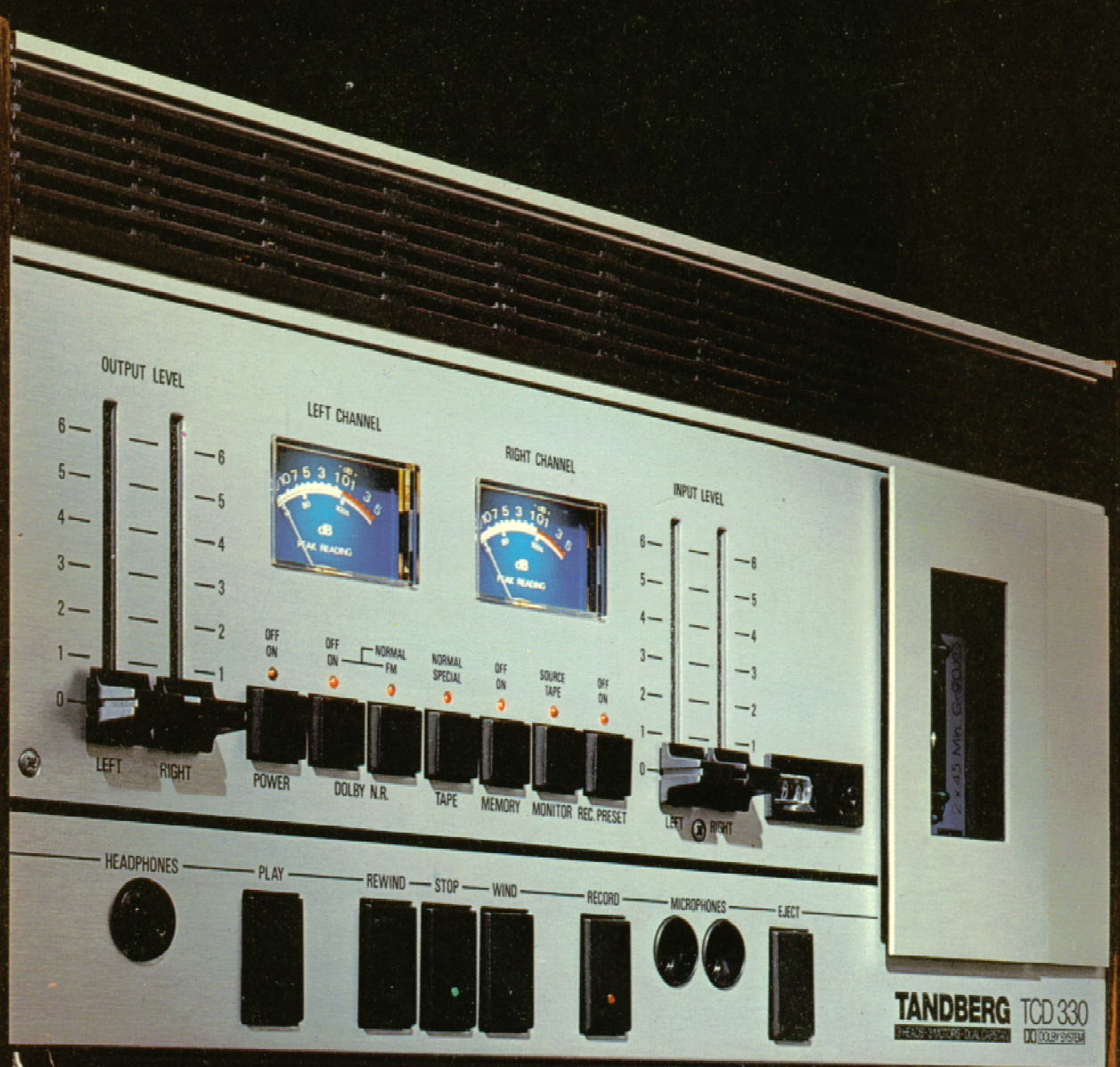


# TANDBERG

# TCD 330 STEREO



# 3 heads, source and tape tests, editing facility, 3 motors, complete logic control, servo tape winding, dual-capstan closed-loop, dual Dolby<sup>\*</sup>)

Tandberg was the first company in the world to design a cassette tape recorder with a combination of 3 motors and an advanced tape transport called the dual-capstan closed-looped system. On the TCD 330 we have taken the development a stage further and included professional features and facilities which hitherto have only been available on the most advanced open reel machines: complete logic control of all operational modes, servo controlled winding and 3 heads with source and tape tests!

This means that with the TCD 330 Tandberg is setting new standards with the application of advanced technology, professional facilities and a professional performance for cassette machines. The signal/noise ratio is 65 dB minimum and the frequency range is 20 Hz to 20 000 Hz measured according to DIN 45 500!

The precision-made tape path and the 3-motor drive system unfailingly handle the cassettes and the tape in the firmest but gentlest manner.

The interplay between the «electronic brain» in the logic control and the tape tensioning system enables the TCD 330 to switch direct from mode to mode without going through stop; this includes direct switchover from playback to record which provides an electronic editing facility (flying start). All modes can be remote controlled.

## Which are the most important factors relating to quality in a cassette machine?

Things that count most are the total design and construction of the machine - the choice of parts and components and the way they are put together in the mechanisms, circuits and modules. The most important audible weaknesses in a cassette recording are:

1. Tape noise.
2. Noise from the electronics.
3. Hum.
4. Distortion.
5. Speed variations.
6. Bass frequency deviations.
7. Unstable tape speed.

