

# TANDBERG

## High Fidelity





## WELCOME TO THE WORLD OF TANDBERG...

For over 45 years, Tandberg has continuously earned and enjoyed its international reputation for the highest quality and integrity in audio products, a reputation that is backed by a 30-year tradition in tape recording that is unequalled anywhere.

In this brochure you will see a range of receivers, tape recorders and related products that are second to none, regardless of country of manufacture. Products that are, in fact, considered by both experts and loyal consumers to be among

the finest and most advanced in their field.

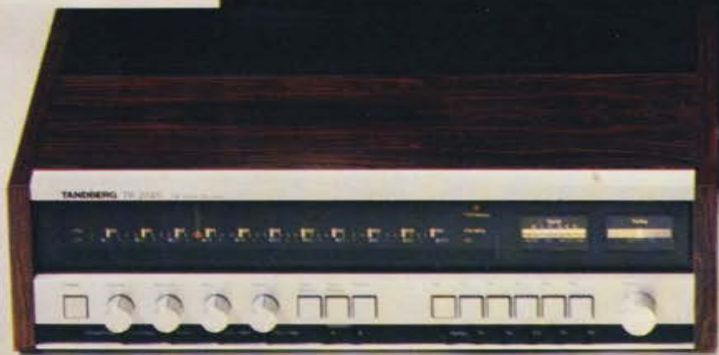
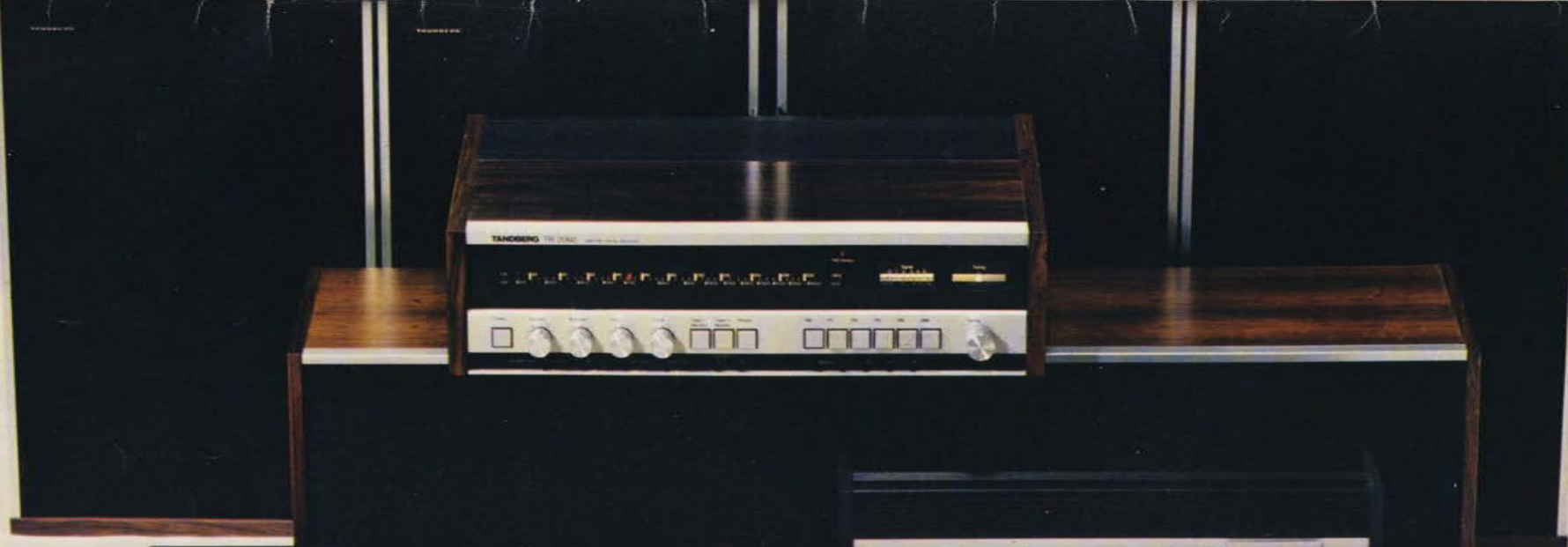
Through the years, customers worldwide have themselves coined the concept "Tandberg Quality" as

a synonym for products with features and performance beyond the ordinary. If you are not already familiar with "Tandberg Quality", we invite you to visit your authorized dealer for a first-hand demonstration.

It's no coincidence that probably more dealers and their salesmen have bought Tandberg equipment for their own personal use than any other brand.











# RECEIVERS

Outside, the timeless beauty of classic Scandinavian design.

The four new receivers you will read about in these pages have all been designed to meet the unique standards of Tandberg's design philosophy. Frankly, we do not seek the customer who is interested simply in the maximum number

More is involved in designing a Tandberg receiver than sophisticated circuitry and close-tolerance parts. The key goal is a balanced performance, a harmony between the tuner section, the preamplifier section, and power amplifier sec-

Tandberg feels that no matter which manufacturer "wins" the power war, the customer always loses. We believe in quality instead of quantity. Tandberg won't play the numbers game because we feel the numbers don't add up cor-

Tandberg's dedication to sonic excellence has required us to be a leader in investigating and eliminating some of the subtler forms of distortion, such as slew-rate limiting and transient intermodulation distortion (TIM). The re-



of watts his dollar will buy, or who is more concerned to show off his hi-fi acquisition than he is to listen to music through it. The emphasis in Tandberg receivers has always been and continues to be on the quality engineering and construction built into them, on the convenience and pleasure of operating them, and on the understated elegance of their appearance.

tion, so that each complements the other within an integrated whole that is more than the sum of its parts. This is not a quality that can be specified, but it will readily be detected and appreciated. Some audio manufacturers are waging an open "power war" against one another. They fire an unending barrage of claims and counterclaims. Each escalation brings announcements of "even more amplifier power than ever before".

rectly. We believe that more power going into an amplifier will be paid for by other components of the receiver and their performance. Therefore, in keeping with our concept of balanced performance, we have kept the output power at optimum relative to the other receiver components.

sult has been the development of sophisticated new circuitry that uses a DC power amplifier section with an extraordinarily fast rise-time and high slew rate. The FM tuner we have developed replaces the traditional multi-section tuning capacitor with far more accurate all-electronic tuning. The ultra-low noise of our preamplifier electronics will be most apparent in what you don't hear: hum and hiss.

You cannot quantify the solid, smooth "feel" of a volume control or the musicality of the effect of a Tandberg-designed tone control, though you will immediately experience and value them. But in the engineering areas that can be specified, Tandberg continues its conservative policy of providing specifications based on guaranteed minimum levels of performance.

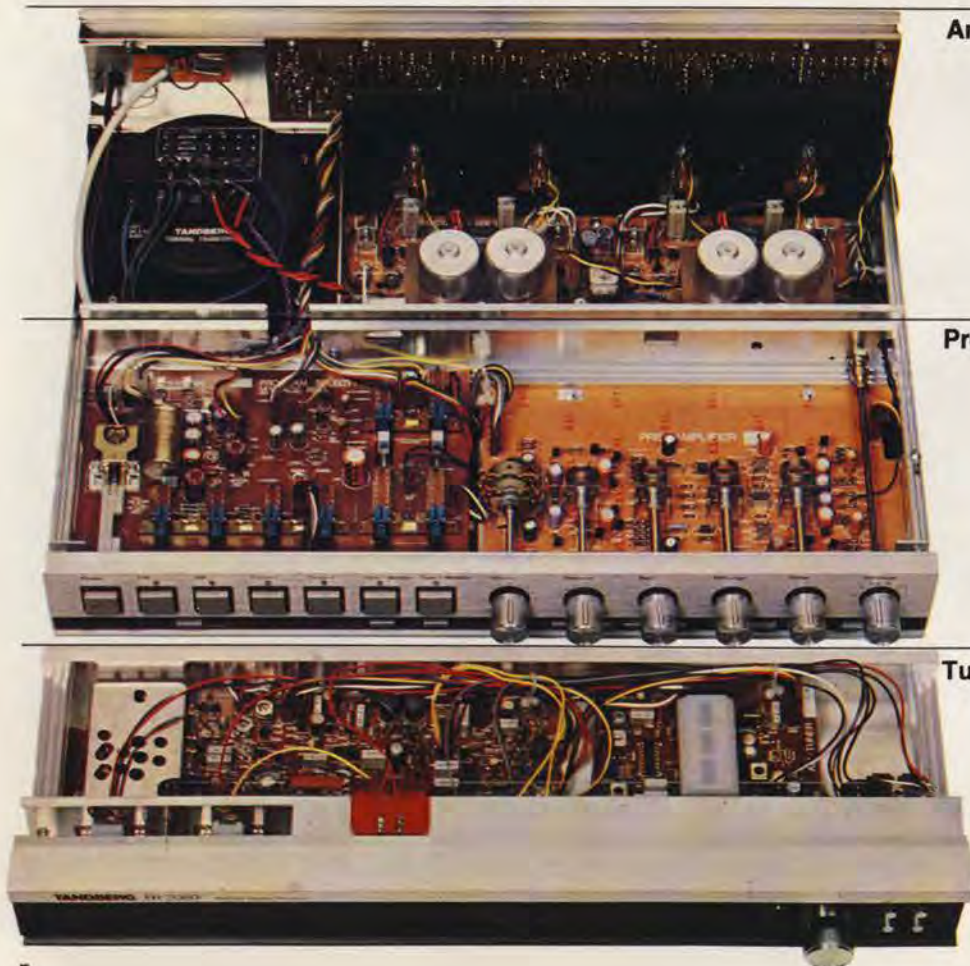
Responsible manufacturers use specifications to reproduce the same result in each unit they produce. We describe our products according to internationally recognized measurement standards. Specifications established by the FTC, IHF, IEEE, DIN, EIA, NAB, RIAA, IEC and USNBS. And we go one step further. The specifications we give are not design averages. Or theoretical maximums. Or figures using hand-picked optimized units. Our specs are **guaranteed minimum** performance standards. This means that every single unit performs equal to—or better than—our specifications.

The plain fact is, we don't hide behind our specs. We stand behind them. This is our assurance that your faith in the integrity of Tandberg's receiver products is well placed and will be rewarded with many years of lasting satisfaction.

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**Inside, three separate, superb audio components working together in harmonious balance, for unsurpassed quality, performance and reliability.**

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**Amplifier**

**Preamplifier**

**Tuner**





## TR 2030

For music systems whose intimate listening areas do not require enormous power outputs, but where no compromise in musicality is permitted, the Tandberg TR 2030 is an ideal choice.

