

**NAGRA KUDELSKI**

**INSTRUCTION MANUAL**



**NAGRA E**

**KUDELSKI SA. 1033 CHESEAUX SWITZERLAND**

# **N A G R A   E**

## **PORTABLE ANALOGUE AUDIO TAPE RECORDER**

### **INSTRUCTION MANUAL**

(KSA code No. 20 02002 151)

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NAGRA Tape Recorder Manufacturer

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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.

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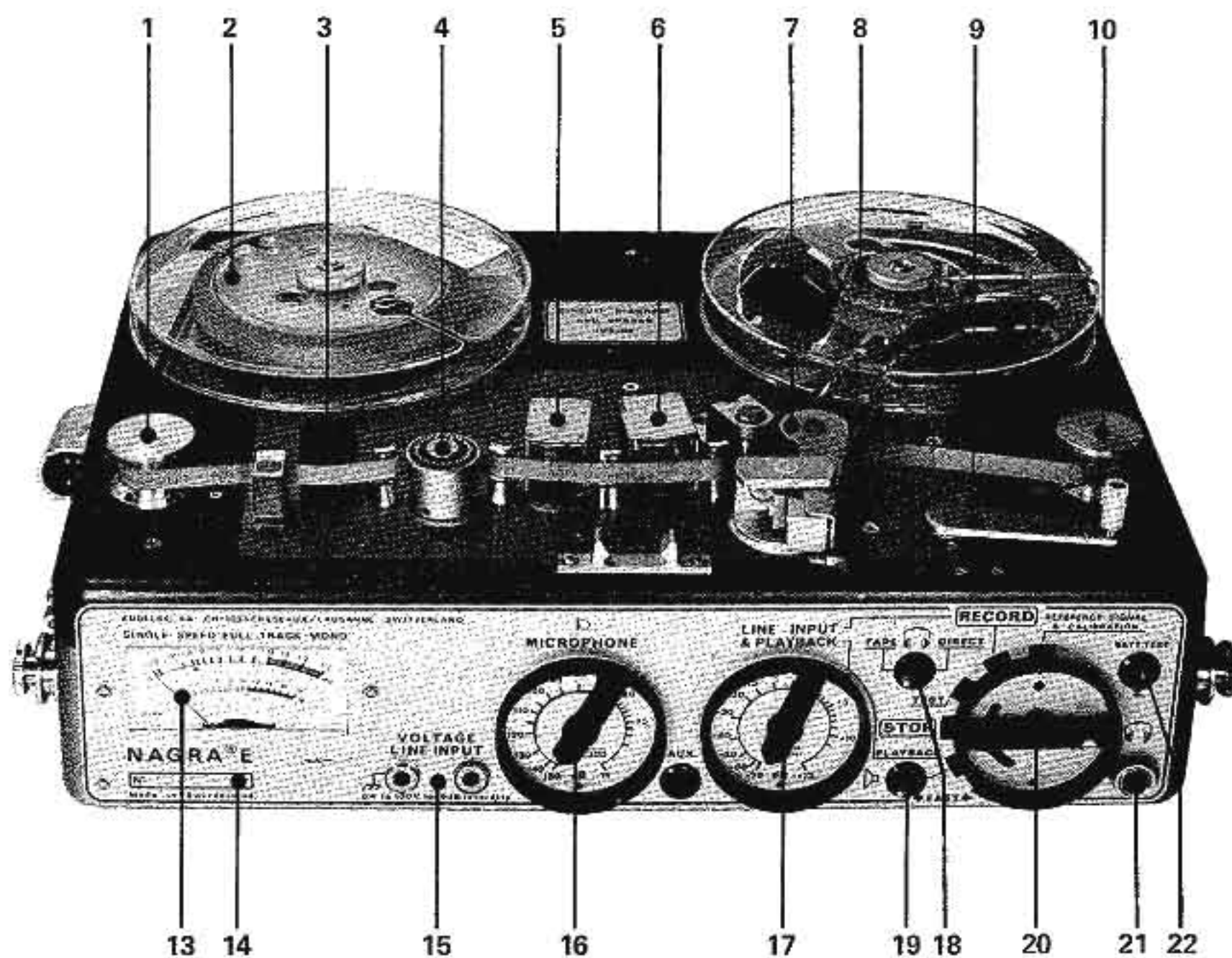
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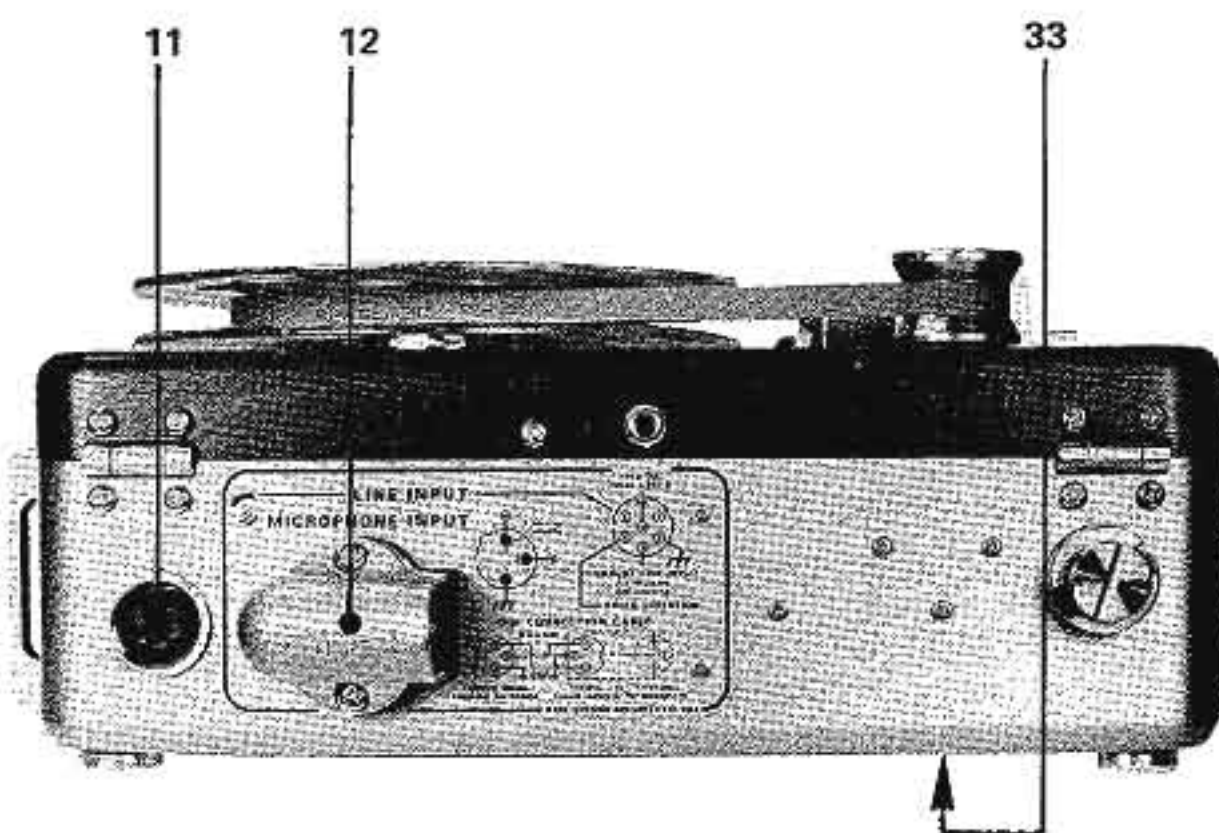
# NAGRA E

## CONTROLS

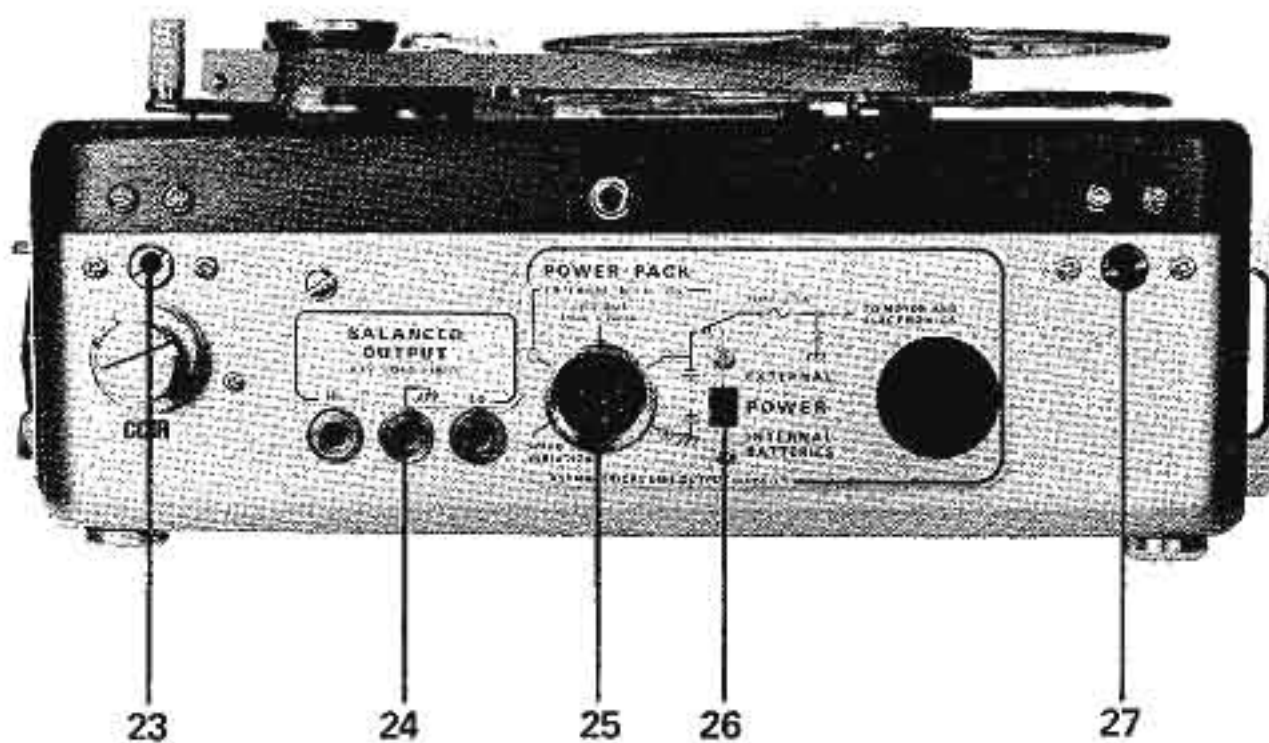


- 1 Left tension roller
- 2 Supply reel
- 3 Erase head
- 4 Stabilizer roller with stroboscope
- 5 Recording head
- 6 Playback head
- 7 Pinch-wheel
- 8 Take-up reel
- 9 Pinch-wheel control lever
- 10 Right tension roller

- 13 Galvanometer
- 14 Calibration screw
- 15 Voltage line input
- 16 Microphone potentiometer
- 17 Line input & playback potentiometer
- 18 Tape-direct switch
- 19 Loudspeaker switch
- 20 Main functions selector
- 21 Headphone output
- 22 Battery test switch



- |    |   |    |                            |
|----|---|----|----------------------------|
| 11 | Line input (current)                                | 25 | Power pack connector       |
| 12 | Mike input  | 26 | Power mode selector switch |
| 23 | Box locking screw                                   | 27 | Box locking screw          |
| 24 | Asymmetrical line output<br>(symmetrical on option) | 33 | Microphone selector switch |





# Chapter 1

## PREPARATION

### 1.1. POWER SUPPLY

#### Batteries or rechargeable cells

Make sure that sliding switch 26 is on "Internal" position.

Turn over the NAGRA E and remove cover 30 by undoing fixing screws 29 and 32.

Place either twelve D-type batteries (R20) or fifteen 2/3 D-type rechargeable cells, all in the same direction, as indicated on the bottom of the compartment. It is easier to place the batteries at each end first, and then to insert the others in between.

Place back cover 30 into place securing it with screws 29 and 32 and turn the NAGRA E over again.

Set main functions selector to "PLAYBACK" or "RECORD" and check voltage by pressing down "Batt. Test" switch 22. With new cells, meter 13 should show 18 V on the lower scale. If the needle remains below 11 V, the voltage is insufficient to power the NAGRA E.