Experience has shown that the mechanisms are amongst the weakest parts in today's cassette machines, and the majority of machines have mechanisms which are simply improved versions of mechanisms used in battery powered machines. And if the tape movement across the heads is not sufficiently stable, no amount of even the most advanced electronics will reproduce the program with good quality.

Right from the time Tandberg first started to design cassette machines, great emphasis was placed on a stable, reliable mechanism, totally independent of variations in the public power supply. Tandberg is one of the world's leading

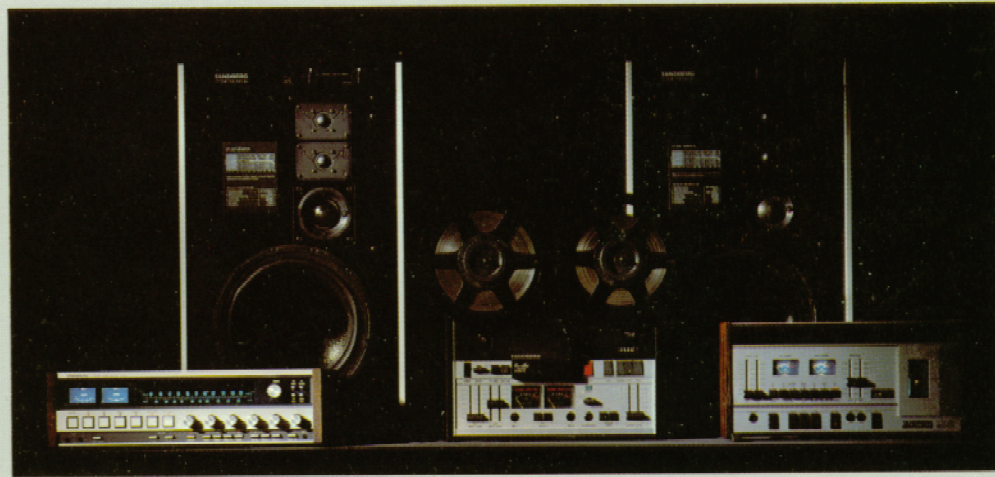
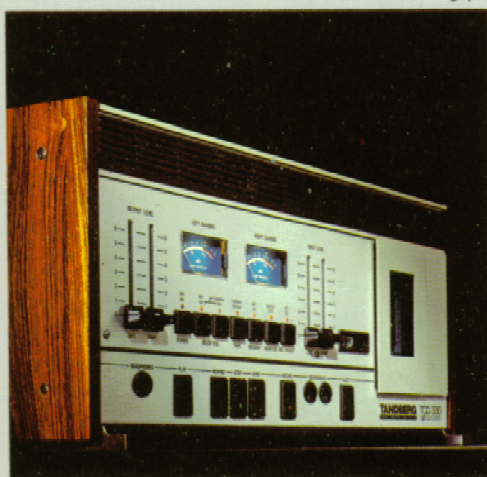
producers of learning laboratories (language laboratories). Learning laboratories, and especially the tape recorders, receive rough treatment day after day. Machines subjected to this kind of use must have robust, reliable mechanisms if they are to survive. The Tandberg mechanisms in these tape recorders have passed the test and the TCD 330 makes use of the same design principles employed in these tough school machines.

