

YAMAHA LSI

— NIPPON GAKKI CO., LTD. —

INTRODUCTION

Yamaha's Policy for the Development of Semi-conductors

In its pursuit of ever more sensitive equipment for better sound and image reproduction, Yamaha's research and development effort in semi-conductor technology is based on the motto "Yamaha adds pleasure to people's life". In its search for superlative sound, Yamaha produces semiconductor devices at its own plant. These semiconductors are used in products which have been well-accepted by users: Electone organs, CD players that incorporate the most advanced R&D discoveries in the field of digital technology, as well as for home computers. With its custom LSI, Yamaha has also been broadening its field of activity and challenging new areas through leading-edge technology.

Using this semiconductor technology, Yamaha leads the field in diversified market needs in all areas of business in the world, particularly in those related to sound, images, and communications, producing a variety of truly original products featuring high cost efficiency.

Yamaha's policy of creating attractive products that bring pleasure to our daily life, is also reflected in the development of our own semiconductor products.

We should like to introduce an outline of typical products to which we have applied our semiconductor technology.

MSX

The MSX series demonstrates our enthusiasm for home computers

Before the concept of INS (Information Network System) was ever announced by the Nippon Telegram and Telephone Inc., Nippon Gakki had developed the Yamaha home computer in the late 1970s, using digital technology for information processing.

This product was based on our advanced digital technology which had evolved from our development of electronic musical instruments. Basic technology and system design knowhow were used in MSX which has the common specifications for the "liberization" of personal computers proposed by Microsoft corporation and the ASCII corporation. Sales of the MSX series home computers began in 1983, using Yamaha's original mechanisms and functions, and they are now playing a leading role in the MSX group.

Sound Generator

Yamaha's digital technology reproduces the natural sounds of musical instruments

Since more information is available by high speed processing through a computer system, electronic musical instruments can offer a better sound. Nippon Gakki has developed a variety of original sound generator systems such as the rectangular wave sound source system, wave memory, or the FM sound source system. These have been incorporated in unique products such as the FS series of Electone

organs, and the DX series synthesizers which are both based on the FM sound source system. These products satisfy user's requirements for high quality sound.

C D Digital audio CD for connoisseurs of superlative sound

The CD-X1 low-priced compact disk player was a good example to demonstrate Yamaha's excellent semiconductor technology. This product fully exemplifies the fact that superb sound can be beautifully reproduced even with an inorganic digital circuit, provided the engineers have expertise and sharp sensitivity to sound. Nippon Gakki's digital technology has been condensed into just two chips for this product which has become a best-seller in the general and OEM market.

Over 230,000 units have been sold in only 6 months since its introduction. The chip incorporates an intelligence function which means the load on the microcomputer device is reduced. With this concept products designers have were flexibility in designing, and many OEM products incorporating this chip are now sold both domestically and overseas.

Yamaha can respond to the needs of the users for better quality products, and will continue to challenge new frontiers in these fields.

CONTENTS

INTRODUCTION

<Yamaha's Policy for the Development of Semi-conductors >	1
CONTENTS	3
History of the Development of Nippon Gakki's Semiconductor Technology	4
Yamaha Standard LSI List	5

MSX

Profile of Semiconductors for Yamaha MSX.	6
MSX-SYSTEM S-3527	8
MSX-VIDEO V-9938	9
Specifications	10

SOUND GENERATOR

How the Sound is Generated	12
OPL YM-3526	13
OPN YM-2203	14
DSG YM-2163	15
SSG YM-2149	16
DAC-SS YM-3014/DAC-MS YM-3012	17
Specifications	19
Comparison with Products from Competitors	21

CD

LSI for Yamaha CD Player	22
SVC YM-3511, 3531	23
SGP YM-2201 [K]	24
DAC-PD YM-4406	25
Specifications	26

■ History of the Development of Nippon Gakki's Semiconductor Technology

- 1969: ● Began project to produce ICs at own plant
- 1970: ● Established organization for production of ICs and began construction of Toyooka Plant.
- 1971: ● Circuit analysis program developed.
- 1972: ● Began mass production of MOS-LSI
 - Began development of SIT
 - Began development of PAS system
- 1973: ● Complete crystallization technology established.
 - Developed low noise FET
 - Developed Be diaphragm for loudspeaker
 - Introduced CAD system.
- 1974: ● Static Induction Transistor developed.
 - Began mass production of 300W SIT
- 1975: ● Rhythm/ABC LSI developed.
- 1976: ● Kagoshima Plant began operations.
 - LSI for electronic piano developed.
 - FM system development program started.
- 1977: ● Digital Electone Organs
 - LSI for Arpeggio effect developed.
 - Complementary SIT developed.
 - Ultra low noise FET developed.
- 1978: ● Dry etcher (RIE) introduced.
 - Projection aligner introduced.
- 1979: ● SITL developed.
 - Device simulator developed.
- 1980: ● Production of VLSI started.
 - Automatic layout program developed.
 - Process simulator developed.
- 1982: ● Vector generator LSI developed.
 - Image sensor developed.
- 1983: ● Export of semi-conductors started.
 - LSI for AHD, LSI for FM operator, graphic processor LSI, LSI for CD, LSI for signal processing, DAC, and pressure sensor for breath control developed.
 - Personal CAD system developed.
 - LSI automatic design system developed.
- 1984: ● Export of custom LSI started.
 - MSX-VIDEO LSI announced.