Rated at 30 watts per channel, min. RMS, both channels driven into 8 ohms from 20 Hz to 20,000 Hz, with no more than 0.09% total harmonic distortion, the TR 2030 will sound audibly cleaner in listening tests than other receivers

### **A word about Tandberg's specifications is in order.**

A few, less reputable manufacturers have been known to inflate their specification claims by using specially-selected units (often laboratory prototypes) as the



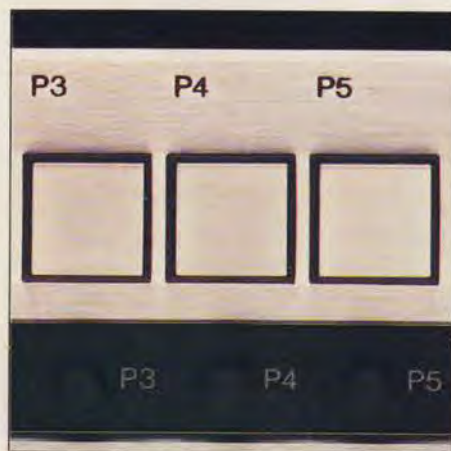
with comparable wattage ratings. That is because Tandberg maintains the same high standards of engineering excellence, craftsmanship in construction, and meticulous attention to user-convenience throughout all of its 2000-series receivers.

For example, the same Tandberg Electronic FM Tuner 4 tuner section, with almost identical specifications, is used in the TR 2030 and in our top-of-the-line TR 2080. You do not have to accept a "step-down" FM tuner simply because you do not need a very high-power amplifier.

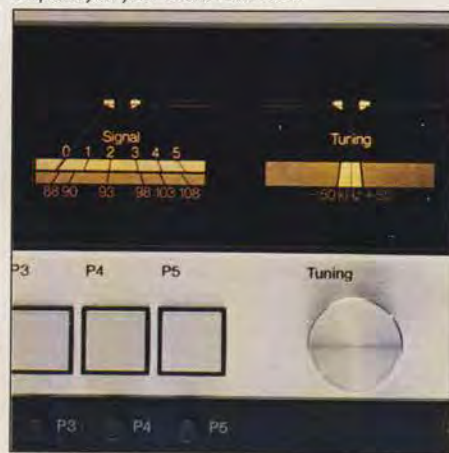
basis for their reported performance. Many more use "design center" criteria, which means that for each unit that exceeds the claim, there will be one that falls short of it. *Tandberg specifications, on the other hand, always represent guaranteed minimum levels of performance, made according to internationally-recognized standards.*

The proof of the importance of Tandberg's conservative approach will be evident to your ears when you audition our products, and is the basis for our ability to provide many, many years of continuing product satisfaction.

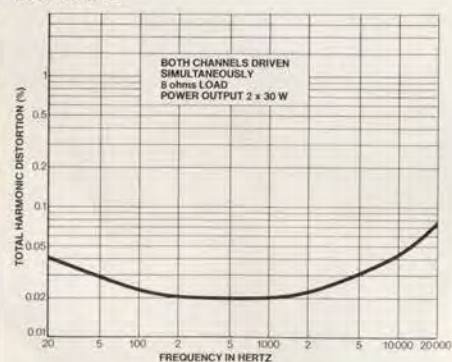
The FM preset pushbuttons let you instantly select up to five FM stations.



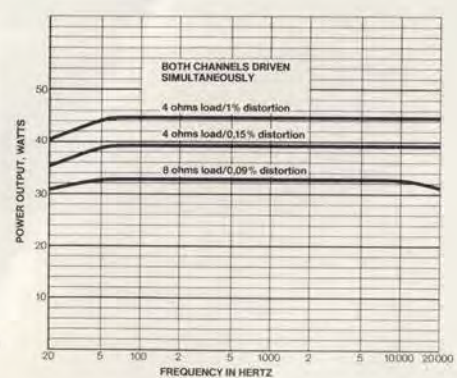
Signal and center-tune meters ensure best possible FM reception. The signal meter also indicates the frequency of your station selection.



Amplifier distortion as a function of frequency at full rated power. Total harmonic distortion does not exceed 0.09%.



Output power as a function of frequency, both channels driven.







## TR 2045

The TR 2045 proves that neither performance nor convenience need be sacrificed in a medium-powered receiver. Rated at 45 watts per channel, min. RMS, both channels driven into 8 ohms from 20 Hz to 20,000 Hz, with no more than 0.09% total harmonic distortion, the TR 2045 uses the acclaimed Tandberg Electronic FM Tuner 4 FM tuner section, and incorporates a host of flexible user features that will add to the pleasure of its use.

The FM section permits you to preset up to five FM stations, which you can thereafter instantly select at a touch of a pushbutton. In this mode, the signal-strength meter is switched automatically to indicate the

The amplifier section of the TR 2045 provides input and monitoring facilities for two tape recorders, as well as for phono cartridge. To ensure maximum signal-to-noise ratio, each input connector is directly

frequency of your station selection. In  
 mounted to the printed circuit board,



In this mode, the signal-strength meter is switched automatically to indicate the

To ensure maximum signal-to-noise ratio, each input connector is directly

frequency of your station selection. In normal tuning operation, it indicates the relative strength of the individual stations received. Precise tuning is facilitated by an accurate center-tune meter. Once set, an automatic frequency control (AFC) circuit keeps the station locked in place for cleanest reception. An FM muting circuit prevents noise bursts when going from one station to another, and a heavy flywheel makes tuning a pleasure. Changeover from monaural to stereo reception is automatic when the received signal is of adequate quality, and is indicated when the "FM-stereo" section of the dial scale lights up.

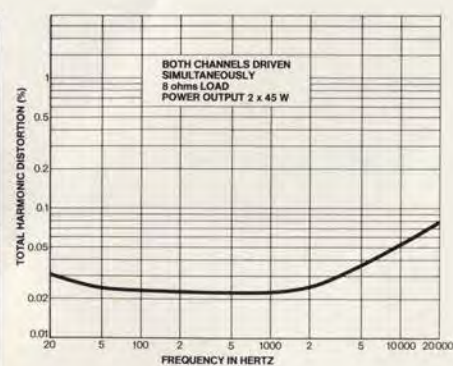
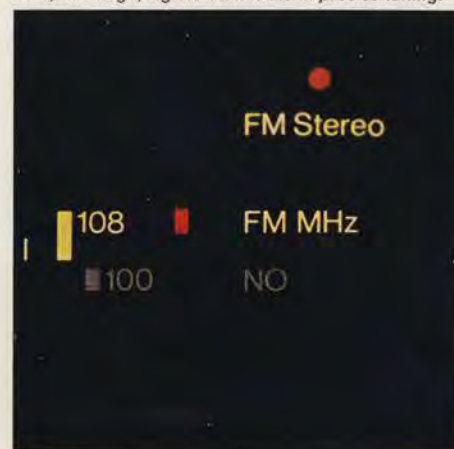
mounted to the printed circuit board, and the phono connector has its own separate input amplifier. High- and low-cut filters are included, as is a switchable loudness control that compensates for the ear's reduced sensitivity to very high and low frequencies when listening at low levels. Accommodations for two pairs of loudspeakers are provided through high-quality, spring-loaded connectors.

All 2000-series Tandberg receivers have easy-to-read dial scales and utilize heavy flywheel-assisted electronic tuning mechanism for accuracy. Automatic indication of stereo FM broadcasts is given by an LED, and large, legible meters aid in precise tuning.

Separate, switch high- and low-cut filters are provided to suppress unwanted hiss or background rumble.

Spring-loaded, heavy-duty terminals provide secure speaker connections.

Total harmonic distortion as a function of frequency.





*am*

## TR 2060

Advanced amplifier design, featuring high slew-rate, fast rise-time, and low Dynamic Intermodulation Distortion (DIM), Tandberg's unique Electronic FM Tuner 4 section, and a high-quality AM tuner, are all combined in the TR 2060. Rated at 60 watts per channel, min. RMS, both channels driven into 8 ohms from 20 Hz to 20,000 Hz, with no more than 0.07% total harmonic distortion, the TR 2060 also reduces dynamic intermodulation distortion to an inaudible 0.03%.

### Brilliant Transient Reproduction

Recent acoustic research has demonstrated that conventionally measured forms of distortion—total harmonic distortion and intermodulation distortion—do not adequately indicate an

Sharp, percussive attacks may require an amplifier to go from essentially no output to full output and back again in extremely brief periods of time—so brief, in fact, that the human ear does not perceive the "true" instantaneous loud-

ness levels reached. The ear can detect the failure of the amplifier to follow the tion components of its own. But simply, the faster the rise time, the more faithful the transient reproduction. The rise time of the amplifiers in Tandberg's 2000-series receivers is 1 microsecond—a millionth of a second.

a PLL (phase-locked loop) multiplex demodulator to provide optimum selectivity, sensitivity, and channel separation, along with high rejection of cross modulation and image frequencies.

amplifier's ability to reproduce sharp, transient sounds without audible flaw.

ness levels reached. The ear can detect the failure of the amplifier to follow the

Slew rate, on the other hand, measures the ability of the amplifier to handle very

The AM tuner incorporated in the TR 2060 features an optimally-tuned input



tortion and intermodulation distortion—do not adequately indicate an

amplifier's ability to reproduce sharp, transient sounds without audible flaw. New measuring techniques have had to be devised to show how well the amplifier can handle these rapid dynamic changes, and the terms "Dynamic Intermodulation Distortion" (DIM) or "Transient Intermodulation Distortion" (TIM) have come into use to describe the distortion products generated by dynamic stresses.

in fact, that the human ear does not perceive the "true" instantaneous loud-

ness levels reached. The ear **can** detect the failure of the amplifier to follow the instantaneous demands upon it, however, since that **failure** generates spurious signals that were not present in the original—that is, distortion. According to the most recent tests, the audibility limit for dynamic distortion is approximately 0.2%. The guaranteed specification of the TR 2060 is 0.03%. Two measurements intimately associated with the ability of an amplifier to handle rapid dynamic changes are "rise time" and "slew rate". Rise-time is a measurement that correlates with an amplifier's frequency bandwidth—which must be many times the conventional 20,000 Hz limit of human audibility if the amplifier is to follow steep rising waveforms without introducing distor-

series receivers is 1 microsecond—a millionth of a second.

Slew rate, on the other hand, measures the ability of the amplifier to handle very powerful high frequencies. It indicates how many volts' change the amplifier can achieve within the specific time period of 1 microsecond. The larger the amplifier, the larger are the voltage swings it must achieve to go from zero output to full output, and so, the higher must be its slew rate. The slew rate of the Tandberg TR 2060 is 20 volts/ $\mu$ sec. The Electronic FM Tuner 4 of the TR 2060 uses dual-gate MOSFETs, three phase-locked, 4-pole ceramic filters, and

cross modulation and image frequencies.

