TECHNICAL MANUAL

CAR AUDIO

Digital Audio Tape Player

KDT-99/99R

KENWOOD

CONTENTS

1. DAT

1-1. Standard and structure of a digital audio tape recorder

Conventional tape recorders use an analog recording system regardless if they are open-reel or cassette. This means that the recording result will inevitably have poorer sound quality and lower S/N than the original source, and that noise will increase and sound degrade as dubbing is repeated. To solve the problem of quality degradation due to repeated dubbing, digital recording (Pulse Code Modulation system) has become the audiophiles subject of attention. In short, PCM digital recording converts an audio signal into a combination of two types of signals, like Morse codes, before recording it. With the Morse code system, the signal content can be decoded regardless of the distortion or noise included in the signal, provided that the presence or absence of a signal is recognizable. Based on this characteristic, the PCM digital recording format used with a DAT player is provided with an additional facility for correcting possible readout errors, by means of error correction codes and signal dispersion.

1-2. DAT, its history

The digital tape recorder is not a recent idea. It has been in the market for more than 10 years, since Sony Corporation released its first consumer-oriented digital recording support system, named the "PCM Processor", in 1974. The present DAT recorder can be regarded as a combination of a PCM processor, which converts an analog signal into a digital signal, and of a tape recorder, which records the converted digital signal.

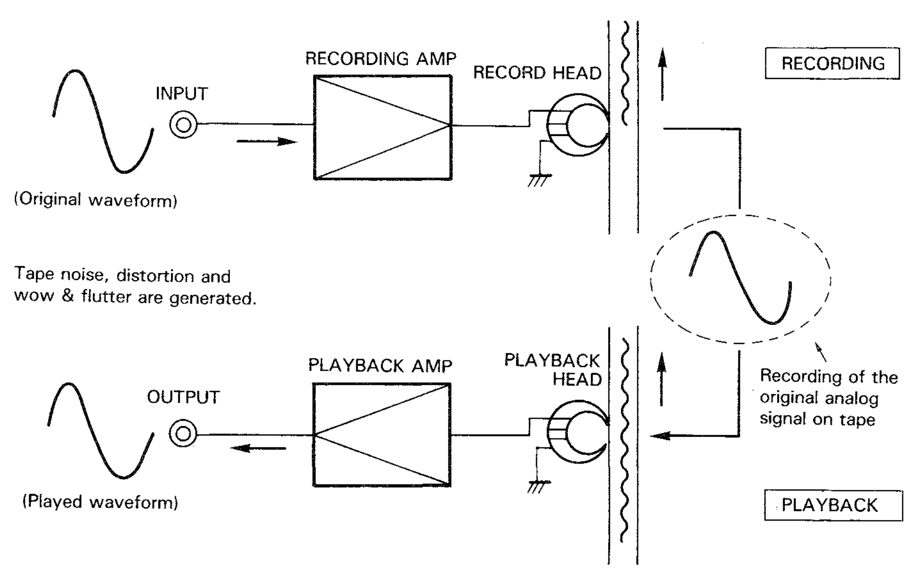
The digital tape recorders using cassettes used to be called "PCM cassette decks", "digital audio cassette recorders", etc. However, this appellation has now been unified to DAT (Digital Audio Tape) recorder, and the standard has also been unified by a DAT Conference.

In the initial development stage, there were two kinds of approaches to the DAT format. One is the stationary-head DAT (S-DAT), which can be regarded as an extension of the Compact Cassette recording format, and the other is the rotary-head DAT (R-DAT), the mechanism of which is closer to 8 mm VCRs. Although both formats have already been standardized, the development of S-DAT is far from the mass-production stage, due to the difficulty of recording 44 tracks with a narrow 0.065 mm width on a 3.81 mm wide tape. All present day consumer DAT recorders are R-DAT recorders, so the word "DAT" almost always refer to R-DAT at present.

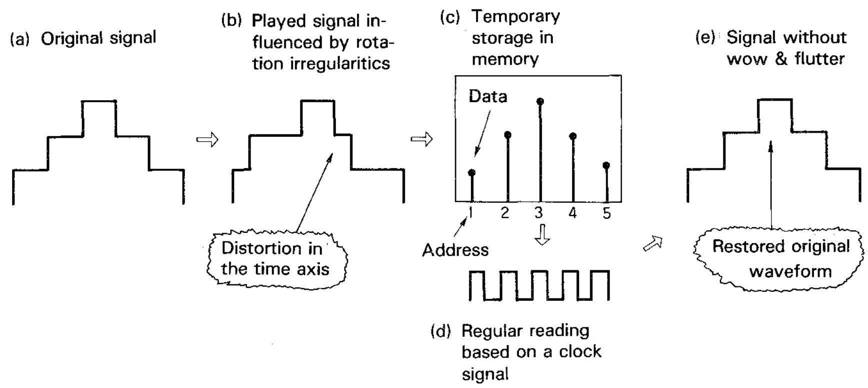
1-3. Analog recording/playback and digital recording/playback

As shown in the following diagram, analog recording records high and low signal voltages as high and low magnetic forces on tape. Its recording/playing system is very simple, and has high reliability based on a long history of actual applications. However, as the performance is always restricted by the characteristics of the tape and heads, noise and distortion are generated and observed in the played waveforms. In addition, the tape transport system is troubled with irregular rotation, causing a frequency fluctuation called "wow & flutter".

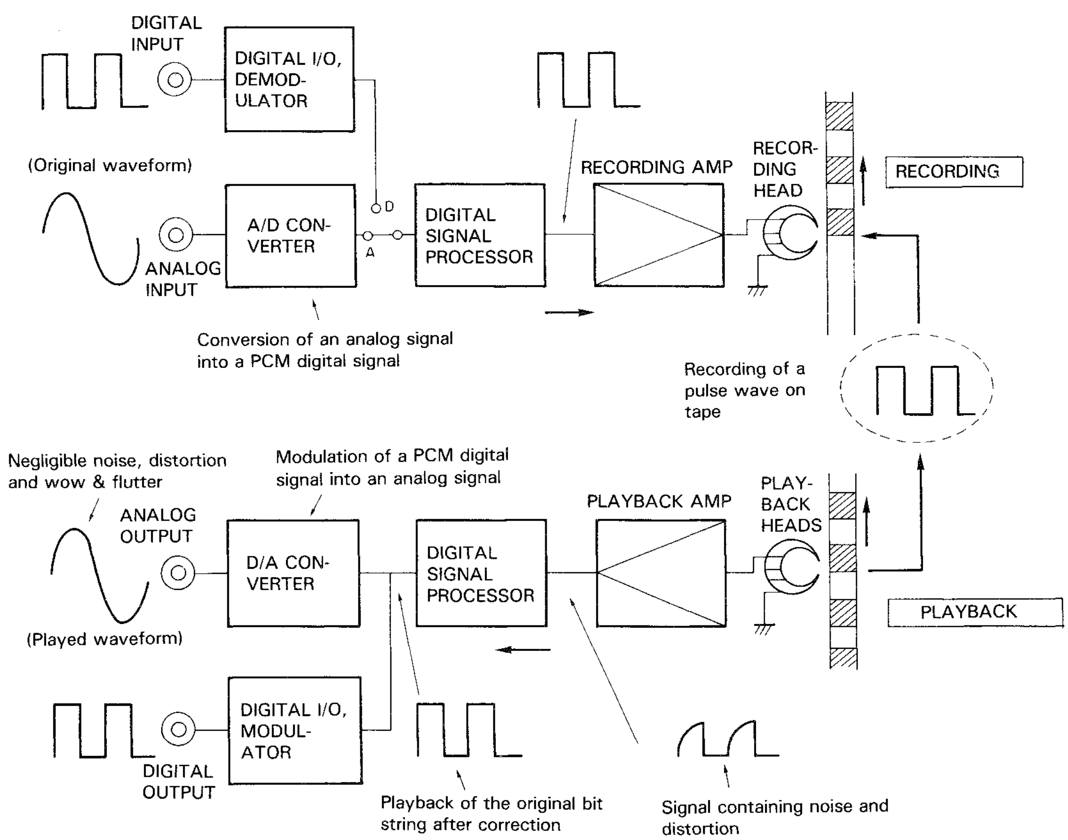
On the other hand, as shown in the next diagram, digital recording converts the analog signal into a pulse signal, which consists of a combination of "1" and "0" codes (represented by High and Low voltages) and record it on tape. For playback, the pulse signal is decoded into the original analog signal, while applying error correction as required.



Analog recording system



Elimination of wow & flutter (conceptual diagram)



Digital recording system

This system necessitates complicated circuitry including a circuit for converting an analog signal into a digital signal and a circuit for converting a digital signal into an analog signal. However, even when the pulse signal read from a tape contains noise and distortion, the original signal can be correctly restored provided that the "1" (High) and "0" (Low) are distinguishable from the pulse signal. As the data from a tape is first written temporarily in memory, which is then read out and processed at discrete intervals, wow & flutter will not be generated even if there is an irregula tape transport motor rotation.

In addition, the digital signals are dispersed recorded and error correction signals are recorded together with the data, so that the correct signal can be restored even if some parts of the signal can't be read out due to tape damage, dropout, etc. The DAT signal format reserves a sub-code area like the CD format, allowing the entering of information signals which improve the operation, such as random tune selection, and time display or auxiliary signals, such as still-image data.

1-4. Comparison between DAT and compact cassette

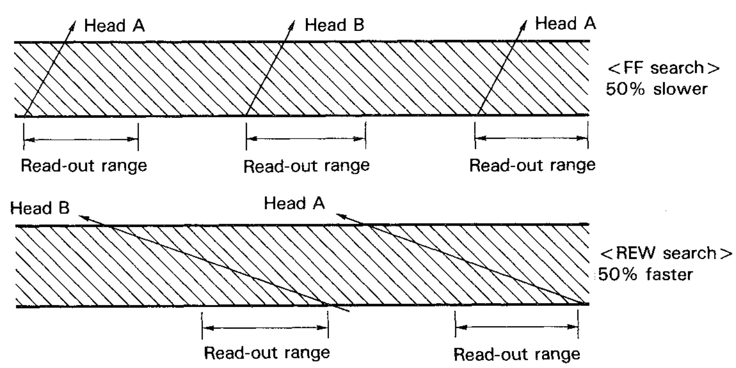
Conventional Compact Cassette tape and DAT tape use the same tape width of 3.81 mm. However, the DAT transports tape at about 1/6 the speed of a Compact Cassette, and the apparent volume of a DAT cassette is almost half that of a Compact Cassette. This small cassette allows up to 2 hours of recording using a standard tape in standard mode, up to 3 hours using thin tape in standard mode, and continuous recording of up to 6 hours using thin tape in long-play mode. DAT now uses mainly Metal tape, but it is estimated that a magnetic oxide material of barium ferrite, etc. will be used in the future.

The magnetic head systems used for the recording signal onto tape are totally different for the Compact Cassette and the DAT (more precisely, R-DAT), because the Compact Cassette uses stationary heads while the DAT uses rotary heads. The DAT heads are attached to a rotary drum just like a VCR, permanently rotating to perform helical scanning of the tape surface. Helical scanning is applied in order to record/play high frequencies, up to a few megahertz, by increasing the relative speed between the tape and each head. Although the DAT tape speed is about 1/6 that of a Compact cassette, its relative speed to the heads is about 66 times higher (two heads are mounted, at 180° opposite positions, on a drum rotating at 2000 rpm).

When their performances are compared, we first notice that the DAT has a much superior dynamic range than the Compact Cassette. (For the following description, also refer to the accompanying Comparison Chart.) A Compact Cassette offers a dynamic range of about 60 dB for the medium frequencies without noise reduction, and the figures for the high and low frequencies are lower than this. Even with Dolby C NR engaged, the limit is about 80 dB for the medium frequencies. On the other hand, the DAT dynamic range is more than 90 dB without noise reduction, and maintains nearly 96 dB over all of the audible frequency range. The left and right channel separation is also nearly 96 dB at all bands making crosstalk negligible, and the influence of wow & flutter is also eliminated with DAT.

A cassette tape recorder can not perform inter-track jumps (random access) like a CD player, and the time required to searching for any program is long. While a DAT recorder can not perform track jumps like CD a player, it is capable of high-speed searching at a maximum of 200 times the normal speed. It may not be as fast as a CD player, but it is incomparably faster than a Compact Cassette recorder, because a whole 2-hour tape can be searched in about 40 seconds.

■ During a search, the heads trace the signal-recorded surface, and the relative speed between the heads and the tape varies by 50% with reference to normal transport speed.



■ To maintain the same relative speed between the tape and heads as in normal transport, the head rotation speed, which is 2000 rpm in normal transport, is switched to 3000 rpm for a FF search and to 1000 rpm for a REW search. This ensures correct reading of the subcode information.

		DAT	Compact Cassette
Sound Quality	Recording Format	Digital	Analog
	Frequency Response	5 ~ 22,000 Hz	40 ~ 18,000 Hz (Metal)
	SN Ratio	More than 96 dB	68 dB (Dolby B)
	Distortion	Less than 0.005%	0.3% (−20 dB)
Cassette Tape	Size	73 x 54 x 10.5 mm	102.4 x 63 x 12 mm
	(Volume Ratio)	(54%)	(100%)
	Recording Time	2 hours (one-way)	Max. 2 hours (two-way)
Search	Speed	200 times normal	20 times normal
	Passing Time per Tune (3 min.)	About 1 second	About 9 seconds
Transport Speed	Tape Speed	0.815 cm/sec	4.75 cm/sec
	(Relative Speed)	(3.133 m/sec)	(−)

Compact cassette and DAT comparison chart

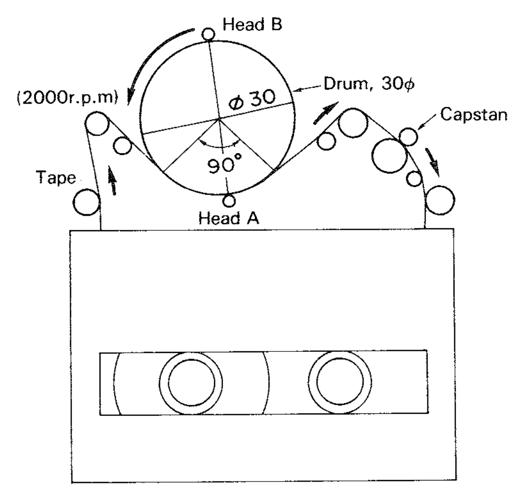
1-5. Comparison between DAT and CD

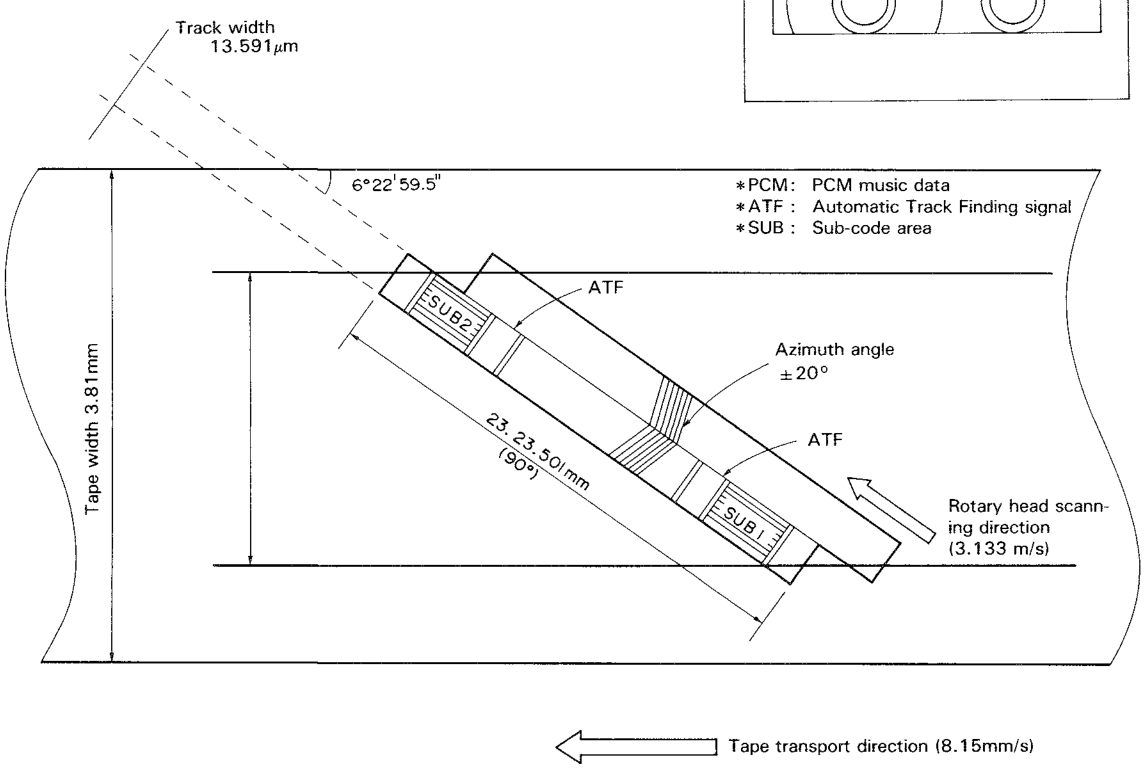
DAT and CD (Compact Disc) feature similar dynamic range and stereo separation levels. However, the sampling frequency (This determines the number of samplings for analog-to-digital conversion. The higher the sampling frequency, the higher the audio frequency that can be handled.) used by DAT is 48 kHz, which is higher than the CD sampling frequency of is 44.1 kHz. This gives DAT a wider reproduction frequency range, because it is capable of handling audio frequencies up to 22 kHz, which is 10% higher than CD. The next advantage of DAT is that it is usable for both recording and playback (there are also play-only car DAT players) while CD is playback-only. The DAT cassette is small and easy to carry, and the maximum recording time of a DAT is 2 to 3 hours, while that of a CD is 74 minutes 42 seconds. With a higher data transmission speed and a sub-code capacity 4.6 times more than CD, DAT can contain various types of sub-code information in addition to the hi-fi music signal, such as calendar information, catalog No. information, etc.

DAT has also its weak point. CD uses non-contact signal tracing with laser light, while DAT uses a contact tracing system which can cause tape wear problems. However, DAT uses a smaller tape wrapping angle than a VCR, and its error correction system can cover a certain degree of increase in dropouts. Therefore, DAT is capable of more than about 1000 recordings or playbacks, and there is no great practical problem estimated with respect to the tape life.

1-6. Actual DAT signal recording/playback system

The following diagram shows the actual signal recording/playback system of a DAT, with which a signal is written onto/read from a tape using rotary heads like, in a VCR (helical scanning). Two heads, A and B, rotate with the drum and alternately read signals from the tape. As the azimuth angles of the heads are provided with a difference of ±20°, data readout error caused by crosstalk from the adjacent tracks is eliminated. This system is called the guard band-less azimuth recording system. The Compact Cassette recording format erases the old audio signal on tape before recording a new signal on it, but DAT uses a recording wave band that allows recording of a new audio signal without erasure (overwriting).





Schematic diagram of signal recording on tape surface

The DAT format records the following three kinds of data on tape.

1. PCM (PCM music data)

Music data digitally codified by PCM (Pulse Code Modulation).

2. SUB (Sub-code)

Address, search and time control signals. The CD format also has a sub-code area, but the DAT sub-code area is 4 times larger than CD.

3. ATF (Automatic Track Finding signal)

This signal adjusts the tracking automatically. Accurate tracing of the heads on the recorded tracks is essential for signal playback in the helical scanning system such as for DAT and VCR (signals are recorded obliquely, and a very small tracking error will considerably degrade the playback quality). To facilitate tracking in playback, DAT records the ATF signal, which is the test data for tracking error detection, together with the digital audio signal. This has eliminated the need for a control head like in a VCR, and DAT has no tracking control function like the VCR.

Variation of DAT modes

Function	Both Recording and Playback				Playback-Only (Recording impossible)	
Mode Name	Mode I	Mode II	Mode III	Mode IV	Mode V	Mode VI
Characteristic	Standard R-DAT mode	Option modes			2 hours (13 μm) or 3 hours (10 μm) of playback	Wide-track format. Compatible with contact printing and suitable for mass-production.
		Compatible with satellite broad-casting mode A	Long-play mode (twice the standard mode)	4-channel mode		
Sampling Frequency	48 kHz	32 kHz			44.1 kHz	
Upper Limit Played Frequency	22 kHz	15 kHz			20 kHz	
Quantization Bits	16-bit linear	16-bit linear	12-bit non-linear (13 polygonal lines)		16-bit linear	
Number of Channels	2 channel	2 channel	2 channel	4 channel	2 channel	
Transmission Rate	2.46 Mbits/s	2.46 Mbits/s	1.23 Mbits/s	2.46 Mbits/s	2.46 Mbits/s	
Sub-code Capacity	273.1 kbits/s	273.1 kbits/s	136.5 kbits/s	273.1 kbits/s	273.1 kbits/s	
Recording Time, Tape Thickness	2 hours/13 μm 3 hours/10 μm	2 hours/13 μm 3 hours/10 μm	4 hours/13 μm 6 hours/10 μm	2 hours/13 μm 3 hours/10 μm	2 hours/13 μm 3 hours/10 μm	80 minutes/13 μm 120 minutes/10 μm
Type of Tape	Metal tape	Metal tape			Metal tape	Oxide tape
Tape Speed	8.15 mm/s	8.15 mm/s	4.075 mm/s	8.15 mm/s	8.15 mm/s	12.225 mm/s
Track Width	13.591 μm	13.591 μm			13.591 μm	20.41 μm
Track Interval	13.591 μm	13.591 μm			13.591 μm	20.41 μm
Track Angle	6°22 59.5°	6°22 59.5°			6°22 59.5°	6°23 29.4°
Head Rotation Speed	2000 rpm	2000 rpm	1000 rpm	2000 rpm	2000 rpm	
Relative Speed	3.133 m/s	3.133 m/s	1.567 m/s	3.133 m/s	3.133 m/s	3.129 m/s
Linear Bit Density	61.0 kbits/inch	61.0 kbits/inch			61.0 kbits/inch	61.1 kbits/inch
Surface Bit Density	114 Mbits/inch²	114 Mbits/inch²			114 Mbits/inch²	76 Mbits/inch²

As shown in the accompanying table, the R-DAT format consists of 6 modes in 3 groups, i.e. standard mode (Mode I), option modes (Modes II to IV) and playback-only modes (Modes V and VI). However, all DAT recorders do not have to be compatible with all modes, and the modes selected vary depending on the manufacturers and models.

- **Mode with priority on sound quality = Mode I (Standard mode)**

Mode I is the standard R-DAT mode, and features a 48 kHz sampling frequency and 16-bit linear quantization for the highest sound quality of all modes. It is comparable to CD. Unless otherwise specified, most references made to R-DAT are related to this mode.
Mode I is used in the widest applications, including live recording, analog dubbing, digital recording of Mode B satellite broadcasting (high sound quality mode), playback of ultra-high quality DAT prerecorded tapes recorded with 48 kHz sampling, etc.

- **Mode compatible with satellite broadcasting mode A = Mode II**

To be compatible with satellite broadcasting mode A, R-DAT mode II uses a 32 kHz sampling frequency, which is lower than the standard mode 48 kHz sampling frequency. This reduces the upper limit frequency from 22 kHz of Mode I to 15 kHz, but the other characteristics are the same as for standard Mode I.

- **Long-play mode with half-speed recording/playback = Mode III**

Mode III puts more importance on quantity than quality. Long-play mode provides twice the recording time of standard mode, with half the tape transport speed and head rotation speed. While the long-play mode of an 8 mm VCR is achieved by halving the track width, the DAT halves the tape and head speeds, thus maintaining the same track width.
This mode allows 4 hours of stereo recording on a 2-hour tape, and 6 hours of stereo recording on a 3-hour tape. However, the sound quality is not as high as for standard mode, because the sampling frequency is 32 kHz, the upper limit frequency is 15 kHz, and the quantization is 12-bit non-linear (equivalent to 13-bit). This mode is most suitable for off-the-air recording of FM broadcasts, etc.

- **4-channel recording/playback mode = Mode IV**

Mode IV also puts priority on quantity over quality. This mode provides a signal quality of the same grade, but its feature is the doubled number of channels instead of a doubled recording time. This makes possible discrete, 4-channel recording and playback with the same recording time as standard Mode I.

- **Playback-only, prerecorded-tape mode = Modes V/VI**

Modes V and VI are provided exclusively for playback of prerecorded DAT music tapes. To allow the use of CD master tapes for prerecorded DAT tapes, these modes use the same 44.1 kHz sampling frequency, 20 kHz upper limit frequency, and 16-bit linear quantization as the CD format. However, these modes are playback-only because of the copy guard function provided to inhibit digital dubbing of CDs and prerecorded DAT tapes. The difference between the two modes lies in the fact that Mode V has been designed for head-to-head type music tapes and Mode VI has been designed for contact-printed tapes.

1-7. Construction of a DAT cassette

1. Compact, hermetic structure

A DAT cassette has a compact size of 73W × 54H × 10.5D mm, almost half that of a Compact Cassette. It features a hermetic structure as shown in Figure, which is similar to VCR cassettes. The front of the tape is covered by a "lid", and the hub holes on the bottom of the cassette are covered by a "slider". The tape and hub holes are not exposed unless the cassette is inserted into a recorder, so the tape is protected from being stained by fingerprints or from penetration of dirt and dust.

2.

When a DAT cassette is inserted into a deck, the slider lock pins are pushed, sliding the slider and exposing the hub holes, and the cassette is positioned on the reel hubs. The lid is opened at the same time, the tape is pulled out of the cassette by two guides, and it is then wrapped around 90° the rotary drum.
After this, the tape is transported at 8.15 mm per second, that is 1/6 the speed of a Compact Cassette, and the signals are recorded or played using heads rotating at 2000 rpm. It can perform a high-speed search at 200 times the normal speed as required.

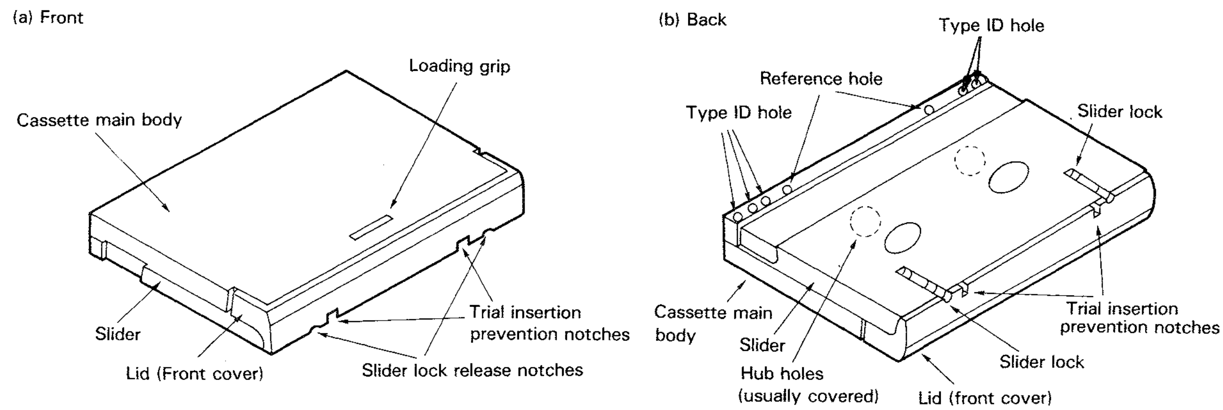
3. Automatic tape identification

The DAT cassette is equipped with a cassette type ID hole on the bottom. When the cassette is inserted into a deck, the deck automatically detects whether the recording time is 2 hours or 3 hours, and whether the track width is normal or wide (Mode **VI**). It is then automatically switched to the corresponding mode.

4. Metal or oxide magnetic tape material

The R-DAT tape has the same tape width of 3.81 mm, as a Compact Cassette, and the length is about 60 meters for a 2-hour tape and about 90 meters for a 3-hour thin tape.

To record and hold a high-frequency signal of nearly 5 MHz, DAT uses Metal tape with a high coercive force and recording density. However, the Mode **VI** contact-print system has been designed for oxide tapes, such as barium ferrite tape and chrome dioxide tape, because they allow for easy transfer while providing as high a recording density as Metal tape.
Similar to high-grade VCR tapes, the magnetic material surface is processed with a special treatment for improved head contact and durability, and the back side is processed by a back-coating for improved tape transport. The tape life is estimated to be more than 1000 passes provided that the deck is normal, so it is virtually not necessary to worry about it.



Structure of a DAT tape

1-8. DAT glossary

4-channel mode

The standard DAT mode features 48 kHz sampling, 16-bit quantization and 2-channel stereo, while 4-channel mode uses 32 kHz sampling and 12-bit quantization for increased 4-channel operation.

AD (Analog-to-Digital) converter

This is a circuit which converts an analog signal into a digital signal by alternating sampling and quantizing operations.

Analog signal

This is the usual form of signals which is continuous in terms of time.

ATF (Automatic Track Finding) signal

This signal is used as the guide for DAT tracking. The tracking servo operates in reference to this signal, so that the heads scan tracks accurately.

Azimuth

When this word is used with tape recorders, it refers to the angle with respect to the line perpendicular to the tracking direction (head scanning direction).

Azimuth close recording

The playback sensitivity of a DAT recorder drops considerably with a different track azimuth. Therefore, by providing different azimuths for the two rotary heads, the problem of crosstalk (signal leakage from an adjacent track) is solved, so that all tracks can be arranged with no spaces between them, improving the tape recording density.

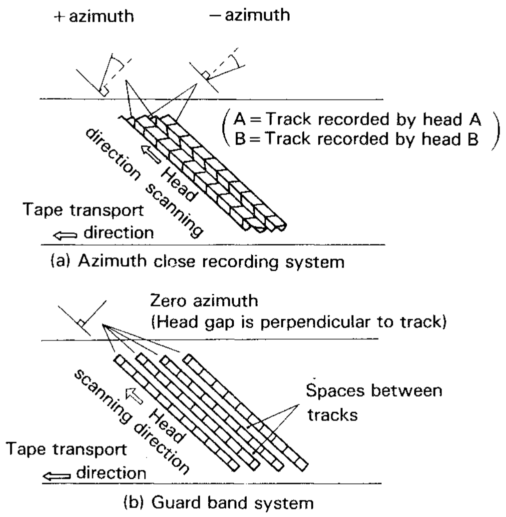


Fig. 1 Azimuth close recording

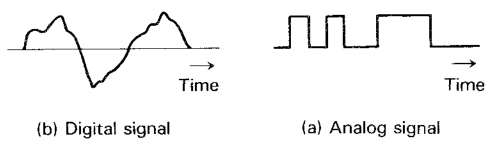


Fig. 2 Analog signal and digital signal

Bit

"Bit" is the abbreviation for "binary digit". It means either one digit of a binary number represented by a 0 or 1, or the maximum amount of data contained by a binary number, i.e. the number of digits.

Bit error rate

A bit error is a mistake between a 1 and a 0 of the data. The bit error rate refers to the percentage of bit error count in the entire bits of a signal.

Bit rate

This is an alternative term for the bit transmission rate or simply the transmission rate. For details, refer to the "Transmission rate" description.

Byte

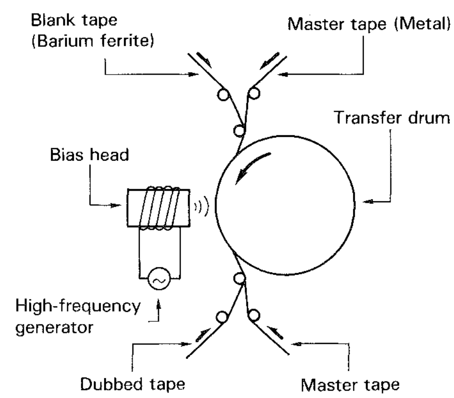
This indicates the unit of digital signal handling, which is 8 bits. The use of this term was started by IBM Corporation and has expanded among the industry and the public in general.

Clock pulse

This is the pulse at constant intervals used in digital circuits to ensure synchronization between signals. It can be considered as "orders" released for the timing of digital signal exchanges and other operations.

Contact printing

A high-speed DAT tape dubbing system utilizing the "transfer" characteristic of tape. A metallic master tape is prepared with signals recorded inversely (geometric mirror symmetry). Its magnetic surface is put into contact with the magnetic surface of a blank tape with oxide material, and the signals on the master tape surface are transferred at a high speed of 200 to 300 times the normal dubbing speed. To improve the efficiency of transfer on oxide tape, high-frequency biasing is applied to barium ferrite tapes and heat is applied to chrome dioxide tapes.



DA (Digital-to-Analog) converter

This circuit converts a digital signal into an analog signal by replacing each digital value with a corresponding voltage or current.

DAT (Digital Audio Tape)

A general term for tape recorders which digitize and record/reproduce audio signals. The greatest feature of DAT is that there is almost no sound quality degradation after repeated dubbings, thanks to the digitized signal handling. DAT is roughly classified into rotary-head R-DAT and stationary-head S-DAT. When referring to an appliance, DAT is more appropriatly called a DAT deck, DAT recorder or DAT player.

Digital output

Output terminals on a digital audio component which are used exclusively for supplying a digital signal. The DAT digital output signals are modulated in compliance with the signal format for consumer electronic equipment, and are compatible with the digital outputs of a CD player or BS tuner.

Digital signal

Unlike an analog signal which is continuous, a digital signal refers to a discrete signal, the parts of which can be counted individually.

Drum servo
This is the servo for controlling the motor driving the rotary drum on which the recording/reproducing heads are mounted. The rotation speed is fixed at 2000 rpm for normal reproduction.

EFM (Eight-to-Fourteen Modulation)
This modulation method is used with CD to facilitate the readout of disc signals. This method is called EFM (8-to-14 converted modulation) because it divides each 16-bit data segment into 8 bits + 8 bits, converts them into 14 bits + 14 bits, and then records these onto the disc. In playback, the 14-bit + 14-bit signals are converted back to 8-bit + 8-bit signals, which are restored to the original 16-bit data segment.

Error correction and error compensation
The DAT format records a signal used for error correction together with the digital audio signal, so it is capable of restoring the original signal in spite of possible readout or transmission errors.
"Error correction" refers to the complete restoration of the original analog signal from a digital signal containing errors. When complete restoration is not possible, the data before the lacking data is used (previous value hold), or the data before and after the lacking data is averaged to obtain the lacking data (averaging interpolation). These approximate restoration methods are referred to as "interpolation".

ETM (Eight-to-Ten Modulation)
This modulation method is used with DAT to facilitate the readout of tape signals. This method is called ETM (8-to-10 converted modulation) because it divides each 16-bit data segment into 8 bits + 8 bits, converts them into 10 bits + 10 bits, and then record these onto the tape. In playback, the 10-bit + 10-bit signals are converted back to 8-bit + 8-bit signals, which are restored to the original 16-bit data segment.

Interleaving
This is a process for dispersing digital signals based on a specified arrangement, and is designed to convert burst errors (sizable lack of signal) into random errors (intermittent lack of signal). Inversely, the process of rearranging the dispersed signals into the original sequence is called de-interleaving.

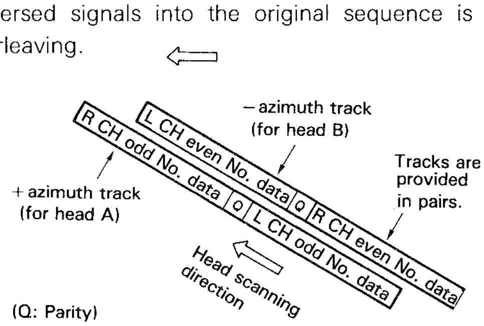


Fig. 3 R-DAT interleaving format

Micron (μm)
1/1000 of a millimeter. Therefore, 1000 μm equals 1 millimeter. The DAT track width is 13.591 μm, or 0.013591 mm, in standard mode.

Overwriting
DAT does not use an erase signal to eliminate the old signal before writing a new signal. It simply overwrites the new signal with a strength that saturates the tape, so that the old signal is replaced automatically.

Oxide tape
Tapes dubbed by contact printing must have a smaller coercive force (force to maintain a magnetized status) than the Metal tapes used as a master tape. Therefore, prerecorded DAT music tapes produced by contact printing use oxide tapes, such as barium ferrite tape and chrome dioxide tape, which feature a smaller coercive force than Metal tapes and the excellent high-frequency characteristics equivalent to Metal tapes.

PCM (Pulse Code Modulation)
This is an A-D conversion method, with which an analog signal is converted into binary pulse codes corresponding to the amplitude.

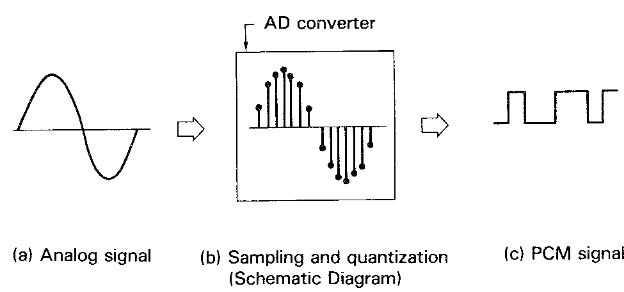


Fig. 4 PCM signal

Quantization
This is the process for comparing sampled voltages with a reference voltage and converting them into digital values. The voltage values are usually converted into binary values.

R-DAT
Refer to the "Rotary-head DAT" description.

Random error
Contrary to a burst error which consists of a sizable lack of signal, random error means an intermittent lack of signal.

Rotary drum

Two recording/playing heads, referred to as head A and head B, are mounted on a 2-story drum, the lower half of which is fixed and the upper half of which rotates. The drum surface is installed at a particular angle with respect to the tape transport direction, so that helical scanning on the tape surface is performed, recording the signals on oblique, stripe-like tracks.

Rotary-head DAT (R-DAT)

DAT must record data with a high density of several megabits per second. To increase the bit density by increasing the relative speed between the tape and heads, it uses the same helical scanning system using rotary heads as a VCR. The rotary-head DAT is usually abbreviated as R-DAT.

Rotary heads

These are the two recording/playing heads mounted on the rotary drum, and are called head A and head B.

S-DAT

Refer to the "Stationary-head DAT" description.

Sampling

This is the signal process with which instantaneous voltages are picked up from an analog signal for use as samples.

Sampling frequency

This is the inverse of the sampling interval period, or, in other words, the number of sampling operations per second. The higher the sampling frequency, the finer the sampling and the higher the upper limit frequency that can be handled. DAT uses three sampling frequencies; 48 kHz, 32 kHz and 44.1 kHz.

Servo

A servo is the automatic correction function which permanently monitors a target and correct its movement any time it seems to deviate from a specified course. DAT uses a drum servo, which controls the rotary drum on which the heads are mounted, and a capstan servo which controls the tape speed. Tracking is controlled by varying the tape speed slightly.

Stationary-head DAT (S-DAT)

This is the DAT format enabling high-density recording using multi-track stationary heads, without rotating the heads. The stationary-head DAT is usually abbreviated as S-DAT.

Sub-codes

Sub-codes are auxiliary signals independent of the music signal, containing information for the user's convenience. DAT sub-code capacity is about 4.6 times larger than CD, and contains various types of information, such as TOC (Table Of Content) data, absolute time data for time search, tune No. and index No. data, playing time data, date data, catalog No. data, etc.

Time-axis compression and time-axis expansion

A digital signal is composed of a series of data segments arranged at the same interval as the sampling interval. As there is nothing between adjacent data, the spaces between the data can be compressed before recording without spoiling any information. When the compressed signal is read out, it can be expanded and restored to the original signal. The process for compressing the data intervals and recording time is called time-axis compression, and that for expanding the compressed data intervals to the original intervals is called time-axis expansion.

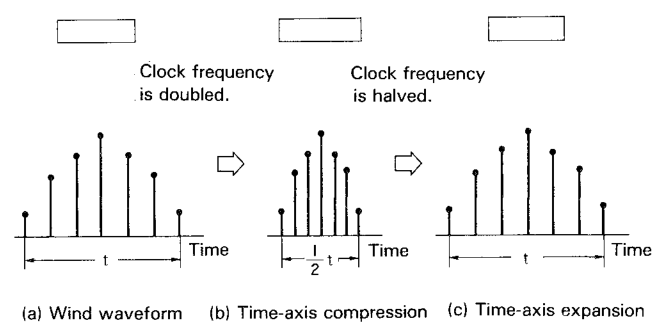


Fig. 5 Schematic diagram of 1/2 time-axis compression

TOC (Table Of Contents)
This is the indexing information for the number of tunes, total playing time and start position of each tune on a tape. The TOC area of a CD is provided separately from the music signal area, but the TOC of a DAT is recorded in the sub-code area.

Track
This term has two meanings. One is the trace on a tape left by the scanning of the heads. The other refers to each program, or tune, on a tape. The number of each tune is called the Track No.

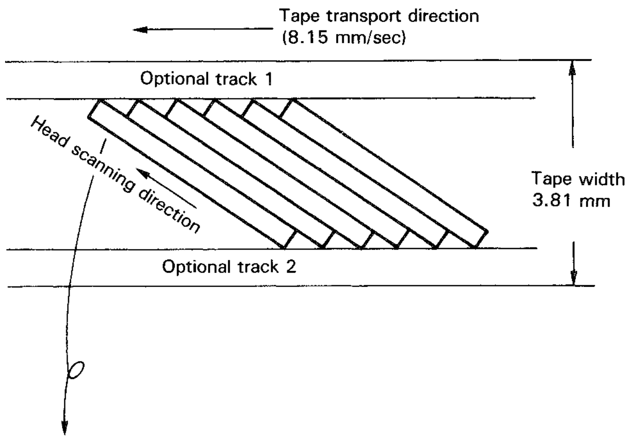
Tracking servo
This is the servo for scanning the helical tracks on a tape with rotary heads. R-DAT controls the tracking by adjusting the tape speed based on the ATF signals detected.

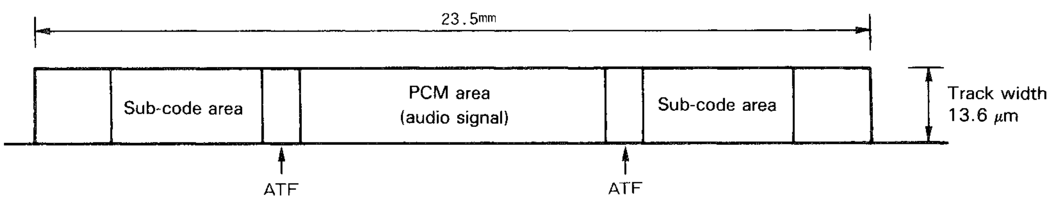
Transmission rate
This is the maximum number of bits that can be transmitted (read/written) in 1 second, and is also called the bit rate. The average transmission rate of R-DAT is 2.46 Mbits/sec, but, since 1/2 time-axis compression is applied before recording, the digital signal is actually recorded with a transmission rate of 4.92 Mbits/sec.

Wide track
Tapes dubbed by contact printing are magnetized less strongly than those recorded using ordinary heads. To prevent degradation of the S/N ratio due to this weak magnetism, the tracks on tapes dubbed by contact printing are 1.5 time larger than standard mode. "Wide track" refers to such a track, with reference to the normal track used in standard mode.

2. DAT TAPE

2-1. Track format





With the helical scanning DAT recorder, the heads rotate at a high speed and record signals obliquely with respect to the tape transport direction.

The DAT tracks are divided as shown in the figure, and the audio signals converted into digital signals are recorded in the PCM area.

The ATF (Auto Track Finding) signals are recorded on both sides of the PCM area. The ATF signals insure stable tracking for the rotary heads, making the DAT recorder more resistant to vibrations than conventional Compact Cassette recorders.

The sub-code areas are reserved on the outer sides of the ATF signal areas. The sub-code areas are used to record various information, such as the signal used in high-speed search, track No. and time information.

2-2. Sub-codes

As described in "Track Format", the signals recorded on DAT tape includes sub-codes, which are auxiliary signals containing information for the user's convenience in music search and other operations.

Sub-codes used with the KDT-99/99R

Start ID: Identifies the start of each program. Used for locating the beginning of tune in search (MS, PNO), IND.S and Repeat-1 operations. These operations are not available unless the start IDs are recorded on tape.

Program No.: (PNO) Indicates the number of each program. Used in the PNO search operation. PNO search cannot be set unless the PNOs are recorded on tape.

Total time: Information on time elapsed from the beginning of the tape. If the total time display is activated while the total time sub-codes are not recorded on tape, the running display will appear in place.

Program time: Information on time elapsed from the beginning of each program. If the program time display is activated while the program time sub-codes are not recorded, the running display will appear in its place.

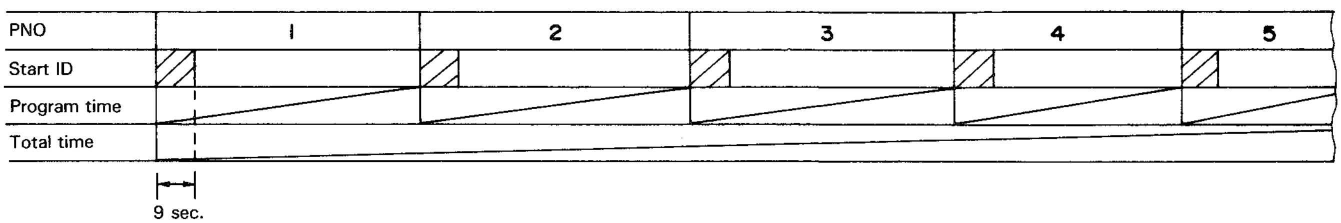
There are also other sub-codes that are not used with the KDT-99, such as the skip ID which is used to skip the program until the next start ID. In total, the DAT has a sub-code capacity of about 4 times larger than CD, and its applications are estimated to be widened in the future.

Sub-code recording formats

Sub-codes are recorded in various formats depending on the recorders, and the display of the KDT-99 also varies depending on the sub-code recording formats on tape as follows.

