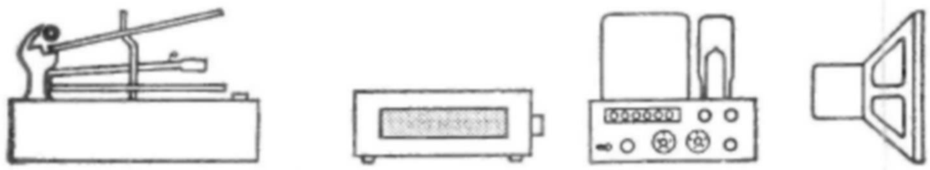
EQUIPMENT



PROFILE

TANDBERG MODEL 64 TAPE RECORDER

During the past half dozen years or so, Tandberg (of Oslo, Norway) has sent this country a succession of tape recorders, each new model representing a high degree of craftsmanship and a step forward in the art of making a compact, high-quality, durable tape machine for home use. Despite the changeover to stereo, which calls for about twice as much tape electronics and introduces switching complications, and despite the addition of a separate playback head, which again nearly doubles the tape electronics, the Tandberg machine has remained unpretentiously small while improving in quality and versatility. Accordingly, Tandberg has won a position of special esteem in the home audio market.

The newest basic stereo tape recorder in the Tandberg line is the Model 64, which includes a number of new features plus subtle improvements in performance compared with the preceding Model 6. In briefest terms, the Tandberg 64 is a compact (15¼ × 11¾ × 6½ in.), light (25 lb.) stereo tape recorder of great versatility and of thoroughly professional design, construction, and performance. It lists for approximately $500.

Operating Features

As stated, the Model 64 is a basic machine, meaning that it must be fed into an external audio system for playback. Otherwise, it has just about everything that the audiofan might reasonably desire of a tape recorder. For maximum performance, and so that one can monitor the tape playback as the tape is being recorded, separate record and playback heads are used. The heads are quarter-track, and the machine permits four-way mono recording as well as two-way stereo recording. Tape speeds are 7.5, 3.75, and 1.875 ips, and the required changes in record and playback equalization are automatically made by the speed-control knob. A four-position digital counter is provided.

The record-level indicator for each channel is a magic-eye tube (EAM86), which presents a fluorescent pattern of two bars that come together at the center of the tube as signal increases. A damping circuit is employed to keep signals briefly at their peak level and thus enable the human eye to follow these peaks. The magic eye covers a range of about 20 db and is about equally sensitive to all frequencies between 30 and 20,000 cps. The persons may raise their eyebrows at the use of a magic eye instead of a VU meter in a tape machine of professional quality. But a good defense can be made for the magic eye. In a professional studio, the VU meter is generally needed to supply an absolute reading of playback level in order not to underdrive or overdrive other studio equipment. It is convenient to use the same meter to indicate recording level (and perhaps also to check bias current). In the home, however, the only need is to indicate recording level. Here the magic eye serves as well or better because, being an electronic device, it can follow transients with substantial accuracy and thus show peak levels, where distortion is greatest. The VU meter, being a mechanical device, may lag anywhere from 6 to 20 db behind transients; therefore the recordist must skillfully judge the actual level of transients and accordingly set the recording level low enough to avoid significant distortion.

Each channel has three inputs: 1. microphone input, presenting an impedance of about 5 megohms in order to preserve bass response fully when using a crystal or ceramic microphone; 2. high-level input, presenting an impedance of 1 megohm; 3. high-level multiplex input, which has a 28k-ohm impedance. The multiplex input is a new feature, replacing what used to be a second high-level input. It feeds the incoming signal through an LC filter sharply tuned to 19 kc, resulting in over 30 db attenuation at this frequency. Unavoidably, there is also some attenuation of audible frequencies below 19 kc, although not too serious. At 10 kc the filter produces about 2 db loss; at 15 kc, about 5 db. The regular and multiplex high-level inputs are effectively in parallel, thus providing a mixing facility. However, when a microphone is inserted into the microphone jack, this cuts out the high-level input signals. The high-level input jacks are at the back of the machine, while the microphone inputs are conveniently on top of the tape deck toward the front.

The output jacks are mounted at the back. The outputs are cathode follower, permitting a long run of cable to the external audio system.

Each channel has a separate gain control for recording level and playback level—four gain controls altogether. The record controls are concentrically mounted, as are the playback controls. In addition, there are 12 internal controls to enable the service technician or knowledgeable operator to adjust the machine for maximum performance. Two are record-level adjustments to assure proper correspondence between the input signal and tape distortion. Two are playback-level adjustments, to achieve equality between the input signal and the tape playback signal when making an A-B comparison. Two are record-level-indicator adjustments, so that the magic eye bars will just close when harmonic distortion on the tape reaches 3 per cent. Two are bias current adjustments. Two are to prevent bias current from reaching the record-level indicators, so that the indicators will not produce a false reading; these controls are variable inductors that form part of an LC bias trap. One control is to balance the pushpull oscillator, thereby minimizing bias-current distortion and resultant noise in recording. The last is a variable capacitor to keep the tape oscillator at constant frequency by compensating for the variation in load on the oscillator when two channels are recording rather than one. The purpose and number of these controls is indicative of the care lavished on the Tandberg 64 by its designers.

