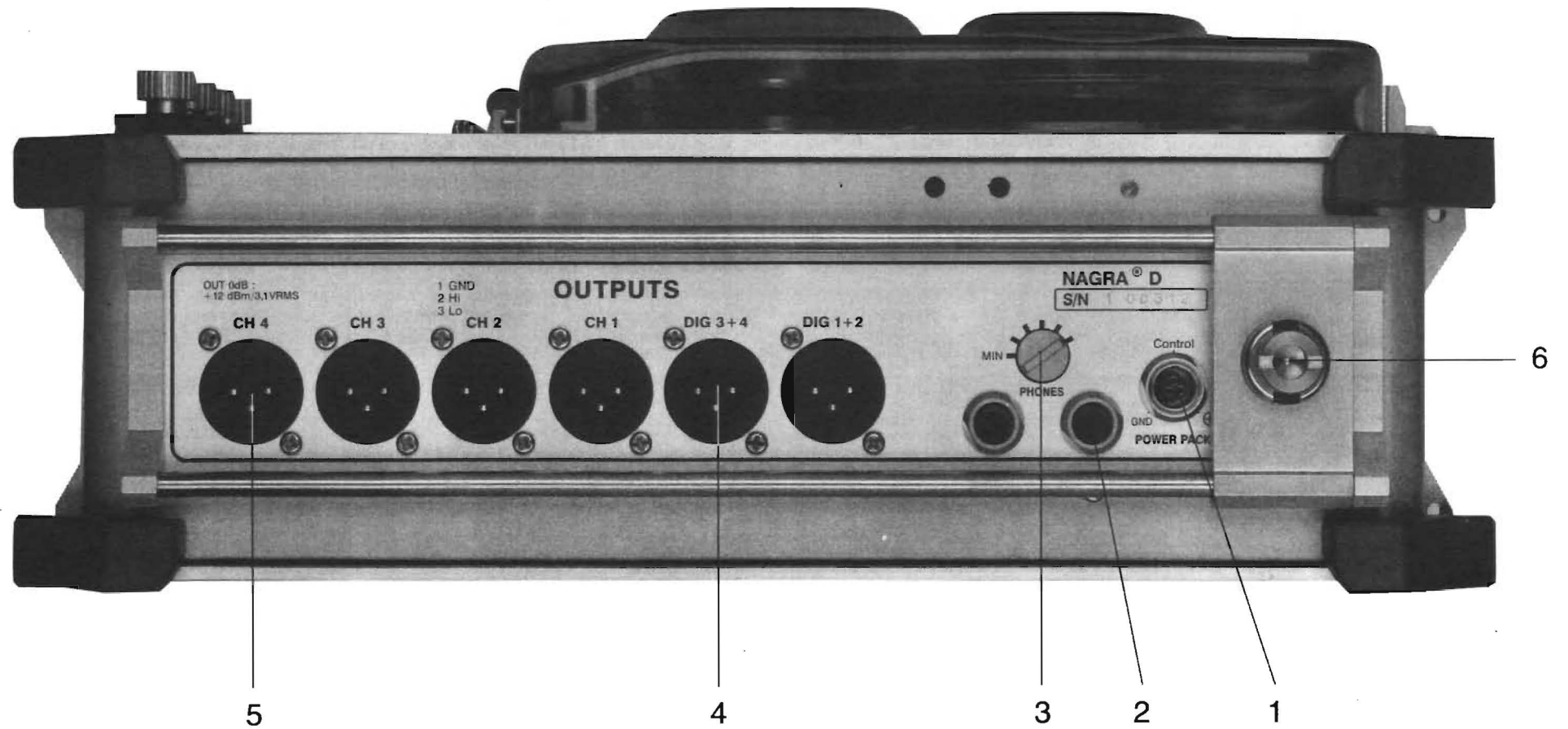
RIGHT-HAND SIDE PANEL

1. POWER CONNECTOR

   The three pole LEMO style POWER connector is the connection for the ND-CCC (Current Controlled Charger), which is used to charge the internal battery pack. The charge current for the internal battery is controlled in the charger by the machine itself, and therefore under NO CIRCUMSTANCES must any charger or power supply other than the ND-CCC or ND-EPC be connected to this point, unless the ND-AP auto power option is fitted. The machine must be ON in order to charge the internal battery. (see "Powering the NAGRA-D").

2. HEADPHONE CONNECTORS

   Two 1/4" standard stereo headphone jack connectors. The outputs of which are governed by the positions of the headphones selector switches on the main control panel.

3. HEADPHONE LEVEL CONTROL

   This is the 5 position stepped headphone output level control, which controls the headphone output level to each socket simultaneously.

4. DIGITAL OUTPUT CONNECTORS

   These are the two XLR (male) digital outputs from the NAGRA-D. These are used for the AES bus connection to other equipment.

5. ANALOGUE AUDIO OUTPUT CONNECTORS

   These are the four XLR (male) analogue outputs. They are transformerless 3.1 V (Zout = 50 Ohms). The output level on these connectors can be modified using the fader potentiometers for the respective channel, assuming the command has been set in the menu mode.

BEWARE: If the 4 audio outputs are being mixed down using an external mixer, be sure that the mixer is not set to +48V phantom, as feeding this to the outputs of the NAGRA-D will blow the output chips.

6. CARRYING HANDLE

   The carrying handle of the machine can also be used to incline the machine during "table-top" operation by sliding it to the rear of its travel.

CHAPTER 3

OPERATING THE NAGRA-D

Power ON
> Switching on the NAGRA-D
> Loading a tape

Menu mode
> Full description of the menus of the machine.
> Display selection
> Time code selection
> Battery reserve
> Inputs selection
> Sampling freq. selection
> Reference freq. selection
> Tape speed selection
> Directories
> Other settings
> Fader settings

Cue track
> Using the Cue track
> Using the ND-CM cue microphone

Monitoring
> Monitoring on headphones

Search / shuttle
Microphone inputs
Recording
> Recording with microphones
> Recording an analog input
> Recording a digital signal

Playback
> Playing back a recorded tape

Copy
> Copying a NAGRA-D tape
> Copying to another digital machine
> Copy of channels 1+2 onto 3+4
Removing the internal battery

Directories
> Explanation
> Use of directories

POWER ON

To switch on the NAGRA-D simply press the black POWER button on the left-hand corner of the main control panel. The display will initially indicate NAGRA-D (or personal name if programmed) followed by the previously selected display, the machine is now ready to accept a tape. If when the machine is powered up and the display initially shows NAGRA-D and then immediately goes off the internal battery is probably flat. If this is the case then the machine must either be used connected to the ND-CCC charger unit or alternatively the internal battery pack must be changed. If the internal battery of the machine has been replaced (while the machine was OFF) then when the power button is pressed the display will indicate "Mem Lost", which indicates that all the USER settings and any directories that were previously in the internal memory have been lost.

LOADING A TAPE

All forms of digital tape are fragile, firstly because they are very thin (approx 30 μm) and secondly they are delicate with respect to moisture. Avoid touching the tape as much as possible.

NOTE: The Error correction of the NAGRA-D is powerful enough to correct errors caused by touching the tape, but as a general rule it is not recommended.

Place a full reel of tape on the left-hand reel holder, with its open end towards the front of the machine and coming off the left-hand side of the reel. Press the POWER button of the machine. Gently pull the available end of the tape and guide it around the right-hand side of the outer tape roller and then around the tension roller. You will notice a slight back tension once it passes the tension roller. Continue to pull the tape across in front of the longitudinal headblock, and then the scanner, following the black line of the tape path printed on the deck plate of the machine. Pass around the right-hand tension roller and then secure it onto the take up reel in the same way as you would with a normal 1/4" tape. The machine will detect this operation, and will automatically take up the tape and will then start to look for a directory on the tape, providing that during this time both tension rollers leave their end-stop position, otherwise press STOP in order to start the search mode. (see directories).

If a directory is detected it will be automatically read, if not then the operator will be asked (on the display) whether the tape is to be formatted. "EXE" will be accepted as YES and "ESC" will be accepted as NO to this request.

The tape is now loaded and ready to be used.

If a tape has been left "tail out" and the directory mode is ON then when the tape is loaded onto the machine, the full reel will be placed on the right-hand reel holder and the operator winds several turns onto the left-hand reel and then presses the REW key. The machine will then go to the start of the tape and automatically look for the directory.

MENU MODE

The NAGRA-D has numerous modes of operation and different functions it can perform. To select each of these by a dedicated key is impractical and space is limited. Another means of selection could be by numeric commands, however this too necessitates a numeric keypad, and also means a list of the necessary numeric commands must be available at all times. The NAGRA-D incorporates a system of menus similar to the "tree" of directories and sub-directories on a PC. The functions that are available via the menu mode are not operations that need to be done too frequently during normal use of the machine in the field.

The menu viewing and modification is made using three keys, "DOWN" (indicated by a vertical downward arrow), "RIGHT" (indicated by a right facing arrow) and by the "EXE" (execute) key. By means of these keys and the display all the operating modes of the machine can be user accessed, and verified at any time. The DOWN and RIGHT arrow keys will not modify any of the settings within the machine. These are used simply to move around in the menus and once the desired selection to be modified is on the display then the EXE key is used to make the modification. When the EXE key has been pressed a "beep" will be heard (either internally or on the headphones depending on the present setting of the beep function) to indicate that the selection has been correctly accepted. The display will then generally return to the counter display, exception to this is when a second selection is generally necessary, the display will jump directly to this. For example if either the inputs 1+2 are selected to digital, then when the EXE key is pressed the display will immediately go to the Inputs 3 + 4 to allow the selection of the other pair of inputs to avoid the user needing to go through all the menus again.

The DIL switch number 2 inside the deck plate of the machine can be used to prevent the EXE function. When this switch is in the ON position then the EXE function will be ignored. This can be used to prevent accidental changing of the internal menu settings.

NOTE: When the machine is powered up, the presently selected settings of the machine will be indicated on the LCD display. If at any time the RESET HOLD switch for the meters is activated the menu's will also scroll through the presently selected choices. All settings of the machine are memorized when the power is switched off, as long as there is sufficient power in the internal battery. If however the internal battery becomes flat, then when the machine is powered up the next time the display will indicate "MEM LOST" and will scroll through its default settings, which are:

48 kHz	-Sampling frequency
MASTER	-NAGRA-D is locked to internal crystals
12 ANA	-Channels 1 + 2 are set to ANALOG
34 ANA	-Channels 3 + 4 are set to ANALOG
FULL SPD	-Tape speed is in the 4 channel mode (99.4 mm/s)

If the RESET HOLD is activated a second time while the menu is scrolling then the time-code and synchronizer settings will be shown. (see time code).

In order to select the MENU mode to the display, simply press the DOWN arrow key, and the display will indicate INPUTS. All the other menus will be explained below. In order to get out of the MENU mode press the DOWN and RIGHT arrows simultaneously (escape) and the display will return to the counter display.

When the machine is powered up the display will show the last mode selected before power down (time code, counter, track number etc).

DISPLAY — ROLLER
— REMAIN
— ECC
— TAKE
— tc — TC OUT — TIME
— USER
— TC REC — TIME
— USER
— TC DELTA   (Dil. Switch #3)

TimeCode — Gen — Format — 25 FPS — Tapeform — 25 FPS
— 29.97 DF — 29.97 DF
— 29.97 FF — 29.97 FF
— 30 DF — 30 DF
— 30 FF — 30 FF
— 24 FPS — 24 FPS
— Rec. Src — INT GEN
— EXT
— Gen Mode — TimeMode — FREE RUN
— REC RUN
— UserMode — DATE
— DATE INC
— FREE
— FREE INC
— Set Gen — FROM EXT
— RESET
— Set Time — 00 00 00 00
— Set User — 00 00 00 00
— DelaY — InPut — ANALOG
— AES
— OutPut — ANALOG
— AES
— GEN OUT
— Sync — Offset — Set — +H00 M00 — S00 F00 .00
— ModifY — +000000
— RESET
— Chase — SYNC
— Sync Inc — REF TC
— REF FR P
— Sync Mode — FIX CLK
— VAR CLK
— Discont. — ENABLE
— DISABLE
— Reac time — 0.15 Fram

Bat XX % — Charge — SET 0%
— SET 25%
— SET 50%
— SET 75%
— SET 100%
— Capacity — 1.0 Ah
— 4.5 Ah
— 5.0 Ah
— 5.5 Ah
— 8.0 Ah

Inputs — In 1–2 — 12 ANA
— 12 AES
— 12 Cpy 34
— 12 MUTE
— In 3–4 — 34 ANA
— 34 AES
— 34 Cpy 12
— 34 MUTE
— Ref.Level — 00 dB
Sam.Freq — 48 kHz
— 44.1 kHz
— 32 kHz

Ref FreQ — MASTER
— AES 12-48
— AES 12-44
— AES 12-32
— AES 34-48
— AES 34-44
— AES 34-32
— PAL — CRYSTAL   (VCLO MACHINES ONLY)
— NTSC — VCLO
— NTSC 80
— REM 48
— REM 44.1
— REM 32
— REM 9600
Tape SPd — FULL SPD
— HALF SPD
Dir — Mode — ENABLE
— DISABLE
— Reel Nb — REEL X
— REFORMAT
OtherSet — Beep — DISABLE
— ENABLE
— TRACKING
— Auto Pow — DISABLE
— ENABLE
— Wind Spd — 1 m/s
— 2 m/s
— 3 m/s
— 4 m/s
— Scan.Rdy — 1 MIN
— 3 MIN
— 5 MIN
— 15 MIN
— TaPr Tens — 40 gr
— 50 gr
— Rtc — 000000 — t 000000
— d DDMMYY — d DDMMYY
— Rs 422 — AUTO
— SONY — NAGRA-D — IF OPTION INSTALLED
— BVU-800
— AMPEX
— Software — V 1.10 — TC V X XX — MEM RESET
— 03/03/95
— Headtime — H XXXX
Fader — Assign — SET 1111
— SET 1133
— SET 1212
— SET 1234
— Fade Src — TAPE
— KEYBOARD
— PhaseSrc — TAPE — Ph NNNN
— KEYBOARD
Template — RECALL 1
— RECALL 2
— RECALL 3
— RECALL 4
— STORE 1
— STORE 2
— STORE 3
— STORE 4

▷ = TO MOVE TO THE RIGHT

▽ = TO MOVE DOWN OR INCREMENT VALUE

EXE = TO EXECUTE A MENU

▷ . ▽ = ESCAPE

= SELECTIONS STORED IN A TEMPLATE

DISPLAY SELECTION

This is the first line of the status display, and will always indicate the preselected mode. If the right arrow key is pressed then the user can select the default display mode, the down arrow is used to scroll through the possible options. This selection is the one that will automatically be displayed when the machine is switched on or after a scrolling of the selected settings has been done. The possible selections are ROLLER, REMAIN, ECC, TAKE and TC (the last one only if ND-TC option is installed). Please note that the word DISPLAY is never indicated, the display at the top of the menu tree is the currently selected choice.

```
DISPLAY        ─┤ ROLLER

                  REMAIN

                  ECC

                  TAKE

                  tc            ─┤ TC OUT   ─┤ TIME

                                                USER

                                   TC REC    ─┤ TIME

                                                USER

                                   TC DELTA
```
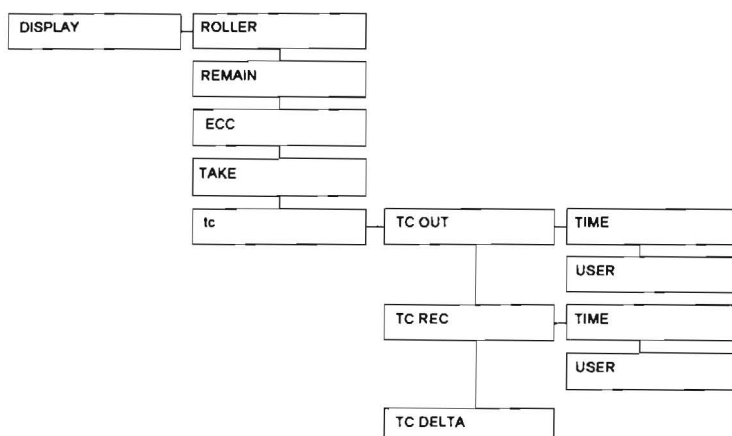
ROLLER   This shows the tape timer counter roller which is indicated in hours, minutes and seconds, and is driven by the left-hand tension roller.

REMAIN   This position allows the operator to look at the remaining tape on the reel. This is calculated by the machine whenever it is in motion. The calculation is made by regarding the relative speeds of the reel motors therefore it takes several rotations of the reel motors to give an accurate reading, while the calculation is being made the display will only indicate "- - - -". It should be noted that the calculation is only accurate if the same reels are being used on both reel motors. If one is a 5" and the other a 7" then the reading will be wrong. Once the calculation is made the display will indicate the remaining tape (R) in Hours and Minutes "R h.mm".

ECC If ECC is selected then the indication is two pairs of numbers corresponding to the channels 1+2 and 3+4 respectively. This operates in both record and replay modes, and indicates from 0 to 99 the amount of errors being detected and corrected. If there is 1 or more errors that are not corrected then FA is indicated instead of the numbers.

This FA stands for FATAL error. If the machine is in the half speed mode then the right-hand pair of digits will read FA permanently, as there are no tracks 3 + 4 recorded on the tape. If the HOLD MAX position of the level switch is selected then the ECC display indication will act in the same manner as the level meters, showing the max ECC level reached up to the present point. This is reset by switching to RESET HOLD.

TAKE When this position is selected the display will indicate the "TAKE" number followed by the time from the beginning of the present take which is indicated in h.mm.ss. The take number will automatically be incremented by "1" each time the machine is put into record mode. This display can be used when the machine is in all operational modes. The take number will automatically be incremented each time the REC + PLAY keys are pressed. This can also be done without dropping out of record by simply pressing the two buttons again to create a new take number.

TC This position of the display is the access to the time code displays (if the machine is fitted with the ND-TC option). When moving to the right from this display the time code indications explained below are shown.

TC OUT If TC OUT is selected then time code that is being fed to the lemo connector is displayed. In playback this will be the time code read from the tape and if GEN OUT is selected then this will be the internal generator. If the right arrow is pressed when TC OUT is on the display then the TIME will be displayed, and if consequently the down arrow is pressed then the USER bits will be displayed, pressing EXE will select the desired mode. (Note that these settings are only the OFF TAPE or GEN OUT information).

TC REC If TC REC is chosen then the time code that is to be recorded onto the tape (either internal generator or external depending on the time code settings) is displayed. From this position the user may move to the right and then select either USER bits or TIME to be displayed, by pressing "EXE".

TC DELTA This display is the changing difference between the external time code reference and the time code on the tape while the machine is in the chase synchronize mode.

Note: The time code features mentioned above only operate if the NAGRA-D is fitted with the ND-TC option.

TIME CODE SELECTION

This position allows the setting of the time code options of the machine. It permits the setting of the internal time code generator, for both TIME and USER data, as well as frame rate selection and the time code mode. It also allows the choice of the time code to be recorded, as well as access to the internal time code synchronizer features, including modes of operation as well as external references to be used. These displays will only be indicated if the machine is fitted with the ND-TC time code option. Scrolling display of the presently selected time code features can be made by pressing the RESET HOLD switch twice.

TimeCode	Gen.	Format	25 FPS	Tapeform	25 FPS
			29.97 DF		29.97 DF
			29.97 FF		29.97 FF
			30 DF		30 DF
			30 FF		30 FF
			24 FPS		24 FPS
		Rec. Src	INT.GEN		
			EXT		
		Gen.Mode	TimeMode	FREE RUN	
				REC.RUN	
			UserMode	DATE	
				DATE INC	
				FREE	
				FREE INC	
		Set Gen.	FROM EXT .		
			RESET		
			Set Time	00.00.00.00	
			Set User	00.00.00.00	
		DelaY	InPut	ANALOG	
				AES	
			OutPut	ANALOG	
				AES	
		GEN.OUT			
	Sync.	Offset	Set	+H00 M00	S00 F00 .00
			ModifY	+000000	
			RESET		
		Chase	SYNC.		
			Sync.Inc.	REF. TC	
				REF.FR.P .	
		Sync.Mode	FIX CLK		
			VAR.CLK		
		Discont.	ENABLE		
			DISABLE		
		Reac.time	0.15 Fram.		

GEN   When the right arrow is pressed from the TIME CODE position access is given to all the internal generator features and hence "in the field" access to setting of the internal generator. If the down arrow is pressed from this point the display will change to SYNC which allows access to all the settings of the internal time code synchronizer. Pressing the right arrow from the GEN position will move to FORMAT allowing the operating modes and features of the internal generator to be set.

FORMAT   When the right arrow is pressed from this position then the operator can select the frame rate of the internal time code generator. The internal time code generator can generate all presently used formats ie 24, 25, 29.97 and 30 (the latter two either with or without drop frame). The first value indicated is the presently selected choice. The default value, automatically selected if the memory has been lost, is 25 frames per second. Pressing the down arrow will scroll through the other possible choices in turn which are selected by pressing "EXE". This choice is kept in memory as long as there is sufficient power in the internal battery, or permanently if it has been stored in a template.

TAPEFORM Moving to the right from the frame rate selection will give access to the tape format menu (providing the DIL switch number 3 is in the ON position. If the DIL switch 3 is off then this menu will not appear). From this point, pressing the right arrow will once again show the list of frame rates available, as for the format. This can be set to the frame rate of the tape that is presently on the machine. What this allows, is for a tape that is for example 29.97 df to be synchronized to a 24 or 25 frame reference. All combinations of tape and reference formats can be used.

REC SRC   When the down arrow is pressed from the FORMAT position the display will show REC.SRC. This is the time code source selection for the time code to be recorded on the tape. It can be set between INTernal GENerator or EXTernal, by pressing the right arrow followed by the down arrow. If in the EXT position then an external longitudinal SMPTE/EBU time code must be fed to the time code connector on the left-hand side of the machine. Making this selection will not necessarily be indicated on the display - only if the correct DISPLAY selection has been made.

GEN MODE From this position pressing the right arrow moves the display to the choice between TIME mode and USER mode. From the TIME MODE position the right arrow allows selection between FREE RUN and REC RUN by means of the down arrow. Free run means that the internal time code generator will run permanently, according to the preselected frame rate. In the REC RUN position then it will only run when the machine is in the record mode, allowing continuous time code to be recorded. Presently the assemble time code feature is not implemented, therefore in the record run mode the first two seconds of recorded time code will not be correct. The TIME and USER mode settings are both remembered if they are stored in a template.

To avoid any problems during post production if this mode has been used please set the reaction time of the slave machines synchronizer to greater than 2 seconds. From the USER MODE position, pressing the right arrow allows access to the possible mode of the USER bits which can be either DATE or FREE. In the DATE position then the date in the DD.MM.YY.xx format must be used. In the FREE position then the user bits can be any value in HEX (0 to F).

Both of these choices also have an INC feature meaning that the last two positions (xx) will automatically be incremented by "1" each time the machine is put into record, starting from 00 up to a maximum value of 99.

SET GEN   This position allows access to the setting of the internal generator. Pressing the right arrow indicates FROM EXT meaning that the internal generator will be set from the external time code on the time code connector, if the "EXE" key is pressed. From this position pressing the down arrow will indicate SET TIME, from where, if the right arrow is pressed the display will indicate 00.00.00.00 and the left most digit will flash. By pressing the arrow keys modification of the values of each digit is allowed. The down arrow will increment the value and the right arrow will move the flashing digit to the right. Press EXE to store the new values into the internal generator. Pressing the down arrow from the SET TIME position will move the display to the SET USER position, and in the same manner as for the time code, the values of the USER BITS can be set. If the generator is in the DATE user bits mode then the numbers entered must correspond to the DD.MM.YY.xx format. If they are in the FREE mode then any value from 0 to F (hex) can be entered in each position. The RESET position allows the operator to immediately set the TIME portion of the time code to zero without affecting the USER information.

DELAY   This position allows the user to select the reference point for the time code of the NAGRA-D. The selection is necessary as there is a very small difference in the time code values on the inputs and outputs of the machine and also between digital and analog signals, due to the different processing time between digital and analog signals. This delay is only a matter of a couple of bits, but in very accurate synchronizing applications it may be necessary to take these delays into account. If these selections are not made then there will definitely be problems during synchronization.