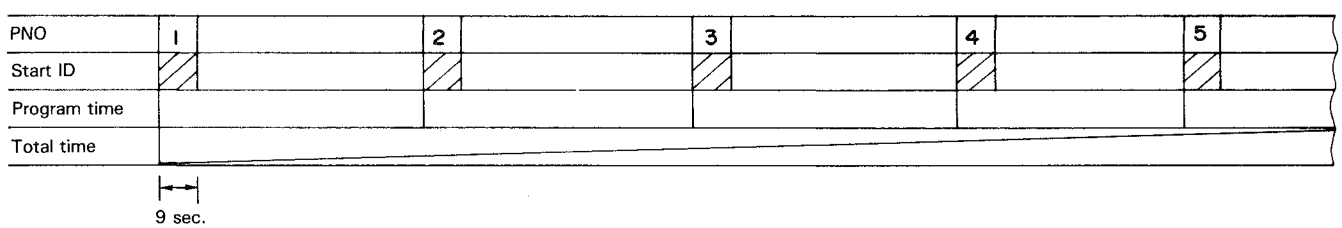
a) When the tape contains the program No., program time and total time in the required positions:

The KDT-99 display shows the PNO, total time and program time immediately after the cassette is inserted. This information is also displayed during FF, REW and search operations.



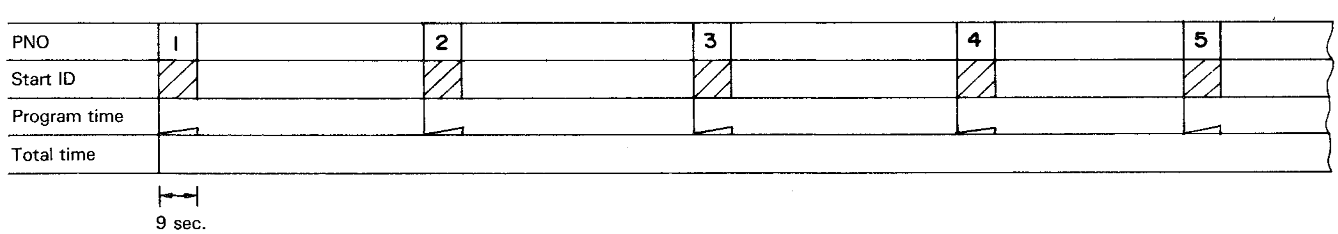
b) When the tape contains the PNO for only the first 9 seconds of each program, and the total time is recorded throughout the tape, but the program time is not:

The KDT-99 display shows the PNO, total time and program time only if the tape is positioned within the first 9 seconds of a program when the cassette is loaded. In other cases, when the cassette is inserted, the display does not show the PNO and shows the running display in place of the program time. The PNO will be displayed after passing the start of a program, and the program time will be displayed only after pressing the start of a program in play mode.



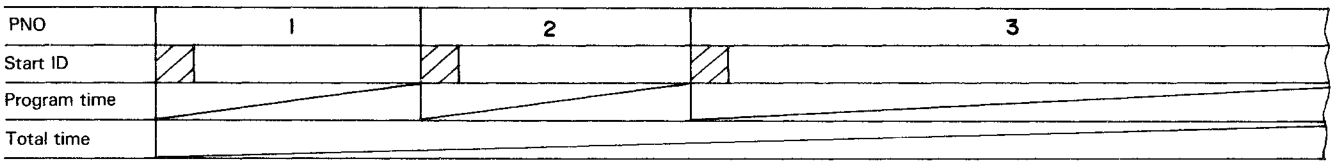
c) When the tape contains the PNO and program time for the first 9 seconds of each program, but does not contain the total time:

The KDT-99 display shows the PNO and program time if the cassette is inserted with the tape positioned within the first 9 seconds of a program, but in any case shows the running display in place of the total time. When the cassette is inserted with the tape not positioned within the 9 seconds, the display does not show the PNO and shows the running display in place of the program time. The PNO will be displayed after passing the start of a program, and the program time will be displayed only after pressing the start of program in play mode.

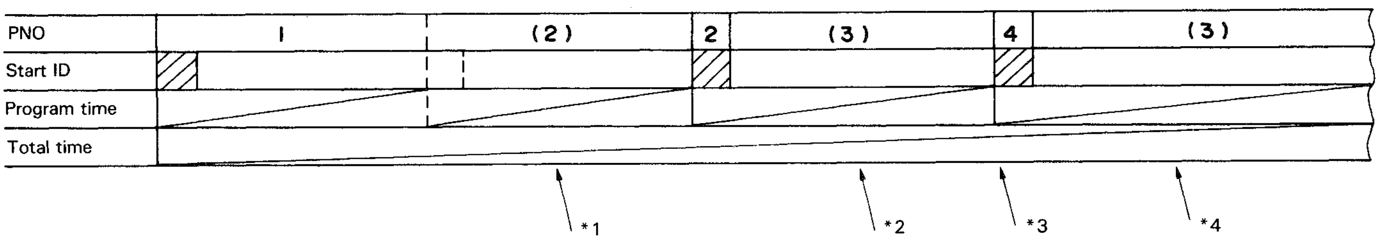


Re-recording the sub-code area

The sub-codes of DAT can be re-recorded or erased without affecting the audio signal. When a tape containing re-recorded sub-codes is inserted into the KDT-99, the display content could slightly differ from the actual content; this is because the sub-codes are re-recorded only for the first 9 seconds of each program.



Assume that the above sub-codes are re-recorded as follows.



*1: When the cassette is inserted with the tape in this position, the PNO is "2" and the program time is the time before re-recording.
When the playback is canceled during FF or REW, the program time is also the time before re-recording.
The PNO after re-recording is displayed when the beginning of a program is passed (in any mode including FF, REW, search and play) for the first time after the cassette insertion.

*2: When the cassette is inserted with the tape in this position, the PNO is "3" similarly to *1, and the program time is correct because it is the same before and after re-recording.

*3: When the cassette is inserted with the tape in this position, the PNO is "4" and the program time is the time after re-recording. However, if FF is started from this position, the program time becomes the time before re-recording.

*4: When the cassette is inserted with the tape in this position, the PNO is "3" and the program time is the time before re-recording. To display the re-recorded PNO and program time, search the beginning of the current program using "-00" search.

Note:
If the PNO search is activated while the PNO- before-re-recording is displayed after cassette insertion, the search may take more time than usual. For smooth search operations, it is recommended to search the beginning of the current program by the MS search immediately after insertion in order to display the re-recorded PNO before starting the search.
Similarly, when Repeat 1 is activated while the PNO-before-re-recording is displayed, the current program may not be repeated correctly. In this case, too, display the re-recorded PNO using the MS search before starting Repeat 1.

2-3. Sampling frequencies and quantization bits

The DAT can use the following combinations of sampling frequencies and quantization bits to digitize analog audio signals.

48 kHz/16-bit (linear) : Used by recording with ordinary DAT recorders.

44.1 kHz/16-bit (non-linear) : Used in pre-recorded DAT music tapes available commercially. DAT users can use this combination only in playback.

32 kHz/16-bit (linear) : Used for recording digital signals of satellite broadcasts.

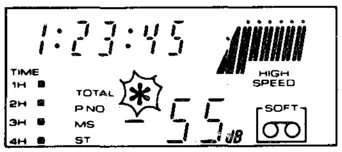
32 kHz/12-bit (non-linear) : Long-play mode recording (at half the normal speed).

Caution:
The KDT-99 cannot play tapes recorded with 12-bit non-linear quantization. When such a tape is inserted, the PNO display shows "E" and no sound will be reproduced.

Notes on condensation and temperature

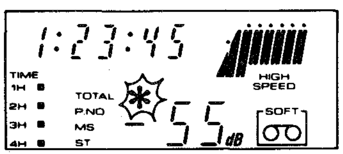
Condensation

- When the heater is operated at high speed to heat up a cold car compartment, or when there is vapor or high humidity inside the compartment, dew may be produced on the windshield and other glass surfaces. This phenomenon is called condensation. At this time, dew may also be produced inside this unit.
  If condensation occurs, the tape may stick to the internal parts, causing a malfunction, or even damage to the tape or the internal parts.
  To prevent this, this unit is equipped with a condensation prevention mechanism.
- When condensation occurs, the built-in protection mechanism operates, causing the buzzer to beep twice and the "*" indicator to light on the display. If a cassette is inside the unit at this time, it is ejected, and a cassette cannot be inserted until the "*" indicator goes off.
  If the "*" indicator is lit, the built-in heater is operating to dry up the internal condensation. When the "*" indicator goes off, it is recommended that the unit be left for about an hour, depending on the ambient condition.
- Condensation progresses gradually in most cases. Even when the temperature and humidity in the compartment changes suddenly, the "*" indicator sometimes lights only after a delay of 10 to 15 minutes. Therefore, after a sudden temperature or humidity change, wait for more than 20 minutes to check that the "*" indicator does not light before using this unit.



Temperature

- When a closed automobile is left under direct sunlight, its internal temperature rises to a very high degree. If it rises above 65°C (150°F), the built-in protection circuitry of this unit operates, causing the "*" indicator to light on the display. If a cassette is inside the unit at this time, it is ejected, and a cassette cannot be inserted until the "*" indicator goes off. In this case, operate the air conditioner or drive the car with the windows open, to cool the compartment before using this unit.



Tape handling precautions

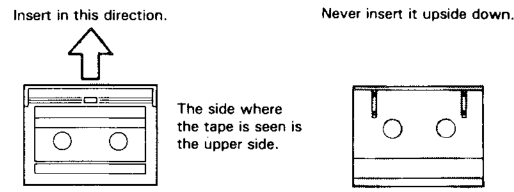
DAT cassette tape

The DAT cassette is only half the size of a conventional compact cassette, and is hermetically designed to prevent penetration of dust.
It is played back in only one direction.

■ Cautions on the use of DAT cassette tapes

To enjoy the superior sound quality of digital audio, observe the following cautions.

- When a cassette is brought from a cold location into a warm car, dew may condense on the tape surface. As the tape could be damaged if it is played with dew on its surface, leave the cassette at the ambient temperature and wait until the condensation disappears (about an hour).
- The DAT cassette is always played on one way, and cannot be played upside down.



- Never attempt to disassemble a DAT cassette, as it is a precision device.
- Do not attempt to open the tape lid, pull out the tape, or touch the tape with your finger.
- Do not repeatly insert and remove a cassette without playing it, otherwise the tape may become slack or could be damaged.
- Do not use a cassette which has its' label partially peeled off, otherwise a malfunction or damage could result.

Cautions on the storage of DAT cassette tapes

- Store a DAT cassette in its case.
- Avoid storing it in a dirty or dusty place.
- Avoid places exposed to direct sunlight, near a heat source such as a heater, or where it is damp.
- Never leave the cassette on the dashboard of a car or on the parcel shelf under the rear window.
- Avoid magnets and other sources of magnetism (speakers, TVs, transformers, motors, etc.), or your precious recording content could be lost.
- After use, rewind the tape before storing. If the tape is not properly rewound or is disordered, it could be damaged during storage.
- Do not drop the tape or apply a strong vibration to it.

Controls and indicators

[DAT]: Operation or display in Tape mode
[TUNER]: Operation or display in Tuner mode

[DAT]: Search Up (⊳⊳|)/Down (|⊲⊲) switch
Switches the search direction between upward and downward.
[TUNER]: Auto tuning Up (⊳⊳|)/Down (|⊲⊲) switch
Press Up switch for up seek operation.
Press Down switch for down seek operation.
Seek operation automatically stops when a marginal broadcast is received.

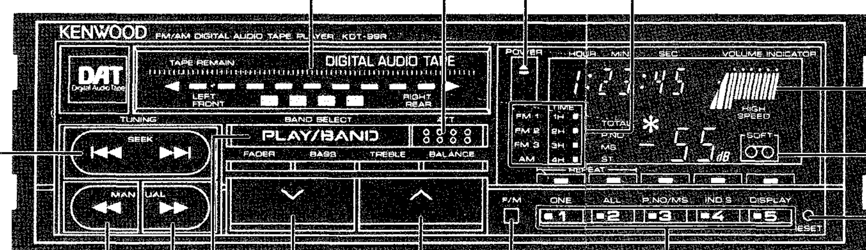
[DAT]: Tape slot
When a cassette is inserted, it is automatically loaded, and playback starts. To engage key OFF eject, turn ignition key to OFF position and the tape is automatically ejected.

Attenuator switch
When this switch is set to ON, the volume indicator blinks and the volume instantaneously drops by −20 dB. When this switch is pressed again, the previous volume resumes.

[DAT]: Eject switch
Press to eject the cassette tape.
[TUNER]: Power switch
Switch the tuner power ON and OFF.

[DAT]: Long-play tape playing time indicator
The indicator LEDs illuminate from the top to the bottom, with each LED representing 1 hour of tape playing time. Adding this time to the time displayed by the playing time display, up to 4 hours 59 minutes and 59 seconds of playing time can be displayed.
[TUNER]: Band indicator
The LED to the side of the selected band illuminates.

Volume indicator
Indicates the volume level.



Tape (ꝏ) indicator
This indicator lights to indicate that a tape has been inserted.
When a commercially-available prerecorded tape is inserted, the SOFT indicator also lights.

[DAT]: Fast Forward (⊳⊳)/ Rewind (⊲⊲) switch
Each switch permits Fast Forward or Rewind operation. To release the operation, press the Play switch.
[TUNER]: Manual tuning Up (⊳⊳)/Down (⊲⊲) switch
Press this switch once to change the receiving frequency by one step. When this switch is kept pressed, the frequency changes continuously.

[DAT]: Play switch
When this switch is pressed, a Fast Forward, Rewind, Repeat One, Index Scan, or Search operation is canceled and the Tape Play operation starts.
[TUNER]: Band selector
Selects the reception band. The band indicator shows the band being received.

Volume Up (∧) Down (∨) switch
Press the Up switch to increase the volume and the Down switch to decrease it. The volume changes by one step when the control switch is tapped once. It changes continuously, but slowly when it is kept lightly pressed, and continuously, but quickly when the switch is kept firmly pressed.

[DAT]: Flat switch
When this switch is pressed, the Bass and Treble effects are immediately returned to flat characteristics.
[TUNER]: Memory switch
Used to program a desired station into the memory presets. When this switch is pressed, this activates the memory position which is displayed by blinking LED's embedded in the presets. At this point you can program any of the presets for your desired station by pressing a Preset station switch.

[TUNER]: Preset station switches (1 – 5)
One switch can memorize one of each FM1, FM2, FM3 and AM.

Reset button
When the installation and all the wirings are finished, press this button.
Not usually used. However, when the microprocessor (microcomputer) malfunctions, press this button using a sharp-pointed object (such as a pencil).
When this button is pressed, the unit is reset to its initial state. Therefore, all the memories and clock are erased and need to be adjusted.

Controls and indicators

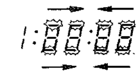
[DAT]: Tape Remaining/ Loading indicator
Normally shows the remaining time of the tape, using 9 indicators. In tape loading or ejection operations, shows that the tape is being loaded, is being ejected, or has been ejected (empty).

[DAT]: Fast Forward/ Rewind indicator
The ⊳ indicator lights steadily while fast forwarding a tape, and blinks while fast forwarding during search.
The ⊲ indicator lights steadily while rewinding a tape, and blinks while rewinding during search.

Balance switch
When this switch is set to ON, the BAL indicator illuminates and the Tape remaining indicator is changed to the balance display. Pressing the Volume Up switch increases the volume level of the right speakers, and pressing the Volume Up switch increases the volume level of the left speakers.

[DAT]: Playing time display
When the Display switch is set for total time display, this section shows the total time, from the beginning of a tape until the present position being played. When the Display switch is set for program time display, this section shows the playing time of the program being played. If the tape does not include sub-code information, this section functions as a tape running indicator.

Tape play
Fast Forward



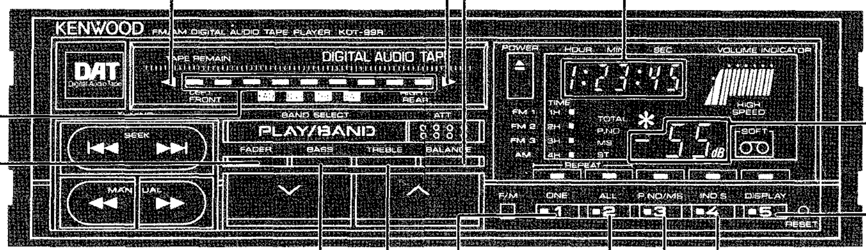
Rewind

Tape running indicator

[TUNER]: Frequency display
Shows the frequency of the station being received.

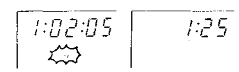
[DAT]: Program/Music-Search No. display
Normally shows the program No. (or the lower two digits when it is 100 or more), and displays the search No. when the Search Up or Down switch is pressed. If the tape does not include Program No. sub-code information, this display shows the volume attenuation level in decibels (dB). The volume attenuation is temporarily displayed when the Volume Up or Down switch is pressed.

[TUNER]: Volume attenuation display
Shows the volume attenuation in decibels (dB).



Fader switch
When this switch is set to ON, the FAD indicator illuminates and the Tape remaining indicator is changed to the Fader display. Pressing the Volume Up switch increases the volume level of the rear speakers, and pressing the Volume Down switch increases the volume level of the front speakers.

[DAT]: Display switch
Switches the function of the playing time display between total time display and program time display.

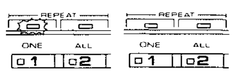


Total time Program time

Bass switch
When this switch is set to ON, the BAS indicator illuminates and the Tape remaining indicator is changed to the bass display. Pressing the Volume Up switch increases bass, and pressing the Volume Down switch decreases it.

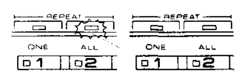
Treble switch
When this switch is set to ON, the TRE indicator illuminates and the Tape remaining indicator is changed to the Treble display. Pressing the Volume Up switch increases treble, and pressing Volume Down switch decreases it.

[DAT]: Repeat One switch
When this switch is ON, the program being played will be played repeatedly.



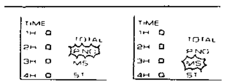
ON OFF

[DAT]: Repeat All switch
The tape is normally rewound to the beginning and then ejected. However, when this switch is ON, it is automatically rewound and played again without being ejected, so that the same tape will be played repeatedly.



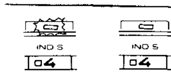
ON OFF

[DAT]: Program No. Search/Music Search select switch
Switches between Program No. search and Music search functions.



Program No. Search Music Search

[DAT]: Index Scan switch
When this switch is pressed, the tape is fast-forwarded and the beginning of each tune (approx. 15 seconds) is played back from the next tune one after another. When the desired tune is heard, press this switch again or press Play switch to release this operation.

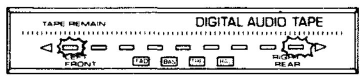


ON OFF

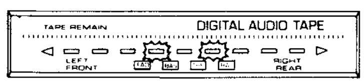
Operation

Tape playback

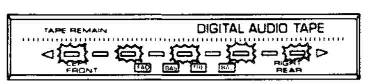
1. Insert the tape into the tape slot, with the side tape is seen facing up and the erroneous erasure protection claw facing toward you. The Tape Remaining/Loading indicator shows the following, indicating that the tape is loading, then that tape playback starts.



2. When a non-signal blank is detected during tape playback, the tape is automatically fast forwarded until a recorded signal is found.
• A non-signal blank is different from non-recorded blank, where no sound is recorded but the format signal is recorded. A non-signal blank contains no type of record on the tape surface.
3. When the entire tape has been played, the tape is automatically rewound until the beginning and then ejected. The Tape Remaining/Loading indicator shows the following, indicating a tape eject operation.



4. To end playback, press the Eject switch. The Tape Remaining/Loading indicator shows the following, indicating that the tape has been ejected.

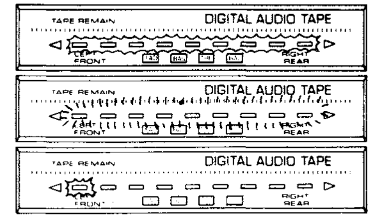


Note:
This unit does not detect the skip ID. If the tape played contains a skip ID, the section including the skip ID will not be skipped.

Tape remaining indicator

The remaining tape volume (approximate remaining time) can be displayed using the 9-segment tape indicator by dividing into eight as follows:

- All 9 LEDs are lit immediately after tape playback has begun.
- When loading, LEDs are blinking while counting the remaining tape.
- This example shows that the remaining amount of tape is less than 1/9.



Program No. search

- A search is performed referring to the Program No. sub-code information.

1. Set the Program No. Search/Music Search select switch to Program No. Search.
2. Press the Search Up switch to select the Program No. of the program to be played. The Program No search covers program No. from 01 to 99, while program No. 100 or more cannot be searched.
3. In a short time, the program search starts and the selected Program No. is played from the start.

Note:
If the Program No. on the tape are not continuous, a program search may take longer than usual.
If the selected Program No. does not exist, the tape is rewound to the beginning and normal tape playback starts.
If the tape does not contain Program No. information, the Program No. Search/Music Search switch may not be able to be set to the Program No. search function.

Music search

- Referencing the program being played as 00, any program within the range of the 99 programs before it and the 99 programs after it can be searched for and played from the start.

1. Set the Program No. Search/Music Search select switch to Music Search.
2. Press the Search Up or Down switch to set the number of programs to be skipped until the desired program.
3. In a short time, music search starts and the selected program is played from the start.

Note:
Music search is not possible with tapes not including the Start IDs.
If the tape end is reached during a music search, the search is canceled, the tape is rewound to the beginning, and is then ejected.
If the tape beginning is reached during a music search, the search is canceled and the tape is played from the beginning.

■ Index scan

The beginning of each tune can be detected and played back for about 15 seconds continuously so that the desired tune is detected easily and speedily.

1. Press the Index Scan switch.
2. The tape is fast forwarded and plays the first 15 seconds of every program it encounters. (An index scan is canceled at the tape end, the tape is rewound to the beginning and is then ejected.)
3. When the desired program is found during an index scan, press the Index Scan switch or Play switch to start normal playback.

Note:

Index scanning is not possible with tapes not including the Start IDs.

■ Key-Off eject

When the ignition key switch is tuned off with the tape loaded, the tape will be automatically ejected to prevent damaging the tape or cassette mechanisms.

■ Auto tuning (seek)

1. Turn the power ON.
2. Select the required band (FM 1 - 3 or AM).
3. When the Auto tuning Up/Down switch is pressed, the unit starts scanning. When a marginal broadcast is received, the scanning stops.

■ Manual tuning

1. Turn the power ON.
2. Select the required band (FM 1 - 3 or AM).
3. Using the Manual tuning Up/Down switch, tune in to the required station frequency. Tap the switch once to vary the frequency one step, hold the switch to vary the frequency continuously.

■ Station memory

1. Turn the power ON.
2. Select the desired band (FM 1 - 3 or AM).
3. Receive the desired station.
4. Press the Memory switch. The Preset station switch indicators blink for about 5 seconds.
5. While the indicator blinking, press the Preset station switch to store the received station frequency.

■ Auto memory

5 stations in the selected band can automatically be memorized.

1. Turn the power ON.
2. Select the desired band (FM1 - 3 or AM).
3. Press the Memory switch. The indicators blink for about 5 seconds.
4. While the Preset station switch indicator blinking, press the Auto tuning Up switch.
5. The selected band is automatically scanned and 5 stations are memorized.
   When 5 stations are memorized, the auto memory function is automatically released.

Care and maintenance

- The power source of this unit is exclusively DC 12 V, negative ground. If you wish to mount the unit on a vehicle with DC 24 V, please consult your appointed KENWOOD dealer.
- Do not place the digital audio tape player in a place where the digital audio tape player may be exposed to direct sunlight, heat or moisture. Be careful that metal objects and water do not enter the set.
- If you have difficulty in installing the set in your car, please contact your KENWOOD dealer.

Head cleaning

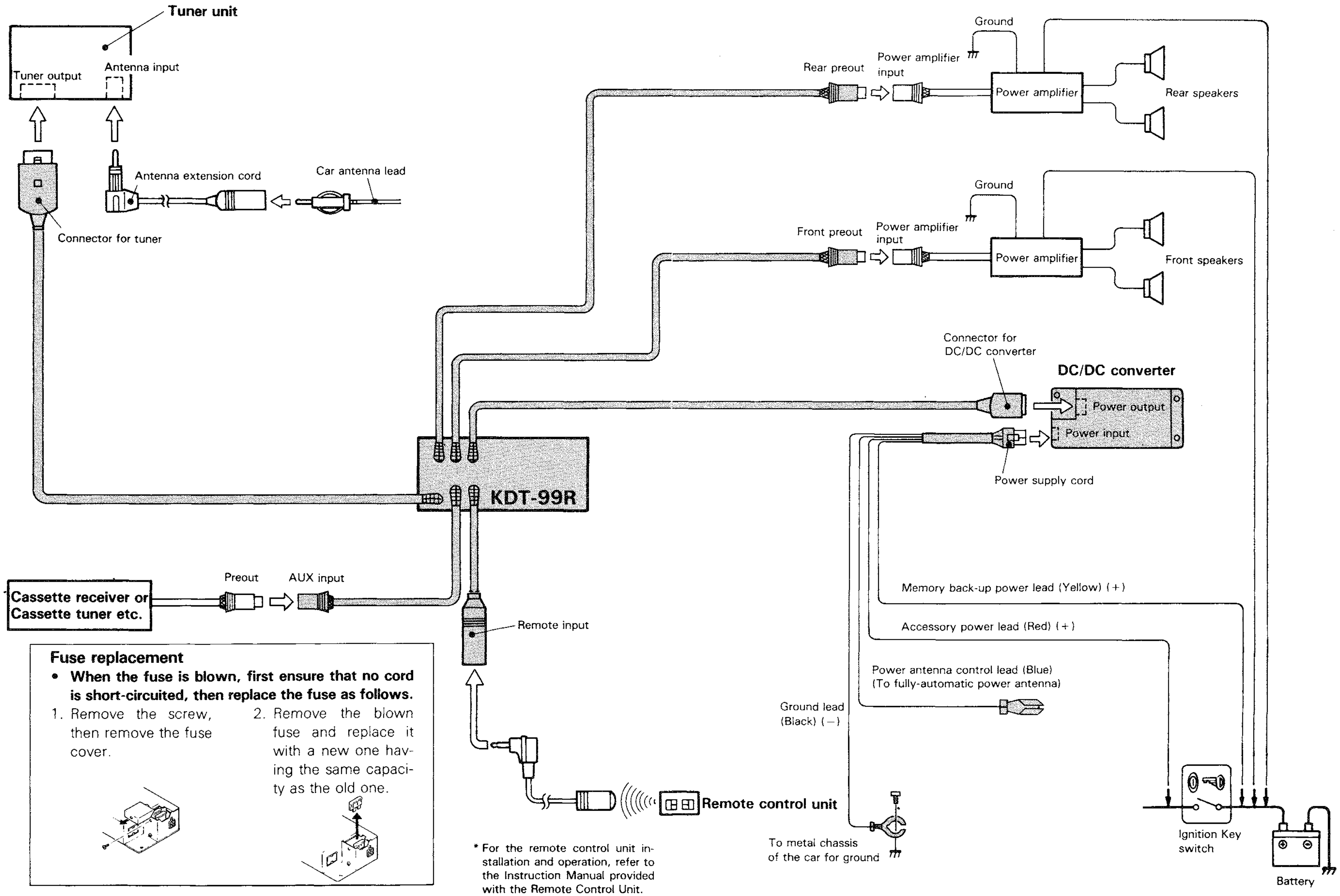
Magnetic particles from the tape adhere to the head surface after a long period of use, resulting in noise and poor quality sound. Clean the head with cleaning tape available at your stereo shop.

Connections

■ Install the KDT-99R in a following manner and wiring them

1. Before installation and wiring, remove the (−) terminal of the battery to prevent short-circuiting.
2. Connect the ground to the metal chassis of the car.
3. Connect the input and output cords of the system.
4. Connect the back-up power supply lead.
5. Connect the accessory power lead.
6. Install the set and after confirming the installation and wirings are correct, connect the (−) terminal of the battery.
7. After all installation and wiring are completed, be sure to press the Reset button.

Connections



Fuse replacement

- **When the fuse is blown, first ensure that no cord is short-circuited, then replace the fuse as follows.**

1. Remove the screw, then remove the fuse cover.

2. Remove the blown fuse and replace it with a new one having the same capacity as the old one.

* For the remote control unit installation and operation, refer to the Instruction Manual provided with the Remote Control Unit.

Troubleshooting

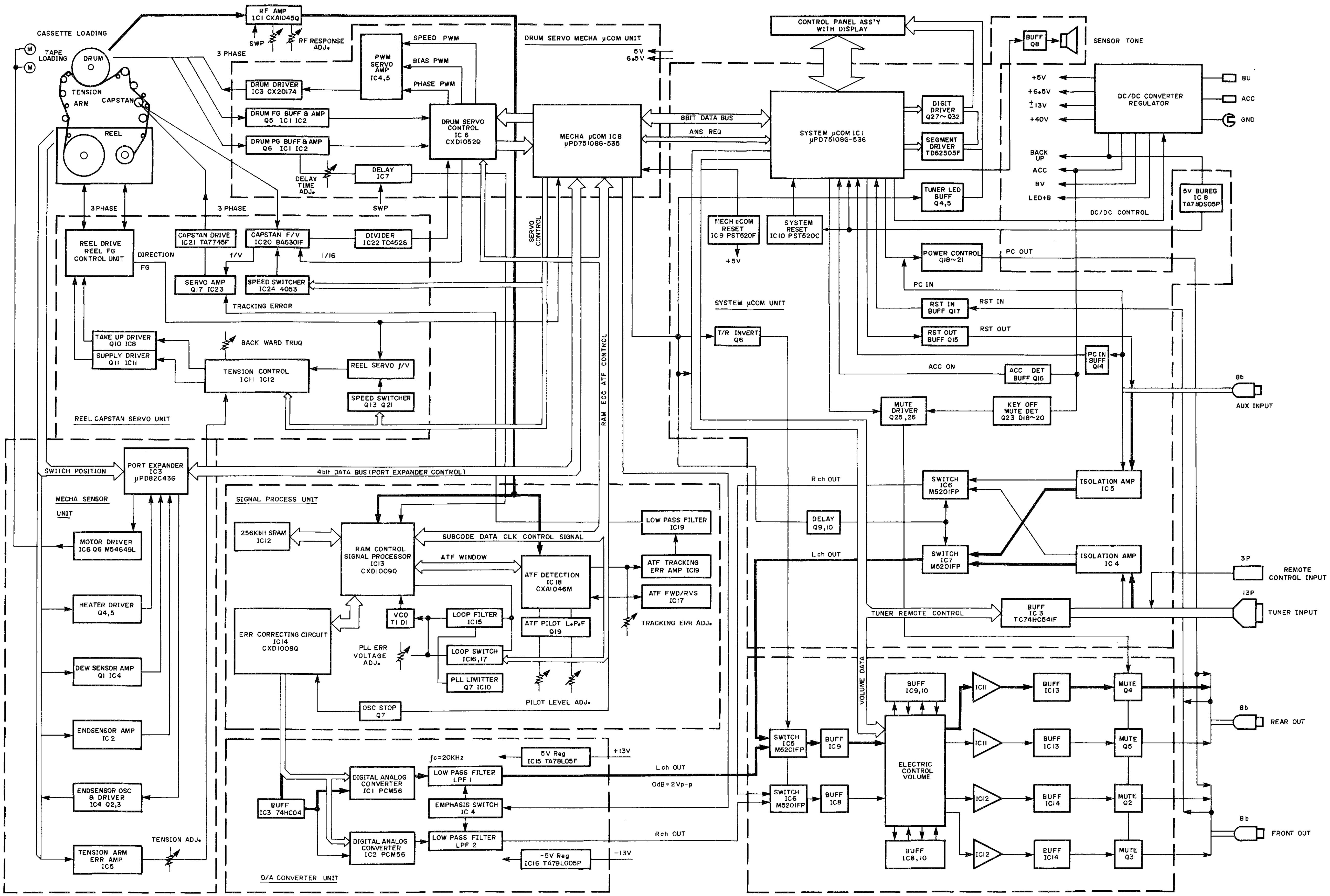
Trouble that seems to be a serious fault is often due to a simple mistake or misunderstanding, and in such a case the unit can be repaired very easily by the user. When your unit seems to malfunction, please check the following list of symptoms before calling for service.

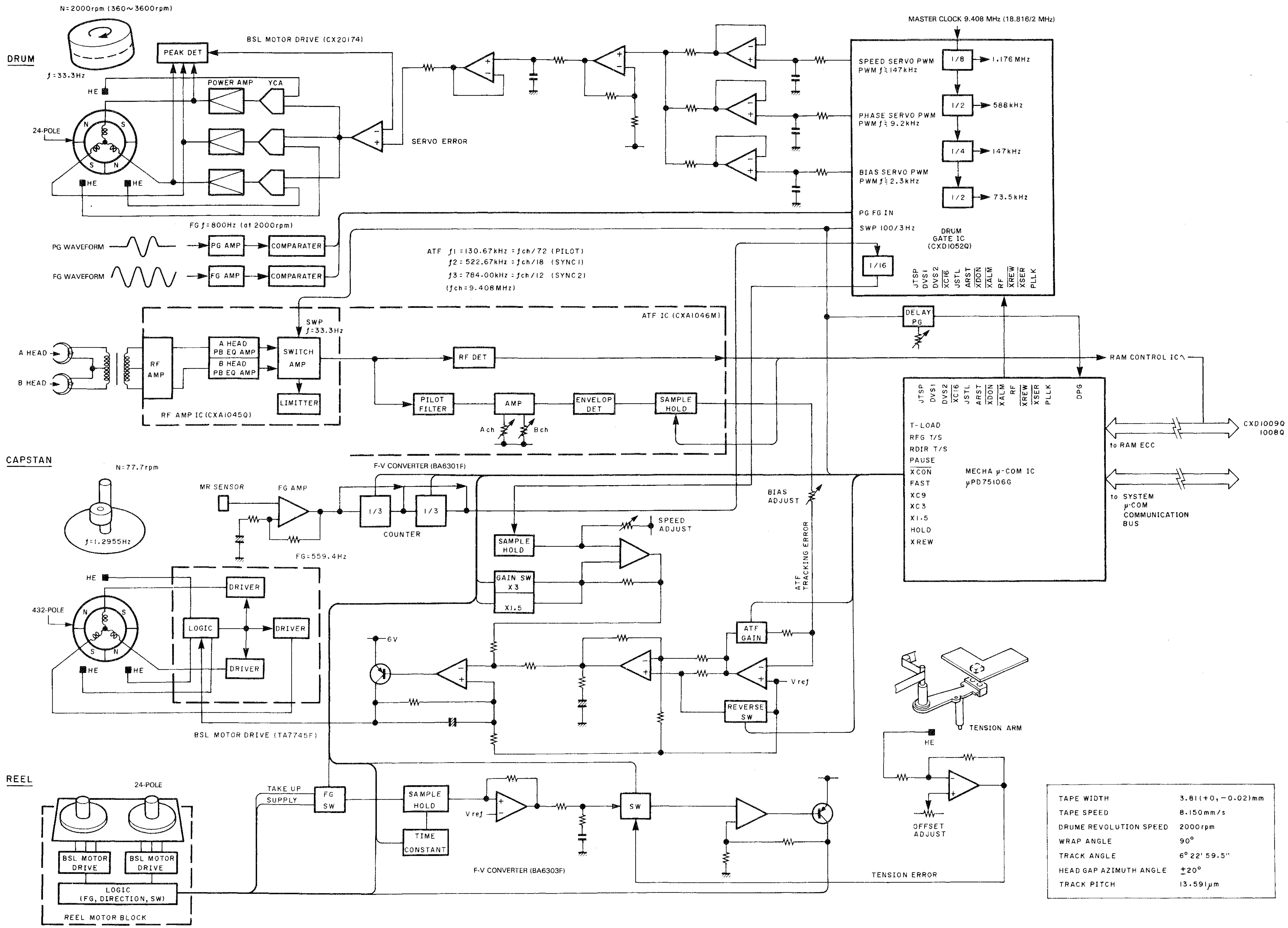
• User's self-diagnosis before calling for service

	Symptom	Possible Causes	Remedy
Operation	**Cassette cannot be inserted.**	1) Cassette is inserted upside down. 2) Cassette cannot be inserted within 2 seconds after the starter key is turned to ACC ON. 3) The humidity or temperature sensor is operating. 4) Another cassette has already been inserted into the unit.	1) Insert the cassette in the correct direction. 2) Wait until the display is illuminated. 3) Wait until the humidity or temperature in the compartment drops. 4) Eject the inserted cassette and insert another.
	Cassette is ejected immediately after it is inserted.	1) Cassette tape is cut. 2) Dew has condensed on the tape surface. 3) The cassette is deformed.	1) Use a cassette tape which is not damaged. 2) Dry the tape. 3) Use a cassette which is not deformed.
	Cassette is not automatically ejected after it has been rewound.	Cassette is not ejected at the beginning of the tape if the Repeat All feature is ON.	Cancel the Repeat All.
	Upward/Downward search by fast-forwarding or rewinding is not possible during tape playback.	1) The Repeat One feature is ON. 2) The Program No. search is ON.	1) Cancel the Repeat One. 2) Cancel the Program No. search.
	Search operations take a longer time than usual.	1) The tape includes non-signal blanks. 2) Program Nos. on the tape are discontinuous.	1) Record programs continuously so that there are no non-signal blanks. 2) Re-write the Program Nos. so that they are in a continuous sequence.
	Program No. search cannot be switched ON.	Program Nos. have not been written.	Write Program Nos. on the tape.
	Programs cannot be skipped.	The skip IDs are not read.	This unit has been designed to perform skip operations.
	Cassette is suddenly ejected in the middle of playback.	1) The humidity sensor is operating. 2) The temperature sensor is operating. 3) Tape has been wound improperly due to tape defect. 4) Cassette is deformed. 5) The car engine was started at that time.	1) Decrease the humidity inside the car compartment (by turning the air conditioner on, etc.). 2) Decrease the temperature inside the compartment (by turning the air conditioner on, etc.). 3) Use a tape that has been wound properly. 4) Use a cassette that is not deformed. 5) Insert the cassette again.

	Symptom	Possible Causes	Remedy
Operation	**Cassette is suddenly ejected in the middle of fast forwarding or rewinding.**	Tape has been wound improperly.	Use another tape, or play the same tape until the end, then rewind it to the beginning.
	Search operations are not possible.	One or more programs are less than 20 seconds long, or one or more start IDs are written in too short of a duration.	Record the tape so that there are no extremely-short programs.
	Crunching noise is heard.	1) Tape has serious scratches. 2) Heads are dirty (in this case the Running indicator appears). 3) Tape is degraded.	1) Rewind the tape and do not use it. 2) Clean the heads using a cleaning cassette. 3) Use a new tape.
	Sound is distorted.	1) The recording level was too high. 2) Tape is degraded.	1) Record sound at an optimum recording volume. 2) Use a new tape.
	Sound is not heard.	1) Tape does not include a recording. 2) Tape has been recorded in the long-hour mode. 3) Cables are connected improperly. 4) The Volume control is set to the minimum.	1) Use a tape that has been recorded. 2) This unit does not play back long-hour recordings, and an "E" appears on the display in such a case. 3) Connect the cables as indicated in the Owner's Manual. 4) Increase the volume.
	Sound is heard, but information is not displayed.	As the sub-code recording formats vary depending on the DAT recorder manufacturers, information is not displayed with tapes recorded using certain recorders.	Identify the case by referring to the tape recording format shown in the separate table (see next page)
	Sound is heard, but search operations are not possible.	Tape does not include start IDs.	Play a tape on which start IDs have been written.

4. BLOCK DIAGRAM





TAPE WIDTH	3.81(+0, −0.02)mm
TAPE SPEED	8.150mm/s
DRUME REVOLUTION SPEED	2000rpm
WRAP ANGLE	90°
TRACK ANGLE	6° 22' 59.5"
HEAD GAP AZIMUTH ANGLE	±20°
TRACK PITCH	13.591μm

5. SIGNAL NAME ABBREVIATIONS AND THEIR FUNCTIONS

Mechanism

Name	Function, Full Spelling	Active	Operation
C-LD	Cassette Loading	—	Cassette loading status
T-LD	Tape Loading	—	Tape loading status
T-LOAD	Reel Tape Loading	H	The mode for providing constant torque in tape loading or unloading
FAST	Reel Speed Switching	H	Increases reel speed in FF/REW
PAUSE	Reel Pause	H	Stops reels temporarily
RFGT	Reel FG — Takeup	Pulse	Takeup reel FG pulse
RFGS	Reel FG — Supply	Pulse	Supply reel FG pulse
RDIRT	Reel Direction — Takeup	H	Indicates the direction of takeup reel support
RDIRS	Reel Direction — Supply	H	Indicates the direction of supply reel support
XCON	Capstan ON/OFF	L	Rotates the capstan motor
XREW	Reel Capstan Direction Switch	L	"H" for forward rotation
REON	Reel ON/OFF	L	Turns reel support ON/OFF
C9	Capstan Speed Switching	H	Capstan speed = FG x 9 times
C3	Capstan Speed Switching	H	Capstan speed = FG x 3 times
C1.5	Capstan Speed Switching	H	Capstan speed = FG x 1.5 time
PS1	Position Sensor 1	—	Detects the tape loading position and pinch roller position
PS2	Position Sensor 2	—	
PACK IN	—	L	Detects when the tape is set in the container
LOE	Loading end	L	Detects the end of cassette loading
LOS	Loading start	L	Detects the start of cassette loading
XDON	Drum ON/OFF	L	Turns drum rotation ON/OFF
EJECT C	Eject Control	H	Switches the motor voltage during cassette loading
SENS	Temperature Sensor Input	L	Activated when the temperature sensor (80°C) operates
JSTL	Just Lock	H	Activated when the drum is locked
RF	RF Sensor	H	Goes "H" when RF is in the specified range
XC16	Capstan Speed Switching	L	Capstan speed = FG x 16 times
PLLK	PLL Lock Signal	H	Activated when PLL is locked during search (FF/REW)
CFGI	Capstan FG Divided Signal Input/Output	Pulse	Divider input/output during ±16 x capstan search
CFGO			
T/R	Tape/Radio Switching	—	Switches between the DAT and tuner (external)
ATF ON	ATF ON/OFF	L	Activated when ATF is ON
XSER PLL	PLL Control during Search	L	Switches the PLL operation during search
Vref	ATF Reference Voltage	—	Reference voltage for ATF operating point
Vs	ATF Servo Voltage	—	Tracking voltage (servo voltage) of ATF

Synthesizer unit (X14-223X-XX)

Name	Function, Full Spelling	Active	Operation
BU	BACK UP	—	Power which is constantly supplied from the battery (14.4 V)
ACC	ACCESSORY	—	Power which is turned ON/OFF by the ACC switch (14.4 V)
GND	GROUND	—	GND for BU, ACC, LED +B, +40, MOTA +B, +5 and +8
PC	POWER CONTROL	H	Power control output for post-stage system (max. 1 A)
RST	RESET	L	Reset input from post-stage system
LED + B	LED POWER	—	Power supply for LED illuminating the display panel (approx. 10 V)
+40	FL TUBE POWER	—	Positive power supply for FL display (40 V)

Name	Function, Full Spelling	Active	Operation
POC	POWER OUT CONTROL	H	DC/DC converter relay ON/OFF signal
MUT	MUTING	H	Audio output muting signal
MOTA + B	MOTOR POWER (1)	—	Power supply for cassette loading and tape loading motors (8 V)
+6	MOTOR POWER (2)	—	Power supply for cylinder, capstan and reel motors (approx. 6.7 V)
+6.GND	MOTOR POWER GND	—	GND for 6 V circuitry
+5	SIGNAL PROCESSOR POWER +5 V	—	Power supply for signal processor circuitry (5 V) OFF when ACC is OFF
+5.GND	SIGNAL PROCESSOR GND	—	GND for 5 V circuitry
−13	ANALOG CIRCUIT −ve POWER	—	Negative power supply for audio circuitry (−13 V)
+13	ANALOG CIRCUIT +ve POWER	—	Positive power supply for audio circuitry (+13 V)
A. GND	ANALOG CIRCUIT GND	—	GND for ±13 V circuitry
EMP	EMPHASIS	H	Emphasis ON/OFF detect signal "H" for turning the de-emphasis circuit ON
T/$\overline{R}$	TAPE/RADIO	—	"H" during DAT operation, "L" in other cases (radio or AUX operations)
CLK	CLOCK	—	Clock for sending data to the electronic VR
STB	STROBE	—	Strobe pulse for latching data sent to the electronic VR
DATA	DATA	—	Data sent to the electronic VR
F+B	FILAMENT POWER	—	Power supply for FL tube filaments (approx. 2.5 V)
F. GND	FILAMENT GND	—	GND for FL tube filament power supply
G. GND	GRID POWER	—	GND for FL tube grids (also used as the GND for positive electrode)
AGC. C	AGC CONTROL	L	Radio IF bandwidth switching signal
SD	STATION DETECT	H	Signal indicating that the radio is tuned into a station
STEREO	STEREO	H	Stereo radio broadcast detect signal
PLL-DATA	PLL-DATA	—	Data sent to the radio tuning PLL
PLL-CLK	PLL-CLOCK	—	Clock for sending PLL-DATA
CE	CHIP ENABLE	H	Radio tuning PLL enable signal
T/$\overline{R}$	TAPE/RADIO	—	"L" during DAT operation, "H" in other cases (for radio operation)
R-SEL	RADIO SELECT	L	Signal indicating that the concealed tuner is connected
R-DATA	REMOTE CONTROL DATA	—	Data from the remote control unit
+8	REMOTE CONTROL POWER	—	Power supply for remote control light receptor (8 V, supplied from MOTA +B)
I/O 0～7	I/O PORT 0 To 7	—	Data bus between Mechanism μCOM and System μCOM (8-bit)
COM-REQ	COMMON REQUEST	H	Data request and reception end signal sent from System μCOM to Mechanism μCOM
$\overline{T}$/R	TAPE/RADIO	L	DAT operation signal output from Mechanism μCOM "H" when DAT does not operate
COM-ANS	COMMON ANSWER	H	Data request and reception end signal sent from Mechanism μCOM to System μCOM
RST	RESET	L	Mechanism μCOM reset signal
−5	PLL −ve POWER	—	Negative power supply for bit sync PLL circuit (−5 V)
K0～3	KEY MATRIX 0 To 3	—	Key matrix signal lines
a～k	SEGMENT a To k	—	Segment signals (for FL tube) and key scanning signals (a to f)
D1～8	DIGIT 1 To 8	—	Digit signals (for FL tube)
D9～11	DIGIT 9 To 11	—	Digit signals (for LEDs)
RADIO	RADIO	H	Radio pilot lamp lighting signal
Vss	Vss	—	GND for RST switch return signal
RST. SW	RESET SWITCH	L	Reset switch signal for System μCOM
Sa～Sg	SEGMENT a To g	—	Segment signals (for LEDs)

Control circuit unit (X29-1830-00 (A/3))

Name	Function, Full Spelling	Active	Operation
SWP	SWITCHING PULSE HEAD SWITCHING PULSE	Ach-L Bch-H	Switches between the A CH and B CH heads
RFDT	DIGITAL PLAYBACK SIGNAL	—	Signal played from the A or B CH
PBDT	DIGITAL PLAYBACK SIGNAL	—	A or B CH playback signal processed by a limiter
CRCM	CRC MONITOR	—	Result of W1, W2 and parity checking
SRVS	SERVO REFERENCE SIGNAL (12.8 kHz)	—	Drum FG reference, capstan reference
C94M	9.408 MHz	—	Master clock for servo circuitry
PLCK	PLL LOCK	H	"H" while the PLL locks
DPG	DELEY PG	—	Pulse generated by SWP
SVRF	SERVO REFERENCE SIGNAL (33.3 Hz)	—	Drum PG reference
SBSY	SUB CODE SYNC	—	200/3 Hz sub-code sync signal
SBDT	SUB CODE DATA	—	Sub-code data between μCOM and LSI
EXCK	SBDT I/O CLOCK	—	Clock for latching SBT inside the LSI
DTC 1.2	SBDT CONTROL 1, 2	—	Indicates the type of data on SBDT
ATD 1	ALL-TRACK TRACKING DATA	L	Generates when ATF sync is detected "H" when No Good
MUTG	MUTING	H	Muting ON/OFF
NOR	NORMAL MODE SETTING	L	Determines whether the Normal mode is used or not
XSER	SEARCH MODE SETTING	L	"L" in Search mode
RFSF	RF SIGNAL DETECT	H	"H" when RF signal is present
ATF ON	ATF ON	L	Judges whether the ATF is ON or OFF "L" when ON
T.E OUT	TRACKING ERROR OUT	—	Capstan servo signal
Vref	V reference	—	Capstan servo reference voltage
X REW	REW MODE SETTING	L	"L" in REW mode

6. CIRCUIT DESCRIPTION

6-1. PLL circuit

Control circuit unit (X29-1830-00)

The phases of the playback data (PBDT) and VCO clock are compared, the phase comparison (PC) output is integrated by integrator IC15(B/2), and its DC voltage output controls the VCO frequency to synchronize the VCO clock with the playback data.