Electrical modes of operation are mainly governed by four pushbuttons (a fifth button, located amidst the others, starts and stops the transport in the record and playback modes): record Track A, record Track B, play Track A, and play Track B. Underlying this seemingly simple arrangement is a good deal of sophistication, because what any one button does depends upon the position of the other buttons.

Fig. 1. The Tandberg Model 64.

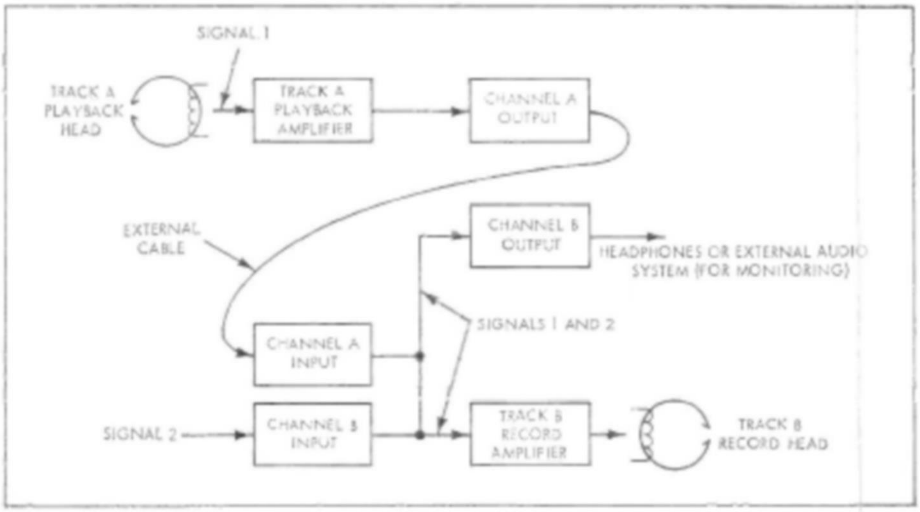


Fig. 2. Sound-on-sound recording with the Model 64.

With both record buttons down, Channel A input is recorded on Track A; Channel B input on Track B. But with only one record button down, both inputs are recorded on one track; thus if record button A is down, inputs A and B are mixed and recorded on Track A. This makes sound-on-sound recording feasible, on which we shall have more to say.

With both play buttons down, the Track A signal goes to the Channel A output; the Track B signal to the Channel B output. But with only one play button down, one signal goes to both outputs; thus if play button A is down, the Track A signal goes to both the Channel A and B outputs. Hence a mono signal can be fed to both outputs.

With both play buttons up, the outputs are connected to the incoming signal. With both play buttons down, the outputs are connected to the tape playback signal. This permits A-B comparison during recording. Or, with both play buttons up and both record buttons up, the Tandberg can be used simply as a voltage amplifier for whatever purpose one desires; for example, to preamplify a microphone signal.

Altogether, through suitable positioning of the record and play buttons, each output jack may be connected to any of four signals: input signal A or B; output signal A or B. The only thing the reviewer found the Tandberg unable to do was combine the Track A and Track B playback signals, which might be desired if feeding stereo signals into a mono playback system.

Electrical operation is further controlled by a three-position sound-on-sound switch concentrically mounted under the playback gain controls. In the "A-B" switch position, operation is as previously described. In the "Normal" position, the A-B test is obviated; that is, the outputs can no longer be connected to the input signals. This prevents the feedback and resultant howl that can occur in some audio systems where a continuous electrical path exists between the tape input jack and tape output jack. The third position is for sound-on-sound recording. This is illustrated in *Fig. 2*, which takes us to the moment when it is desired to transfer Signal 1 from Track A to Track B and simultaneously record Signal 2 on Track B. The switch is moved to the "S-on-S" position, the operator connects an external cable between the output and input of Channel A, and he depresses the Track B record button and Track A play button. Thus Signal 1 is played back from Track A and recorded on Track B; simultaneously, Signal 2 is also recorded on Track B. Signals 1 and 2 combined are monitored by the recordist via headphones or an external audio system connected to the Channel B output.