The AM tuner incorporated in the TR 2060 features an optimally-tuned input circuit for high sensitivity, selectivity, and image rejection, together with high overload capacity to prevent distortion and image-frequency responses. In addition to its directly-connected phono input, the TR 2060 provides full facilities for two tape recorders. Like all the models in the 2000-series, the output amplifier of the TR 2060 is direct-coupled for minimum low-frequency phase shift, and has a high damping factor to ensure clean bass reproduction.

The TR 2060 provides AM as well as FM reception. Preset buttons provide instant selection of up to four FM stations.



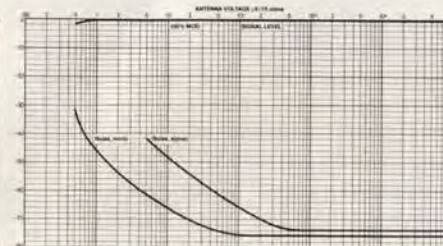
Multiple protection circuits ensure the safety of both speakers and amplifier in the event of a component failure. The power-supply circuit breakers are accessible without opening the receiver.



Phono signals are connected directly to a separate RIAA equalizer circuit.



Stereo and mono signal/noise ratio and distortion curves for the Electronic FM Tuner 4.







## TR 2080

The flagship of the line, Tandberg TR 2080 receiver combines an extraordinarily advanced amplifier design with a tuner section so audibly superior that we could use nothing less for our other receivers.

Norway is an excellent country for the development of advanced tuners, for its mountainous terrain places maximum difficulties in the way of good FM reception. The Electronic FM Tuner 4 which Tand-

berg developed for the TR 2080 ap-  
home listening environments, and its ex-

Rated at 75 watts per channel, min. RMS, both channels driven into 8 ohms from 20 Hz to 20,000 Hz, with less than 0.05% total harmonic distortion, the amplifier section of the TR 2080 provides more-than-adequate power output for

Nor is there any compromise on the convenience features that make the TR 2080 the most pleasurable receiver you can use. Individual sensitivity controls equalize the volume levels between different

(treble, mid-range, and bass), individually adjustable for each channel, and usable in recording, as well as in playback, as are the two High and one Low filters. A separate tone-control defeat switch is also provided to bypass the action of the



tion.  
The Electronic FM Tuner 4 which Tand-

berg developed for the TR 2080 approaches the theoretical limits of physics in terms of its sensitivity and signal-to-noise ratio, producing 50 dB of quieting with an input as low as  $3\mu\text{V}$ , and an ultimate stereo signal-to-noise ratio of 75 dB. The signal-strength meter used in our Electronic FM Tuner 4 operates over an extremely wide sensitivity range, giving useful indications on signals as weak as  $0.5\mu\text{V}$ , and not reaching maximum readings until a 200 mV level is attained. For precise, distortion-free reception, a second, center-tune meter is included, with markings of  $\pm 50\text{ kHz}$ , to center the received signal within the tuner's pass-band.

amplifier section of the TR 2080 provides more-than-adequate power output for

home listening environments, and its exceptional rise time ( $1\mu\text{Sec}$ ) and slew-rate ( $20\text{ V/ Sec}$ ) specifications ensure that no orchestral crescendo or steep-rising transient waveform will ever exceed the amplifier's capacity for audibly-perfect sound reproduction. (If some of these rather new specification parameters are unfamiliar to you, see the discussion on pp. 10—11. The TR 2060 section on Brilliant Transient Reproduction.)

Individual sensitivity controls equalize the volume levels between different

sources, and when you switch from one to the other, there are not only a total absence of annoying "clicks" (which can harm loudspeakers as well as your listening satisfaction), there is actually automatic electronic fading. This means that you can alternate between two turntables for blending and cueing just as the professionals do. The phono input connectors for Phono 1 and Phono 2 are mounted directly on the printed circuit board, with each signal source having its own input amplifier, ensuring maximum signal-to-noise ratio. Two recorders can be used with the built-in circuits of the TR 2080, with full freedom to monitor either, copy from one to the other, or copy tapes while you listen to a completely different program. And, if you wish, unlike most receivers, the TR 2080 provides you with three tone controls

separate tone-control defeat switch is also provided to bypass the action of the

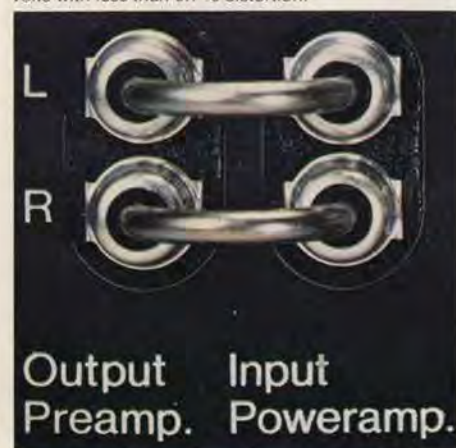
tone control circuitry, and each input is provided with a separate "buffer" amplifier stage, ensuring optimal signal-to-noise ratio. Two high-cut filters (which can be used jointly) and a low-cut filter, all switchable, are provided for less-than-optimum sources, and a total of seven speaker/receiver protection circuits are incorporated to prevent damage in the event of any mishap. A hum-free shielded toroidal transformer, provides power without noise to the highly regulated power supply.

Separate preamplifier outputs and power amplifier inputs permit interfacing such accessories as equalizers or reverberation amplifiers. The newly-designed preamplifier is capable of an output of up to 5 volts with less than 0.1% distortion.

Tandberg's shielded toroidal transformer, prevents stray fields that can cause hum.

The large signal-strength meter gives easy to read indications up to 200 mV, and can be switched to read output power. An accurate center-tune meter ensures clearest reception of FM stereo broadcasts.

The built-in ferrite-rod AM antenna can be rotated through  $270^\circ$  for optimum reception, and terminals are provided for external FM and AM antennae.





# THE NEW ACTILINEAR RECORD AMPLIFIER

The greatest limitations on the quality of tape recording today lie in signal-to-noise ratio and in reduced high frequency response, especially at slow tape speeds. It can be shown that these two factors are reciprocally related; that is, if we improve the frequency response, the signal-to-noise ratio will deteriorate, and vice-versa.

Today's recording tapes use a plastic film, usually polyester, as their base material. For open-reel it is generally about 20  $\mu\text{m}$  in thickness, and is coated on one side with an emulsion approximately 12  $\mu\text{m}$  thick which contains the magnetic particles. An inert, flexible material known as the "binder" serves to bond the particles to the base film while isolating them from each other. In terms of total volume, the emulsion contains about 40% magnetic material and 60% binder. The magnetic particles themselves are needle-shaped, and have an average length of about 0.5  $\mu\text{m}$ , and a diameter of about 0.1  $\mu\text{m}$ . During manufacture, while the coating is still wet, these particles are oriented in a longitudinal direction by passing them through a powerful magnetic field. The physical and magnetic qualities of the particles, and the way they are applied to the base film (orientation, density, surface smoothness, etc.) determine the ultimate quality of the tape.

Two of the most important qualities of the magnetic particles are their retentivity (abbreviated  $B_m$ ) and their **coercivity** ( $H_c$ ). Retentivity is an indication of how much magnetic energy is re-

how well the tape will retain high frequency information at slow tape speeds. As tapes have improved over the years, coercivities have steadily climbed, from the 250 Oersted level of early cassette formulations to the 500—550 Oersted range characteristic of chromium dioxide and today's premium cobalt-modified ferrit formulations. Table 1 shows this progress, and also indicates that advanced "fine metal particle" tapes with a coercivity of approximately 1000 Oersteds, are currently nearing production. At each stage, recorder manufacturers have had to increase the capabilities of their decks to accommodate the more coercive (higher bias) tapes.

As we looked to the requirements for the new generation of "metal" tapes, as well as to how best to optimize recorder performance with existing formulations, Tandberg performed a stage-by-stage analysis of how the audio signal can best be processed before it is fed to the record head. We reached the conclusion that existing circuit designs were weak in three specific areas: (1) confining the flow of bias current to the record head, where it belongs; (2) providing adequate overload margin in the record output stage to accommodate the required recording current; and (3) proper matching the signal current from the record amplifier to the record head. Tandberg's answer has been the development of the ACTILINEAR Record Amplifier circuitry. As you know, for proper recording, two signals must actually flow through the

Tape recording developments take place at two different, though ultimately related levels. On the one hand, improvements in magnetic tapes themselves often require the manufacturers of recording equipment to modify and upgrade their products to gain the full advantage of new oxide formulations. On the other hand, improvements in low-noise, low distortion recorder electronics can make a system—open-reel or cassette—"tape limited" by imperfections in existing tape media.

a high-quality filter which permits the proper flow of the audio signal toward the record head while sharply rejecting the backward flow of bias current to the record head, meeting design objective (1).

If you look at Fig. 1, you will notice that between the output of a conventional Record Amplifier and record head itself, there is a "constant current resistor". Making this resistor rather large in value (in comparison with the a.c. resistance of the record head itself, which rises directly in proportion to frequency), one can more or less ensure that at all audio frequencies the audio current flowing through the record head to magnetize the tape will accurately reflect the input signal voltage. This ensures overall flat frequency response. This is the almost universal method of connecting the output from the Record Amplifier to the record head.