The playback data is an intermittent signal. While the data is absent, the PC output is high-impedance and the integrator is biased at 2.5 V (Vcc/2). During normal playback, SW1 is switched to the bias voltage side by the resistors. R91 and R92, R95 and R96 and VR5, and R137 and R138 are respectively used to provide a 2.5 V DC bias voltage.

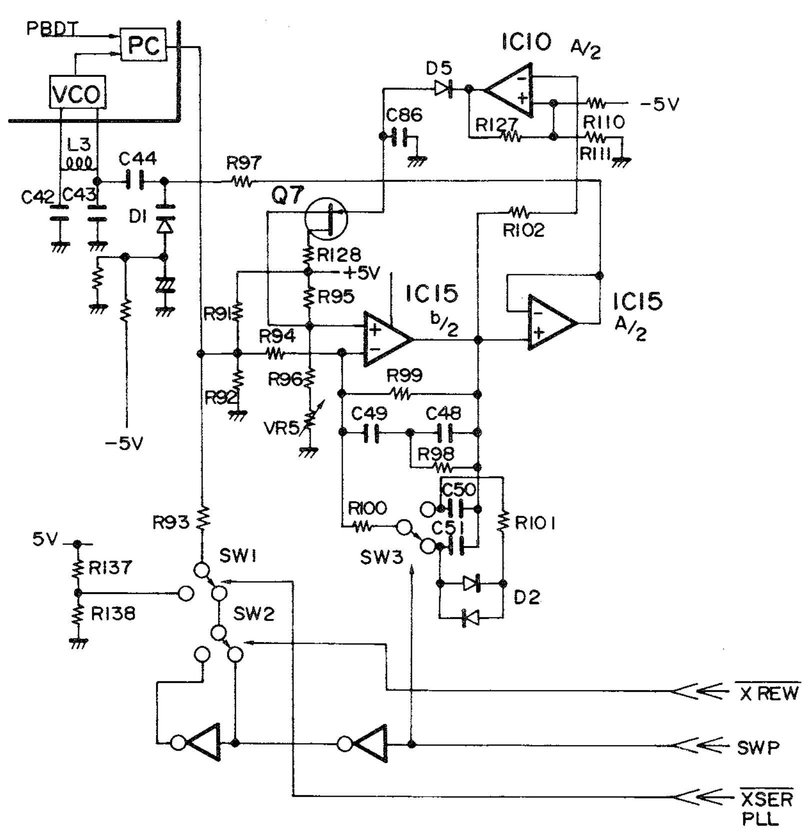
During fast winding, the relative speed between the tape and heads should be the same as in normal playback. However, due to the difference in azimuth angle between the A and B heads, the A head speed is slightly slower than the B head speed in FF mode, and faster in REW mode. As a result, the VCO control voltages, and also the integrator output voltages, vary depending on the head reproducing each data (causing a difference of 0.8 to 1 V). To maintain the smooth operation of the integrator and its DC voltage output against this voltage variation, the DC bias provided by R91 and R92 is varied slightly by the head switching pulse (SWP) via SW1 and SW2, and the capacitor which forms the integrator together with resistors is switched by SW3 depending on the A or B head.

Namely, during FF, SW1 is connected to SW2 so that the DC bias is affected by SWP. SW2 is used to switch the polarity of SWP depending on FF or REW, and SW3 switches the integrator's capacitor according to the SWP in order to maintain the output voltage while the other head is being used for reproduction.

The circuit formed by R101 and D2 is a limiter. Even in case a channel (one of the heads) should be mis-locked, this limiter prevents the influence of mis-locking by limiting the voltage difference between the two heads within 1 V.

If the PLL mis-locks causing the output voltage to drop below −1 V, hysteresis comparator of IC10(A/2) detects the voltage drop, and turns Q7 (FET switch) ON to vary the DC bias so that the integrator output is forced to return to near 0 V.

VR5 is used in case the PLL locks during normal play, adjusting the DC bias to set the integrator output voltage to 0 V. The comparator operation range is determined by this (the comparator goes ON at −1 V).

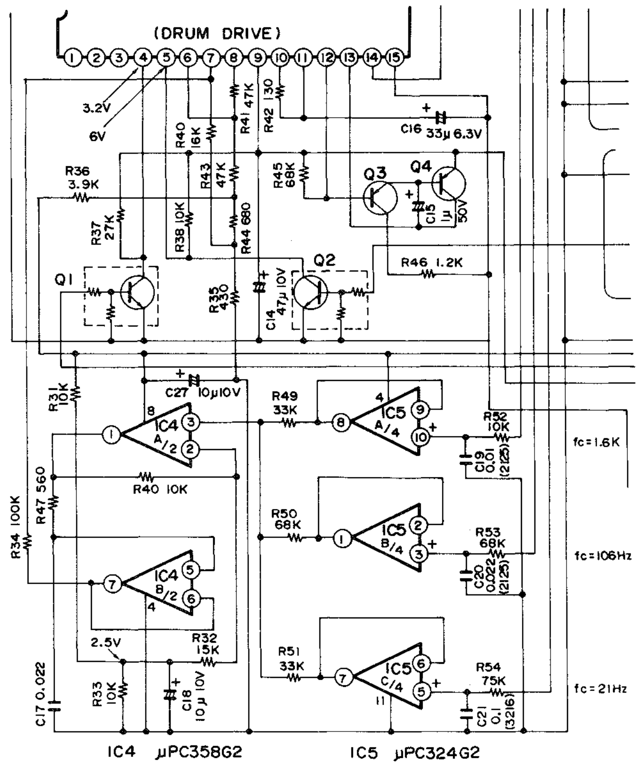


6-2. Drum PWM-V converter

Control circuit unit (X29-1830-00)

The drum servo is controlled by digital servo. While the capstan or reel servo circuitry obtains the servo voltage by f/V conversion of FG, the digital servo circuit compares the reference stable oscillations (in this case, X'tal oscillator output and its divided frequencies) with the FG PG. Servo voltage is obtained when this ratio is equal to 50%.

The 147 kHz speed-servo pulse is applied to IC5(A/4), 9.2 kHz phase-servo pulse is applied to (B/4), and 2.3 kHz bias-servo pulse is applied to (C/4). When the drum locks, the voltages input to the mix amp (A/2) become the same.



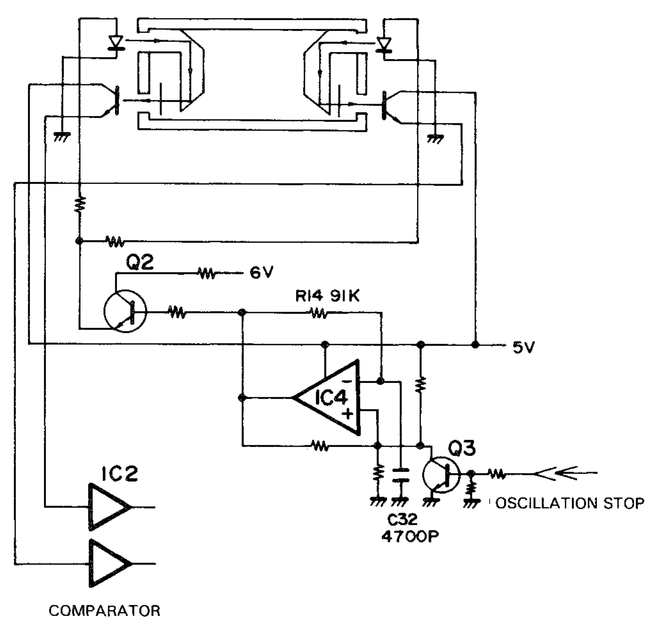
6-3. End sensor circuit

Sub-circuit unit (X13-5690-00)

The R-DAT detects the end of tape using a prism inside the cassette. As shown in the illustration, the light is emitted into the prism and is reflected toward the tape surface. The light does not pass through a magnetic tape portion but does through a leader portion. When the light does shine through, it is detected by the phototransistor.

IC4 is the oscillator of the sensor drive pulse with a frequency of approx. 1 kHz. Its generated pulse lights the end-sensor LED via driver Q2.

The light transmitted through the leader tape is converted into DC voltage by the phototransistor. This DC voltage is detected by comparator IC2. The comparison level is 0.8 V.

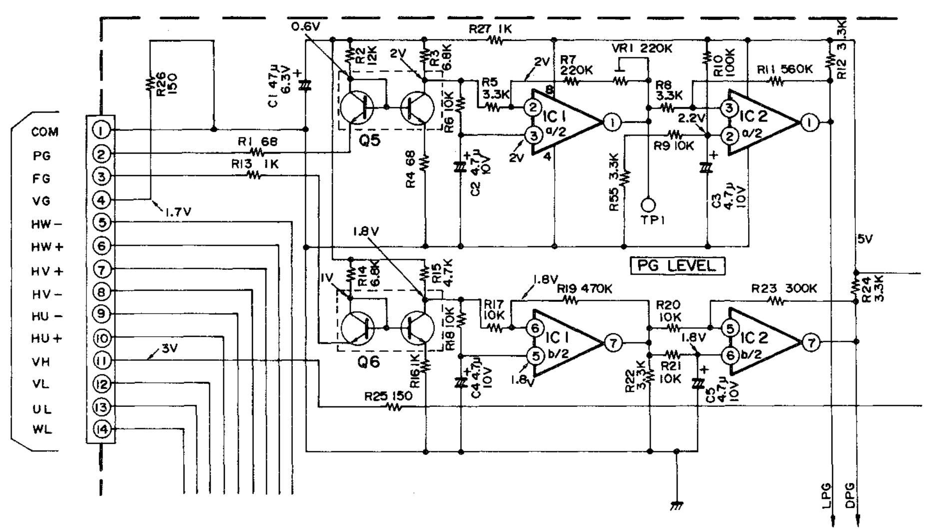


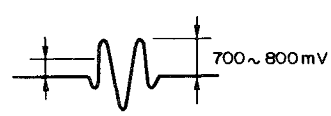
6-4. Drum PG FG amplifier circuit

Control circuit unit (X29-1830-00)

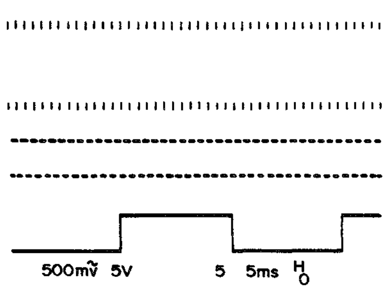
The drum FG PG magnetized on the drum rotor is detected by the MR element via the stator's coil pattern. As it has a very small output level of less than 10 mVp-p and sensitive to noise, the first-stage of the amplifier uses a current mirror circuit to convert the input to low impedance. As the pulse is amplified and its is impedance converted in the first stage, the circuit uses a structure that is highly resistant to noise.

For stable operation even in case the operating point varies due to temperature drift, the amplifier and comparator operations are obtained from the DC component of signal.
Q5 and Q6 form the current-mirror, impedance converter circuit.





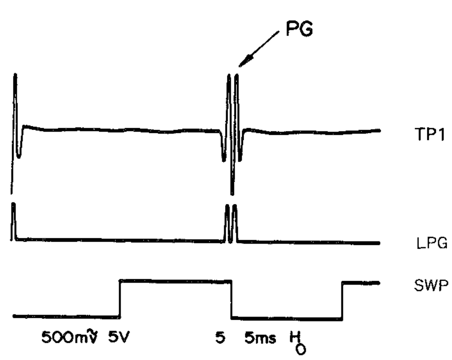
Comparison level
300 mV



IC1 pin ⑦ output

DPG

SWP



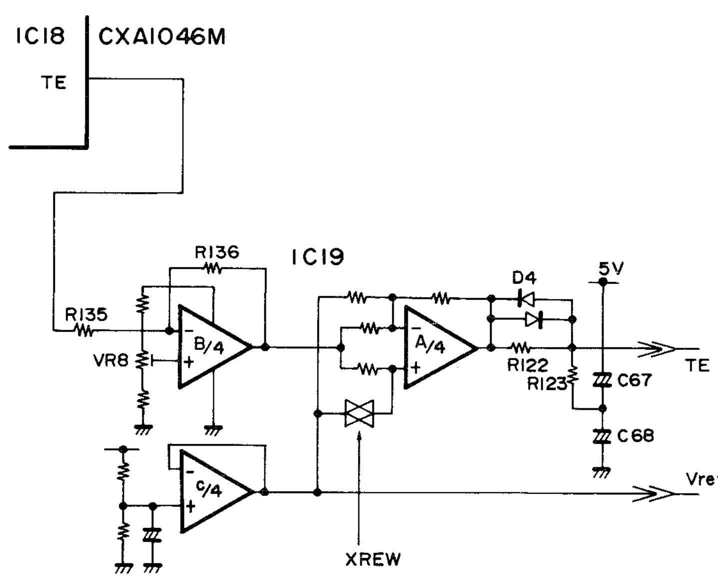
6-5. ATF phase compensator circuit

Control circuit unit (X29-1830-00)

The tracking error voltage is generated from the ATF pilot signal and output from IC18. The output error voltage is amplified by the inverted amp and voltage follower of IC19(B/4) and, to absorb the variance in the tracking error voltage from IC26, DC offset is applied to it so that the error voltage output level becomes approx. 2.5 V.

IC19(C/4) generates the reference voltage, which is also sent to X29(C/3) for use as the capstan servo Vref. IC19(A/4) includes a forward/inverted amp which can invert the error voltage polarity for correct ATF in case of reverse mode operation (-X1).

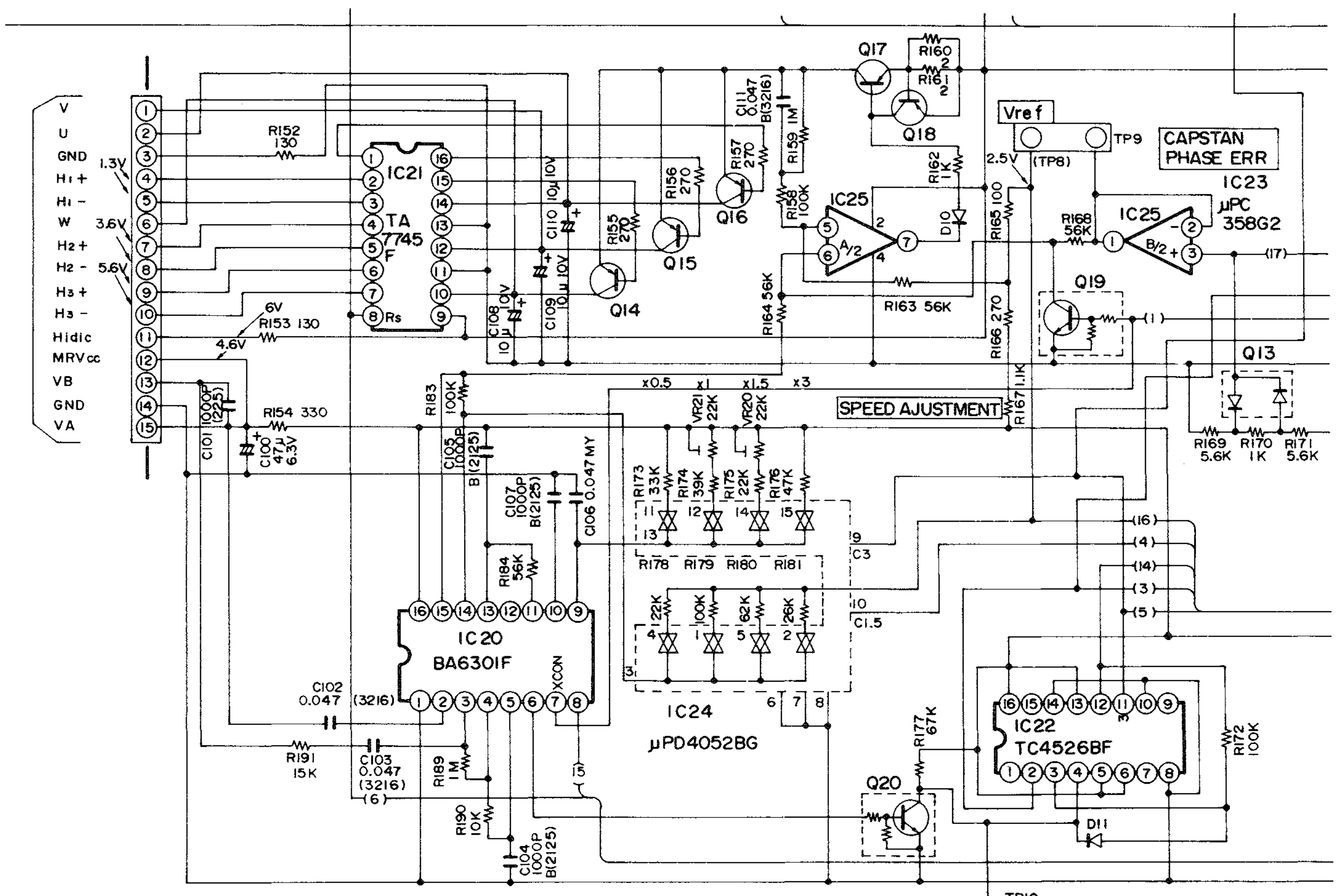
R122, R123, C67 and C68 form the phase compensation filter for the phase servo. D4 is used to improve the transient response of servo.



6-6. Capstan speed servo circuit

Control circuit unit (X29-1830-00)

The capstan speed servo regulates the capstan speed within the range that allows the tracking by ATF. If the capstan speed varies too much, ATF tracking will not be possible.
The capstan rotor is magnetized much like the drum servo. The magnetic field is detected by the MR element and amplified to become the FG.
IC20 amplifies the FG from the MR element, and its internal hysteresis amp provides the FG with the duty ratio of nearly 50%. To obtain the capstan search speed required in search operations, the FG is divided by IC22 into 1/3 and 1/9, and by the drum IC to 1/16. The FG (which is not divided in other operations) is applied to the f/V converter of IC20 to become the speed servo voltage. Analog SW IC24 connected to IC20 is used to adjust the speed by varying the f/V conversion setting.
IC23(A/2) is a mix amp, to which the tracking error voltage is applied during ATF operation.
IC21 and Q14 to Q16 form a 3-phase capstan motor driver. The servo voltage for driving is obtained from the mix amp via driver Q17.

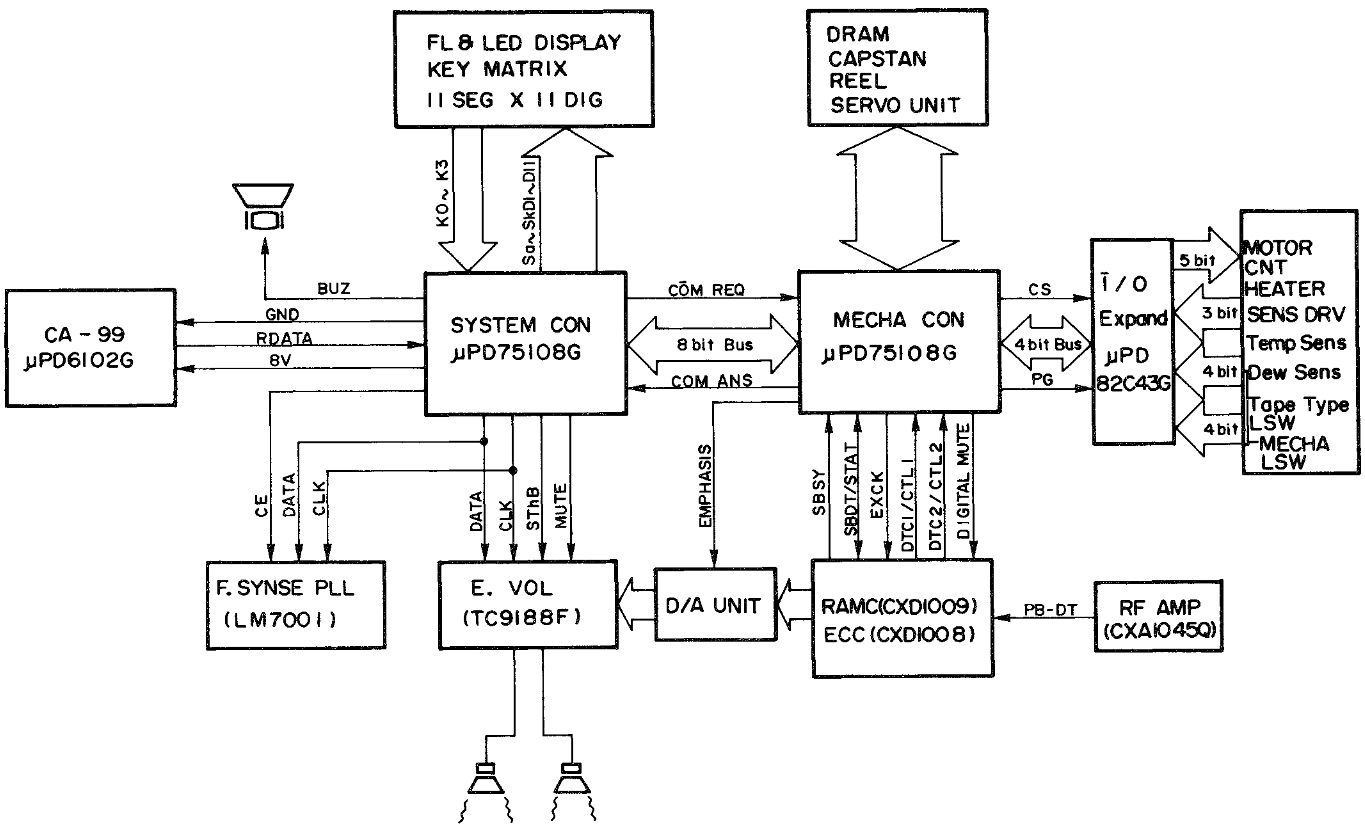


FG frequency 559.44 Hz (×1)
839.16 Hz (×1.5)

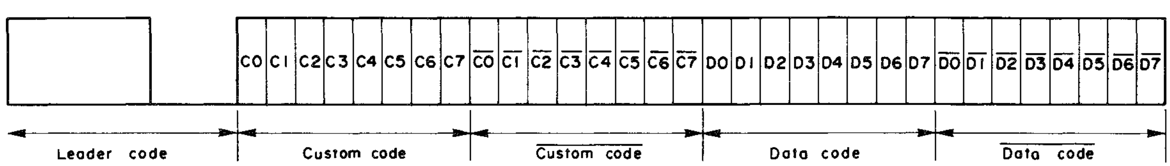
7. REMOTE CONTROL TRANSMISSION DATA FORMAT

IC used: μPD6102G

7-1. KDT-99 system configuration



1. REM output



As shown in the illustration, the transmission codes consist of the leader code, 8-bit custom code and 8-bit data code. Because the negative codes of the custom and data codes are also sent, each transmission consists of 32 bits.

2. Custom code

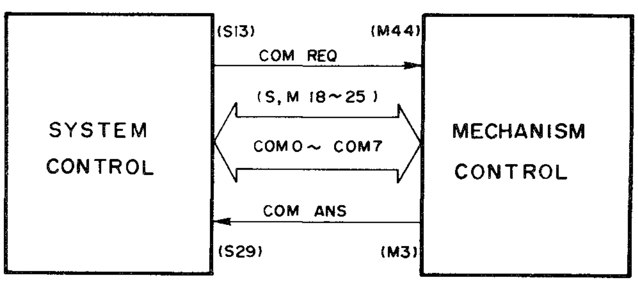
The assigned custom code is B9H (C7-6).

3. Key data codes

Corresponding Mode	Key Assignment	DATA CODE							
		D_0	D_1	D_2	D_3	D_4	D_5	D_6	D_7
DAT	VOL UP	0	0	0	0	1	0	0	0
	VOL DOWN	1	0	0	0	1	0	0	0
	ATT	0	1	0	0	1	0	0	0
C Cassette	VOL UP	0	0	1	0	1	0	0	0
	VOL DOWN	1	0	1	0	1	0	0	0
	ATT	0	1	1	0	1	0	0	0
CD	VOL UP	0	0	0	1	1	0	0	0
	VOL DOWN	1	0	0	1	1	0	0	0
	ATT	0	1	0	1	1	0	0	0
Common	REW (Search)	0	0	1	1	1	0	0	0
	FF (Search)	1	0	1	1	1	0	0	0
	PLAY/BAND	0	1	1	1	1	0	0	0
	EJECT/POWER	1	1	1	1	1	0	0	0

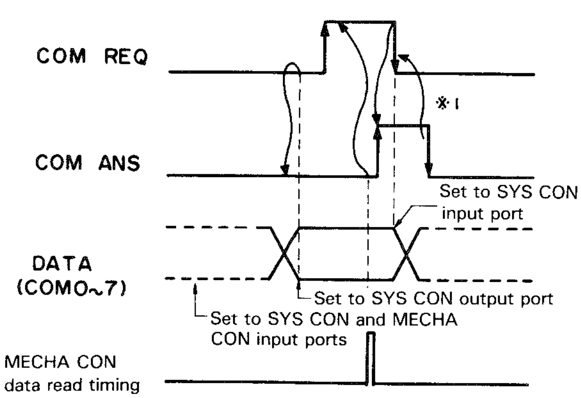
Remote control key data code assignment table

7-2. System control (SYS CON) ←→ Mechanism control (MECHA CON) Data transfer format



Communication Signal Diagram

As shown in the diagram on the left, the signals between SYS CON and MECHA CON consist of 2 communication request control signal lines and 8 data I/O lines. The communication timing is shown in the following chart.



SYS CON → MECHA CON data transfer timing

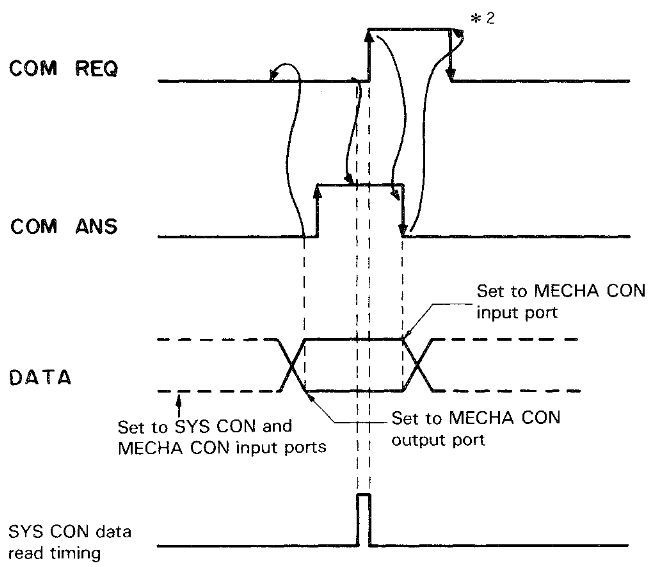
*1 When the data has been input, the MECHA CON raises COM ANS and waits until COM REQ falls. When COM REQ falls, COM ANS also falls immediately.
The SYS CON confirms the fall of COM ANS.

7-3. System control (SYS CON) → Mechanism control (MECHA CON) transfer data

The following table shows the formats of 8-bit data of the request commands sent from the SYS CON to MECHA CON.

Command	Data Format								Function
	b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0	
EJECT	0	0	0	1	0	0	0	1	Eject request
PLAY	0	0	0	1	0	0	1	0	Play request Also functions to release FF, REW, IND.S and search
FF	0	0	0	1	0	0	1	1	Fast forward request
REW	0	0	0	1	0	1	0	0	Rewind request
IND.S	0	0	0	1	0	1	0	1	Index Scan request
STOP	0	0	0	1	0	1	1	0	To stop motor while tape is loaded (usually not used)
Tape	0	0	0	1	0	1	1	1	To switch audio source to DAT
ACC ON/OFF	0	0	0	1	1	0	0	0	To switch ACC ON→OFF or OFF→ON
PNO Search (1)	0	0	1	0	PNO 1's digit BCD				PNO search data BCD code for digit of 1 of PNO
PNO Search (10)	0	0	1	1	PNO 10's digit BCD				PNO search data BCD code for digit of 10 of PNO
M. Search+(1)	0	1	0	0	+search No. 1's digit BCD				Forward-direction music search data BCD code for digit of 1 of search No.
M. Search+(10)	0	1	0	1	+search No. 10's digit BCD				Forward-direction music search data BCD code for digit of 10 of search No.
M. Search−(1)	0	1	1	0	−search No. 1's digit BCD				Reverse-direction music search data BCD code for digit of 1 of search No.
M. Search−(10)	0	1	1	1	−search No. 10's digit BCD				Reverse-direction music search data BCD code for digit of 10 of search No.
Test Mode	1	0	0	0	0	0	0	1	Capstan×1
	1	0	0	0	0	0	1	0	Capstan×3
	1	0	0	0	0	0	1	1	Capstan×9
	1	0	0	0	0	1	0	0	Capstan×16
	1	0	0	0	0	1	0	1	1.5Tp
	1	0	0	0	0	1	1	0	PAUSE
Repeat 1	0	0	0	1	1	0	0	1	To repeat the current program an infinite number of times
Repeat All	0	0	0	1	1	0	1	0	To not eject cassette at tape start but to start playback
Radio	0	0	0	1	1	0	1	1	To switch audio source to radio or AUX

7-4. Mechanism control (MECHA CON) → System control (SYS CON) Data transfer format



*2 When the data has been input, the SYS CON raises COM REQ and waits until COM ANS falls. When COM ANS falls, COM REQ also falls immediately.
The MECHA CON confirms the fall of COM REQ.

7-5. Mechanism control (MECHA CON) → System control (SYS CON) transfer data

(1) PCM-ID

bit	7	6	5	4	3	2	1	0
	1	1	1	1				
	Command				PCM-ID DATA			

Bit 0 → T-PICH; bit 1 → Empha; bits 3, 2 → FS

bit DATA	0	1
T-PICH	13.6 μm	20.4 μm
Empha	OFF	50/15 μ
FS	00 : 48K 01 : 44.1K	10 : 32K 11 : RF absent

(2) Sub-code data

The sub-code data consists of 1 byte of command, 3 bytes of time data and 2 bytes of PNO data. However, the S-ID command consists of only 1 byte because it does not contain data.

(i) Command codes

Sub-code	Command Code								Function
	7	6	5	4	3	2	1	0	
Absolut-Time	0	0	0	0		0	0	1	Output of absolute time data
Program-Time	0	0	0	0		0	1	0	Output of program time data
PNO	0	0	0	0		0	1	1	Output of PNO data
Last PNO	0	0	0	0		1	0	0	Output of final PNO read from TOC of pre-recorded music tape
S-ID	0	0	0	0		1	0	1	Output when S-ID is read
No-Rec	0	0	0	0	1	1	1	1	Output when sub-code is not recorded

→ Sub-code record check bit

1: Not recorded 0: Recorded

* S-ID is output from the MECHA CON only during search.

(ii) Data

a) Time data

Data is transferred in the sequence from the hour, minute and second. The contents of data are as follows.

7	6	5	4	3	2	1	0
BCD code for digit of × 10				BCD code for digit of × 1			

b) PNO data

2 bytes of data are output as follows.

7	6	5	4	3	2	1	0
				PNO 1			

7	6	5	4	3	2	1	0
PNO 2				PNO 3			

(3) Mechanism mode data

These are the data for informing the System Control (SYS CON) of the mechanism modes. The following data are used.

Data Name	Data Code								Function
	7	6	5	4	3	2	1	0	
Tape Remain	0	0	0	1	Remaining tape data				Output of tape remaining amount data. Data is 0 to 9, and indicator lights according to the data value
Loading	0	0	1	0	0	0	0	1	Output at the start of cassette loading
Play	0	0	1	0	0	0	1	0	Output at the star of playback The SYS CON releases muting when this signal is received
FF	0	0	1	0	0	0	1	1	Output at the start of fast forward
REW	0	0	1	0	0	1	0	0	Output at the start of rewind
EJECT	0	0	1	0	0	1	0	1	Output at the start of ejection
Tape Out	0	0	1	0	0	1	1	0	Output at the end of ejection
Tape End	0	0	1	0	0	1	1	1	Output when tape end is detected
Search up	0	0	1	0	1	0	0	0	Output at the start of forward search
Search down	0	0	1	0	1	0	0	1	Output at the start of backward search
IND.S	0	0	1	0	1	0	1	0	Output at the start of Index Scan
No Dew	0	0	1	0	1	0	1	1	Output when condensation is recovered
MUTE ON	0	0	1	0	1	1	0	0	Muting ON request
Rre-rec tape	0	0	1	0	1	1	0	1	Output with pre-recorded tape

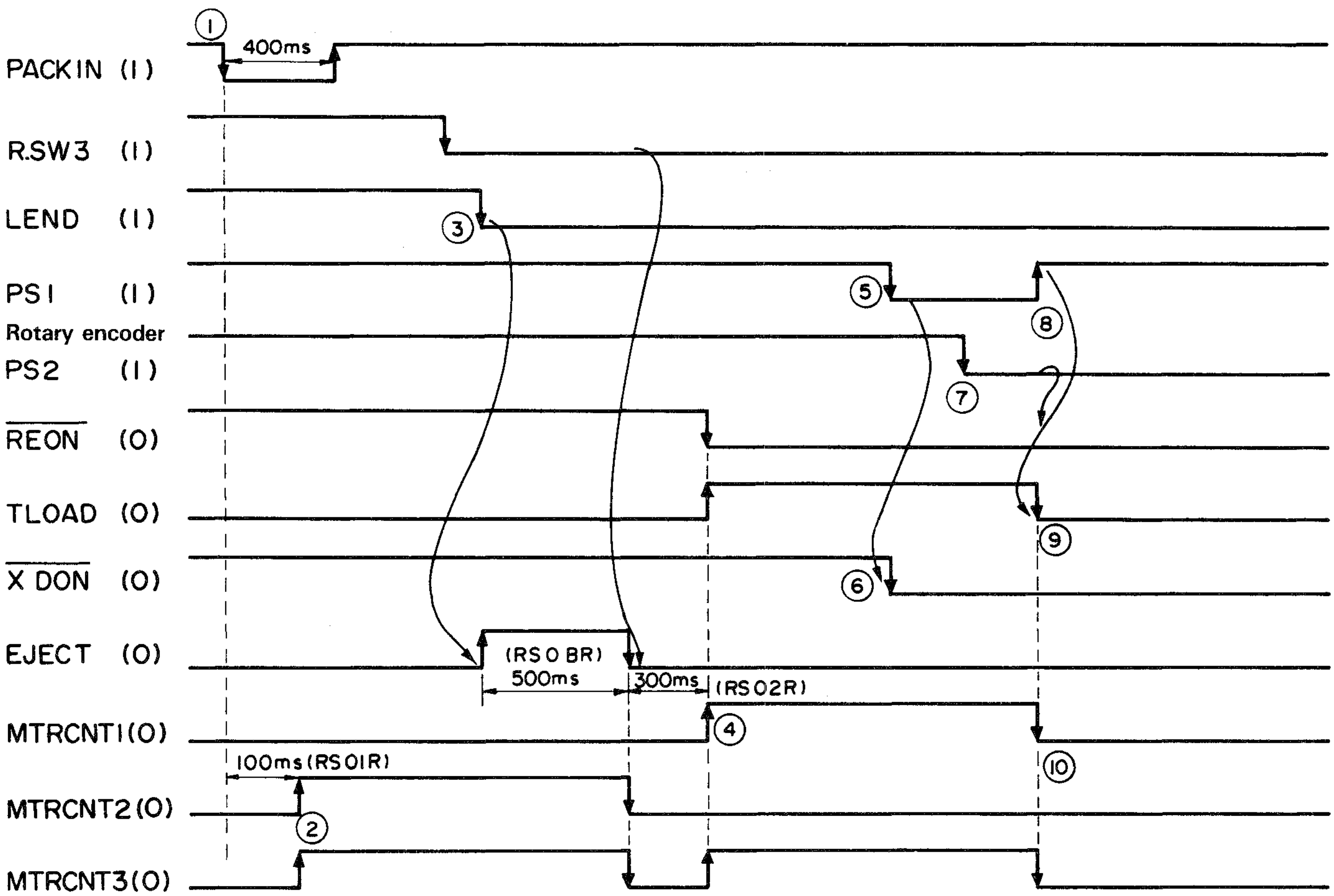
(4) Fault alarm data

The following data are output in case of mechanism error. When the System Control (SYS CON) receives one of the data, it displays the data value in the PNO display.

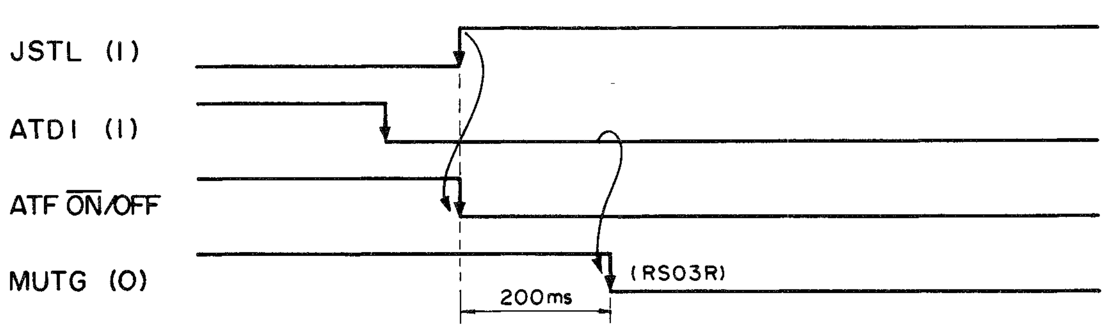
Data Name	Data Code								Function
	7	6	5	4	3	2	1	0	
Eject/Loading error	1	1	1	0	0	0	0	1	Output when ejection or loading failed to complete
	1	1	1	0	0	0	1	0	Tape loading mistake
	1	1	1	0	0	0	1	1	Reel stoppage
					0	1	0	0	Tape loading abnormal
					0	1	0	1	Cassette-up
					0	1	1	0	Mode switching mistake
					0	1	1	1	Tape breakage
					1	0	0	0	Drum stoppage
					1	0	0	1	12 bit non linear
					1	0	1	0	
					1	0	1	1	
					1	1	0	0	
					1	1	0	1	
Dew	1	1	1	0	1	1	1	0	Output in case of condensation
					1	1	1	1	

7-6. Timing charts

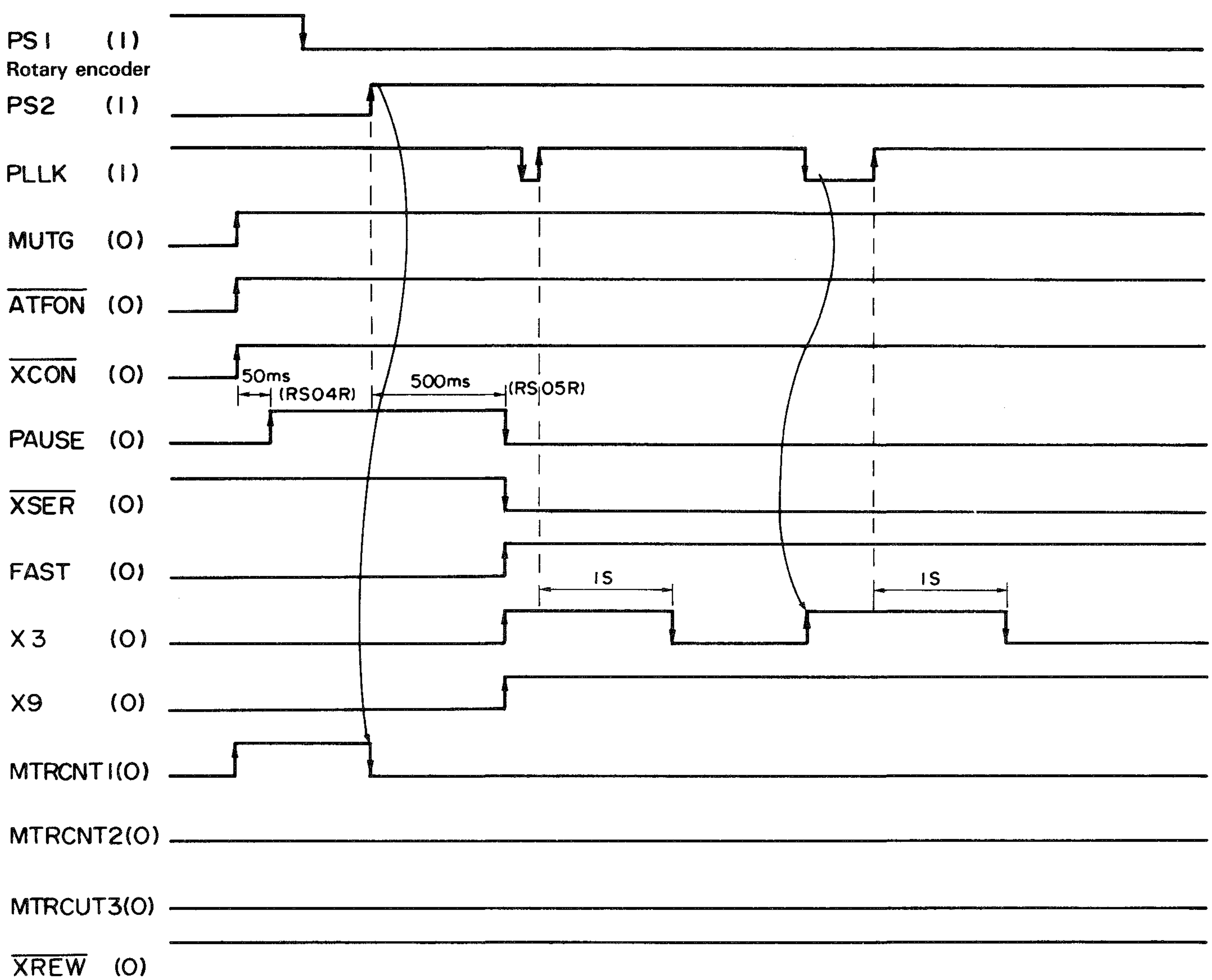
Loading timing chart



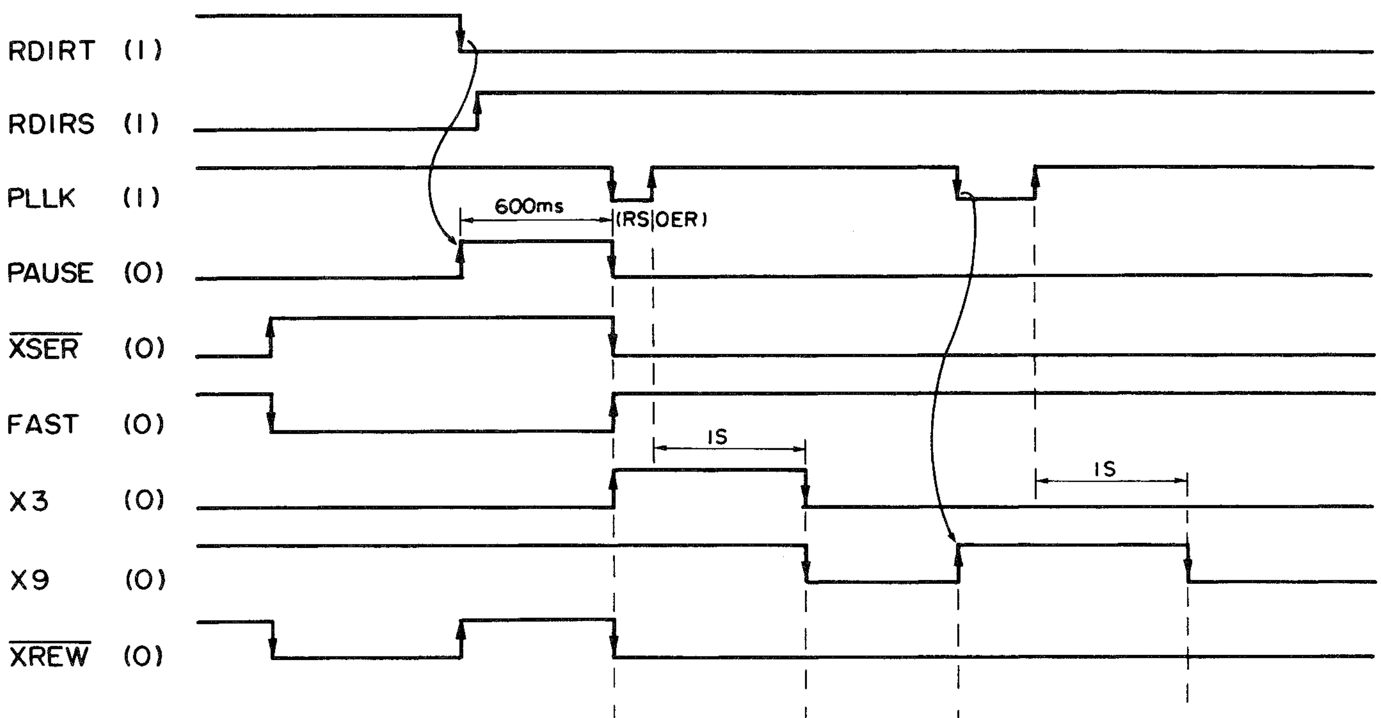
Loading end → Digital muting OFF timing chart