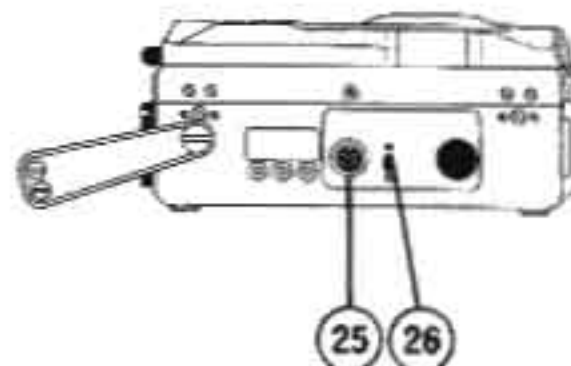
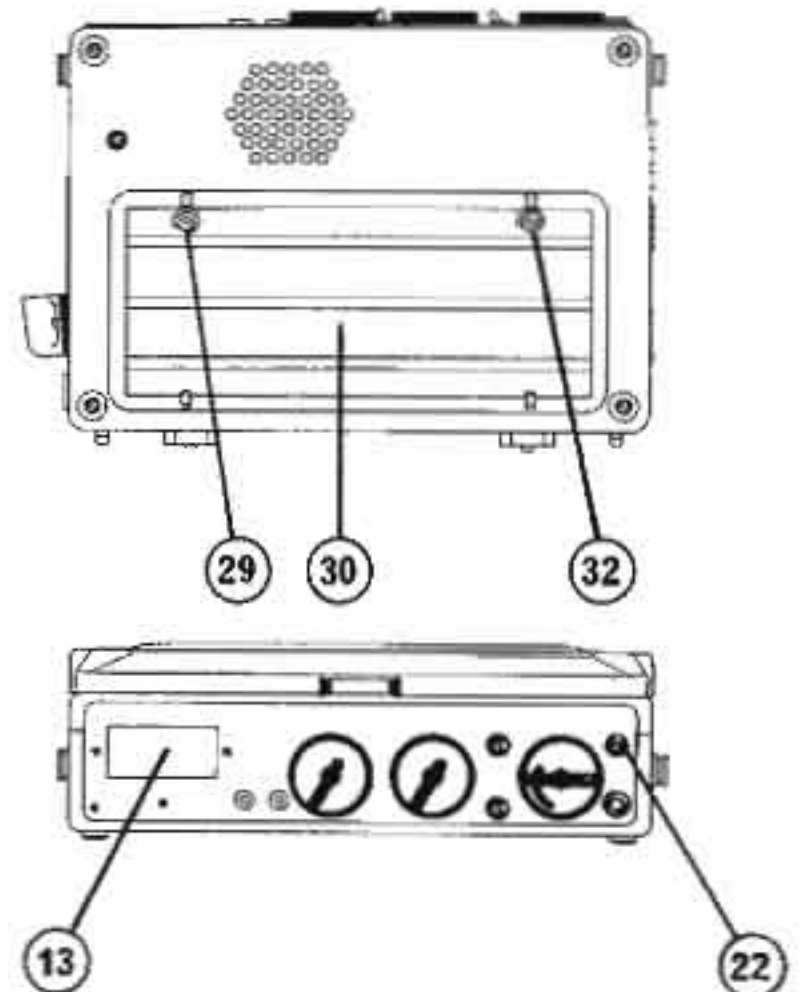
#### External power supply

Throw switch 26 to "External".

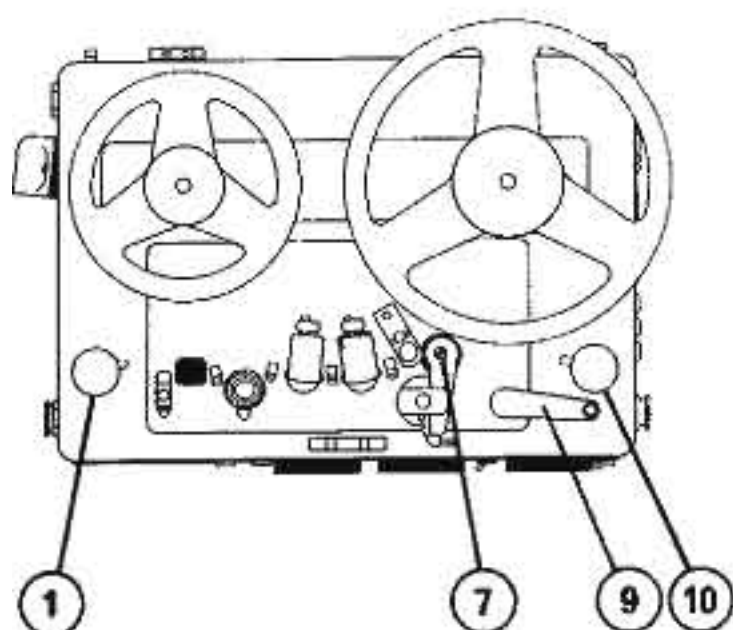
The NAGRA E can also be powered by the ATN external power supply which connects to input 25 Power Pack. Thus when pressing "Batt. Test" switch 22, the needle of meter 13 must go to the far right, as the voltage supplied is approximately 30 V.

NB :

It is possible to check the voltage supply of the NAGRA E (Batt. Test 22) at any time, no matter what function has been selected.



## 1.2. THREADING THE TAPE



Release pinchwheel 7 by pulling forward lever 9. Place the full reel on the left and the empty reel on the right hand side. Secure them. Thread the tape around tensionrollers 1 and 10, and wind sufficient tape on the empty reel. Engage the pinchwheel by pushing lever 9 back into its original position; it should snap sharply into place. The recorder is now ready to operate.

NB :

When threading the tape, ensure that the oxide layer faces the heads.

The record chain of the NAGRA E is calibrated at the factory with a given type of tape. If another type of tape is to be used, it will be necessary to re-calibrate the machine as explained in Chapter 4.2.

If the NAGRA E remains unused for a long period of time, lever 9 should not be left in the released position as the clutch might deteriorate and become the source of noisy rewinding.

## 1.3. SPEED AND REELS

The NAGRA E is a single-speed recorder available either in 19 cm/s (7 1/2 ips) or 9.5 cm/s (3.75 ips) version.

The recording times given below are an indication only and correspond to 35µ long play tape.

	Reels	9.5 cm/s	19 cm/s
Cover closed	127 mm	47 min.	24 min.
with QSET	178 mm	1h34 min.	47 min.
with QGB	267 mm	2h12 min.	1h06 min.

standard 50 µ tape :

	Reels	9,5 cm/s	19 cm/s
Cover closed	127 mm	32 min.	16 min.
with QSET	178 mm	1h03 min.	32 min.
with QGB	267 mm	1h36 min.	48 min.



# Chapter 2

## OPERATION

### 2.1. METER READINGS

The meter has two graduated scales, one in volts and the other in decibels. It is used to check the supply voltage, to adjust the input sensitivity, to effect a rough check of the circuits and to calibrate the record and playback chains.

#### Mechanical zero setting

By means of adjustment screw 14 the modulometer needle can be moved to the left or to the right and thus positioned exactly at the beginning of the scale.

#### Battery check

Lower scale. The thick part of the scale indicates the minimum and maximum levels of the supply voltage (with batteries).

#### Input sensitivity

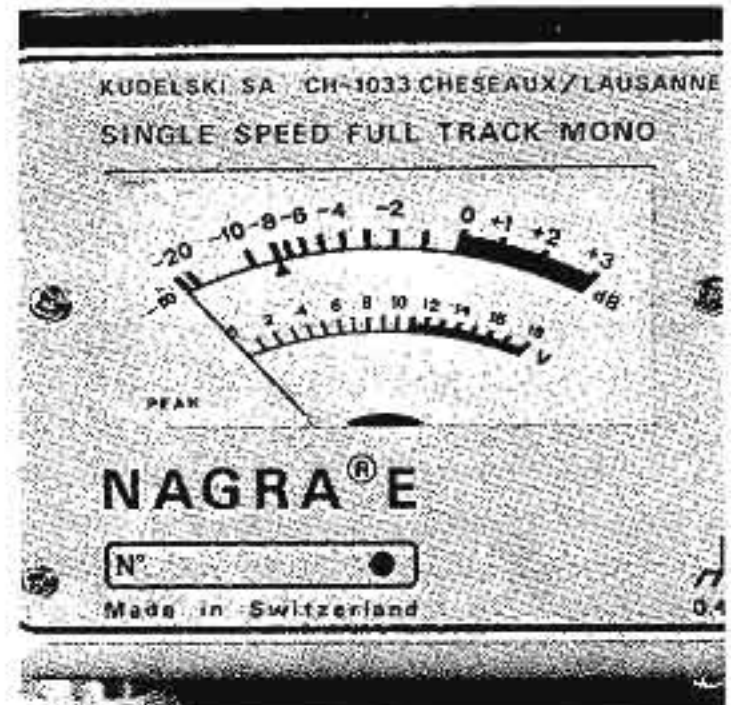
Upper scale. The NAGRA E meter functions as a modulometer, i.e. it shows the peak value, with fast rise time and integrated fall of the recorded signal. It incorporates a memory device making it possible to read the value displayed. As is customary with VU-meters, graduation is only from -20 dB to +3 dB.

#### Voltage measurement

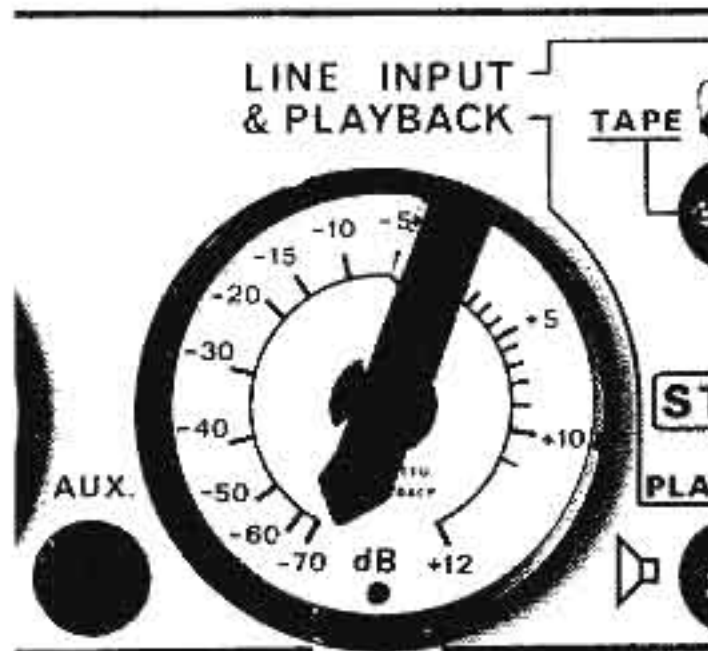
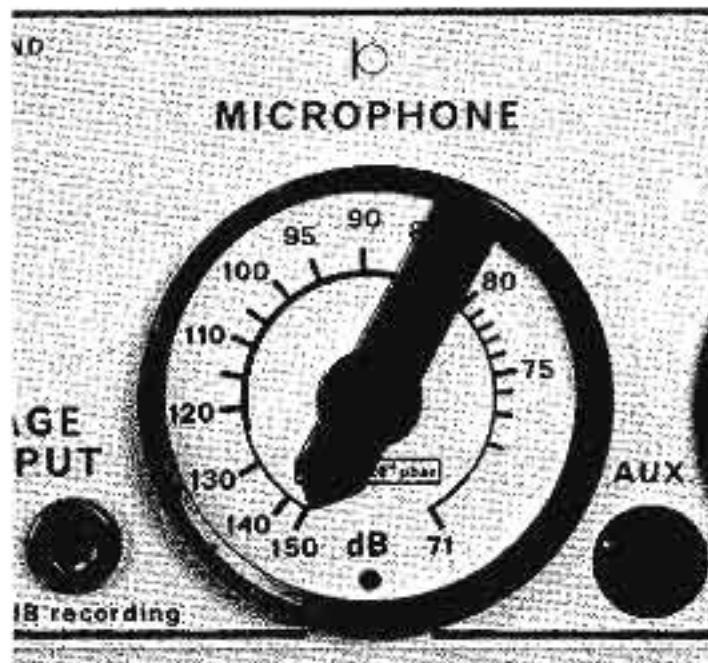
Lower scale. The NAGRA E is equipped with its own checking device. A probe placed inside the recorder permits a quick check of all circuits. The voltage measured is shown on the meter (see Chapter 3.3.).

#### Calibration of the recorder

Upper scale. This scale is used for calibration (see Chapter 4)



## 2.2. POTENTIOMETER POSITIONING



## 2.3. SAFETY CATCH

The two NAGRA E potentiometers 16 and 17 are graduated differently.

### Potentiometer 16 microphone

Graduated from 150 to 71 dB. This scale expresses the sound level in dB for a recorded level of 0 dB, i.e. a 320 nWb/m flux. The thick part of the scale corresponds to the best operational range of the microphone preamplifier. If sensitivity must be increased as far as between 82 and 71 dB, the background noise will no longer be negligible with respect to tape noise. However, if sensitivity must be decreased to between 125 and 150 dB in order to record at 0 dB on the modulometer, then the input signal is too strong. It is therefore necessary either to reduce the signal level by means of an attenuator, provided the microphone itself is not saturated, or to switch the input to a less sensitive position.

### Potentiometer 17 Line Input & Playback

Graduated from -70 to +12 dB. If a tape recorded at 0 dB level, i.e. a 320 nWb/m flux, is played back with the potentiometer at 0 dB, it will give a nominal signal of 0.94 V at unbalanced line output 24. The modulometer will read 0 dB. If the potentiometer is set to +12 dB the modulometer will indicate 0 dB for a signal recorded at -12 dB.

As a safety precaution on the NAGRA E, main function selector 20 is equipped with two slotted buttons, one is red, the other white.

During transportation, : to avoid inadvertent operation of the recorder, it is possible to lock the selector in STOP position by pressing the white button and turning it 90°.

During playback or editing : to avoid accidentally switching to record, it is possible to use the red button in the same way. The main selector will turn freely but it will be impossible to switch it to record.

## 2.4. MAIN FUNCTION SLECTOR

Selector 20 has six positions for the following functions :

**STOP** : power supply disconnected

By turning clockwise :

**TEST** : All is set for recording; the tape is not running. Modulometer 13 shows the amplitude of the signal thus making it possible to adjust the input sensitivity.