Mechanical operation is controlled by an operating lever—a joystick, as it is sometimes called—that moves in a "plus" figuration. Pushing the lever to the right or left rapidly winds or rewinds the tape. Pushing it up frees the turntables from their brakes to facilitate threading the reels (formerly the lever moved in a "T" rather than "plus" slot, and it was clumsy to thread the tape because the reels were difficult to turn by hand against the brakes). Moving the lever down completes a linkage between the drive motor and the capstan, preparatory to recording or playing the tape. Now the capstan turns, but the pressure roller is kept a fraction of an inch from the capstan. To bring the roller against the capstan and thereby drive the tape, it is necessary to depress the start-stop button. This is in the nature of a "pause" device because it enables the recordist to halt the tape temporarily without changing the operating mode.

There is a safety interlock between the record buttons and the operating lever to prevent accidentally setting the machine in the record mode and erasing a valued tape, or accidentally disengaging the machine from the record mode. The record buttons can be depressed only when the operating level is in neutral. To lock these buttons down, the lever must be moved down. The record buttons are released only when the lever is returned to neutral (the middle of the "plus"). The playback electronics are actuated only when the lever is down. This prevents ultrasonic frequencies that may be developed during rapid winding or rewinding from reaching the external audio system and possibly injuring the speaker; these frequencies can attain considerable magnitude.

One of the valuable new features is an automatic stop that halts the transport if the tape runs out or breaks. When the tape is inserted in the loading slot, the tape nudges aside a wire finger connected to a sensitive microswitch, which permits the transport to operate. In the absence of tape tension—that is, when the tape breaks or runs out—the finger returns to its original position and the microswitch halts the transport. The device is simple, effective, conducive to peace of mind if the machine is left alone, and much more convenient than the former method of automatically stopping the transport; the latter required metal foil to be spliced onto the tape ends, and was of no help if the tape broke rather than ran out.

Another innovation prevents the tape from creeping when the transport is in the pause mode. A rubber bumper presses the tape fast against the playback head. The bumper is released when the start-stop button is released.

Performance

At 7.5 ips the Tandberg 64 on the whole adheres very well to NAB equalization, as measured by playing Ampex test tape 31321–01. Only at 50 cps, where bass was slightly excessive, did playback equalization stray significantly from the NAB standard, which permits response relative to 1000 cps to be up 1 db between 50 and 15,000 cps; down 1 db between 100 and 7500 cps; down 2 db at 80 cps, 3 db at 60 cps; and 4 db at 50 cps; and down 2 db at 9500 cps, 3 db at 12,000 cps, and 4 db at 15,000 cps. Following is the measured playback response; although the Ampex tape uses 700 cps as a reference, the following data have been converted so that 1000 cps is the 0-db reference.

Frequency	*Left Channel*	*Right Channel*
15,000 cps	−2.25 db	−2.75 db
12,000	−1.75	−2.75
10,000	−0.75	−2.25
7500	0.25	−1.25
5000	0.75	−0.25
2500	0.25	0.00
1000	0.00	0.00
500	0.25	0.50
250	0.25	0.75
100	−0.25	1.00
50	2.75	4.25

Record-playback response at 7.5 ips was exceptionally smooth between 50 and 15,000 cycles, without significant emphasis at 50 cps:

Frequency	*Left Channel*	*Right Channel*
20,000 cps	−7.00 db	−8.00 db
15,000	−2.00	−2.00
12,000	−1.50	−1.50
10,000	−1.50	−1.50
7500	−1.50	−1.50
5000	−1.50	−1.25
2500	−1.50	−0.50
1000	0.00	0.00
500	1.00	0.75
250	1.00	0.50
100	−1.50	−1.00
70	−1.00	−0.50
50	0.00	1.00
30	−5.00	−3.00

Good record-playback response was maintained to 7500 cps at 3.75 ips, and to 4000 cps at 1.875 ips. Other tape recorders sometimes maintain response to considerably higher frequencies at these reduced speeds, but usually at the cost of a noticeable treble peak. In the case of the Tandberg, smoothness of response is apparently favored over extended response. Following are the measured results at 3.75 ips:

Frequency	*Left Channel*	*Right Channel*
10,000 cps	−6.50 db	−7.00 db
7500	−2.50	−1.50
5000	−0.50	0.50
2500	0.50	0.50
1000	0.00	0.00
500	0.50	0.25
250	1.00	0.50
100	0.50	−0.25
50	−3.50	−3.50

Following are the results at 1.875 ips:

Frequency	*Left Channel*	*Right Channel*
5000 cps	–7.00 db	–7.00 db
4000	–3.50	–4.00
2500	–1.00	–1.00
1000	0.00	0.00
500	1.00	0.75
250	2.00	1.00
100	1.00	0.00
50	–0.50	–1.00

Record-playback response was also checked by a listening test. A phono disc was simultaneously recorded and played back, and the tape playback was compared with the original signal. Participating in this A-B test was a musician who spends a good part of his time editing tape on professional equipment. At 7.5 ips neither he nor the reviewer could distinguish the tape from the original. At 3.75 ips, the two could be barely distinguished. The reviewer made his differentiation largely on the basis of slightly higher background noise when the tape was played. The musician noticed some "constriction" of the sound but described it as very slight. At 1.875 ips there was an obvious difference between the original and the tape, but still small enough to render this speed useful for such purposes as background music, dictation, party fun, and so on.