## How you should compare the TCD 330 with other cassette machines

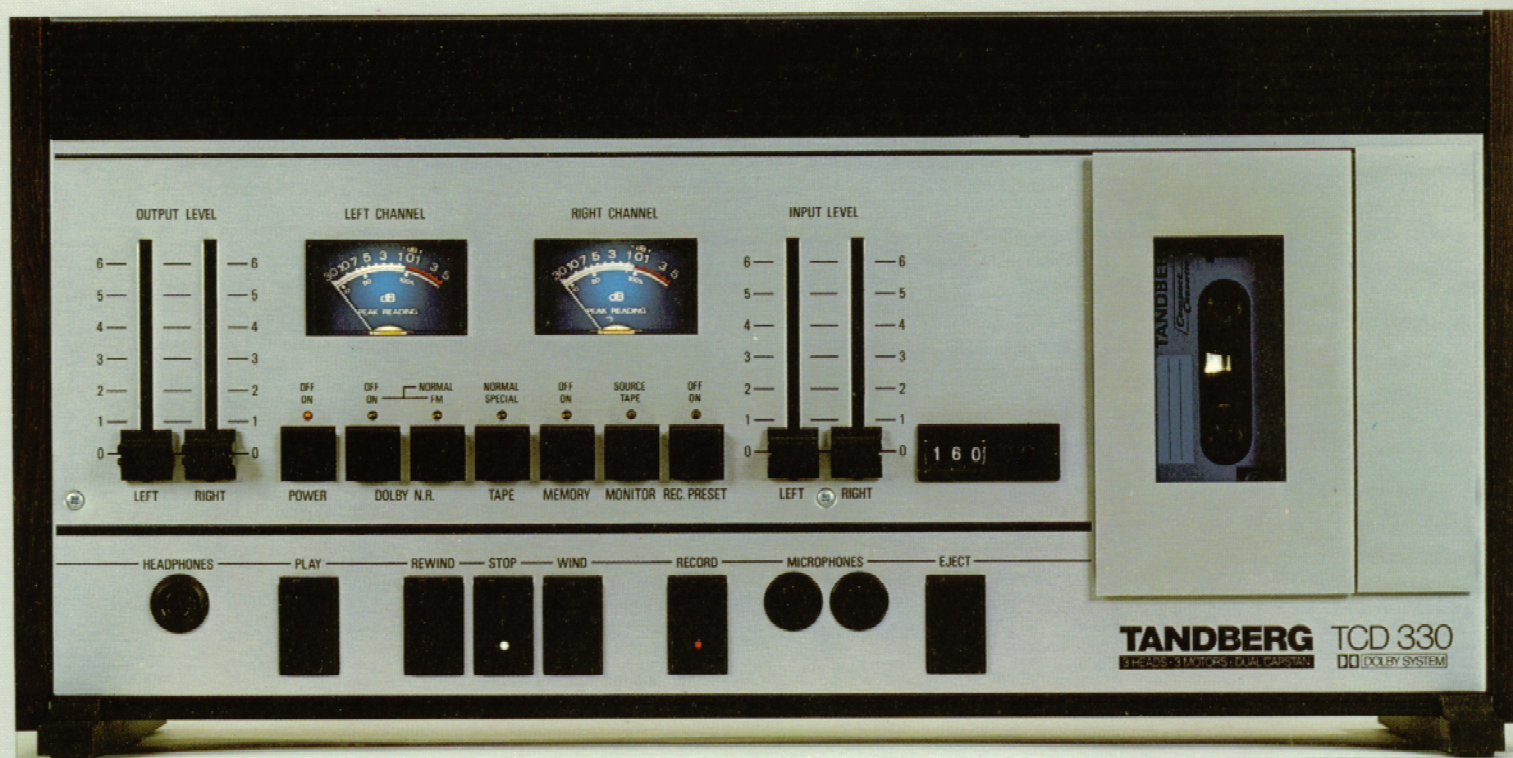
The most important test you should make is to record and playback some good program material, for example a gramophone record with a good dynamic range. A good quality tape recorded on a bad cassette machine and played back on a good machine will make the good machine sound bad. On the other hand if the same tape is recorded on a good machine, the playback quality will be acceptable even if it is played back on a moderate quality machine. So you should never accept pure playback as the only demonstration when you are judging machines. Make sure you always bring your critical faculties to bear on a combined recording and playback demonstration!

<sup>\*</sup>The name Dolby B is a registered trademark of Dolby Laboratories Inc., USA.

The TCD 330 combined with other Tandberg products: the receiver TR 2075, the open reel tape deck 10X and Studio Monitor loudspeakers.



# The audio section



## Self-adjusting input amplifiers

Electronic noise from the input amplifiers is a well known problem and a weakness with many tape recorders. You can listen to this noise and judge it for yourself while recording weak sound signals when you must use the full sensitivity of the tape recorder (input level controls set at maximum). This kind of test is valuable for comparing the TCD 330 with other cassette machines.

As you know, the Dolby system reduces tape noise, but it does not remove the electronic noise generated in the input amplifiers. So first we removed this noise and then applied the Dolby B system to reduce the tape noise! If audible noise is generated in the input amplifiers it will always be recorded on the tape regardless of how good the tape is.

The self-adjusting input circuit is a Tandberg speciality. Ordinary input circuits are optimised to one particular program source and do not work very well with other program sources.

The Tandberg circuit automatically adjusts itself to different program sources so that you always have the full dynamic range and minimum electronic noise - regardless of the recording level you use!

## The Dolby B system

This is a valuable extra feature on the TCD 330 that reduces tape noise (hiss) by up to 10 dB. The Dolby B system can be used in the normal record and playback modes, and to record «Dolbyized» FM stereo programs. This last mentioned facility is unusual on a tape recorder, but we have included it to give the TCD 330 the full range of advanced features and facilities we believe a top class machine should have.

More and more countries are starting to transmit FM stereo programs using Dolby noise reduction. The advantage is that the programs are almost noise-free when they leave the transmitter. But to achieve correct reproduction and the full benefit of the

improved quality, the reproduction equipment must have a Dolby decoder. The decoder can either be in the radio receiver or in the tape recorder. With the DOLBY N.R. button in the position «FM» the TCD 330 acts as a decoder. So you do not need to buy a receiver especially to get this facility.

## Multiplex filter can be switched in and out

All FM stereo transmissions have a pilot tone that needs to be attenuated by a filter before the program is recorded. In tape recorders using the Dolby system (such as the TCD 330) it is essential to have a filter because the Dolby circuits accept the pilot tone as a program signal. If the filter is not present, the recording will have the wrong frequency curve and the reproduction will not be true. The TCD 330 has the big advantage that the multiplex filter can be switched out when it is not needed (when recording from program sources other than

stereo FM). So the full frequency range of these programs is reproduced without any restriction from the filter!