Still, common sense must protest that some penalty must be paid if you waste a good deal of audio power destined for the record head (where it would be used to record information on the tape) by burning it up in a large fixed-value resistor. At the very least, you will have to provide a record amplifier capable of producing an abnormally high amount of audio power: enough not only to record the tape, but enough to burn up in a resistor whose only function is to swamp out the frequency-dependent variations in the record head's a.c. resistance by being much larger than any of them. When this requirement of

abnormally high power is coupled with the additional requirement that the record amplifier must sharply boost the treble frequencies (so that overall record/playback response will be flat), the penalty paid by conventional systems lies in insufficient overload margin and slew-rate limiting in the record amplifier. Tandberg's ACTILINEAR recording system provides a solution to this common problem. Instead of using a large, power-wasting passive resistor to convert the voltage output of the record amplifier into a constant current, a 2-transistor "transconductance amplifier" stage is employed. (Fig. 2.) This circuit eliminates the excessive power requirement (especially at the boosted high frequencies), thus eliminating the slew-rate limiting that causes Record Amplifier distortion. Indeed, the additional Tandberg circuitry provides the Record Amplifier with a full 20 dB better overload margin! Since the result is "linear" (undistorted) recording, and the means to produce it is an "active" (transistorized) rather than a passive (resistance) circuit, we call the process the "ACTILINEAR Recording System". (Of course this is a completely simplified explanation. The uniqueness of the Actilinear System — and therefore its success lies in the complete circuitry. Further technical details are available upon request.) ACTILINEAR helps ensure that, not only with today's formulations, but with tomorrow's as well, Tandberg recorders will only be limited in performance capacity by the tapes available.

tained by the tape after it has been exposed to the field generated by the re-

cord head simultaneously: the audio signal to be recorded, and a steady

*The impressive dynamic range of the patent pending*



**coercivity** ( $H_C$ ). Retentivity is an indication of how much magnetic energy is re-

As you know, for proper recording, two signals must actually flow through the

of them. When this requirement of

by the tapes available.

tained by the tape after it has been exposed to the field generated by the record head. The higher a tape's  $B_m$  rating, the stronger will be the playback signal, and consequently, the better will be the signal-to-noise ratio. Coercivity ( $H_C$ ) is a direct measure of how much force is required to erase a tape, but because of the way in which recordings are actually made in the presence of a.c. bias, coercivity is indirectly an indicator of how much energy will be required by a tape low-distortion recording, as well as

record head simultaneously: the audio signal to be recorded, and a steady, ultrasonic current called "bias". In the traditional arrangement, while **most** of the bias current flows through the record head, as it should, **some** of it flows backwards, through the "constant current" resistor, and enters input of the record amplifier through the equalizing network, where its presence can cause non-linearities (distortion) in the record amplifier. The first step in the development of the "ACTILINEAR" record amplifier, therefore, was the development of

The impressive dynamic range of the patent pending Actilinear recording system, as compared to the dynamics of a conventional recorder of high quality.



Fig. 1. Conventional

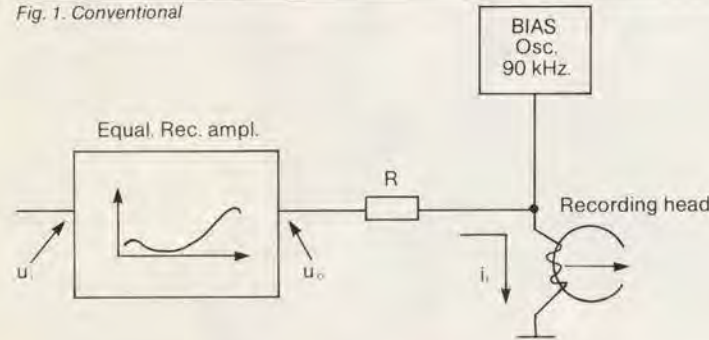
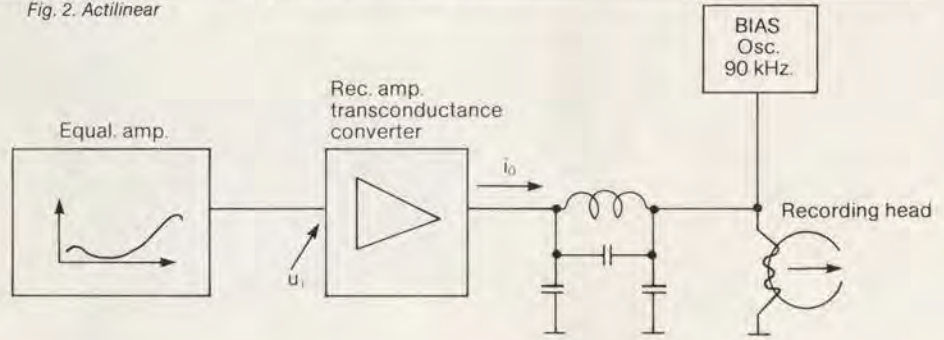


Fig. 2. Actilinear



It is customary to divide different tapes into groups. This table reviews some of the most important data concerning groups of cassette-tapes and tapes for reel-to-reel recorders.

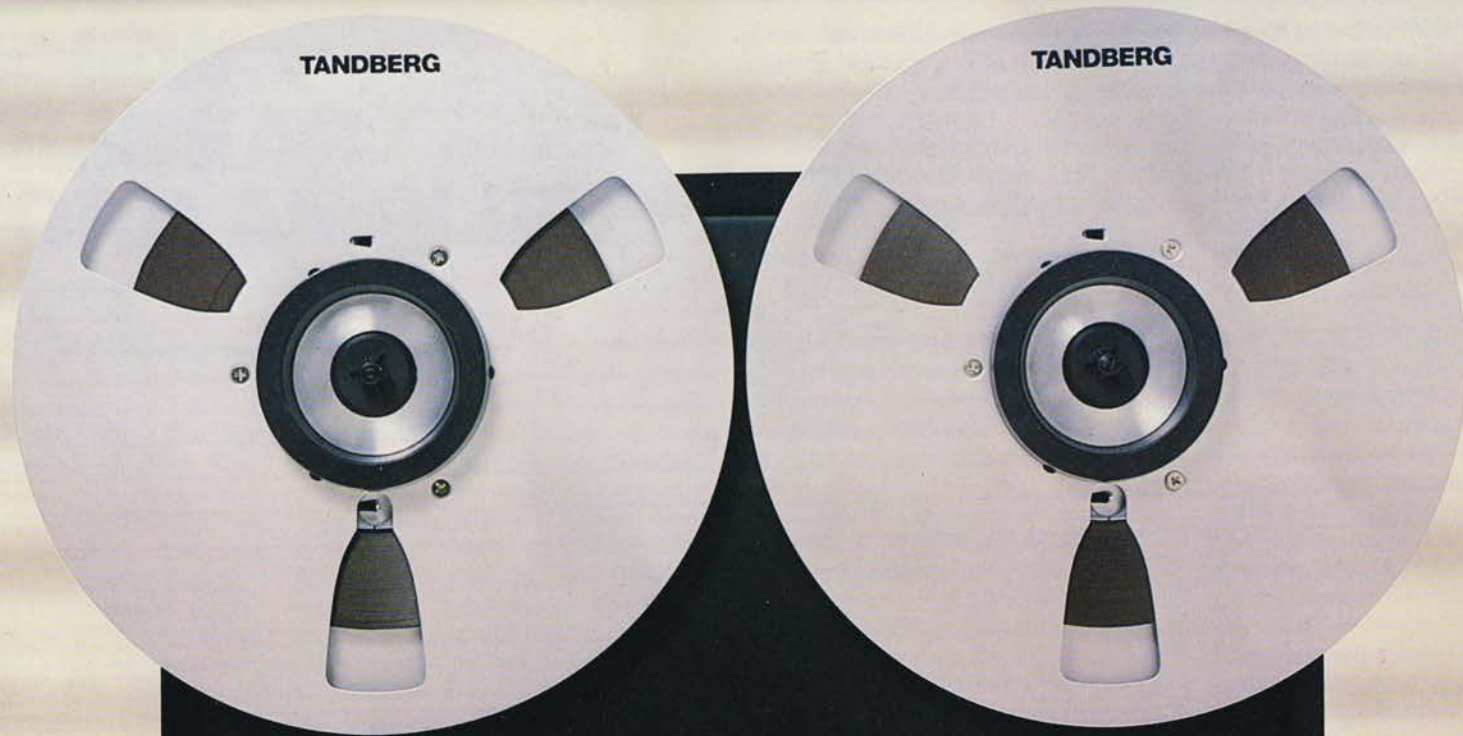
Group	Cassette-tapes				Tapes	
	I	II	III	IV	I	II
Backing material, thickness $\mu\text{m}$	7	7	7	7	23	21
Magnetic coating, thickness $\mu\text{m}$	5	5	4+1	3.8	13	14
Width, mm	3.81	3.81	3.81	3.81	6.25	6.25
Retentivity, $B_r$ Gauss	1400	1500	1500	3000	1260	1350
Coercivity, $H_C$ (Oersted, Oe)	320	550	320/550	1000	315	325
Magnetic coating	$\gamma\text{Fe}_2\text{O}_3$	$\gamma\text{hFe}_2\text{O}_3$ ( $\text{CrO}_3$ )	$\gamma\text{Fe}_2\text{O}_3 + \text{CrO}_2$	Fe	$\gamma\text{Fe}_2\text{O}_3$	$\gamma\text{hFe}_2\text{O}_3$
Example, tape type	Maxell UDXL I Master I (3M)	Maxell UDXL II Master II (3M)	Sony Ferrichrome Master III (3M)	Metafine***	Maxell UD-35	Maxell UDXL-35
Suited for models	TCD 310 MK II TCD 330 TCD 320 TCD 340 A	TCD 310 MK II TCD 330 TCD 320 TCD 340 A	TCD 310 MK II** TCD 330** TCD 320** TCD 340 A**	TCD 340 A*	10 X 10 XD TD 20 A*	TD 20 A

\* After readjustment.

\*\* Tape selector in different positions during recording and playback.

\*\*\* "Metafine" is a registered trademark of 3M Company, USA.





**TANDBERG TD 20A**

Aclinear Recording  
Sel Sync  
4 Motors

Power On/Off

Speed Low/High

Reel 0/1

Output Left

Output Right

Playback Mode  
Left Stereo Right

Source Tape

Monitor

Left Channel

Right Channel

Equalized peak reading -dB  
24 12 6 3 0  
10 50 100%

Equalized peak reading -dB  
24 12 6 3 0  
10 50 100%

Headphone

Mic Left

Mic Right

Record Stand By

Rewind

Stop

Free

Wind

Play

Input Left

Mic Radio Line 2

Input Right

Remote Control

Input Left Line 1

Input Right

Master Control

Bi-As Ad. L R

Rec. Select Left

Rec. Select Right

Mic Sens. 0 dB -25 dB

Tandberg has long been best-known for the craftsmanship and innova-  
 tion. For years, Tandberg's "crossfield"



# TD 20 A

The TD 20 A is Tandberg's first open-reel recorder to incorporate the ACTILINEAR process.

Described more fully on pp. 14—15 of this catalogue, the benefits of ACTILINEAR recording include a dramatic increase (20 dB) in the signal handling capacity of the record electronics, making them essentially immune to slew-rate limiting and transient intermodulation distortion (TIM). This means better transient response and lower distortion overall.

Front-panel bias adjustment controls have been included to facilitate optimum performance with any known or prospective tape. Tandberg's equalized, peak-reading record level indicators have been retained, ensuring that you

will always know the true signal level being fed to the tape, and have been graphically redesigned for easier reading than ever before. A new, phase-correction network has been added to sharpen stereo imagery and prevent phase non-linearity. Four separate record-level controls, plus a master record control, permit full mic/line and line/line mixing, and a switchable 25 dB microphone attenuator is provided to prevent possible overload when using high output speciality microphones. Even a switchable "Sel-Sync" feature has been included, making separate, synchronized recording of the two channels possible.