On each channel, the signal-to-noise ratio measured an exceptional 57 db at 7.5 ips, based on a 400-cps note recorded at maximum level (magic eye barely closed). At this level, harmonic distortion measured 2.2 per cent on the left channel and 2.4 per cent on the right channel. Inasmuch as S/N is usually based on 3 per cent harmonic distortion (for home tape machines), it is probably more correct to say that the Model 64's ratio is about 58 db. At 3.75 ips and 1.875 ips, the ratios were about 55 db and 53 db on each channel. These measurements conformed to the NAB standard so as to include all forms of noise: playback noise, noise produced in recording, and remanent signal due to inadequate erasure. The procedure was to record a 400-cps signal at maximum level, rewind, play back, and measure the signal; then rewind, record again but without signal input (thus erasing the tape), rewind, play back, and measure the noise. The highly effective erasure, it may be noted, is due to another new feature, which is the use of an erase head with a ferrite metal core. The manufacturer claims that this makes for 15 to 20 db stronger erasure than previously.

Motion was tested by recording and playing a 3000-cps tone. The musician participated in this test too. At 7.5 ips, motion was truly excellent, a very steady replica of the original. The musician described the motion fully as good as that of professional studio equipment operating at 15 ips. At 3.75 ips, some wavering or pusling was evident, but on a relative basis could still be described as quite good. Motion at 1.875 ips was fair.

Recording four tracks of mono can be satisfactory only if there is extremely little crosstalk between channels; that is, between the two sections of each head and between the two sets of electronics. The Tandberg 64 does very well in this respect. Its specifications claim at least 60 db separation at 400 cps, and 30 db at 50 cps. Crosstalk was unmeasurable at 400 cps, and at 50 cps it measured 45 db of separation rather than the 30 db claimed by the manufacturer. On listening to program material, no crosstalk was discernible.

Tape speed was very accurate. This appears due to use of a constant-speed hysteresis motor and to accurate machining of parts. Professional standards call for speed accuracy of 0.2 per cent. Playing Dubbings test tape D-110, which provides beeps covering a 10-minute interval, the Tandberg ran about 1 second slow during this period—an error slightly under 0.2 per cent.

Tape is handled well. A 1200-foot reel can be wound or rewound in slightly under 90 seconds, which is about par for home machines. When rapidly winding or rewinding, the mechanism can be stopped suddenly without throwing loops. One can shuttle immediately between rapid forward and reverse without breaking, stressing, or spilling the tape. The only danger of tape breakage is in case of power failure while the tape is in rapid motion.

Construction

The design is highly sophisticated in its attention to and execution of details. Nevertheless, like most well-made products, the Tandberg transport is relatively simple in its fundamental aspects. Attached to the motor shaft is a pulley with two grooves and three tracks of differing diameter. The grooves are for rubber belts that drive the supply and takeup turntables. Each turntable has a shaft on which a pulley disc revolves freely. The pulley is driven by one of the rubber belts that go to the motor pulley. When the pulley disc is pushed up the turntable shaft, friction between two felt surfaces causes the turntable to move with the pulley disc. A rubber idler wheel, riding against one of the three tracks of the motor pulley, engages a large weighted flywheel whose shaft is the capstan. To change speed, the idler wheel is shifted from one pulley track to another track of different diameter.

Considering the inevitable complexity of a unit incorporating a tape transport, stereo electronics, and elaborate switching facilities, the below-chassis area has a remarkably uncluttered and well-organized appearance. To one side, in a shielded compartment, is the majority of the tape electronics, kept compact with the aid of printed circuit boards. In a separate section outside the cage, to avoid interfering with the rest of the electronics, is the tape oscillator circuitry on a printed board. Off in a corner, to avoid hum problems, is the power transformer. There is plenty of open space. The careful layout should facilitate servicing.

All components are of excellent grade. It has already been mentioned that a hysteresis-synchronous motor is used; the unit bears the well-known Papst name. The power transformer appears very heavily shielded to minimize hum problems. Liberal use is made of high-quality capacitors and resistors, such as metalized capacitors, oil paper capacitors, deposited carbon resistors, carbon-film resistors, wire-wound resistors, and so on. Tubes and their shields are carefully shock-mounted. All tubes but the oscillator and magic eyes are d.c. operated. It is evident that nothing has been spared to make the Tandberg 64 a top notch performer. C-17