**Why the TCD 330 has peak meters**

A VU meter only indicates the average value of the sound level which is somewhere between the weakest level and the strongest level during a given time interval. This type of meter will not reveal the peak intensity of short, powerful sound impulses and therein lies its disadvantage - exactly where there is the biggest danger of distortion. In practice it is impossible to avoid overloading a tape now and then on a tape recorder equipped with this type of level meter. Tandberg tape recorders have always been equipped with *peak-indicating meters* because we believe they give the truest indication of the sound level. On all Tandberg tape recorders the level meters are connected *after* the frequency-corrected record amplifier. For this reason the meters measure direct the current flowing in the record head. Tandberg is one of the very few manufacturers in the world who connect peak-indicating meters in this way! Peak-indicating meters *always show the most powerful components in the sound signal.*

**Electronic editing («flying start») facility**

On the TCD 330 you can switch direct

to record from playback without going through stop. This is a very useful facility for editing tapes and cleaning up recording overlaps and gaps in a simple precise way without clicks. If you are comparing the TCD 330 with other cassette tape recorders that have this facility, you should make sure that the other machines can perform this operation without introducing unwanted electrical noise. The TCD 330 generates no clicks, plops, or noise of any kind!

**The TCD 330 can be used with all the best tapes on the market**

With a top quality machine such as the TCD 330 you should of course always use the best tape available to achieve high quality results on record and playback. With the tape selector in one position the TCD 330 is adjusted to all kinds of chrome dioxide (CrO<sub>2</sub>) and SA tape. With the tape selector in the other position the machine gives the best performance with all Low Noise High Output (LH) ferric oxide tapes - UD, UDXL, XD, LMS, and ED. The electronic circuits in the TCD 330 are so good that the ultimate performance you can achieve is only limited by the quality of the tape you use!

**Some cassette machines with 3 heads do not provide the source test (B test)!**

Cassette machines with 3 heads have

long been awaited. If the playback head is located after the record head, you can have source test and tape test (A test and B test) during recording. The tape test (monitoring a recording from the tape a fraction of a second after it has been recorded and while the rest of the recording continues) is one of the most important control facilities there are. You can tell precisely how the recording is going. Used in conjunction with the peak meters on the TCD 330 you have every opportunity to exploit the tape characteristics to their fullest extent. On the TCD 330 we have taken full advantage of the 3-head technique incorporating source and tape tests.

**Adjustable output level**

The TCD 330 has been designed for connection to top quality audio power amplifiers therefore it has no built-in end amplifiers. The output level from the TCD 330 preamplifiers can be regulated precisely by means of the slide potentiometers.

**Front output jack for stereo headphones**

The TCD 330 is equipped with a transformer-less output for stereo headphones. The 1/4" (6 mm) jack output is suitable for all headphones with an impedance greater than 8 ohms. The output level can be controlled by the slide potentiometers.

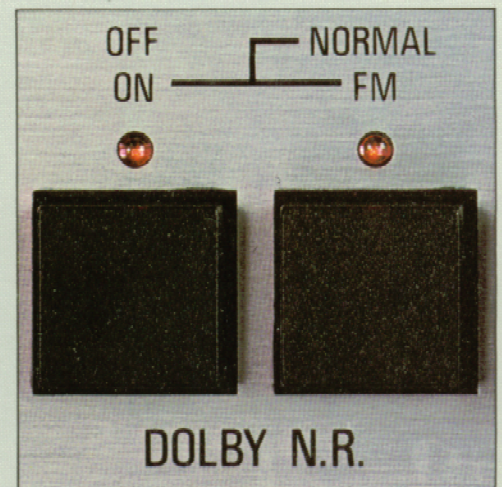
The TCD 330 has large peak meters.



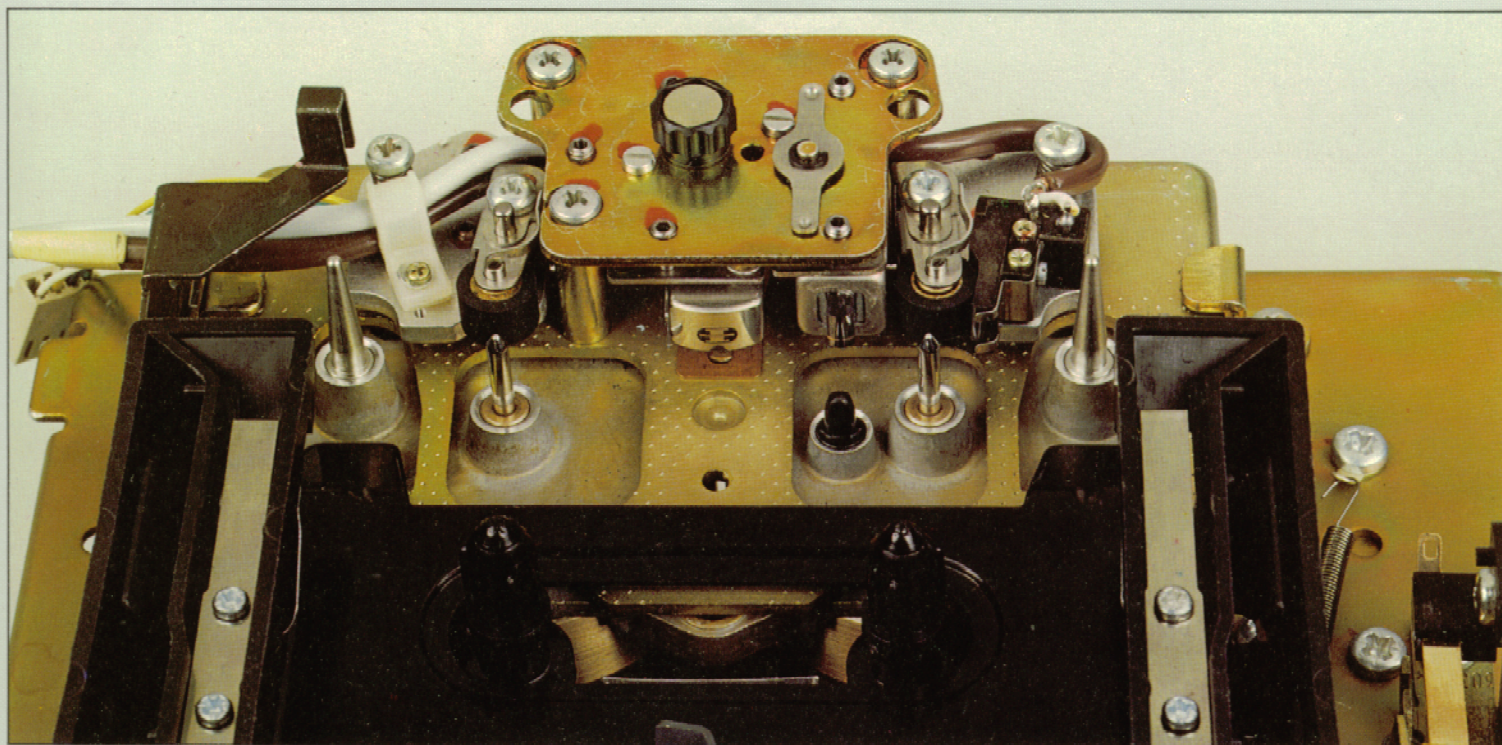
The multiplex filter can be switched in and out.