**RECORD** : The tape is running; it is first erased and then recorded.

**REFERENCE SIGNAL AND CALIBRATION** : Position allowing the calibration of the record chain. (See Chapter 4.2.).

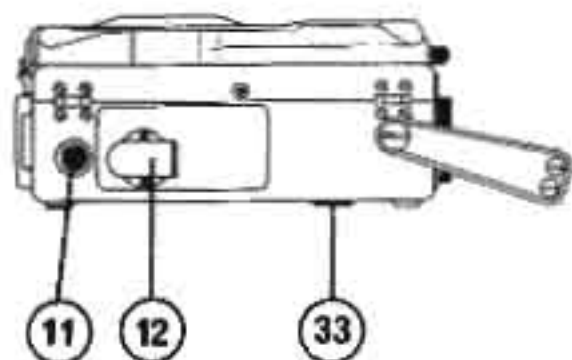
Counter-clockwise :

**PLAYBACK** : The signal read is available at the headphones output. It can be listened to through the built-in loudspeaker by throwing switch 19 to the loudspeaker symbol. Level is adjusted by means of potentiometer 17 "Line Input & Playback" providing "Tape Direct" switch 18 is in the "Direct" position.

**FAST** : This position permits fast rewind (lever 9 released) or fast foward (lever 9 engaged). In fast forward, the loudspeaker is disconnected; the signal is available at headphones output 21.



## 2.5. CONNECTIONS



Six connectors on three sides of the recorder permit the use of various accessories for recording or playback.

### Left side

Line input 11 (female Tuchel 6-pole)  
Current line input, level of which is adjusted with potentiometer 17 "Line Input & Playback".

#### Characteristics :

Sensitivity	3 $\mu$ A for 0 dB
Impedance	330 $\Omega$
Maximum level	140 $\mu$ A
Source impedance	higher than 1 k $\Omega$

Mike input 12 (XLR 3-pole)

Mike input, level of which is adjusted by microphone potentiometer 16. This input can be adapted to different types of microphones by means of switch 33 on the underside of the recorder.

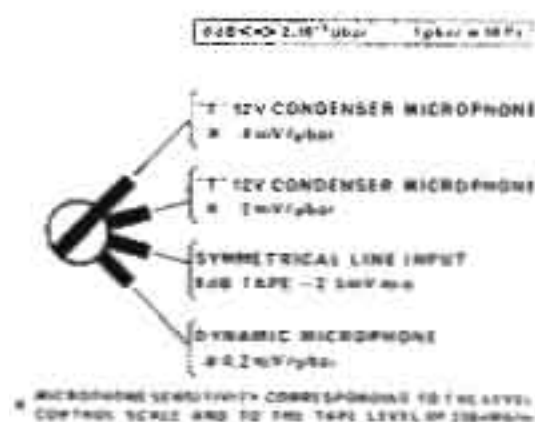
#### Characteristics :

Capacitor mike "T"	+ 12 V, 4 mV per $\mu$ bar
Impedance	330 $\Omega$
Sensitivity	2.5 mV for 0 dB (320 nWb/m) 4 mV for 0 dB (510 nWb/m)
Maximum level	1200 mV

Capacitor mike "T"	+ 12 V, 2 mV per $\mu$ bar
Impedance	330 $\Omega$
Sensitivity	1.25 mV for 0 dB (320 nWb/m) 2 mV for 0 dB (510 nWb/m)
Maximum level	800 mV

Symmetrical Line Input	
Impedance	10 k $\Omega$
Sensitivity	2.5 mV for 0 dB (320 nWb/m) 4 mV for 0 dB (510 nWb/m)
Maximum level	1200 mV
Source impedance	higher than 1 k $\Omega$

Dynamic Mike 200 $\Omega$	
Impedance	10 k $\Omega$
Sensitivity	0.138 mV for 0 dB (320 nWb/m) 0.22 mV for 0 dB (510 nWb/m)
Maximum level	100 mV



## Front

Voltage line input 15 (banana plugs)

The level is adjusted by potentiometer 17 "Line Input & Playback".

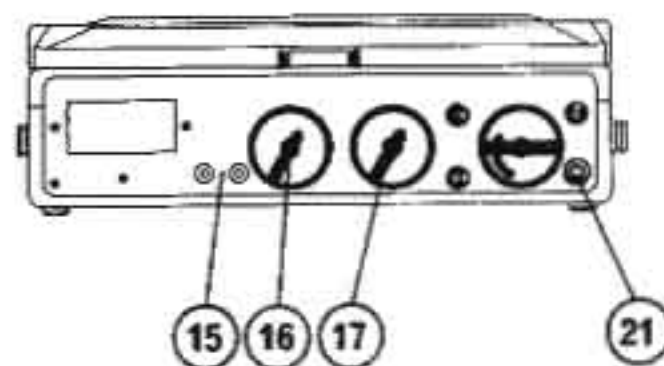
Characteristics :

Sensitivity	0,4 V RMS for 0 dB
Impedance	150 k $\Omega$
Maximum signal	100 V

Headphones output 21 (standard jack)

Voltage output adjustable inside the recorder (see Chapter 3.4.).

Maximum signal	0.56 V RMS for 50 $\Omega$ 0.81 V RMS for 600 $\Omega$
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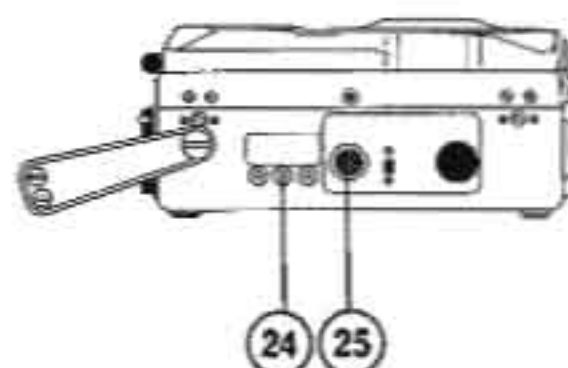


## Right side

Asymmetrical Line Output 24 (banana plugs)

Characteristics :

Output level	0.94 V RMS for 320 nWb/m 1.55 V RMS for 510 nWb/m
--------------	--



NB :

It should be recalled that the broadcast flux level standard is usually 320 nWb/m for mono recorders; this is why the recorder is delivered with this calibration. However, it is very easy to adjust the flux to 510 nWb/m by re-calibrating the modulometer and the reference generator, thus improving the signal-to-noise ratio by 4 dB. Optionally, this asymmetrical line output can be replaced by a floating line output.

Characteristics :

Output level	4.4 V/600 $\Omega$ 1.55 V/600 $\Omega$
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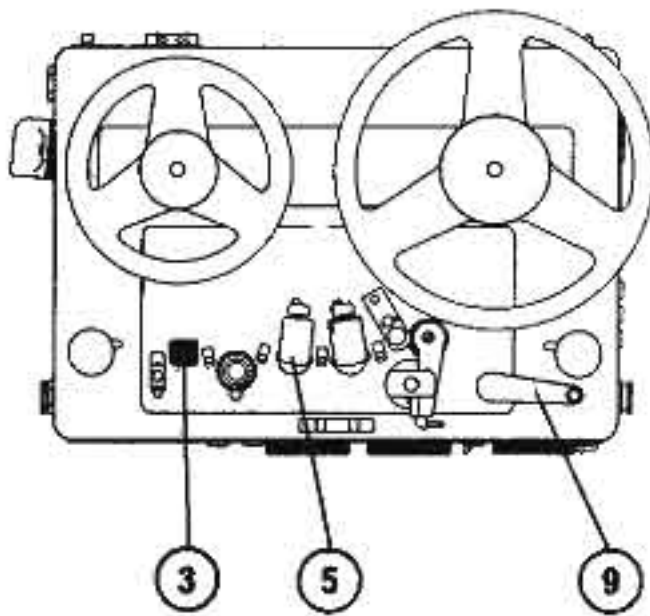
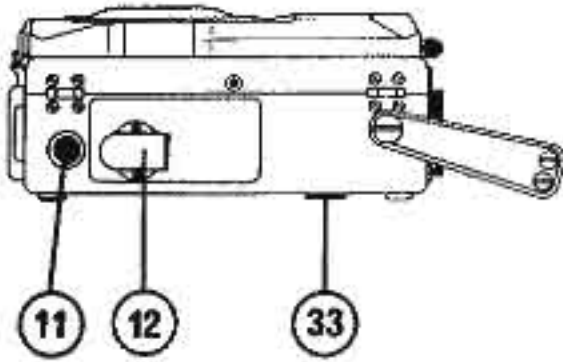
Power pack 25 (female Tuchel 6-pole)

Characteristics :

External power supply. Supply voltage must be between -10.7 et -35 V. Acceptable ripple is  $\pm 0,7$  V.



## 2.6. RECORDING



### With microphone

Connect the microphone to input 12 and switch 33 to correspond to the type of mike used; main function selector 20 on TEST. Adjust the input sensitivity with potentiometer 16. If a headset is available, it is also possible to evaluate the quality of the sound recording and determine the best positioning of the microphone.

Turn selector 20 to RECORD. The tape is running. Anything already recorded on the tape will be first erased as it runs across erase head 3. At the headphones output two types of signals can be heard. When "Tape-Direct" switch is on "Direct", the signal being recorded can be heard; whereas in position "Tape", the signal heard is already recorded on the tape and is reproduced by the playback head. Comparison of these two signals permits an evaluation of the quality of the recording, and in particular enables detection of faults, such as dirt on a head or a tape threaded the wrong way.

### NB :

The tape can be rewound leaving main selector 20 on RECORD, but releasing lever 9 : However, should the tape accidentally touch erase head 3 or record head 5, it would be partially erased.

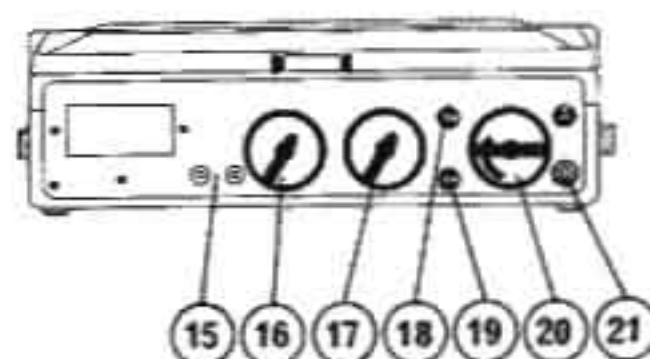
### With line input

Connect the signal source to the adequate line input 11 or 15 (see Chapter 2.5.). Selector 20 on TEST and adjust the sensitivity with potentiometer 17.

To read a recorded tape, turn selector 20 to "PLAYBACK". To adjust the playback level, switch 18 to "Direct" and use potentiometer 17. If 18 is on "TAPE", the playback level remains constant. The signal read is also available at headphones output 21 and at asymmetrical line output 24. To switch on the built-in loudspeaker, throw switch 19 to the loudspeaker symbol.

NB :

It is possible to rewind a tape leaving selector 20 on "PLAYBACK" and releasing lever 9.



### Transmission by telephone

This is possible if the recorder is equipped with a floating output 600  $\Omega$ , 4.4 V or 1.55 V (option).

With main selector on "PLAYBACK" and lever 9 slightly released so that the tape is not running, the reporter can make a microphone commentary. The recording can then be transmitted by simply fully engaging lever 9. A commentary by the reporter over the recording is also possible by adjusting potentiometers 16 and 17.

### Connection with other equipment

#### Earthing loops

When the NAGRA E is supplied from an ATN its earth is strapped to that of the mains. If it is feeding an amplifier the earth of which is also connected to that of the mains the transmission of the signal can present a problem : because of the earthing loop so formed the earth of the NAGRA may not be exactly at the same potential as the earth of the amplifier. Tensions may appear due to currents circulating in the earthing loop or due to parasitic magnetic fields. Even if the earth of the NAGRA is directly connected to the earth of the amplifier the conductivity of this connection may not be adequate to suppress the whole difference.

The simplest solution is, in our opinion, to use two power diodes back-to-back in the connection between the ATN earth and the mains earth.

The diodes do not conduct below approximately 1 V; they ensure full protection from the safety point of view but do not intervene at millivolt level. Unfortunately this method has not yet been introduced in various national regulations.

Another solution is to have a differential input on the amplifier. This is the case with the DSM monitor and, in general with professional equipments. Two wires are sufficient to make the connection, the earths being strapped through the mains. On the other hand, in the case of battery operation a third earth wire is required.

If the NAGRA E is connected to an unbalanced amplifier, the problem can be minimized by the use of short earth connections to the amplifier and the ATN; by keeping the mains wires of the amplifier and of the ATN as parallel as possible to avoid formation of a big loop.

Do not forget that the microphone input of the NAGRA E is balanced and used as line input for levels between 2.5 and 1200 mV. Thus the operation is always carried out using 3 wires, one connecting the earth of the equipment and the other two transmitting the signal. If the source is unbalanced, one of the input wires should be connected to its earth and the other one to its active terminal. If the two equipments are already connected to a common earth, the first earth wire should be cut.

# Chapter 3

## MAINTENANCE

### 3.1. BATTERIES

#### Risk of electrolyte leakage

Despite the efforts of cell manufacturers, there always exists a risk of leakage of the electrolyte, especially from flat batteries. Such a leakage may cause serious damage to the NAGRA, especially if it is kept in its carrying case which retains the corrosive liquid.

Thus :

- if, for any length of time, you do not intend to use your NAGRA on batteries, remove them. If you place your batteries in a freezer, you practically stop their self-discharge.
- when your batteries are flat, remove them immediately.
- if a leakage occurs, wash with water. The NAGRA suffers much less from water than from the electrolyte of the batteries.