INPUT   Pressing the right arrow from the DELAY position moves the display to the INPUT position. If EXE is now pressed this means that the time code is referenced to the sound at the input of the machine, and is the mode that should be used during recording. Pressing the right arrow allows the user to then select either ANALOG or AES inputs depending on the inputs being used for the recording. If the user is using one pair of inputs in the analog mode and the other pair in the digital mode at the same time then he must decide which of the two is to be the reference, the other will then have a small delay. The input delay selection can be stored in a template.

OUTPUT   Pressing the down arrow from the DELAY position moves the display to the OUTPUT position. This means that the time code is referenced to the sound on the output of the machine, and is the mode that should be used during playback and synchronization of the machine. Pressing the right arrow from OUTPUT allows the user to select either ANALOG or AES outputs depending on the outputs being used. If the user is using one pair of outputs in the analog mode and the other pair in the digital mode at the same time then he must decide which of the two is to be the reference, the other will then have a small delay. The output delay selection can be stored in a template.

GEN OUT   Pressing EXE when GEN OUT is on the display will feed the internal generator to the external time code connector on the left-hand side of the machine. Thus the internal time code generator of the NAGRA-D can be used as a master clock to set any external device.
This mode is only operational until another function is activated. Thus if for example the PLAY key is pressed then the signal on the time code connector will automatically switch to the time code playback signal. However this position is remembered when the machine is switched OFF, it will only be cancelled when another transport function such as PLAY is pressed.

SYNC   This is the start of the menu selections affecting the internal time code chase synchronizer of the machine. The internal synchronizer of the NAGRA-D is activated by pressing the PLAY + FF + REW keys simultaneously, and the synchronizer will synchronize according to the settings below. If the right arrow is pressed then the display will change to OFFSET.

OFFSET   The OFFSET position allows the operator to have access to the time code offset between the "off tape" time code and the time code reference. Pressing the right arrow key moves to the setting mode and pressing the down arrow moves to the next synchronizer option, which is SYNC MODE, the operating mode of the CHASE feature. If the right arrow is pressed then the display will show SET meaning that the operator has the possibility to press the right arrow again and set the offset in hours and minutes, and then automatically the seconds, frames and bits afterwards, upon pressing "EXE". This has to be done on two different display screens as there are only eight digits and it is not possible to indicate the hours portion and the bits of OFFSET at the same time. Values are entered using the down arrow to increment the value of the current digit and the right arrow to move to the next digit. Once the offset has been set, if the "EXE" key is pressed then this offset will be stored in the offset register. If the down arrow is pressed from the SET position the display will change to MODIFY and moving to the right now will display the current offset (in secs, frames and bits) and will also activate the N°4 FADE potentiometer allowing the offset to be changed "on the fly". In this mode the offset will change UP or DOWN depending on the rotational movement of the #4 pot. There are three angular positions STOP, SLOW modification and FAST modification depending on the angle through which the pot is turned. If the down arrow is pressed from the MODIFY position, then the display will show RESET. If EXE is pressed then the offset will be reset to 0.

CHASE The CHASE position allows the selection of the manner of synchronization of the NAGRA-D. There are two different possibilities of synchronization, the first being simply SYNC meaning that the time code on the tape corresponds exactly to that of the external reference, the second being SYNC INC (Incremental) meaning that there is an unknown time code offset between the external reference and the time code on the tape. When the machine is put into the SYNC INC mode (by pressing PLAY + FF + REW simultaneously) the offset between the two time codes at that exact moment is stored in the offset register automatically. From the SYNC INC position the right arrow may be pressed and the display will indicate the choice of external reference for the time code synchronizer.

The choices are REF TC (reference time code) or REF.FR.P. (reference frame pulse). The reference frame pulse allows the synchronizer to synchronize the time code on tape with an external video reference. In all cases, an external reference, of one form or another, must be fed to the machine for any mode of synchronization to be accomplished. The possible selections of the CHASE mode can be stored in a template.

SYNCMODE The NAGRA-D has two possible clock references that affect the operation of the synchronizer. The first is the FIX CLK. mode, where the machine will chase synchronize as normal until it reaches the exact SYNC point and will then switch to its internal crystals and continue from that point locked to its own internal reference rather than following the variations in the external reference. The machine will stay in the locked state until a difference of 1 frame is detected between the external reference and the "off tape" time code. The second mode is the VAR CLOCK mode which means that the machine remains locked via the VCLO to the external time code reference, and will follow the master time code exactly. Pressing the right arrow will show the present mode (FIX CLK or VAR CLOCK) and then the down arrow toggles between the two and EXE is used to select the desired mode. The selected SYNCMODE setting can be stored in a template.

NOTE: When slowing down the tape (from 60 to 59.94) the AES outputs of the machine will not be stable enough to make a digital copy UNLESS the machine is fitted with the VCLO option (10200). Machines with serial number lower than 1000600 may need a modification on the Encoder circuit before the option can be installed.

DISCONT This position allows the operator to switch ON or OFF the discontinuity handling feature of the internal synchronizer. This function is only operational when the machine is at nominal speed and in the LOCKED state. It is used to allow the machine to cross over discontinuities in the time code smoothly by either adding or subtracting the jumps from the offset register automatically. The operation of this feature can be stored in a template.

REACTIME This position gives access to the reaction time of the internal synchronizer. This is the number of incorrect consecutive frames that will be accepted during the SYNC mode before the NAGRA-D will drop out of the LOCKED state. The default setting for this is 15 frames, and can be set to any value from 15 to 999 frames (33 seconds at 30 fps or 42 seconds at 24 fps). This is used to handle time code drop-outs during post production. The reaction time of the internal synchronizer can be stored in a template.

BATTERY RESERVE DISPLAY

BAT XXX % is the display indicated when the down arrow is pressed from the TIME CODE position. This indicates in percentage the amount of power left in the internal battery. When an internal battery is removed and replaced, the machine will assume it is full and set the display to 100% unless it is otherwise programmed by the user.

```
┌─────────────┐  ┌─────────────┐  ┌─────────────┐
│ Bat. XX %   ├──┤ Charge      ├──┤ SET    0%   │
└─────────────┘  └─────────────┘  └─────────────┘
                                  ┌─────────────┐
                                  │ SET   25%   │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ SET   50%   │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ SET   75%   │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ SET  100%   │
                                  └─────────────┘
                 ┌─────────────┐  ┌─────────────┐
                 │ Capacity    ├──┤ 1.0 Ah      │
                 └─────────────┘  └─────────────┘
                                  ┌─────────────┐
                                  │ 4.5 Ah      │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ 5.0 Ah      │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ 5.5 Ah      │
                                  └─────────────┘
                                  ┌─────────────┐
                                  │ 6.0 Ah      │
                                  └─────────────┘
```
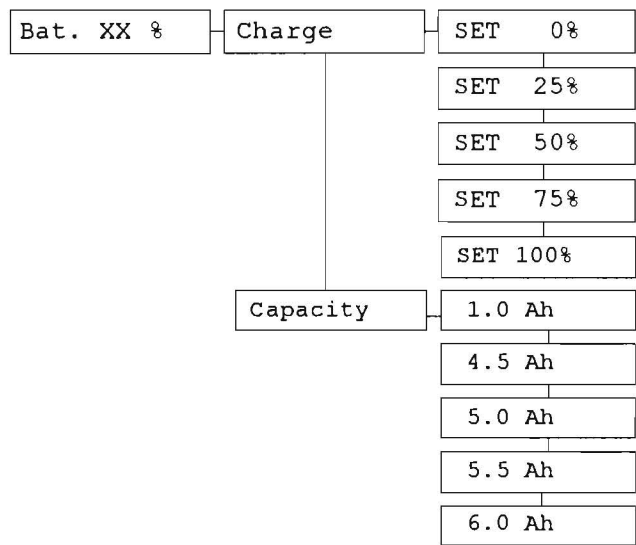
CHARGE From this position pressing the right arrow will indicate SET XX % (XX being the known battery reserve in %) this can be set to 0, 25, 50, 75 or 100 % by pressing the down arrow. When the correct value is displayed press the EXE key and the displayed value is automatically stored. Naturally if the operator sets this value incorrectly, for example to 75% when in fact the battery is only at 25%, when the charger is connected to the machine, the internal battery will charge until the display shows 100% but actually the battery itself will only be at 50%. In this event, during use of the machine the BATT warning led will start to flash once the battery drops to 50% on the display. As the internal battery pack of the NAGRA-D is a nickel cadmium has no electronics inside it is impossible for the machine to determine the amount of reserve that a battery has. Thus if the setting is done incorrectly by the operator then the battery reserve indication will never be right.

If the battery is set to anything other than 100% then the ND-CCC / ND-EPC (when connected) will automatically be instructed to charge it at the 400 mA rate until it reaches 100 %.

CAPACITY If the down arrow is pressed from the CHARGE position then the display will change to CAPACITY. Pressing the right arrow from this point will indicate the capacity of the battery installed (4.5 Ah). If a different capacity battery is being installed in the machine then the capacity can be selected by pressing the down arrow until the correct capacity is displayed and the EXE key is hit. The possible settings are 1.0 Ah, 4.5Ah, 5.0Ah, 5.5Ah or 6.0 Ah.

The 1 Ah setting is specially for those who wish to use the machine with external batteries, portable, and to keep the overall weight of the machine to a minimum. When the internal battery display reaches 20% and the internal battery is not being charged from an external source then the BATT led will flash on for 1 second periods every 5 seconds to indicate that the battery is getting flat. When the internal battery falls below 10.8V then it is considered flat, and the display is set to 0% even if it previously read higher.

INPUTS SELECTION

This position in the menus allows the operator to select the status of the audio inputs of the machine. As the NAGRA-D has both analog and digital inputs, then the required ones need to be selected. Muting and copying possibilities are also possible. This setting can be stored in a template if desired.

```
┌─────────┐  ┌─────────┐  ┌──────────────┐
│ Inputs  ├──┤ In 1--2 ├──┤ 12       ANA │
└─────────┘  └─────────┘  └──────────────┘
                          ┌──────────────┐
                          │ 12       AES │
                          └──────────────┘
                          ┌──────────────┐
                          │ 12  Cpy  34  │
                          └──────────────┘
                          ┌──────────────┐
                          │ 12      MUTE │
                          └──────────────┘
             ┌─────────┐  ┌──────────────┐
             │ In 3--4 ├──┤ 34       ANA │
             └─────────┘  └──────────────┘
                          ┌──────────────┐
                          │ 34       AES │
                          └──────────────┘
                          ┌──────────────┐
                          │ 34  Cpy  12  │
                          └──────────────┘
                          ┌──────────────┐
                          │ 34      MUTE │
                          └──────────────┘
             ┌───────────┐  ┌──────────────┐
             │ Ref.Level ├──┤   00   dB   │
             └───────────┘  └──────────────┘
```
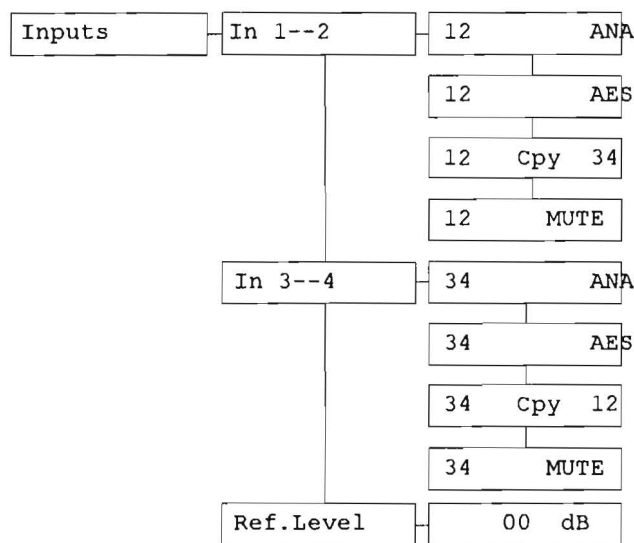
IN 1--2   If the right arrow is pressed with INPUTS on the display it will change to IN 1-2 indicating the setting for channels 1 and 2 is being looked at, and when pressed again will indicate ANALOG, AES, COPY 3--4 or MUTE. If execute is pressed then the inputs 1 and 2 are set according to the current display. Pressing the down arrow will scroll through the other choices. The AES position is the position to be used if the digital inputs of the machine are to be used. Copy 3--4 means that the inputs 1 and 2 are set to copy the information that is being sent to channels 1 and 2. This is done digitally within the machine and the copy will be made whether the analog or digital inputs 3 and 4 are being used or not.

IN 3--4   Once a selection for inputs 1 and 2 has been made, the display will automatically move to the position IN 3+4 and by pressing the right arrow (and then the down arrow) the same possible selections can be made for the other two inputs.

REF LEVEL If the down arrow is pressed again after IN 3--4 then the display will change to REF LEVEL which is the internal reference oscillator. Pressing the right arrow will change the display to XX dB. Pressing the down arrow allows the level to be changed. The level of the reference can be set at any value from 0 dB to -20 dB in 2 dB steps. When the EXE key is pressed then the generator is activated, and will remain so until the display is changed to another indication. If the machine is now put into RECORD mode the internal generator will be recorded onto the tape (assuming the audio channel selectors are in the READY position).

NOTE: The overload leds will always be alight when the reference oscillator is activated irrespective of the level selected.

SAMPLING FREQUENCY SELECTION

The NAGRA-D is capable of playing back tapes recorded at one sampling frequency at a different sampling frequency, for example a tape recorded at 48kHz can be played back at 44.1 kHz the only difference will be that the sound will be "slower". It is quite easy to make this mistake. Naturally when the tape is played at a sampling frequency other than that at which it was recorded then the whole transport will change speed. The scanner will also change speed. This will cause problems with synchronization as the time code will also change speed. The actual sampling frequency recorded on the tape can only be visualized on the screen of the PC in the NADCOM software. This setting can be stored in a template if desired.

SAMP FREQ This is the indication if the down arrow is pressed from the INPUTS position. If the Right arrow is pressed then the display will indicate the presently selected sampling frequency (ie 48 kHz) the down arrow will then move through the other options which are 44.1 (kHz) and 32 (kHz). If execute is pressed while one of these is on the display then that value will be selected as the digital sampling frequency for the incoming audio signals.

Sam.Freq .	48 kHz
	44.1 kHz
	32 kHz
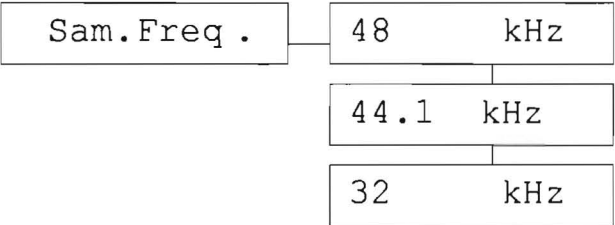
NOTE: If a tape is played back and its sampling frequency does not correspond to the sampling frequency selected in the machine then the FLAG 1 indication on the display will be lit. (This feature will not work if the machine is in the EE position).

REFERENCE FREQUENCY SELECTION

This is the reference frequency selection that tells the machine to which signal the clocks of the machine are to be synchronized. Generally the machine will be synchronized to its internal crystals (in the MASTER position), which will guarantee the correct sampling frequency and the full dynamic range. It is however possible to select another external reference, by moving through the possible choices using the arrow keys. If an external reference is being used then this signal must be stable. Pressing EXE on any of these positions will select the displayed choice as reference, and a single beep will be heard. These selections can be stored in a template if desired.

```
Ref.FreQ.  ─┤MASTER
            ├─AES 12-48
            ├─AES 12-44
            ├─AES 12-32
            ├─AES 34-48
            ├─AES 34-44
            ├─AES 34-32
            ├─PAL ──────┬─CRYSTAL
            ├─NTSC      └─VCLO        (VCLO MACHINES ONLY)
            ├─NTSC  60
            ├─REM .  48
            ├─REM .  44.1
            ├─REM .  32
            └─REM .9600
```
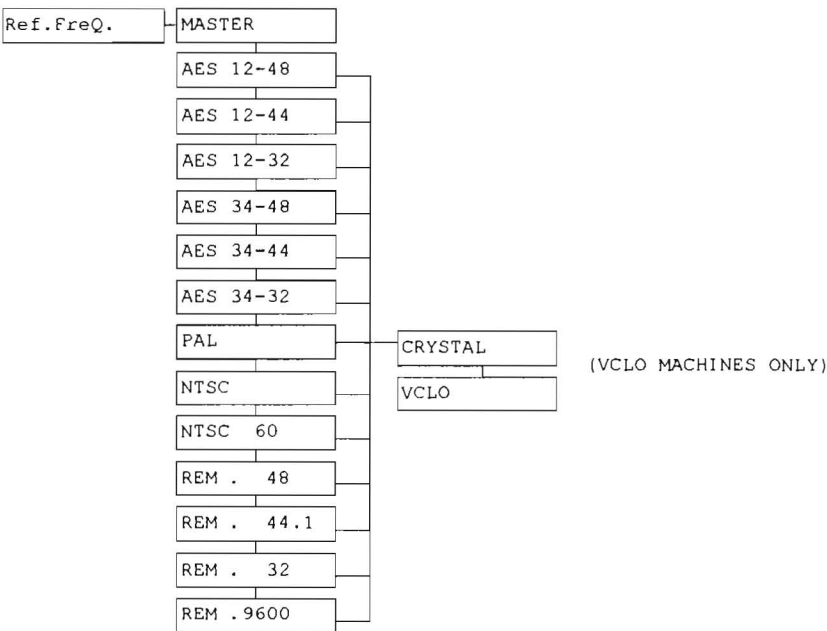
MASTER	Machine is set to be the master, and all internal clocks are synchronized using the internal crystals.
AES 12-48	External ref to be used is arriving on the digital inputs 1 - 2 at 48 kHz
AES 12-44	External ref to be used is arriving on the digital inputs 1 - 2 at 44.1 kHz
AES 12-32	External ref to be used is arriving on the digital inputs 1 - 2 at 32 kHz
AES 34-48	External ref to be used is arriving on the digital inputs 3 - 4 at 48 kHz
AES 34-44	External ref to be used is arriving on the digital inputs 3 - 4 at 44.1 kHz
AES 34-32	External ref to be used is arriving on the digital inputs 3 - 4 at 32 kHz
PAL	External reference is on the BNC connector in PAL 25 fps
NTSC	External reference is on the BNC connector in NTSC 29.97 fps
NTSC 60	External reference is on the BNC connector in NTSC 30 fps
REM 48	External reference is on the 15 pole "D" type at 48 kHz
REM 44	External reference is on the 15 pole "D" type at 44.1 kHz
REM 32	External reference is on the 15 pole "D" type at 32 kHz
REM 9600	External reference is on the 15 pole "D" type at 9600 Hz

Machines fitted with the VCLO 14 MHz. input reference possibility.

In normal operation the NAGRA-D's external reference must be very stable and close to the tolerances of the internal crystals (100ppm) otherwise the alarm led will flash to indicate loss of synchronization of the internal clocks of the NAGRA-D. The alarm led indicates that digital IN or OUT is impossible.

If the NAGRA-D is fitted with the VCLO option the machine can use an external clock reference that is not exactly at the correct frequency. An example of such an application would be to feed the video reference of NTSC (59.94) to the external video reference connector and to set the REF FREQ. selection in the MENU mode to NTSC 60 and the internal clock reference of the machine will then slow down by 0.1% and the AES outputs will still be usable and the output sampling frequency will be 44.056 kHz (if the original was 44.1 kHz) or 47.995 (if the original was at 48 kHz).

This VCLO function is on the inputs of the external clock reference and has nothing to do with the VAR CLK position for the time code reference and should not be confused.

The VCLO option can be selected in the menu mode by going to the REF FREQ position and moving to the desired reference (ie NTSC) and then pressing the right arrow key and the display will then indicate CRYSTAL (indicating VCXO operation) if the down arrow is then pressed then the display will show VCLO. This selection is possible for all the reference positions, with the exception of the MASTER position where the machine will always use its internal crystals (VCXO).

Note: The installation of this option can be made on machines with serial number 1000600 or higher and this requires the installation of the software version V1.03 for the CPU or higher.

TAPE SPEED SELECTION

This selection allows the operator to select either the standard tape speed (99.2 mm/s) for four channel operation, or the half speed position (49.6 mm/s) for two channel operation. At this tape speed only channels 1 and 2 are operational. In the half speed mode of operation of the machine will give 2 hrs of stereo operation using a single 5" reel of tape. During operation at the slow speed, the ECC display will indicate FA permanently for the right two digits as there are no tracks 3 + 4 on the tape. The default mode of the machine is the FULL SPEED position. Pressing EXE when the desired speed is on the display will select it. This setting is stored in memory and need not be set each time the machine is powered up. This selection can be stored in a template if desired.

```
┌──────────┐    ┌─────────────┐
│ Tape SPd.│────│ FULL SPD  . │
└──────────┘    └─────────────┘
                ┌─────────────┐
                │ HALF SPD  . │
                └─────────────┘
```
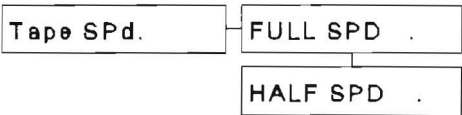
DIRECTORIES

This position in the menu tree allows the operator to have access to the tape directory function. Moving to the right from this position will display MODE and moving again to the right will give the choices ENABLE or DISABLE to either turn ON or OFF the directory mode. The operation of the directories can be stored in a template if desired.

REEL NO Pressing the down arrow from the MODE position will display REEL N° X which indicates the reel number presently being used. Moving to the right from this position allows the operator to enter the reel number (from 0 to 9) using the arrow key. Pressing EXE will then store this reel number.

REFORMAT Pressing the down arrow from the REEL N° position will move to the REFORMAT display. This will erase the directory from the beginning of the tape AND WILL ERASE THE FIRST PART OF THE RECORDED TAPE while this is happening, the display will indicate "Erasing". If the REFORMAT command is executed the display will first indicate "SURE ?" which will require EXE to go ahead or ESC to abort. This is simply a protection to avoid accidental reformatting and consequent loss of information.