The transport mechanism of the TD 20 A is as advanced and noteworthy as its electronics.

Capable of accepting reels up to 10<sup>1</sup>/<sub>2</sub>" in diameter, the TD 20 A transport contains four motors rather than three. The capstan is driven by a brushless synchronous motor, and uses a belt drive and heavy flywheel to eliminate vibrations from being transferred from the motor to the capstan. The two reel motors are directly coupled to the reel turntables, and are controlled by a "PROM" (program read only memory) with a trial output to provide constant tape tension (regardless of the amount of tape on the reel) both in record/playback and in high-speed winding modes. The fourth motor is used to op-

erate the pinch roller and tape gate, achieving smooth, noiseless control impossible with the conventional solenoid-activated system. Tandberg's full-logic button control permits you to go from rewind into playback with complete safety, and allows the inclusion of "step-stop" editing with full monitoring capability. An optional PCM wireless remote-control that operates by infra-red signals is available, so you will not be limited by the length and inconvenience of a cable. The TD 20 A is Tandberg's answer to the challenge of the future in the present.

*Tandberg's revolutionary new ACTILINEAR system permits handling signal levels approximately 20 dB higher than required by any of today's tapes. The frontpanel bias adjustment controls will permit trained personnel with proper equipment to optimize the recorder's performance for a variety of tapes.*

*The photo coupler that controls the automatic end-stop operation of the TD 20 A operates by infra-red light, preventing false "stop" commands triggered by sunlight or artificial light.*

*A cordless infra-red remote-control accessory provides maximum flexibility and ease of operation without interfering with signals during record or playback, and also permits use of a timer switch for automatic start and stop in play or record.*

*The separate Master Record Control simultaneously regulates all four possible input signals during recording.*







## TCD 340 A

Successor to the famed TCD 330, Tandberg's new TCD 340 A offers even higher performance than the cassette deck many experts believed could successfully challenge the supremacy of open-reel recorders. To the 3-head, 3-motor dual-capstan design that brought such critical acclaim, we have added Tandberg's remarkable new ACTILINEAR recording system.

ACTILINEAR recording (Patent pending) is discussed in more detail on pp. 14—15, but it brings to the TCD 340 A some advantages which are particularly important for the cassette format. Tandberg's ACTILINEAR process, built

and a playback of that same signal from the tape. Of the relatively few cassette decks that provide this feature, most install the playback head and the record head in the same physical case. This compromise, however, leads to bias-in-

and permits an unusually high fastwinding speed. The closed-loop dual-capstan drive effectively isolates the tape at the critical point where it passes across the heads, and reduces motional disturbances (wow and flutter) to an in-

The 4 Dolby\* noise reduction circuits in the TCD 340 A allow you to monitor a properly decoded playback signal when the Dolby system is in use, and an FM switch permits decoding FM Dolby broadcasts whether you wish to record

into the TCD 340 A, increases the total signal handling capacity of the record

terference effects between such closely-spaced heads, and to high frequency

significant level. All transport control functions are logic-operated for smooth,

them or not. A sharp multiplex filter eliminates FM subcarrier interference



into the TCD 340 A, increases the total signal handling capacity of the record amplifier by some 20 dB more than the present tapes require, ensuring that the amplifier will not be overloaded at any frequency. This means extremely low distortion, especially at high frequencies, freedom from transient intermodulation distortion (TIM) and slew rate limiting; no interference from bias voltage, and overall, a truer, more faithful recording than has been possible before. Tandberg's true 3-head design is another example of its refusal to compromise the requirements of good music recording and reproduction. By using separate record and playback heads, the TCD 340 A permits you to make an instantaneous comparison between the signal being fed to the tape

interference effects between such closely-spaced heads, and to high frequency losses in the uppermost register due to azimuth misalignment. Tandberg, by contrast, uses heads of its own design and construction that are entirely separate, and provides a 10 kHz test-generator to permit the user to optimize recorded performance despite the mechanical variations found in different cassettes. The use of separate, directly-coupled motors for fast-forward and rewind, plus a third, synchronous motor for the closed-loop dual-capstan drive, is another indication of the extraordinary engineering and craftsmanship that has gone into the design of the TCD 340 A. The separate spooling motors eliminate the complex linkages that are usually employed (and can often break down),

significant level. All transport control functions are logic-operated for smooth, 100% fail-safe operation. The TCD 340 A also incorporates Tandberg's equalized, peak-reading meters, a unique design that permits you to monitor the true level of the signal going to the tape, rather than the customary average value (VU-meters) before the application of the record treble pre-emphasis.

them or not. A sharp multiplex filter eliminates FM subcarrier interference with the Dolby operation. A tape-type switch adjusts the recorder for the best of today's premium tapes, and a memory rewind switch allows you to return quickly to any selected point on the tape. An optional remote-control accessory is available, and the unit can be timer-programmed for unattended recording. The TCD 340 A can be operated either vertically or horizontally, for maximum flexibility in installation, and an optional rack-mounting kit is available.

Light-touch pushbuttons with LED indicators/control all the functions of the TCD 340 A.

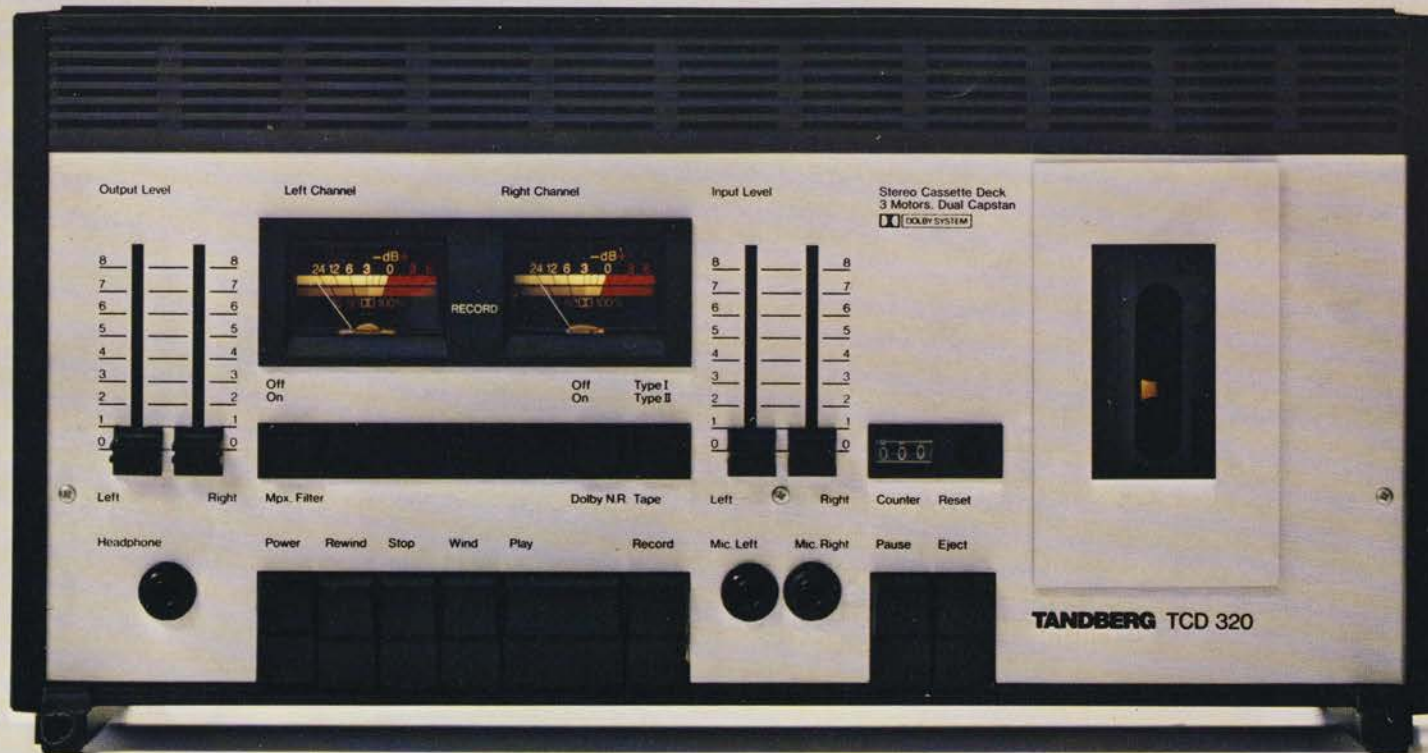
The problem of fitting three separate heads and dual capstans into the tape openings of the standard cassette is completely solved in the TCD 340 A design.

\* The name "Dolby" is a registered trademark of Dolby Laboratories, Inc.

Separate record and playback Dolby circuits permit true record/playback comparison. Dolby FM stereo broadcasts can be decoded with or without recording.







# TCD 320

Tandberg's reputation for sonic excellence and durable design engineering will not be compromised, even in its least costly cassette deck. Thus, the TCD 320 also uses the dual-capstan closed-loop tape drive system which Tandberg was the first to develop.

By isolating the length of tape actually in contact with the recorder heads from any irregularities in the cassette shell or in the tape winding, and by using the differential tension generated between the two capstan/pinch-roller assemblies

to provide optimal tape-to-head pressure, stable, gentle, low-wow tape mo-

The input circuits of the TCD 320 automatically adjust to the different levels produced by phono, tuner, or microphone sources, ensuring full dynamic range and lowest possible input noise for all sources. A switchable multiplex

filter eliminates any possible interference to the built-in Dolby\* system from the 19



differential tension generated between the two capstan/pinch-roller assemblies

to provide optimal tape-to-head pressure, stable, gentle, low-wow tape motion is assured. A smooth-running, synchronous drive motor keeps tape speed accurate to within  $\pm 1\%$ . Separate wind and rewind motors, direct-coupled to their respective spindles, eliminate wear-prone mechanical clutch linkages, and reduce the high-speed winding time of a C-60 cassette to less than 45 seconds.

filter eliminates any possible interference to the built-in Dolby\* system from the 19 kHz FM stereo multiplex carrier. Tandberg's equalized peak-reading record indicators, unlike conventional VU meters, indicate the precise signal level the tape is actually receiving, making it possible to maximize the signal-to-noise ratio without introducing distortion. A tape type selector switch optimizes performance with today's leading cassettes, and separate playback controls match the levels from the TCD 320 to other components in your system and adjust the front-panel headphone listening level.

The Tandberg TCD 320 may be mounted vertically (using the legs supplied) or horizontally, and an optional 19 inch rack-mounting kit is available.