The Dolby switches have three functions.



# Dual-capstan closed-loop tape transport system, 3 motors, 3 heads



## What we demand from a perfect tape path

1. Correct contact between the heads and the tape.
2. Correct tape tension.
3. Stable tape flow, independent of the cassette.
4. Minimum speed variations (wow and flutter).
5. The machine must eliminate irregularities in the sound reproduction caused by the cassette itself.
6. Correct and stable tape winding.
7. Gentle tape handling.
8. Low mechanical noise from the drive mechanism.
9. The tape path must accept all kinds of cassettes.
10. The mechanical systems will maintain this performance after long and hard use.

## The TCD 330 tape transport

The tape transport system consists of 2 pinch rollers and 2 capstans operating in a closed-loop system. The system guarantees precise and reliable tapeflow

across the heads during record and playback because one of the capstans runs 0.3% slower than the other. This provides the correct tension for the tape and ensures good contact between tape and heads. The tension also makes the tape independent of irregularities in cassette construction because the tape transport system has complete control over the tape as it crosses the heads. In contrast to tape transport systems with only one capstan, the tape loop in front of the heads is in a way isolated from the cassette by a mechanical filter on each side.

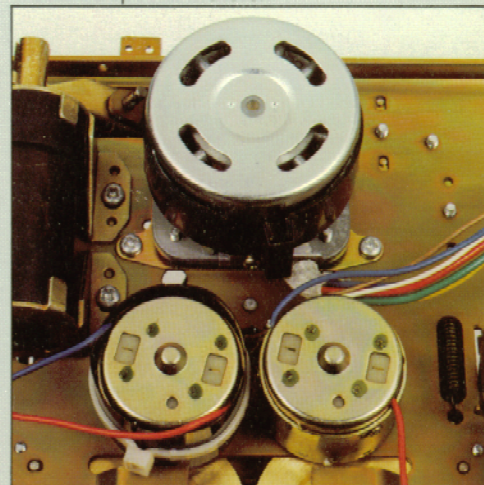
## The mechanical precision

To achieve the high performance of the TCD 330 we had to demand a great deal from the characteristics and tolerances of the drive belt, motors, capstans, pinch rollers, and fly-wheels. Here are some of the tolerances we must achieve:

Drive belt: thickness deviation less than  $4\mu\text{m}$  (0.004 mm).

Capstan: dynamic eccentricity less than  $1\mu\text{m}$ , static eccentricity less than  $0.3\mu\text{m}$ , and diameter difference less than  $1\mu\text{m}$ .  
Pinch roller: radial eccentricity less than 0.02 mm.  
Fly-wheel: radial eccentricity less than 0.01 mm and diameter difference less than 0.02 mm.

The three special motors.



### Automatic removal of tape loops

It can happen that the tape lies in a small loop and is not completely stretched between the reels inside the cassette. As soon as the cassette is inserted into the cassette compartment and pressed down into the reel spindles, the electronics in the TCD 330 ensure that the loop is pulled in and the tape lies correctly between the reels.

### 3 special motors

The TCD 330 has a hysteresis synchronous motor for record and playback, and two d.c. motors providing the fastest and gentlest winding ever seen on a cassette machine! The reel spindles are connected direct to the motor spindles and this reduces the number of moving parts to the absolute minimum. So the TCD 330 has no complicated clutch systems or other transfer mechanisms to eventually wear out and give a poor performance. Tandberg cassette machines have always had 3 motors because one of our aims has been to make uncomplicated, reliable machines without vulnerable mechanical systems having too many moving parts. This means that with the TCD 330 we have achieved the same mechanical excellence normally found only on advanced open reel machines.