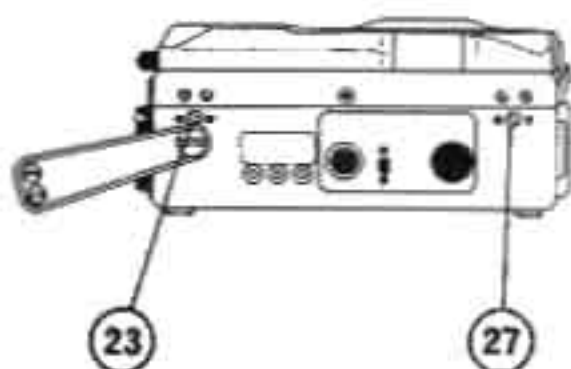
### 3.2. CLEANING THE MAGNETIC HEADS

In order to record and playback, the tape must be in a perfect contact with the heads. Unfortunately, certain tapes lose some of their oxide which may then settle on the heads. The playback then becomes muffled and the recording distorted. Fortunately, inspection of the heads is very easy in the NAGRA E. It is sufficient to inspect the recorder without the tape. The active part of the head is white and polished like a mirror; if black or brown traces are visible there, it is necessary to remove them.

It is not recommended to rub the heads when dry, they should be cleaned with a piece of wetted cotton. Alcohol is good, but water is acceptable too. In urgent cases the corner of a handkerchief, wetted with some saliva, can be used. On the other hand, strong solvents, like trichlorethylene and similar liquids must never be used, as they cause the epoxy resins used in the manufacture of the heads to expand.



### 3.3. ACCESS TO THE INTERIOR OF THE NAGRA

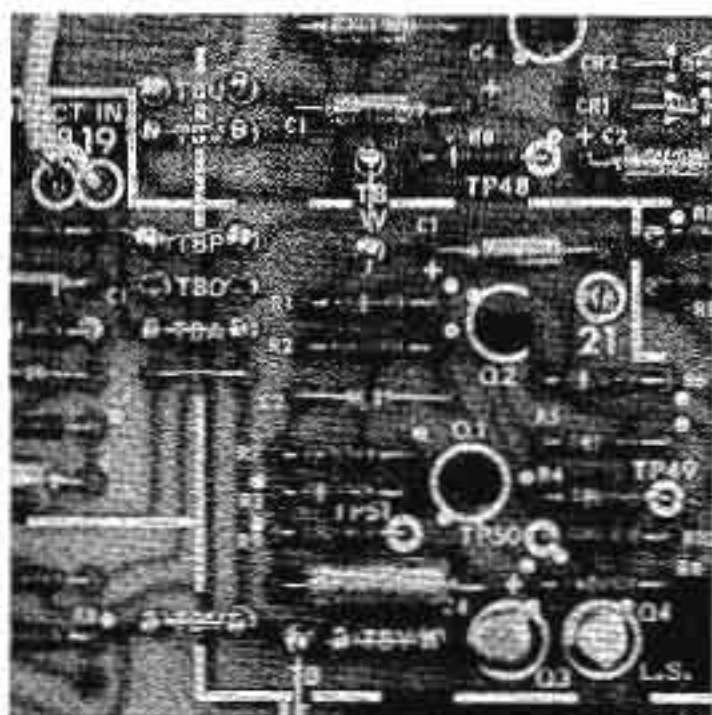


#### Opening

To open the NAGRA E two large screws, 23 and 27, should be undone by 4 to 6 turns and pushed into the recorder in order to release the lock. Then the tape deck will open up, being hinged at the left-hand end. If it does not, unscrew 23 and 27 a little more and push harder. If you unscrew them too far, the nuts will fall inside and it will be necessary to recover them. The nuts are yellow bars 24 mm long with two guiding slots. The chamfer should be turned towards the outside of the recorder.

#### Circuit diagram and bag of spare parts

Once the recorder is open you will see the main circuit board. The circuit diagram and bag of spare parts are underneath this behind the battery compartment. To obtain access to the spares it is necessary to lift the main circuit board which is hinged along its rear edge. The front of the circuit board is fixed by two screws, which must be removed before the circuit board can be lifted up. These screws are located on power transistor heat sinks at both edges of the circuit board. The right hand clamping screw goes through the case of the recorder just above the line output socket whilst the left hand screw is internal hard up against the side of the machine.



#### Internal voltmeter

In order to use the modulometer as a voltmeter take from the bag the black wire with a connector at one end and an insulated measuring probe at the other. The connector should be plugged onto pillar No. 21 which is on the main circuit board, on the right handside in line with the supply selector "Power". If you require the voltmeter for coarse measurements only, i.e. checking the supply voltage, it is not necessary to disconnect the circuit of the modulometer. If greater accuracy is required remove bridge TB-P on the left handside of the pillar. Removing the link TB-P removes the earth path of the modulometer circuits. Therefore, should you wish to make measurements on these circuits a link should be fitted between TB-O. The positive pole of the voltmeter is always connected to the main earth of the recorder and the voltages measured are negative with respect to earth. As a check you can measure the internal stabilized voltage you will find on the first pillar which has a grey wire connected to it. This pillar is on the right handside of the circuit board next to the power transistor heat sink. The voltmeter should read 10 on the lower scale, i.e. -10 volts DC.



## **Fuses**

The general supply fuse protects the NAGRA against :

- the short-circuits which could be caused, for example, by a loose part inside the recorder.
- a reversal of the supply which is always possible in case of accumulators with non-standard terminals or in case of a reversed external supply connection. The use of a diode in series with the supply means a waste of energy which would shorten the useful life of the batteries; we prefer to fit a diode in parallel with the supply which would conduct in case of supply reversal, and the fuse would blow if the current became dangerously strong.

The general fuse is of the in-line soldered type; it is located near supply selector "Power" 26, on the right, inside the NAGRA, under the main circuit board. The rating of the fuse is 2.5 A; a spare fuse is in the bag of spare parts; before replacing check with a voltmeter that the blown fuse has completely melted i.e. that there is the voltage at one of its ends and none at the other.

## **Battery fuses**

The batteries of the NAGRA E consist of three groups in series; each group contains four cells. These groups are connected by wires run inside the NAGRA behind the battery box. Some accumulators (not ours) have a thin external insulation; if it is damaged this may cause a short-circuit between two groups of cells and the current may easily reach one hundred amps, which is sufficient to melt the connecting wire; its insulation will then burn, producing extremely corrosive gas damaging the whole tape recorder. To avoid this, we have incorporated fuses in the battery contacts, on the right handside; a spare fuse is in the bag. Commercial fuses may be used (but their contacts will not be made of precious alloys). Fuse data is as follows : diameter 5 mm. length 20 mm, rating 2.5 A.

### 3.4. SIMPLE FAULT FINDING

#### Machine completely dead

Basically the power supply is suspect. Press the switch "Batt. Test" the needle should deflect.

If it does not deflect at all, check if the batteries are fitted or the ATN is connected. Check also whether the switch "Power", on the right handside, is in the correct position.

The ATN may not be powered; its voltage switch may not be in the correct position or its fuses may be blown. Before dismantling the NAGRA, try it first with another ATN or with the batteries.

If this is not successful, check the main fuses, (see Chapter 3.3.).

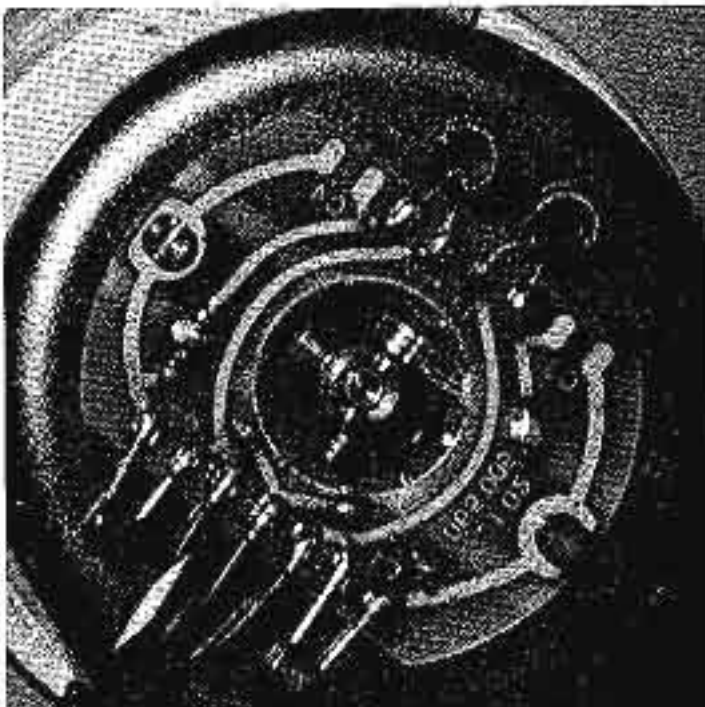
- If the needle deflects but less than 10.7 V change the batteries
- If the needle deflects above 10.7 V and the recorder does not operate, there is a serious fault which requires expert attention.

#### The electronics operate (amplifiers, modulator, headphones) but the motor does not rotate.

Switch the machine to fast rewind and turn the left reel by hand. If the motor starts it means that its collector is faulty. It must be repaired but, in the meantime, it may still continue to work. If a service engineer is not available, open the recorder (see Chapter 3.3.), remove the screening-can shielding the motor and try to clean the collector with a tissue soaked in alcohol. Take care not to distort or damage the brushes; they are made of precious alloy and are very expensive.

#### The motor rotates at full speed on playback or on recording.

It may be a fault due to the speed stabilizer or the tachometric head. This head is near the motor inside the belt which goes to the right reel. Check that its wires are not broken or that it is not misplaced. The normal gap between the head and the tachometric wheel is 0.1 mm, i.e. the thickness of a stiff piece of paper.



**The recorder works normally on record or on playback but does not rewind.**

Check whether the belt is in good condition.

**Low level crackles are heard in the background noise of the recorder.**

If you operate in a very dry atmosphere there may be electrostatic discharges produced by the friction of the belts. Usually the charges should be led away by small metal brushes almost touching the belts, if too far away they will not have any effect; on the other hand, if too near they can cause unpleasant acoustic noise and wear the belts.

**The speed of the tape is unstable. The tape slips from time to time.**

Check the pinchwheel adjustment. A small lever disengages the pinchwheel in the stop position. The mechanism is operated by a small lever visible on the tape deck, on the right of the lid catch, above the letter U in the "Line Input". During playback or recording there should be a gap of a few tenths of mm between the levers; if not it should be adjusted. Open the recorder : the transmission rod is in the form of a screw and nut, by withdrawing the cam roller (recorder open) the rod is released and can be adjusted.

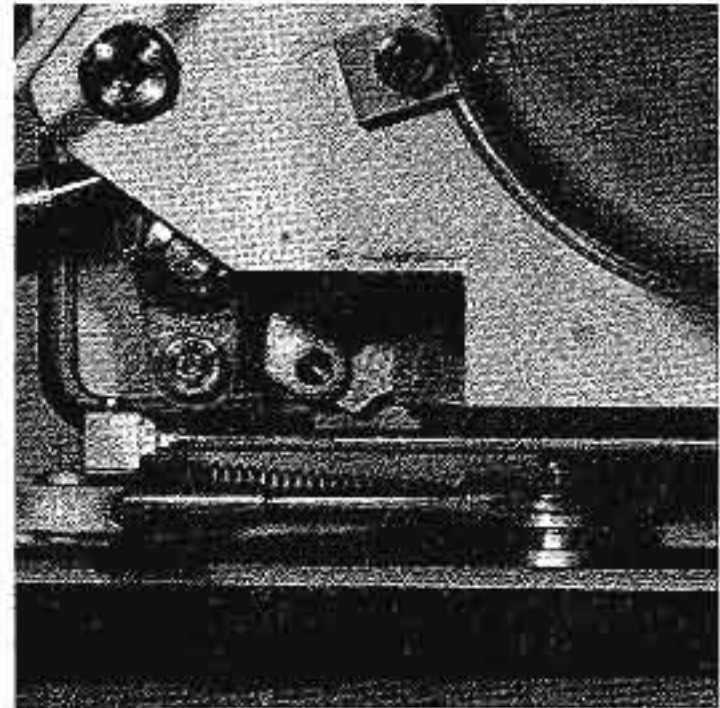
**The commutation noise of the motor is heard in the headphone; the power consumption is too high.**

Check that the motor brake which operates when the main function selector is in the "Stop" position is released when the recorder is switched on. The brake is actuated by the same mechanism as that which disengages the pinch wheel but it has its own adjustment.

**The sound quality is poor.**

The sound is dull on playback, lacks high frequencies.

On recording, the sound is weak and distorted. Check the cleanliness of the recording head; an oxide layer on this head is equivalent to a larger gap and an under-biasing causing distortion.