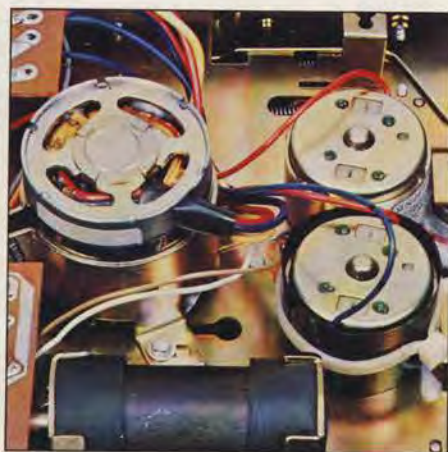
\* The name "Dolby" is a registered trademark of Dolby Laboratories, Inc.

Dual-capstan closed-loop drive system in combination with 3 motors, a Tandberg innovation, ensures smooth, gentle tape flow across the head, where it matters most.

The three specially-designed motors eliminate the need for mechanical clutches that will wear out and degrade performance.

The separate record and playback level controls of the TCD 320 help integrate it into your overall system. The playback control also adjusts the volume at the front-panel headphone jack.

The complete mechanical stability of the TCD 320 permits it to be used as a front loader, with the standard legs provided, as a top-loader, or at any angle in between. You can even hang it from a wall.







# STUDIO

Right from the early days when the firm was founded, Tandberg has developed and manufactured loudspeakers. We have always had strong



# STUDIO MONITORS

When a loudspeaker system is being designed, a number of problems must be solved. The system consists of relatively few parts, but even a small change to one detail can mean a large change in the sound picture. The final design is therefore a very careful compromise between many factors.

Tandberg has compiled a list of 6 target features for the design and construction of Hi-Fi loudspeakers:

- 1) Low cut-off for the bass frequencies
- 2) Low distortion over the entire frequency range
- 3) High power handling capability over the entire frequency range
- 4) Good transient response
- 5) Homogeneous sound distribution over a large room angle
- 6) Good tonal balance



## 1. Low bass cut-off

Every loudspeaker system has a particular bass resonance which is a function of the cabinet size (volume) and the construction of the woofer (the stiffness of the diaphragm suspension and the mass of the moving unit). These factors also affect the bass cut-off frequency and fixing them always involves a compromise between their various effects.

A large part of the research that went into the Tandberg Studio Monitor was devoted to finding the ideal compromise between these factors to achieve a low bass cut-off frequency in a cabinet of this volume. The woofer has a very long axial movement and a large magnet.

Therefore the bass reproduction is good and the distortion is low — even at high powers.

## 2. Low distortion over the entire frequency range

Distortion in a loudspeaker system can have many causes, including weaknesses in the filter, non-linearity in the magnetic field and/or in the diaphragm suspension. These problems can be overcome by selecting loudspeaker drive units with large magnets because large magnets produce a homogeneous magnetic field. In the crossover filter the coils are one of the commonest sources of distortion. The filter in the Studio Monitor has air-cored coils. They do not have the disadvantages of iron-cored coils such as distortion at high sound levels caused by magnetic saturation. These are some of the reasons why the Studio Monitor has very low distortion.

Right from the early days when the firm was founded, Tandberg has developed and manufactured loudspeakers. We have always had stringent requirements for test and inspection. Our object is to make loudspeakers with the same high quality as the other products which have made the name Tandberg known throughout the world.

## 3. High power handling capability over the entire frequency range

A loudspeaker system designed to deliver high power must withstand the mechanical and thermal effects that go with high power. At very high powers the temperature in the voice-coil and in the filter is high, at the same time as the axial excursion of the diaphragm is large. These conditions can lead to permanent deformation or destruction of vital parts in the system. This is why for the Studio Monitor we were very careful to choose high quality drive units and to set stringent requirements on the design of the filter.

## 4. Good transient response

Transient response is an expression that describes how the loudspeaker system responds to a sudden change in the program signal from the amplifier. We say the transient response is good when the system reacts very quickly to a change in the signal and converts it to sound without itself affecting or distorting the sound. A very decisive factor for a good transient response is a large magnet such as the one we have in the woofer in the Studio Monitor.

## 5. Homogeneous (uniform) sound distribution

In a loudspeaker system the sound reproduction is also dependent on the location of the drive units. In the Studio Monitor the drive units are mounted slightly off-center with regard to the middle axis of the front panel. This avoids undesirable edge resonances from the cabinet. Each drive unit has been carefully selected and matched to the system so that the circular sound distribution pattern for its own frequency range is optimum. This means that the Studio Monitor produces very uniform sound distribution over the entire frequency range.

## 6. Good tonal balance

In the opinion of many people this is the most important characteristic in the design and choice of loudspeaker systems. The frequency response of a system depends on the acoustics of the room it is in. With the mid-frequency and treble controls in the neutral position the Tandberg Studio Monitor is suited to the acoustics of an average listening room. But to give the listener the opportunity to adjust the Studio Monitor so that it produces the best possible sound pattern in a particular room, the mid-frequency and treble ranges can be tuned by  $\pm 2$  dB. The controls, which are conveniently placed at the front, provide very smooth tuning.

See specs. for Tandberg Studio Monitor on p. 31.





## TL 3520/FASETT

Loudspeakers—created for all kinds of music. The TL 3520 are top quality loudspeakers from Tandberg, technique and design are in line with the other products. The TL 3520 has been tested by the German technical journal "Hi-Fi Stereophonie" and by the State Research Laboratory (Sweden), and was introduced in the Swedish Hi-Fi Handbook 1977. The tests have given excellent results.

### **TL 3520 is a three-way system with dome tweeter, mid-range speaker and woofer.**

The individual loudspeakers have been specially selected to give the best possible results in relation to the size of the

The tone controls of the amplifier must be set in neutral position (mid-position), so that they do not compensate for weakness in individual speakers. Make sure that the sound intensity is the same when you change between different

sound levels. This has always been an important objective in the construction of Tandberg loudspeakers! Tandberg Fasett combines faithful sound reproduction and novel design in one small loudspeaker. Fasett has been

new to modern loudspeaker production. The Fasett is a dual-system with bass and treble driving units. Furthermore the Fasett employs the bass-reflex principle (see explanation under the paragraph Technical Terms, last page) which means

cabinet. We consider it imperative that

speakers. Take care that the speakers

designed and constructed with many

the loudspeaker boasts an impressive



specially selected to give the best possible results in relation to the size of the

sure that the sound intensity is the same when you change between different

sound reproduction and novel design in one small loudspeaker. Fasett has been

(see explanation under the paragraph Technical Terms, last page) which means

cabinet. We consider it imperative that the sound picture for all loudspeakers have the same character. The TL 3520 has real wood cabinet, black fabric in front and an aluminum trim on the sides.

### It is important to make the right choice.

The task of the loudspeakers in a Hi-Fi system is to convert the program from record, tape or radio into sound via the amplifier. If you have a good program source and a good amplifier, the speakers must be at least as good to accomplish this task. It is therefore unwise to save money on this last link of the sound reproduction chain. It may be difficult to make the right choice. There are many factors to consider, but if you choose the loudspeakers which the manufacturer recommends for the amplifier, a good result is guaranteed. Tandberg's loudspeakers have been developed for use with Tandberg's amplifiers. They take full advantage of the performance characteristics of the amplifier.

### How to evaluate and compare loudspeakers

Listen to different types of music. Make sure that the program source is good, a good record for instance and that the playback equipment is of high quality.

speakers. Take care that the speakers which are being compared are placed in the same way in the room, and one of them is not in a corner or closer to the floor than the other. Listen carefully to the bass, treble and mid-frequency ranges. The bass must be clean and clearly audible. If you have a record player, tape recorder and amplifier with a wide frequency range, then choose a loudspeaker which can reproduce it.

### Relation between loudspeaker and amplifier

All high quality amplifiers today have an almost distortionless sound reproduction. One of the most important tasks for the speaker manufacturer is to make loudspeakers which do not themselves add any audible distortion—even at high

designed and constructed with many small surfaces joined together at different angles. Consequently the Fasett can be tilted and turned to many positions dependent on where it is placed and how the sound is required to flow through the room. This makes the Fasett a very versatile sound source. It can be hung from the ceiling, fixed to the wall (keyhole slots on the back), or placed in a bookshelf or on the floor. Several Fasetts can be placed together in clusters of 2, 4, 6 or 7. Used in this way the Fasett is an interesting alternative to ordinary loudspeakers in big music installations, discotheques, department stores, hotels and restaurants.

### New techniques

The technical design and the appearance of the Tandberg Fasett are both

the loudspeaker boasts an impressive bass response despite its small size.

### Living sound

With the Tandberg Fasett all the advantages of direct and indirect sound distribution can be exploited. In the concert hall the sound flows out from the instruments in all directions. It spreads out in the room, partly beamed directly at the listeners and partly reflected as indirect sound from the walls, ceiling and floor. The total sound in a concert hall is therefore a combination of direct and indirect sound. The strength of the indirect sound in comparison with the direct sound depends upon the hardness of the reflecting surfaces—the walls, ceiling and floor. The sound reflected from a hard surface (glass, concrete) is stronger than the sound reflected from a soft surface (curtains, perforated tiles). With the Fasett this living "sound picture" can be re-created in the home.

### Colors

Tandberg Fasett is delivered in three colors, black, antique white and orange. The surfaces of the Fasett are treated with matt lacquer. The shape and choice of colors with the Fasett make it suitable for a wide variety of interiors.







### Tandberg's new remote control means cordless remote control

Not everyone wants remote control with a tape recorder. This feature is therefore an optional accessory. Those who require remote control for the TD 20 A, will receive really advanced units which offer a high degree of operating comfort. Tandberg has designed infra red transmitter and receiver units which are extremely easy to operate—the RC 20-system.

With cordless remote control you needn't be limited to remaining within a certain distance of the instrument. You can move about freely in the room and still have the vital functions under full control.

### Tandberg Microphone TM 6 Complete

TM 6 has an elegant case of extruded aluminium and it is well suited for reproduction of speaking voice, singing voice and music. The TM 6 is not overly sensitive to movement noise, and it mutes wind noise and breathing sounds. The TM 6 is ball shaped, and it can, in fact, record sounds coming from all directions in an equally satisfactory manner. The TM 6 comes with a plastic carrying case, a table stand and a holder with which to mount it to a floor stand holder. A larger table stand comes as supplementary equipment. It has many uses.

Every single microphone must pass strict quality control tests, and no microphone leaves the factory before it satisfies the technical requirements we demand. Frequency response: 50—15.000 Hz (+3, -6 dB). Directional form: Ball (omnidirectional). Principle: Electrodynamic. Sensitivity: 0.1 mV/bar (at 1000 Hz). Impedance: 250 ohms. Coupling: Fixed mounting, 4 meters of cord with DIN plug. Dimensions: Length 185 mm, largest diameter 23.5 mm. Weight: 160 grams with cord and plug.