### Rapid servo-controlled winding

The TCD 330 winds and rewinds rapidly. The winding time of a C 60 cassette is only about 45 seconds while the average time is about 75 seconds for machines with mechanical tape transports. This rapid winding is possible because the TCD 330 has an automatic electronic servo-system to control the tape speed. The problem is that the tape can easily be stretched at the ends if the speed and winding power are too great. We solved this problem by automatically reducing the speed as the tape gets near the end.

### Rewind memory

When playing back a tape you may reach a spot that you want to return to later. You can do this easily on the TCD 330 by pressing the counter button as you pass the spot. Later, if you press the REWIND and MEMORY buttons the machine will automatically rewind to the chosen spot. This facility is very useful for repeating a passage during language training, or for repeating a piece of music.

### How the tape path for the 3 heads and dual capstans was designed

The designer of a tape path for advanced cassette machines is faced with certain constraints, e.g. the cassette has 5 different windows and the

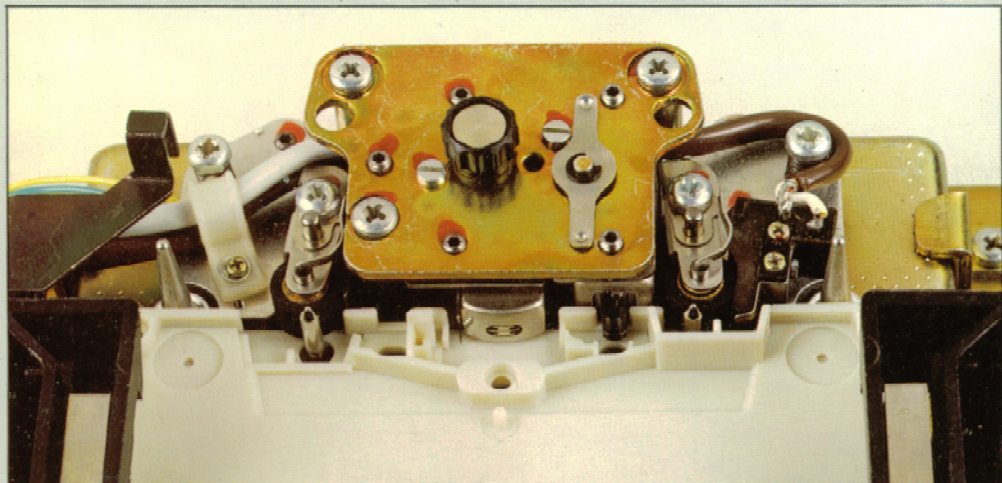
heads and capstans must be inserted into these windows in a particular order to obtain tape/source tests and a good performance. With the TCD 330 we believe we have used all the opportunities open to the designer. The playback head is located in the middle window which is the only window where it benefits from the cassette humshield. The record head was specially designed to fit in the window beside the playback head and the erase head is located in the same window as the first capstan.

### Azimuth adjustable on record head

The critical stage in the recording process is where the tape crosses the record head. Correct reproduction of the highest tones is very dependent on the angle between the tape and the head face. The angle must be  $90^\circ$  to achieve the best performance. A  $10'$  error will give 6 dB loss at 15 kHz, and a  $15'$  error will give 6 dB loss at 10 kHz.

The tape path is always slightly different from one cassette to another because of small deviations in cassette construction. So the tape/head angle will not always be  $90^\circ$ . The TCD 330 has a simple, built in head-angle adjustment facility (azimuth adjustment) that allows you to set the head exactly to  $90^\circ$  for any cassette (see last page).

How the three heads and dual capstans are placed in the narrow openings in the cassette.



The record head azimuth adjustment.

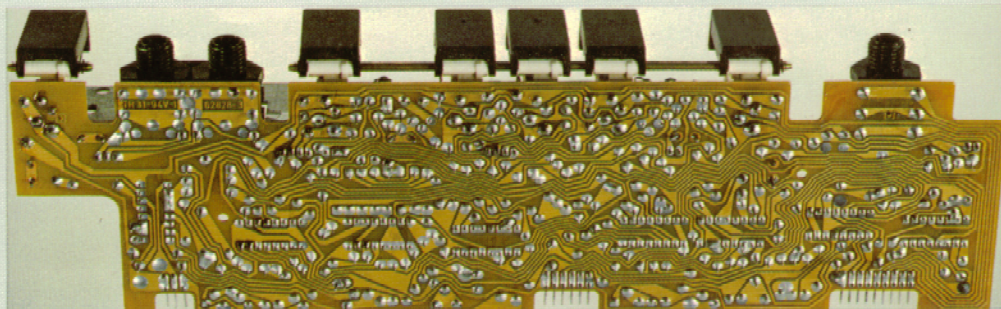


# Complete logic control

## High level logic, integrated circuits with 3 motors

The operating modes in a tape recorder can either be controlled mechanically or electronically. A mechanical system, which is typical for many single motor machines, implies definite weaknesses compared with an electronic system.