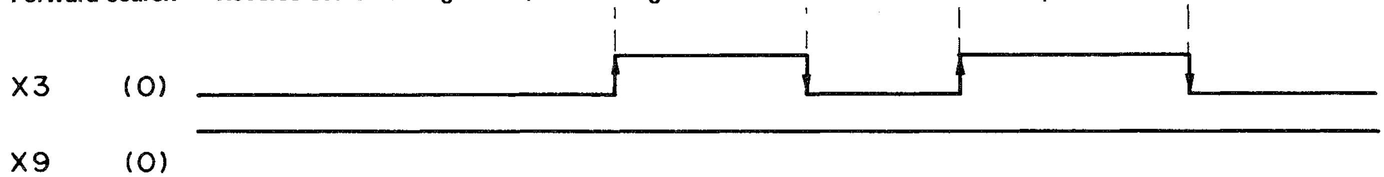
Play → FF/forward search timing chart



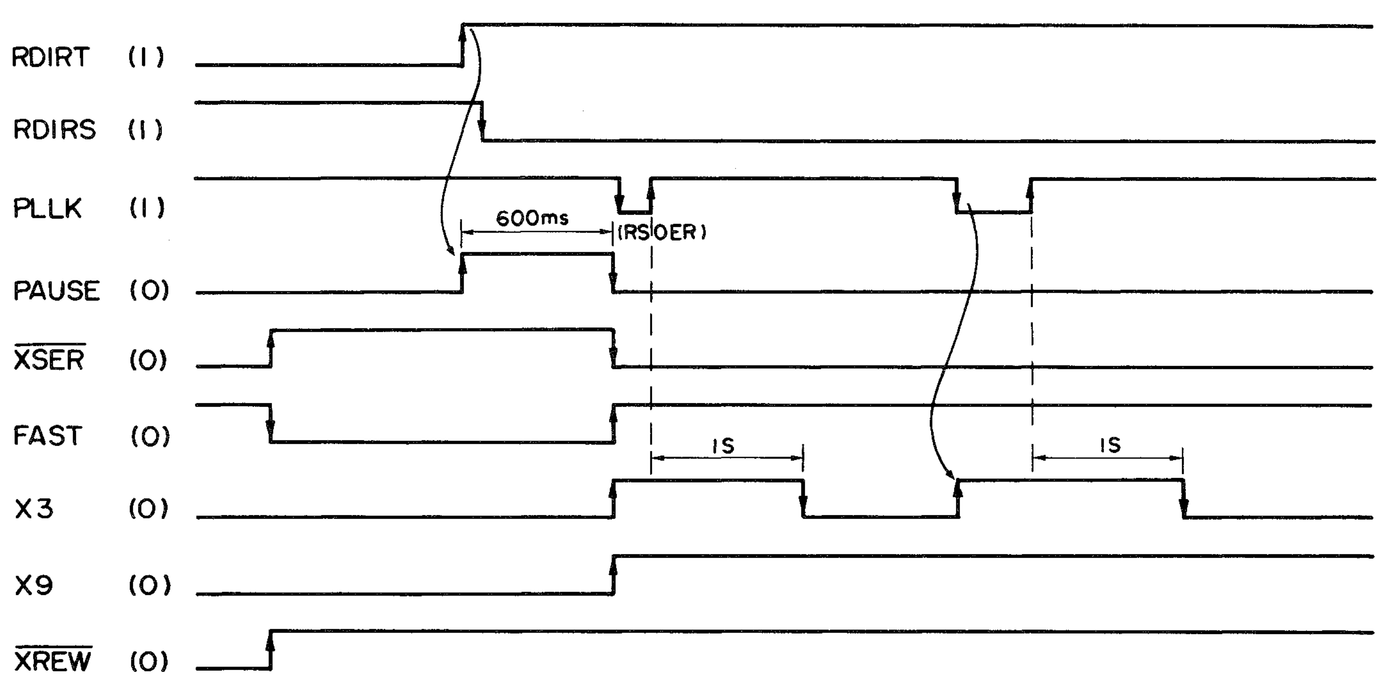
FF → REW timing chart



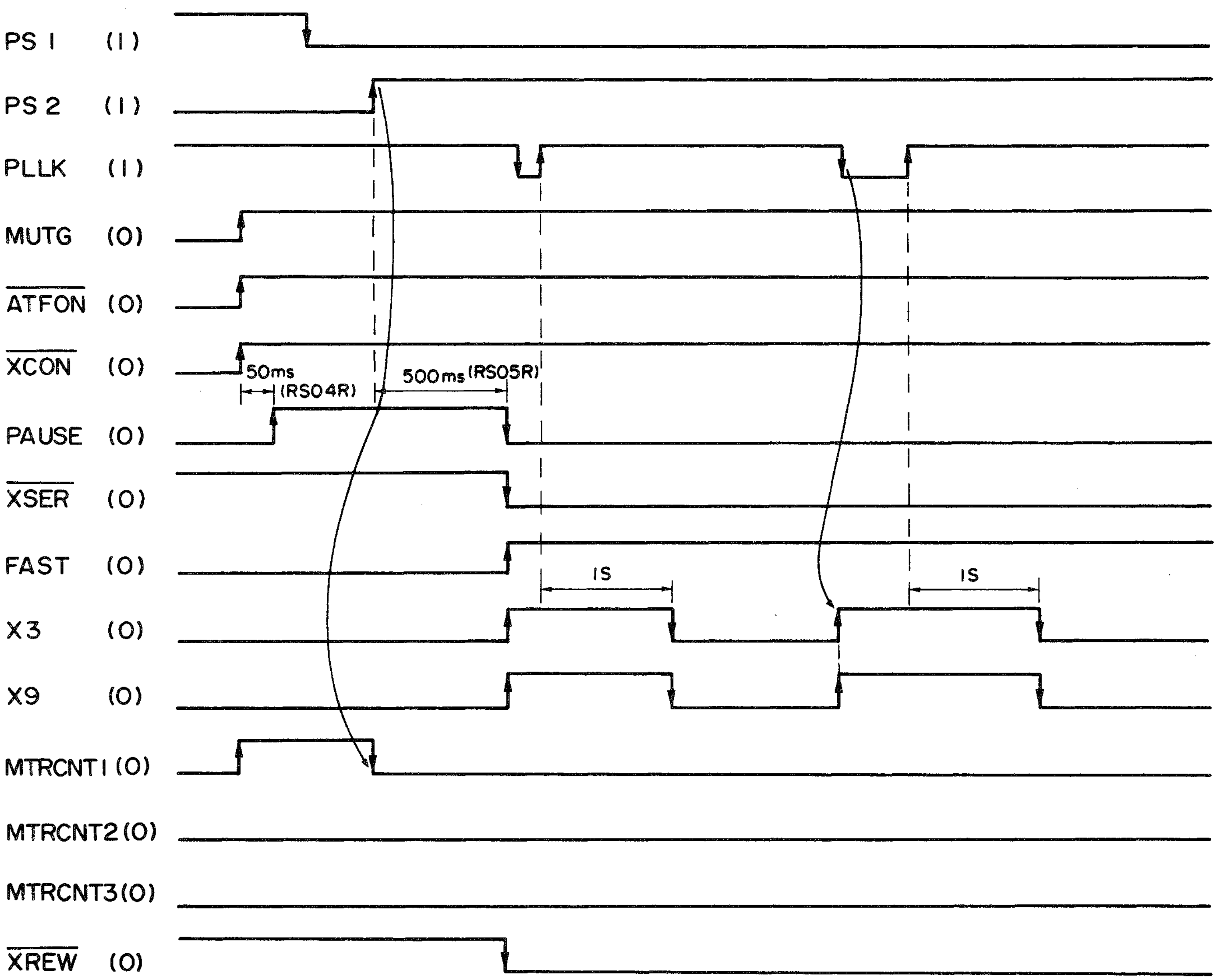
Forward search → Reverse search timing chart (other timings are the same as with FF → REW.)



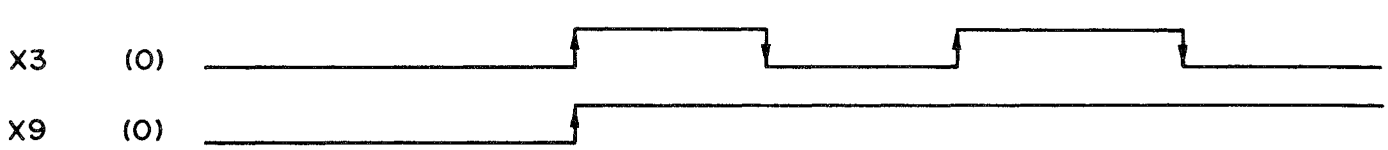
REW → FF timing chart



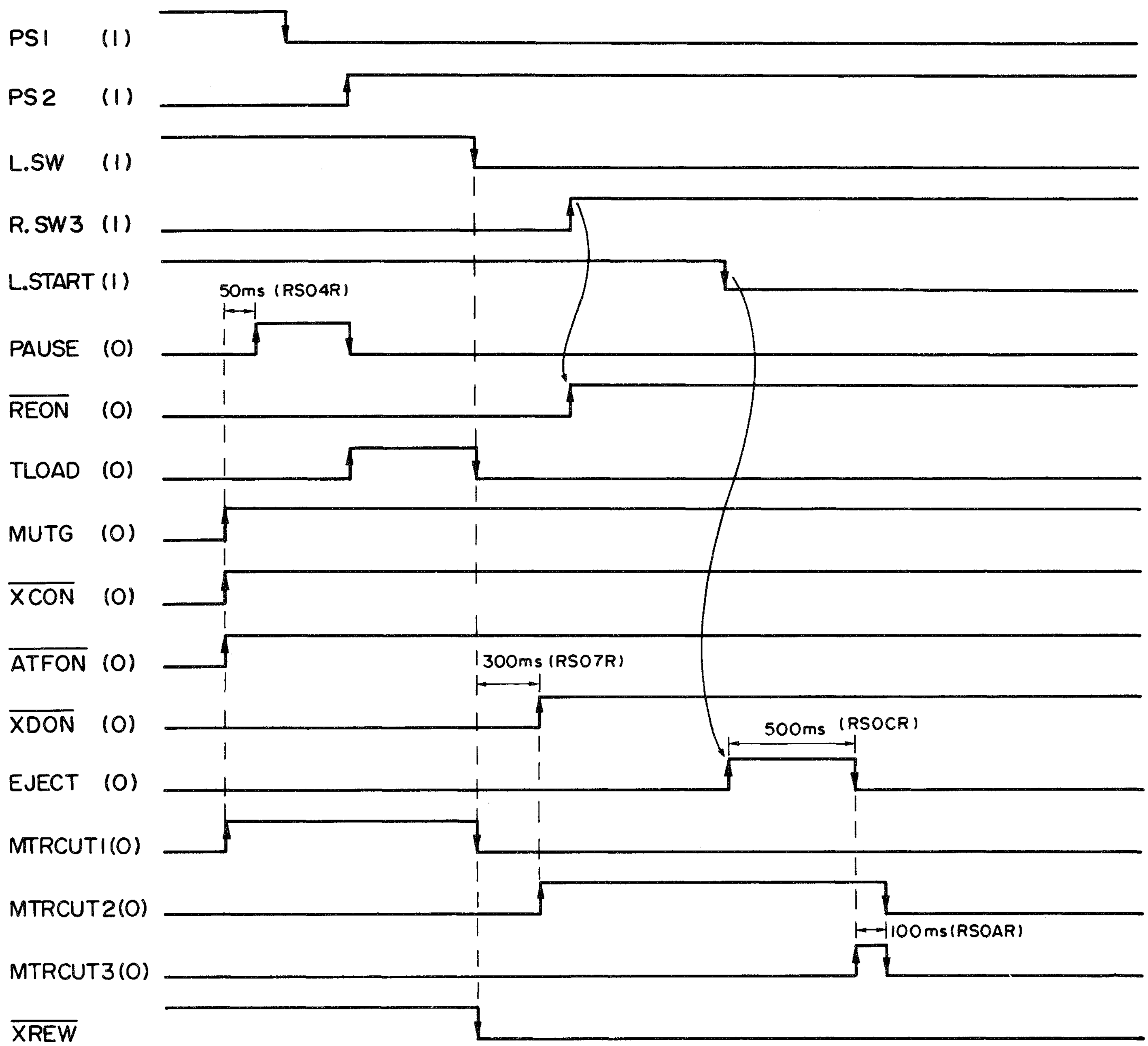
Play → REW timing chart



Play → Reverse search timing chart (other timings are the same as with PLAY → REW.)

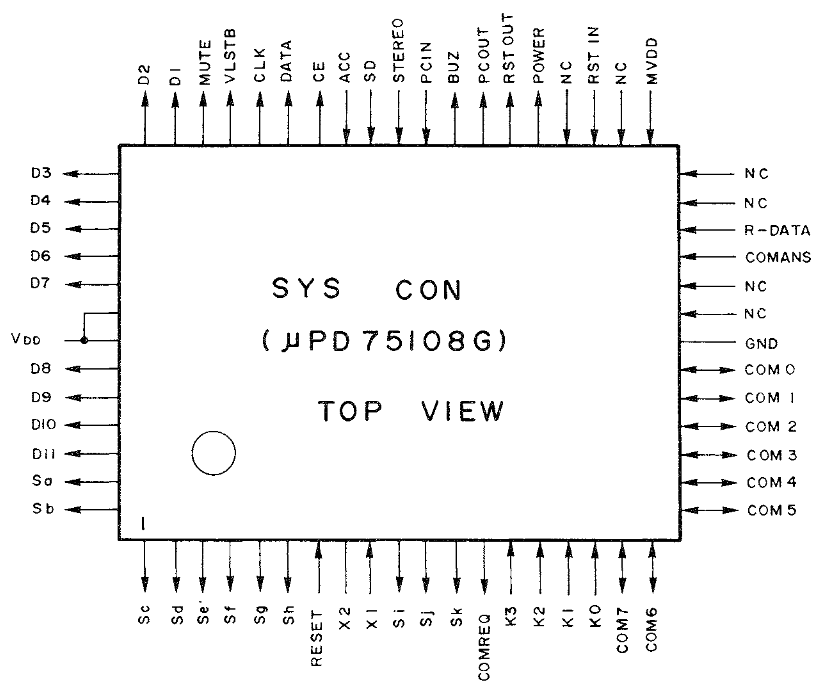


Play → Ejection timing chart



8. SEMICONDUCTOR DATA

8-1. IC1: μPD75108G574-1B (X14-223X-XX) Microprocessor (system control)

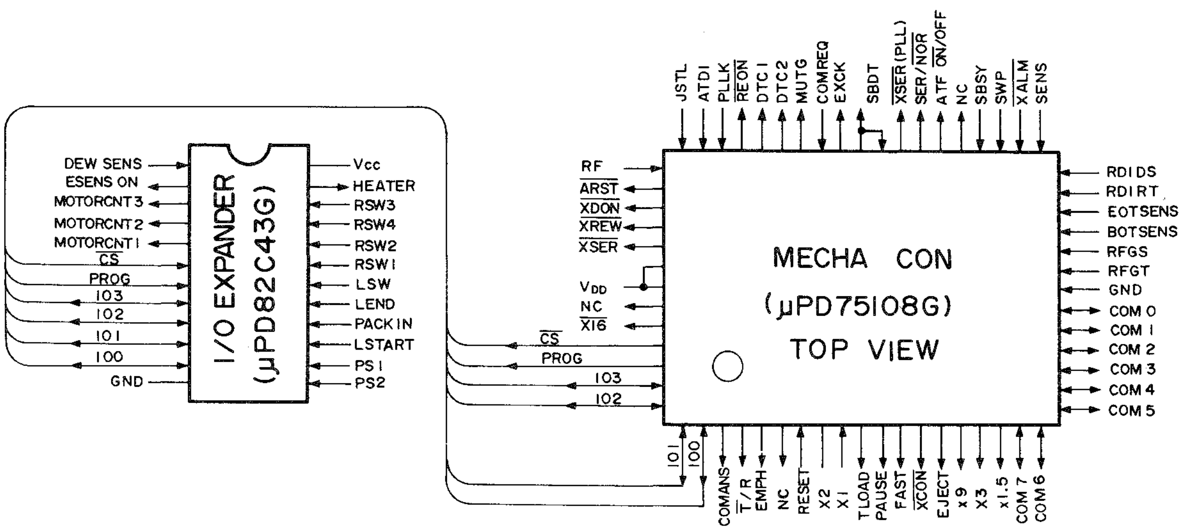


Terminal pin functions

Pin no.	Name	Function
1—6 10—12 63, 64	Sa—Sk	Key return signal source, display segment output signals
7	RESET	Microprocessor initialization terminal. "L" for initializing the microprocessor.
8—9	X2, X1	Oscillator connection terminals.
13	COMREQ	Communication request signal from the System Control microprocessor (hereafter SYS CON) to Mechanism Control microprocessor (MECHA CON). For the details of communication timing, refer to the timing charts shown later.
14—17	K0—K3	Input terminals for key return signals from dynamic key matrix.
18—25	COM7—COM0	Data buses for communications between SYS CON ←——→ MECHA CON.
26	GND	Microprocessor GND.
27, 28	NC	No connection.
29	COMANS	Communication request signal from MECHA CON to SYS CON. For the details of the communication timings, refer to the timing charts shown later.
30	R-DATA	Remote control serial data input terminal.
31, 32	NC	No connection.
33	MVDD	MECHA CON power supply line monitor terminal. Reset the MECHA CON at below 4.5 V.
34, 36	NC	No connection.
35	RSTIN	Operation stop request signal from the set connected to PRE OUT. "H" for ejecting cassette and turning tuner OFF.
37	POWER	DC/DC converter ON/OFF signal. "H" for ON.
38	RSTOUT	Operation stop request signal to the set connected to AUX IN.
39	PCOUT	Amplifier power ON/OFF signal, and operation stop request signal to the set connected to PRE OUT. "H" for turning power ON and sending the request.
40	BUZ	Operation buzzer output terminal.

Pin no.	Name	Function
41	PCIN	Operation stop request signal from the set connected to AUX IN. ''L'' for ejection and turning the tuner OFF.
42	STEREO	Stereo reception signal. ''H'' with stereo.
43	SD	Station reception signal. ''L'' for reception canceling muting.
44	ACC	ACC switch sensor signal. ''H'' for ACC switch OFF, with the tape ejected if it has been played.
45	CE	PLL (LM7001) chip enable terminal.
46	DATA	Data output terminal for the electronic VR (TC9188F) and PLL (LM7001).
47	CLK	Data latch clock signal for the electronic VR and PLL.
48	VLSTB	Strobe signal for the electronic VR data latching.
49	MUTE	Audio muting signal.
50–56 69–62	D1–D11	Digit signals for dynamic light display.
57	NC	No connection.
58	VDD	Power supply

8-2. IC8: μPD75108G590-1B (X29-1830-00) Microprocessor (mechanism control)



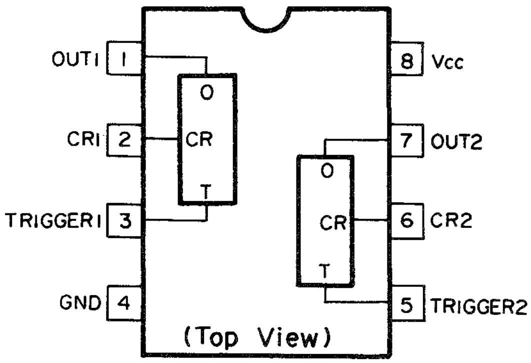
Terminal pin functions

Pin no.	Name	Function
1, 2 63, 64	I/O0—I/O3	Expanded I/O (μPD82C43G) data buses.
3	COMANS	Communication request signal from MECHA CON to SYS CON. For details of the communication timings, refer to the timing charts shown later.
4	T/R	Audio source switching signal. Switches between the DAT and other audio.
5	EMPHASIS	Emphasis ON/OFF signal. "H" for ON.
6	NC	No connection.
7	RESET	Microprocessor initialization terminal. "L" for initializing the microprocessor.
8—9	X2, X1	Oscillator connection terminals.
10	TLOAD	"H" for setting the reel to tape loading or unloading status.
11	PAUSE	"H" for setting the reel in pause mode. Used in mode switching from play to FF/REW or from FF/REW to play.
12	FAST	"H" for high-speed reel rotation. Used in FF, REW and search operations.
13	XCON	Capstan motor ON/OFF signal. "L" for motor ON.
14	EJECT (MVCNT)	"H" for varying the voltage applied to the motor from 5 to 4 V. This signal is turned "H" for 500 ms after the end of cassette loading or ejection.
15	×9	"H" for setting the capstan motor speed ×9 times higher than normal. Also increases the reel speed.
16	×3	Similar to above, except that this sets ×3 times higher speed, and decreases the reel speed.
17	×1.5	Similar to above, except that this sets ×1.5 times higher speed.
18—25	COM7—COM0	Data bus for communications between SYS CON ←——→ MECHA CON.
26	GND	Microprocessor GND.
27—28	RFGT, RFGS	Takeup and supply reel FG pulses. Used for calculation of tape remaining time and detection of reel stoppage. If the rise of either signal is not detected three times, the cassette is ejected.
29	ENDSENS (F)	Tape top-end sensor input. A 1 kHz pulse is input when the sensor is ON.
30	ENDSENS (R)	Tape end-end sensor input. A 1 kHz pulse is input when the sensor is ON.

Pin no.	Name	Function
31	RDIRT	Reel rotation direction signal. ''H'' in FWD direction.
32	RDIRS	Reel rotation direction signal. ''H'' in REW direction.
33	SENS	Temperature sensor input. ''H'' when the sensor is ON.
34	XALM	Alarm indicating the drum PLL lock error during high-speed search. When sweeping has repeated 8 times, this signal goes ''L'' to stop sweeping.
35	SWP	Drum switching pulse input.
36	SBSY	RAMC (CXD1009) operation mode setting and sub-code input sync signal. The mode is set and sub-code is input at the negative-going edge of this signal.
37	NC	No connection.
38	ATFON	ATF ON/OFF signal. ''L'' for ON. The ATF is turned ON when JSTL is ''H'' in play mode.
39	SER	''H'' at the start of blank skip. Usually ''L''.
40	PLLG	PLL search mode set signal. ''L'' during FF/REW/search.
41, 42	SBDT	RAMC operation mode setting output and sub-code input serial data line. Pin 41 is the input and pin 42 the output port.
43	SUBEXCK	Sync clock for the above serial data.
44	COMREQ	Communication request signal from SYS CON to MECHA CON.
45	MUTG	Digital muting signal ''H'' for muting ON.
46, 47	DTC1, DTC2	SBDT control signal. The 2-bit signal sets the SBDT input/output. For details, refer to RAMC (CXD1009).
48	REON	Reel motor ON/OFF signal. ''L'' for ON.
49	PLLK	PLL lock signal. ''H'' for locking. This signal regulates the reel speed during FF/REW/search.
50	ATD1	All-track tracking signal. When this is ''H'', tracking is assumed to be No Good and muting is activated.
51	JSTL	Drum just-locked signal. The ATF is turned ON when this signal is ''High'' during normal playback.
52	RF	RF present/absent detect signal. ''High'' when RF is present. When this signal goes ''L'' for 10 seconds during normal playback, blank skip starts.
53	ARST	Alarm reset signal. To re-start drum sweeping when XALM has become ''L'', turn this signal ''L'' for 10 μsec to reset XALM.
54	XDON	Drum motor ON/OFF signal. ''L'' for drum motor ON.
55	XREW	Reel motor rotation direction set signal. ''L'' for REW.
56	XSER	Drum search mode set signal. ''L'' during FF/REW/search.
57	NC	No connection.
58	VDD	Power supply.
59	NC	No connection.
60	×16	When this signal is ''L'', the capstan motor speed is set to ×16 times the normal speed.
61	CS	Expansion I/O (μPD82C43G) chip select signal. ''L'' for accessing this IC.
62	PRG	Programming signal for the IC above. The input/output and I/O ports are set by the I/O bus at the negative-going edge of this signal, and data is input to or output from the I/O bus at the positive-going edge.

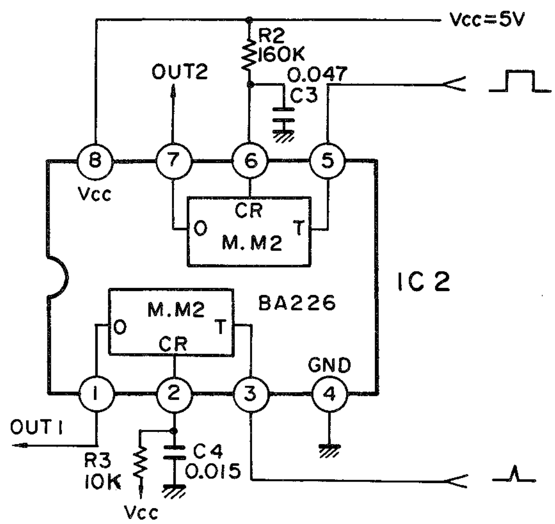
8-3. IC7: BA226F (X29-1830-00) Monostable multivibrator

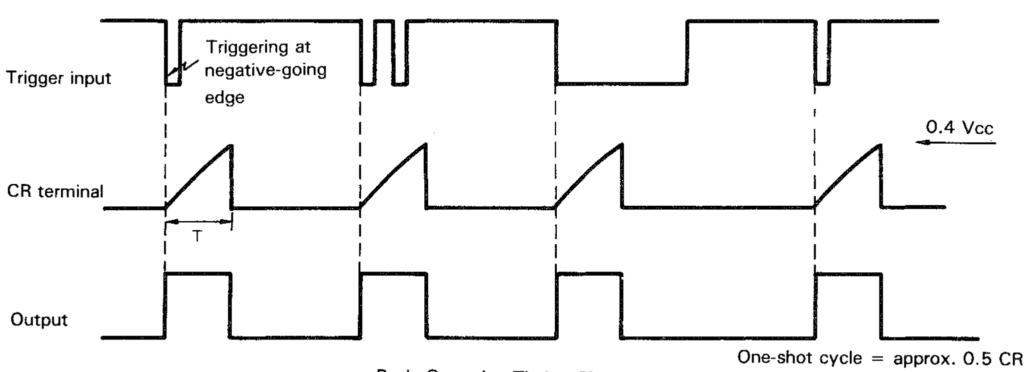
Block diagram



Operation

The following diagram shows the timing chart of the basic operations of this IC. When the trigger signal is not applied, the output is "L" and the timing capacitor is discharged. When the trigger signal is applied, the output goes "H" at its positive-going edge and the timing capacitor starts charging. The charging time of the timing capacitor is determined by the time constant of the external timing resistor and timing capacitor. When the capacitor is charged up to 0.4×Vcc, the flip-flop inside the IC is reset, and the IC output turns from "H" to "L". At the same time, the timing capacitor discharges and gets ready for the next operation.

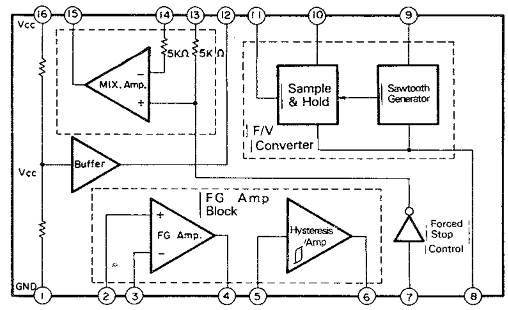




Basic Operation Timing Chart
(Negative-Going Edge Triggering)

8-4. IC20: BA6301F (X29-1830-00) FG system speed control IC

Block diagram

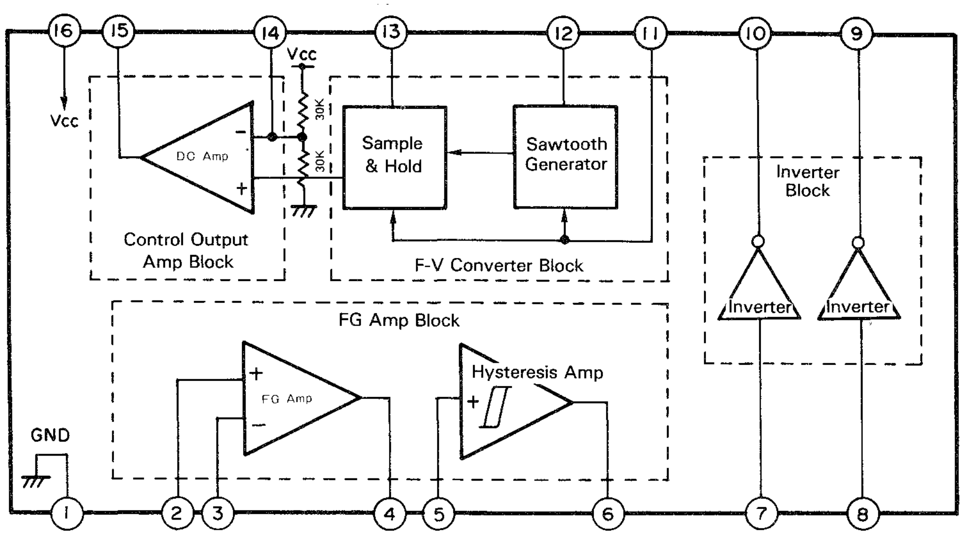


Terminal pin functions

Pin no.	Name	I/O	Waveform	Function	Remark
1	GND	—			
2	FG IN	I	1.4V, 0V; 0.5 ms range	FG amp +ve input.	
3	FG IN	I	1.4V, 0V; 0.5 ms range	FG amp −ve input.	
4	FG OUT	O	3V, 0V, 1.4 ms; 0.5 ms range	FG amp output.	
5	FG INPUT	I	3V, 0V, 1.4 ms; 0.5 ms range	Hysteresis amp input.	
6	FG OUTPUT	O	4.5V, 0V, 1.4 ms; 0.5 ms range	Hysteresis amp output.	
7	CONT	I	"L"	Mixing amp output, forced stop input.	"H" for stoppage. The signal is supplied from IC3 (μPD82C43G) port expander pin (XCON) on the X13-5690 unit PCB.
8	CFGO IN	I	5V, 1.4 ms; 5V, 1.4ms; 5V, 1.4 ms; 0.5 ms range	The input is the FG divided into 1/1, 1/3, 1/9 or 1/16 depending on the mode.	The signal is supplied from IC9 (CXD1052D) pin (CFGO) on the X29-1830 unit PCB.
9	SPEED SET	I	3V, 0V, 1.4 ms; 0.5 ms range	Connection terminal for C and R used for sawtooth generation.	
10	HOLD C	I	3V, 1.4ms, 0V; 0.5 ms range	Connection terminal for hold capacitor.	
11	S/H OUT	O	2.5V	Sample & Hold output.	
12	REF VOLTAGE	O	2.5V	Power voltage which is divided and output from buffer.	
13 14	MIX AMP IN	I	2.5V	F/V output mixing amp input terminal.	
15	MIX AMP OUT	O	2.5V, 1.4ms	F/V output mixing amp output terminal.	
16	VDD	—		5 V	

8-5. IC13: BA6303F (X13-5690-00) FG system speed control IC

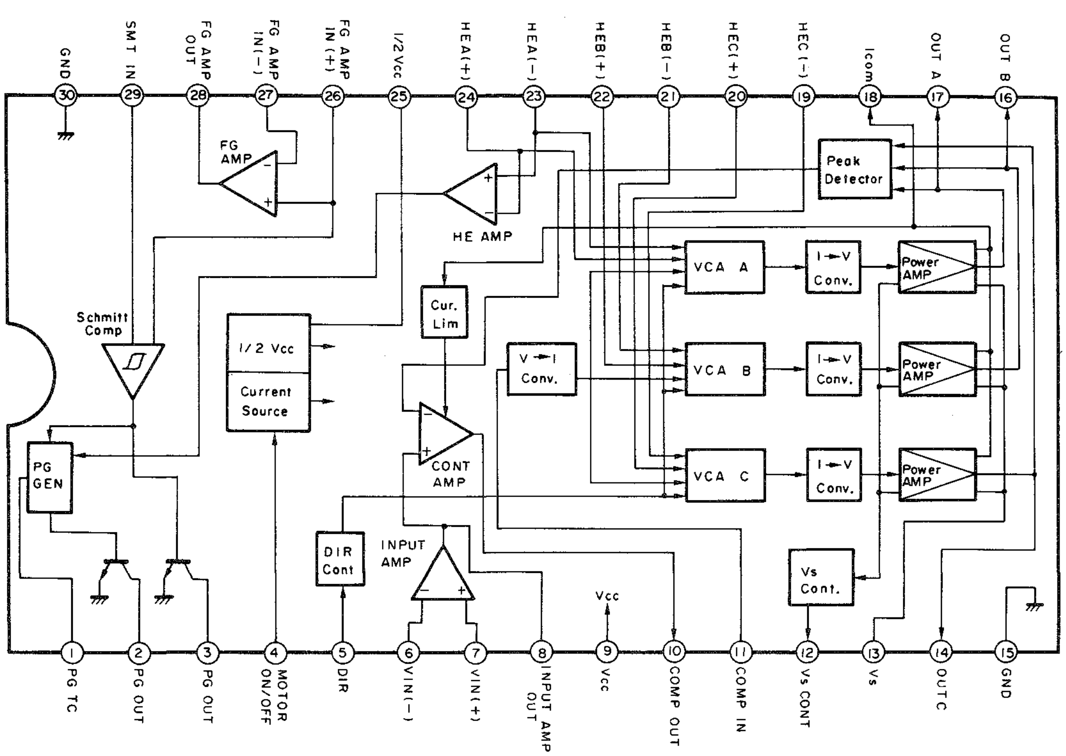
Block diagram



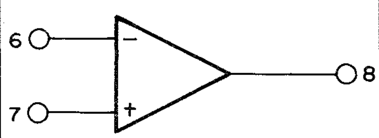
8-6. IC3: CX20174 (X29-1830-00) 3-phase linear BSL motor driver IC

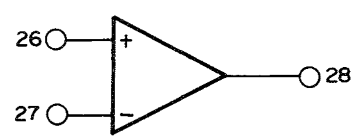
The CX20174 is the IC driving the 3-phase linear BSL motor.
As well as driving the motor, it also controls the drive output and generates frequency pulse and phase pulse.

Block diagram and pin configuration



Terminal pin functions

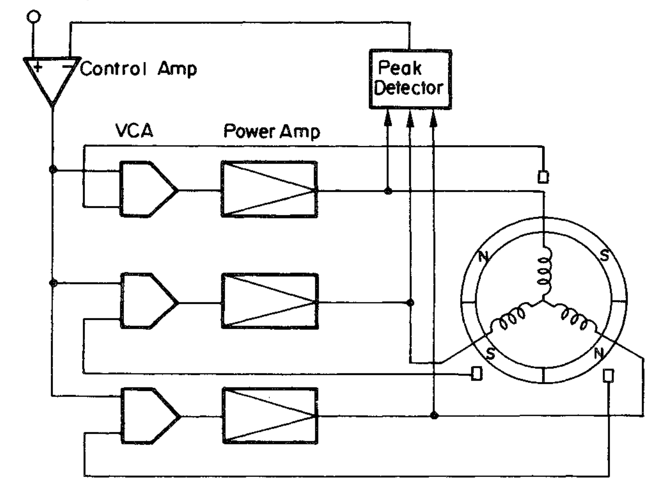
Pin no.	Name	Voltage (typical)	Function, condition
1	PG TC	2 V	PG (Phase Generator) pulse duration set terminal. 2-pin output. $tw = 2.5 \times 10^{-4} C_t$ C_t: Capacitor inserted between pin 1 and GND. ㉔ input voltage > ㉓ input voltage (0 V in opposite case).
2	PG OUT	150 mV	PG pulse output terminal. Open-collector. ㉔ input voltage > ㉓ input voltage (0 V in opposite case).
3	FG OUT	150 mV	FG pulse output terminal. Open-collector. ㉙ input voltage < ㉖ input voltage.
4	MOTOR ON/OFF	6 V	Turns the current supply inside the IC OFF to set OUT A, B and C to high impedance. External resistor RB determines the value of the current supply inside the IC. $R_B = Vcc/2 \times 1/(100 \times 10^{-6})$ (ohms). EX: Vcc = 12V, RB = 56 to 68 kilohms Connect a 68-kilohm R between ④ and 12 V.
5	DIR	0 V	Motor rotation direction switching terminal. The threshold voltage is 1/2 Vcc. Connected to GND.
6	VIN (−)	2 V	Motor control voltage amp. 
7	VIN (+)	2 V	
8	INPUT AMP OUT	2 V	Input voltage range: 0 to Vcc-2 V (at pins 6 and 7) The 20 kilohm connected to pin ⑥ is biased to 2 V. Pin ⑦ is biased to 2 V.
9	Vcc	12 V	Power supply. 4 to 14 V. Vcc = 12 V.

Pin no.	Name	Voltage (Typical)	Function, Condition
10	COMP OUT	80 mV	Phase compensation terminals for stabilizing the feedback loop of the amplitude control of the motor drive circuit. Rc is determined so that the voltage at pin 9 is 2.1 V or more. $Rc < (Vcc - 2.1 - I)/100 \times 10^{-6}$ Cc, Rc: Externally attached. The 20 kilohms connected to pin ⑥ is biased to 2 V. Pin ⑦ is 0 V.
11	COMP IN	80 mV	
12	VsCONT	10.6 V	Controls the external transistor which controls Vs to reduce heat generation inside the IC.
13	Vs	6 V	Motor drive power supply terminal.
14	OUTC	3 V	Motor coil connection terminals. To prevent oscillation, capacitors of 0.047 to 0.1 μF are connected between these pins and GND.
16	OUTB	3 V	
17	OUTA	3 V	
18	Icom	0 V	Motor drive GND terminal. The motor current can be detected by attaching an external resistor.
19	HEC (−)	6 V	Hall element input terminals. The phases of the Hall element outputs are made different by resistance addition, so that impedance of each terminal is around 2 to 4 kilohms. Bias voltage of Hall elements.
20	HEC (+)	6 V	
21	HEB (−)	6 V	
22	HEB (+)	6 V	
23	HEA (−)	6 V	
24	HEA (+)	6 V	
25	1/2Vcc	6 V	1/2 Vcc terminal for determining the operating point. To prevent oscillation and noise, a capacitor of 0.1 to 1 μF is attached externally.
26	FG AMP IN (+)	6 V	FG amp.  Input voltage range: 1/2 to Vcc − 2 V.
27	FG AMP IN (−)	6 V	
28	FG AMP OUT	6 V	
29	SMT IN	6 V	Schmitt comparator input terminal.
15 30	GND		

Operation description

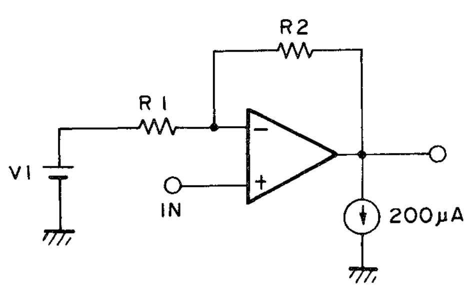
- **Motor drive block**

The CX20174 uses the 3-phase linear drive system.
The intensities of the magnetic fluxes of the magnets are detected by the Hall elements and amplified by the VCAs and power amps for use as the drive output.
To make the circuit adjustment-free, the maximum and minimum peak values of the 3-phase output are detected and a feedback loop is used so that the measured values are the same as the value of the control input.



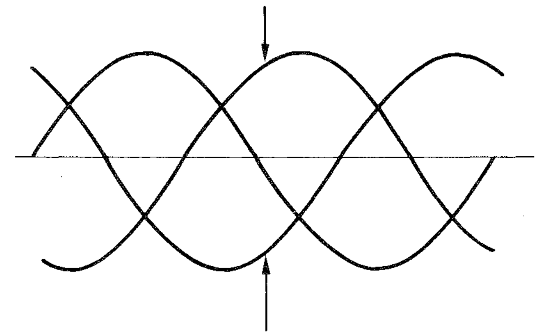
- **Input amp**

The input amp is used to amplify the control input signal (servo error signal). The input voltage range is 0 to Vcc−2 V, and the output voltage is 0 to Vcc−1.5 V. At the output, a constant current of 200 μA is fed to R2 for offset.
R1, T2 and V1 are determined so that V1 < (R1+R2) ×200 μA, because this condition allows to decrease the output voltage near 0 V.



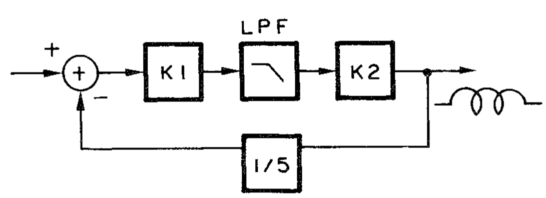
- **Peak detector**

This circuit detects the maximum and minimum values of the 3-phase output.
The 1/5 of the difference between the maximum and minimum values is sent back to the control amp.

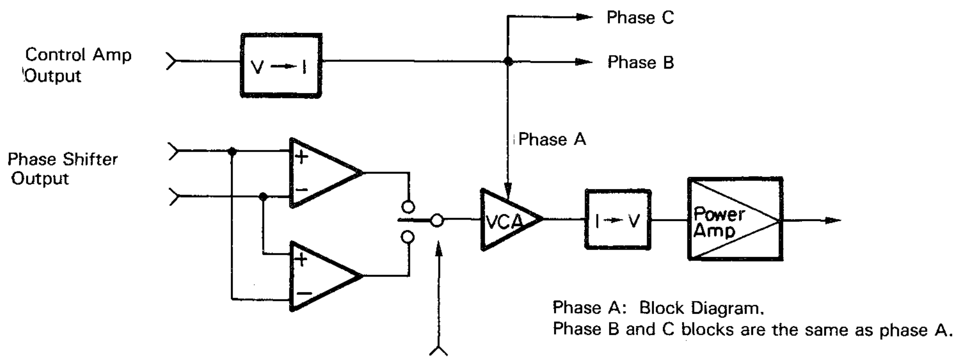


- **Control amp**

This circuit compares the amplitude outputs detected by the peak detector, and applies the difference to the VCA.
It accepts the input from 0 V and above.
To provide a blind sector which can turn the control amp output completely OFF, an offset of 48 mV is applied to the input from the peak detector.
As the amplitude control loop including the control amp is unstable, a primary LPF is added externally to the control amp output.
Because the output is a constant current regulated at 100 μA, the VCA in the next stage will not be able to operated if the LPF resistance is too small. Therefore, assuming that the minimum value for the VCA is 2.5 V, the resistance should be R > (Vcc−0.7−2.5)/100 μA. The fc of the LPF shall be between 20 and 60 Hz.



• **VCA**

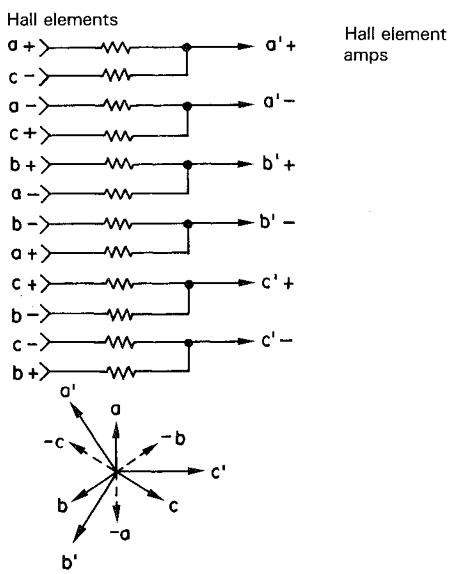


Phase A: Block Diagram.
Phase B and C blocks are the same as phase A.

Each VCA varies the phase-shifter output of the Hall element output signal amplitude using the control amp output.
The control amp output is V-I converted after being filtered by the LPF, and applied to the VCA of each of the 3 phases.

• **Phase shifter**

The phase shifter is used to provides a delay of 30° to the 3-phase outputs from the Hall elements by resistance composition. Although the Hall elements should be located on the center of coil in case of 3-phase linear drive, such location is actually difficult to achieve. Therefore, they are located on the centers of coil frames or between coils, and a 3-phase signal is composed to obtain the required signal.

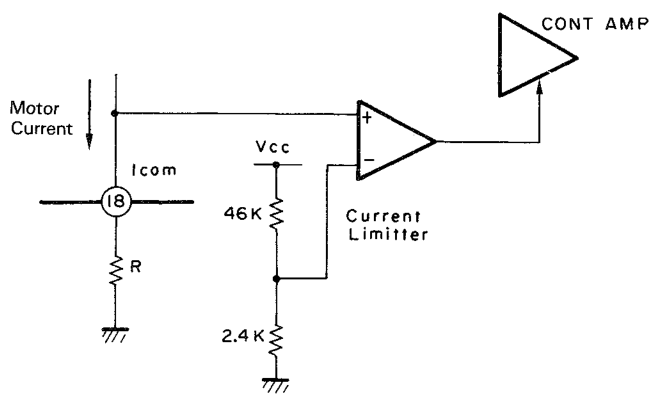


• **Power amp**

The maximum current is determined by the capacity of the aluminum wiring.
Assuming that the average start current of 200 mA is 50% duty, the maximum current is 400 mA.

Each VCA uses two Hall element amps, the output of which are applied to the VCA anti-phase. The rotation direction can be switched by selecting one of the amps.