# TANDBERG QUALITY



# TANDBERG QUALITY

The word quality is difficult to define. But for most people it means that the product will perform according to the specification, that it will be reliable—operate satisfactorily over a long period—and last but not least that it will continue to perform according to specification even when it is no longer new.

To achieve all this puts strong demands on the individual components and the way they are assembled. This is precisely the area of production that gives rise to the products from some factories being better than the products from other factories. What we are really talking about is "concealed quality"—not the quality that is concerned with operational facilities and features, but the quality that reveals itself only when you use the product over and over again.

## Learning laboratories and data products

In recent years Tandberg has developed and produced special products for the non-domestic electronic market. Best known are the Tandberg learning laboratories, which have been marketed for more than 15 years. So far Tandberg has installed learning laboratories with about 90,000 student places in more than 50 countries. Today Tandberg is one of the world's largest producers of learning laboratories.

Tandberg also produces a range of data products for the professional market, and the range includes display terminals and digital cartridge recorders.

It has always been Tandberg's objective to design and produce quality products. It is a reward in itself that satisfied customers in markets all over the world have themselves coined the concept "Tandberg Quality" as a synonym for reliable products with features out of the ordinary.





# TECHNICAL EXPRESSIONS

## RECEIVERS

Tandberg's TR 2000s are a complete series of advanced receivers.

A receiver consists of three parts: Tuner, preamplifier and power amplifier. To understand a receiver's performance completely, it is necessary both to listen to the quality of sound and to study the specifications for each separate part.

## TUNER

### The signal/noise ratio.

The signal/noise ratio in the tuner is a measurement showing how clearly the signal (the radio program) sounds in relation to the electronic disturbances surrounding it. The higher the measurement, the better the sound quality.

### Sensitivity

Sensitivity is a further measurement for a really advanced tuner. The degree of sensitivity tells how clearly a weak signal can be reproduced. This specification shows the weakest signal which can be received and reproduced in stereo with 46 dB signal/noise ratio. For all tuners in the 2000 series, the guaranteed minimum measurement for sensitivity is 20  $\mu$ V.

### Selectivity

Selectivity is a measurement showing how accurately the tuner separates the different stations. The higher the selectivity, the less the interference and the better the sound and the tuner. Tuner 4, which is a part of all the receivers in the 2000 series, is measured after IHF.  $\pm$ 400 kHz as high as 80 dB.

### Capture ratio

Capture ratio is an expression used to

level as they enter the apparatus, and the forthcoming result is a superb quality of sound.

### Amplifier

Apart from the output and distortion results, it is important to take a closer look at the data for the transient reproduction. This explains the amplifier's dynamic capacity, i.e. how it deals with sudden signal changes.

### Rise Time, Slew Rate and DIM

Rise Time shows how long (or short) a time is required for the amplifier to reproduce a high frequency tone. Rise Time for the amplifier in the 2000 series is 1  $\mu$  sec or 1 millionth of a second. Slew Rate tells how well the amplifier reproduces strong high frequency signals. Slew Rate is given in V per. second. The Tandberg 2000 series specifies a minimum of 20 V/ $\mu$  sec.

DIM is an expression used for dynamic intermodulation and tells which distortions occur as a result of sudden signal changes. The audibility limit for DIM is 0.2%, but all the models in the Tandberg 2000 series have a DIM of no more than 0.05%.

## TAPE RECORDERS/CASSETTE DECKS

### SIGNAL/NOISE RATIO

The signal/noise ratio can be defined as the relationship between the required signal level (the program) and the noise level. The signal/noise ratio is given in dB and the measurements should be as high as possible.

### Noise

In addition to the program which is

stant, can be very irritating — especially in quieter passages of music or in pauses. This noise can be reduced by increasing the recording level so that the distance between the program signal and the noise is made greater.

### Distortion

The construction of tapes is such that distortion will increase with increased strength of the recording signal. Distortion changes the character of the sound. This phenomenon occurs especially at high signal levels and can be reduced by a muting of the recording level. As is illustrated in the previous paragraph, however, this has an undesirable effect on the signal/noise ratio.

Because of the relationship between these factors, the signal/noise ratio and the distortion should always be evaluated together. It is therefore necessary to know at what level of distortion the signal/noise ratio is measured. Recognized manufacturers of HI-FI equipment always give the level of distortion.

### Distortion and signal/noise ratio

There are many different methods of measuring the signal/noise ratio. Each of these represents a clearly defined standard. And each of these standards can be given weighted or unweighted. A weighted measurement is one where certain types of noise are removed. This gives the highest measurement and also, apparently, the best result. The unweighted measurement represents an un-filtered result.

Keep this in mind when looking at data

which does not specify whether it is weighted or not. As is indicated by the

basis for comparison.

If a manufacturer does not state which kind of measurement he uses it can be assumed that it is a weighted measurement used to present the product in a most favorable way.

### Dynamic range

A program's dynamic range is the relationship between the strongest and weakest signals in the program. In orchestra music the dynamic range is wide.

A tape recorder's dynamic range is limited in the lower part of the scale by tape noise and by distortion in the upper part. Because higher tones are more difficult to record, they are specially strengthened during recording. They therefore reach the distortion level more quickly. If the recording is done properly, the signal/noise ratio is the same as the dynamic range.

### Frequency range

The greater the frequency range a tape recorder has, the more the recording sound will resemble the program sound. In addition, all the tones within this range must be reproduced with the correct reciprocal strength relationship. Therefore, the specifications of the frequency range are insufficient if the measurement method or tolerance level for deviations in strength relationships are not given at the same time. Therefore, in reading the specifications for the frequency range, the figure for  $\pm$  dB should be observed. This figure shows

the tolerance level. The less the tolerance, the more precise the measure-



2000 series, is measured after IHF.  $\pm 400$  kHz as high as 80 dB.

dB and the measurements should be as high as possible.

un-filtered result. Keep this in mind when looking at data

frequency range, the figure for  $\pm$ dB should be observed. This figure shows

### Capture ratio

Capture ratio is an expression used to show how well the tuner rejects disturbing reflected signals. Low values are best.

### Channel separation

This is a measurement showing how well the tuner can separate signals meant for the right channel from the signals meant for the left channel during stereo broadcasts. Tandberg measures this over a frequency range from 60 to 10,000 Hz and not only at 1000 Hz. The channel separation in the 2000 series is at a minimum level of 40 dB.

### Preamplifier

The input signals which the preamplifier is concerned with, are weak. They are therefore extremely sensitive towards noise and disturbances from the electric fields which are invariably formed in electric equipment. Even so, Tandberg has succeeded in creating a preamplifier which is unusually free from noise. First, the 2000 series has a preamplifier part with a separate preamplifier unit on each single output. In addition, these units are coupled directly to the inputs. The weak input signals reach the correct

### Noise

In addition to the program which is recorded, there will always be a certain amount of noise on the recording. The noise comes mainly from the tape itself and is usually a humming sound. This humming sound, which is almost con-

which does not specify whether it is weighted or not. As is indicated by the technical data given by Tandberg, there is a great difference between results with and without filtering. Tandberg gives the results according to both methods of measurement to give the best possible

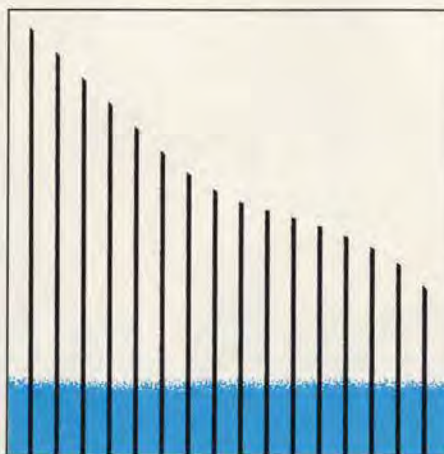
the tolerance level. The less the tolerance, the more precise the measurement. If the tolerance is not given, the specification should be looked upon with scepticism.

### \*Dolby noise reduction (TCD 320 and TCD 340 A)

*Recording without Dolby.*  
The signal is blended with the tape noise. When playing, the noise will drown the weak tones in high frequencies.



*Recording with Dolby.*  
The weaker high frequency tones are strengthened in such a way that they drown the tape noise.



\*The name "Dolby" is a registered trademark for Dolby Inc., U.S.A.

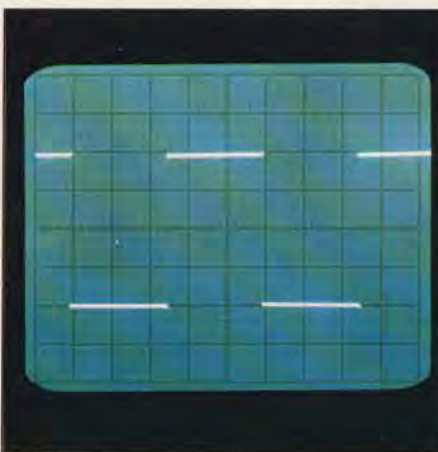
*Playback with Dolby.*  
The tones are played on their original level. The noise is subdued accordingly.



### Phase correction

The electronic correcting circuits which are necessary for the recording and playing of programs on a tape recorder always give a certain phase torsion resulting in bad transient response. To improve this, the Tandberg TD 20 A is fitted with specially developed phase correction circuits. The transient response can be examined by recording a clear *square wave signal* from a signal generator and then play the tape and study this signal on an oscilloscope. The more it resembles the original *square wave signal* from the generator, the better the transient response.