## CALIBRATION

### 4.1. CALIBRATION OF THE PLAYBACK CHAIN

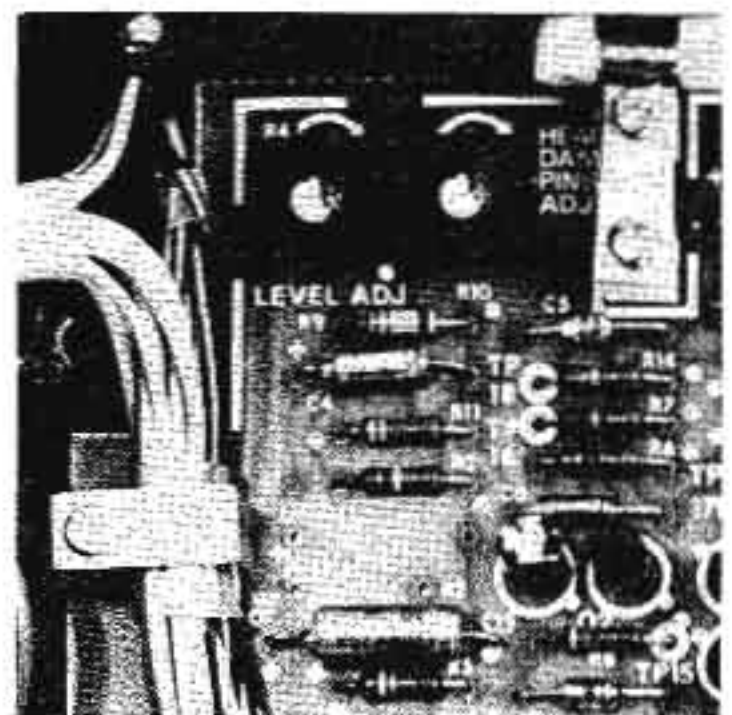
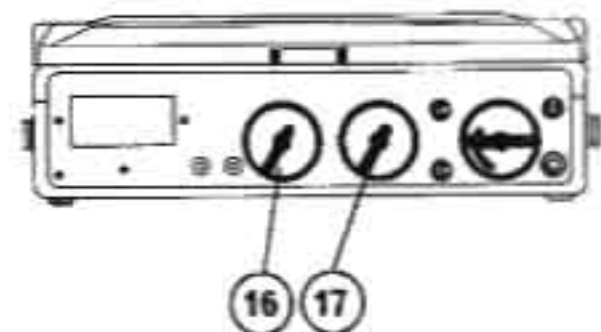
The playback chain of the Nagra E is calibrated at the factory after manufacture, and in theory should not require any further adjustment except to correct for head wear or replacement. In the back left hand corner of the main circuit board you will find two pre-set controls, one marked "LEVEL ADJ" which sets the gain of the replay chain and the other marked "HEAD DAMPING ADJ" compensates for high frequency losses in the replay head and is used to set the high frequency response on replay. The replay standard, i.e. NAB or CCIR can be set by solder links on the main circuit board as indicated on the circuit diagram.

Before using a test tape the heads should be cleaned and demagnetized.

Set "MICROPHONE" control 16 fully anticlockwise and "LINE INPUT & PLAYBACK" control 17 on the 0 dB calibration mark.

Replaying a test tape recorded at a level of 320 nWb/m (CCIR standard), the modulometer should indicate 0 dB; if not, it can be corrected by adjusting the "LEVEL ADJ" preset. With a NAB test tape recorded at a level of 200 nWb/m, the modulometer should indicate -4 dB.

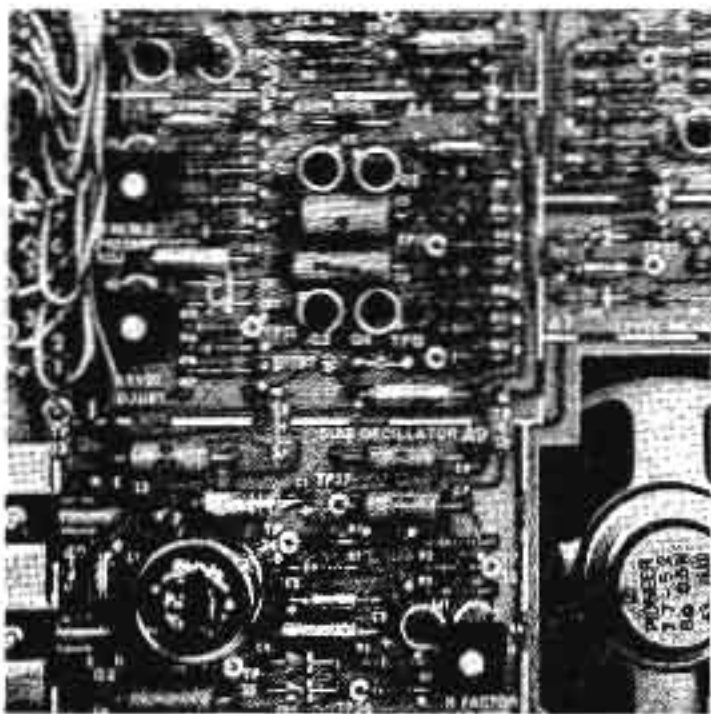
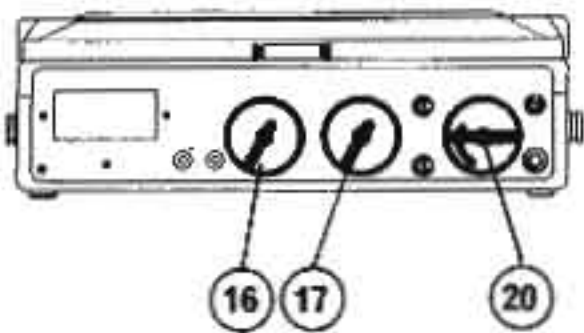
The azimuth section of the test tape is recorded at a lower level than the reference level section so that the setting of "LINE INPUT & PLAYBACK" control 17 should be increased to give a higher modulometer reading. When replaying the azimuth section (normally 10 kHz) press the head sideways (using a finger or thumb) to both left and right whilst observing the modulometer reading; the highest reading should be obtained without any pressure on the head. If not, the azimuth requires adjusting. This is done by inserting a demagnetized 2.5 mm Allen key into the small gear wheel in front of the replay head and rotating it for maximum reading.





The next section on the test tape is the frequency response section. This is recorded at a lower level than the azimuth section and it will be necessary to increase the setting of "LINE INPUT & PLAYBACK" control 17 to the maximum to get a significant reading. When replaying this section adjust the HEAD DAMPING ADJ preset for the flattest overall frequency response remembering that this preset will only affect the level of frequencies of about 6 kHz and above.

## 4.2. CALIBRATION OF THE RECORD CHAIN



The adjustments to be done are bias level, record gain and frequency response. The presets concerned are located on the left side of the main circuit board and are marked as follows : K FACTOR ADJUST for bias level, LEVEL ADJUST for record gain and TREBLE PREEMPHASIS ADJ for high frequency response.

Load on the machine a reel of tape of the type to be used. Set MICROPHONE control 16 fully anti-clockwise and LINE INPUT & PLAYBACK control 17 in the fully clockwise position. Switch the internal reference oscillator to 10 kHz -12 dB position (grey knob on the right side of the main circuit board). Switch main function selector 20 to the REFERENCE SIGNAL & CALIBRATION position. It can be locked in this position by using the small red button.

Starting in the fully anti-clockwise position turn the K FACTOR ADJUST preset clockwise whilst observing the modulometer reading, adjust for a maximum reading. If necessary reduce the record gain LEVEL ADJUST to keep the modulometer reading on scale. Now further increase the bias (clockwise rotation) until the modulometer reading reduces by 1 dB.

Any old tape for which you have no data should be set to 3 dB which is a good average value.

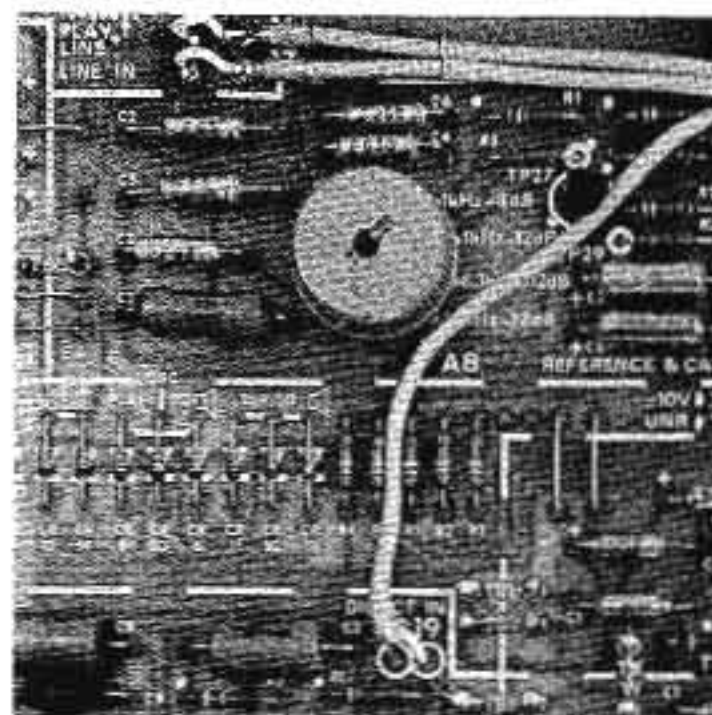
The record head azimuth should now be checked in the same way as for the replay head whilst recording 10 kHz.

Now switch the oscillator to 1 kHz -12 dB and turn the LEVEL ADJUST preset to give a reading of 0 dB on the modulometer. Now switch the oscillator back to 10 kHz -12 dB and adjust TREBLE PRE-EMPHASIS ADJ for a reading of 0 dB on the modulometer. Then switch the oscillator to 6.3 kHz -12 dB and check that the modulometer reading remains 0 dB  $\pm$  1 dB.

If not, it will be necessary to readjust the TREBLE PRE-EMPHASIS ADJ for a compromise setting to give the flattest response.

It may be that with modern tapes on the 10 kHz -12 dB setting, the modulometer reading may still be too high, even with the TREBLE PRE-EMPHASIS preset turned right down. In this case the bias level may be increased a little more in order to reduce this reading.

Now set the oscillator back to 1 kHz -8 dB and close the recorder as the calibration is now complete.





## NAGRA E-L WITH PILOT

### 5.1. DESCRIPTION

The NAGRA E-L is equipped with a pilot head placed between the record and playback heads, a crystal generator circuit and a pilot circuit combined with a synchronizer.

The pilot system developed by KSA and called Neopilot, used on the NAGRA E-L is the same as the one used in the pilot versions of the NAGRA 4.2 and NAGRA IS recorders. The pilot signal is recorded in phase opposition thus suppressing any pilot signal interference with the audio track.

Externally the following controls and sockets were added :

On the front panel a pilot "flag" 40 giving five indications :

#### **"white P"**

In record mode : The pilot signal is fed to the head

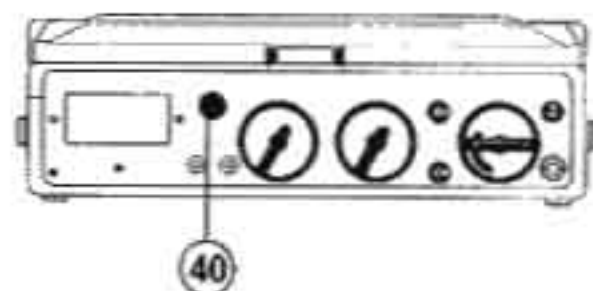
In playback mode : A pilot signal is recorded on the tape but either synchronization is out of tolerance or there is no reference signal

#### **"green S"**

In playback mode : Playback is synchronized within sync. tolerance ( $\pm 3\%$ )

#### **"black"**

In record or playback mode : No pilot signal was recorded or the pilot signal recording level is too weak



On the right side, pilot socket 41 wired as on the other NAGRA pilot recorders, enables the NAGRA E-L to be pilot controlled by an external reference signal.

**"Pilot In" terminal**

voltage :	1 V to 10 V RMS
impedance :	10 k $\Omega$

**"Xtal out" terminal**

voltage :	1 V
impedance :	22 k $\Omega$
recording level :	160 nWb/m

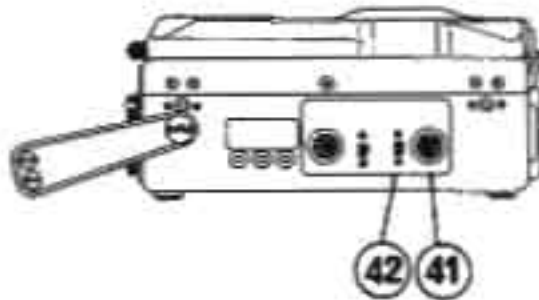
On the same side, switch 42 replaces the strap plug used on the other NAGRA pilot recorders :

**"Internal"**

For record or playback using the signal delivered by the internal generator

**"External"**

For record or playback using an external pilot/reference signal e.g. from the ATN power supply

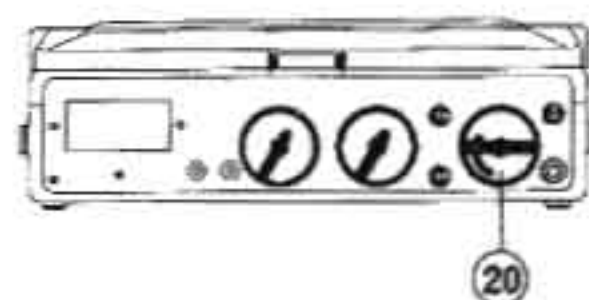


NOTE : Terminal 3 on "Power Pack" socket 25 used as "Asymmetrical Line output" on non-sync models is used as "Pilot out" on the NAGRA E-L



**Reference source selection**

- To use the signal delivered by the internal generator, throw switch 42 to "Internal"
- To use the signal delivered by the ATN mains power supply, throw switch 42 to "External" and connect the QCP cable between the ATN banana socket and "Pilot" socket 41 on the recorder
- To use another reference signal, if within the above mentioned specifications, throw switch 42 to "External" and connect the source to terminal 4 of "Pilot" socket 41

**Check**

Turn main selector 20 to "TEST" position. The pilot "flag" should be on the "white P" position. If it is not check all connections or the position of switch 42.