• **Current limiter**

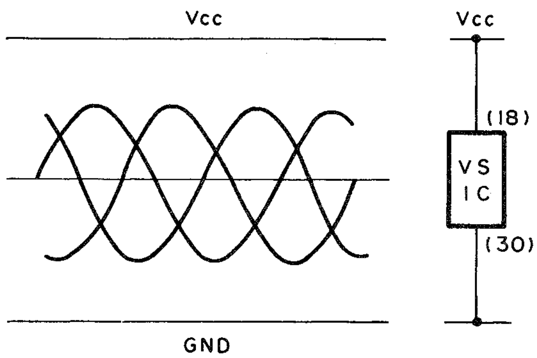


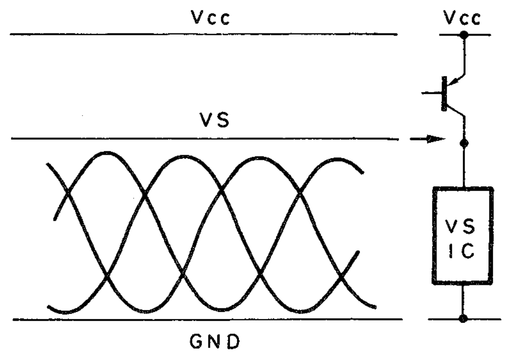
The current limiter detects the motor current via the resistor, and compares it with the reference voltage which is 2.4K/(46K+2.4K) x Vcc. When the motor current increases excessively, the current limiter decreases the control amp output.
The motor current limiting value can be varied by varying the external resistor value.

However, since this limiter is used to decrease the output amplitude, it does not operate during breaking or shorting between Vs and Icom.

- **Power saver**

The power saver is used to decrease the power loss inside the IC. It adjusts the motor drive power (Vs) to a value corresponding to the output amplitude using an external transistor, distributing the IC internal loss to it.

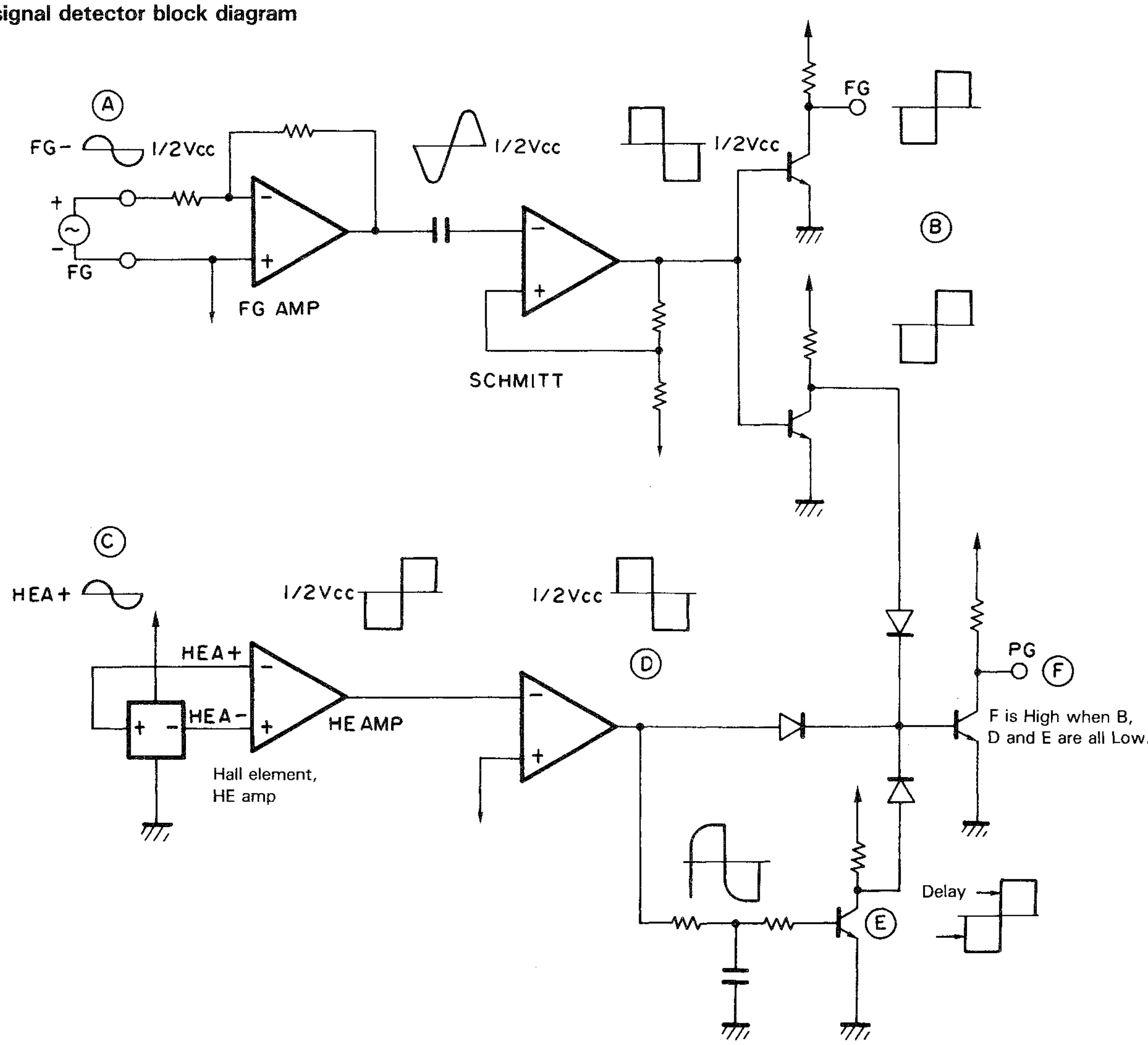




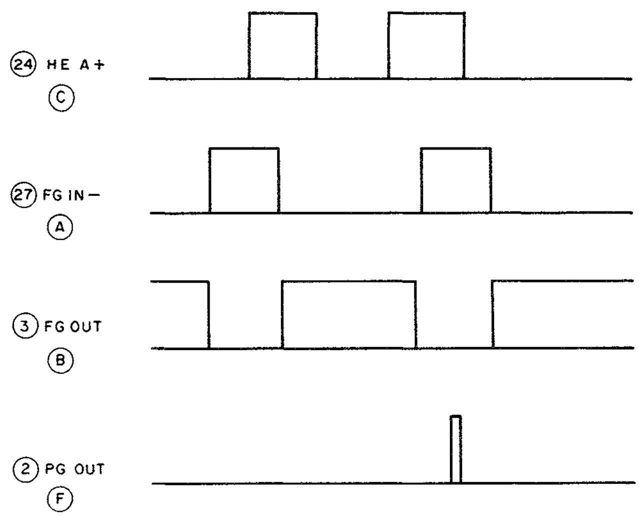
The voltage of Vs varies to become the maximum value among the following four values.

1 Phase A output voltage +0.7 V
2 Phase B output voltage +0.7 V
3 Phase C output voltage +0.7 V
4 1/2 Vcc

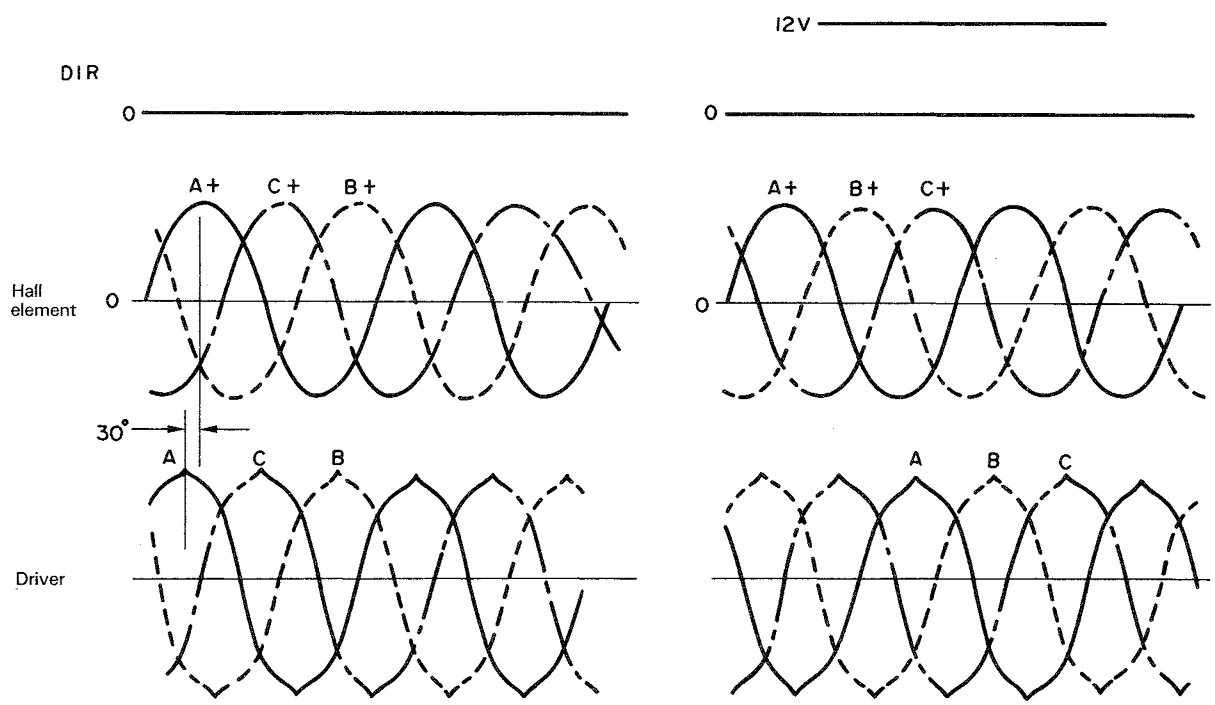
FG and PG signal detector block diagram



FG and PG signal timing chart



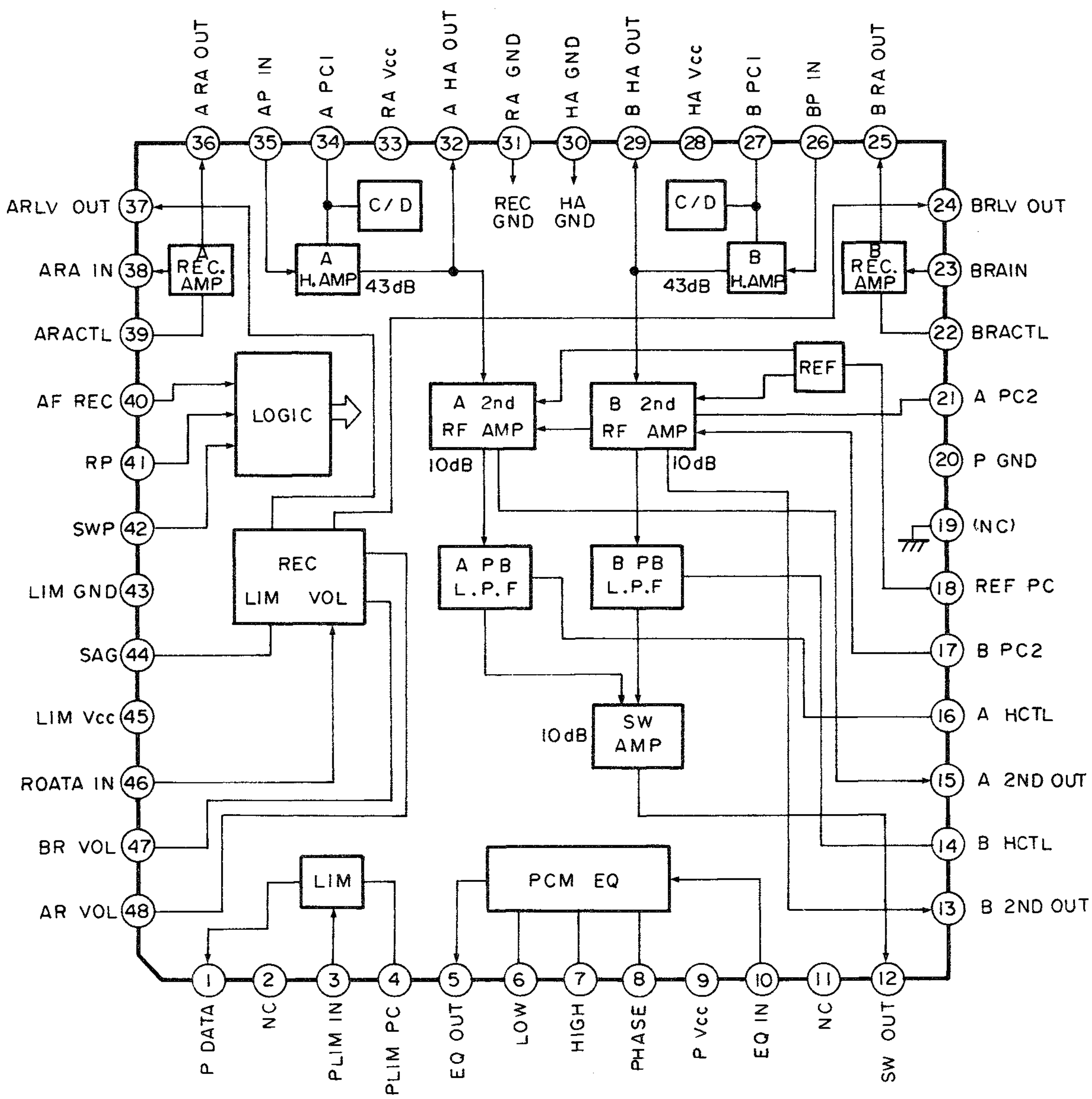
Driver timing chart



The order of Hall element inputs can be varied arbitrarily.

8-7. IC1: CXA1045Q (X13-5690-00) R-DAT REC/PB equalizer amp IC

Block diagram



Outline

The CXA1045Q is a multifunction bipolar IC which integrates the circuits required for functions related to the R-DAT heads. It makes possible interfacing with the digital signal processor IC using few externally-attached components.

Functions

- PB mode : Head amp,
  PCM equalizer,
  limiter
- REC mode : Output amplitude constant limiter
  REC amp
- Mode switching logic and switch

Structure

Bipolar, silicon, monolithic IC.

Features

- Built-in PCM equalizer filter.
- Easy interface with digital signal processor IC.
- Multifunction, reducing the necessity of external components.
- Single, 5 V power operation.
- Small package, making possible high-density mounting.

Terminal pin functions

Pin no.	Name	Voltage	Function
1	PDATA	H;3.4 V L;2.2 V	Playback signal output terminal.
2	NC	—	No connection. To be connected to the GND.
3	PLIM IN	2.6 V	PB limiter input terminal.
4	PLIM PC	2.6 V	PB limiter path control terminal.
5	EQ OUT	1.9 V	PCM equalizer output terminal.
6	LOW	1.7 V	Connection terminal for the resistor determining the low-frequency characteristic of PCM equalizer.
7	HIGH	1.7 V	Connection terminal for the resistor determining the high-frequency characteristic of PCM equalizer.
8	PHASE	1.7 V	Connection terminal for the resistor determining the phase characteristic of PCM equalizer.
9	P Vcc	5 V	Power supply terminal for the playback circuitry other than the head amp and limiter, and for the control logic circuitry.
10	EQ IN	3.2 V	PCM equalizer input terminal.
11	NC	—	No connection. To be connected to the GND.
12	SW OUT	2.6 V	Output terminal for the switching amp which unifies the outputs from 2 channels.
13	B 2ND OUT	2.5 V	B CH 2nd RF amp output terminal.
14	B HCTL	1.7 V	Connection terminal for the resistor determining the cutoff frequency of the B CH PB LPF.
15	A 2ND OUT	2.5 V	A CH 2nd RF amp output terminal.
16	A HCTL	1.7 V	Connection terminal for the resistor determining the cutoff frequency of the A CH PB LPF.
17	B PC2	1.6 V	B CH 2nd RF amp path control terminal.
18	REF PC	2.6 V	REF block path control terminal.

Pin no.	Name	Voltage	Function
19	(NC)	(0 V)	Connected internally to the GND. Be sure to leave this terminal open.
20	P GND	0 V	GND terminal for playback circuitry other than the head amp and limiter.
21	A PC2	1.6 V	A CH 2nd RF amp path control terminal.
22	B RACTL		Not used normally. To be connected to the power voltage.
23	B RA IN	0.7 V	B CH REC amp output terminal.
24	B RLV OUT	3.3 V	B CH output terminal for REC limiter VR (REC output amplitude variable-limiter).
25	B RA OUT	—	B CH REC amp output terminal.
26	B PIN	2.5 V	B CH head amp input terminal.
27	B PC1	1.7 V	B CH head amp path control terminal.
28	HA Vcc	5 V	Head amp power supply terminal.
29	B HA OUT	3.0 V	B CH head amp output terminal.
30	HA GND	0 V	Head amp GND terminal.
31	RA GND	0 V	REC amp GND terminal.
32	A HA OUT	3.0 V	A CH head amp output terminal.
33	RA Vcc	5 V	REC amp power supply terminal.
34	A PC1	1.7 V	A CH head amp path control terminal.
35	A PIN	2.5 V	A CH head amp input terminal.
36	A RA OUT	—	A CH REC amp output terminal.
37	A RLV OUT	3.3 V 47, 48 pin 2.2 V	A CH output terminal for REC limiter VR (REC output amplitude variable-limiter).
38	A RA IN	0.7 V	A CH REC amp input terminal.
39	A RACTL		Not used normally. To be connected to the power voltage.

Pin no.	Name	Voltage	Function
40	AF REC	—	Logic control terminal initiating the after-recording mode. H; 4 V or more (After-recording). L; 1 V or less (Normal). Open status is "L".
41	RP	—	Control terminal specifying the REC or PB mode. H; 4 V or more (Record). L; 1 V or less (Playback). Open status is "L".
42	SWP	—	Control terminal switching between A CH and B CH. H; 4 V or more (B). L; 1 V or less (A). Open status is "L".
43	LIM GND	0 V	PB limiter and REC limiter VR GND terminal.
44	SAG	3.7 V	REC sag compensation capacitor connection terminal. Connect an external capacitor of approx. 470 pF assuming that the external C and R connected to REC amp input are of 2200 pF and 2.7 kilohms.
45	LIM Vcc	5 V	PB limiter and REC limiter VR power supply terminal.
46	RDATA IN	—	Recording data input terminal for REC limiter VR (amplitude variable-limiters).
47	BR VOL	—	B CH amplitude adjust terminal for REC limiter VR (amplitude variable-limiter). Must not be open.
48	AR VOL	—	A CH amplitude adjust terminal for REC limiter VR (amplitude variable-limiter). Must not be open. Apply a voltage from 2.0 to 2.6 V to pins 47 and 48.

Operation description

(Playback mode)

Head amps, 2nd RF amps

The gain of the head amps is approx. 43 dB, and that of the 2nd RF amps is approx, 10 dB. The head amp outputs are used in feedback damping.

PB LPFs

A primary LPF is provided for each channel, so the cutoff frequencies can be adjusted with external VRs independently for the two channels.

SW amp

This unifies the outputs from 2-CH heads at an optimum timing and sends the single output to pin 12 (PIN SW OUT). At this time, it also provides a gain of approx. 10 dB.

Equalizer

This compensates the head output characteristic. The lower frequencies than 1 to 1.5 MHz are compensated by an integrator, and higher frequencies than this range are compensated by a differentiator. Then, the signal around 4 MHz is slightly enhanced, and the high frequencies are filtered by an LPF. The phases are also compensated during this process. These settings can be determined using three externally-connected resistors.

PB limiter

This judges the level of the PCM equalizer and also converts it into a signal level that can be handled by the signal processor LSI (output amplitude of approx. 1.2 Vp-p). Be careful that the output from this circuit does not pass near the head amp.

C/D (Charge-Discharge) circuits

These are used for quick charging or discharging of the head-amp path controllers (which are the capacitors connected to pins 27 and 34). Connect these circuits to the Vcc of the head amps.

[The KDT-99/99R does not use the record mode.]

(Record mode)

REC limiter VR (REC output amplitude variable-limiter)

The REC limiter VR adjusts the amplitude of data input from pin 46 according to the head used with each channel. The amplitudes of the two channels can be controlled by the voltages applied to pins 47 and 48 (typ. 2.2 V, 2.0 to 2.6 V). The control voltage used is selected by SWP at pin 42.

The amplitude is variable within ±5 dB with respect to an output of 250 mVp-p.

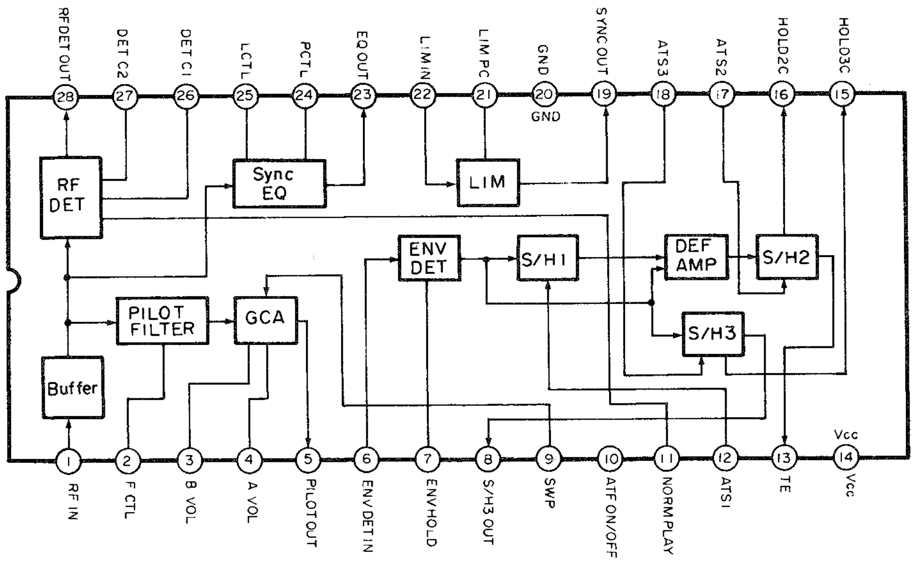
The threshold level for pin 46 is set to approx. 2.1 V. It can be connected directly to the signal processor LSI.

REC amps

Two REC amps are provided independently for the A CH and B CH. Each of them is a current amp, which amplifies the current input to REC IN (with low impedance) by approx. 160 times and outputs is to REC OUT (open-collector). The inputs to the REC amps are the REC limiter VR outputs converted into currents by resistors. These circuits are normally used with feedback damping.

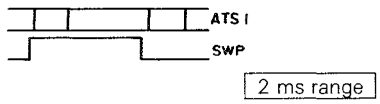
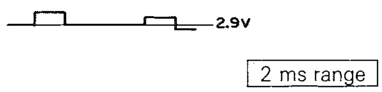
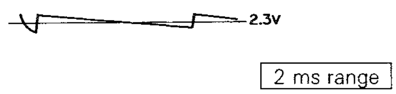
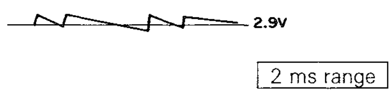
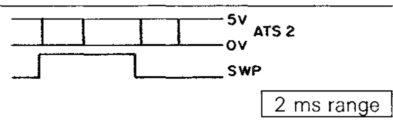
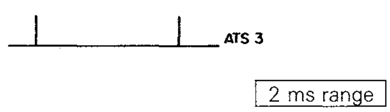
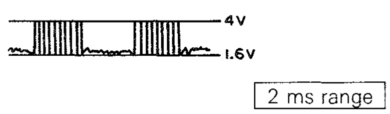
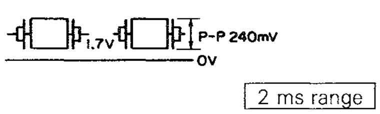
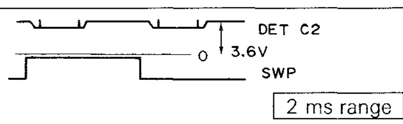
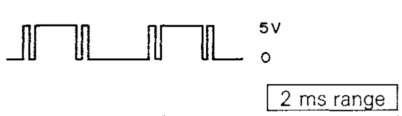
8-8. IC18: CXA1046M (X29-1830-00) R-DAT ATF

Block diagram



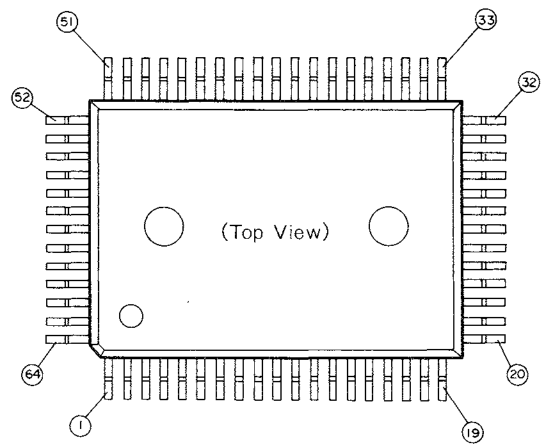
Terminal pin functions

Pin no.	Name	I/O	Waveform	Function	Remark
1	RF IN	I	370mV 3V 0V 15ms 1.9V [2 ms range]	RF input (RF signal without being processed by PCM equalizer).	
2	FCTL	I		Pilot filter external resistor terminal.	
3	B VOL	I	2.4 V	130 kHz B CH gain control VR terminal.	
4	A VOL	I	2.4 V	130 kHz A Ch gain control VR terminal.	
5	PILOT OUT	O	* The level varies depending on the recording status. 3.5V 220mV 5.5ms [1 ms range]	Pilot signal output terminal.	
6	ENV DET IN	I	* The level varies depending on the recording status. 2.2V 600mV [1 ms range]	Envelope detector input terminal.	For tracking sample & hold.
7	ENV HOLD	—	1.7V 2.3V [1 ms range]	Envelope detection hold capacitor connection terminal.	
8	S/H 3OUT	O	4V 0V [2 ms range]	ON track sample & hold output.	Not used.
9	SWP	I	5V SWP 0V 15ms [2 ms range]	Switching pulse. For gain control amp.	
10	ATF ON/OFF	I	"L"	"L" for ATF operation. "H" for ATF OFF.	

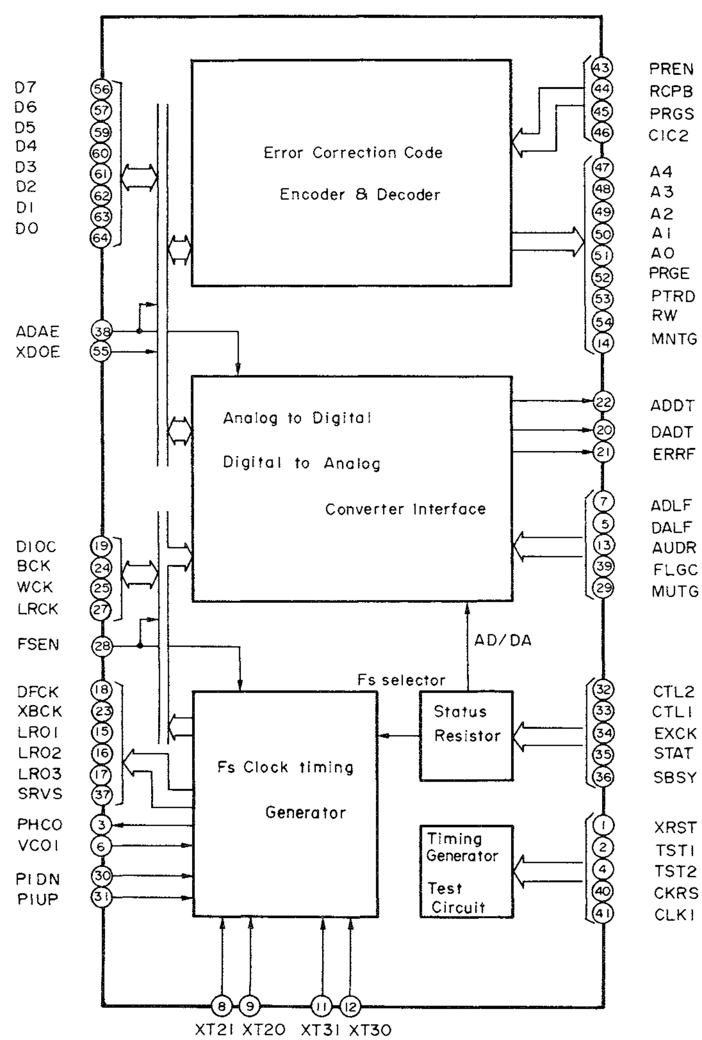
Pin no.	Name	I/O	Waveform	Function	Remark
11	NORM PLAY	I	"L"	"L" for normal playback. Varies the threshold levels of the RF detector in search and in normal playback.	
12	ATS 1	I		Sampling pulse input terminal. For use in Sample & Hold 1. Used for holding the earlier (front) pilot signal (for adjacent track).	
13	TE	O		Tracking error output.	
14	Vcc	—		5 V	
15	HOLD 3C	—		Connection terminal for capacitor used in holding of Sample & Hold 3.	
16	HOLD 2C	—		Connection terminal for capacitor used in holding of Sample & Hold 2.	
17	ATS 2	I		Sampling pulse input terminal. For use in Sample & Hold 2. Used for holding the difference signal (for adjacent track).	
18	ATS 3	I		Sampling pulse input terminal. For use in Sample & Hold 3. (Used for detecting the 130 kHz level) (for ON track).	
19	SYNC OUT	O		ATF synchro output terminal. RF input which has been processed by equalizer and limiter.	
20	GND	—			
21	LIM PC	—	2 V	Connection terminal for limiter block path capacitor.	
22	LIM IN	—	2 V	Limiter input.	
23	EQ OUT	O		ATF sync equalizer output terminal.	
24	PCTL	—	1.7 V	External resistances for sync equalizer.	
25	LCTL	—	1.7 V		
26	DET C1	—	3.7 V	Connection terminal for capacitor determining the RF DET threshold level setting.	
27	DET C2	—		Connection terminal for capacitor used in adjusting the RF envelope waveform.	
28	RF DET OUT	O		RF DET output terminal.	

8-9. IC14: CXD1008Q (X29-1830-00) R-DAT signal processor (ECC)

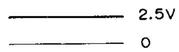
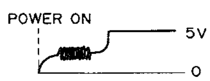
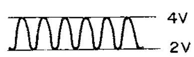
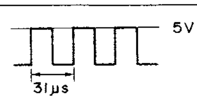
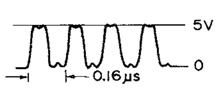
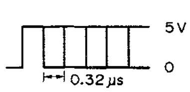
Pin configuration

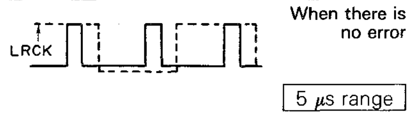
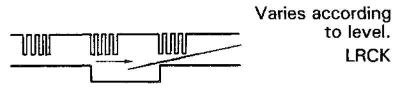
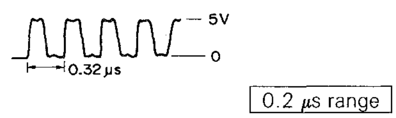
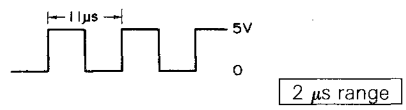
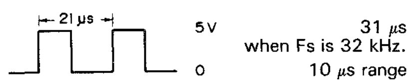
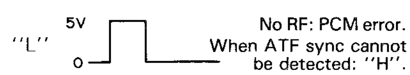
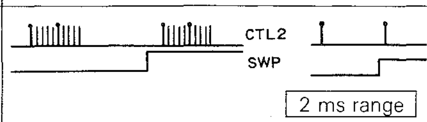
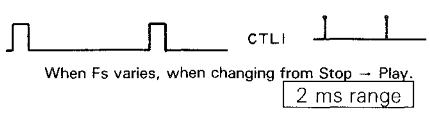
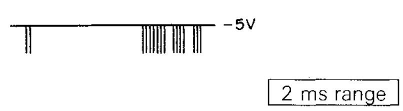
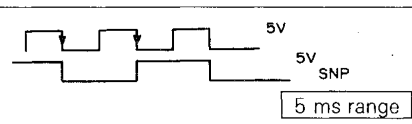
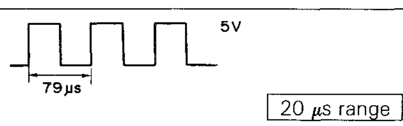


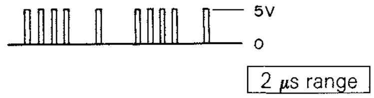
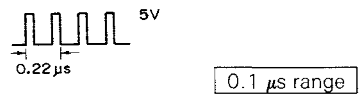
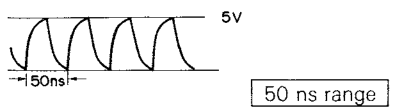
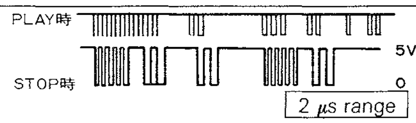
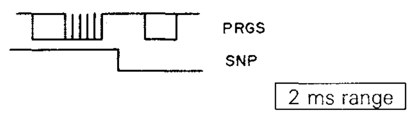
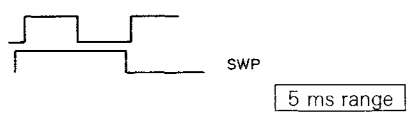
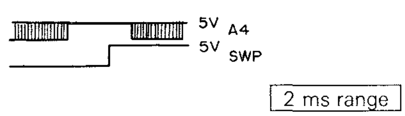
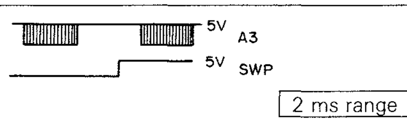
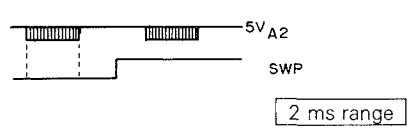
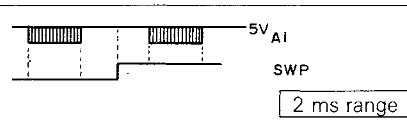
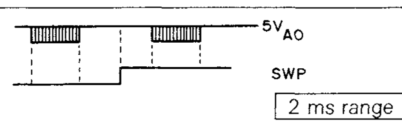
Block diagram

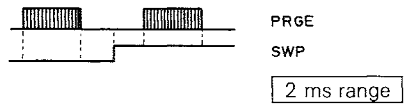
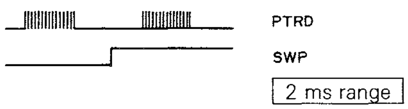
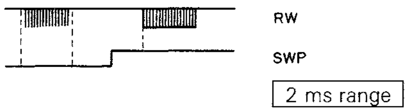
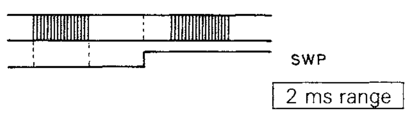
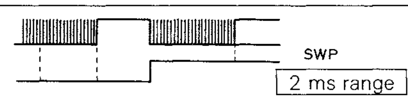
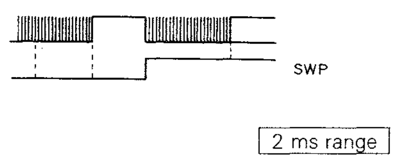


Terminal pin functions **Fs: 48 kHz, during PLAY.**

Pin no.	Name	I/O	Waveform	Function	Remark
1	XRST	I	 5V POWER ON 10 ms range	Reset signal.	
2	TST1	I	"L"	Test terminal.	
3	PHCO	O	"L"	Varipitch phase comparison.	Not used.
4	TST2	I	"L"	Test terminal.	
5	DALF	I	"L"	DA data LSB-1st/MSB-1st switching. "H" for LSB 1st, but used with MSB.	
6	VCOI	I	"L"	VCO input (256 Fs for varipitch).	
7	ADLF	I	"L"	AD data LSB-1st/MSB-1st switching. "H" for LSB 1st, but used with MSB.	
8	XT2I	I	 2.5V 0	X'tal input, for 44.1 kHz (22.5792 MHz).	
9	XT2O	O	 POWER ON 5V 0 10 ms range	X'tal output, for 44.1 kHz (22.5792 MHz).	
10	Vss	—		GND	
11	XT3I	I		X'tal input, for Fs of 48 kHz and 32 kHz.	
12	XT3O	O	 4V 2V 0.1 μs range	X'tal output, for Fs of 48 kHz and 32 kHz.	
13	AUDR	I	"H"	Audio 16-bit select terminal. "H" for audio 16-bit.	
14	MNTG	O	 5V 20 ms range	"H" for error monitor output at D7 to D0.	
15	LR01	O	 5V 31μs 31 μs with Fs 32 kHz. 10 μs range	LRCK delayed by 15 BCK.	Not used.
16	LR02	O		LRCK delayed by 16 BCK.	LRCK for AD.
17	LR03	O		Inverted LR02 (Fs).	—
18	DFCK	O	 5V 0 40ms 50 ns range	256 Fs output. Output when FSEN is "H" (3-state).	Not used.
19	DIOC	I/O	 5V 0 0.16μs 0.2 μs range	128 Fs input/output. Output when FSEN is "H".	Digital Input/ Output Clock.
20	DADT	O	 5V 0 0.32μs 0.2 μs range	DA data. Output during PB or REC monitoring.	

Pin no.	Name	I/O	Waveform	Function	Remark
21	ERRF	O	 When there is no error; LRCK; 5 μs range	DA data error flag. "H" with error.	When error occurs: 
22	ADDT	I	 Varies according to level. LRCK	AD data input (REC).	
23	XBCK	O	 5V; 0; 0.32 μs; 0.2 μs range	Inverted BCK. 64 Fs.	
24	BCK	I/O		64 Fs input/output. Output when FSEN is "H".	
25	WCK	I/O	 11 μs; 5V; 0; 2 μs range	2 Fs input/output. Output when FSEN is "H".	
26	VDD	—		+5 V	
27	LRCK	I/O	 21 μs; 5V; 0; 31 μs when Fs is 32 kHz. 10 μs range	LRCK (Fs) input/output. Output when FSEN is "H".	LRCK for DA.
28	FSEN	I	"H"	Determines whether DFCK, DIOC, BCK, WCK and LRCK are output or not. "H" for output.	
29	MUTG	I	"L"  5V; 0; No RF: PCM error. When ATF sync cannot be detected: "H".	Digital muting. Muting ON/OFF. "H" for muting ON.	
30	PIDN	I	"H"	Pitch down control terminal.	Fixed
31	PIUP	I	"H"	Pitch up control terminal.	Fixed
32	CTL2	I	 CTL2; SWP; 2 ms range	When both CTL1 and CTL2 are "H", the status is loaded using the shift-in clock at EXCK.	
33	CTL1	I	 CTL1; When Fs varies, when changing from Stop → Play. 2 ms range	Shift-in enable signal. The status signal determines the AD mode, Fs, DA mode, etc.	
34	EXCK	I	 -5V; 2 ms range	Status shift-in clock. "⌐" for shifting-in.	
35	STAT	I	 5V	Status shift-in data input terminal.	
36	SBSY	I	 5V; 5V; SNP; 5 ms range	Status load clock. Loading at the negative-going edge (200/3 Hz).	
37	SRVS	O	 5V; 79 μs; 20 μs range	Servo reference signal, 12.8 kHz (variable with varipitch).	

Pin no.	Name	I/O	Waveform	Function	Remark
38	ADAE	I	 5V, 0; 2 μs range	This is the DA data read enable signal, and is received from IC3 (CXD1009Q) pin 16 (DARE) which goes "H" during output/input of AD/DA data to/from the bus.	During playback, "L" in input period. During recording, "L" in output period.
39	FLGC	I	"L"	Input terminal of forced muting signal used for waveform splicing during varipitch operation. Received from CXD1009Q pin 15.	* Digital muting when Open or "H".
40	CKRS	I	 5V; 0.22μs; 0.1 μs range	Master clock reset signal.	
41	CLKI	I	 5V; 50ns; 50 ns range	Master clock (18.816 MHz).	
42	Vss	—		GND	
43	PREN	I	 PLAY時; STOP時; 5V, 0; 2 μs range	ECC data access INH signal. "L" for INH.	
44	RCPB	I	"L"	ECC REC/PB judging signal. "H" with REC.	
45	PRGS	I	 PRGS; SNP; 2 ms range	ECC processing start signal. "L" for start (↴).	
46	C1 C2	I	 SWP; 5 ms range	ECC C1/C2 judging signal. C1/C2 operation processing indication signal. Received from CXD1009Q (IC3) pin 8.	"H" for C1 processing. "L" for C2 processing.
47	A4	O	 5V A4; 5V SWP; 2 ms range	ECC data address A4.	
48	A3	O	 5V A3; 5V SWP; 2 ms range	ECC data address A3.	
49	A2	O	 5V A2; SWP; 2 ms range	ECC data address A2.	
50	A1	O	 5V A1; SWP; 2 ms range	ECC data address A1.	
51	A0	O	 5V A0; SWP; 2 ms range	ECC data address A0.	

Pin no.	Name	I/O	Waveform	Function	Remark
52	PRGE	O		Program end data address (inverted after processing of each code).	
53	PTRD	O		Judging signal to determine whether the ECC data access request is an error pointer or data. "H" with error pointer.	Pointer Read.
54	RW	O		ECC data R/W signal. "H" for R (Read). (Judges whether the ECC data is to be read or written.)	Read/Write
55	XDOE	I		D7-D0 output enable signal. "L" for output.	
56	D7	I/O		Data lines (MSB).	
57	D6	I/O			
58	VDD	—		5 V	
59	D5	I/O		Data lines (MSB).	
60	D4	I/O			
61	D3	I/O			
62	D2	I/O			
63	D1	I/O			
64	D0	I/O			

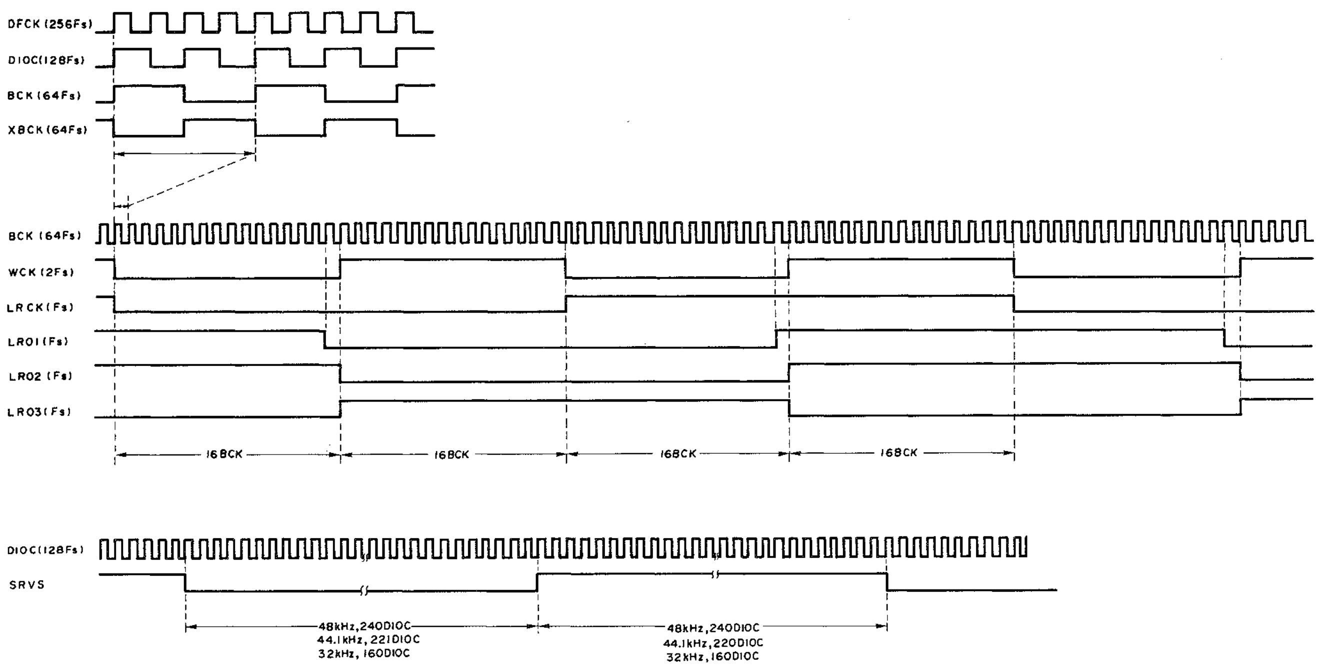
Notes: 1) When not in audio 16-bit mode (AUDR = "L");
1 Interpolation is not performed.
2 By dividing the PCM 16 bits into upper 8 bits and lower 8 bits, ERRF outputs their error flags.

2) ADDT/DADT inputs/outputs L CH data when LRCK = "L", and R CH data when LRCK = "H".

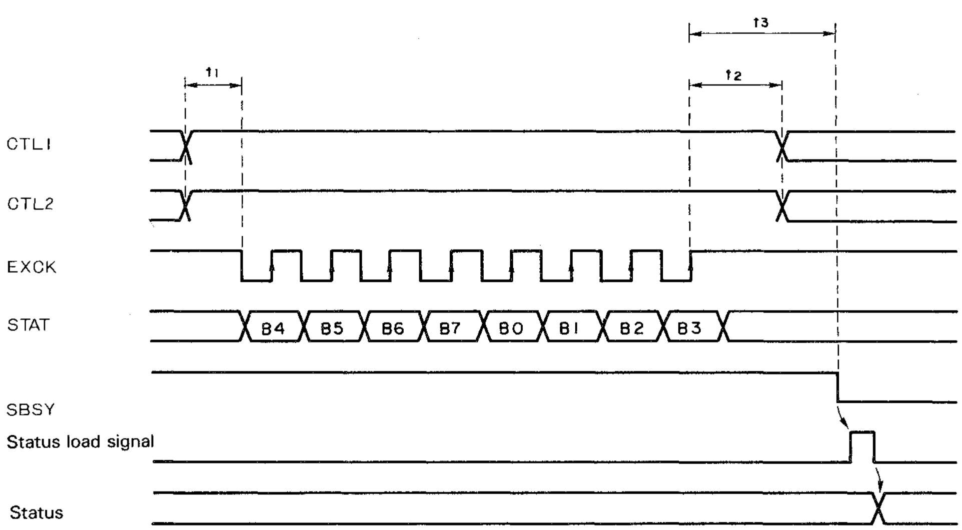
The terminals are grouped into Groups A to D as follows.