The operation and contents of the directories is covered in more detail at the end of this chapter under TAPE DIRECTORIES.

```
┌─────────────┐   ┌─────────────┐   ┌─────────────┐
│ Dir.        ├───┤ Mode        ├───┤ ENABLE      │
└─────────────┘   └──────┬──────┘   └─────────────┘
                         │          ┌─────────────┐
                         │          │ DISABLE     │
                         │          └─────────────┘
                  ┌──────┴──────┐   ┌─────────────┐
                  │ Reel Nb     ├───┤ REEL   X    │
                  └──────┬──────┘   └─────────────┘
                  ┌──────┴──────┐
                  │ REFORMAT    │
                  └─────────────┘
```
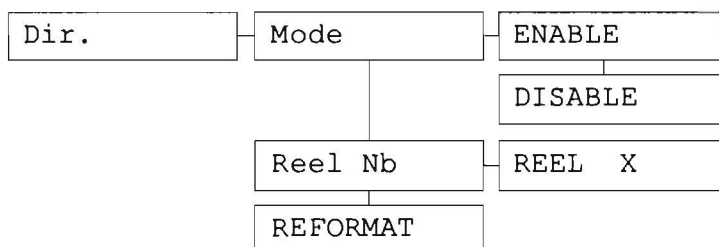
OTHER SETTINGS

This option allows access to various features of the machine that are not normally looked at on a regular basis. It allows the operator to either enable or disable the beep option, to activate the auto power down option, to look at and set the internal real time clock and also indicates the version of software installed as well as its date of release. In the OTHERSET menu, the scanner ready duration setting can be stored in a template if desired.

| OtherSet | Beep | DISABLE |
| | | ENABLE |

| | TRACKING |

| | Auto Pow. | DISABLE |
| | | ENABLE |

	Wind Spd.	1 m/s
		2 m/s
		3 m/s
		4 m/s

	Scan. Rdy.	1 MIN
		3 MIN
		5 MIN
		15 MIN

| | TaPeTens | 40gr. |
| | | 50 gr. |

| | Rtc | t 000000 | t 000000 |
| | | d DDMMYY | d DDMMYY |

	Rs 422	AUTO
		SONY	NAGRA-D
			BVU-800
		AMPEX

(IF OPTION INSTALLED)

| | Software | V 1.10 | TC V X.XX | MEM.RESET |
| | | 03/03/95 |

| | Headtime | H   XX,XX |
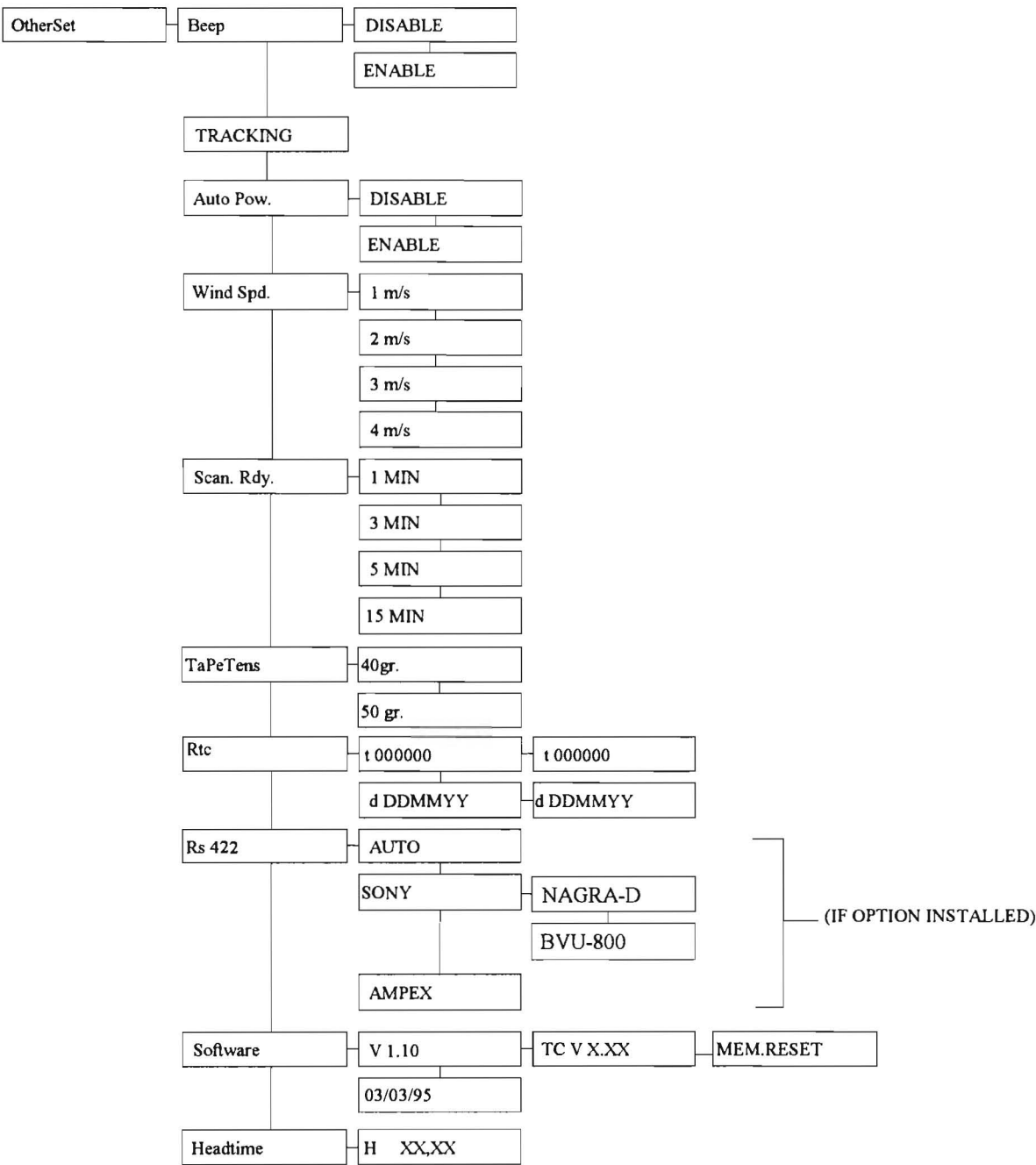
BEEP   The beep function can indicate several different actions within the machine, which are explained below. The options in the menu mode allow the beep signal to be either enabled (meaning that it will be heard on the headphones and internally via the beeper located within the machine) or it can be disabled in which case it will only be heard on the headphone outputs. As mentioned under battery, the beep signal will indicate when the machine is about to stop due to insufficient power available from the internal battery. Another operation of the beep function is when an Assemble is being made.

Two beeps will be heard if a CRASH RECORD on a new tape is made, or alternatively if a feature selected in the menu mode is refused. Two beeps will be heard if a CRASH RECORD is attempted on a new tape, or alternatively if a selection executed in the menu mode is refused.

If the machine is put into the Record mode and the tape has either a poor or missing control track and the INS/ASS selector is in the INS position, then THREE beeps will be heard and the machine will automatically go into the STOP position. This will also occur if the machine comes across a section of tape that is missing the control track during a recording. Secondly if the machine is put into record in the ASS mode, and there is no control track already recorded on the tape (ie a CRASH RECORD), then two beeps will be heard. If the machine is put into record mode (in ASS position) and there is a control track already on the tape then a single beep will be heard, to indicate an assemble is being made and the capstan is in sync. If the operator attempts to put the machine into RECORD mode before the tape directory (if the directories mode is on) then 5 beeps will be heard and the machine will refuse to go into record mode.

N° of beeps		Description
1		Acceptance of an executed command
	or	Assemble edit being performed
2		Crash record on a new tape or refused command
	or	Track not located after SKIP or GOTO END.
3		Abort insert edit
5		Attempted RECORD before the tape directory
	or	Memory lost on power up.

TRACKING   If EXE is pressed when "tracking" is on the display then the manual tracking adjustment is activated. This will turn the fourth fader pot into a tracking control similar to that on a VHS machine. When this feature is activated the LCD display will indicate the current tracking value and then the RF level. A Display such as "T119 L81" means Tracking "t" is currently 119 and the RF level "l" is at 81. If problems are encountered reading tapes then adjust the tracking so as to have the highest possible RF level indicated. Monitoring on headphones will clearly indicate the improvement as the RF level gets higher.

AUTO POW In order to prevent the internal battery going flat when the machine is not in use, the NAGRA-D is fitted with an AUTO POWER DOWN feature. When the machine is operating on its internal battery, with no external power attached then it will switch off after 15 minutes providing no keys or switches are activated during this period. If the feature is enabled, then this will also be the case even if the machine is connected to the external charger, however it will only come into effect once the internal battery is at 100% so that the machine does not switch itself off during charging. If the feature is disabled, then it will still switch itself off if it is on internal battery operation, as above but it will remain ON permanently as long as there is an external supply providing power. Before the machine actually switches OFF, the BAT led will flash rapidly for 15 seconds to indicate to the operator that the machine is about to turn itself off. Also two beeps will be heard at the moment that the machine goes off.

	External Supply Connected		No External Supply
Auto Power	Battery charging Batt < 100%	Battery charged Batt=100%	
ENABLE	NO Auto power off	Auto power off after 15 mins	Auto power off after 15 mins
DISABLE	No Auto power off	No auto power off	Auto power off after 15 mins

WINDSPD   The wind speed selection gives the user the possibility to slow down the winding speed of the machine so that the spooling of the reels is even. This feature can be activated in the all modes. The possible speeds that can be selected are in meters per second (4 being full speed). To activate it simply press EXE when the desired speed is on the display.

SCAN RDY   The scanner of the NAGRA-D will stay in the ready mode for 1 minute when no key is pressed, before stopping under normal circumstances. This menu allows the operator to select how long it will continue to rotate. The selection can be 1 min, 3 mins, 5 mins or 15 mins. This setting can be stored in a template if desired.

TAPE TENS   The Tape tension selection has been introduced in order to allow the user to select a slightly higher tape tension in PLAY and RECORD modes. If the lower tension is used there may be slight drop in RF signal level at the start of each track with certain tapes. Moving to the right from this display will show the presently selected tape tension (either 40 gr. or 50 gr) and pressing the down arrow will display the other tension. Pressing EXE will select the new value. The setting needs to be selected for 5" or 7" operating positions. The tape tension should be selected for the tape according to the table below:

Low Tension 40 gr.	High Tension 50 gr.
AMPEX 467	3M 275 LE
BASF DM 931	
SONY DIGITAL	

RTC   Apart from the time code system, the NAGRA-D is fitted with its own internal real time clock. The time and date of this clock can be accessed through the RTC menu. If the user wishes to set the time and date to a value other than the present one, simply use the right arrow key while looking at the time or date to move to the set mode. In this mode the left most digit of the display will be flashing and can be altered using the down arrow. Once the desired value is reached then press EXE. All the date modes within the NAGRA-D are in the format DD MM YY. This feature is very important when the DIRECTORIES are being used as it is this information that is used to indicate when (date and time) a certain recording was made.

RS 422   This position allows the selection of the RS 422 protocol. The default setting is the AUTO selection which means that the machine will detect which protocol is being used. In some cases it may be necessary to specifically select a protocol, this is done by pressing the EXE key when the desired protocol is displayed. Moving to the right from this position gives the possibility for the user to "force" either the Sony or Ampex protocol. If the Sony protocol is selected to the display, then the user can move to the right and select the type of machine to emmulate. The possible choices are either NAGRA-D or

BVU-800.

SOFTWARE This is to display the version of the CPU software installed in the machine. If the right arrow is pressed when this is on the display then the actual number will appear. It will indicate V X.XX which corresponds to the version number of the software for the main micro-processor. If the right arrow is pressed then the display will show the version of the software installed on the time code circuit. If the down arrow is pressed while the machine version number is being shown, then the display will indicate the date of the software release. If the right arrow is pressed when the time code version of the software is on the display then the display will move to the MEM RESET position. This feature will reset all the default settings of the menu tree, and will erase any directories etc that may be in memory. To activate it, press EXE and the display will ask SURE ? and EXE a second time will confirm the request.

HEADTIME When the right arrow is pressed from this position, then the display will move to the headtime display. This is the indication of the number of hours that the pinchwheel carriage of the machine has been in its forward psoition (tape in contact with the scanner). It indicates the time in hours and tenths of hours. This indicator is for those who wish to charge for the machine based on the amount of use that it has. It is very difficult to use this indication as an accurate timer for head life as the actual life of heads can vary greatly.

FADER POT SELECTIONS

FADER   This position in the menu allows access to some of the possible features of the fader potentiometers. The FADER pots in the machine allow several other features other than simply the FADE command. These include, FADE OVERRIDE and PHASE OVERRIDE.
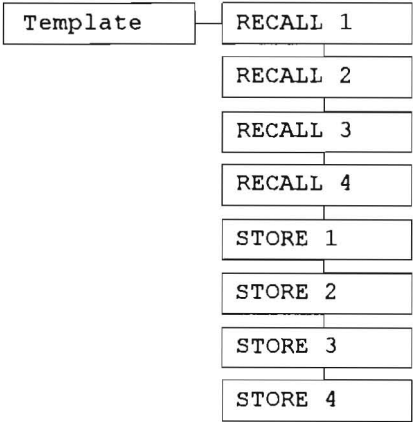
```
┌──────────┐   ┌──────────┐   ┌──────────────┐
│ Fader    │──┤Assign    │──┤ SET 1111     │
└──────────┘   └──────────┘   └──────────────┘
                              ┌──────────────┐
                              │ SET 1133     │
                              └──────────────┘
                              ┌──────────────┐
                              │ SET 1212     │
                              └──────────────┘
                              ┌──────────────┐
                              │ SET 1234     │
                              └──────────────┘
               ┌──────────┐   ┌──────────────┐
               │Fade Src. │──┤ TAPE         │
               └──────────┘   └──────────────┘
                              ┌──────────────┐
                              │ KEYBOARD     │
                              └──────────────┘
               ┌──────────┐   ┌──────────────┐   ┌──────────────┐
               │PhaseSrc .│──┤ TAPE         │──┤ Ph. N.N.N.N  │
               └──────────┘   └──────────────┘   └──────────────┘
                              ┌──────────────┐
                              │ KEYBOARD     │
                              └──────────────┘
```
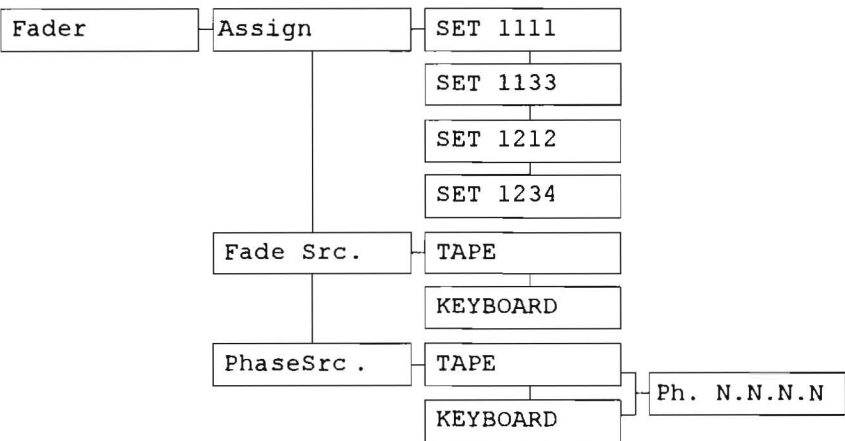
ASSIGN   The ASSIGN position allows the operator to assign the configuration of the fader potentiometers in their normal mode of operation. Moving to the right here will indicate the present configuration. The default setting is 1,2,3,4 and this means that fader pot # 1 acts only on channel 1, fader pot # 2 acts only on channel 2 etc etc. There are other possibilities that can be chosen, to allow multiple channels to be controlled from different pots when making fades. The choice is selected by pressing EXE when the desired selection is displayed. This is not remembered when the machine is switched off. If 1,1,1,1 is selected then all four channels will react to the position of the fader pot # 1. If 1,2,1,2 is selected then channels 1 and 3 will be controlled by the fader pot # 1 and the channels 2 and 4 will be controlled by the fader pot # 2. If 1,1,3,3 is chosen then the channels 1 and 2 will be controlled by the fader pot # 1 and the channels 3 and 4 will be controlled by the fader pot # 3. This setting can be stored in a template if desired.

FADE SRC   This selection allows the operator to decide from where the fade commands are to be taken during playback. Either those initially recorded onto the tape or new ones made from the keyboard. This setting can be stored in a template if desired.

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PHASE SRC In the PHASE SRC position, the position of the PHASE switches (also recorded) can be selected to use either those recorded or those presently selected on the front panel (if KEYBOARD is selected). If the right arrow is pressed when in the TAPE position the display will show four digits separated by comma's corresponding to the recorded PHASE position of channels 1,2,3 and 4 respectively. This setting can be stored in a template if desired.

TEMPLATE

SETTINGS   The template settings position gives the user the possibility to store in the EEPROM his personalized settings for the menu's of the machine. All the required settings should be set for the particular application and then the number of the template to be used by pressing STORE 1, 2, 3 or 4. From then on each time the RECALL 1, 2, 3 or 4 is pressed then their respective settings will be restored.

```
┌──────────────┐   ┌──────────────┐
│  Template    ├───┤  RECALL  1   │
└──────────────┘   └──────────────┘
                   ┌──────────────┐
                   │  RECALL  2   │
                   └──────────────┘
                   ┌──────────────┐
                   │  RECALL  3   │
                   └──────────────┘
                   ┌──────────────┐
                   │  RECALL  4   │
                   └──────────────┘
                   ┌──────────────┐
                   │  STORE  1    │
                   └──────────────┘
                   ┌──────────────┐
                   │  STORE  2    │
                   └──────────────┘
                   ┌──────────────┐
                   │  STORE  3    │
                   └──────────────┘
                   ┌──────────────┐
                   │  STORE  4    │
                   └──────────────┘
```

As this information is stored in the EEPROM of the machine the settings will not be lost if the internal battery of the machine is removed, or if the software version is updated.
All the possible settings that can be stored in a template are indicated on the main menu drawing at the beginning of this section, by a thick outline to the particular menu.

CUE TRACK

As mentioned in chapter 1 of this manual the NAGRA-D has a longitudinal CUE track located along the upper edge of the tape which has two main functions, either the recording of an external cue microphone for commentary purposes, or recording a mix of the 4 digital channels.

NOTE: Recording of the Cue channel after the original recording has been made will result in future playback problems, as this type of recording will corrupt the control track already recorded on the tape.

USING THE CUE TRACK

Check that the CUE channel lock-out switch is set to the READY position. When the machine is put into record mode the cue track will automatically record a mixture of the four audio channels, either from the digital or analog inputs depending on the input selections made. The information for the cue track is recorded on a longitudinal track at the top of the tape (see "footprint") and is recorded in analog by the longitudinal head that is also used to record time code and the control track. The signals are taken after the D/A converters, which means that even if the input signal to the standard audio channels is being supplied in the AES format to the two digital inputs, an analog signal is still recorded on the cue track. The advantage of this mode is that in EDIT mode (EXE + PLAY) the cue track can be read and fed to the headphone outputs allowing location of a particular section of the tape audibly at speeds other than nominal, the direction of the tape and its speed is controlled by the fader pot # 4 during this mode.

In order to listen to the cue track the headphone mode selector can be put in the CUE position, and then the monitoring is only made on the cue track. (If the headphone outputs are selected to monitor the normal helical tracks then the monitoring will automatically switch to the cue track when the tape is not at nominal speed.) When the machine is put in playback mode the cue track is now fed to the headphone outputs. If the fast forward or fast rewind keys are pressed while in the playback mode then the tape will move at 4 times nominal speed in the corresponding direction as long as the respective key is held down, thus allowing audible searching off tape by monitoring the longitudinal cue track.

USING THE ND-CM CUE MICROPHONE

The ND-CM is the cue microphone adapted for use with the NAGRA-D. When connected to the 15 pin EXTENSION connector on the left-hand side of the machine, the cue track can be used to record commentary upon pressing the small black button on the cue mic. (assuming that the cue track lock-out selector is in the READY position. It should be noted that the CUE track will also record the mixture of the four digital channels and any commentary made will be recorded in addition to this. The ND-CM cue microphone can only be used during the initial recording (unlike on the NAGRA IV-S where it can also be used during playback), as a signal recorded on the cue track during playback will interfere with the control track already recorded on the tape.

MONITORING ON HEADPHONES

The NAGRA-D is fitted with two 1/4" Jack headphone outputs located on the right-hand side of the machine. This has been done to prevent the operator removing his headphones in order to allow a third party to monitor the recording. The headphone outputs are taken after the D/A converters, so that even when working in the digital domain the signals can still be monitored. The output level of these headphone outputs is controlled via a 5 position switch located directly above them. This volume control acts for both outputs together. The selection of the signals fed to the headphone output connectors is governed by the monitoring selectors on the main control panel.

The 4 headphone selection switches function in conjunction with the mode selector switch 2 and the direct switch 3 (see chapter 2 for these references). There are four switches (each corresponding to one channel) each having three positions. These positions are SOLO / ON / OFF. The SOLO position is a snap switch and must be held in the SOLO position. When in the SOLO position the signal from the selected channel is centered on the headphone outputs, and the other channels are inhibited while the switch is held in the SOLO position. The four (1, 2, 3, 4) headphone switches are also labelled L, R, L, R respectively. This means that if selector 1 is ON then the signal will be fed to the left channel of each of the headphone outputs. If selector 2 is ON then it will be fed to the right channel and so on. Thus having stereo monitoring between two channels is possible between the following combinations: 1+2, 1+4, and 2+3. The combination of 1+3 is not possible as they would both be on the same channel superimposed.

The headphone mode selector is a three position switch which selects the mode of the headphone outputs. The three positions correspond to MONO / STEREO / CUE. In the cue position the headphone outputs monitor the longitudinal CUE track.
Under normal operation, then the audio outputs are automatically switched to the CUE track as soon as the machine is not at nominal speed, allowing rapid audio location of portions of the recording.

EDIT MODE (SEARCH / SHUTTLE)

This mode is selected by pressing EXE and PLAY which is marked EDIT above the playback key. Once it has been switched ON then the speed and the direction of the tape can be controlled using the fader potentiometer corresponding to channel 4. When this mode is selected the monitoring is made on the longitudinal CUE track (which either has a mix of the 4 digital channels or commentary recorded on it). Using this mode the operator can rapidly locate specific sections of the recording audibly. To stop the search / shuttle mode, simply press the STOP key on the main control panel. The search mode will allow the machine to move from -1 to +1 times nominal speed. During the search mode both of the leds REW and FF will be alight. If the fader pot is put into its central position, the tape will stop moving, and after 3 seconds the tape guide carriage will move back, taking the tape away from the drum and the PLAY led will start to flash. This is done to prevent the scanner turning on the same point on the tape in order to prevent unnecessary tape and head wear. The play led will flash until the fader pot is moved again, which will immediately revert to the edit mode.

MICROPHONE INPUTS $See\ CH.2,\ PAGE\ 5 + PAGE\ 18,\ PAR.2$

Audio sound recordists are used to working with mixing consoles equipped with a sliding "fader" potentiometer and a "pad" to obtain the operating level / input sensitivity, for each microphone input. Initially, the pad position is set to give approximately zero dB and is then left in the same position for the entire recording. Any fine adjustments, made during the recording, are done using only the fader. If this method is used for a recording that begins at a signal level of -40dB, then as the level increases during the recording, the slider is slowly lowered to compensate, and there becomes a point where the inputs are saturated. If the reverse occurs, that is to say a normal recording is being made, and the level slowly falls off in a quiet portion to -40 or -50 dB then the inherent noise of the source (microphone for example) becomes too great.

The user may take the precaution of keeping a suitable reserve by means of the input sensitivity attenuator (pad), however in this case it is the noise that limits the performance of the input amplification chain. Calculation shows that, in order to guarantee a dynamic range of 108 dB, necessary to make a recording with 18 bits, guarding a reserve of 20 dB is only possible at the cost of heavy power consumption, as the reserve is lost across the potentiometer, which is not practical in a self-contained recorder.

To work using a system based on 18 or 20 bit resolution, obliges us to use a different philosophy with respect to the input circuitry, and also to slightly change the habits of the sound recordist. Many different points came to light while studying the concept of the input circuitry of the NAGRA-D.

-        To guarantee a real dynamic range of 108 dB, thanks to the internal levels being very high.
-        To clearly indicate to the sound recordist that the positions of the Fade and Level which guarantee an optimal dynamic range are clearly marked.
-        To drastically reduce the number of active and passive components in the amplification chain in order to limit distortion and the effects of intermodulation.
-        To make the phase errors and group delay negligible by a distribution and a choice of correct RF and anti-alaising filters.

The sound engineer adjusts the input sensitivity of his microphone and of the approximate recording level by means of the PAD, which is often in the form of a switch. During the recording, he therefore only has access to the fader control in order to refine the recording level, being obliged to accept the inconveniences explained above.
In the case of an analog recording, or a digital recording limited to 16 bits this problem is minimal. However this is not the case for a recording of 18 or 20 bits.

As the synoptic diagram above shows, the level is adjusted by means of a potentiometer, and it is this that will be used during the recording process to insure the correct level at the input of the A/D converter. The range of its adjustment is from ⓠ+3 dB to -34 dB. That is to say that while operating within these limits the full dynamic range is guaranteed.

Below -34 dB the thermic noise of the input source (200 Ω) on the input, will be greater than the noise of the A/D converter. Above + 3dB, the input stages will be saturated due to the restrictions on the power consumption needed in a self-contained recorder.

Having passed through the standard filters (LFA, Speech and Flat) as on other NAGRA portable recorders and carrying or not the correct accentuation for digital systems, the signal is then digitalized. The next stage of the signal treatment is then taken care of by the DSP
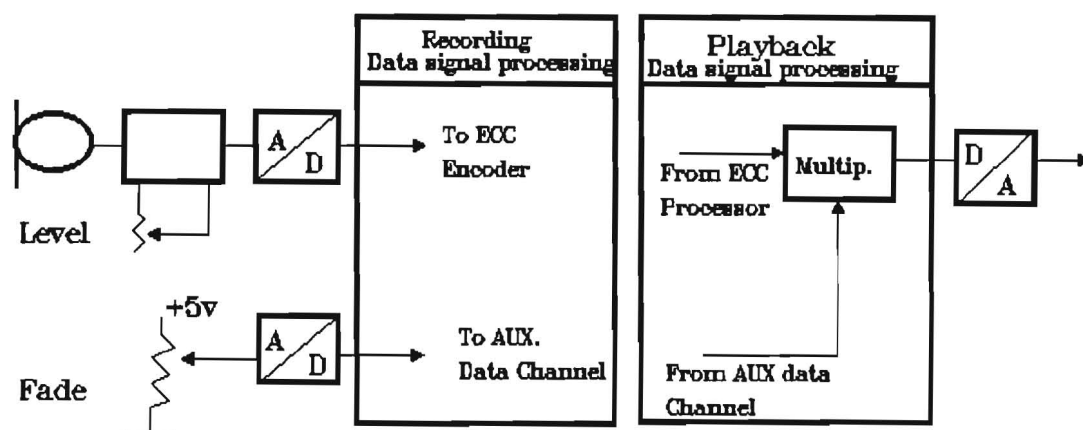
(or high speed microprocessor whose architecture is destined towards signal processing)

The operation of the Fade is then insured by a software potentiometer. An interesting peculiarity in the NAGRA-D is that the fades are not made on the original recording, but simply the corresponding fader pot position information is recorded as auxiliary data channel, and following these instructions the fade is then effected during the replay, digitally. The obvious advantage of this system is that in the event that a fade has been missed or badly

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Ⓠ + 3.0 db could B too high. 0.0 db seems to be better

executed during the recording process (due to an unexpected restart, or a surprise "encore" etc) the originally recorded fade commands can be inhibited by means of the PC, and can be re-made at a later date in the studio using the fader potentiometers, as the original material was recorded despite the fade command. This can be termed "Non destructive fading". The fader pots can also be linked (using the menu's) so that two pots can be used to control four channels, or pot # 1 to control all four channels.