These weaknesses exist primarily because it is necessary to maintain strict tolerances on a number of mechanical parts if the system is to work properly. Even small mechanical imperfections or maladjustments can easily lead to poor tape flow. Moreover a mechanical system is heavy to operate and cannot be remote controlled. The advantages with electronic control of the TCD 330 are first and foremost, no mechanical time delays between operational modes and second, all operation times are minimal (see the Function Diagram). The TCD 330 can go direct from wind to rewind, or from rewind to wind, or from wind/rewind to playback. All the operational modes are logic controlled - including even the cassette eject mechanism. The control system is an «electronic brain» with integrated circuits. Regardless of how the mode buttons are operated the electronic control system ensures that the tape travel is always correct and the tape is never damaged.



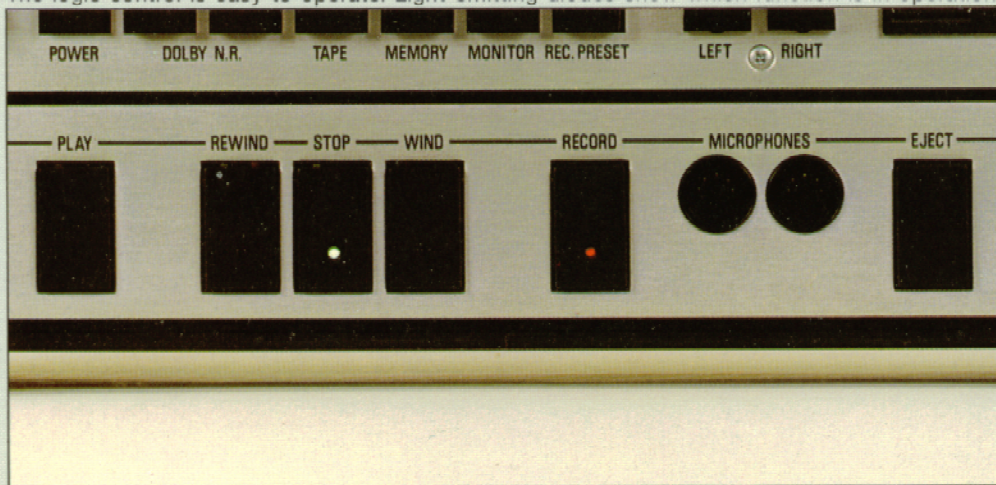
## Electronic protection

The TCD 330 has an electrical end stop, and this also acts as an emergency stop. If the tape jams itself to a standstill in a faulty cassette, the drive stops automatically and the pinch rollers are retracted from the tape. This also prevents tape spilling out of the cassette and at the same time the tape is not subjected to unnecessary physical stress! Tandberg has chosen electronic control of the operating modes to avoid complicated mechanical transmission systems.

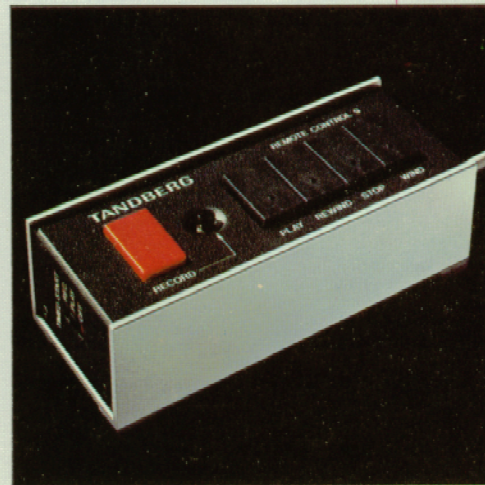
## Remote control (accessory)

All the operating modes can be remote controlled from a separate control unit with a 13 ft. (4 m) cable. The remote control unit has the same operating panel as the tape recorder and all the buttons have the same light-diodes to indicate the mode in use. You can use the operating panel on the tape recorder even though the remote control unit is connected. The TCD 330 can be connected to a clock. This gives you automatic recording, playback or stop at a chosen time.