**Recording**

When recording, the pilot "flag" must be on the "white P" position. If it turns black the pilot signal is either missing or its level is insufficient (below 500 mV).

NOTE : Even if the pilot "flag" turns "black" the pilot track bias is active.

## 5.3. PLAYBACK

The reference source selection is effected as when recording.

**Internal synchronizer characteristics**

Capture range :  $\pm 3.5\%$  from nominal frequency.  
Once locked, it remains operational over a range of  $\pm 4\%$  from nominal frequency.

**Pilot "flag" indications****"green S"**

Indicates active synchronization over a range of only  $\pm 3\%$  from nominal frequency, thus leaving a safety margin of  $\pm 1\%$

**"white P"**

A pilot signal has been recorded on the tape but playback is out of synchronization range

**"black"**

No pilot signal recorded on the tape or pilot signal recorded on the tape but with an insufficient level (below 500 mV).

## 5.4. ADJUSTMENTS

### Pilot signal frequency setting

- Open the NAGRA E-L
- Switch S 1/A 16 (small circuit board near motor) to the corresponding frequency 50 Hz or 60 Hz.
- Adjust R 26/A 15 (right angle board under deck) to tune filters "5-6-7 of IC 2/A 15" to 100 Hz for a 50 Hz pilot signal or 120 Hz for a 60 Hz pilot signal.

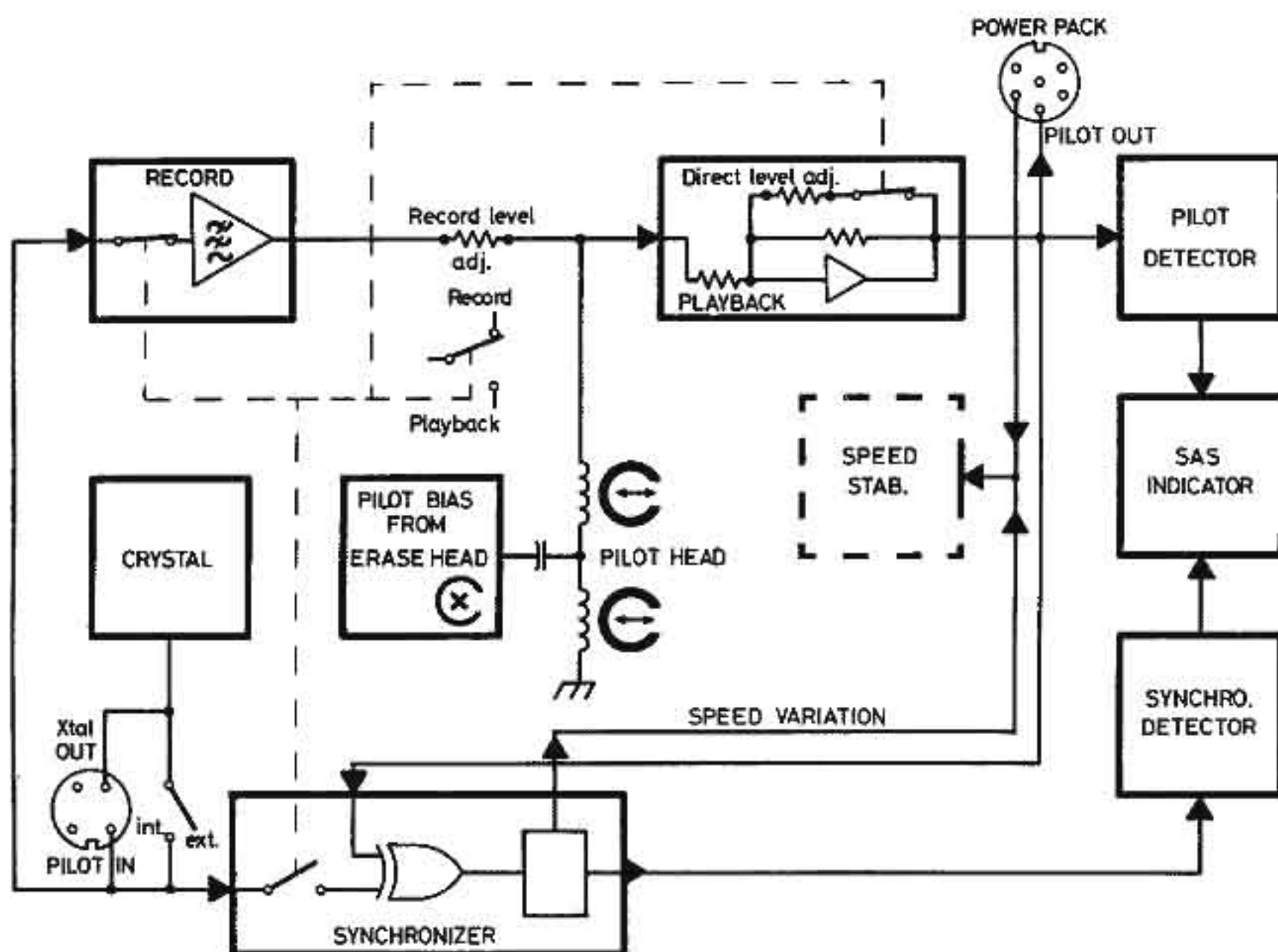
### New tape setting

For certain types of tape the characteristics of which are very different from standard professional tapes (e.g. Chromium-dioxide, old tape type) it is necessary to readjust the recording and direct pilot levels

- Record the pilot signal on a stretch of tape
- Play it back and measure the pilot output voltage on terminal 3 of the "Power Pack" socket  
 $U_{out} = 1\text{ V} \pm 0.2\text{ V}$
- If necessary adjust recording level resistor (R 14/A 15) to reach this value.
- Switch main selector 20 to "TEST"
- Measure the pilot output voltage on "pilot out" terminal 3 of the "Power Pack" socket  
 $U_{out} = 1\text{ V} \pm 0.2\text{ V}$
- If necessary readjust direct level resistor (R 24/A 15) to reach this value.

NOTE : Do not readjust the playback level resistor, this is to be carried out only when replacing the pilot head.

### 5.5. NAGRA E-L BLOCK DIAGRAM





# SPECIFICATIONS

The typical and maximum values are defined as follows :

Typical value, average value measured on 100 units.

Maximum value, between square brackets, value below which or above which a recorder is rejected when going through the final check procedure.

Les valeurs typiques et maxima sont définies comme suit :

Valeur typique, valeur moyenne mesurée sur 100 appareils.

Valeur maximum, entre crochets, valeur au-dessus ou en-dessous de laquelle un appareil n'est pas accepté au contrôle final.

## 6.1. SIZE AND WEIGHT

Size of box itself, lid closed without knobs, handles or handle mountings 318 x 222 x 104 mm  
(12.5 x 8.7 x 4.1 ins)

Overall size, without handle 357 x 237 x 108 mm  
(14.1 x 9.3 x 4.3 ins)

Thickness of anticorodal sheet used for the box 2 mm  
(0.08 ins)

Thickness of tape deck 3 mm (0.12 ins)

Empty weight, without tape or batteries 4.15 kg (9 lb 3 oz)

Weight with ordinary batteries and 5" reel of tape 5.5 kg (12 lb 2 oz)

## 6.1. DIMENSIONS ET POIDS

Dimensions du boîtier proprement dit, couvercle fermé, sans les boutons, la poignée et sa fixation 318 x 222 x 104 mm

Dimensions hors-tout, sans poignée 357 x 237 x 108 mm

Epaisseur de la tôle anticorodal du boîtier 2mm

Epaisseur de la platine de défilement 3 mm

Poids à vide, sans piles ni ruban 4,15 kg

Poids avec piles ordinaires et ruban sur bobine de 127 mm 5.5 kg



## 6.2. POWER SUPPLY

DC voltage, positive ground -11 V to - 35 V

Consumption on RECORD 200 mA [230 mA]

Type of batteries used (12 pieces)  
CEI standard R 20  
ASA standard D and L 90

Type of rechargeable cells used  
set of 3 x 5 pieces 2.5 Ah  
set of 12 pieces 4 Ah

Approximate battery life when used 2 hours every 24 hours (50% record, 50% playback)

Carbon batteries 18 hours  
Alkaline batteries 36 hours

– continuous use

Carbon batteries 10 hours  
Alkaline batteries 24 hours  
Rechargeable cells 2.5 Ah 10 hours  
4 Ah 16 hours

## 6.2. ALIMENTATION

Tension continue d'alimentation positif à la masse -11 V à - 35 V

Consommation en enregistrement 200 mA [230 mA]

Type de piles utilisées (12 pièces)  
norme CEI R20  
norme ASA D et L 90

Type d'accumulateurs rechargeables utilisés  
jeu de 3 x 5 pièces 2,5 Ah  
jeu de 12 pièces 4 Ah

Durée approximative de service, utilisation 2 heures par 24 heures (50% lecture, 50 % enregistrement)

avec piles au carbone 18 h  
avec piles alcalines 36 h

– en service continu

avec piles au carbone 10 h  
avec piles alcalines 24 h  
avec accumulateurs 2,5 Ah 10 h  
4 Ah 16 h

## 6.3. TAPE

Nominal width 6.25 mm (1/4 ins)

Acceptable thicknesses 12 to 50  $\mu$  (0.5 to 2 mils)

Maximum diameter of reels, lid closed 127 mm ( 5 ins)

Maximum diameter of reels, lid open 178 mm (7 ins)

Recording time 50  $\mu$ m (2 mils) tape, 7.5 ips  
5" reel 16 min  
7" reel 32 min

Rewind time with 5" reel, 35  $\mu$ m (1.5 mils) tape:

Mains nominal ATN 1.2 min  
New batteries 1.5 min

## 6.3. RUBAN MAGNETIQUE

Largeur nominale 6,25 mm

Epaisseurs admissibles 12 à 50  $\mu$ m

Diamètre maximum des bobines, couvercle fermé 127 mm

Diamètre maximum des bobines, couvercle ouvert 178 mm

Durée d'enregistrement à 19,05 cm/s, ruban de 50  $\mu$ m  
bobine 127 mm 16 min  
bobine 178 mm 32 min

Durée de rebobinage avec bobine de 127 mm ruban de 35  $\mu$ m  
secteur nominal ATN 1,2 min  
piles neuves 1,5 min

#### 6.4. TAPE TRANSPORT

Nominal speed 19.05 cm/s (7.5 ips)

Nominal speed stability with respect to the position of the recorder, distribution of the tape between the reels and voltage supply (at 20° ± 10°C or 68°F ± 18°F)  
± 0.1%

Wow and flutter, peak-to-peak value, DIN 45 507 weighted ± 0.08% [± 0.12%]

#### DEFILEMENT

Vitesse nominale 19,05 cm/s

Stabilité de la vitesse nominale, en fonction de la position de l'appareil, de la répartition de la bande entre les bobines et de la tension d'alimentation (à 20° ± 10°C)  
± 0,1%

Pleurage et scintillement mesurés en valeur crête-à-crête, pondérée selon norme DIN 45 507 ± 0,08% [± 0,12%]

#### 6.5. AMPLIFIER CHAIN

Nominal microphone sensitivity (200 Ω dynamic mike)

Minimum input level for 0 dB 140 μV

Nominal microphone sensitivity (condenser mike), minimum input level for 0 dB switchable 2.5 mV 1.25 mV

Overall frequency response, dynamic mike input 200 Ω, line output without load from 50 Hz to 15 kHz ± 0.8 dB [± 1 dB]

Distortion at 0 dB, 43.6 mV (+50 dB) input, output load 600 Ω, at 1 kHz H<sub>3</sub> ("dynamic" position) < 0.7% [< 1%]

Noise level of mike preamplifier, ASA A weighted, ref. 1 mW, dynamic position (200 Ω) 121.5 dBm [121 dBm] condenser position (2 mV) 0.8 μV [1 μV]

Symmetrical input sensitivity Minimum input level for recording at 0 dB 2.5 mV

Line voltage input, impedance 150 kΩ, minimum voltage for recording at 0 dB 400 mV

Maximum tolerated voltage 100 V

Current line input, minimum current to record at 0 dB 3 μA

#### 6.5. CHAÎNE AMPLIFICATRICE SEULE

Sensibilité micro nominale, micro dynamique 200 Ω.

Niveau d'entrée minimum pour 0 dB 140 μV

Sensibilité micro nominale, microphone à condensateur.