In passing it should be noted that the LF signals do not pass through fader potentiometer, it simply supplies a continuous flow of instructions, which can be filtered thus eliminating the "spitting" noises inherent in this type of component. It is this digitalized level which follows the multiplication coefficient in the DSP during replay.

Physically on the NAGRA-D these two controls, Fade and Level, are mounted coaxially.

(Please refer to the photograph of the potentiometers on the following page)

The external ring controls the level and is calibrated from +3 dB to -34 dB, and the center knob controls the fade function. Here another explanation is needed in order to explain the need for two distinctive working areas of the fade control.

The shaded area to the right insures the actual fade function. The area to the left (calibrated 0 to -34 dB) is used to increase the input sensitivity, allowing 0 dB to be indicated on the meter even with a very feeble input signal. It however goes without saying that the noise level will increase equally. For example if the fade control is placed in the -30 dB position, the useable dynamic range will now be 108 - 30 = 78 dB. The central position of this potentiometer is indicated by the green CAL led. To resume, as long as the fade potentiometer is in the central position, the user can be sure that throughout the working zone of the level adjustment (external ring), and if the modulometer indicates 0 dB, that 18 bits (108 dB) of dynamic range is available using a source of 200 Ω.

Finally, the sum of the level and fade scales and that of the indication on the modulometer gives the input level in dB/600 Ω.

Example: Level   + 2 dB   *(MIGHT OVER-DRIVE THE INPUT)*
                Fade   - 4 dB   *SEE CH. 3, P. 37 "RECORDING A*
                Modulometer - 4 dB   *LINE SIGNAL*

Input level = +2 -4 -4 = -6 dB.
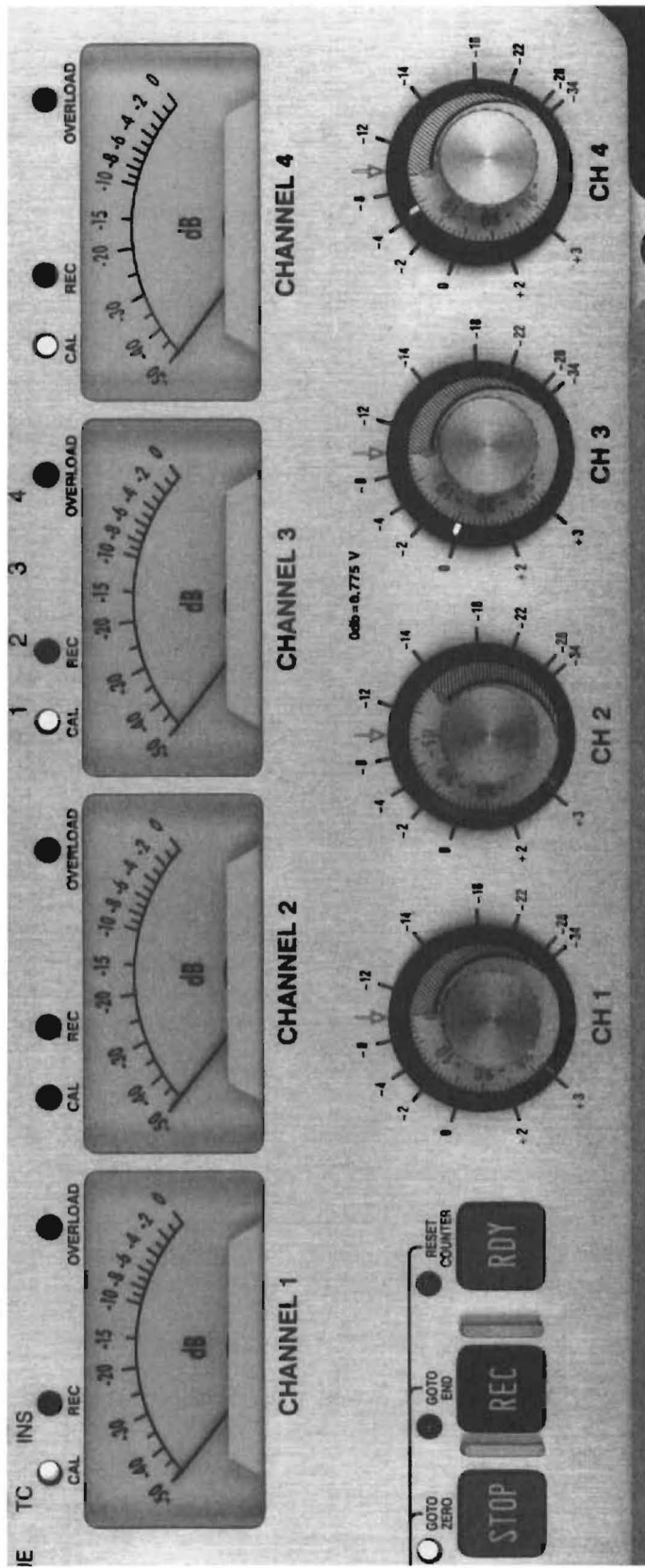
In this instance, this indicates an incorrect set up because in the above example the fader is set to -4 and the level allows a further 1 dB (max +3dB). The fade being at -4 means that we loose 4 dB in signal-to-noise ratio. In this case it would be more advantageous to set the potentiometers as follows:

Level	+ 3 dB
Fade	0 dB
Modulo	- 4 dB

The 108 dB of dynamic range will not be obtained in these examples as the modulometer is indicating -4 dB.

RECORDING

The NAGRA-D can record using ANALOG, DIGITAL and CUE microphone. The selection of ANALOG or DIGITAL inputs is made via the MENU mode under the title INPUT selection. Analog inputs are recorded through the four analog input XLR connectors on the left-hand side of the machine, and the digital inputs through the two AES input XLR connectors. Cue information is a mix of the four audio channels, and if required a CUE signal fed to the EXTENSION connector or from the ND-CM cue microphone. The cue track is fitted with an ALC circuit so all the signals will be recorded at the same level.

RECORDING WITH MICROPHONES

The four XLR inputs on the side of the NAGRA-D are cabled according to the standard XLR pinning. That is to say pin 1 is earth, pin 2 is the signal positive, and pin 3 is the signal return. Unlike the NAGRA 4.2 and IV-S the powering for "T" power microphones is NOT reversed.

Connect the desired microphones to the chosen inputs (remember the stereo pairs are inputs 1 + 2 and 3 + 4. Select the desired type of microphone using the rotary selector above each input. Press the POWER ON button. The machine is automatically set to the EE (direct) mode, and the microphone levels for each channel can now be adjusted using the outer ring of the co-axial potentiometers corresponding to each input. Check that the fader potentiometers are in their CAL position and that the green led above each meter is alight. (these may be turned to increase the input level sensitivity if necessary, if the input level is not great enough). Phase inversion and filters may also be selected using the corresponding switches on the front face of the machine if desired. The direct signal can be monitored on the two headphone outputs.
The default mode of the machine is high speed 4 channel operation.
Set the lock out selectors to the ready position for the channels to be recorded. Put a new reel of digital tape on the machine and leave the machine to format the directory (if the directory mode is ON) (SEE DIRECTORIES) once this is complete press STOP. Set the INS/ASS switch to the ASS (assemble) position. Set the EE/AUTO/TAPE selector to the AUTO position.

Press the RDY (ready) key and the scanner of the machine will start to rotate, once it is stabilized the yellow led will stop flashing. The machine is now ready to be put int record.

Press the REC and PLAY buttons simultaneously, the tape will be laced onto the scanner, and the recording will begin and a beep will be heard in the headphones to indicate that the machine has started recording. During the recording the input sensitivity may be adjusted if necessary using the input level sensitivity potentiometers and fades may be made with the ① FADER pots. If the monitoring selector is left in the AUTO position then the monitoring in the headphones is the "off tape" signal. The maximum peak levels obtained during the recording may be seen on the meters by putting the meter switch into the MAX HOLD position, and then reset by pushing the switch to the RESET HOLD position.

It should be noted at this point that if the machine has microphones connected to the analog inputs, and the tape selector switch is in the position AUTO or EE then automatically the inputs are fed to the line outputs.
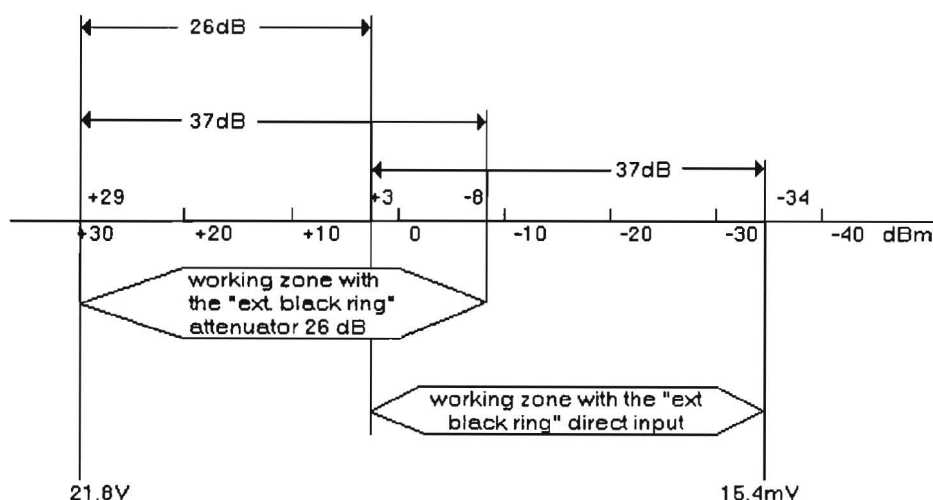
RECORDING A LINE INPUT SIGNAL

The line input connectors are the same connectors as used for the microphone inputs. Connect the line signals to be recorded to the input connectors and set the switches above the connectors to the LINE position. Then proceed in the same manner as explained above for recording with microphones. The maximum input level for the NAGRA-D is +3 dB which is a lot lower than the output of most mixers. The accessory ND-LIA (Line Input Attenuator) should in this case be used for matching. The drawing below shows the respective input levels that can be used with and without the attenuators.

① THESE ARE BETTER LEFT IN THE "CAL" MODE

RECORDING A DIGITAL SIGNAL.

To record a digital input on the NAGRA-D, firstly ensure that the digital signal being supplied is in the AES format. Put the display of the machine into the MENU mode by pressing the DOWN arrow and INPUTS will be displayed. Go through the procedure as explained, in detail, under MENUS earlier in this manual, and set the desired pair (or both pairs) of inputs to the AES position. Then proceed to set the reference frequency (it must be set to the same frequency as that of the incoming AES signal, either 32 kHz, 44.1 kHz or 48 kHz) also in the menu mode. The lock-out switches for the channels to be recorded must of course be in the READY position before the machine is put into record. Once this has been done the machine is ready to make the recording. Monitoring is the same as explained above for recording with microphones or line, however, naturally the input level sensitivity potentiometers no longer have any effect on the incoming AES signal.

PLAYING BACK A RECORDED TAPE

Install the tape to be played back on the machine as explained under "loading a tape". Wait for the machine to take-up the tension and for it to locate the directory (if the directory mode is on) once this is complete then the machine is ready to play back the tape. When ready to play the tape press the PLAY key, the tape will engage and the playback signal will be on the four (or 2) analog outputs as well as the two digital AES outputs. Monitoring of the playback signal on the headphone outputs is of course possible and the selections of the channels must be made with the headphone selection switches. During playback, if either the FF (fast forward) or REW (rewind) keys are pressed then the tape will move in the desired direction at 4 times nominal speed. The standard outputs will automatically be muted, however monitoring of the longitudinal CUE track is possible on headphones.

If the directory mode is ON then the SKIP features as well as the GOTO END are activated. Pressing EXE + REW will go to the previous take, pressing EXE + FF will go to the start of the next take and EXE + REC will go to the end of the recorded part of the tape. If the directory mode was OFF when the tape was recorded then these features will not operate. Selection of a particular take to be played back can also be made via the PC using the NADCOM software (see EXTERNAL CONTROL).

MAKING A COPY OF A NAGRA-D TAPE

Copying a NAGRA-D tape is possible in several ways, either digitally onto another NAGRA-D, or digitally onto another recorder having AES bus possibilities, or of course in analog.

COPY TO ANOTHER DIGITAL MACHINE

Simply connect the digital outputs in question to the other equipment, check that the sampling frequency and reference of the receiving machine are the same as those on the NAGRA-D. Put the recorder machine into record and then press play on the NAGRA-D.

MIRROR COPY OF A NAGRA-D TAPE TO ANOTHER NAGRA-D

This feature is not yet available. Naturally making a simple copy as explained above is possible but the directory will not be updated, and hence the skip features and other information stored in the directory will not work on the copy.

COPY CHANNELS 1 + 2 FROM THE NAGRA-D ONTO CHANNELS 3 + 4

This can be done in two ways, either in analog or digital, however generally this will be done in digital. Connect the digital outputs (1 + 2 assuming that the source material is recorded on channels 1 + 2) to the digital inputs 3 + 4. Set the mode selector ASS/INS into the INS (insert) position, make sure that the lock out switch for channels 1 + 2 is in the SAFE position and then put the machine into REC by pressing REC and PLAY together. Channels 1 + 2 will then be copied onto channels 3 + 4.

REMOVING THE INTERNAL BATTERY PACK

The internal battery of the NAGRA-D is considered as an integral component of the machine, and it is not something that is supposed to be changed regularly. The use of either the ND-CCC mains charger, or the ND-EPC external DC/DC converter should be used whenever possible. However if it is absolutely necessary to remove the internal battery it may be done by following the instructions below. Switch off the machine by pressing the POWER button, and disconnect any external power supply presently connected to the power socket on the right-hand side of the machine. Loosen the two deck fastening screws on the front of the main control panel. Lift the deck plate of the machine until it is supported by the bracket on the right-hand rear side of the case. Disconnect the battery power cable from the socket. Lift the right-hand side of the metal fastening cover from the battery pack, using a screwdriver, and gently lift it to the left being careful that it does not touch the circuit boards. Carefully remove the battery pack and replace it with a charged one. Reverse the above procedure and then close the machine.

NOTE: If the internal battery is removed from the machine for more than a few minutes then the internal settings of the machine (time code frame rate, sampling frequency presently in use etc.) will be lost and at the next power up, the machine will select the default settings and will display MEM LOST on the display for a couple of seconds and five beeps will be heard to indicate.

TAPE DIRECTORIES

GENERAL

There are two main reasons/functions of the tape directories of the NAGRA-D and these are firstly that they serve as a "log book" for each tape/take and secondly they make the machine more ergonomic to use. Of course there are numerous particularities of operation that can have strange effects on the operation of the machine. However simple operation of the machine with the directories, as long as the following "rules" are obeyed, it is relatively simple.

Principle rules:

1. **Always use the same size reels on both of the reel motors (either 5" or 7" never mixed).**
2. **Do not remove the tape in the middle of the reel always wind the tape off.**
3. **Remove the tape by fully REWINDING it whenever possible.**
4. **The tape speed should not be changed during a tape.**

Exceptions to these rules are possible, however with differing consequences. Reading further in this chapter will give a detailed outline of the operation of the directories, and will explain the possible problems that may occur if these rules are not adhered to. The Directory mode can be switched ON of OFF in the menu mode, and the text below assumes that the directory mode is in operation, if it is OFF the features below will not operate.

WHAT IS A DIRECTORY ?

The directory of the NAGRA-D's tape is a file recorded on the tape which includes a lot of information about the "in/out" points, "takes", "drop-outs" and the "overloads" on the tape. Analysis of the information in the directory can only be accessed fully using a PC equipped with the NADCOM software. On the machine itself only the take numbers and reel number can be displayed. The major advantage of the directory feature is that the operator can now use the SKIP features (EXE + FF and EXE + REW) as well as the GOTO END feature, in order to locate sections on the tape quickly and easily. All this means that each and every tape is identified by its directory.

WHERE IS A DIRECTORY RECORDED ?

The directory is recorded at the beginning of every new tape put onto the NAGRA-D. When a tape is put onto the machine, once a few turns have been wrapped around the take-up reel then the machine will automatically start to wind the tape and will look for the directory. If it does not locate a directory (the tape is virgin) then it will ask the operator (via the LCD display), FORMAT ?. If the operator presses the EXE key then the machine will format the tape in order to record the directory, this operation takes about 5 - 8 seconds. If the operator presses ESC when the FORMAT question is on the display then the machine will immediately go into the stop position and the directory mode will be switched off automatically.

In normal operation (directory ON) once the formatting of the tape is completed the machine will sit in the STOP mode ready for the first recording. Each time the machine is put into record, the information about the take is stored in memory. Whenever the recording session is finished, the operator presses the REW key to rewind the tape and the machine will automatically stop at the beginning of the point where the directory is recorded at the start of the tape and it will stop. To remove the tape from the machine press REW a second time and the machine will immediately record the directory on the tape and will then rewind the tape fully.

Note: This procedure of rewind is the same even if the directory mode is OFF)

WHAT IS IN A DIRECTORY ?

The directory contains the information listed below. A more graphic indication of all the points is covered in the chapter EXTERNAL CONTROL under the NADCOM software.

CONTENTS	BRIEF REMARKS
The tape reel number	(user selectable from 0 to 9)
Up to 350 "drop-outs" per tape	(Input overload and incorrectable ECC errors)
Duration of the "take"	(minutes and seconds)
Date and time of recording	
16 characters for "take title"	(entered from the PC)
Sampling frequency	
Status of the inputs	(ie 1+2 ANA, 3+4 AES, or copy)
Peak on the inputs	(highest level recorded on each channel)
Fader position flag	(indicating "CAL")
Take time code start	(no frames / user bits)

All of this information is shown on a new screen in the NADCOM program called "Tape Directory Management" which indicates all the above information for each take horizontally, and each line is clearly explained. Each time a recording is made on the tape the above mentioned information will be stored in the machines' memory.

TAPES WITHOUT DIRECTORIES

If a tape that does not contain a directory, but was previously recorded (either with the directory mode OFF or on a machine fitted with a previous version of software that did not have this possibility) then the machine will still load the tape in the same manner and will look for the directory. When it is not found the display will indicate "NO DIR" and the directory mode for this tape will automatically be switched OFF.

NOTE: It is not possible to record a directory onto a tape that was previously recorded without one.

TURNING ON/OFF THE DIRECTORY MODE

The directory mode, like many other features of the NAGRA-D is switched ON via the MENU mode. Pressing the EXE key when ENABLE is on the display in the DIR menu will activate the mode. This is the default mode of the machine. Turning the directory mode OFF is either done in the menu mode (as above) or automatically by the machine if for example it detects that a pre-recorded tape without a directory has been put on the machine.

DATA (and SETTING of) FOR THE DIRECTORY

In order for the directory mode to operate correctly, certain information must be set in the machine by the operator. Some of the information is "user" type information such as the reel number, however the most important is the setting of the RTC (real time clock) as it is this information that is used to record the time, date etc. for each reel and each take, and this is totally independent of the internal time code (if fitted). Setting of all of this data is done in the menu mode, by moving to the corresponding display, setting the required values using the down arrow to increment and the right arrow to move to the next digit, followed by ENTER. The take number will automatically be incremented by "1" each time the machine is put into the RECORD mode. The take numbering starts from number "01" and goes up to "99". (take "00" is the directory itself). The take number and reel number may be looked at using the display, the rest of the information in the directory can only be looked at and modified (where possible) via a PC running the NADCOM software.

DIRECTORIES AND HALF SPEED OPERATION

The directories will operate in the same manner for both the normal speed and the half speed modes of the machine. However the machine cannot read the directory if it is set at the wrong speed. If the directory is not read correctly then the message NOTFOUND will appear and the machine will be in the STOP mode. To this message, either EXE meaning RETRY or ESC meaning "OK - too bad" must be pressed. All other transport features will be locked out until this is done. If the reason is because the machine is at the wrong tape speed, then the operator must press ESC followed by rewind to unlace the tape. The tape speed can then be changed in its corresponding menu, and the tape then re-laced. The machine will once again try to read the directory, if this is not the cause and the directory still cannot be read, it is probably due to drop outs or some other deformation of the tape (finger prints etc). The two tape speeds could be considered as different formats as far as the directory is concerned, a little like trying to read an MS-DOS formatted disk on a MAC !

OPERATION OF THE DIRECTORIES

Under normal operation of the machine, with the directory mode on, there are only a few operations that the operator must be conscious about in addition to his standard procedures. All the rest is pseudo-automatic. In this section we will consider several situations that may occur while using the machine and explain the procedure to be followed.

MAKING A STANDARD RECORDING.

Once the machine has been powered up, check that the information in the RTC (real Time Clock) is correct. This is looked at in the "Otherset" menu. Then select the other settings required for the machine (sampling freq, input selection, time code mode, TC delay etc). Once the machine is prepared, place a new reel of tape on the supply reel holder, and thread the tape in the normal way. The machine will automatically take up the tape and will automatically go and look for a directory. As it is a new tape this will not be found, the machine will then return to where the directory should be and will stop. The display will then indicate "Format ?". At this point the operator must reply. No other feature of the machine (transport) will be operational until this is done.

Pressing "EXE" be taken as a YES answer and the machine will automatically switch to the record mode. That is to say, the REC leds will light up on all four channels, and the led above the REC key will also light up. The audio channels will be forced into the ready position (despite the position of the selectors), however the audio inputs will be MUTE, NO time code of CUE track will be recorded. This takes between 5-8 seconds. Once this is complete, the tape is "formatted" and is now ready to be recorded. If necessary this operation can be carried out on several tapes before the recording session starts, and can be considered as the same procedure as is needed to format a floppy disk before it can be used in a PC. Pressing "ESC" will be taken as a NO answer, and the machine will automatically switch off the directory mode.

Assuming the directory has now been formatted, the recording of the tape is now made in the normal way. Each time the machine goes it REC mode, and each time it returns to STOP the information about the "take" (number, time, date, duration etc) will be stored in the internal memory of the machine. Along with this there is a great deal of additional information such as the drop-outs, and the input peaks status of the channels to name just a few. More detail is given under the chapter EXTERNAL CONTROL of this manual.

Once the recording is finished, the tape is rewound in the normal way. When the machine arrives at the start of the tape, it will stop, without having completely removed the tape. Pressing REW again now will cause the machine to again switch to record (in the same way as formatting) and it will record the directory (the entire contents of its memory) which takes again 5-8 seconds. Once complete it will switch to REW and will reel off the tape completely. This can be considered as the "standard" operation for recording a tape using the directory mode, however there will be many cases where this method cannot be stuck to for one or more reasons.

PLAYING BACK A TAPE WITH A DIRECTORY

The tape is placed on the supply reel holder in the normal manner and laced around the transport. The machine will automatically take up the tape and look for the directory. Once it has been located it will read the entire directory and store it in its internal memory. Once complete the machine will stop and await further instructions. As all the "take" information is now in memory the SKIP features as well as the GOTO END feature will be operation. Otherwise the normal playback and chase synchronizer operations can be used. At any time during playback the operator can look at the take number in the DISPLAY menu or the reel number in the DIR (directory) menu.

NOTE: Explanation of the data that can be seen on the screen of the PC in the NADCOM software is explained in the chapter EXTERNAL CONTROL of this manual (Tape Directory Management).

WORKING WITH TAPES "TAIL OUT"

There are some applications where there is not enough time to rewind a full reel of tape before the next take, and at the end of a reel the tape is simply spooled forward and kept "tail out". In this case how does the directory get recorded ?