Group A	XRST, TST1, TST2, DALF, VCOI, ADLF, AUDR, DIOC, FSEN, MUTG, PIDN, PIUP, CTL1, CTL2, EXCK, STAT, SBSY, FLGC
Group B	ADDT, BCK, WCK, LRCK, ADAE, CKRS, CLKI, PREN, RCPB, PRGS, C1C2, XDOE, D0, D1, D2, D3, D4, D5, D6, D7
Group C	MNTG, LR01, LR02, LR03, DFCK, DIOC, DADT, ERRF, XBCK, BCK, WCK, LRCK, SRVS, A4, A3, A2, A1, A0, PRGE, PTRD, RW, D7, D6, D5, D4, D3, D2, D1, D0
Group D	All tri-state terminals

Fs clock timing chart

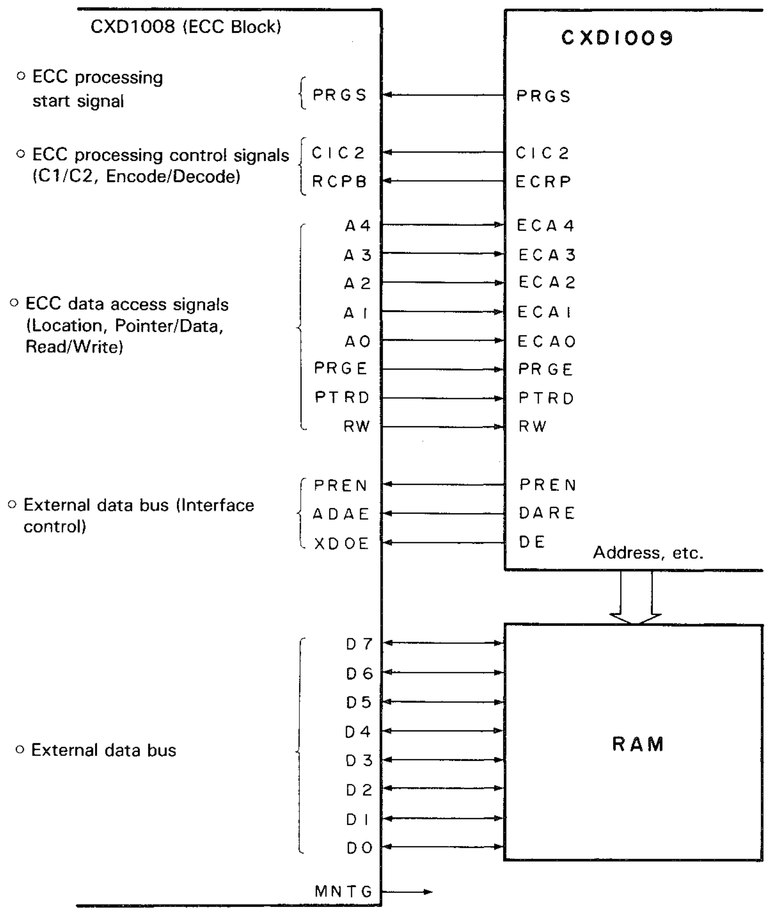


Status register interface timing chart

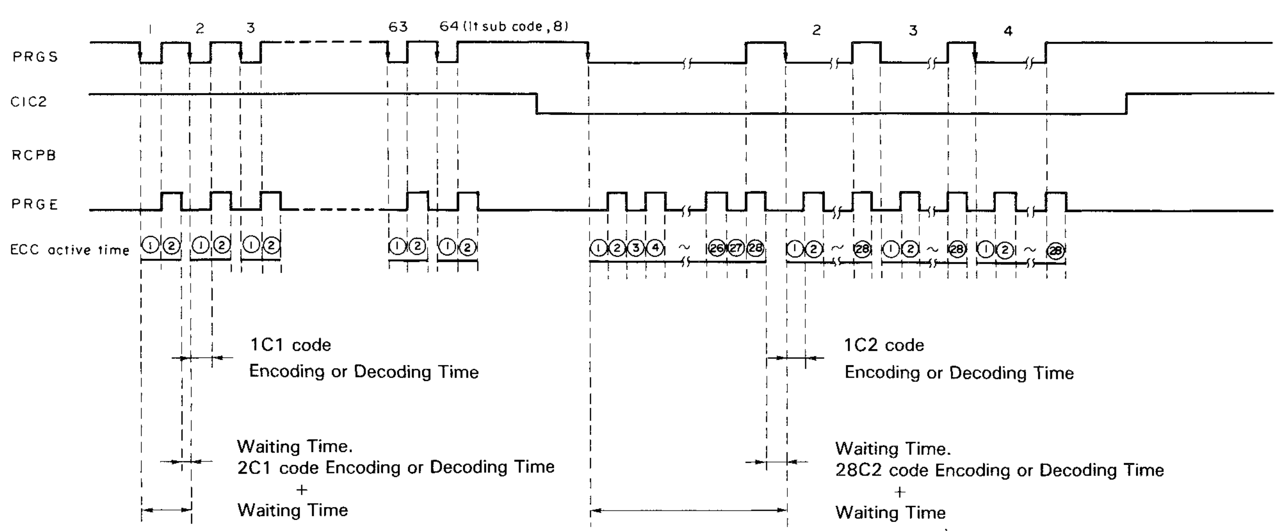


Note: $t_1 > 1\ \mu s$, $t_2 > 0$, $t_3 > 0$.
EXCK frequency < 800 kHz.

ECC block input/output signals

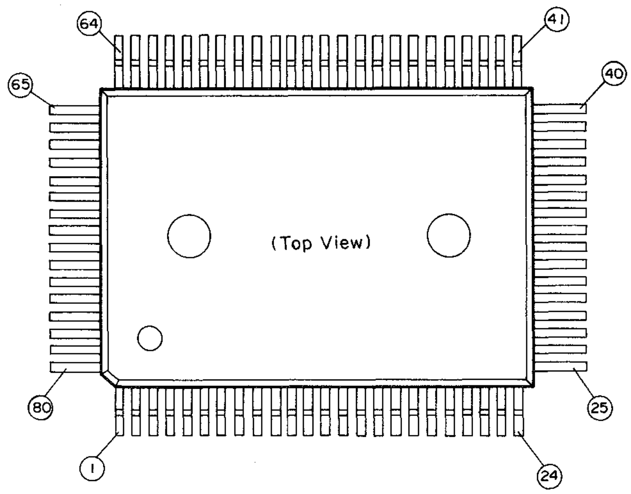


ECC timing chart

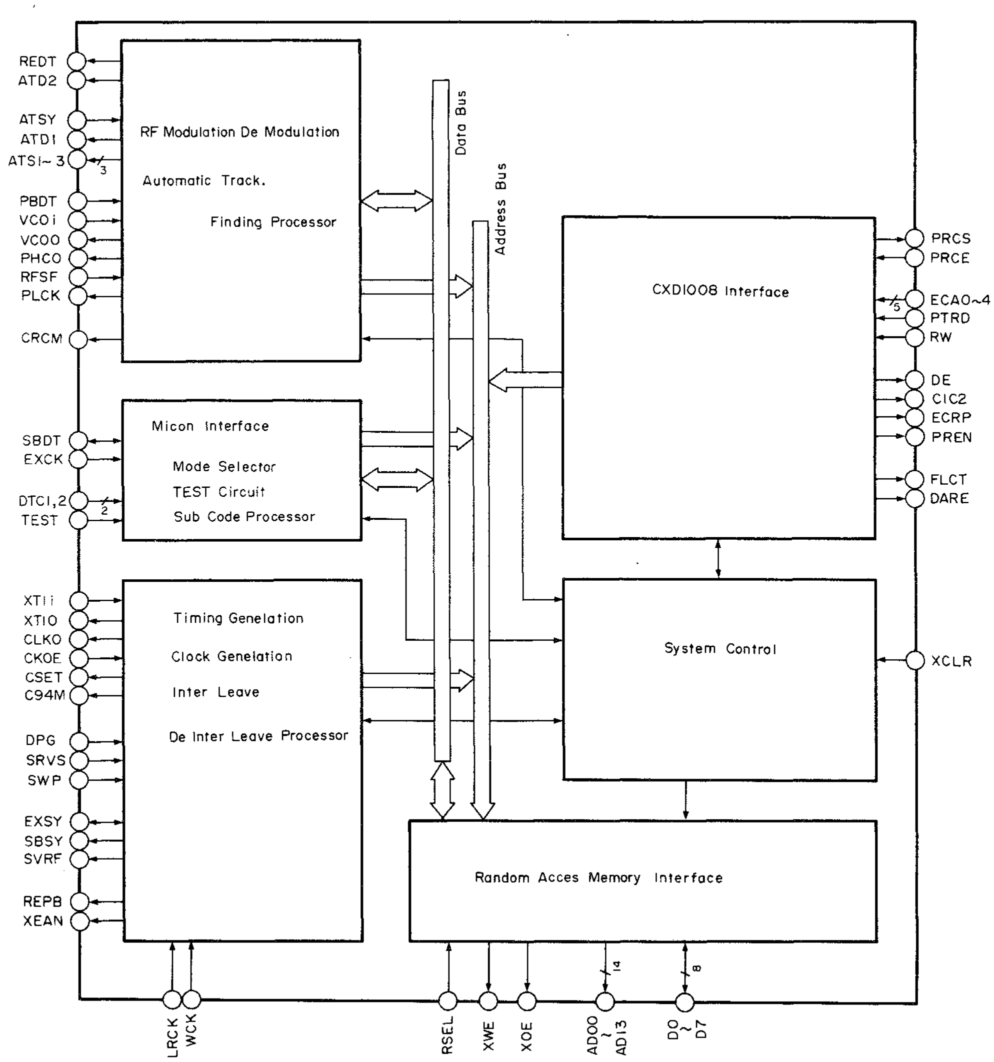


8-10. IC13: CXD1009Q (X29-1830-00) R-DAT signal processor (RAM control)

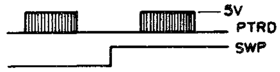
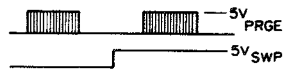
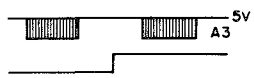
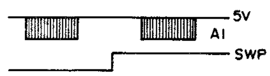
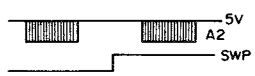
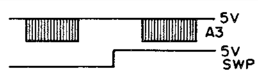
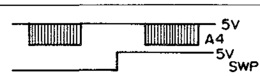
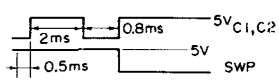
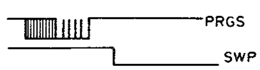
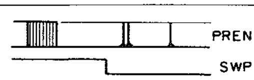
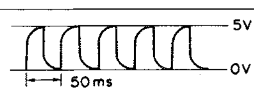
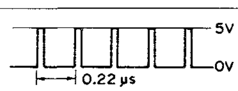
Pin configuration

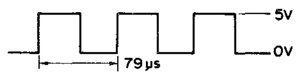
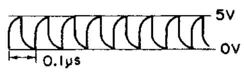
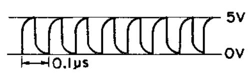
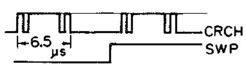
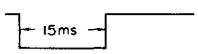
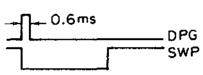
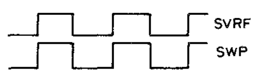
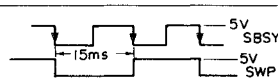
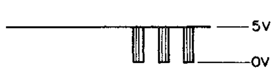


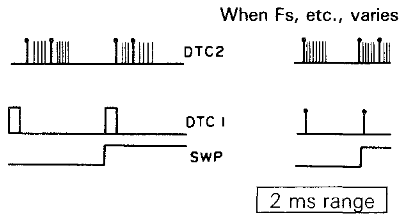
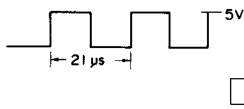
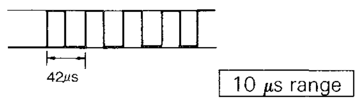
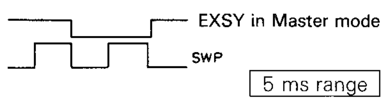
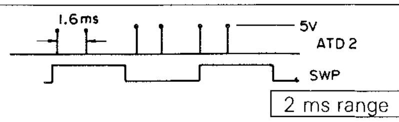
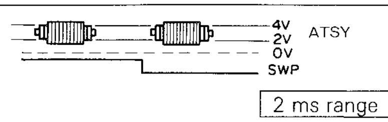
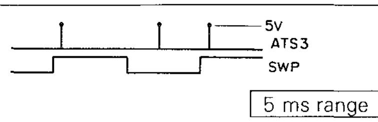
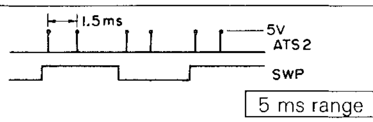
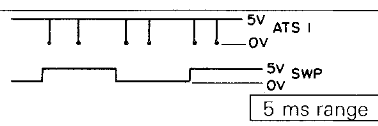
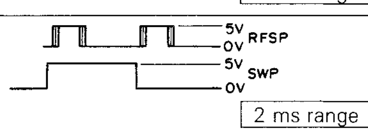
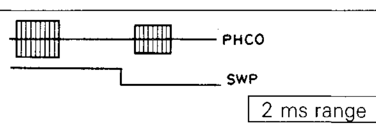
Block diagram

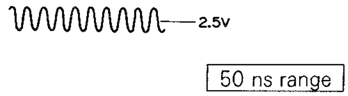
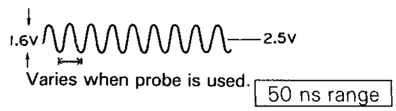
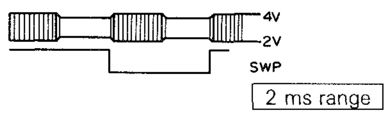
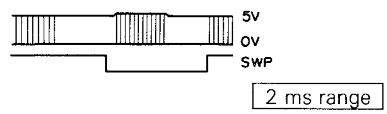
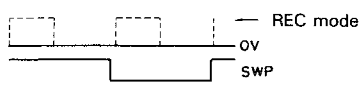
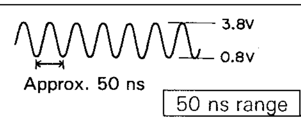
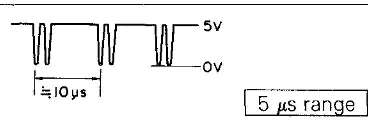
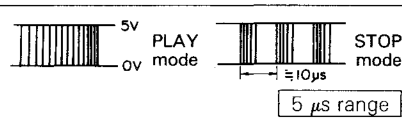
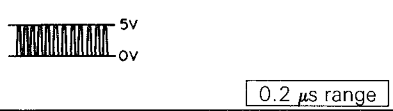


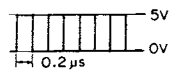
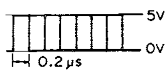
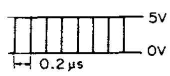
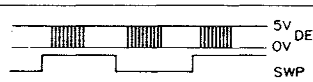
Terminal pin functions

Pin no.	Name	I/O	Waveform	Function	Remark
1	PTRD	I	 2 ms range	Judging signal to determine whether the ECC data access request is an error pointer or data. "H" with error pointer.	
2	PRGE	I	 2 ms range	Program end signal (inverted after processing each code).	
3	ECA0	I	 2 ms range	ECC data address A0	
4	ECA1	I	 2 ms range	ECC data address A1	
5	ECA2	I	 2 ms range	ECC data address A2	
6	ECA3	I	 2 ms range	ECC data address A3	
7	ECA4	I	 2 ms range	ECC data address A4	
8	C1C2	O	 2 ms range	C1/C2 operation processing indication signal. "H" for C1 processing, "L" for C2 processing.	.
9	PRGS	O	 2 ms range	Ecc processing start signal.	
10	ECRP	O	"L"	Judging signal to determine whether ECC is for the REC or PB processing. "H" with REC.	
11	PREN	O	 2 ms range	Ecc data (external RAM I/O processing) enable terminal. "L" for INH.	
12	Vss	—		GND	
13	CLKO	I/O	 50 ms range	Master clock. 18.816 MHz (X'tal output).	
14	CSET	O	 0.1 µs range	CXD1008, CXD1009 sync signal (master clock reset signal).	

Pin no.	Name	I/O	Waveform	Function	Remark
15	FLCT	O	''L''	Control signal for CXD1008. Forced muting signal for waveform splicing during varipitch operation.	
16	DARE	O	 2 μs range	DA data read enable.	
17	SRVS	I	 20 μs range	Servo reference signal, 12.8 kHz (for capstan servo).	
18	C94M	O	 0.1 μs range	9.408 MHz output (clock for counter inside CXD1052).	
19	PLCK	O	 0.1 μs range	RF PLL playback clock, 9.408 MHz ±△.	
20	CRCM	O	 2 ms range	$W_1 + W_2$ + Equivalent CRC monitoring during PB. ''H'' when OK, ''L'' with error.	
21	SWP	I	 2 ms range	Variation occurs at the negative-going edge of FG after the rise of LPG. Switching pulse input.	
22	DPG	I	 2 ms range	PG pulse input (aligned to PCM center).	
23	SVRF	O	 5 ms range	Servo reference signal, 100/3 Hz (normally used as the drum reference signal during PB).	
24	RSEL	I	''L''	External RAM select signal. ''L'' for SRAM, ''H'' for DRAM.	Fixed at ''L''
25	SBSY	O	 5 ms range	Status load clock. Loading at negative-going edge. Sub-code sync signal of 200/3 Hz.	
26	SBDT	I/O	 2 ms range	Sub-code data. Operation mode setting, output to sub-code.	
27	EXCK	I	 2 ms range	Sub-data. Shifting in at ''↑'' of IN/OUT clock.	

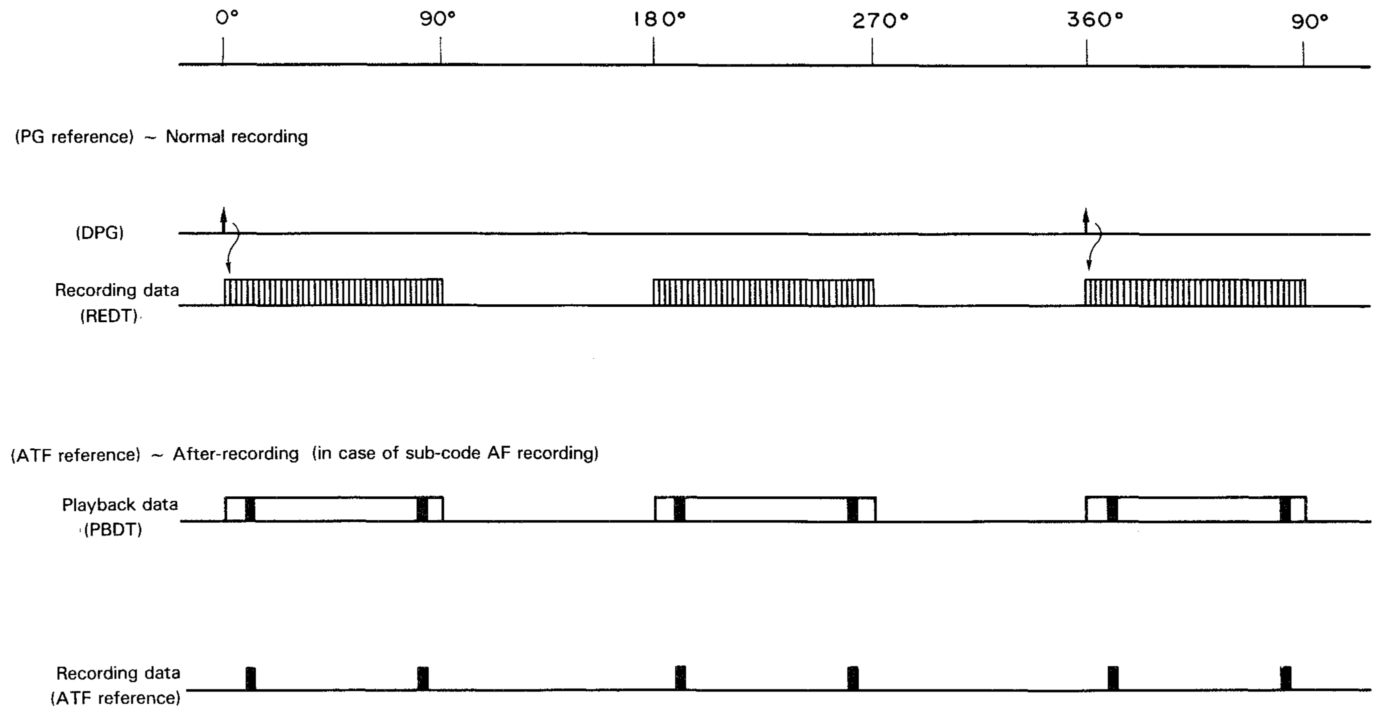
Pin No.	Name	I/O	Waveform	Function	Remark
28	DTC1	I		Sub-data content judging signal (used in pair with DTC2). Used for judging the pack data, pack data I/O control, PCM ID, sub-code ID and status. Assigns the AD mode, DA mode, etc., to the status.	
29	DTC2	I			
30	LRCK	I		L/R clock. "H" for Right, "L" for Left (Fs).	
31	WCK	I		Word clock (2 Fs).	
32	EXSY	I/O		System sync signal. The mode switching between output as the Master and input as the Slave (50/3 Hz) is switched based on the microprocessor status information.	
33	VDD	—		5 V	
34	ATD2	O		Pilot window pulse for ATF and REC. Counting with reference to DPG (during REC only).	
35	ATD1	O	"L" with recorded tape.	ATF sync detect signal. "L" for OK, "H" for NG (no ATF).	
36	ATSY	I		PB ATF signal. Used for sampling pulse generation (at ATS1 to ATS3).	
37	ATS3	O		On-track sampling pulse.	
38	ATS2	O		Adjacent-track pilot sampling pulse.	
39	ATS1	O			
40	RFSF	I		PLL window signal. Obtained by envelope detection of RF PB signal.	
41	PHCO	O		PLL phase comparison signal. Result of comparison between PBDT and VCO.	
42	TEST	I		Test terminal.	

Pin no.	Name	I/O	Waveform	Function	Remark
43	VCO I	I		VCO oscillation terminal. Input, approx. 18 MHz.	
44	VCO O	O		VCO oscillation terminal. Output, approx. 18 MHz.	
45	CKOE	I	"L"	Clock output enable. When "H", CLKO (⑬) becomes an input port.	
46	PBDT	I		RF PB input. Used for PLL and signal processing.	
47	XCLR	I	"H"	"L" for power ON.	
48	REDT	O		REC data.	
49	REPB	O		REC block window pulse. "L" during PB.	
50	XT1O	O		18.816 MHz X'tal oscillation terminal. Output.	
51	XT1I	I	Oscillation stops when touched with an oscilloscope.	18.816 MHz X'tal oscillation terminal. Input.	
52	Vss	—	0 V		
53	XEAN	O		External RAM external address sync enable.	
54	XWE	O		External RAM $\overline{W \cdot E}$.	
55	XOE	O		External RAM $\overline{O \cdot E}$.	

Pin no.	Name	I/O	Waveform	Function	Remark
56	AD00	O			
57	AD01	O			
58	AD02	O			
59	AD03	O			
60	AD04	O			
61	AD05	O			
62	AD06	O		External RAM address (LSB).	
63	AD07	O			
64	AD08	O			
65	AD09	O			
66	AD10	O			
67	AD11	O			
68	AD12	O			
69	AD13	O	0.2 μs range	External RAM address (MSB).	
70	D0	I/O		External RAM data bus (LSB).	
71	D1	I/O			
72	D2	I/O	0.2 μs range	External RAM data bus.	
73	VDD	—		5 V	
74	D3	I/O			
75	D4	I/O			
76	D5	I/O		External RAM data bus.	
77	D6	I/O			
78	D7	I/O	0.2 μs range		
79	DE	O	 5 ms range	Enable signal for signal output from CXD1008 to DATA bus.	
80	RW	I	 5 ms range	Judging signal determining whether CXD1008 reads or write ECC data.	

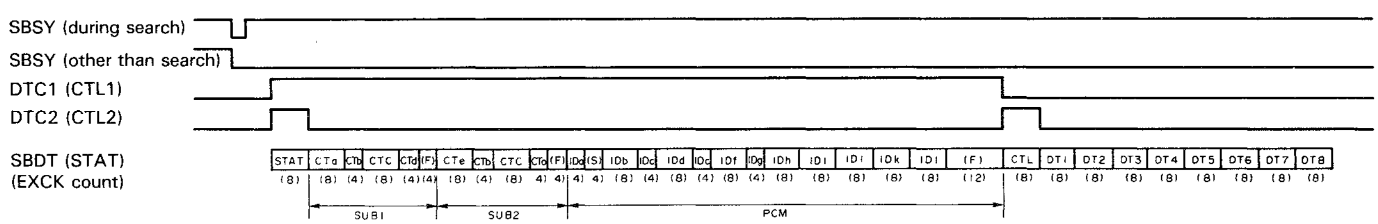
Group A	RSEL, SBDT, EXCK, DTC1, DTC2, RFSF, TEST, CKOE, XCLR
Group B	PTRD, PRGE, ECA0, ECA1, ECA2, ECA3, ECA4, CLKO, SRVS, SWP, DPG, LRCK, WCK, EXSY, D0, D1, D2, D3, D4, D5, D6, D7, RW
Group C	C1C2, PRGS, ECRP, PREN, CLKO, CSET, FLCT, DARE, C94M, PLCK, CRCM, SVRF, SBSY, SBDT, EXSY, ATD2, ATD1, ATS3, ATS2, ATS1, REDT, REPB, XEAN, XWE, XOE, AD00, AD01, AD02, AD03, AD04, AD05, AD06, AD07, AD08, AD09, ADI0, ADI1, ADI2, ADI3, D0, D1, D2, D3, D4, D5, D6, D7 DE
Group D	All tri-state terminals

Signal recording timing chart



Sub-code I/O timing chart

08, 09 → Microprocessor: SBSY, SBDT (PB)
08, 09 → Microprocessor: EXCK, DTC1 (CTL1), DTC2 (CTL2), SBDT (REC)



(F): Plug (PB only, dummy in REC mode) (S): Frame address (PB only, dummy in REC mode)

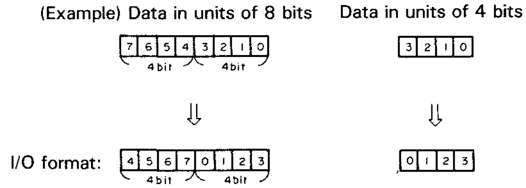
CTa: Control ID, data ID
CTb: S/P ID (PB only, dummy in REC mode), format ID (3-bit)
CTc: PNO-2, PNO-3
CTd: S/P ID (same as above), PNO-1 (3-bit)

iDa: iD1, 2
iDb: option 1
iDc: iD3, 4
iDd: option 2
iDe: iD5, 6
iDf: option 3

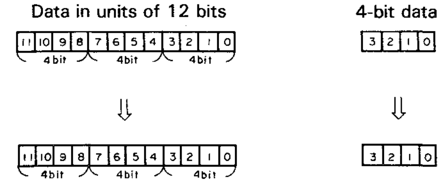
iDg: iD7, 8
iDh: option 4
iDi: option 5
iDj: option 6
iDk: option 7
iDl: option 8

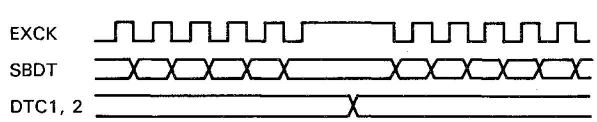
* Data I/O bit sequence

All data are in units of 4 bits, with LSB 1st.

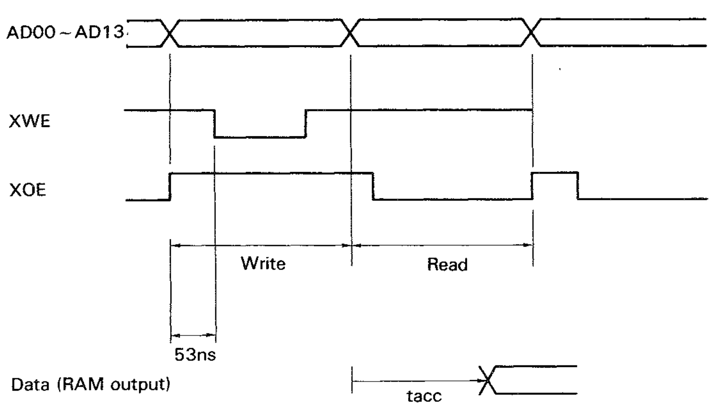


* (F) sequence

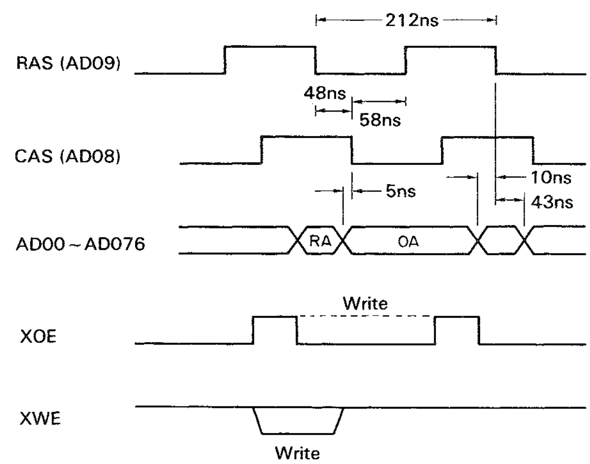




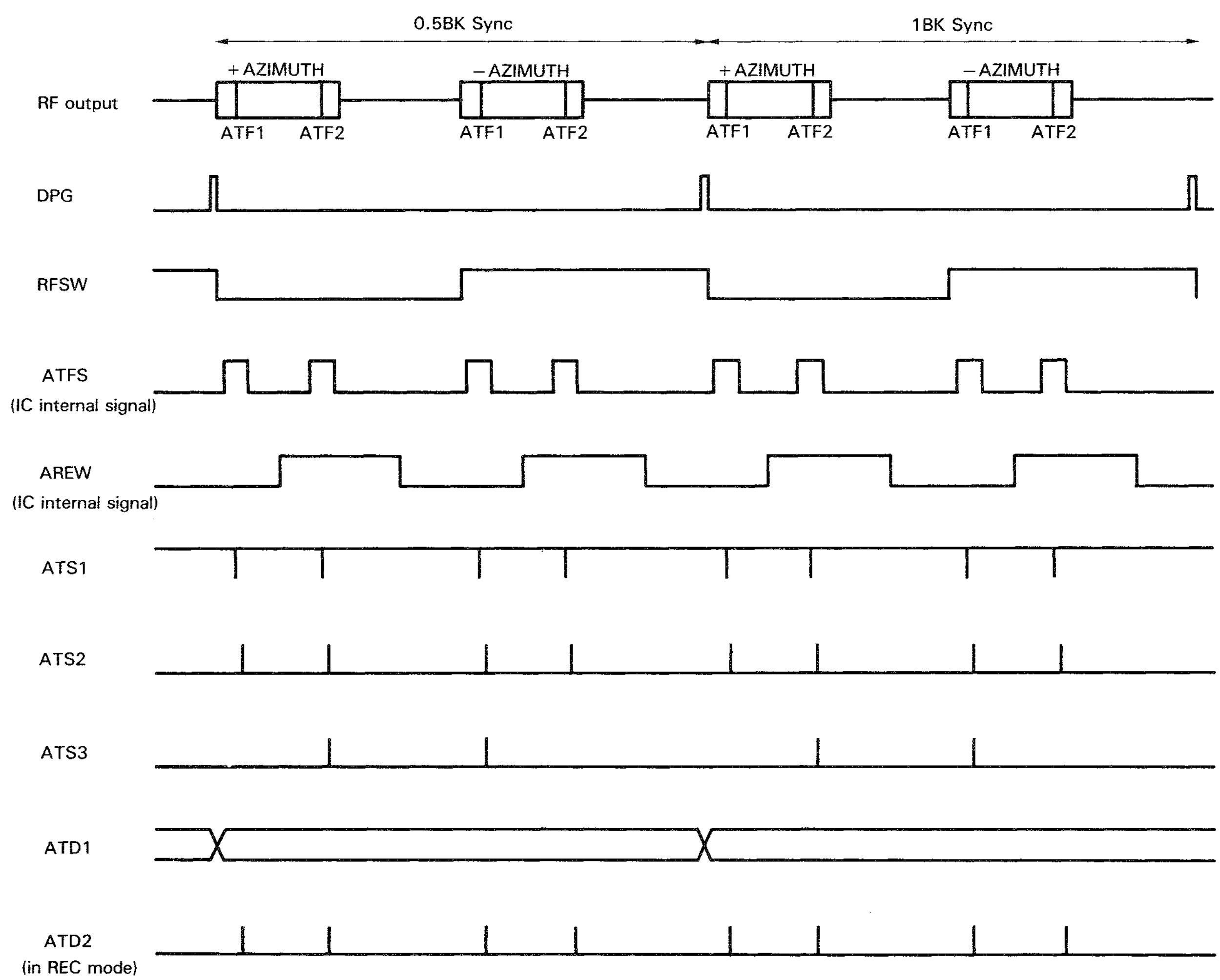
SRAM mode timing chart



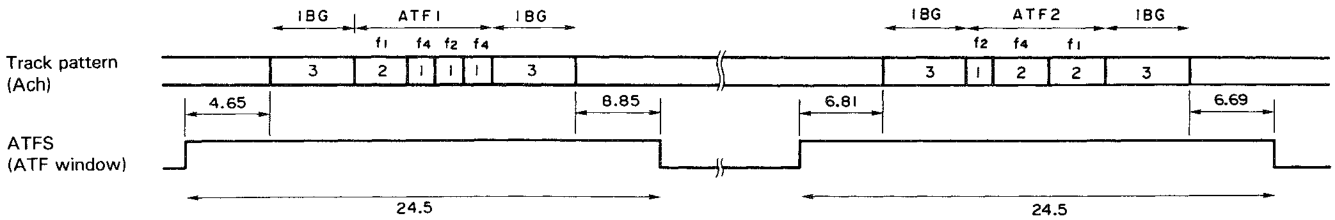
DRAM mode timing chart

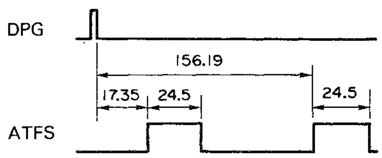


Various signal timings



ATF window timing

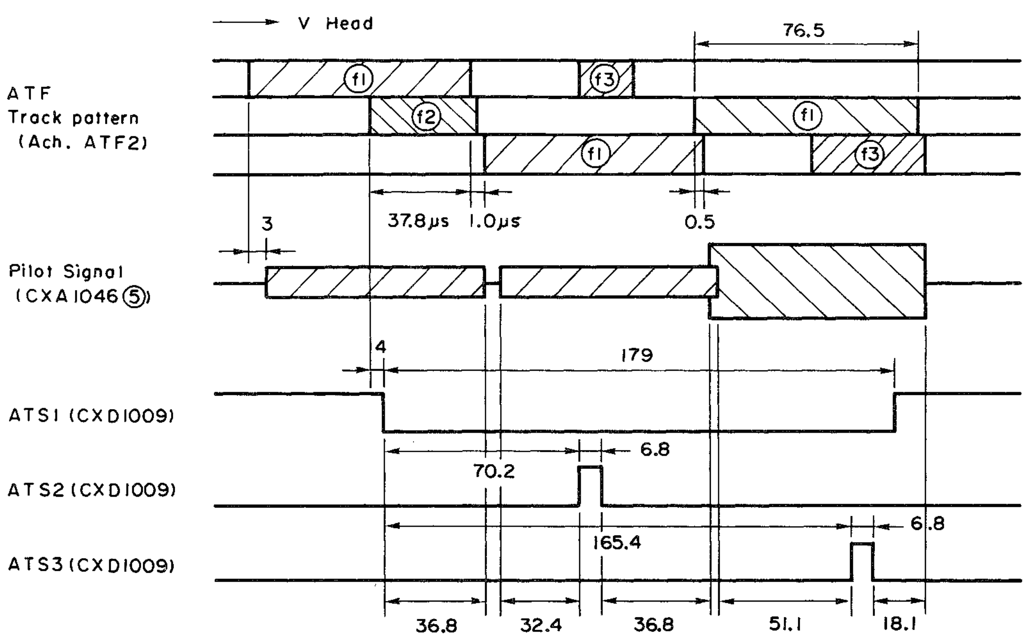




* Figures are in units of block.
1 block = 38.27 μs

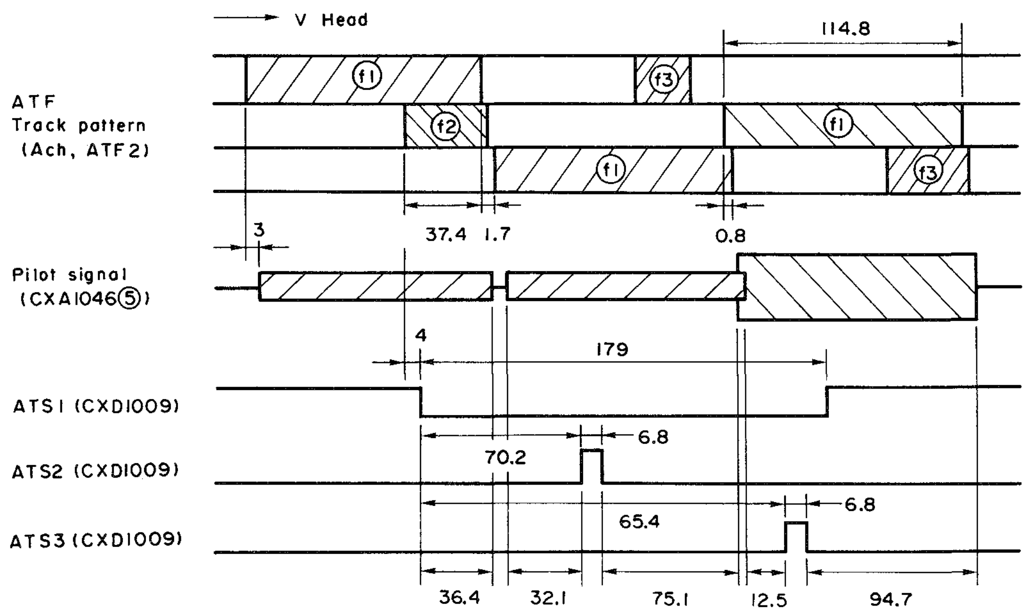
Sampling pulse timing

(1) Ta = 13.59 μm



* Figures are in units of normal playback time (μs).

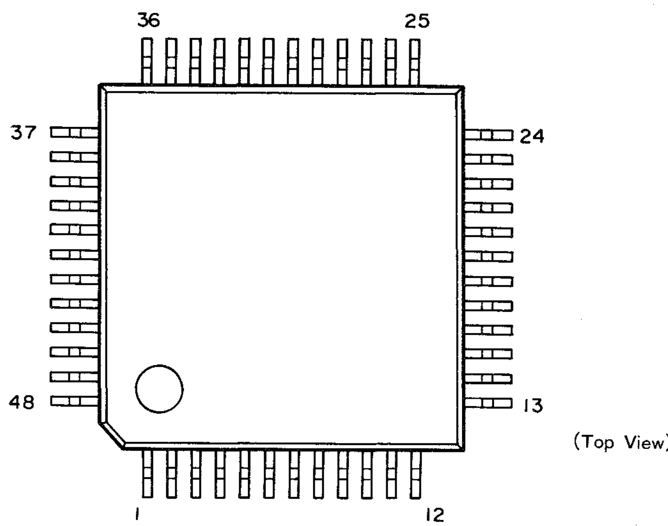
(2) Tp = 20.41 μm (for use with pre-recorded music tapes)



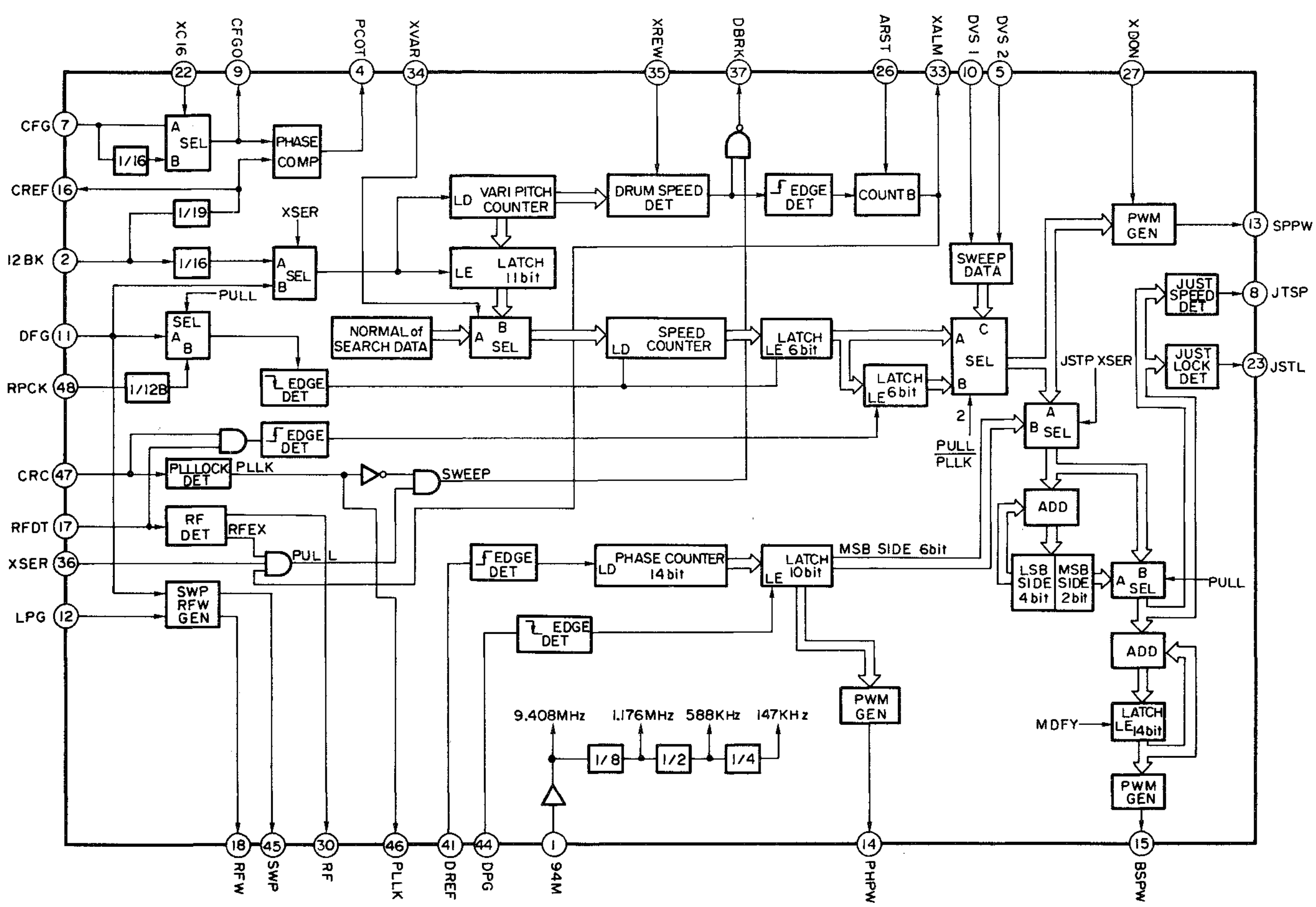
* Figures are in units of normal playback time (μs).