Niveau d'entrée minimum pour 0 dB commutable 2,5 mV 1,25 mV

Courbe de réponse globale, entrée micro dynamique 200 Ω, sortie ligne non chargée de 50 Hz à 15 kHz ± 0.8 dB [± 1 dB]

Distorsion à 0 dB, entrée 43,6 mV (+50 dB) sortie sur 600 Ω, à 1 kHz H<sub>3</sub> (position "dynamique") < 0.7% [< 1%]

Niveau de bruit du préamplificateur micro, pondéré ASA A, référence 1 mW, position dynamique 121,5 dBm [121 dBm] sur 200 Ω position condensateur (2 mV) 0,8 μV [1 μV]

Sensibilité entrée symétrique Niveau d'entrée minimum pour 0 dB 2,5 mV

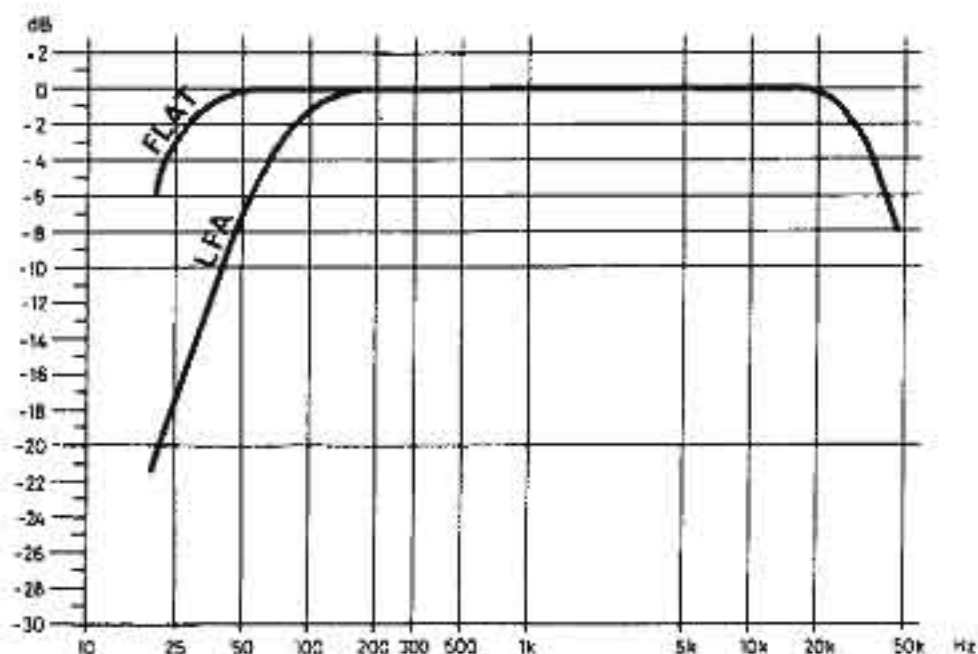
Entrée ligne en tension, impédance 150 kΩ, tension minimum pour enregistrer à 0 dB 400 mV

Tension maximum admissible 100 V

Entrée ligne en courant, courant minimum pour enregistrer à 0 dB 3 μA

## 6.6. "DIRECT" AMPLIFIER FILTERS

FLAT	with bridges TBB and TBC
LFA	without bridges TBB and TBC
FLAT	avec les ponts TBB et TBC
LFA	sans les ponts TBB et TBC



## 6.7. REFERENCE GENETATOR

1 kHz sine wave signal level 0 VU	-8 dB $\pm$ 0.5 dB
internally switchable to	1 kHz -8 dB
	1 kHz -12 dB
	6.3 kHz -12 dB
	10 kHz -12 dB

## 6.7. GENERATEUR DE REFERENCE

Signal 1 kHz sinusoïdal niveau 0 VU	-8 dB $\pm$ 0,5 dB
commutable interne sur	1 kHz -8 dB
	1 kHz -12 dB
	6,3 kHz -12 dB
	10 kHz -12 dB

## 6.8. OUTPUTS

Asymmetrical line output voltage, unloaded, at 1 kHz for 0 dB on modulometer	0.94 V
Distortion at 2 V (+6 dB) unloaded	
H <sub>2</sub>	[0.3%]
H <sub>3</sub>	[0.1%]
Voltage drop on 600 $\Omega$	0.175 dB [0.2 dB]
Floating line output voltage at 1 kHz for 0 dB on modulometer	4.4 V
Voltage drop on 600 $\Omega$	0.91 dB [1 dB]
Distortion at 8 V (+6 dB) unloaded	
H <sub>2</sub>	[0.3%]
H <sub>3</sub>	[0.1%]
Headphone output voltage on 50 $\Omega$ adjustable	0 V to 590 mV

## 6.8. SORTIES

Tension de sortie ligne asymétrique à vide à 1 kHz pour 0 dB au modulomètre	0,94 V
Distorsion à 2 V (+6 dB) non chargé	
H <sub>2</sub>	[0,3%]
H <sub>3</sub>	[0,1%]
Chute de tension sur 600 $\Omega$	0,175 dB [0,2 dB]
Tension de sortie ligne flottante à 1 kHz pour 0 dB au modulomètre	4,4 V
Chute de tension sur 600 $\Omega$	0,91 dB [1 dB]
Distorsion à 8 V (+6 dB) non chargé	
H <sub>2</sub>	[0,3%]
H <sub>3</sub>	[0,1%]
Tension de sortie casque sur 50 $\Omega$ ajustable	0 V à 590 mV

**6.9. BUILT-IN LOUDSPEAKER**

Power output of the amplifier 0.6 W

**6.10. OPERATING CONDITIONS**

Admissible temperatures  
 – with alkaline batteries (–4 to +160° F)  
 – with external power supply (–22 to +160° F)

The recorder operates correctly in any position

**6.11. MODULOMETER**

Integration time for –2 dB 5 ms ± 20 %

Usable scale –20 to +3 dB

Frequency response from 50 Hz to 15 kHz  
 ± 0.6 dB [ ± 1 dB]

**6.12. RECORD-REPRODUCE CHAIN**

Nominal recording level  
 0 dB = 320 nWb/m

Maximum peal level (MPL) +3 dB

Tape used for tests :  
 as mentioned in the "protocol of  
 measurement" supplied with every Nagra E.

Erase efficiency at MPL at 1.25 kHz  
 CCIR standard 79 dB [77 dB]

Frequency response, recording at –20 dB  
 7.5 ips  
 CCIR from 50 Hz to 15 kHz ± 1.5 dB [ ± 2 dB]

**6.9. HAUT-PARLEUR INCORPORE**

Puissance électrique délivrée par  
 l'amplificateur 0,6 W

**6.10. CONDITIONS DE FONCTIONNEMENT**

Températures admissibles  
 – avec piles alcalines –20° à +70°C  
 – avec alimentation externe –30° à +70°C

Fonctionnement correct dans toutes les positions

**6.11. MODULOMETRE**

Temps d'intégration pour –2 dB 5 ms ± 20%

Echelle utilisable –20 à +3dB

Courbe de réponse de 50 Hz à 15 kHz  
 ± 0.6 dB [ ± 1 dB]

**6.12. CHAINE ENREGISTREMENT-LECTURE**

Niveau d'enregistrement nominal  
 0 dB = 320 nWb/m

Niveau d'enregistrement maximum M.P.L. +3 dB

Ruban magnétique utilisé pour les tests :  
 selon données du "protocole des mesures"  
 livré avec chaque Nagra E

Efficacité de l'effacement à 1,25 kHz au niveau  
 M.P.L.  
 en norme CCIR 79 dB [77 dB]

Courbe de réponse, enregistrement à –20 dB  
 19,05 cm/s  
 CCIR de 50 Hz à 15 kHz ± 1,5 dB [ ± 2 dB]

Distortion (headphones output, 500 Hz), CCIR standard at 0 dB

H <sub>3</sub>	<0.7% [ $< 1\%$ ]
H <sub>2</sub>	<0.4% [ $< 0.5\%$ ]

at +3 dB

H <sub>3</sub>	<1.25% [ $< 2\%$ ]
----------------	--------------------

Signal-to-noise ratio of playback chain alone, motor running and simulated tape, ASA A weighted, MPL

71 dB [68 dB]

Signal-to-noise ratio in record-reproduce mode, MPL at 7.5 ips, ASA A weighted

CCIR 63 dB [60 dB]

Distorsion (sortie casque, 500 Hz), norme CCIR à 0 dB

H <sub>3</sub>	<0,7% [ $< 1\%$ ]
H <sub>2</sub>	<0,4% [ $< 0.5\%$ ]

à +3 dB

H <sub>3</sub>	<1,25% [ $< 2\%$ ]
----------------	--------------------

Rapport signal/bruit de la chaîne de lecture seule, avec moteur en marche et stimulateur de ruban, mesure pondérée, ASA A niveau M.P.L.

71 dB [68 dB]

Rapport signal/bruit en enregistrement-lecture au niveau M.P.L., à 19,05 cm/s pondéré ASA A

CCIR 63 dB [60 dB]

This manual replaces all previous editions

Le présent manuel annule et remplace toutes les éditions précédentes.

All values given are typical; exact values for each machine are given on its accompanying final measurement protocol sheet.

Les valeurs mentionnées sont typiques. Pour les valeurs exactes correspondant à votre appareil veuillez vous référer au protocole de mesure qui y est joint.

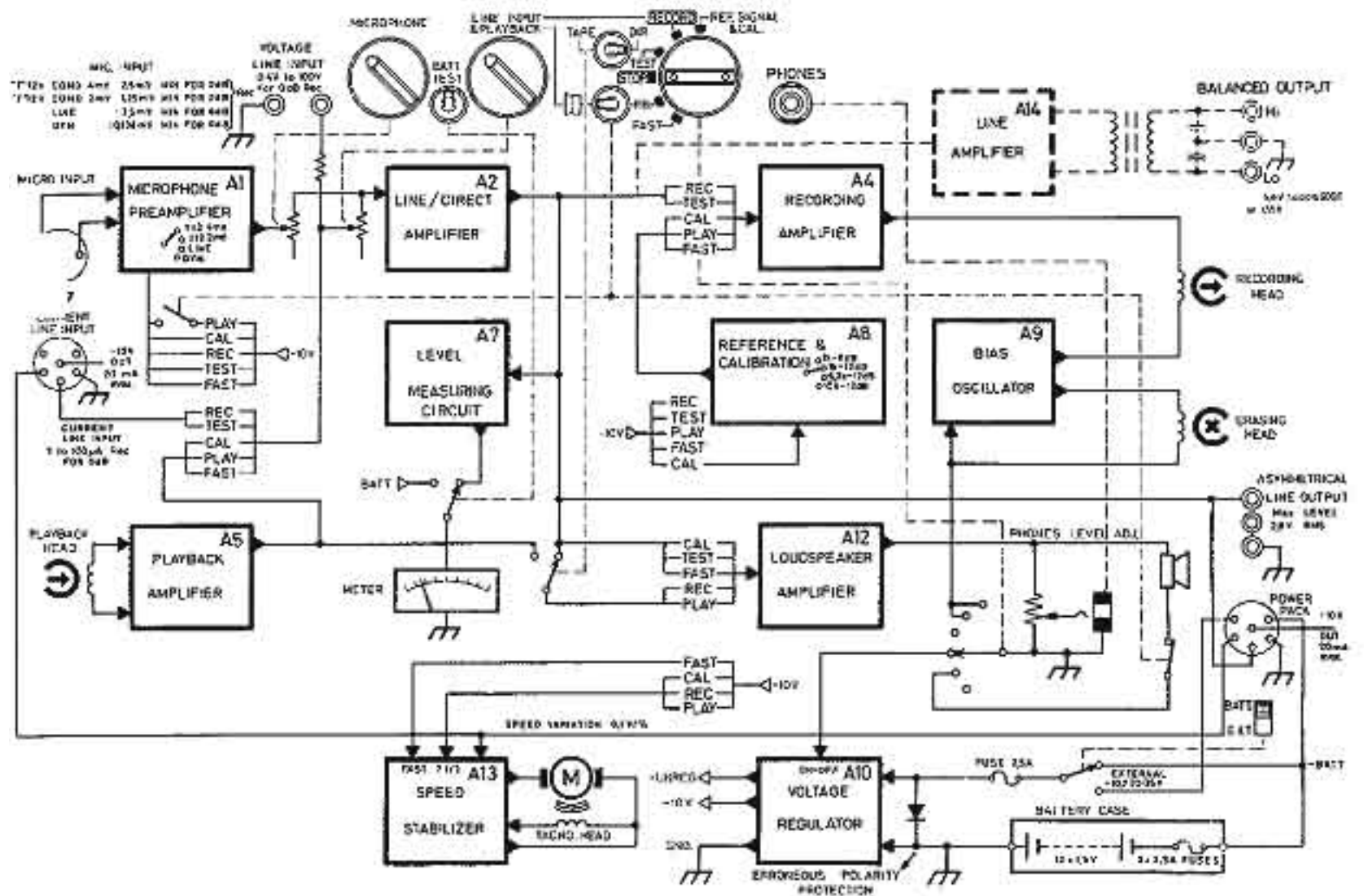
The company reserves the right to modify the design of the equipment and to amend specifications, without notice.

Nous nous réservons le droit de modifier le dessin et les spécifications de l'appareil sans information préalable.