Providing that previously formatted tapes are used on the machine then the NAGRA-D will remember the directories of the last 4 tapes that are put onto the machine (Three in memory and the fourth on the machine). This means that if formatted tapes are used on the machine during the day but are taken off "tail out" then the operator can simply put the tape back on the machine at a later time (when the pressure is off) and the machine will recognize the tape and will immediately wind to the location of the directory and will update the directory from the information stored in its internal memory. The last four tapes used can be done in this manner and no information will be lost. If a fifth tape is put onto the machine (without even pressing REC) the oldest directory in the memory WILL be lost.

NOTE: This information is only remembered as long as there is sufficient power in the internal battery (or during the short period of time used for a battery change). If the machine is left without sufficient power (or the battery is removed for a long period of time) then this information will be lost.

If a tape that is "tail out" (with its already updated directory) is put onto the machine, then the procedure will be as follows. Put the reel on the right-hand reel holder and lace the tape around the transport then BEFORE pressing STOP press REWIND and the machine will go and look for the directory at the beginning of the tape. If STOP is pressed while it is winding to look for the directory, then the machine will stop and will display NOTFOUND. Pressing EXE will be interpreted as "Continue to look" and ESC will be interpreted as "OK Directory OFF".

Once the tape has been rewound to the directory at the beginning, it will read it and the tape can then be used as any other.

UPDATING OF A DIRECTORY

There may be occasions when the contents of a directory on a tape need to be modified. Two situations could be for example:

EXAMPLE 1 A complete tape is made with many different takes, during the day, and later on the names of the individual takes need to be added with the aid of a PC.

EXAMPLE 2 A recording is added to the end of a previously recorded tape.

In example 1 above, the operator would power up the machine and place the recorded tape on the supply side. When laced around the transport, it will automatically be taken-up by the machine and the tape directory will be read. The machine will then rewind to the beginning of the directory and will stop. The information from the directory will be in the memory, and will also be displayed on the "Tape Directory Management" screen of the NADCOM software. Leaving the machine alone now, the operator can use the PC to add (or change) the names of each take individually. (see CHAPTER 5) Once the modifications have been made on the screen of the PC if the operator now presses REWIND (either on the machine or by means of F3 on the PC, the machine will immediately go into Record and update the directory and will then automatically unlace the tape. The directory on the tape will now contain the modified data.

In example 2 above, the tape is loaded as above and the machine will read the directory. Once this is done stop will automatically be selected. The operator then presses, GOTO END (EXE + REC) and the machine will automatically locate the end of the last take recorded on the tape. The operator can then continue to make recordings on the unused portion of tape. Once this is completed, REW is pressed and the machine will rewind to the beginning of the directory and will then STOP. Pressing REW again, the machine will automatically record the directory and then wind the tape off. The directory on the tape will now be updated with the addition of the new information regarding the added material.

SKIP FEATURES

The addition of the directory mode to the software of the NAGRA-D means that the SKIP features can now be used. Pressing EXE + REW is the skip to previous take command, and pressing EXE + FF is the skip to next take. If skip forward is pressed when the tape is already positioned at the end of the last recorded take on the tape then nothing will happen. Likewise if skip backwards is pressed when the tape is positioned at the very beginning of the reel (before the first take) equally nothing will happen. Pressing EXE + REC will activate the goto end of recording. All of the skip features will stop at a position just before the required point so as to allow a short pre-roll distance. Thus if GOTO END is activated, the machine will park a few seconds before the end of the last recording on the tape. If REC is then pressed the machine will make an assemble edit on the very next track after the end.

INSERT AND ASSEMBLE

The directory mode of the machine is only active in the ASSEMBLE position. That is to say that if an insert is made on a previously recorded tape then this will not affect the data in the directory.

DISPLAY MESSAGES IN DIRECTORY OPERATION

Message	Reason
"No Dir."	No directory found on present tape, or ESC was pressed when the machine was unable to read or write the directory. Press ESC to remove the message, and the machine will continue in the directory OFF mode of operation. This display will not affect the operation of the machine.
"FORMAT ?"	A virgin tape has been put onto the machine. Pressing EXE will format the tape. Pressing ESC will leave the tape unformatted and will put the directory mode OFF for the present tape.
"READ ERR"	There has been an error while reading the directory on the tape. Pressing EXE will retry to read the directory, and pressing ESC will turn the directory mode OFF.
"NOTFOUND"	Directory cannot be located on the tape. Pressing EXE will retry to look for it, pressing ESC will turn the directory mode OFF.
"REC. ERR."	An error has occurred during the recording process of the directory. Pressing EXE will retry to record the directory again and pressing ESC will cancel the directory and put the directory mode OFF. Pressing ESC will not loose the directory in memory.
"TAPE ID."	The ID information at the start of the directory does not correspond with that in memory. Probably the tape has been changed in the middle without updating the previous directory. Normally this message should never appear if the "rules" at the beginning of this section are adhered to.
"NEWTAPE?"	Following the loading process the machine is doubtful as to whether the tape on the machine has been changed. Normally this message will never appear. Pressing ESC will be understood as "same tape" and pressing EXE will be understood as "new tape" upon which the machine will immediately go and read the directory.
"Reading"	This is displayed during the reading process of the tape directory.
"Writing"	This is displayed during the recording process of the tape directory.
"Erasing"	Erasing a tape and directory after a reformat command.
"Dir.In mem"	When reading, the tape is recognized as having a directory already in memory but not yet saved on tape

CHAPTER 4

SYNCHRONIZATION

General

   Video reference
   AES bus
   External sync signal

Time code
   Time code display
   Setting the time code
   Format selection
   Operating mode of the generator
   Set from external
   Recording a time code
   Time code playback
   Time code synchronization
   Synchronization displays

Tape counter

SYNCHRONIZATION POSSIBILITIES

GENERAL

Up until now the audio / video domain has always related the word SYNCHRONIZATION with the speed and direction of a tape transport, as is the case with an analogue machine using center track time code. That is to say that the speed of the transport is directly controlled with respect to an incoming time code signal, and if this time code were to be reversed then the machine itself will reverse. In the case of the NAGRA-D when we talk about synchronization possibilities, we cover all aspects of time code, the use of an external video reference, using the AES bus etc.

If we were to imagine the tape of the NAGRA-D running in reverse (as on an analogue center track TC machine) the helical scans could not be read by the scanner. Thus in the case of AES bus for example, synchronization is in terms of data form and flow for reasons of compatibility. The AES bus for example can be considered as a synchronized transport for information, whereas a time code signal is transport synchronization information.

All the different synchronization methods are selected on the NAGRA-D by the menu mode. (see MENU's) The diagram below shows the synchronization possibilities of the NAGRA-D each of which will be covered in more detail.

The NAGRA-D can accept the following references:

Audio SYNC

48 kHz		48 kHz
44.1 kHz		44.1 kHz
32 kHz		32 kHz
NTSC B/W Television (60 Hz)		
NTSC color Television (59.94)		
PAL / SECAM		

rx   NAGRA-DIGITAL   tx

24 Fps CINEMA
25 fps (PAL / SECAM)
29.97 Fps (NTSC with Drop Frame)
29.97 Fps (NTSC without drop-frame)
30 Fps (NTSC with drop frame)
30 Fps (NTSC Without dropframe
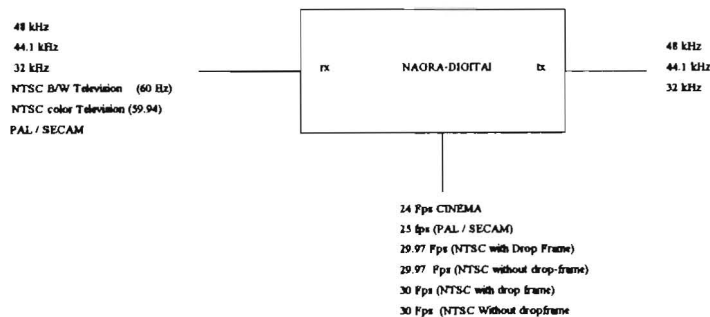
The actual connectors for these various synchronization inputs and outputs are located on the sides of the NAGRA-D. The Video signals are via a standard BNC connector (terminated internally 75 Ohms). The AES synchronization is taken from the AES input (Dig 1+2 or Dig 3+4)menu selectable on the XLR connectors, the External SYNC is on the 15 pole miniature "D" type connector and the time code is via a 5 pin LEMO connector.

It must be noted that transformation between standards (ie 48 kHz IN to 44.1 kHz OUT) is not possible with the NAGRA-D. This could be possible with an external "black box".

VIDEO REFERENCE

Via the BNC socket located on the left-hand side the NAGRA-D can be fed with composite video signals of the PAL, SECAM or NTSC standards. A composite video signal has the horizontal sync (line sync) just before the burst, and this horizontal sync is extracted from the signal by the NAGRA-D and this is used as a reference for the first VCXO (Voltage controlled crystal oscillator). All the other internal frequencies are in turn referenced to this first VCXO.

AES BUS SYNCHRONIZATION

The AES bus permits the synchronizing of stereo signals. As the NAGRA-D operates with 4 channels, a compromise in order to adapt the system to the AES format was necessary. In order to be compatible the NAGRA-D inserts two channels onto one AES bus line, that is to say channels 1+2 and 3+4 are grouped together, on both the input and the output from the machine.

(REC means AES receiver and DEC means AES decoder)
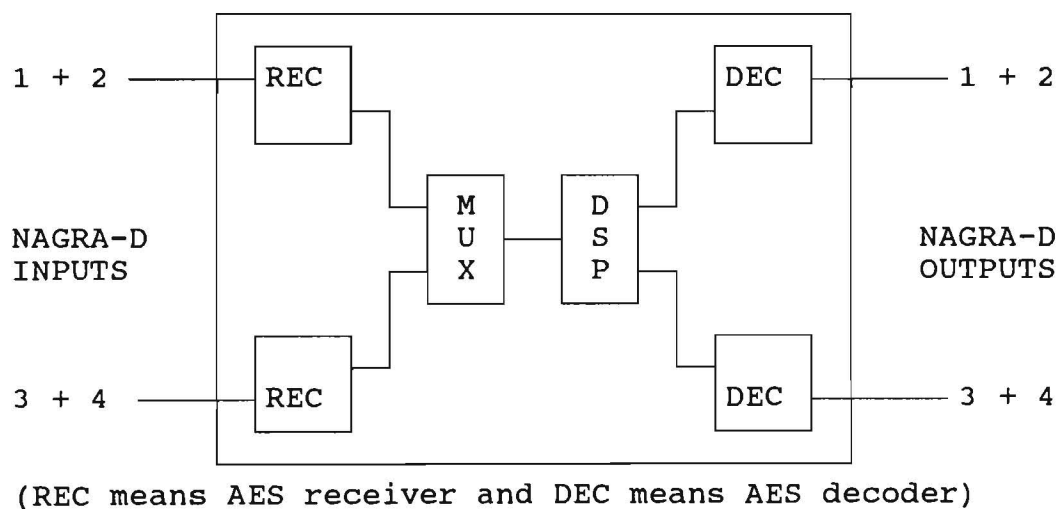
As the scanner rotation speed of the NAGRA-D is 3750 rpm (62.5 rotations per second) then we know that each rotation of the scanner takes 16 mS. As the scanner consists of 2 recording heads (and 2 playback) one track on the tape corresponds to 4 mS. If the track is sub-divided down then there are 4 AES blocks per track. Thus each AES block represents 1 mS of stereo music. If we continue to break down the blocks, we find that each of these AES blocks consists of 192 smaller sub-divisions which are in turn divided in two sub-frames.

Each of these sub-frames contains specific information relating to each channel. Each sub-frame is made up of 32 bits containing 4 sync bits 24 data bits and 4 auxiliary bits (VUCP). On the data portion of this sub-frame, the NAGRA-D uses 20 bits for the audio and the last 4 bits to record the auxiliary information. The information in the auxiliary has not yet been totally defined in the AES format, presently we only use the "C" and in that we store information such as emphasis (ON or OFF), sampling frequency, stereo/two channel etc. etc.

As with the composite video reference, the AES signal is used as a reference for the first VCXO.

EXTERNAL SYNC

The external sync input is yet another way to synchronize the internal clocks of the NAGRA-D. The advantage of this 5V logic input is that it can be used to control the first VCXO (Voltage Controlled Crystal Oscillator) from an external source without the need of turning the whole input signal into the AES format. (this is very useful in instrumentation). The input can be 32 kHz, 44.1 kHz or 48 kHz or even a remote 9600 baud, depending on the selections made in the REF menu.
This signal can be fed to the machine through the 15 pole miniature "D" type connector.

TIME CODE (if ND-TC option is fitted)

SMPTE/EBU time code has become a standard in film and video applications as an accurate and reliable means of machine synchronization and sequence location. Location of particular points on the tape in a digital recorder is often done using ID markers, however these do not allow the synchronization to film or video during post production.

The NAGRA-D can accommodate all presently recognized formats, these being the following:

24	FPS	-Film applications
25	FPS	-PAL/SECAM Video and film to video applications
29.97	FPS	-NTSC black and white television
29.97	DF	-NTSC colour television
30	FF	-Film applications (NTSC)
30	DF	-Film to video (NTSC)

The time code system of the NAGRA-D also accommodates the standard USER bits in either DATE or FREE modes.

The time code system on the NAGRA-D is equipped with two time code readers (for "external" and "off tape" time codes) as well as an internal time code generator according to the SMPTE / EBU 80 bits longitudinal time code format. It is modulated using the Manchester Bi-Phase technique (a transition during a period represents a "1" and a period without a transition represents a "0"), which is recorded on a dedicated track (see "footprint" in chapter 1 of this manual). The time code system is the only synchronization mode described in this chapter that will allow the operator to search around the tape. The time code track is a 0.35mm track located just below the control track at the bottom edge of the tape and it is recorded by the longitudinal head. The NAGRA-D is also fitted with an internal chase synchronizer, allowing it to synchronize to any external time code.

The time code input and output is located on a 5 pole LEMO connector, the pinning of which corresponds to that of the IV-STC and T-Audio-TC. The time code system of the NAGRA-D is more complicated than that of the IV-STC or NAGRA T-Audio as it offers possibilities that were not previously available and also requires care on the part of the operator to ensure that the correct information is being recorded and displayed at all times. The QCTCU time code cable delivered with the machine has one point marked "RS 232" this is for the AATON interface for the IV-STC only and should be ignored in the NAGRA-D.

If the RESET HOLD switch is pressed twice in quick succession the display will scroll through the presently selected generator and synchronizer settings, the default values are as follows:

25 fps	(Generator format)
INT. GEN.	(Record source)
FREE RUN	(Generator mode)
SYNC	(Chase mode)
REF. TC.	(Chase reference)
VAR. CLK.	(Sync mode)

DISPLAYING A TIME CODE

The small 8 digit 14 segment display of the NAGRA-D or a PC connected to the RS 422 port can be used to display time code. If the right arrow is pressed from the normal display position then either the time code playback signal (TC OUT) (replayed from the tape) or TC REC (the time code that will be recorded if the machine is put into record), this is according to the REC SRC setting (either internal generator or external). The ROLLER (counter roller) or ECC (Error Correction Code) may also be displayed (see DISPLAY in the menu mode). Remember that setting the internal generator will not necessarily change what is displayed if the display is not set to the TC REC position, and the recording source is not set to internal generator. TC DELTA which is the changing difference between the external reference and the time code on the tape during the synchronizing process, can also be displayed.

SETTING THE INTERNAL GENERATOR

The internal generator of the NAGRA-D can be set either from the keyboard using the arrow keys, or from an external time code source. Once the internal generator has been set from the EXT source the counting is continued by means of the internal generator, hence there is no need to have a cable link permanently.

KEYBOARD SETTING OF THE INTERNAL GENERATOR

It is important to remember that when setting the time code, the format of the time code must also be set. Once any settings have been executed in the machine these will be remembered even when the power is turned off, as long as there is sufficient power in the internal battery. To set the internal generator from the keyboard proceed as follows:

Press the power key and wait for the machine to scroll through the presently selected menu settings. When this is complete the machine will indicate the chosen display feature (ROLLER/ECC/TC OUT/TC REC/TC DELTA) the TC OUT and TC REC in either time or user mode. Press the down arrow and the display will indicate TIME CODE. Pressing the right arrow will now move the display into the time code menu and GEN will be displayed, allowing access to all the settings of the internal generator.

SELECTING THE TIME CODE FORMAT (Frame rate selection)

From this point access is given to all the time code functions. Pressing the right arrow from the TIME CODE display will indicate FORMAT, and pressing the right arrow again will indicate the currently selected frame rate. Pressing the down arrow will scroll through the other possibilities in turn. When the desired frame rate is reached press EXE to enter the command. A single beep will be heard to indicate that the command has been accepted and the display will return to the originally displayed option (TC, ROLLER, ECC etc).
If when entering the FORMAT menu, the desired frame rate is immediately displayed, then it is possible to press both the arrow keys simultaneously (ESC) to exit without making any modification.

SELECTING THE RECORDING SOURCE (Internal generator or EXT)

From the FORMAT display, press the down arrow and the display will indicate REC SRC allowing the selection of the time code source to be recorded, the choice being either from the internal generator or from an external source. Simply press EXE when the desired source is displayed.

SELECTING THE OPERATING MODE OF THE GENERATOR

From the FORMAT position press the down arrow twice and the display will show GEN MODE. When pressing the right arrow now, the operator can select the operating mode of the internal generator for either the time portion of the signal or the user part. For the TIME portion the two possibilities are FREE RUN and REC RUN. Free run means that the time code generator will count permanently, according to the selected frame format. Thus allowing the user to work with "time of day" or "sequential" time code. In the REC RUN (record run) mode, the internal time code generator will only run when the machine is in the record mode. As soon as the machine stops recording then the internal generator is frozen and will remain that way until the machine is put into record again. This allows "continuous" time code recording along a tape. For the USER portion of the signal, there are four different modes that can be selected. The most important selection here is between the DATE or FREE positions. The user bits must be in the same format as the external source if setting is to be made in either direction. The other two possibilities for the user bits are FREE INC or DATE INC. These two are essentially the same as the normal date and free modes except the right-most two digits are automatically incremented by one, from 00 to 99, each time the machine is put into the record mode.

SETTING TIME/USER DATA FROM EXTERNAL OR THE KEYBOARD

From the FORMAT position press the down arrow three times and the display will then indicate SET GEN. Moving to the right now, the display will indicate FROM EXT. If EXE is now pressed the time code will be JAM synced from an external time code, and the display will return to the selected display mode. If however the down arrow is pressed then SET TIME will be displayed. Moving to the right will indicate the time portion of the code with the left-most digit flashing. The down arrow key will now increment the flashing digit. Pressing the right arrow will move to the next digit. Continue in this manner until the desired time is indicated and the press EXE. Remember that the time code entered must correspond to the frame rate that has been selected in the FORMAT setting. Thus if the machine is in 24 FPS mode then entering a time code of 10.55.25.27 will not be accepted.

From the SET TIME position press the down arrow and the display will indicate SET USER. Proceed in the same manner as above to set all the USER bits. Remember that the format of the user bits must correspond to the format selected in the USER MODE selection. All dates must correspond to the DD.MM.YY.xx format. The free user bits may be programmed in HEX from 0 to F for each of the 8 positions.

SETTING THE TIME CODE DELAY

The time code delay selection is a new feature that was not installed in previous NAGRA time code products. Due to the difference in time needed to process digital and analog signals, either from the inputs or on the outputs, it is necessary to reference the time code system according to the operation being made. That is to say that if a digital input signal is being recorded then the time code needs to be referenced to the AES input, so that exact synchronization can be guaranteed during replay. Thus the possible settings for this are either ANALOG or AES for both INPUT and OUTPUT.

USING NAGRA-D AS MASTER TIME CODE CLOCK

First set the internal time code generator as described above. Then move down through the menus until GEN OUT is displayed. When EXE is pressed the internal time code generator is fed to the time code output and can then be used to set external equipment. It will remain on the output connector until a transport key is pressed, and will then revert to the time code playback signal.

RECORDING A TIME CODE SIGNAL

Set the RECORDING SOURCE in the menu mode to the desired setting and if necessary set the internal time code generator as described above. Check that the tape to be recorded is a new tape and that the INS/ASS switch is in the ASS position. It is not possible to record time code after the audio has been recorded as the time code signal will interfere with the control track already on the tape. In the MENU mode, set the DELAY to INPUT and then either analog or digital depending on the audio inputs being used. This position is the reference point for the time code, in order to compensate for the delays in digital processing of the audio signals.Set the time code lock out switch to the READY position and then put the machine into the record mode on the desired pair of channels. The time code will be recorded according to the mode of the generator (Free run or REC run).

REPLAYING TIME CODE

Place the tape to be played back on the machine, and press playback. The time code from the tape can now be read on the time code output connector, and can also be seen on the display providing it has been set to time code PLAY position. In the MENU mode, set the DELAY to OUTPUT and then either analog or digital depending on the audio outputs being used. This position is the reference point for the time code, in order to compensate for the delays in digital processing of the audio signals.

TIME CODE SYNCHRONIZATION

The time code version of the NAGRA-D is fitted with an internal time code chase synchronizer. The synchronizer performs in much the same way as the internal synchronizer of the NAGRA T-AUDIO TC. It has the possibility to synchronize the machine either to an external time code that is fed to the LEMO connector on the left-hand side of the machine, or to a video sync reference fed to the BNC connector.

Chase synchronizers in the digital domain are not as simple to understand as those used in analog machines. If for example the machine is synchronized to a reference that is not at the correct speed then the digital outputs of the machine will not be at their correct sampling frequency which will cause problems during digital transfers. It is for this reason that the internal synchronizer of the NAGRA-D has two different operating modes. One is called the VAR CLK (variable clock) (VCLO) mode and the other is the FIX CLK (fixed clock)(VCXO). In the first instance the machine will lock its VCLO to the incoming time code and the digital outputs may have jitter etc. rendering them unusable. In the latter mode of synchronization, once the correct sync point is reached and the machine is locked, then it will automatically switch over to the internal crystal as its reference allowing the digital outputs to be used. At present the only way for the machine to make the "slow down" needed in NTSC to synchronize the machine at 59.94 Hz (NTSC colour) as opposed to 60 Hz (NTSC black and white) is to use the VCLO (VAR CLK) mode and use the analog outputs.

The actual operation, and explanation of the synchronizer terms, are covered in the MENU chapter under the heading TIME CODE. The internal synchronizer of the NAGRA-D is activated according to the pre-selected modes, by pressing the PLAY, FF and REW keys simultaneously. While the machine is not sync locked, all three of the leds above these keys, as well as the RDY led will flash. When the transport is locked then all these leds will be ON permanently, and the apostrophe (') on the display opposite the "lock" will be on.

In the MENU mode, set the DELAY to OUTPUT and then either analog or digital depending on the audio outputs being used. This position is the reference point for the time code, in order to compensate for the delays in digital processing of the audio signals.

SYNCHRONIZER DISPLAYS

Several indications are made on the LCD display while using the time code synchronizer, these are explained below:
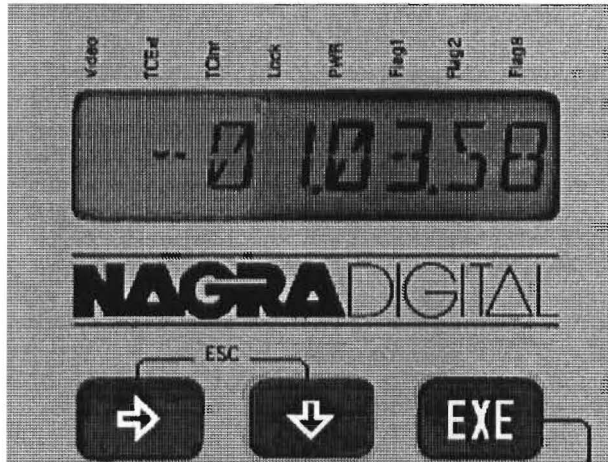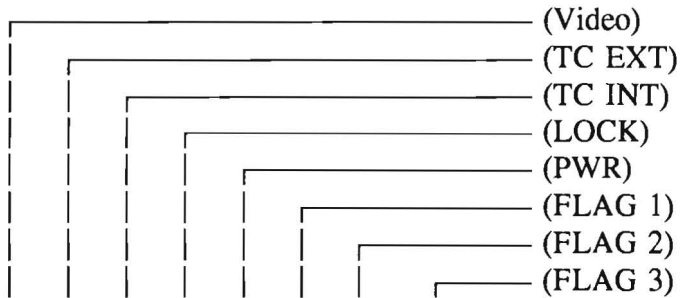
The (') indications between the digits will light up under certain conditions which are:

VIDEO	When alight this indicates that a valid video reference is present on the BNC connector, either PAL or NTSC (for the time code only) the video reference if used, must correspond to the time code (ie PAL = 25 Fps TC).
TC EXT	When alight this indicates external time code is present and is being correctly decoded by the time code circuit.
TC INT	When alight this indicates that time code is being read from the tape and is being correctly decoded by the time code circuit.
LOCK	When alight this indicates that the internal synchronizer has locked the transport to the external reference, according to the synchronizer settings.
PWR	When alight this indicates that an external source is connected to the machine and that the internal battery is being charged.
FLAG 1	Sampling Frequency on tape not the same as that of the machine. (will not indicate in the EE position)
FLAG 2	Not presently used
FLAG 3	When alight this indicates that the internal time code synchronizer sync mode is set to VCLO (VAR CLOCK).