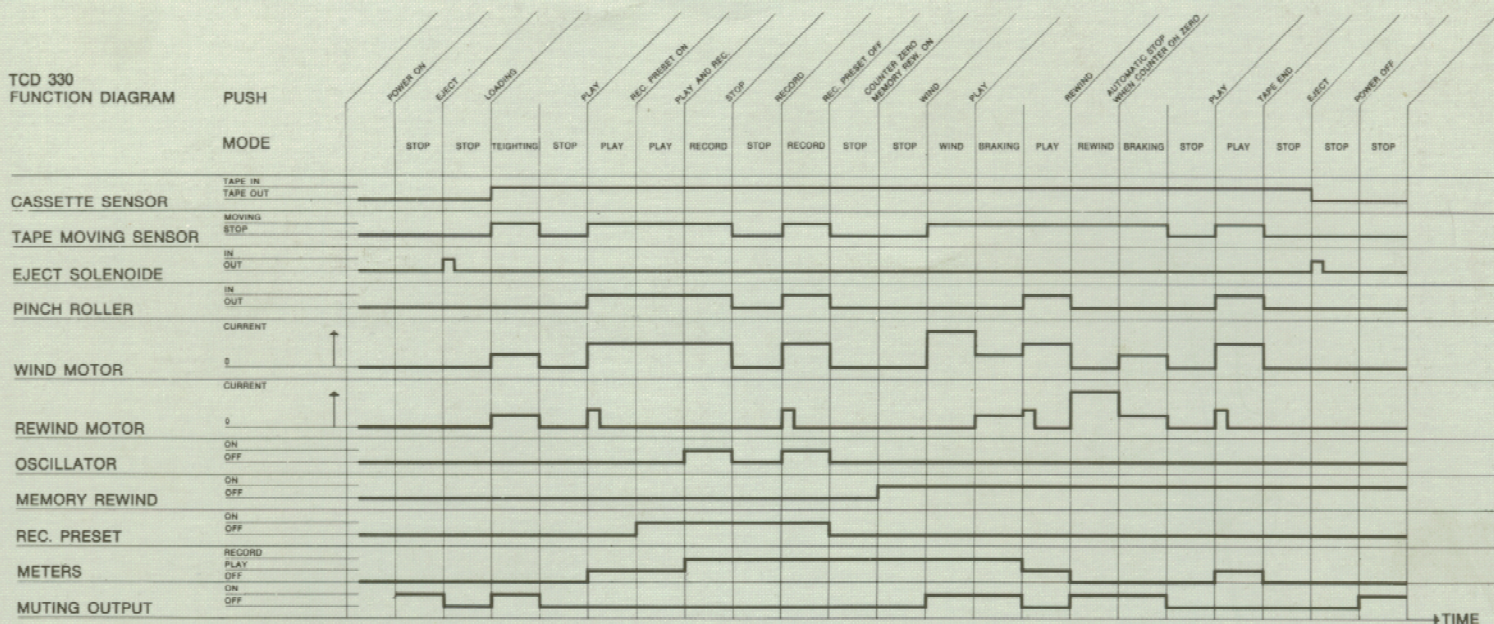
The logic control is easy to operate. Light emitting diodes show which function is in operation.



The remote control unit.



# Technical specification and function diagram



**Dimensions:** width 18½" (47 cm), height 4½" (10.5 cm), and depth 9½" (23 cm).

**Weight:** 15¾ lb (6.6 kg).

**Power requirements:** 240 V, 50 Hz or 115 V, 60 Hz.

**Power consumption:** 40 watts maximum.

**Tape speed:** 1⅞" (4.75 cm) per second.

**Speed tolerances:** ± 0.5% maximum with nominal power voltage and normal operating temperature.

**Speed variations:** maximum 0.12% weighted RMS; maximum 0.18% according to DIN 45 511, peak, weighted.

**Frequency range:** 20 Hz to 20 000 Hz (DIN 45 500); 30 Hz to 18 000 Hz (± 3 dB), with the FM/MPX filter disconnected.

**Signal/tape noise ratio, ref. 3rd. harm. dist., Dolby circuits connected:** greater than 65 dB according to DIN 45 500, Geräuschspannung (IEC A curve RMS), 3% distortion.

greater than 55 dB according to DIN 45 000, Fremdspannung (IEC, linear), 3% distortion.

**Channel separation** at 1000 Hz: greater than 60 dB from side 1 to side 2 and greater than 35 dB from track 1 to track 2.

**Harmonic distortion:** less than 0.3% from the amplifier with 0 dB rec. level; less than 3% from the tape with 0 dB rec. level.

**Inputs:** MIC: the input impedance adjusts itself automatically to dynamic microphones with an impedance between 100 and 800 ohms. Sensitivity from 0.15 mV to 20 mV. LINE: input impedance 470 k ohms. Sensitivity from 80 mV to 10 V. RADIO: input impedance 47 k ohms. Sensitivity from 8 mV to 1 V.

**Outputs:** RADIO: output impedance 5 k ohms. Voltage level 775 mV. LINE: load impedance 100 ohms. Voltage 1.5 V. Headphones: minimum load impedance 8 ohms. Output power 5 mW maximum.

#### Standard accessories

The TCD 330 is delivered with feet for use in the vertical position, a back cover, and a cable for connection to an amplifier (DIN plugs).

#### Tandberg of America, Inc.

Labriola Court  
Armonk, New York 10504  
Tel.: (914) 273-9150 (212) 892-7010  
West Coast Office:  
6400 Independence Ave.  
Woodland Hills, Cal. 91364  
Tel.: 213-887-5862

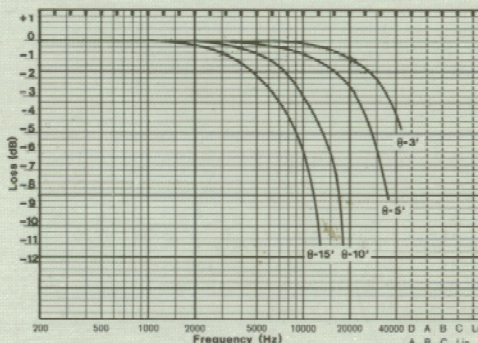
**Tandbergs Radiofabrikk A/S, Oslo 8, Norway.**

#### Extra accessories

**Microphone:** Tandberg TM6. Moving coil with circular polar diagram. Frequency range: 50 to 15 000 Hz (+ 3, - 6 dB).

**Tape:** Tandberg tape in C 60 and C 90 cassettes.

**Remote control unit:** see separate description.



The curves show loss in the high frequency range if the angle between the record head and the tape is incorrect. Deviation in minutes (') from 90°. 3-head machines without adjustable azimuth will get high frequency loss dependent on the angle deviation. On the TCD 330 this can be manually adjusted for all cassettes for correct high frequency sound reproduction!