■ Yamaha Standard LSI List

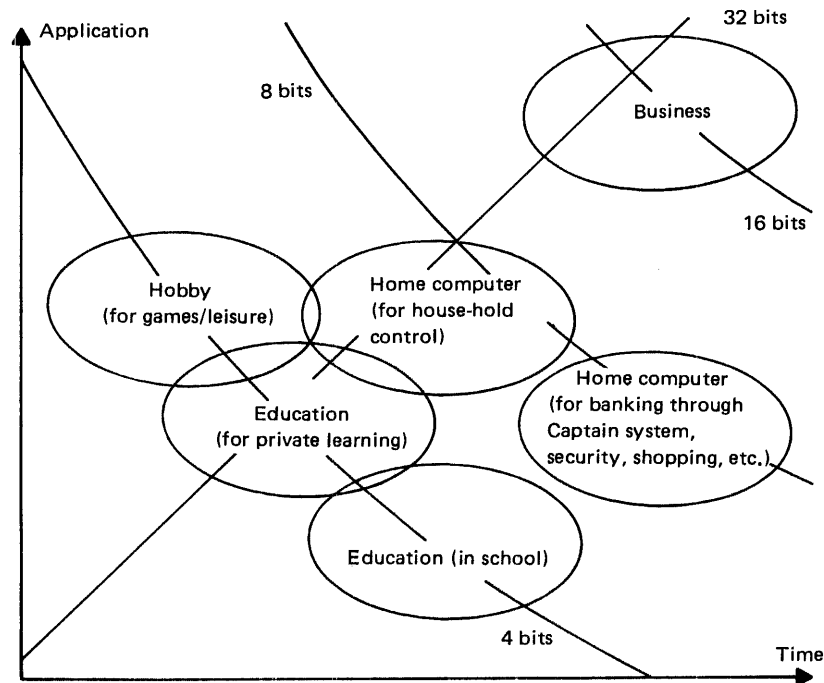
	Product No.	Item	Mass production date
Sound generator	YM-2149	S S G	August 1983
	YM-2203	O P N	April 1984
	YM-2163	D S G	July 1984
	YM-3526	O P L	March 1985
D A C	YM-3012	DAC-MS	April 1984
	YM-3014	DAC-SS	April 1984
	YM-4006	DAC-PD	February 1985
D A D	YM-2201 (K)	S G P	October 1983
	YM-3511	S V C	October 1983
	YM-3531	SVC-II	August 1984
Mask R O M	YM-2211	(128k bits)	August 1983
	YM-2212	(64k bits)	August 1983
	YM-2301	(256k bits)	February 1984
	YM-23907	U S A R O M	August 1984
	YM-23908	U K R O M	August 1984
	YM-21896 ~ YM-21899	Kanji R O M	August 1983
	YM-21941 ~ YM-21945	Kanji R O M	August 1984
M S X	YM-5214	M M C	August 1983
	S-3527	MSX-System	February 1985
Video processor	V-6355	L C D C	April 1985
	V-9938	MSX-VDP	March 1985

MSX

Profile of Semiconductors for Yamaha MSX

With the MSX, Yamaha has tried to realize the ideal home use computer. Apart from compatibility, we have achieved easy operation at a competitive price which enables users to incorporate our LSI products into their own systems. The MSX series is the crystallization of the technology and knowledge unique to Yamaha. The S-3527 introduced here incorporates all the functions of the MSX, and has been further upgraded for use in the MSX together with the Z-80, ROM, RAM, and several other components. The unit also includes the function of LSI for a sound system <SSG> developed by Yamaha, which means it has a wide field of application. Furthermore, the V-9938 is the upgraded version of the TMS9918A, which responds to the diversified needs of the market.