TAPE COUNTER

The tape counter roller is the default display mode for the machine. The counter indicates in hours, minutes, and seconds, and is driven from the left-hand tension roller. The counter can be selected to be displayed by pressing the right arrow and then the down arrow until ROLLER is shown, followed by the EXE key.

The tape counter can be reset to zero at any moment (even during recording) by pressing the EXE + RDY keys simultaneously. If the EXE + STOP keys are pressed together this will activate the GOTO ZERO feature. This mode does not operate in the REC mode.

CHAPTER 5

EXTERNAL CONTROL

NADCOM
    Installation
    Main menu screen
    Analog measures
    Interactive control panel
    Audio settings
    Feature settings
    Tape directory management
    Time code menus
    ECC report
    Miscellaneous settings
    Time code counters
    Tape speed override
    Quit

EXTERNAL CONTROL

The NAGRA-D is fitted with an RS 422 port giving direct access to the main microprocessor. The communication protocol of the machine is a NAGRA protocol based on the existing AMPEX protocol. That is to say that the NAGRA-D will operate under the AMPEX protocol but will also allow access to many features that the existing standard protocol does not. The standard AMPEX protocol is made up of two "pages" of commands these can be considered as 1 and 1a.

Presently the protocol operates with the NAGRA-D from a PC. This software is delivered on a High Density Double Sided 3 1/2" diskette, and requires a PC of 286 or better in order to operate. The PC is connected to the NAGRA-D via the ND-PCA RS 232 / RS 422 adapter. A standard PC is not normally fitted with an RS 422 serial port. This adaptor simply converts the standard RS 232 port into an RS 422 port compatible with the NAGRA-D.

INSTALLATION

Connect the NAGRA-D to the PC via the accessory ND-PCA and copy the diskettes' contents into a sub-directory of the PC's hard disk "C:\NADCOM". The NADCOM software defaults to operate through the communication port COM2. If the PC is only fitted with one serial port this will probably be COM1. Thus, in order to launch the program type the following command: NADCOM -PCOM1
This tells the PC to use the communication port COM1.

The PC will now display the main menu of the NADCOM software.

Launching the NADCOM by typing either NADCOM -h or NADCOM -? will indicate the options.

On certain screens it is possible to move from one selection to another. This is done by pressing either the right (or left) arrow keys or alternatively the TAB key. The up and down arrows on the keyboard are used to change values where possible.

MAIN MENU SCREEN

```
─                              NADCom                              ▼ ▲
  NADCom 1.6 (Apr 8) NAGRA-D [ 1000426] "KSA DEMO" v01.06  14/04/94 15:58    OK
  ─ Main Menu ─

                        A   Analog Measures
                        C   Interactive Control Panel
                        D   Audio Settings
                        F   Feature Settings
                        L   Tape Directory Management
                        M   Time Code Menus
                        N   Username setting
                        R   ECC Error Report
                        S   Miscellaneous settings
                        T   Time Code Counters
                        U   Tape Speed Override

                        Q   Quit


  DSP1:     0.0 sectors / ECC  0.0 •        DSP2:    0.0 sectors / ECC  0.0 •
  In.12: Analog  In.34: Analog   Dig.Out.12:   ?[--]  Dig.Out.34:   ?[--]
  NO TAPE   00:00:00:00 [P    L ] Full Spd  48KHz Ck.Ref.:        Master   LOCKED
       F2        F3        F4       F5       F6             F8
       TAPE      REW       FF       PLAY     STOP    REC    RDY
```

Permanently, when using the NADCOM software the function keys of the PC are reserved for the main transport features of the machine. They can be accessed at any time and they are described individually below:

F2:   TAPE Below the F2 key, the current status of the TAPE/EE switch is indicated. If the position of the switch is changed then the indication will be either TAPE or E/E. If the position is in the AUTO mode then the display corresponds to the mode of the machine. (see MENU mode). Pressing the F2 key will override the switch setting on the machine itself and will toggle between TAPE and EE.

F3:   REW This is the REWIND command which will put the machine into rewind according to the winding speed selected in the OTHERSET menu.

F4:   FF This is the FAST FORWARD command which will put the machine into forward wind according to the winding speed selected in the OTHERSET menu.

F5:   PLAY This is the standard PLAYBACK command for the machine.

F6:   STOP This is the main STOP command.

F7:   REC This is the RECORD key that will put the machine into the record mode

according to the positions of the READY SAFE keys on the main control panel as well as the corresponding INPUT settings in the menu mode. It should be noted that on a colour screen this is indicated in RED and on a monochrome display it is underlined. This indicates that it is a shifted function, and the shift key must be held down in order to activate this feature. This is done simply to avoid the machine being accidently put into the RECORD mode.

F8:   RDY   This is the scanner on key (READY) and will start the scanner if pressed. The scanner will run for 1 minute and then stop again if no other feature is activated.

F10:   EXIT   When in any sub menu of the NADCOM the F10 key will return to the main menu. From the main menu screen simpl press "Q" QUIT to leave the program.

NOTE: The selected function is indicated in **BOLD** print when activated.

On the center of the screen there are 12 possible sub menus that can be activated by simply pressing the corresponding letter. Each of these is shown and described on the following pages.

Above the function key displays, there are three lines of additional information that are present all the time. Firstly the DSP1 and DSP2 indications show that 192 sectors per track are present (for each pair of tracks, followed by the " / " and the number of errors detected on each pair of tracks in the above case there are no errors.

On the next line the present status settings of the inputs and outputs of the machine. In the case shown Inputs 1 + 2 and inputs 3 + 4 are both set to ANALOG. The outputs of the machine are 48 kHz AES and between the "[ ]" the letters NN indicate No emphasis on any channel. When a tape is being played back, these two last indications show the sampling frequency that is recorded on the tape irrespective of the present sampling frequency setting of the machine.

The third line of the status information shows the current transport mode of the machine (NO TAPE in the case shown). To the right of this is the counter roller value (or time code output if ND-TC option is fitted), which is shown in hours minutes seconds and frames. Beyond this inside "[ ]'s" are AMPEX status indications:

P=PAL
N=NTSC
D=DROP FRAME
T=TIME LINE RUNNING
F=DEFERRED BUFFER FULL
E=CURRENT EVENT EXECUTING   Not yet implemented
L=LOCAL EVENT EXECUTING   Not yet implemented
R=REMOTE EVENT EXECUTING   Not yet implemented.
?=DOWNLOADING REQUIRED   Not yet implemented
!=EDIT ERROR   Not yet implemented

To the right of the status indication is the present operating mode of the machine. In the case shown FULL SPD (4 channel operation), 48 kHz sampling frequency, MASTER clock internal reference and LOCKED (to the reference in this case the internal crystals of the machine).

Above the main commands window there is one line of information at the top of the screen indicating the Version and date of the NADCOM program, the serial number of the NAGRA-D connected (in this case the machine 1000426), followed by the name of the owner that has been programmed (in this case KSA DEMO) and the version and date/time of the EPROM installed on the main CPU board (v1.06). Finally in the top right-hand corner of the screen is the status of the communication between the PC and the NAGRA-D this being either OK (when all is working) or KO (in RED) will flash (if the machine is not communicating).

A ANALOG MEASURES

If "A" is pressed the ANALOG MEASURES are displayed. This page indicates many voltages, currents and other information about the machine, and is updated permanently depending on the state of the machine. Each measurement is listed and explained below. Some of these are very useful to the user, and some are purely for use within the factory. This page is generally used for diagnostic purposes, to help locate possible problems within the machine.


```
                                      NADCom                                 ▼ ▲
  NADCom 1.6 (Apr 8) NAGRA-D  1000426 "KSA DEMO" +01.06  14/04/94 15:58      OK
  ─ Analog Measures ─
  CapsSpeed      11.2U   IBat      +0.115A   P11UL256        99.9%
  CapsPhase      11.1U   I12         0.4A    P1180D          50.5%
  CapsLed         1.5U   I15         0.6A    P11175           0.2%
  ScanLed         1.6U   I5          0.9A    P1114           52.5%
  ControlTrack    5.0U   UCaps     +0.4U     P1196           60.8%
  TensR           2.8U   UScan     +1.0U     Uclo14Present      0
  TensL           6.2U   UReelR    +1.0U
  ReelsUDR         1u    UReelL    +0.1U
  ReelsUDL         1u    ICaps       7.3mA
  ReelsLedR       0.8U   IScan       1.0mA
  ReelsLedL       0.5U   IReelR      0.0mA
  ICarriage       49mA   IReelL      0.0mA
  Carriage        8.5U   Fade1       -3.9°
  UBat           13.5U   Fade2       -1.1°
  U15            15.4U   Fade3       -0.6°
  U12            12.0U   Fade4       +0.6°
  U5              5.3U   P11UX256    54.5%

  DSP1: 192.0 sectors / ECC  0.0       DSP2: 192.0 sectors / ECC  0.0
  In.12: Analog  In.34:Copy 12    Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]
  STOP     12:50:32:04 [P     L  ] Full Spd   48KHz Ck.Ref.:    Master     LOCKED
        F2        F3        F4       F5       F6              F8       F9      F10
        E/E       REW       FF      PLAY     STOP            RDY     COOKED   EXIT
```

The values may change slightly from machine to machine, also depending on the current operating mode of the machine, and therefore these values shown should not be taken as the absolute values. However they should be approximately the same as any other machine. The meaning of each position is explained on the following page.

EXPLANATION OF THE POSITIONS

CapsSpeed	Capstan speed represented in Volts.
CapsPhase	As above but for the phase measurement.
CapsLed	Voltages of the LEDS inside the capstan motor. Used to detect deteriation of the condition of the leds.
ScanLed	As above but for the scanner motor.
ControlTrack	Level of the control track.
TensR	Position of the right-hand tension arm. when in the central position.
TensL	As above but for the left-hand tension arm.
ReelsUDR	Direction of rotation indication of the right-hand reel motor.
ReelsUDL	As above but for the left-hand reel motor.
ReelsLedR	Internal leds of the reel motor (see CAPSLEDS)
ReelsLedL	Internal leds of the reel motor (see CAPSLEDS)
ICarriage	Current being drawn by the carriage motor.
Carriage	Voltage indication relating to the position of the carriage.
VBat	Voltage of the internal battery.
V15	Measurement of the 15V line within the machine.
V12	Measurement of the 12V line within the machine.
V5	Measurement of the 5V line within the machine.
IBat	Current being supplied to, or drawn from the internal battery.
I12	Current being drawn on the 12 volt line.
I15	Current being drawn on the 15 volt line.
I5	Current being drawn on the 5 volt line.
VCaps	Voltage on the capstan motor.
VScan	Voltage on the scanner motor.
VReelR	Voltage on the right-hand reel motor.
VReelL	Voltage on the left-hand reel motor.
ICaps	Current being drawn by the capstan motor.
IScan	Current being drawn by the scanner motor.
IreelR	Current being drawn by the right-hand reel motor.
IReelL	Current being drawn by the left-hand reel motor.
Fade1	Rotational position of the fader n°1 indicated in degrees.
Fade2	Rotational position of the fader n°2 indicated in degrees.
Fade3	Rotational position of the fader n°3 indicated in degrees.
Fade4	Rotational position of the fader n°4 indicated in degrees.
PllVX256	VCXO (256 times sampling freq) PLL.
PllVL256	VCLO (256 times sampling freq) PLL.
Pll800	RF clock PLL.
Pll175	Video sync PLL.
Pll14	Crystal correction PLL.
Pll96	DSP serial clock PLL.

It should also be noted that the function keys F9 and F10 are also activated in this mode.

F9:   COOKED indicates that all the above values have been treated and are indicated in Volts etc. If F9 is pressed then the word RAW will appear and all the above values will be indicated in their Hexadecimal value.

F10: EXIT - This key is used to return to the main menu.

C INTERACTIVE CONTROL PANEL

When the "C" is pressed from the main menu the screen will switch to the interactive control panel. This screen gives an "LCD style" bar graph indication of the 4 modulometers in the top left-hand corner, the present operational mode of the machine in the top right-hand corner and a display of time code (UB or OFFSET) below. The indication of the time code display is indicated by the highlighted term above. It can indicate TC OUT, UB OUT, TC EXT, TC REC, UB REC or OFFSET. Simply use the "TAB" to change the highlighted choice. This interactive control panel can be considered as a long distance viewing screen.

D AUDIO SETTINGS
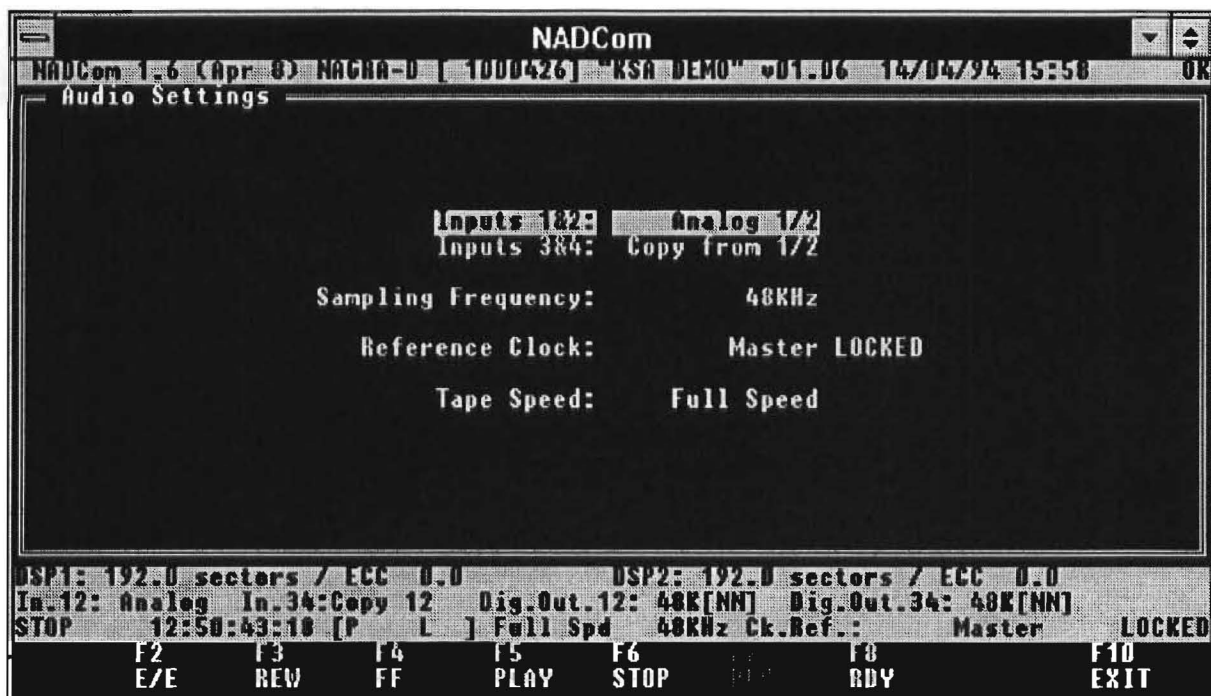
The aim of the AUDIO SETTINGS screen is to give the user access to the rest of the user selectable menus, without the need of going through all the menus on the display of the machine. It allows access to the Input configuration for the two pairs of inputs, in the case shown inputs 1 and 2 are set to ANALOG and inputs 3 and 4 are set to copy 1 and 2. It also gives access to the sampling frequency of the machine (presently 44.1 kHz). Access to the REFERENCE frequency for the internal clocks is also given The last position is the tape speed (presently FULL SPEED).

In order to move around this screen from one selection to another, simply press TAB and then the UP arrow (or DOWN arrow) keys to change the presently selected values.

```
┌──────────────────────────────────────────────────────────────────────────┐
│ ⊟                              NADCom                                  ▼ ▲ │
│ NADCom 1.6 (Apr 8) NAGRA-D [ 1000426 ] "KSA DEMO" ♥01.06  14/04/94 15:58 OK│
│  ┌ Features Settings ─────────────────────────────────────────────────┐   │
│  │                                                                     │   │
│  │                                                                     │   │
│  │       Feature Code: 80                                              │   │
│  │          Password: ULEH-UHEK-OHAH█                                  │   │
│  │          Features: [SONY Protocol]                                  │   │
│  │                                                                     │   │
│  │     Use <TAB> to change between Feature Code and Password           │   │
│  │     Use <ENTER> to send password                                    │   │
│  │                                                                     │   │
│  └─────────────────────────────────────────────────────────────────────   │
│ DSP1: 192.0 sectors / ECC  0.0        DSP2: 192.0 sectors / ECC  0.0       │
│ In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]    │
│ STOP      00:00:00:00 [P    L  ] Full Spd   48KHz Ck.Ref.:      Master LOCKED│
│       F2      F3     F4      F5     F6              F8          F10         │
│       E/E     REW    FF     PLAY   STOP           RDY          EXIT        │
└──────────────────────────────────────────────────────────────────────────┘
```

If "F" is pressed from the main menu screen the PC display will switch to the FEATURE SETTINGS screen. This screen is used to activate certain options within the machine. For example if the SONY protocol is purchased then a feature code identification number along with its corresponding password will be supplied (which corresponds to the particular serial number of the machine) and when these numbers are entered via the PC then the SONY protocol will be activated. The RS 422 menu will then appear in the menu tree under the sub-heading other settings.

The features line is simply to indicate the current options installed in the machine.

In order to move from one position to the next press the TAB key and use the RETURN (enter) is used to send the new settings once they have been entered from the PC's keyboard.

```
┌─┐                            NADCom                              ▼ ◆
│─│                                                                  │─│
│NADCom 1:6 (Apr 8) NADHA-D [ 1DDD426] "KSA DEMO" v01.06 14/04/94 15:58      OK│
│─ Tape Directory Management ──────────────────────────────────────────────│
│  Take Duration Date         Timecode   Title              Drops  Level    │
│   D11  0D'18"   28/04/94 08:43          KSA DEMO TAPE                      │
│      1 00'13"   28/04/94 09:31  12:45:15 Initial test             -16.2dB │
│=▶    2 05'09"   28/04/94 09:34  12:47:29 Touch tape        3      -0.5dB   │
│      3 00'58"   28/04/94 09:39  12:52:45 Conversation      1      -0.0dB   │
│      4 01'06"   28/04/94 09:40  12:53:57 Telephone call           -11.2dB │
│      5 01'44"   28/04/94 09:41  12:55:12 Overload / Drop   3      -0.0dB   │
│      6 03'46"   28/04/94 09:44  12:57:24 Input overload    3      -0.1dB   │
│      7 01'44"   28/04/94 09:48  13:02:03 CH 1+3 UNCAL             -19.1dB  │
│      8 00'46"   28/04/94 09:50  13:04:13 CH 2+4 UNCAL             -22.9dB  │
│      9 00'27"   28/04/94 09:51  13:05:09                          -30.6dB  │
│     10 00'02"   28/04/94 09:52  13:05:43 Start missed            -45.4dB   │
│     11 00'30"   28/04/94 09:52  13:05:46 restart                 -29.9dB   │
│    END          (total recorded time: 00:16'39")                          │
│                                                                            │
│                                                                            │
│Tape "5DE1F4" (Reel D): 11 takes, 1D drops.               Take  2 +D3'14"  │
│                                                                            │
│DSP1: 192.0 sectors / ECC  0.0         DSP2: 192.0 sectors / ECC  0.0       │
│In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]     │
│STOP      00:00:00:00 [P    L ] Full Spd  48KHz Ck.Ref.:      Master  LOCKED│
│   F2     F3      F4      F5     F6            F8      F9     F10            │
│   E/E    REW     FF      PLAY   STOP   REC    RDY    DROPS   EXIT           │
└────────────────────────────────────────────────────────────────────────────┘
```

If "L" is pressed from the main menu screen then the PC will switch to the Tape Directory Management. Operation of the directory mode is explained in chapter 3. This screen not only clearly indicates all the information that is stored in the directory, but also allows the operator to change certain information, as well as to remotely control the machine and sent it to certain well defined points on the tape (drop-outs, end of recorded section etc).

The upper design screen is the tape directory showing only the takes and their relevant information, and the lower shows the drop outs in the DROPS mode F9. Both screensare fairly self explanatory however each position is briefly covered here.

The first column is the Take number column, which is automatically incremented each time the machine is put into record. The first horizontal line (effectively TAKE # 0) position is the directory itself and the following horizontal lines are numbered consecutively 1, 2, 3, 4 ..etc.

The second column is the duration of the particular take in minutes and seconds. The third column is the date that the take was recorded. followed by the time at which it was recorded. This time is the time from the internal real time clock (RTC) and has nothing to do with the time code option ND-TC.

The next column is the time code location of the start of the take. On NON time code machines, or if the time code READY / SAFE switch was in the SAFE position during the recording, this column will indicate 00.00.00 (Time code frames are not included).

The next column is the title of the take. Up to 16 characters may be added here either during the recording or afterwards, by the operator using the normal keys of the PC. The DIR (take # 0) can also be given a name which is effectively classed as the TAPE name.

The final column gives the number of drops, written next to the actual take, and if F9 "DROPS" is highlighted, the following line indicates the type of problem , on which channels it occurred and the duration of the problem indicated in minutes, seconds and hundredths of seconds. If an error has been indicated, then the duration column will indicate where the drop occurs with respect to the start of the take, indicated in minutes and seconds, the display will also show on which channels it occurred. All this can be clearly seen in the diagram.

On the far left side of the screen, there is one (or sometimes two, or even three if there are drop-out or overloads) arrows. The upper arrow indicates in which take the machine presently is, and the second arrow indicates which drop(s) we are at. If the line joining the two arrows is a double line then this indicates that the take has already passed, and we are moving towards the next drop.

There is also a cursor "highlighted" bar across the whole screen. This bar can be moved up and down using the normal cursor keys of the PC. (Pg Up and Pg Dn will also move this cursor bar to the next screen). When the bar is moved to a particular take then the operator may type up to 16 characters to add a title to the take (or a tape name if done next to the DIR position). If the operator moves the cursor to a particular take and presses "Control + F5" the machine will go and play back the selected take. Control + F6 is the "STOP AT" command and control + F6 when the cursor is on the last take (marked "END") will send

Other information available on this screen is an indication of the FADERS which will mark UNCAL if any one of the faders was not in the CAL position at any moment during the take. The position of any input overloads is also marked for each channel corresponding to the position of the upper arrow. The other information on this screen is self explanatory.