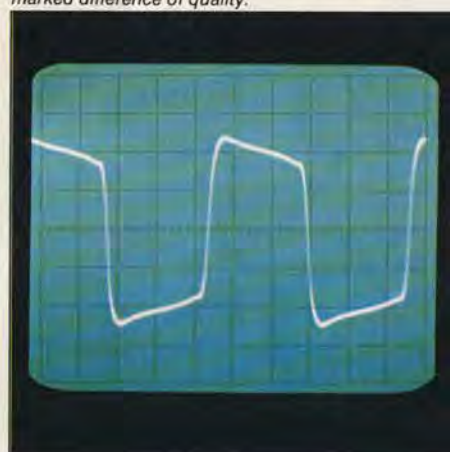
*Signal from signal source fed into the tape recorder. (Square wave)*



*The square wave after recording and playback on a typical tape recorder without phase correction circuits.*



*Similar square wave after recording and playback on TD 20 A with phase correction circuits. There is a marked difference of quality.*





# TECHNICAL DATA

## RECEIVERS

AMPLIFIER SECTION	TR 2080	TR 2060	TR 2045	TR 2030
<b>Output power</b> per channel, sine wave from 20 to 20,000 Hz in 8 ohms. Both channels driven simultaneously (FTC). Distortion in %.	75 W 0.05 %	60 W 0.07 %	45 W 0.09 %	30 W 0.09 %
<b>Distortion</b> at 1 dB under nominal output power and lower at 1 kHz and 8 ohms	0.01 %	0.03 %	0.03 %	0.03 %
<b>Intermodulation</b> according to IHF	0.05 %	0.07 %	0.09 %	0.09 %
<b>Damping factor</b> by nominal output power in 8 ohms	60 20-20,000 Hz	55 20-20,000 Hz	55 20-20,000 Hz	55 20-20,000 Hz
<b>Frequency response</b> from linear inputs (-1.5 dB)	6-80,000 Hz	8-50,000 Hz	8-50,000 Hz	8-50,000 Hz
<b>Channel separation</b> at 1 kHz, minimum.	60 dB	60 dB	60 dB	60 dB
<b>Tone controls.</b>				
Treble control at 10 kHz:	±15 dB	±15 dB	±15 dB	±15 dB
Loudness at 10 kHz, maximum:	+ 3 dB	+ 3 dB	+ 3 dB	+ 3 dB
Mid-frequency control at 1 kHz:	± 7 dB	—	—	—
Bass control at 50 Hz:	±15 dB	±15 dB	±15 dB	±15 dB
Loudness at 50 Hz, maximum:	+ 8 dB	+ 8 dB	+ 8 dB	+ 8 dB
<b>Low tone filter</b> - 12 dB per octave, - 3 dB at	30 Hz	70 Hz	70 Hz	70 Hz
<b>High tone filter 1</b> - 12 dB per octave, - 3 dB at	9,000 Hz	8,000 Hz	8,000 Hz	8,000 Hz
<b>High tone filter 2</b> - 6 dB per octave, - 3 dB at	8,000 Hz	—	—	—
<b>Input sensitivity</b> for nominal output power in 8 ohms.				
TAPE 1:	150-600 mV	240 mV	210 mV	180 mV
TAPE 2:	150-600 mV	240 mV	210 mV	180 mV
PHONO 1:	2.2-10 mV	3.5 mV	3.0 mV	2.5 mV
PHONO 2:	3.0 mV	—	—	—
<b>Signal/hum and noise ratio</b> , IHF A-network Max. output, 8 ohms load, shorted input				
TAPE 1:	98 dB	94 dB	94 dB	94 dB
TAPE 2:	98 dB	94 dB	94 dB	94 dB
PHONO 1:	88 dB	86 dB	86 dB	86 dB
PHONO 2:	88 dB	—	—	—

## FM SECTION

<b>Wave band</b>	87.5-108 MHz	87.5-108 MHz	87.5-108 MHz	87.5-108 MHz
<b>Tone frequency range</b> (- 3 dB).	20-15,000 Hz	20-15,000 Hz	20-15,000 Hz	20-15,000 Hz
<b>Usable sensitivity</b> , 300 ohms, mono	1.7 μV/9.8 dBf	1.9 μV/10.8 dBf	1.9 μV/10.8 dBf	1.9 μV/10.8 dBf
<b>50 dB quieting sensitivity</b> , 300 ohms				
MONO:	3 μV/14.8 dBf	3.5 μV/16.2 dBf	3.5 μV/16.2 dBf	3.5 μV/16.2 dBf
STEREO:	32 μV/35 dBf	40 μV/37.3 dBf	40 μV/37.3 dBf	40 μV/37.3 dBf
<b>Signal/noise ratio</b> by 1 mV aerial voltage (65 dBf): According to IHF				
MONO:	78 dB	76 dB	76 dB	76 dB
STEREO:	75 dB	74 dB	74 dB	74 dB
<b>Distortion</b> , IHF, 65 dBf 30 Hz - 15 kHz, stereo (mono):	0.5 % (0.4 %)	0.5 % (0.4 %)	0.5 % (0.4 %)	0.5 % (0.4 %)
<b>Selectivity</b> according to IHF ± 400 kHz.	80 dB	80 dB	80 dB	80 dB
<b>Image frequency rejection.</b>	100 dB	100 dB	100 dB	100 dB
<b>AM suppression</b> according to IHF.	70 dB	70 dB	70 dB	70 dB
<b>Mid-frequency damping.</b>	100 dB	100 dB	100 dB	100 dB
<b>Limiting</b> (- 3 dB) at 75 ohms aerial impedance.	0.7 μV	0.7 μV	0.7 μV	0.7 μV
<b>Noise suppression level</b> at 75 ohms aerial impedance.	3 μV	3 μV	3 μV	3 μV
<b>Capture ratio.</b>	0.9 dB	1.5 dB	1.5 dB	1.5 dB
<b>Channel separation</b> , 60 Hz - 10 kHz, measured selectively.	40 dB	40 dB	40 dB	40 dB
<b>Pilot tone suppression</b>	70 dB	62 dB	62 dB	62 dB
<b>38 kHz suppression</b>	62 dB	62 dB	62 dB	62 dB

## AM SECTION

<b>Wave bands:</b> Medium wave	518-1600 kHz	518-1600 kHz		
<b>Selectivity</b> at 1 MHz ± 9 kHz.	42 dB	40 dB		
<b>Distortion</b> by 30 % modulation.	0.8 %	0.8 %		
<b>Sensitivity</b> at 1 MHz, 30 % modulation and 20 dB signal/noise ratio.	25 μV	25 μV		

## SCALE AND WEIGHT

Width cm	51.5	51.5	51.5	51.5
Height	15.5	14.5	14.5	14.5
Depth	35.5	32.0	32.0	32.0
(+ knobs cm)	2.5	2.0	2.0	2.0
Weight kg	12.5	10.0	9.6	8.3



## TAPE RECORDERS

All data better than DIN 45,500 P.4.

Please note that the technical data figures shown are related to the measuring methods used.

	TD 20 A			TCD 340 A	TCD 320
Operating voltage: 60 Hz	115 V ± 10 %			115 V ± 10 %	115 V ± 10 %
Power consumption	110 W			40 W	40 W
Speed tolerance, max. <sup>1)</sup>	± 0.5 %			± 0.5 %	± 1 %
Tracks	2	4	4		
Tape speed, inches per second	15-7 <sup>1</sup> / <sub>2</sub>	15-7 <sup>1</sup> / <sub>2</sub>	7 <sup>1</sup> / <sub>2</sub> -3 <sup>3</sup> / <sub>4</sub>	1 <sup>7</sup> / <sub>8</sub>	1 <sup>7</sup> / <sub>8</sub>
Speed variations, max. (Wow & Flutter)					
W.R.M.S.	15" per sec. 7 <sup>1</sup> / <sub>2</sub> " per sec. 3 <sup>3</sup> / <sub>4</sub> " per sec. 1 <sup>7</sup> / <sub>8</sub> " per sec.	0.03 % 0.05 %	0.03 % 0.05 %	0.05 % 0.10 %	
W.R.M.S.	Played back			0.12 % 0.08 %	0.15 % 0.09 %
Frequency ranges ± 3 dB	15" per sec. 7 <sup>1</sup> / <sub>2</sub> " per sec. 3 <sup>3</sup> / <sub>4</sub> " per sec. 1 <sup>7</sup> / <sub>8</sub> " per sec.	20-30,000 Hz 20-25,000 Hz	20-30,000 Hz 20-25,000 Hz	20-25,000 Hz 20-18,000 Hz	30-18,000 Hz 40-17,000 Hz
Signal/tape noise ratio minimum at max. speed, with recommended tape, see instructions for use.					
IEC-A-CURVE	69 dB	67 dB	66 dB	65 dB	65 dB
IEC linear R.M.S.	60 dB	60 dB	60 dB	55 dB	55 dB
Cross talk at 1000 Hz, minimum.	64 dB (mono) 54 dB (stereo)			side 1-2: 60 dB track 1-2: 35 dB	side 1-2: 60 dB track 1-2: 35 dB
Harmonic distortion, max. From tape at 0 at dB recording level	2 %			3 %	3 %
Inputs. Input impedance/sensitivity/maximurr voltage at 400 Hz. (The sensitivity of the microphone inputs adjusts itself according to the impedance of the microphones).					
Microphone	(0 dB): 800 ohm/0.2 mV-20 mV (- 25 dB): 15 kohm/3 mV-300 mV			0.15 mV-20 mV	0.15 mV-20 mV
Radio	(0 dB): 22 kohm/5 mV-500 mV (- 25 dB): 38 kohm/10 mV-1 V			47 kohm/8 mV-1 V	47 kohm/8 mV-1 V
Line in 1	150 kohm/50 mV-5 V			470 kohm/80 mV-10 V	220 kohm/40 mV-5 V
Line in 2	250 kohm/50 mV-5 V				
Outputs. Min. load impedance/voltage by unloaded output, or output power per channel.					
Radio	5 kohm/775 mV			5 kohm/775 mV	1.5 kohm/775 mV
Line out	100 ohm/1.5 V			100 ohm/1.5 V	1.5 kohm/775 mV
Headphone	8 ohm/1.3 V			8 ohm/1.5 V	8 ohm/2.3 V
<b>SCALE AND WEIGHT</b>					
Width cm	43.5			47.0	47.0
Height cm	45.0			10.5	10.5
Depth cm	19.5			23.0	23.0
Weight kg	17.0			6.6	6.6

<sup>1)</sup> By nominal mains voltage and nominal operating temperature.

## LOUDSPEAKERS

	STUDIO MONITOR	TL 3520	FASETT
Outer dimensions, cm			
Length:	47.0	59.0	28.0
Width:	75.8	35.5	24.5
Depth:	34.2	26.0	22.0
Enclosed volume, litres	80	35	6.5
Frequency range	25-20,000 Hz	38-20,000 Hz	50-20,000 Hz
Resonance frequency	30 Hz	53 Hz	85 Hz
Sensitivity <sup>*)</sup>	6 watts	4 watts	6 watts
Max. sine wave driving power	100 watts	50 watts	25 watts
Music power	160 watts	75 watts	40 watts
Impedance	8 ohms	8 ohms	4 ohms
Loudspeaker application			
Bass	12"	10"	5"
Mid-frequency	2" Dome	3 <sup>3</sup> / <sub>8</sub> "	
Treble	2 x 1" Dome	1" Dome	2 <sup>1</sup> / <sub>4</sub> "

<sup>\*)</sup> Necessary power to reach a determined sound level (96 dB), measured at a distance of 1 metre from the loudspeaker.



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