8-11. IC6: CXD1052Q (X29-1830-00) R-DAT servo control IC

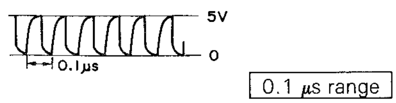
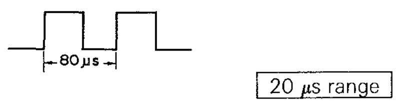
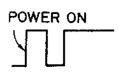
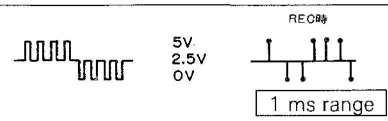
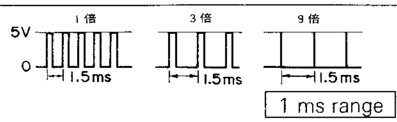
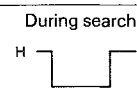
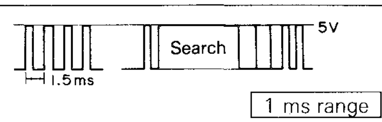
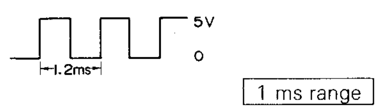
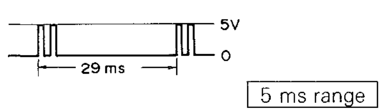
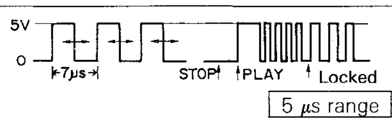
External view

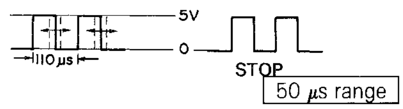
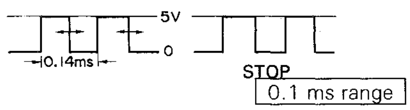
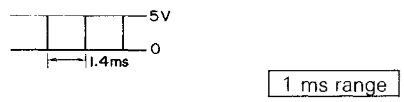
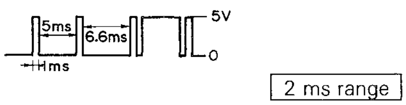
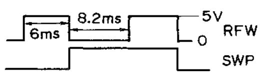
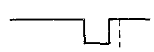
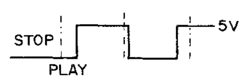
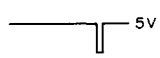
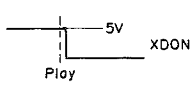
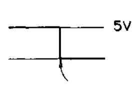


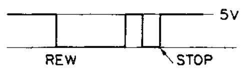
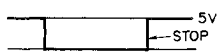
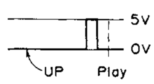
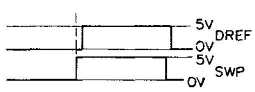
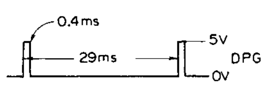
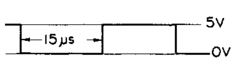
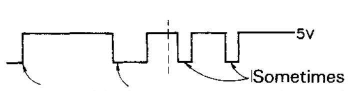
Block diagram

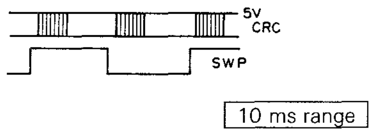
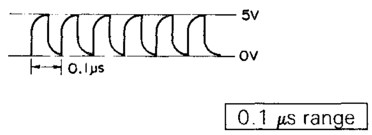


Terminal pin functions **(in PLAY mode)**

Pin No.	Name	I/O	Waveform	Function	Remark
1	94M	I		Master clock, 9.408 MHz. The drum cannot rotate without this clock.	
2	128K	I		For drum FG and capstan reference (12.8 kHz).	
3	XCLR	I	"H" 	IC power-ON reset.	
4	PCOT	O		Capstan phase comparator output (3.5-state). Used in REC mode (comparison between capstan FG and 12.8 kHz).	
5	DVS2	I	"H"	Determines the voltage applied to the drum during sweep.	
6	Vss	—		GND	
7	CFG	I		Capstan FG input. FG is divided into 1/1, 1/3 or 1/9 before being input.	
8	JTSP	O	"H" 	Just-speed signal. "H" when the drum rotation speed is as specified.	"L" for STOP
9	CFGO	O		Capstan FG output. Outputs 1/16 FG when XC16 (pin ㉒) is "L", outputs 1/1 in other cases.	
10	DVS1	I	"H"	In combination with DVS2, determines the voltage applied to the drum during sweep.	For bias servo in sweep operation
11	DFG	I		Drum FG input. Approx. 800 Hz (for SWP generation).	
12	LPG	I		Drum PG input (for SWP generation).	1 pulse/rotation
13	SPPW	O		Speed servo PWM (comparison between FG and 12.8 kHz).	"L" for STOP

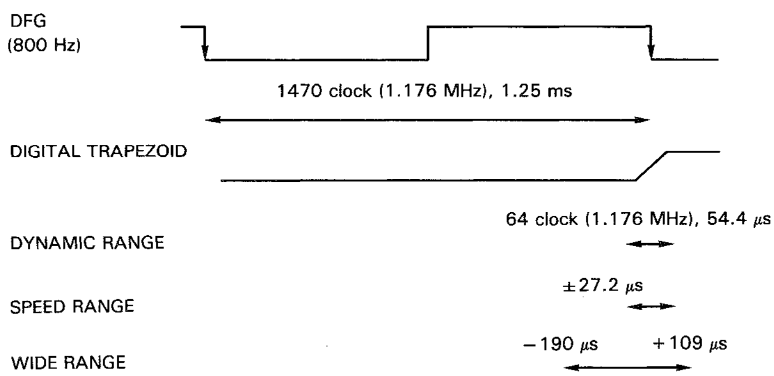
Pin no.	Name	I/O	Waveform	Function	Remark
14	PHPW	O	 50 µs range	Phase servo PWM (Pulse Width Modulation). Comparison between 100/3 Hz and DPG fall.	Operation start when the speed has matched.
15	BSPW	O	 0.1 ms range	Bias servo PWM (operates within the speed range).	
16	CREF	O	 1 ms range	1/19 of 12.8 kHz, i.e. 674 Hz output. Capstan FG reference signal.	
17	RFDT	I	 2 ms range	RF signal present/absent detect signal. "H" when RF is present.	As the RFSF signal
18	RFW	O		RF window. "L" where RF should be present (generated from drum FG).	Signal for front-side ATF
19	VDD	—		5 V	
20	TST1	I		Test terminal (GND).	
21	TIO1	I/O		Test terminal (GND).	
22	XC16	I	"H"  "H" also in STOP mode "L" near search end point.	Capstan ×16 mode signal. "L" for ×16 mode.	
23	JSTL	O	"H"  Search Search end	Drum just-lock signal. "H" when the difference between the DPG positive-going edge and DREF negative-going edge is within ±2.6°.	
24	TIN4	I		Test terminal (GND).	
25	TIN1	I		Test terminal (GND).	
26	ARST	I	Signal is output when non-recorded tape is searched. "H" 	Alarm status reset signal. "L" for resetting. When locking is not possible after 8 sweep operations, alarm occurs and the drum stops.	
27	XDON	I		Drum ON/OFF signal. "L" for ON.	
28	TIN3	I		Test terminal (GND).	
29	TOU3	O		Test terminal (GND).	
30	RF	O	"H"  "L" when playing non-recorded section.	RF signal absent/present detect signal. "H" when present (generated from RFSF).	

Pin No.	Name	I/O	Waveform	Function	Remark
31	Vss	—		GND	
32	TIO2	I/O		Test terminal (GND).	
33	XALM	O	"H" When RF disappears during search, drum sweep occurs 8 times, and normal speed rotation resumes (in case of error).	Alarm status signal. "L" in case of alarm. The signal goes "L" when locking does not occur after 8 drum sweep operations.	
34	XVAR	I	"H"	"L" for varipitch mode.	
35	XREW	I	"H" 	FF/REW judging signal. "L" with REW. Determines the drum rotation speed during sweep (FF: 3600 to 2000 rpm, REW: 2000 to 3600 rpm).	
36	XSER	I	 During up, down, blank search, etc.	Drum speed switching signal for switching from FG reference to PLL reference during search. "L" in search mode.	When there is no RF signal, 3600 rpm in FF and 2000 rpm in REW mode.
37	DBRK	O	"L"  FWD search (not output in BWD search)	Drum brake control. "H" for braking. To decrease the drum rotation speed, a constant voltage in the opposite direction is applied.	
38	TOU1	O		Test terminal.	
39	TOU2	O		Test terminal.	
40	TIN5	I		Test terminal (GND).	
41	DREF	I	 Delay by DPG width 5 ms range	Drum PG reference, 100/3 Hz.	
42	TST2	I		Test terminal (GND)	
43	VDD	—		5 V	
44	DPG	I	 10 ms range	Delay PG input. For phase lock at when DPG falls and DREF falls.	
45	SWP	O	 10 ms range	Switching pulse output. Varies when FG drops after the LPG has risen.	
46	PLLK	O		PLL logic signal. "H" when locked (generated from CRC).	

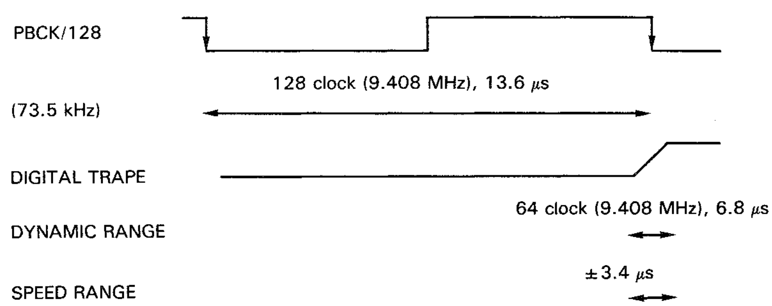
Pin no.	Name	I/O	Waveform	Function	Remark
47	CRC	I		$W_1 + W_2$ check OK signal. "H" when OK.	
48	RPCK	I		PLL clock, for use in PLCK search.	

Timing chart, flow chart

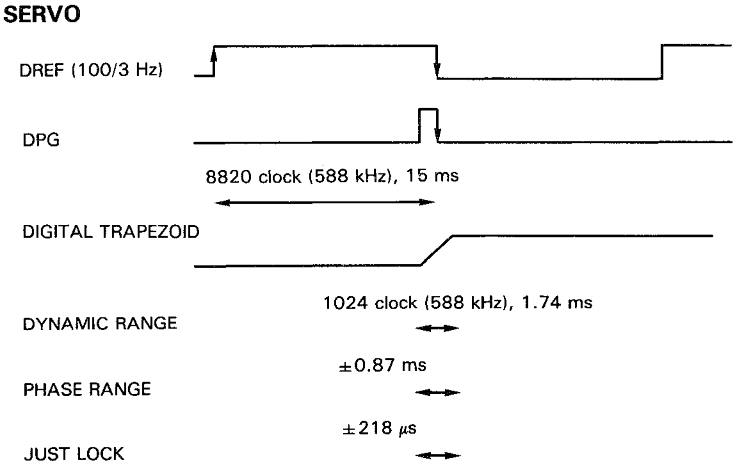
- **DRUM SPEED SERVO**



- **PBCK SPEED SERVO**

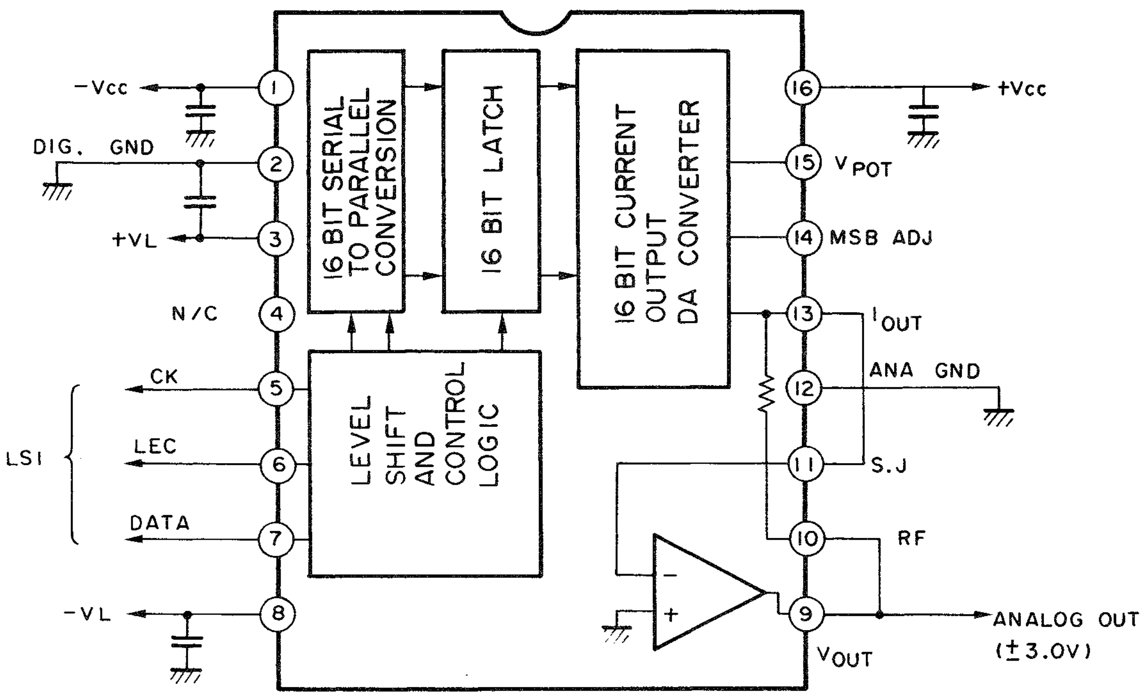


- **RUM PHASE SERVO**

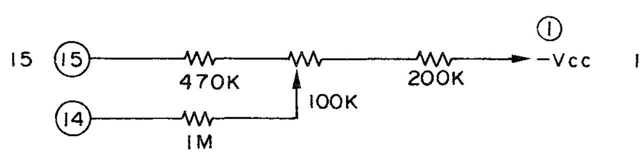


8-12. IC1, 2: PCM56P (X09-2550-XX) D/A converter ICs

Pin configuration/block diagram



Note: The MSB error and bipolar-zero differential linearity error can be adjusted to zero using the following external circuit.



Terminal pin functions

Pin no.	Name	Function	Pin no.	Name	Function
1	−Vcc	Analog negative power supply.	9	Vout	Voltage output.
2	DIG GND	Digital GND.	10	RF	Feedback resistor.
3	+VL	Logic positive power supply.	11	S.J	Summing junction (opamp input).
4	NC	No connection.	12	ANA GND	Analog GND.
5	CK	Clock input.	13	Iout	Current output.
6	LEC	Latch enable control input.	14	MSB ADJ	MSB adjustment terminal.
7	DATA	Data input.	15	VPOT	Potentiometer terminal.
8	−VL	Logic negative power supply.	16	+Vcc	Analog positive power supply.

8-13. IC7: TC9188F (X09-2550-XX) Electronic VR IC

1. Outline

The TC9188F is an electronic VR system incorporating the Volume, Balance, Fader, Bass, Treble and Loudness VRs on a single chip.

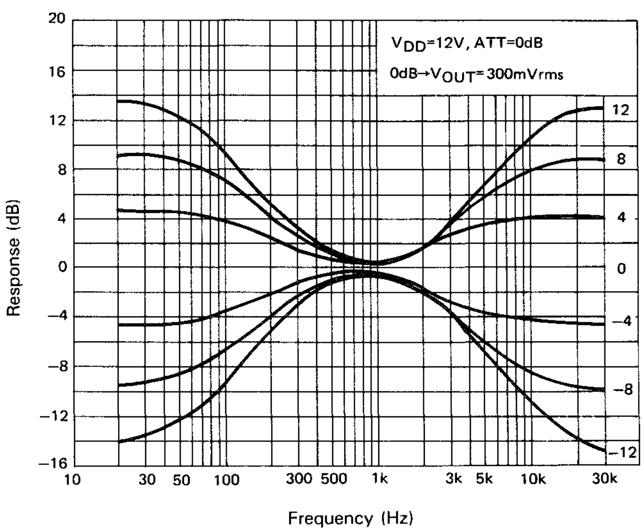
- The VRs can be selected and controlled as desired by applying the specified serial data.

Volume : 0 to −79 dB (1 dB/step)
Fader : 0 to −60 dB (16 steps)
Tone : ±12 dB (2 dB/step) with both Bass and Treble.
Loudness

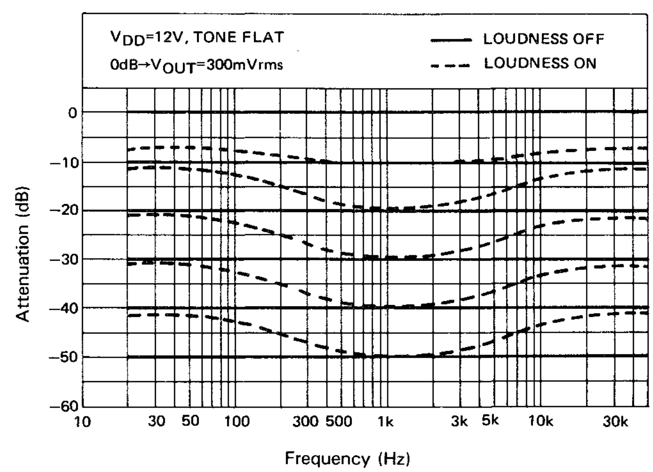
- As the serial data input terminal has the logic level from 0 to 5V, there is no need of providing a microprocessor interface circuit.
- The C-MOS structure features wide operating voltage range and low current consumption.

- **Reference**

1) Tone control characteristic

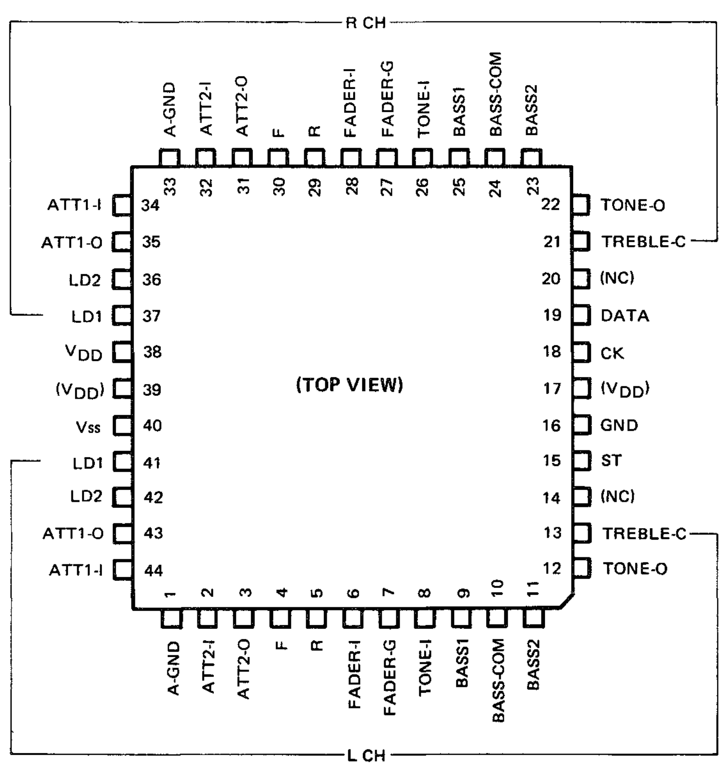


2) Loudness characteristic



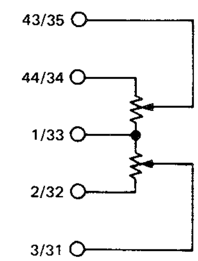
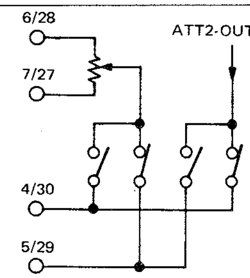
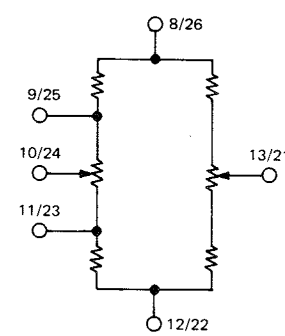
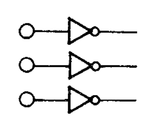
2. Terminals

- **Pin configuration**



- **Terminal pin functions**

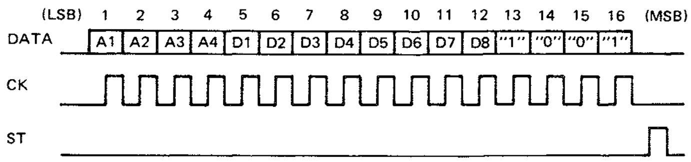
Pins 17 and 39 shall be connected to the VDD terminal (Pin 28).

<table>
<tr><th>Pin No.</th><th>Name</th><th>Function</th><th>Remark</th></tr>
<tr><td>1 (L)
33 (R)</td><td>A-GND</td><td>Analog GND terminals.</td><td rowspan="5"></td></tr>
<tr><td>2 (L)
32 (R)</td><td>ATT2-IN</td><td>1 dB/step attenuator input terminals.</td></tr>
<tr><td>3 (L)
31 (R)</td><td>ATT2-OUT</td><td>1 dB/step attenuator output terminals.
The signals input to ATT2-IN are attenuated by 0 to −9 dB in 10 steps, with 1 dB increments.</td></tr>
<tr><td>43 (L)
35 (R)</td><td>ATT1-OUT</td><td>10 dB/step attenuator output terminals.
The signals input to ATT1-IN are attenuated by 0 to −70 dB in 8 steps, with 10 dB increments.</td></tr>
<tr><td>44 (L)
34 (R)</td><td>ATT1-IN</td><td>10 dB/step attenuator input terminals.</td></tr>
<tr><td>4 (L)
30 (R)</td><td>F</td><td>Fader control Front output terminals.</td><td rowspan="4"></td></tr>
<tr><td>5 (L)
29 (R)</td><td>R</td><td>Fader control Rear output terminals.</td></tr>
<tr><td>6 (L)
28 (R)</td><td>FADER-IN</td><td>Fader control input terminals.</td></tr>
<tr><td>7 (L)
27 (R)</td><td>FADER-GND</td><td>Fader control attenuator GND terminals.</td></tr>
<tr><td>8 (L)
26 (R)</td><td>TONE-IN</td><td>Tone control input terminals.</td><td rowspan="6"></td></tr>
<tr><td>9 (L)
25 (R)</td><td>BASS1</td><td>Tone control Bass tap terminals.</td></tr>
<tr><td>10 (L)
24 (R)</td><td>BASS-COM</td><td>Tone control Bass VR common terminals.</td></tr>
<tr><td>11 (L)
23 (R)</td><td>BASS2</td><td>Tone control Bass tap terminals.</td></tr>
<tr><td>12 (L)
22 (R)</td><td>TONE-OUT</td><td>Tone control output terminals.</td></tr>
<tr><td>13 (L)
21 (R)</td><td>TREBLE-COM</td><td>Tone control Treble VR common terminal.</td></tr>
<tr><td>14 (L)
20 (R)</td><td>NC</td><td>To be Opened or connected to GND.</td><td></td></tr>
<tr><td>15</td><td>ST</td><td>Strobe input terminal for switching to the input control data.
Low-threshold inverter input similar to CK and DATA inputs.</td><td rowspan="3">As the low-threshold inverter is incorporated, the logic level is 0 to 5 V.
</td></tr>
<tr><td>18</td><td>CK</td><td>Control data read clock input terminal.</td></tr>
<tr><td>19</td><td>DATA</td><td>Control data input terminal.</td></tr>
<tr><td>41 (L)
37 (R)</td><td>LD1</td><td rowspan="2">Loudness network connection terminals.</td><td rowspan="2"></td></tr>
<tr><td>42 (L)
36 (R)</td><td>LD2</td></tr>
<tr><td>16</td><td>GND</td><td rowspan="3">Power supply terminals.</td><td rowspan="3"></td></tr>
<tr><td>38</td><td>VDD</td></tr>
<tr><td>40</td><td>Vss</td></tr>
</table>

3. Function description

• Data format

The TC9188F can be controlled arbitrarily by applying data from the controller. Each data consists of 16 bits.



1) A1 ~ A4 (bits 1 to 4)

Data bits 1 to 4 are used to select one of Volume L/R, Bass Treble and Fader.

	A1	A2	A3	A4
Volume (L)	L	L	L	H
Volume (R)	H	L	L	H
Bass	L	H	L	H
Treble	H	H	L	H
Fader	L	L	H	H

2) D1 ~ D8 (bits 5 to 12)

Data bits 5 to 12 set the increment step of the VR. D1 to D4 are used for Bass and Treble, and D1 to D4 and D8 are used for Fader.

2-a) Volume

Data bits 1 to 4 (A1 ~ A4) select the L or R Volume, and data bits 5 to 12 (D1 ~ D8) set the attenuation data for the Volume. D1 to D4 are the data for ATT2 with 1 dB/step, and D5 to D8 are for ATT1 with 10 dB/step.

D1	D2	D3	D4	ATT2
L	L	L	L	0 dB
H	L	L	L	−1 dB
L	H	L	L	−2 dB
H	H	L	L	−3 dB
L	L	H	L	−4 dB
H	L	H	L	−5 dB
L	H	H	L	−6 dB
H	H	H	L	−7 dB
L	L	L	H	−8 dB
H	L	L	H	−9 dB
L	H	L	H	− ∞

D5	D6	D7	D8	ATT1
L	L	L	*	0 dB
H	L	L	*	−10 dB
L	H	L	*	−20 dB
H	H	L	*	−30 dB
L	L	H	*	−40 dB
H	L	H	*	−50 dB
L	H	H	*	−60 dB
H	H	H	*	−70 dB

* Loudness

Note: Data other than those listed above will result in inconstant volume steps.

2-b) Loudness

D8 of Volume L data is the Loudness ON/OFF data. Loudness is ON when D8 is "H", and OFF when it is "L". Loudness is turned ON/OFF simultaneously for the L and R channels. Meanwhile, D8 of Volume R data has no effect so it can either be "L" or "H".

2-c) Tone control (Bass, Treble)

Data bits 1 to 4 (A1 ~ A4) select Bass or Treble, and data bits 5 to 8 (D1 ~ D4) sets the tone control data. Bass and Treble can be set independently, but L and R channels cannot be set independently.

D1	D2	D3	D4	
L	H	H	L	+ 12 dB
H	L	H	L	+ 10 dB
L	L	H	L	+ 8 dB
H	H	L	L	+ 6 dB
L	H	L	L	+ 4 dB
H	L	L	L	+ 2 dB
L	L	L	L	0 dB
H	H	H	H	− 2 dB
L	H	H	H	− 4 dB
H	L	H	H	− 6 dB
L	L	H	H	− 8 dB
H	H	L	H	− 10 dB
L	H	L	H	− 12 dB

* **Note:** Data other than those listed above will result in inconstant volume steps.

2-d) Fader

Data bits 1 to 4 (A1 ~ A4) selects Fader, and data bits 5 to 8 (D1 ~ D4) sets the Fader VR data for attenuating either the front or rear volume. One VR is used to adjust both the L and R channels, and whether the front or rear is to be attenuated is selected by data bit 12 (D8). The Fader VR attenuates the front volume when D8 is "H", and the rear volume when it is "L".

D1	D2	D3	D4	
L	L	L	L	0 dB
H	L	L	L	− 2 dB
L	H	L	L	− 4 dB
H	H	L	L	− 6 dB
L	L	H	L	− 8 dB
H	L	H	L	−10 dB
L	H	H	L	−12 dB
H	H	H	L	−14 dB
L	L	L	H	−16 dB
H	L	L	H	−18 dB
L	H	L	H	−20 dB
H	H	L	H	−26 dB
L	L	H	H	−35 dB
H	L	H	H	−45 dB
L	H	H	H	−60 dB
H	H	H	H	− ∞ dB

3) Code bits (bits 13 to 16)

Data bits 13 to 16 are the code bits for the TC9188F. Therefore, only the following code is accepted.

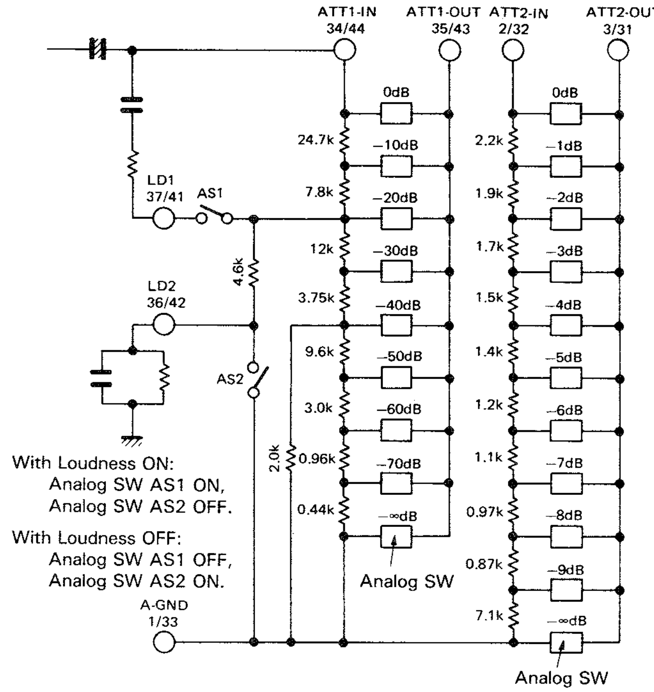
Data bits

15	14	15	16
H	L	L	H

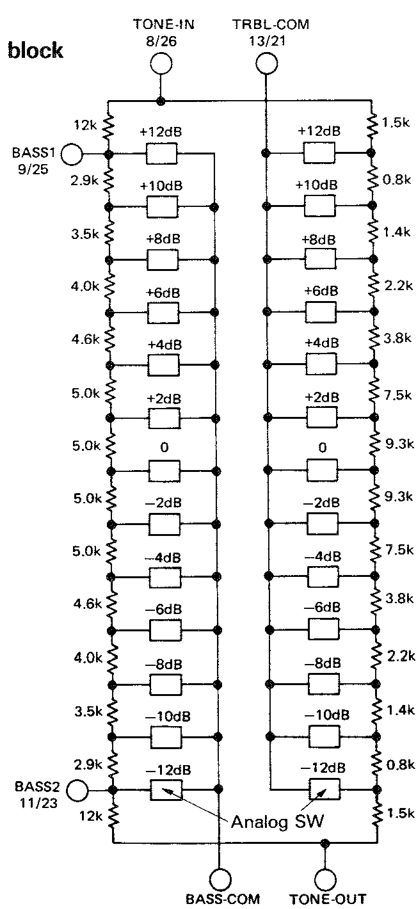
• Description of each VR block

Each VR consists of diffused resistor arrays and analog switches.

1) Volume and loudness block

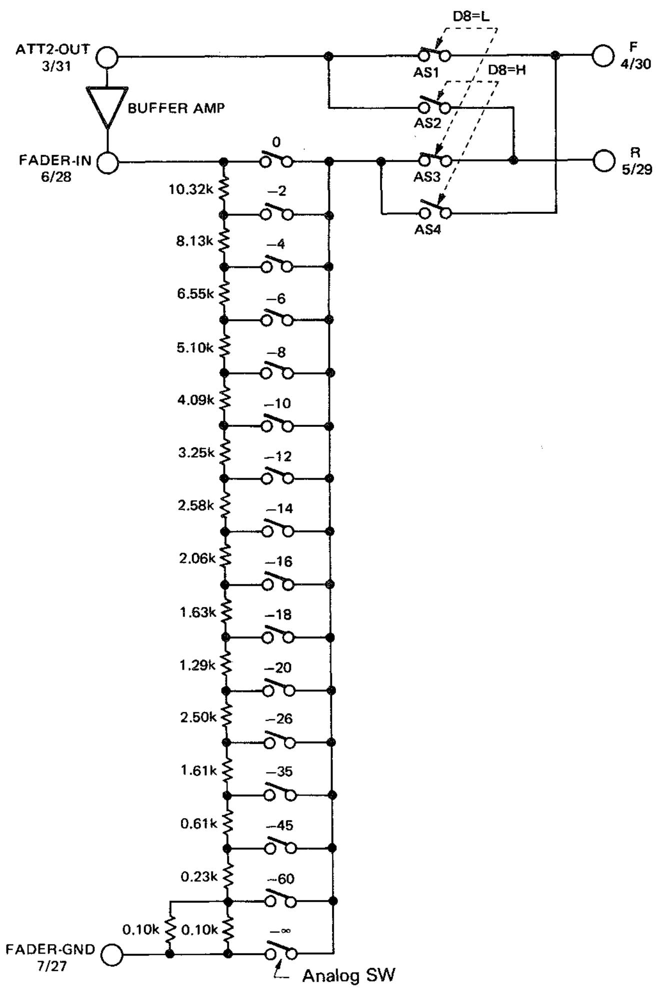


2) Tone control (Bass, Treble) block



3) Fader block

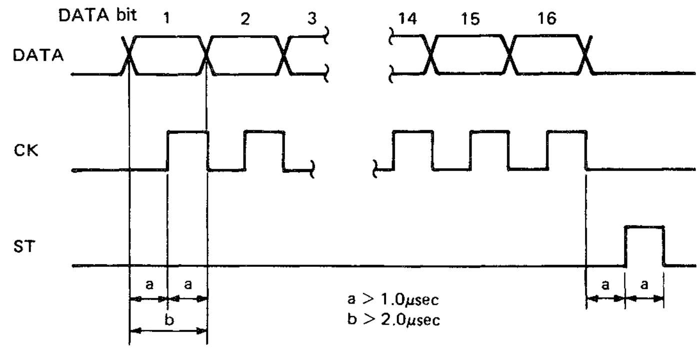
When Fader control data D8 is "H", analog SWs AS2 and AS4 turns ON so the Fader VRs attenuate the front volume. When D8 is "L", analog SWs AS1 and AS3 turns ON so the Fader VR attenuates the rear volume.



D8	OUTPUT
"0"	F ← ATT2-OUT
	R ← FADER-VR
"1"	F ← FADER-VR
	R ← ATT2-OUT

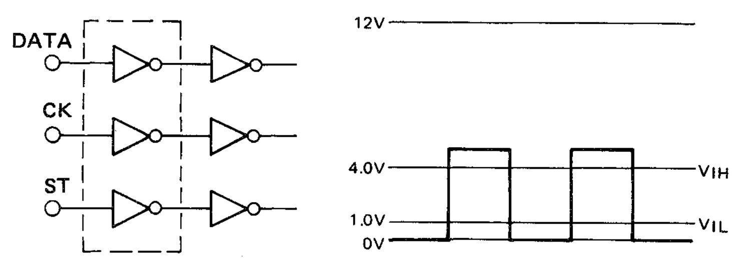
- **CK, DATA and ST input timing**

The CK, DATA and ST inputs are to be applied with the timing shown below.



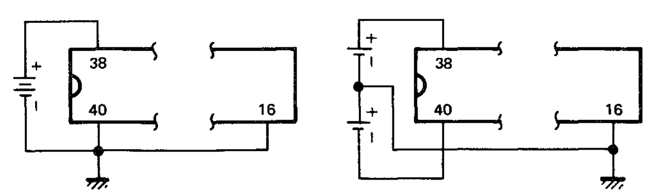
- **CK, DATA and ST input**

Each of the CK, DATA and ST inputs incorporates a low-threshold inverter so that it can function on the TTL logic level of 0 to 5 V even when VDD = 12 V.



- **Power supply**

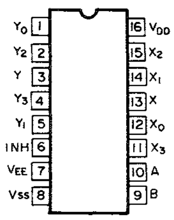
The TC9188F normally operates on a single power supply, but can also operated on two power supplies. Even in case of two power supplies, CK, DATA and ST operate on the TTL logic level of 0 to 5 V.



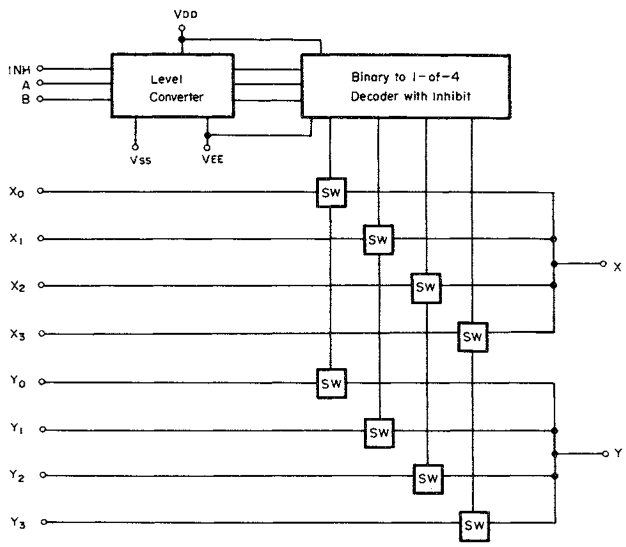
8-14. IC24: μPD4052BG (X29-1830-00) 4-channel analog switch IC

The μPD4052PG is a multiplexer composed of a level converter and analog SWs. The switches corresponding to the required channels are turned on according to the digital signal input to the control terminals.

Pin configuration



Block diagram



Truth table

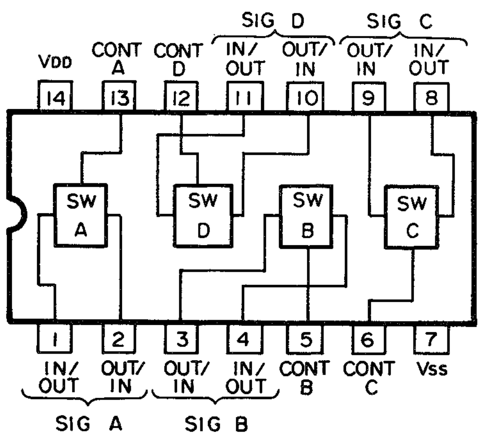
Control input			"ON" channel
INHIBIT	B	A	μPD4052BC
L	L	L	X_0, X_0
L	L	H	Y_1, X_1
L	H	L	Y_2, X_2
L	H	H	Y_3, X_3
L	L	L	—
L	L	H	—
L	H	L	—
L	H	H	—
H	×	×	NONE

H: "High" level. L: "Low" level. X: H or L

8-15. IC17: μPD4066BG (X29-1830-00) 4-channel analog switch IC

The μPD4066BG is a switch that can be controlled with a logic input signal. The CMOS construction minimizes the influence of control input on the signal lines. With small variation of ON resistance due to signal input, this IC is applicable in a wide range of operations including a chopper, modulator, demodulator, etc.

Pin configuration

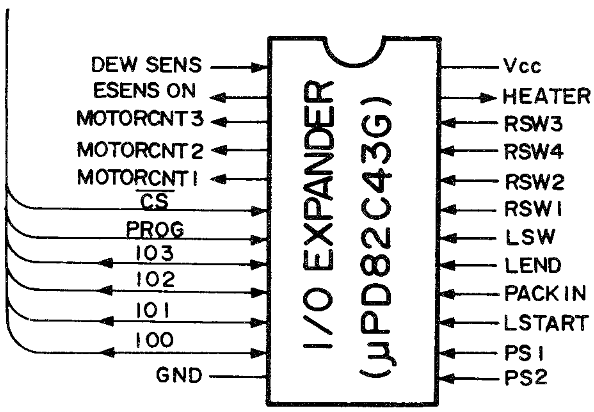


Truth table

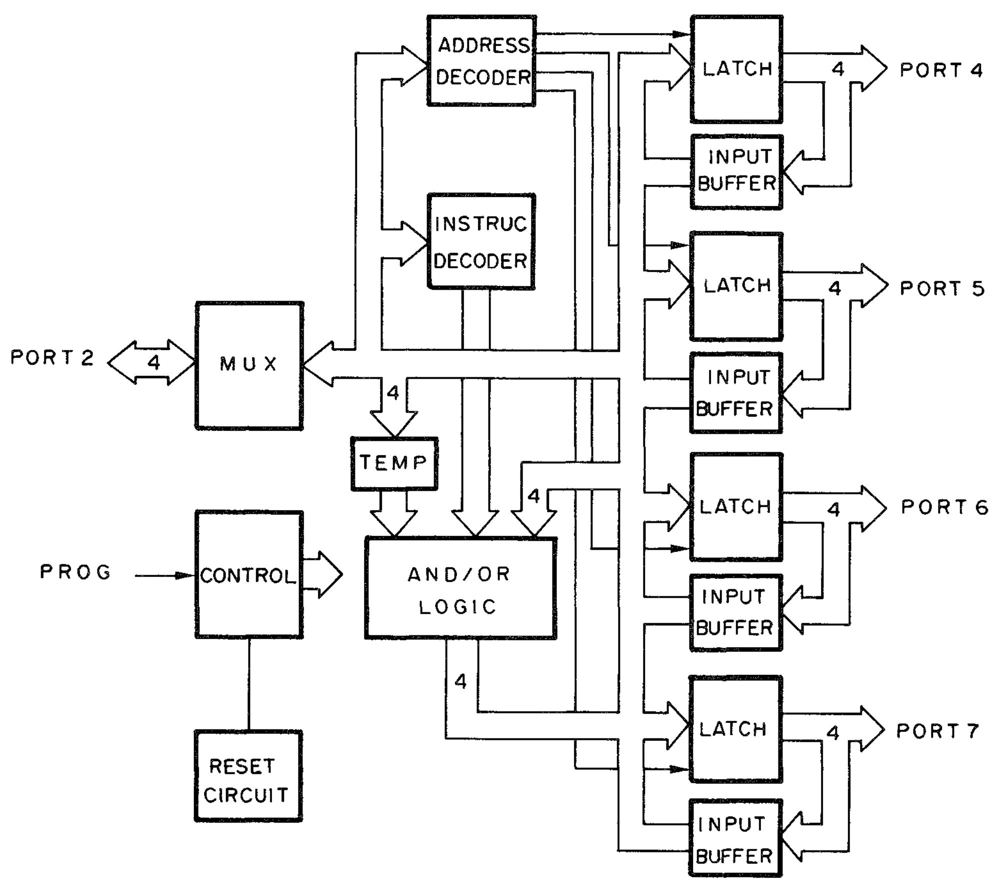
Control	Switch
L	ON
H	OFF

8-16. IC3: μPD82C43G (X13-5690-00) I/O expansion port

Pin configuration



Block diagram



9. MECHANISM OPERATIONS

9-1. General

The Mechanism Ass'y (X92-1180-00) is a DAT deck mechanism featuring 4 DD motors, 2 drive motors, 2 heads, 90° coil winding, and M loading.

9-2. Features

- Cassette: DAT standard cassette.
- Playback only.
- Fast Forward, Rewind.
- Forward/Reverse search,
  capstan search,
  reel search.
  (Proper tension is required at the drum entrance.)
- Front loading (Power loading/ejection by motor drive).
- Motor-drive tape loading/unloading.
- Electronic tension detect mechanism.
- Cassette ID hold detect SW.
- Tape end detection: Optical detection conforming to DAT standard.
- Supply/takeup reel base rotation detect mechanism.
- Cassette presence/absence detection.
- Auto-shutter door.
- Dew sensor with heater.
- Temperature sensor (operating temperature: 80°C (reference value)).

9-3. Main component parts

- Cassette mechanism Ass'y (cassette loading)
  Cylinder Base Ass'y,
  Slant Pole Base Ass'y,
  Guide Roller Ass'y.
- Drum Ass'y.
- Capstan Motor Ass'y.
- Reel Motor Ass'y.
- Loading motor,
  cassette loading motor,
  tape loading motor.
- End sensor.
- Rotary encoder.
- Recognition switch.
- Limit switch.
- RF unit.
- Mechanism sensor unit.
- RAM/ECC ATF unit.
- Drum servo mechanism microprocessor unit.
- Reel capstan servo unit.

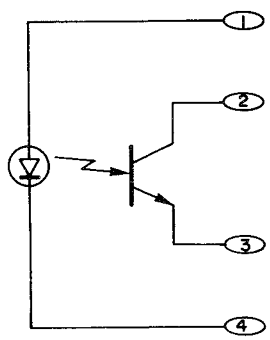
9-4. Mechanical specifications

- Cassette insertion force (measured by pushing the cassette center in the horizontal direction using a push-pull gauge): Less than 600 gf.
- Tape speed deviation:
  8.15 mm/sec ±0.25% (×1),
  12.225 mm/sec (×1.5) (reference value).
- Pressure:
  Pinch roller pressure 220 ±30 gf.
  Slant pole pressure
    Play; more than 100 gf (reference value),
    FF/REW; more than 100 gf.
- Tape drive force:
  More than 60 gf
- W & F:
  Capstan FG,
  drum FG.
- Torque setting:
  Tape tension:
    9±0.5 gf (at the drum entrance).
    Measured with a tension analyzer.
    Normal measurement shall use a torque meter (the torque is to be determined in relation with the tension value).
  Takeup torque: 12±3 g-cm.
  Reverse torque: 12±3 g-cm.
  FF torque:
    20 to 25 g-cm (reference value max. 30 g-cm).
  REW torque:
    20 to 25 g-cm (reference value max. 30 g-cm).
  Tape unloading torque: 8±3 g-cm.
- FF/REW time (with 120-min tape fully recorded with RF):
  FF; 60 sec ±10%.
  REW; 46 sec ±10%.
- Loading time:
  Cassette loading time; less than 2.5 sec.
  Tape loading time; less than 4.5 sec.

9-5. Structure of R-DAT tape-end sensor

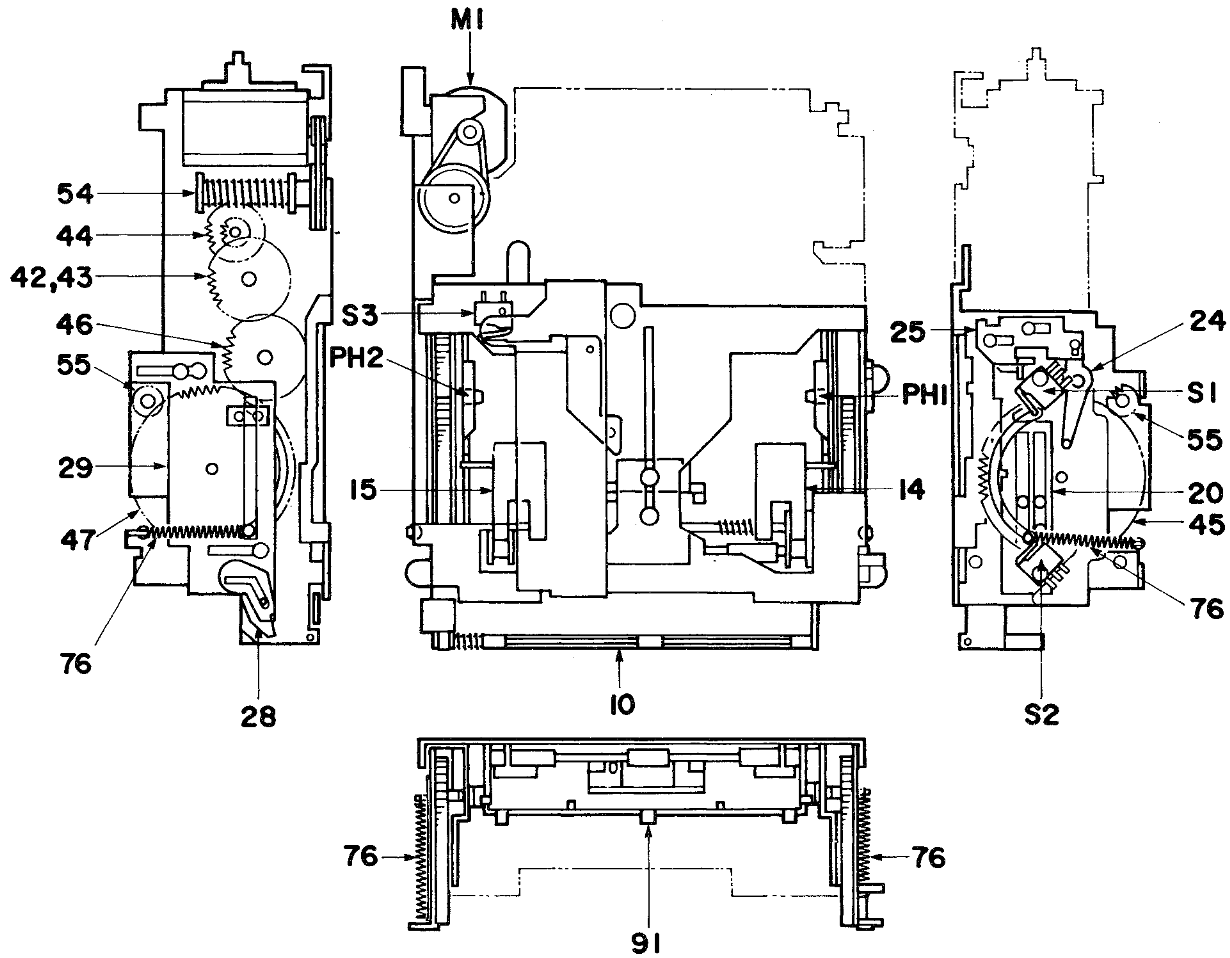
Light emission: GaAs infrared LED.
Light reception: NPN silicon phototransistor.
A phototransistor with a prism integrating the light emitter and receiver on a same surface is used.