F9   This is the DROPS key, which gives the possibility of seeing purely the takes (without the drop-out/overload indications) or as above with all the information. This is a toggle function, and is explained above and corresponds to the screen showing drops.

```
┌────────────────────────────────────────────────────────────────────────────┐
│ ▭                               NADCom                                  ▼ ◆  │
│ NADCom 1.6 (Apr 8) NAGRA-D [ 1000426] "KSA DEMO" v01.06  14/04/94 15:58    OK│
│ ┌─ Time Code Menus ──────────────────────────────────────────────────────┐ │
│ │              Format:          25 fps      Set/Mod Offset:   :  :  :  :    │ │
│ │                                                                           │ │
│ │        Time Mode:    Free Run              Chase Mode:           Sync      │ │
│ │    Record Source:  From Internal    Reference Source:          TCExt      │ │
│ │        Set Time:    :  :  :                                               │ │
│ │   User Bits Mode:         Free     Synchronizer Mode: Variable Clock      │ │
│ │   Set User Bits:    .  .  .                                               │ │
│ │                                          Reaction Time:    15 frames      │ │
│ │   Go To Time Code:    :  :  :                                             │ │
│ │                                                                           │ │
│ │       Input Delay:  Analog                                                │ │
│ │      Output Delay:  Analog                                                │ │
│ │                                                                           │ │
│ │   Set From External:                                                      │ │
│ └───────────────────────────────────────────────────────────────────────┘ │
│ TC EXT:00:00:00:00 TC REC:18:09:41:08 TC OUT:00:00:00:00 DELTA:-00:00:00:00:65│
│        00.00.00.00            10.01.94.20            00.00.00.00 OFFS.:+00:00:00:00:00│
│ DSP1: 192.0 sectors / ECC  0.0          DSP2: 192.0 sectors / ECC  0.0       │
│ In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]      │
│ STOP      00:00:00:00 [P    L ] Full Spd   48KHz Ck.Ref.:        Master   LOCKED│
│      F2       F3       F4       F5       F6            F8       F9      F10    │
│      E/E      REW      FF      PLAY     STOP    REC   RDY     CHASE    EXIT    │
└────────────────────────────────────────────────────────────────────────────┘
```
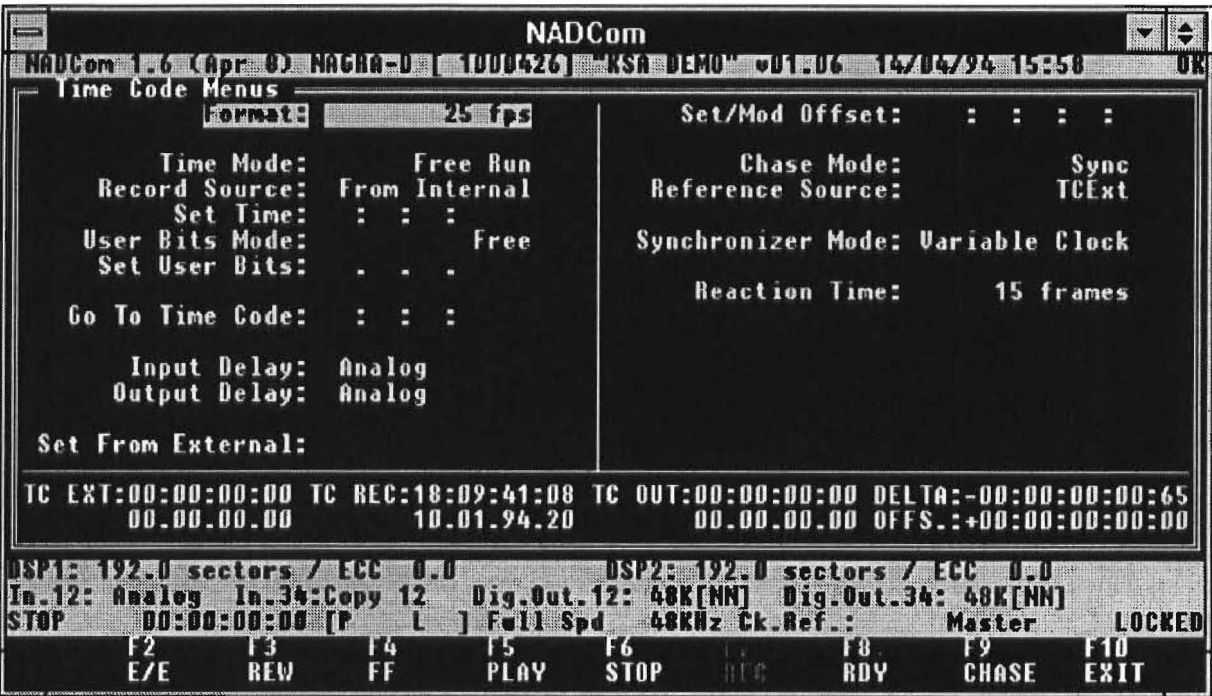
When "M" is pressed from the main menu screen the Time code Menus are displayed. This screen gives the user access to the internal time code features of the NAGRA-D. The TAB key (or PgUP / PgDn) are used to move around the various options available and the right and left cursor arrow keys are used to change the selection.

The upper left side of the display gives access to the internal time code generator. If the cursor is moved to the FORMAT position then by means of the RIGHT and LEFT arrows on the PC the frame rate of the internal generator can be changed. All the other possible menu choices are modified in the same manner. If the cursor is placed on one of the "SET" positions such as Set time code then the numbers may be entered directly using the numeric keypad. When the desired value has been entered, then press "ENTER" to accept the value. The numbers are entered from the right hand side therefore to enter the time code value of 12H 23M 45S 21F simply type 12234521 followed by ENTER.

Indication of the time code reference point (input delay) and the time code output reference (output delay) is also given (see Menus for further explanation as to their meaning).

The right hand upper part of the screen is related to the internal time code chase synchronizer of the machine. The settings are changed in the same way as for time code. The Synchronizer mode position may indicate one of two different things. TSO (as above) is the term used in the Ampex protocol and stands for Tape Speed Override which within the NAGRA-D corresponds to the VAR CLOCK mode of synchronization. The other indication is Fixed Clock corresponding to the FIX CLK mode in the NAGRA-D.

While in the "set / mod offset" position, the UP and DOWN arrow key can be used to adjust the offset by 1 bit at a time, and in steps of 10 bits if "Shift" is pressed with the UP/DOWN arrow keys.

Directly below these two halves of the screen there is permanent indication of all the time code and values including offset and delta.
On this screen the F9 key can be used to send the SYNC command, according to the mode of the internal synchronizer.

N USER NAME SETTING

```
┌─────────────────────────────────────────────────────────────────────┐
│ ▤                            NADCom                              ▾ ▴▾ │
│ NADCom 1.6 (Apr 8) NAGRA-D [ 1000426] "KSA DEMO" ▾01.06 14/04/94 15:58   OK│
│ ┌ User Name Setting ─────────────────────────────────────────────    │
│ │                                                                     │
│ │                                                                     │
│ │                                                                     │
│ │         User Name:  KSA DEMO█                                       │
│ │                                                                     │
│ │                                                                     │
│ │       Use <ENTER> to set user name                                  │
│ │                                                                     │
│ └─────────────────────────────────────────────────────────────────  │
│ DSP1: 192.0 sectors / ECC  0.0        DSP2: 192.0 sectors / ECC  0.0 │
│ In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]│
│ STOP      00:00:00:00 [P    L ] Full Spd  48KHz Ck.Ref.:   Master   LOCKED│
│        F2      F3      F4      F5      F6           F8           F10  │
│        E/E     REW     FF     PLAY    STOP   RFC    RDY          EXIT │
└─────────────────────────────────────────────────────────────────────┘
```

If N is pressed from the main menu screen the operator has the possibility to install his name or Company name as identification. The name (up to 8 characters) is entered from the PC and will appear on the display of the machine in place of the Nagra-d originally. This new name can be locked by using a password, obtained from the factory in Switzerland in the same way as the SONY protocol is installed.

This option is simply a security measure and the name , once locked, will not be erased from the permanent memory of the machine.
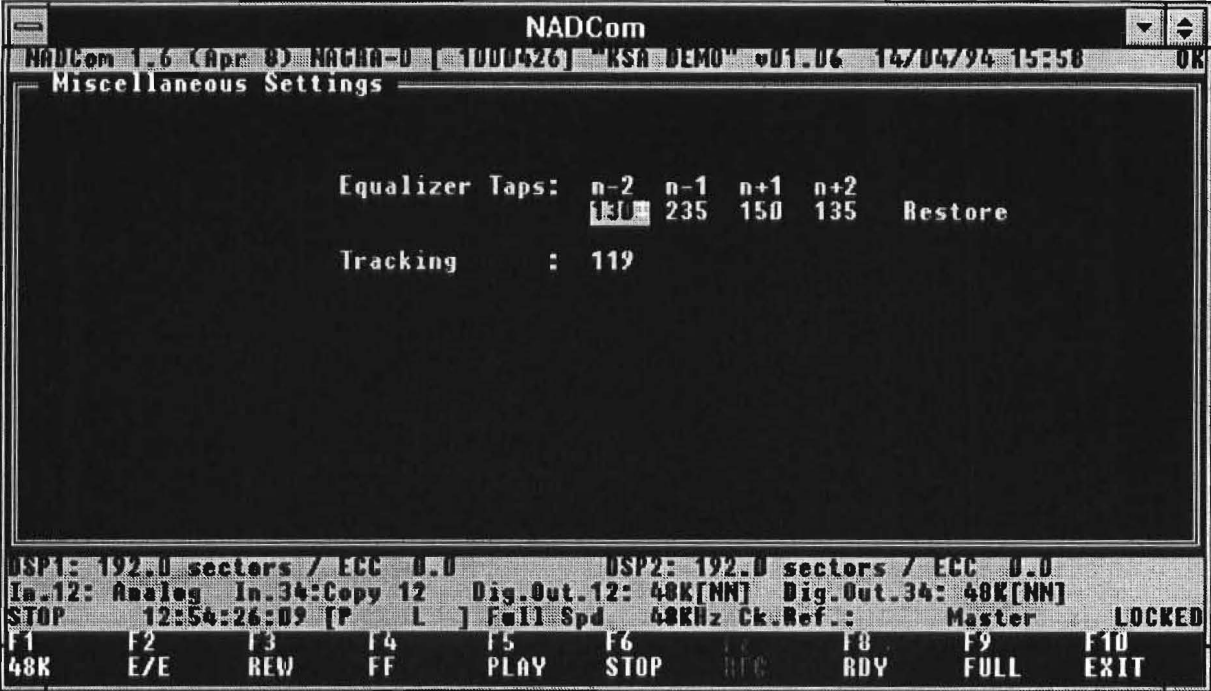
R ECC ERROR REPORT
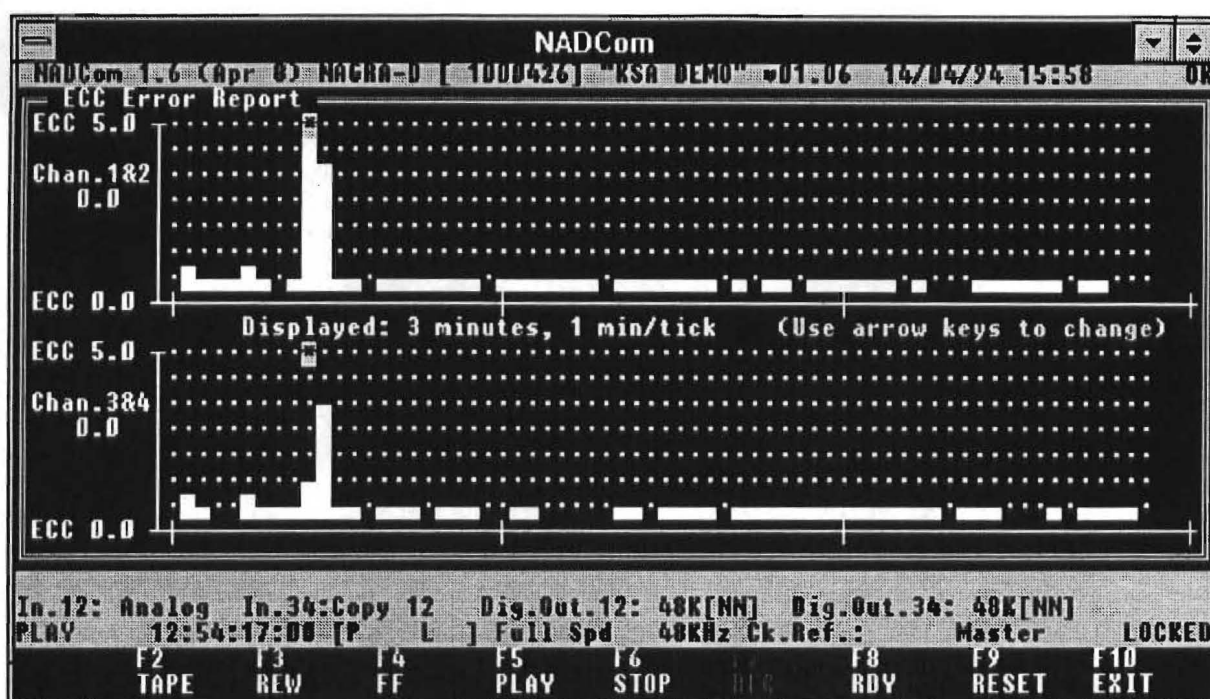
If "R" is pressed from the main menu screen, then the ECC ERROR REPORT screen will be displayed. This screen shows two graphical displays, the first represents channels 1 and 2 and the second represents channels 3 and 4. Each graphic represents (in the above diagram) a 10 minute section of the tape. The indicated duration can be user selected to be 3 minutes, 10 minutes, 30 minutes, 1 hour or 2 hours by means of the arrow keys. This display is used to indicate the amount of errors along the section, which gives the operator the possibility of studying the quality of the recording on the tape. A FATAL error is indicated by a "*" (see diagram) and all the other errors have been entirely corrected by the ECC. A gap in the bottom line indicates that at that point there were zero errors.

This display can be user during the playback of a tape and serves to indicate at a glimpse whether there have been any uncorrected errors during the take. When the end of the screen is reached, then the screen will scroll horizontally so that the last 3 minutes (in this case) are always on the display.

Below the channel numbers is the instantaneous indication of the present drop-outs as was previously indicated at the bottom of the screen.
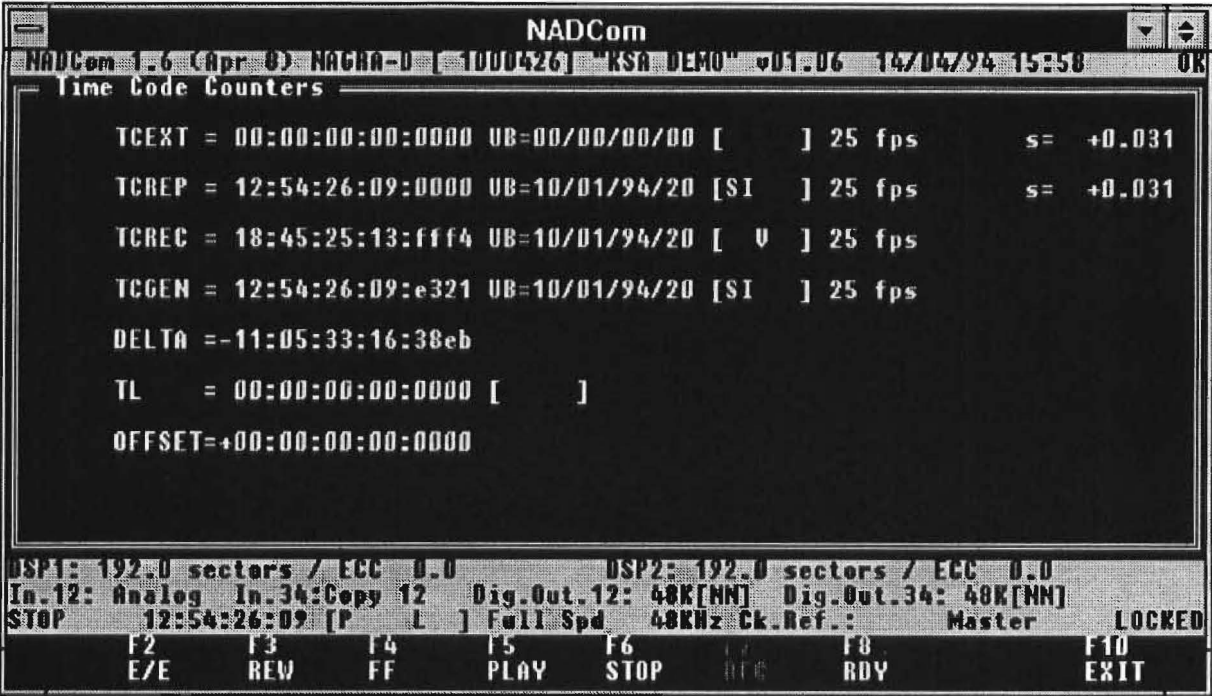
```
┌─ ─────────────────────────── NADCom ──────────────────────── ▼ ▲ ┐
│ NADCom  1.6 (Apr  8) NAGRA-D  [1000426] "KSA DEMO" v01.06  14/04/94 15:58    OK │
│ ┌─ Miscellaneous Settings ────────────────────────────────────────── │
│ │                                                                     │
│ │          Equalizer Taps:  n-2   n-1   n+1   n+2                      │
│ │                           130   235   150   135    Restore          │
│ │                                                                     │
│ │          Tracking      :  119                                       │
│ │                                                                     │
│ │                                                                     │
│ │                                                                     │
│ │                                                                     │
│ │                                                                     │
│ │                                                                     │
│ └─────────────────────────────────────────────────────────────────── │
│ DSP1: 192.0 sectors / ECC  0.0          DSP2: 192.0 sectors / ECC  0.0         │
│ In.12: Analog  In.34:Copy 12    Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]       │
│ STOP       12:54:26:09 [P    L  ] Full Spd   48KHz Ck.Ref.:       Master  LOCKED│
│ F1      F2      F3      F4      F5      F6      F7      F8      F9      F10      │
│ 48K     E/E     REW     FF      PLAY    STOP    REC     RDY     FULL    EXIT     │
└─────────────────────────────────────────────────────────────────────┘
```

This position give access to the Equalizer settings within the machine, as well as the control track adjustment. The Equalizer Taps settings are factory set but can be modified here. When leaving the program the original factory values will be restored if "R" is pressed or alternatively if the NAGRA-D is switched OFF. These are the adjustments of the preamp on the REC/PLAY circuit to have the correct eye pattern at each sampling frequency.

The Tracking position is the calculated offset between the scanner and the control track head. At full speed this setting is always 119 and at half speed it will be between 175 and 245.

On this display screen, the function key F1 can be used to change the sampling frequency of the machine. Each time it is pressed it will toggle through the three possible sampling frequencies in turn.

The function key F9 is also used, and can be used to change the tape transport speed. Each time it is pressed it will toggle between FULL SPD and HALF SPD.

```
┌─                              NADCom                              ▼│▲│
│ NADCom 1.6 (Apr 8) NACRA-D [ 1000426] "KSA DEMO" v01.06  14/04/94 15:58      OK│
│ ┌─ Time Code Counters ──────────────────────────────────────────────────────
│
│      TCEXT = 00:00:00:00:0000 UB=00/00/00/00 [      ] 25 fps      s=  +0.031
│
│      TCREP = 12:54:26:09:0000 UB=10/01/94/20 [SI    ] 25 fps      s=  +0.031
│
│      TCREC = 18:45:25:13:fff4 UB=10/01/94/20 [  V   ] 25 fps
│
│      TCGEN = 12:54:26:09:e321 UB=10/01/94/20 [SI    ] 25 fps
│
│      DELTA =-11:05:33:16:38eb
│
│      TL    = 00:00:00:00:0000 [       ]
│
│      OFFSET=+00:00:00:00:0000
│
│
│
│ DSP1: 192.0 sectors / ECC  0.0      DSP2: 192.0 sectors / ECC  0.0
│ In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]
│ STOP     12:54:26:09 [P    L  ] Full Spd  48KHz Ck.Ref.:     Master    LOCKED
│     F2      F3      F4      F5      F6            F8              F10
│     E/E     REW     FF      PLAY    STOP    hf?   RDY             EXIT
```
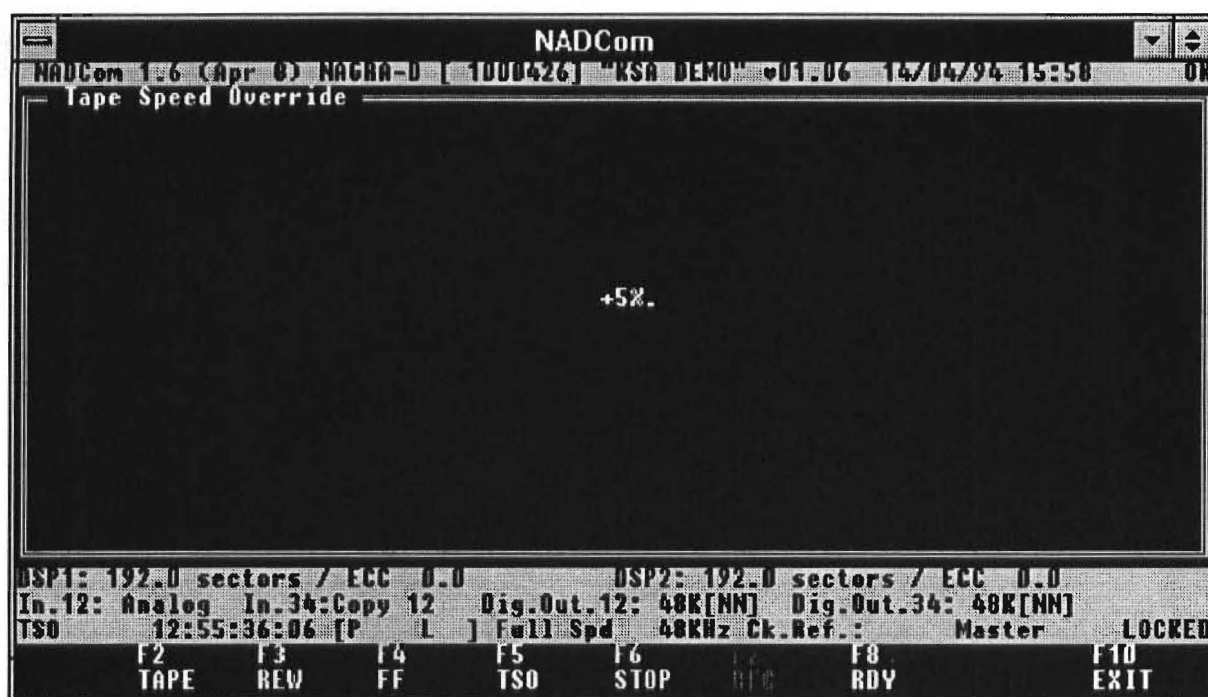
Pressing "T" will enter the time code display. This position indicates all the available time code values in the HH:MM:SS:FF format along with the subframes, for the external signal, the time code replayed from the tape, the internal time code generator and the time code to be recorded. The user bits are also indicated next to each time code position. Inside the []'s there is one of five possibilities:

[V] = Valid time code
[VB] = Valid backwards
[S] = Still
[D] = Discontinue
[   ] = Invalid or no time code

After this indication the current frame rate of each position is indicated. Next to the first two positions is the speed indication. This should be 0.00 when stopped and 1.00 when running.

V TAPE SPEED OVERRIDE

```
┌─────────────────────────────────────────────────────────────────────┐
│ ─                            NADCom                             ▼ ▲▼  │
│ NADCom 1.6 (Apr 8) NAGRA-D [1000426] "KSA DEMO" v01.06 14/04/94 15:58 OK│
│ ─ Tape Speed Override ─────────────────────────────────────────────── │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
│                               +5%.                                    │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
│                                                                       │
│ DSP1: 192.0 sectors / ECC  0.0       DSP2: 192.0 sectors / ECC  0.0   │
│ In.12: Analog  In.34:Copy 12   Dig.Out.12: 48K[NN]  Dig.Out.34: 48K[NN]│
│ TSO      12:55:36:06 [P   L  ] Full Spd  48KHz Ck.Ref.:   Master  LOCKED│
│      F2       F3       F4      F5      F6          F8          F10     │
│      TAPE     REW      FF      TSO     STOP        RDY         EXIT    │
└─────────────────────────────────────────────────────────────────────┘
```

In this position the longitudinal tape speed can be modified. The indication in the center is 0% for nominal speed and + or - depending on the selections made. To change the value, either use the UP arrow or DOWN arrow of the curser keys on the PC, or page UP and page DOWN (to jump in fixed steps) or simply enter the desired value using the numeric keypad, followed by "ENTER".

Q QUIT

When "Q" is pressed the PC will leave the NADCOM program and will return to DOS.