# SYNOPTIC DIAGRAM

# SCHEMA SYNOPTIQUE



# NAGRA E

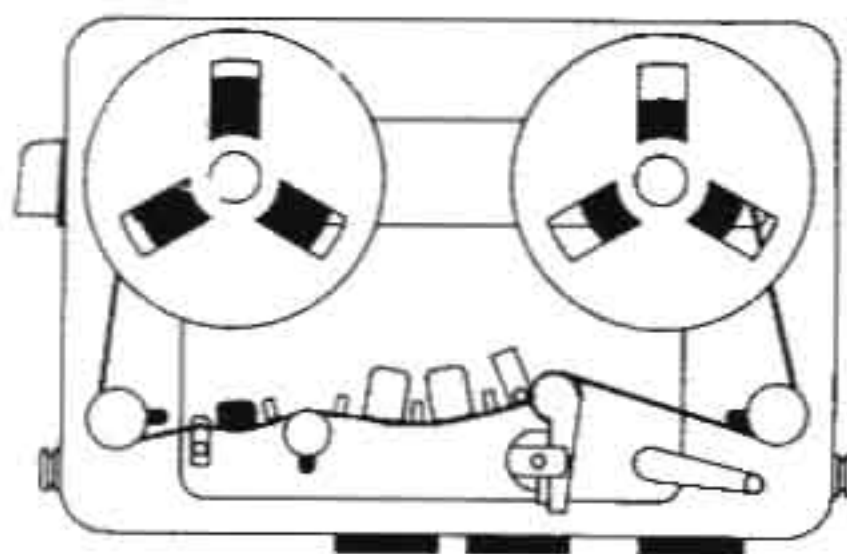
## CONFIGURATOR

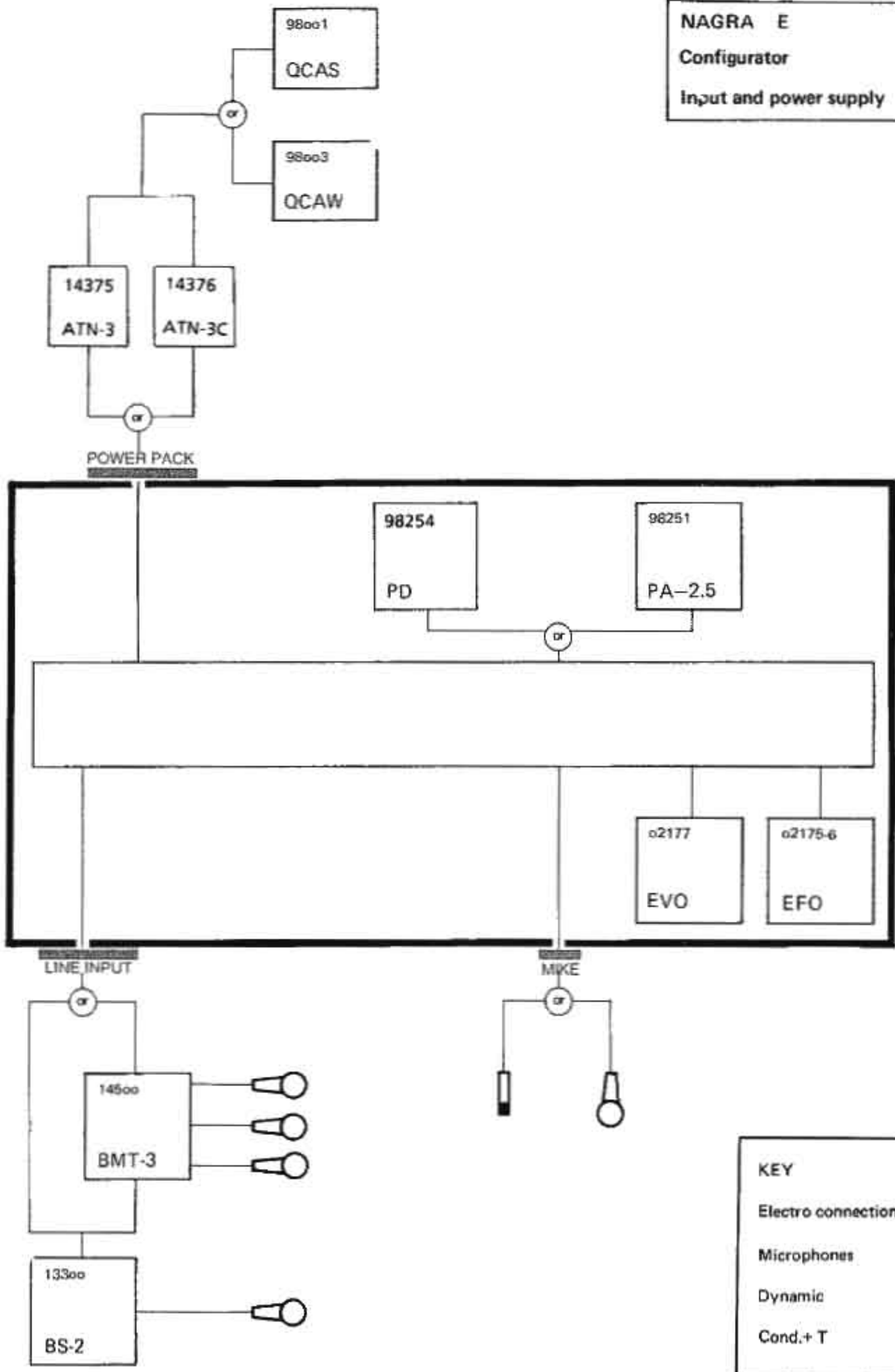
### Power supply

ATN-3	14375	Mains power supply 110-250 V Alimentation secteur 110-250 V
ATN-3C	14376	Mains power supply and charger 110-250 V Alimentation secteur avec chargeur 110-250 V avec sortie
QCAS	98001	Mains cable with swiss plug Câble d'alimentation secteur avec fiche suisse
QCAW	98003	Mains cable without main plug Câble d'alimentation secteur sans fiche secteur
PA-2.5	98251	Set of 15 rechargeable cells, 2.5 Ah, with contact extension Jeu de 15 accumulateurs, 2,5 Ah avec rallonge de contact
PA-4	98254	Set of 12 4 Ah rechargeable cells Jeu de 12 accumulateurs 4 Ah

### Input-output

BMT-3	14500	Mixer with 3 balanced microphone inputs and one line input Mixer à trois entrées microphone symétriques flottantes et une entrée ligne
BS-2	13300	External preamplifier for dynamic microphone Préamplificateur externe pour micro dynamique
EFO	02175	Floating line output 4.4 V Sortie flottante 4,4 V
EFO-6	02176	Floating line output 1.55 V Sortie flottante 1,55 V
EVO	02177	Speed option for 3 3/4 ips instead of 7 1/2 ips to be specified when ordering the recorder Option vitesse 9,52 cm/s au lieu de 19 cm/s à spécifier lors de la commande de l'appareil





# NAGRA E

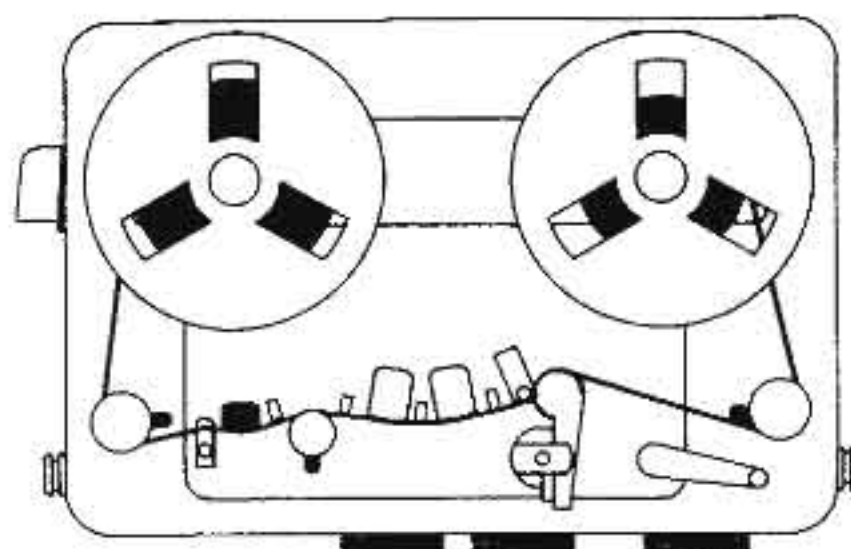
## CONFIGURATOR

### External electro accessories

QGB	14001	10 1/2" reel adapter Adaptateur grande bobine 267 mm
EQGB	12905	Extenders for use of the QGB Rallonge support pour l'emploi du QGB
TPBC	18907	Normal 8 mm cinespool holder Porte-bobine cinema (standard)
QGBN	14006	NAB-type hub holder Porte noyau type NAB
QGBA	14007	AEG-type hub holder Porte-noyau type AEG
DSM	14700	Field monitor and amplifier Moniteur-amplificateur de reportage
IACC	17910	Removable cell compartment for DSM and IS Magasin amovible d'accumulateurs pour DSM et IS
QCAS	98001	Mains cable with swiss-type plug Câble d'alimentation secteur avec fiche suisse
QCAW	98003	Mains cable without mains plug Câble d'alimentation secteur sans fiche secteur

### Mechanical accessories

QTIM	14650	Tape driven timer Compteur temps entraîné par la bande
QLEN	14655	Tape driven metric counter Compteur métrique entraîné par la bande
QRAC	06260	Tape cleaning blade Râcleur de bande
MAG	90801	Electronically-controlled degausser 220-240 V Démagnétiseur à commande électronique 220-240 V
	90802	Electronically-controlled degausser 110-117 V Démagnétiseur à commande électronique 110-117 V



### Carrying cases

ETS	99032	Carrying case, synthetic material, with microphone pocket Sacoche en matière synthétique avec poche pour microphone
QHC-2	14127	Spare carrying strap for NAGRA E Courroie de rechange pour porter le NAGRA E
QHP	14120	Carrying handle Poignée
QHCP-2	14123	Special strap for carrying a recorder equipped with a QHP handle Courroie spéciale à monter sur un appareil équipé d'une poignée QHP

### Headphones

DT 48	96239	Beyer DT 48 headphones Casque d'écoute Beyer DT 48
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99032  
ETS



14127  
QHC-2

14120  
QHP

14123  
QHCP-2

90801-2  
MAG



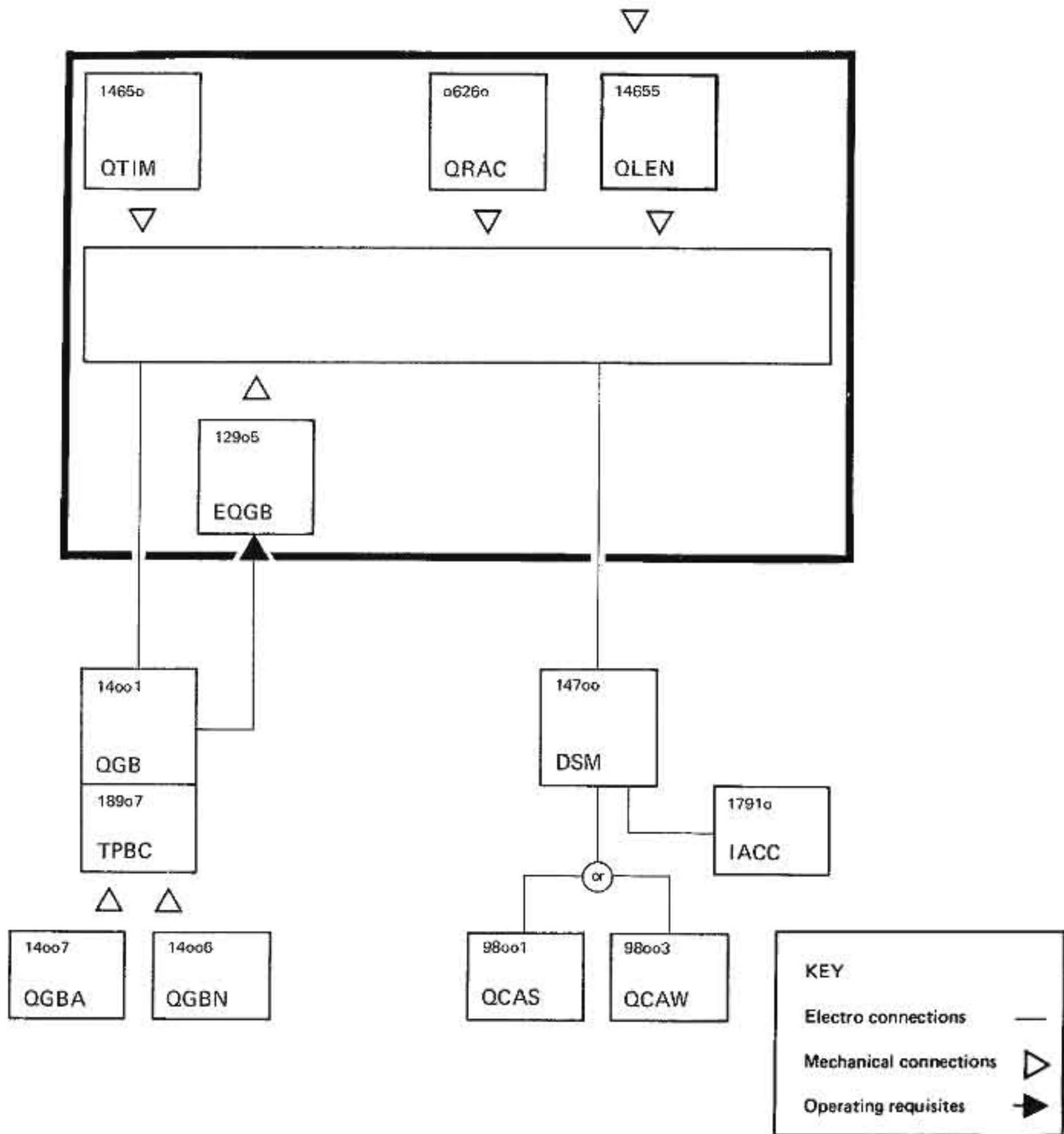
96239  
DT 48

**NAGRA KUDELSKI**

CH-1033 Cheseaux / Lausanne

NAGRA E

Configurator accessories







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