Pin configuration



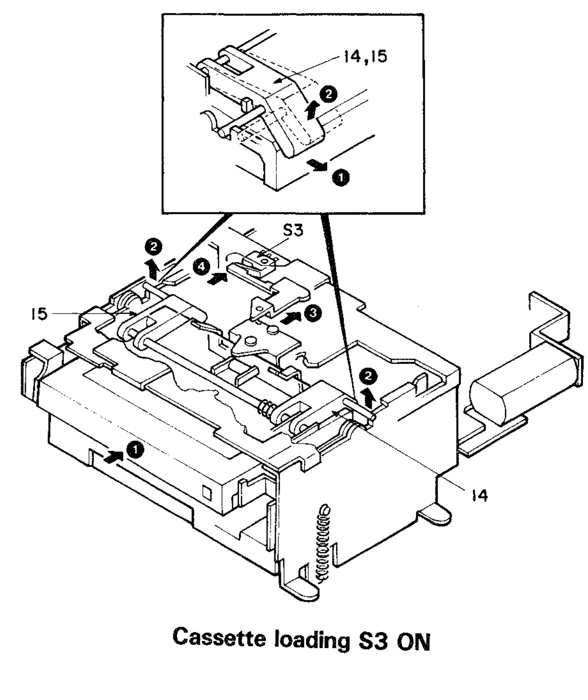
No.	Name
1	Anode (LED)
2	Collector (Tr)
3	Emitter (Tr)
4	Cathode (LED)

9-6. Cassette loading



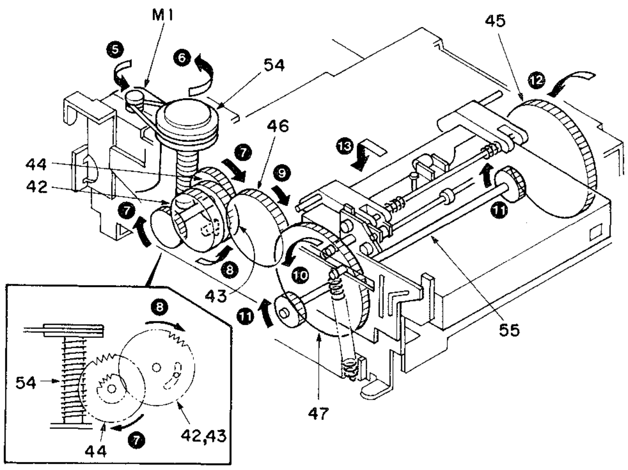
Cassette loading — stop mode

1. When the cassette is inserted through the insertion slot, the door opens and the lug on the cassette container block (91) pushes the cassette slider.
2. Then the left and right arm Ass'ies (14, 15) move upward, unlocking the cassette container block (91) (❶, ❷).
3. The cassette slider is pushed toward the deep (❸), reel hub opens and the pack-in SW (S3) turns ON (❹).

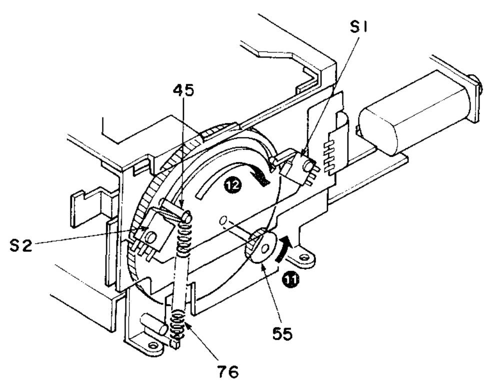


Cassette loading S3 ON

4. When the pack-in SW (S3) turns ON, the cassette loading motor (M1) starts rotation and cassette container block (91) moves backward. At this time, the holder Ass'y pushes the cassette holding hole (❺ to ⓬).

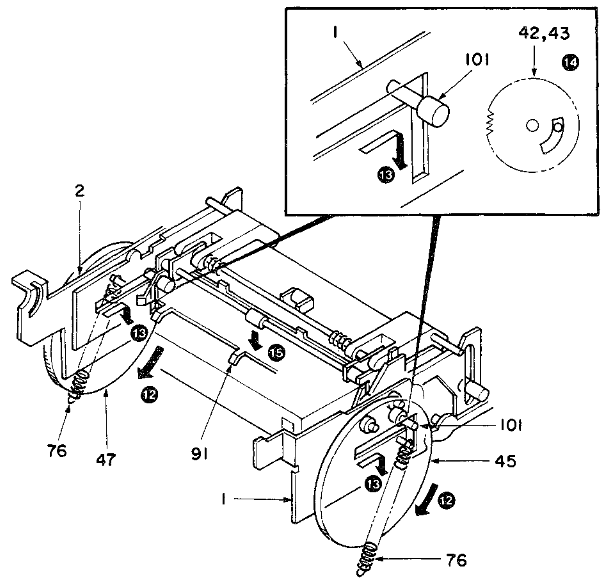


Cassette loading



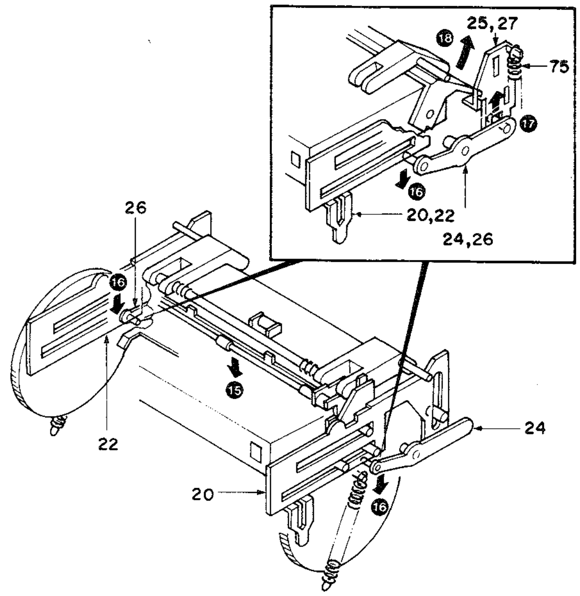
Cassette loading S1/S2 ON/OFF

5. After being moved horizontally by the gear (45, 47) rotations (⓬ , ⓭ , ⓮), the cassette container block (91) is then moved down to the loading position along the vertical drop guide grooves on the guide plates (1). By means of the gear (42, 43) grooves and the pins, the cassette container block moves down at a higher dropping speed than the motor rotation speed.

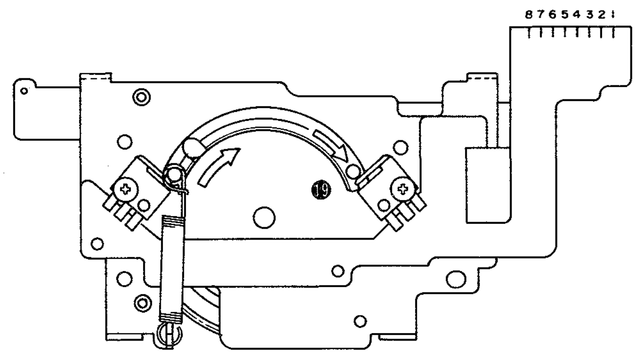


Elevation

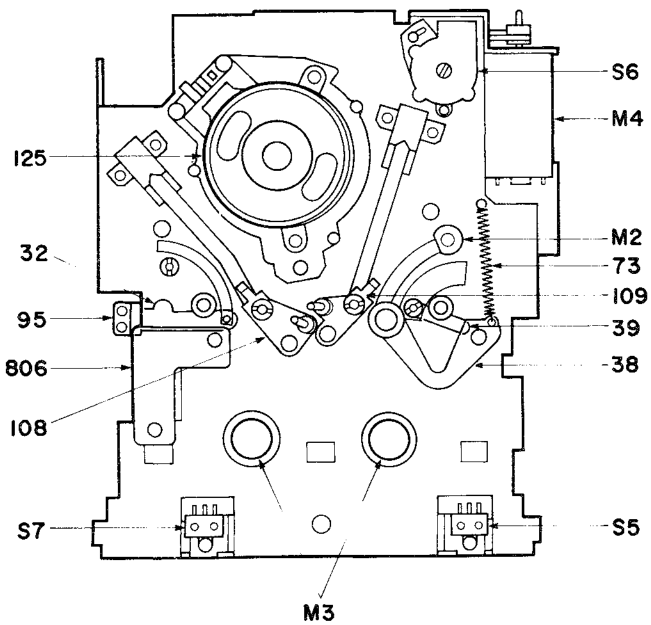
6. At the same time, the cassette container block (91) pushes up the levers (25, 27) via the arms (24, 26), opening the cassette lid (⓯ to ⓲).



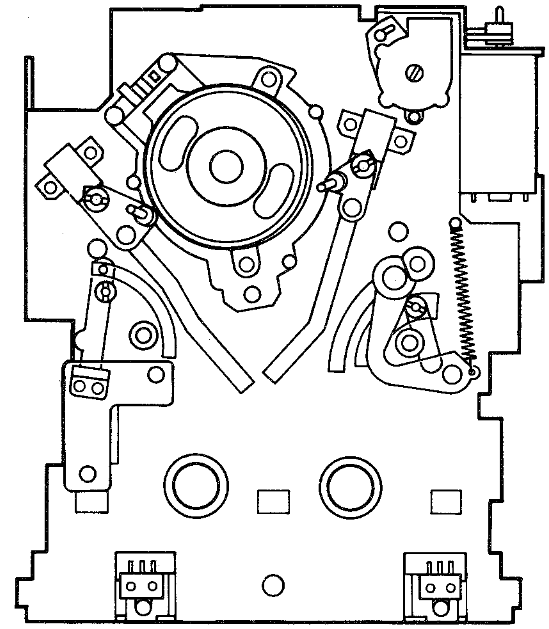
7. When the cassette loading has completed, the loading end SW (S1) turns ON, stopping the cassette loading motor (M1) rotation.



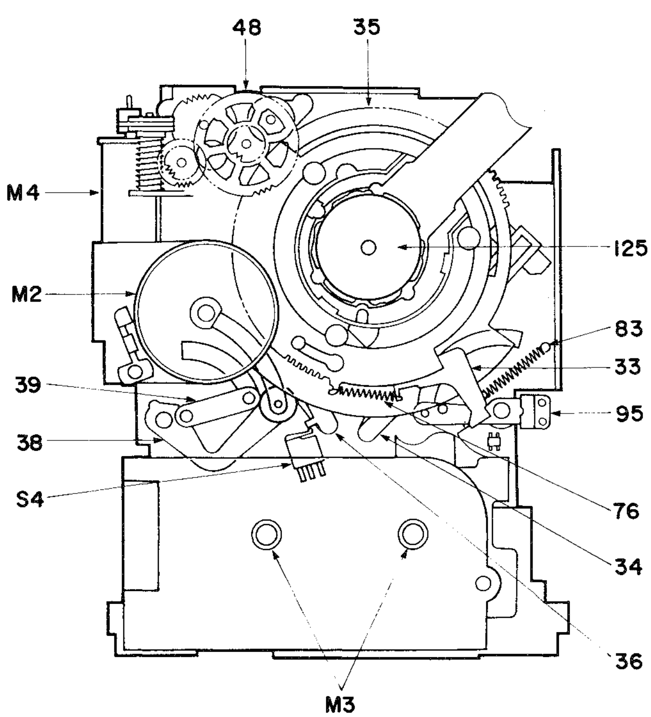
9-7. Tape loading → play



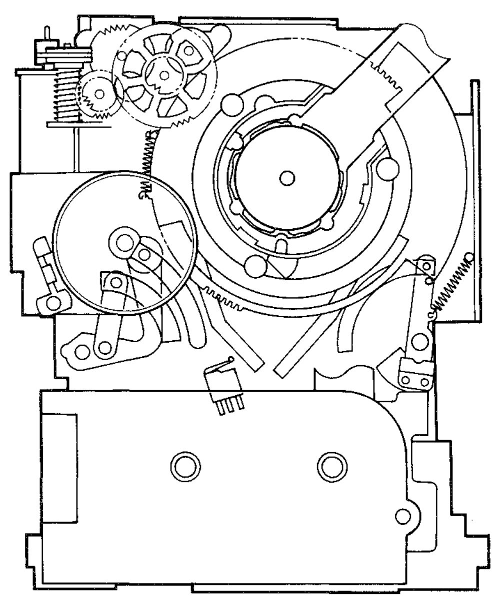
Front side stop condition



Front side loading condition

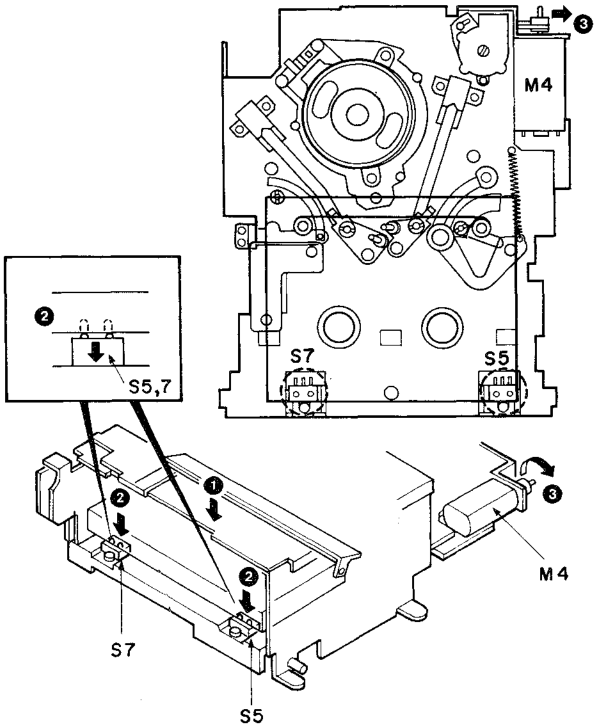


Back side stop condition

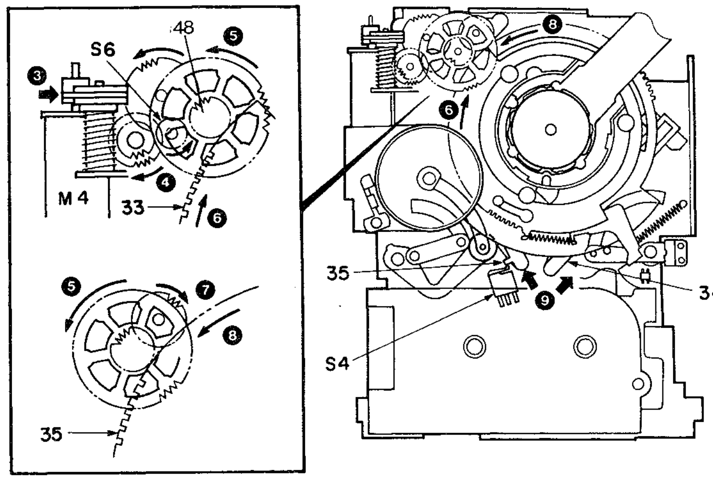


Back side loading condition

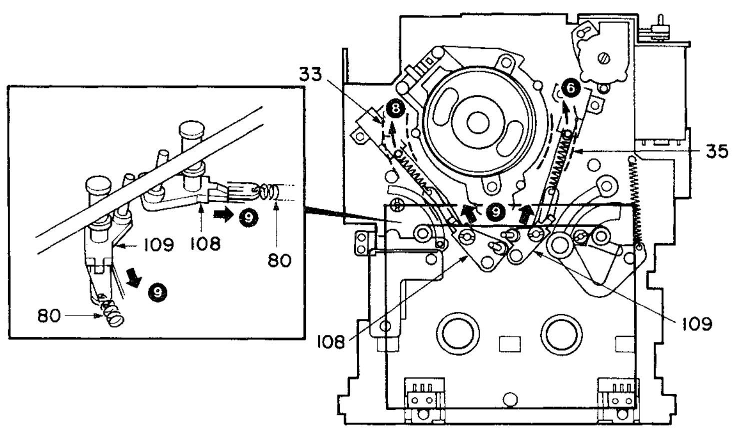
1. When the cassette loading has completed, the recognition SWs (S5, S7) are pushed (❶ , ❷), and the tape loading motor (M4) starts rotation. The capstan motor (M2) also starts rotation at this time.



2. The rotation of the tape loading motor (M4) is transmitted via the gear block (48) to the ring gears (33, 35), which start rotations in opposite directions (❸ to ❽).

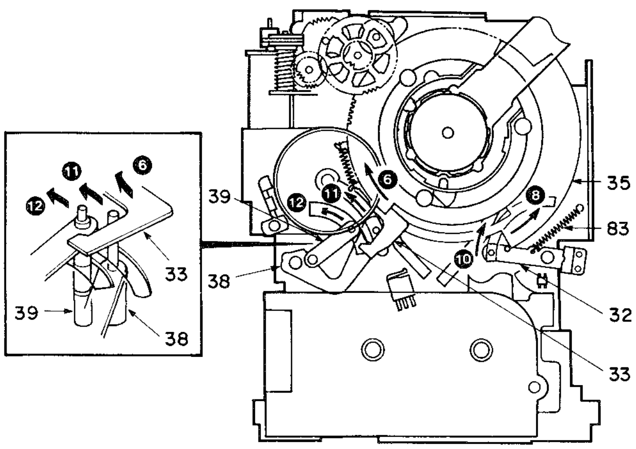


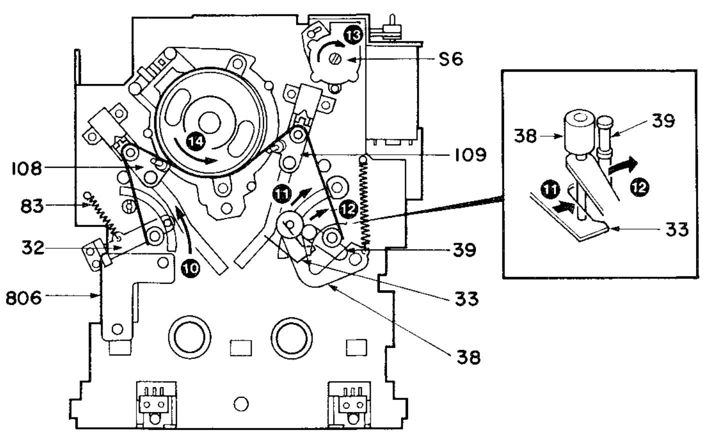
3. The ring gears (33, 35) pulls, via the spring (80), the slant poles (108, 109) together with the cassette tape (❾).



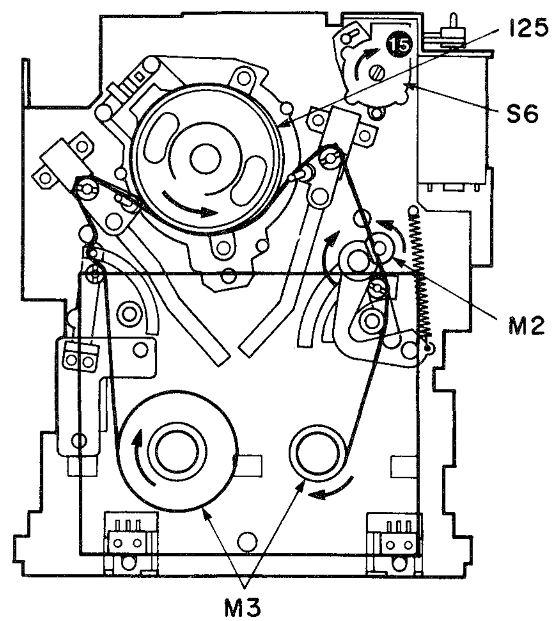
4. The rotary encoder (S6) detects the position where tape contacts the cylinder head (125), and rotates the cylinder head (125) (⓮).

5. When the ring gears (33, 35) further move, the tension arm (32), pinch roller (38) and guide (39) are moved to their Play positions (❿ to ⓬).



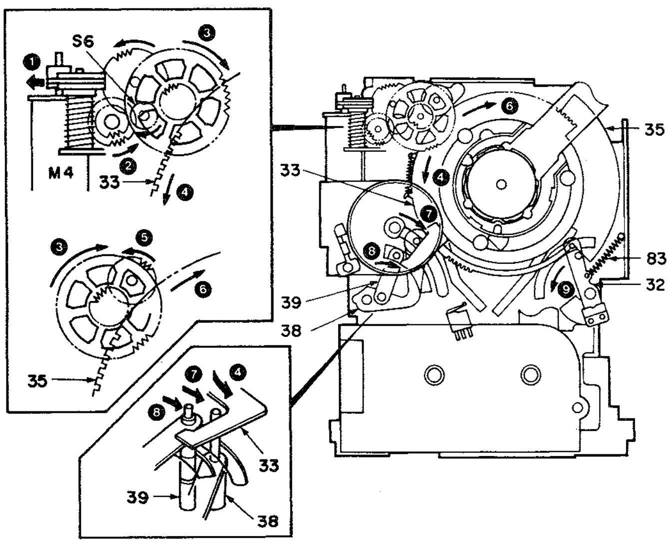


6. When the tape loading has completed, the rotary encoder (S6) detects it (⓯), stops the tape loading motor (M4) rotation, and the mechanism enters the play mode.



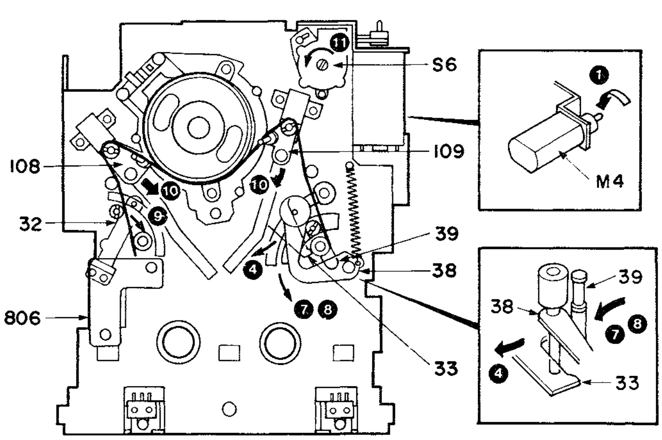
9-8. FF/REW

1. In FF/REW mode, the tape loading motor (M4) rotates in the reverse direction, moving the ring gears (33, 35) to the FF/REW position (❶ to ❾).



FF/REW

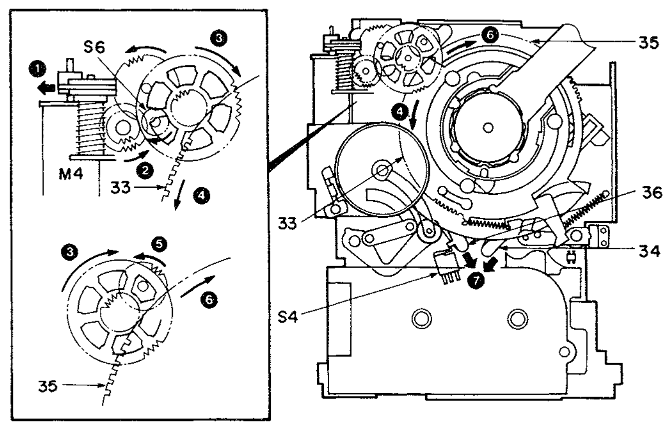
2. As the slant poles (108, 109) also return, the reel motor (M3) starts winding the tape.
The pinch roller (38), tension arm (32) and guide (39) leave the tape. When the ring gears (33, 35) comes to the FF/REW position, the rotary encoder (S6) detects it and stops the tape loading motor (M4) rotation. The mechanism now enters the FF/REW mode (❿ , ⓫).



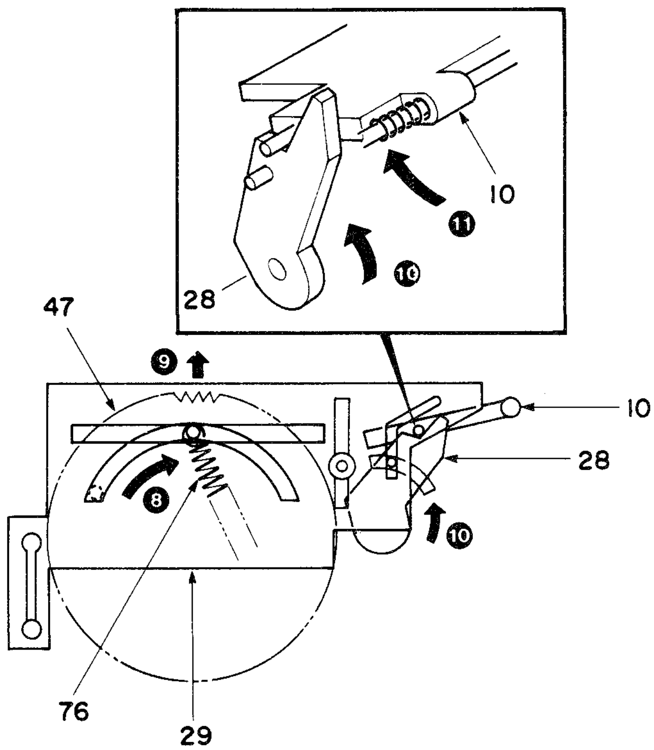
FF/REW

9-9. Ejection

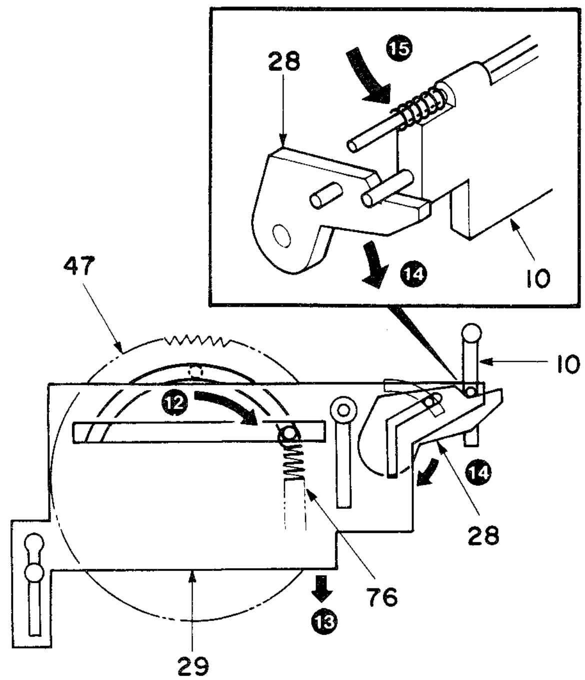
1. The tape loading motor (M4) rotates in the reverse direction, returning the ring gears (33, 35).
When the ring gears (33, 35) return to the start positions and slant poles (108, 109) come inside the cassette case, the loading SW (S4) turns ON, stopping the tape loading motor (M4) rotation.



2. Then, the cassette loading motor (M1) starts rotating in the reverse direction, and the cassette is moved upward then forward.
   At the same time, the plate (29) is moved up by means of the gear (47) rotation, opening the door via the lever (28) (❽ to ⓫).



3. When the gear further rotates, the plate (29) is moved downward so that door is no longer pushed by the lever (⓬ to ⓯).



10. MECHANISM OPERATION TIMING CHARTS

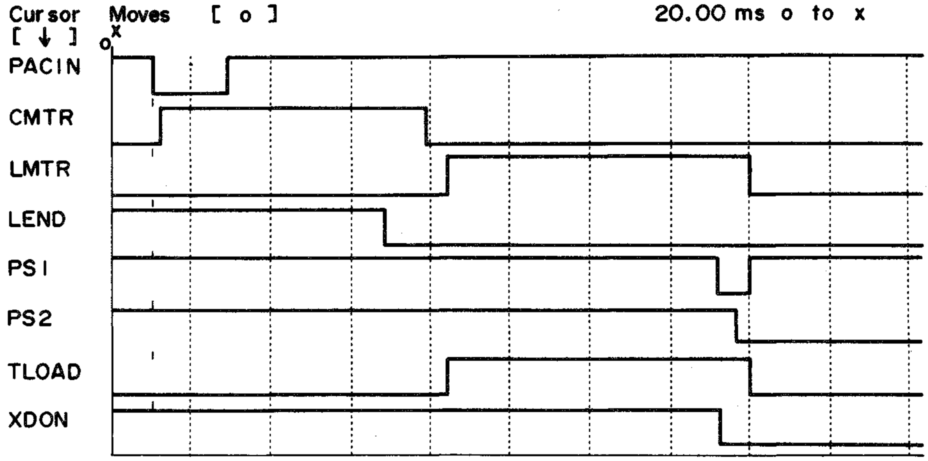
10-1. Loading operation

In 100 ms after the pack-in SW has been deactivated, the loading motor is rotated in the forward direction until 520 ms after the loading end SW has turned "L". In 250 ms after this, TLOAD is turned "H" to lock the takeup reel and the tape loading motor is rotated in the forward direction. When the tape guide has moved to the specified position, PS1 goes "L" and XDON goes "L" so that the head starts rotation. Afterward, PS2 goes "L", PS1 goes "H" and, at the same time, TLOAD goes "L" turning the tape loading motor OFF.

Timing Waveform Diagram

Sample Period [10 ms]
Magnification [1X]
Magnify About [x]
Cursor Moves [o]

1.000 s / div
10.00 ms / sample
20.00 ms o to x



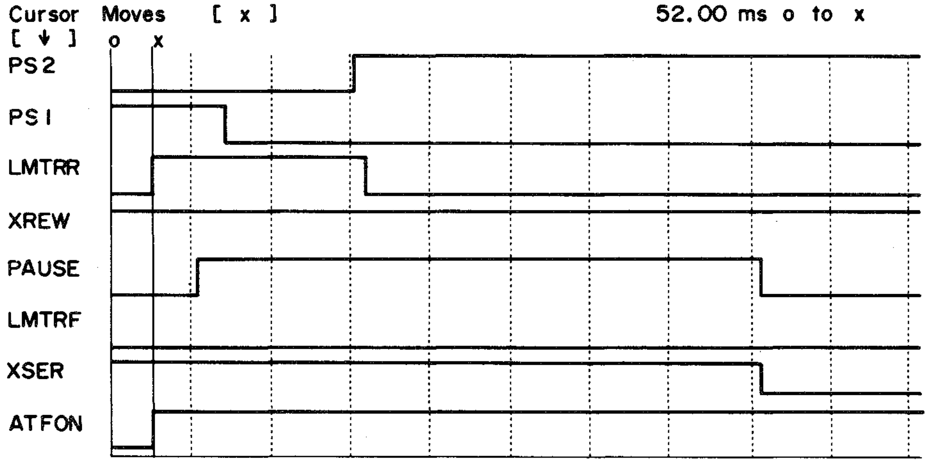
10-2. Play → FF switching

ATF ON is turned "H" and, at the same time, the tape loading motor is rotated in the reverse direction. In 57 ms after this, PAUSE is turned "H" to free the reels. When the tape guide has moved to the specified position, PS1 goes "L". Then, the tape loading motor is turned OFF when PS2 goes "H". In 500 ms after this, PAUSE is turned "L" and XSER is turned "L" to switch to the search mode.

Timing Waveform Diagram

Sample Period [1 ms]
Magnification [1X]
Magnify About [x]
Cursor Moves [x]

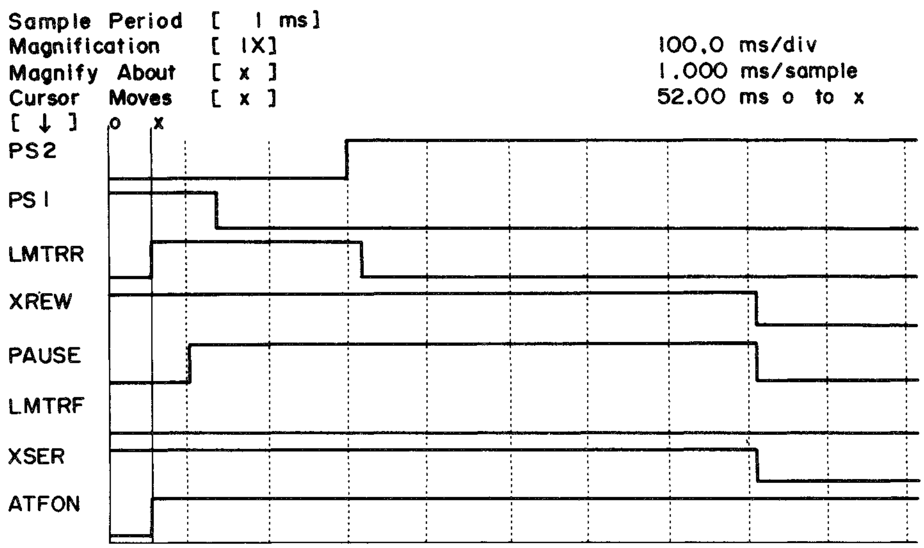
100.0 ms/div
1.000 ms/sample
52.00 ms o to x



10-3. Play → REW switching

ATF ON is turned "H" and, at the same time, the tape loading motor is rotated in the reverse direction. In 48 ms after this, PAUSE is turned "H" to free the reels. When the tape guide has moved to the specified position, PS1 goes "L". Then, the tape loading motor is turned OFF when PS2 goes "H". After this, PAUSE is turned "L" and XSER is turned "L" to switch to the search mode. At this time, XREW is also turned "L".

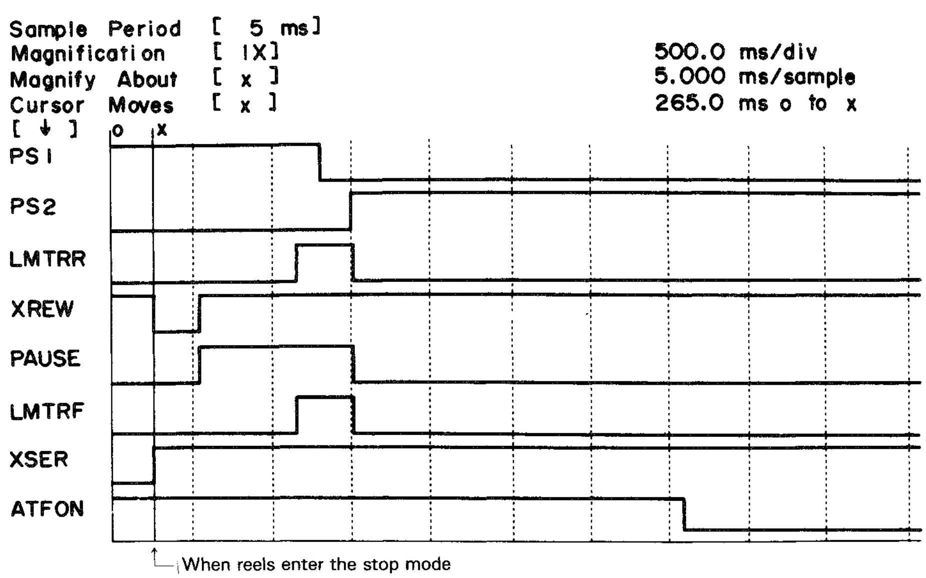
Timing Waveform Diagram



10-4. FF → Play switching

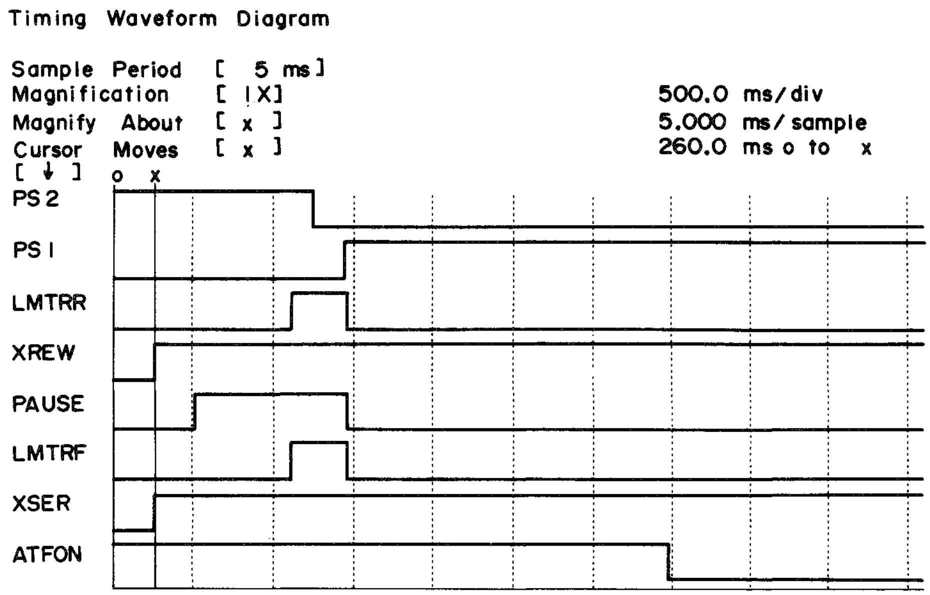
XSER is turned "H" at the same time as the fall of XREW to cancel the search mode, and PAUSE is turned "H" at the same time as the rise of XREW to free the reels. Then, the tape loading motor is rotated in the forward direction and, when the tape guide is moved to the specified position, PS1 goes "L". After this, when PS2 goes "H", the tape loading motor is turned OFF and PAUSE is turned "L". Later, when the cylinder is locked, ATF ON goes ON ("L").

Timing Waveform Diagram



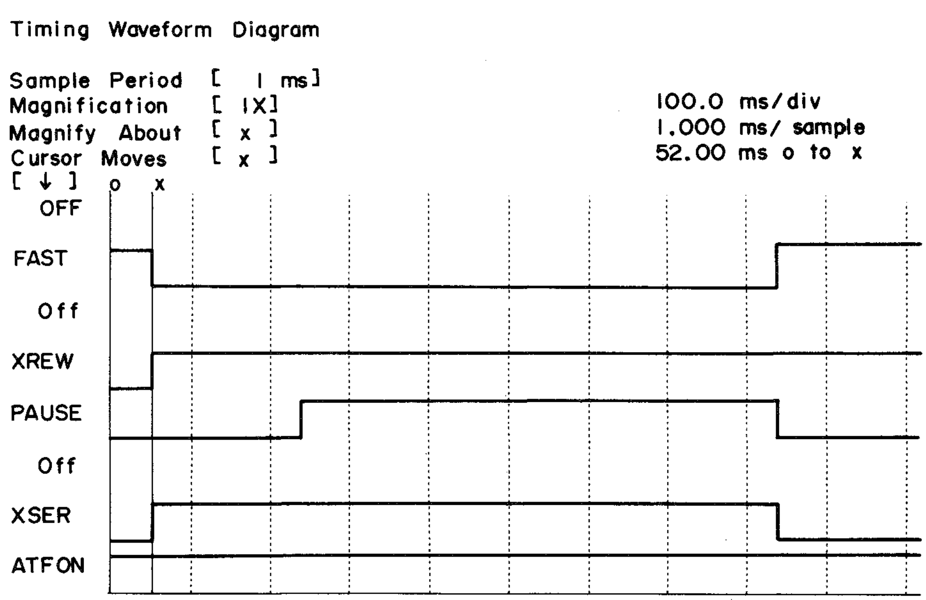
10-5. REW → Play switching

XSER is turned "H" at the same time as XREW goes "H" to cancel the search mode, and PAUSE is then turned "H" to free the reels. Then, the tape loading motor is rotated in the forward direction and, when the tape guide is moved to the specified position, PS2 goes "L". After this, when PS1 goes "H", the tape loading motor is turned OFF and PAUSE is turned "L". Later, ATF ON is turned "L".



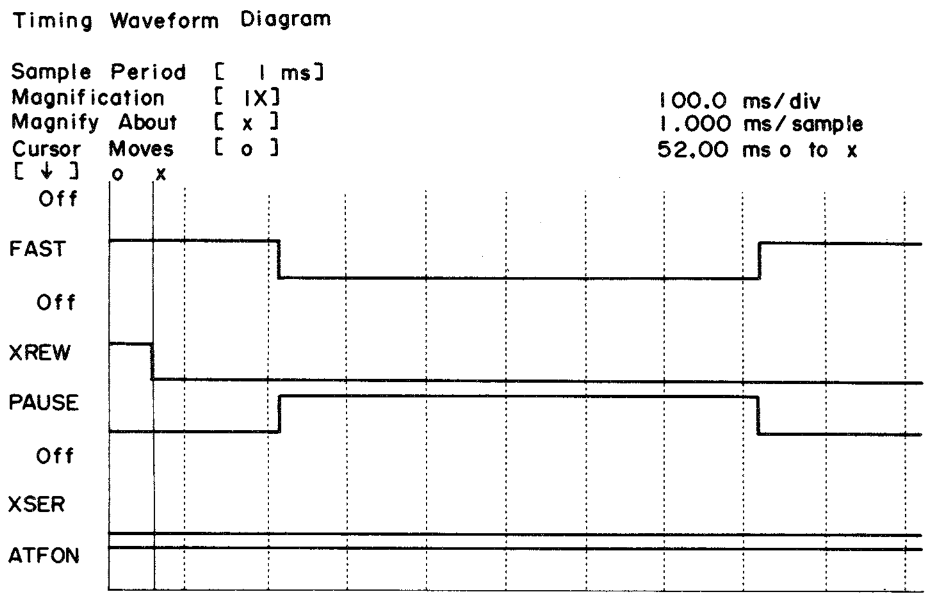
10-6. REW → FF switching

FAST is turned "L" at the same time as XREW is turned "H", and XSER is turned "H" to cancel the search mode. Then PAUSE is turned "H" to free the reels. In approx. 0.6 sec. after this, PAUSE is turned "L", FAST turned "H" and XSER turned "L" to enter the search mode.



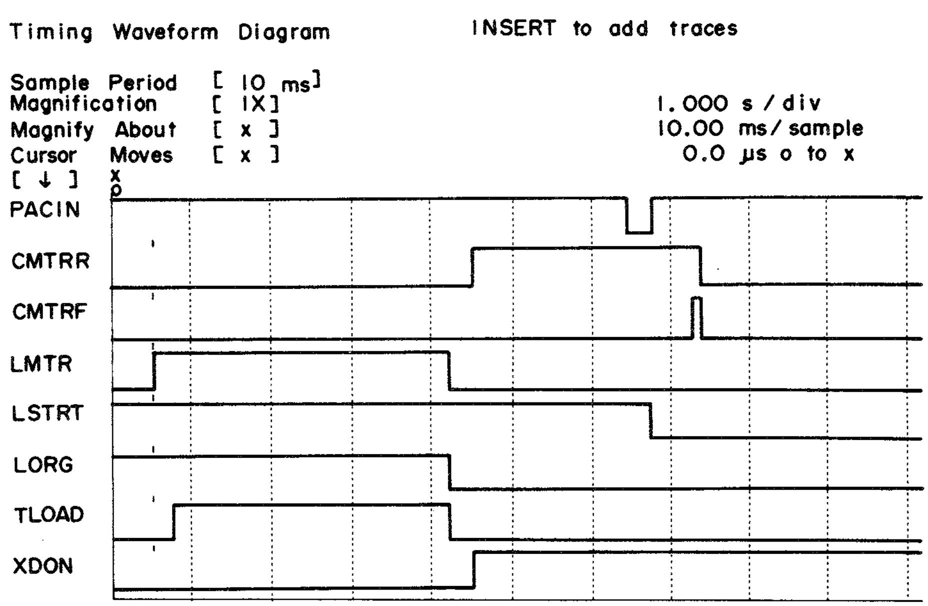
10-7. FF → REW switching

After XREW is turned "L", PAUSE is turned "H" at the same time as FAST is turned "L" to free the reels. In approx. 0.6 sec. after it, FAST is turned "H" and PAUSE is turned "L" at the same time.



10-8. Ejection

The tape loading motor is rotated in the reverse direction and TLOAD is turned "H" to lock the takeup reel. Then, TLOAD is turned "L" at the same time as the limit SW goes "L" to turn the tape loading motor OFF. In 290 ms after this, the loading motor is rotates in the reverse direction and XDON is turned "H" to stop the head rotation. When the cassette has moved and pack in SW has been held "L" for 0.3 sec, LOADING START turns "L". In 520 ms after this, the loading motor is rotates in the forward direction for 100 ms.



11. Specifications KDT-99R

Specification subject to change without notice.

FM Tuner Section

Frequency range	87.9 MHz ~ 107.9 MHz
Channel Space	200 kHz
Usable Sensitivity	12.0 dBf (1.1 μV/75 ohms)
50 dB Quieting Sensitivity	15.2 dBf (1.6μV/75 ohms)
Frequency Response (± 1 dB)	30 Hz-15 kHz
Signal to Noise Ratio (IEC-A)	75 dB
Alternate Channel Selectivity	80 dB
Capture Ratio	1.5 dB
Image Response Ratio	70 dB
IF Response Ratio	75 dB
Stereo Separation (1 kHz)	40 dB

AM Tuner Section

Frequency Range	530 kHz ~ 1620 kHz
Channel Space	10 kHz
Usable Sensitivity	28 dBμ

DAT Section

Head	Rotary Type
Sampling Frequency	44.1 kHz, 48 kHz
D-A Conversion (Linear)	16 bit
Tape Speed	8.15 mm/s
Wow and Flutter	Below Mesurable Limit
Frequency Response	10 Hz-20 kHz (±1 dB)
Total Harmonic Distortion (1 kHz)	0.005%
Signal to Noise Ratio (IEC-A)	92 dB
Dynamic Range	92 dB

Audio Section

Tone Action (BASS)	± 10 dB (100 Hz)
(TREBLE)	± 10 dB (10 kHz)
Preamp Output	Normal: 300 mV/10 k ohms load High: 1.0 V/10 k ohms load

General

Operating Voltage (GND)	14.4 V (11-16 V allowable)
Current Consumption (PLAY)	2.0 A at Rated Power
Body size (W x H x D)	180 x 50 x 155 mm (7-1/16 x 1-15/16 x 6-1/8 in.)
Weight	2.6 kg (5.7 lb)
Operating temperature lange	0°C ~ +60°C

Kenwood follows a policy of continuous advancements in development. For this reason specifications may be changed without notice.

Kenwood poursuit une politique de progrès constants en ce qui doncerne le développement. Pour cette raison, les spécifications sont sujettes à modifications sans préavis.

Kenwood strebt ständige, Verbesserungen in der Entwicklung an. Daher bleiben Änderungen der technischen Daten jederzeit vorbehalten.

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