CHAPTER 6

SPECIFICATIONS

Tape format / Transport
Audio performance
Inputs / Outputs
General

SPECIFICATIONS NAGRA-D

TAPE FORMAT / TRANSPORT

Recording system	: Rotary heads and 3 Longitudinal tracks
Monitoring	: Read after write
Tape type	: 1/4" (6.35 mm) Digital tape
Tape speed	: 49.6 mm/s for 2 channels 99.2 mm/s for 4 channels
Recording time	: 5" reel (346m) 2 Ch = 2 hr. 4 Ch = 1 hr. 7" reel (692m) 2 Ch = 4 hr. 4 Ch = 2 hr.
Variable speed	: ≈ ± 10%
Search possibilities	: Using longitudinal analog Cue track
Start up time	: From READY to REC better than 2 sec
Winding speed	: 90 secs (for 5" reel)

AUDIO PERFORMANCE

N° of channels	: 2 or 4
Sampling frequencies	: 32 kHz, 44.1 kHz and 48 kHz.
Analogue IN/OUT	: 18 bits
Signal/noise ratio	: Better than 98 dB
Frequency response	: 20 Hz to 20 kHz ± 0.5 dB (48 kHz sampling frequency)
Total Harmonic distortion	: Less than 0.05%
Wow and flutter	: Below measurable limits
Channel separation	: 80 dB
Digital IN/OUT	: 24 bits (AES)
Error correction	: Reed Solomon (38,34,5) (12,9,4)

INPUTS / OUTPUTS

Analogue inputs	: Switchable Line or Microphone
Microphone	: 4 XLR (switchable, 12V "T" power, Phantom +12V, Phantom +48V)
Line	: Symmetrical, transformerless (Zin > 8 kΩ)
Analog outputs	: Symmetrical, transformerless on XLR connectors 3.1V max (Z out = 50Ω)
Digital I/O	: AES (standard mode)
Time code I/O	: SMPTE/EBU symmetrical (balanced)
External sync	: PAL / SECAM / NTSC / EXT / AES / TC
Serial communication	: RS 422 9-pin
Headphone outputs	: 2 x Stereo (Z out 2 x 47 Ω) with stepped level adjustment (1.45V @ 0 dB no-load)

GENERAL

Power requirement	: Internal battery pack
Battery type	: Betacam (4.5 Ah 12V)
Autonomy	: 1 hr 45 mins.
Consumption	: STOP = 24 W REC = 29 W
External dimensions	: 13 $^{1/16}$ x 13 $^{21/32}$ x 5 $^{5/8}$" (LxWxH) (332 x 347 x 143mm)
Weight (batt incl)	: 8.5 kg (18.7 lbs)

ANNEX A

Application Aid Sheets

#1   8 Channel recording using 2 NAGRA-D machines
#2   8 Channel digital playback using 2 NAGRA-D machines
#3   8 Channel analog playback using 2 NAGRA-D machines
#4   Sync of 24/25 FPS time code to telecine
#5   Sync to 24 FPS film on telecine in NTSC
#6   Sync NAGRA-D to video ref without slow down
#7   Sync NAGRA-D to VTR with slowdown
#8   Slow down only using NTSC reference
#9   Sync NAGRA-D to VTR PAL
#10   Sync NAGRA-D to VTR NTSC

APPLICATION: 8 CHANNEL RECORDING USING 2 NAGRA-D'S

```
                              TC
                          >
                              AES

             1              1
  INPUTS     2    ND 1      INPUTS    2    ND 2
             3              3
             4              4
```
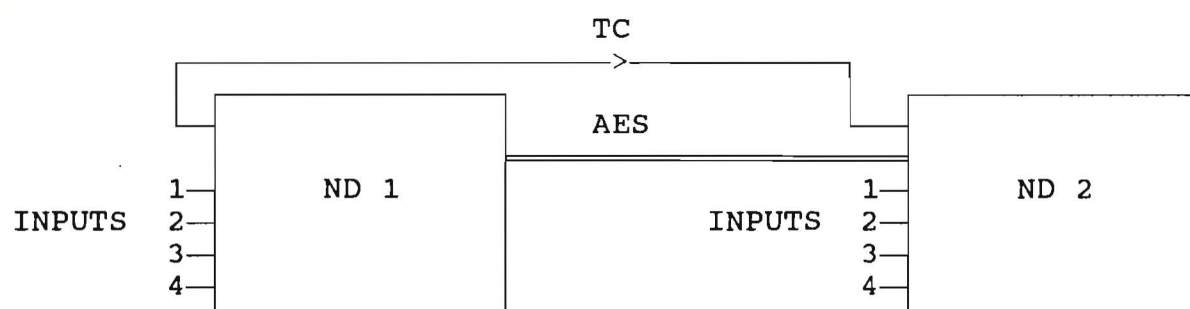
SETTINGS REQUIRED:

	ND 1	ND 2
AUDIO INPUTS	1+2 ANA	1+2 ANA
AUDIO INPUTS	3+4 ANA	3+4 ANA
CLOCK REFERENCE	MASTER	AES 1+2 (or 3+4 if used)
TC RECORD SRC	INT GEN	EXT
TC DELAY	INPUT ANALOG	INPUT ANALOG
OPERATING MODE	RECORD	RECORD

NOTES:

1)   When using this application, some important points need to be mentioned. Firstly that the AES link is used as a reference to the second NAGRA-D to ensure that the sampling frequency clocks of the two machines are locked in phase. This reference could be a video reference fed to both machines instead.

2)   The time code cable need not be used permanently, in this case simply make a "set from external" from the second machine and then record the internal time code generator.

the GOTO END command. Pressing ALT + P will allow the operator to print out the list of takes / drops, which can be placed in the box with the recorded reel. This will work on any type of printer. It has been limited in the number of lines per page so that it can also print on US format paper.

If the cursor is placed on one of the drop-outs or overloads, then the machine will go to the point on the tape but will allow a pre-roll before the error occurs. This pre-roll is approximately 2 seconds at a sampling frequency of 48 kHz.

Along the bottom of this screen are the features activated by the function keys of the PC. F1 and F9 are listed here as they are the only two that are different from other NADCOM screens already explained.

F1   This is the ZOOM feature which will "ZOOM IN" on a selected take and will indicated (as shown below) graphically the section of tape in question.
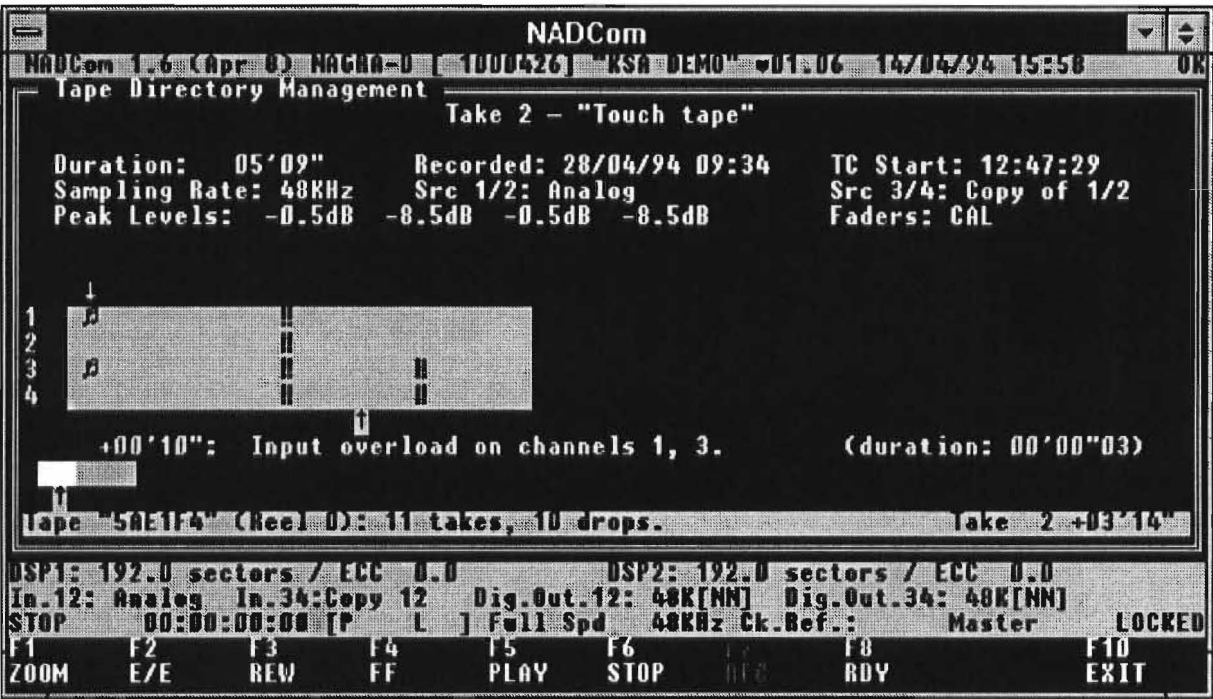
Screen showing the ZOOM.

This screen shows one take at a time. The top arrow (near the "1") indicates the drop we wish to hear. This arrow can be moved with the left and right cursor keys. The lower arrow (in reverse video) indicates where the scanner is presently and indicates relative to the whole tape. The music note sign signifies an input overload and the exclamation mark signifies an ECC error.

APPLICATION: 8 CHANNEL DIGITAL PLAYBACK USING 2 NAGRA-D'S

REF VIDEO

TC

ND 1   ND 2
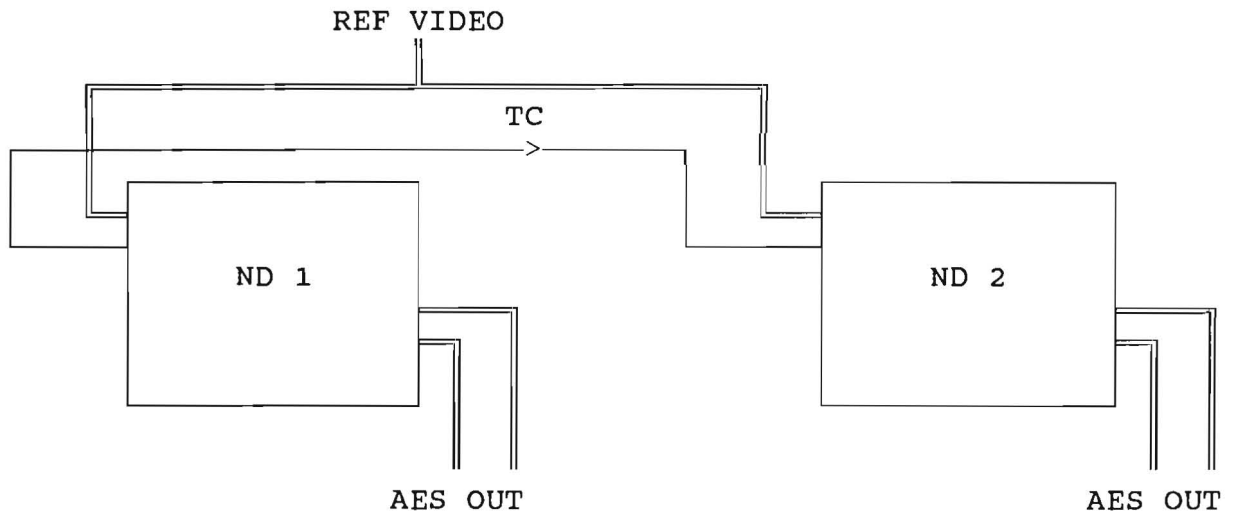
AES OUT   AES OUT

SETTINGS REQUIRED:

	ND 1	ND 2
CLOCK REFERENCE	PAL / NTSC	PAL / NTSC
TC DELAY	OUTPUT AES	OUTPUT AES
SYNC MODE	-	FIX CLK
SYNC REF	-	REF TC (auto selected)
OPERATING MODE	PLAYBACK	SYNC

NOTES:

1)   The external reference need not be video. The reference could equally be an AES signal from an external source fed to each machine, or even an external clock fed to the EXTENSION socket, at any of the following frequencies; 48 kHz, 44.1 kHz, 32 kHz or 9600 Hz.

2)   If using an NTSC reference at 59.94 then the time code on the two tapes must be recorded at 29.97 frames per second.

3)   The time code format of the internal generator must be set to the same frame rate as that which is recorded on the tape.

NAGRA

APPLICATION: 8 CHANNEL ANALOG PLAYBACK USING 2 NAGRA-D'S

TC

AES

ND 1 —1
      —2
      —3
      —4

ND 2 —1
      —2
      —3
      —4
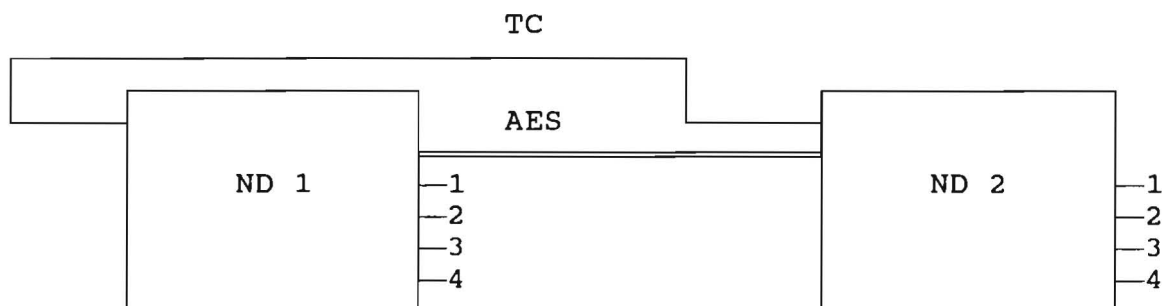
SETTINGS REQUIRED:

	ND 1	ND 2
CLOCK REFERENCE	MASTER	AES 1+2 (or 3+4 if used)
TC DELAY	OUTPUT ANALOG	OUTPUT ANALOG
SYNC MODE	-	FIX CLK
SYNC REF	-	REF TC (auto selected)
OPERATING MODE	PLAYBACK	SYNC

NOTES:

1) The external reference need not be AES. The reference could equally be an AES signal from an external video reference fed to each machine, or even an external clock fed to the EXTENSION socket, at any of the following frequencies; 48 kHz, 44.1 kHz, 32 kHz or 9600 Hz.

2) If using an NTSC reference at 59.94 then the time code on the two tapes must be recorded at 29.97 frames per second.

3) The time code format of the internal generator must be set to the same frame rate as that which is recorded on the tape.

APPLICATION: SYNC OF 24/25 FPS TIME CODE TO TELECINE

SETTINGS REQUIRED:

ND

CLOCK REFERENCE	MASTER
TC DELAY	OUTPUT ANALOG
SYNC MODE	VAR CLK
SYNC REF	REF TC (auto selected)
OPERATING MODE	SYNC (or SYNC INC)

NOTES:

1)   If the SYNC INC mode is to be used instead of SYNC then the time code reference needs to be selected to REF TC.

2)   If the film is 24 frames per second and the audio recorded on the NAGRA-D is also at 24 then the NAGRA-D will playback 4% faster if the telecine is accelerated to 25 FPS.

3)   As the SYNC ref is VAR CLK then the analog audio outputs must be used as the AES signal is out of format.

APPLICATION: SYNC TO 24 FPS FILM ON TELECINE IN NTSC

```
                                              TC
  ┌──────────────┐      ┌──────────────┐  ┌──────────────┐
  │              │ BIΦ  │  BIΦ  TO  TC │  │              │──1
  │   TELECINE   │──────│  CONVERTER   │──│      ND      │──2
  │              │      │              │  │              │──3
  │              │      └──────────────┘  │              │──4
  └──────────────┘                        └──────────────┘
```

SETTINGS REQUIRED:

                    <u>ND</u>

CLOCK REFERENCE   MASTER
TC DELAY   OUTPUT ANALOG
SYNC MODE   VAR CLK
SYNC REF   REF TC (auto selected)

OPERATING MODE   SYNC (or SYNC INC)

NOTES:

1)   If the SYNC INC mode is to be used instead of SYNC then the time code reference needs to
      be selected to REF TC.

2)   The film is 24 frames per second and the audio recorded on the NAGRA-D must be 30 FPS.
      Then the 3:2 pull down made by the telecine will create 30 video images per second. The
      telecine is then slowed down by 0.1 % from 30 FPS to 29.97 and the NAGRA-D will do the
      same.

3)   As the SYNC ref is VAR CLK then the analog audio outputs must be used as the AES signal
      is out of format.

APPLICATION: SYNC NAGRA-D TO VIDEO REF W/O SLOW DOWN

VIDEO REF

```
          ┌──────────────┐
      ┌───┤              │
      └───┤     ND       ├─1
          │              ├─2
          │              ├─3
          │              ├─4
          └──────────────┘
```
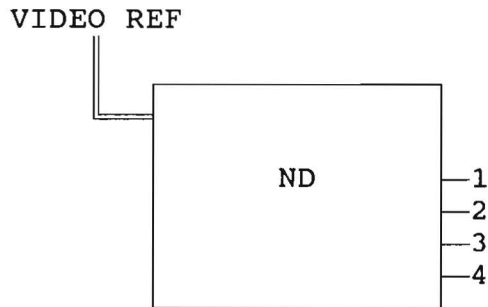
SETTINGS REQUIRED:

                    <u>ND</u>

CLOCK REFERENCE	PAL / NTSC
TC DELAY	OUTPUT ANALOG / DIGITAL
SYNC MODE	-
SYNC REF	-
OPERATING MODE	PLAYBACK

NOTES:

1)   If the video reference is PAL then the time code on the tape must be 25 FPS.
      If the reference is NTSC then the time code on the tape must be 29.97 either drop frame or
      non drop frame.

2)   The outputs may also be digital as long as the slow down (NTSC 30 to 29.97) is not being
      made. In this case then the time code delay must be OUTPUT AES.

3)   If during recording, the time code source was EXTERNAL then the SYNC MODE must be
      set to VAR CLK for long takes (more than several minutes), in which case the digital outputs
      cannot be used. In this case the OPERATING MODE of the machine must be SYNC INC
      and the SYNC REF must be set to REF FRAME PULSE.

APPLICATION: SYNC NAGRA-D TO VTR WITH SLOW DOWN

NTSC VIDEO REF

VTR	TC	ND	—1
			—2
			—3
			—4

SETTINGS REQUIRED:

                    ND
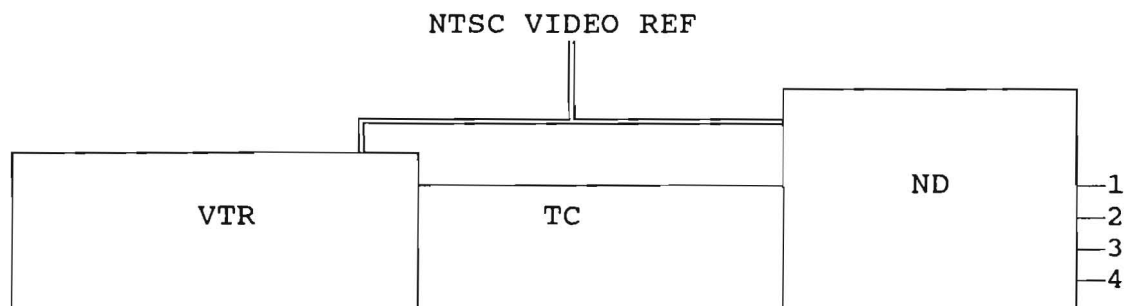
TC FORMAT (INT)	29.97 (DF OR FF)
TAPE TC FORMAT	30 (DF OR FF)
CLOCK REFERENCE	NTSC / MASTER
TC DELAY	OUTPUT ANALOG
SYNC MODE	VAR CLK
SYNC REF	REF TC (auto selected)

OPERATING MODE   SYNC

VTR IN PLAYBACK

NOTES:

1)   This will perform the slow down from 30 FPS to 29.97 the audio outputs must be analog.

APPLICATION: SLOW DOWN ONLY USING NTSC REFERENCE
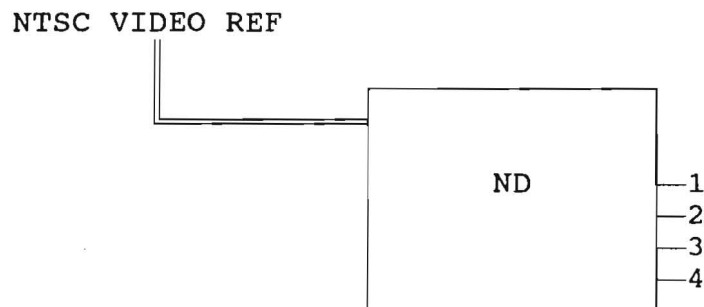
NTSC VIDEO REF

```
                                    ┌──────────────┐
                                    │              │──1
                                    │      ND      │──2
                                    │              │──3
                                    │              │──4
                                    └──────────────┘
```

SETTINGS REQUIRED:

ND

TC FORMAT (INT)	29.97 (DF OR FF)
TAPE TC FORMAT	30 (DF OR FF)
CLOCK REFERENCE	NTSC / MASTER
TC DELAY	OUTPUT ANALOG
SYNC MODE	VAR CLK
SYNC REF	FRAME PULSE
OPERATING MODE	SYNC INCREMENTAL

NOTES:

1)   This will perform the slow down from 30 FPS to 29.97 FPS using only an external "house" video reference the audio outputs must be analog, as the AES outputs are out of format because the SYNC MODE is set to VAR CLK.

APPLICATION: SYNC NAGRA-D TO VTR PAL

PAL VIDEO REF

```
                        ┌──────────────┐
                        │    ND      ──1
  ┌──────────┐          │            ──2
  │   VTR    │   TC     │            ──3
  │          │          │            ──4
  └──────────┘          └──────────────┘
```
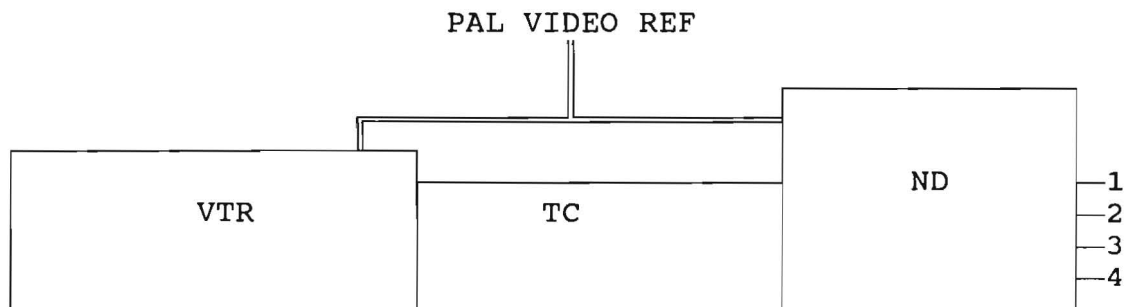
SETTINGS REQUIRED:

ND

TC FORMAT (INT)	25 FPS
TAPE TC FORMAT	25 FPS
CLOCK REFERENCE	PAL
TC DELAY	OUTPUT ANALOG / DIGITAL
SYNC MODE	FIX CLK
SYNC REF	REF TC (auto selected)

OPERATING MODE   SYNC

VTR IN PLAYBACK

NOTES:

1) In this application there is no slow down being performed and therefore the audio outputs can be either ANALOG or DIGITAL. The time code DELAY must be set according to the outputs being used.

2) If during the recording both machines were not fed an external reference then the sync mode VAR CLK must be used for the transfer of long takes (more than several minutes).

3) As the SYNC ref is VAR CLK then the analog audio outputs must be used as the AES signal is out of format.

APPLICATION: SYNC NAGRA-D TO VTR NTSC

NTSC VIDEO REF

| VTR | TC | ND | 1 2 3 4 |

SETTINGS REQUIRED:

ND
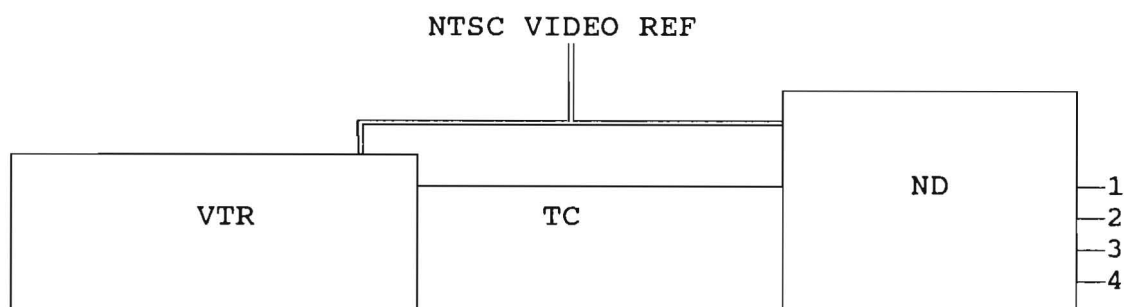
TC FORMAT (INT)	29.97 FPS
TAPE TC FORMAT	29.97 FPS
CLOCK REFERENCE	NTSC
TC DELAY	OUTPUT ANALOG / DIGITAL
SYNC MODE	FIX CLK
SYNC REF	REF TC (auto selected)
OPERATING MODE	SYNC

VTR IN PLAYBACK

NOTES:

1)   In this application there is no slow down being performed and therefore the audio outputs can be either ANALOG or DIGITAL. The time code DELAY must be set according to the outputs being used, and the time code on the NAGRA-D tape as well as that of the VTR must be 29.97 DF or FF.

2)   If during the recording both machines were not fed an external reference then the sync mode VAR CLK must be used for the transfer of long takes (more than several minutes).

3)   As the SYNC ref is VAR CLK then the analog audio outputs must be used as the AES signal is out of format.

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