■ Market of Personal Computers



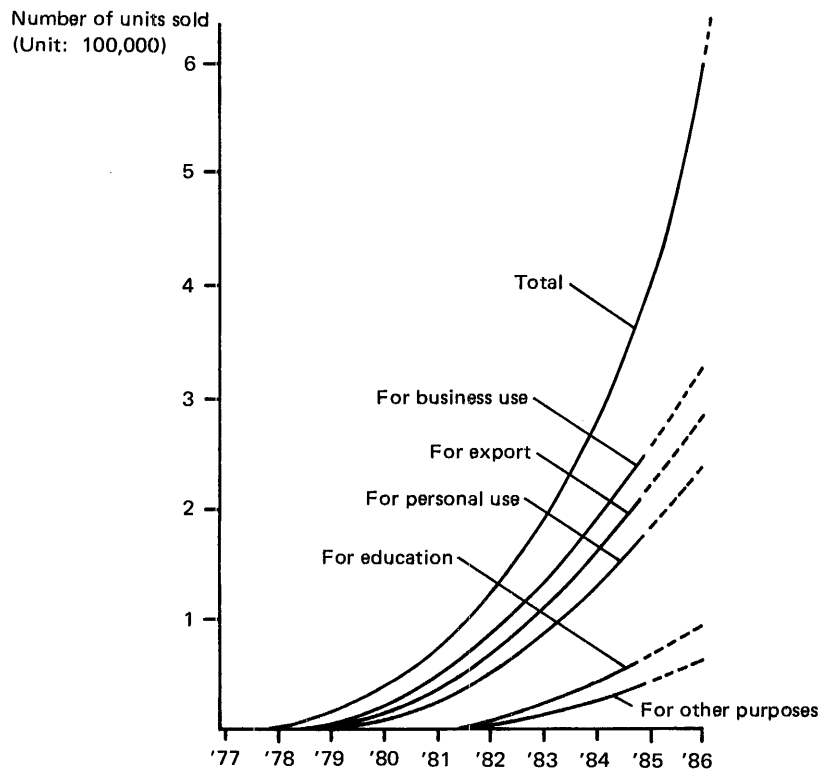
■ Utilization of Personal Computers in the U.S.

The personal computer market in the United States has undergone rapid growth over the last few years in the fields of 32-bit personal computers for business use in companies, and 8 and 16-bit personal computers for home use. There are now more than 150 personal computer manufacturers, and competition for market share among the manufacturers has become increasingly severe as market prices have rapidly declined with the fall in prices of the components.

In the application of personal computers too, there is a growing need for additional functions featuring originality. Computers for personal use are being used increasingly for security or data collection through data banks via telephone lines, rather than for hobbies such as video games. Hand-held personal computers are also becoming popular.

As far as business applications are concerned, personal computers are the mainstay of office automation these days. This trend is becoming increasingly evident in Japan too, and it is expected that the needs for personal computers will become more diversified in the future.

Growth of Personal Computer Sales by U.S. Manufacturers

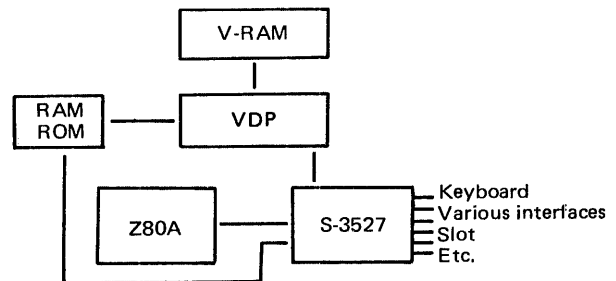
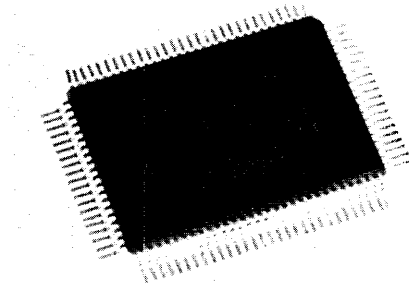


MSX-SYSTEM S-3527

LSI for MSX computers based on MSX specifications, and incorporating slot extension function etc., as standard device.

■ Principal Role of the S-3527

- The S-3527 is used to build up the MSX system, by adding the Z-80 (CPU), ROM, RAM, and very few other additional components.
- This unit incorporates a memory controller for slot extension, and can provide controls for peripherals such as a keyboard or printer.



■ Every Function has advantage

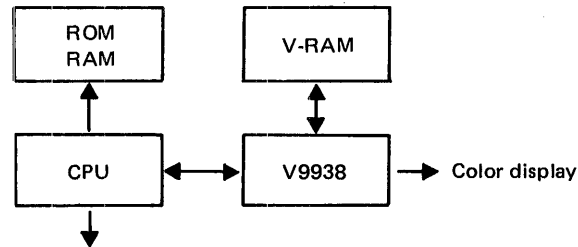
- (1) In this unit, all the functions of peripheral parts excluding the CPU, ROM, and RAM, are condensed and packaged into a single chip, thereby drastically reducing the number of components required such as TTL and IC.
- (2) When a slot is extended, this unit can specify the slot to be extended as either slot # 0 or #3.
- (3) Can address immediately up to 64K bytes of RAM.
- (4) The ten key can be mounted.
- (5) The interface buffer for the printer board is built-in, which enables direct connection to the printer.
- (6) The two pairs of multi-purpose ports enable such items as a joy stick to be connected without any modification.
- (7) The SSG generates musical sound signals in the range of 8 octaves, 3 notes, and a noise.

MSX-VIDEO V-9938

This LSI plays the role of video display process or for a personal computer.

■ Principal Role of the V-9938

- This LSI is the upgraded version of the TMS-9918A.
- It incorporates a visual processing tool which can display computer graphics and characters.



■ Every Function has advantage

- (1) Finer resolution (212 vertically, 512 horizontally) enables finer reproduction of images.
- (2) Up to 26 lines and 80 columns of characters can be displayed on the screen at once, and up to 4 colors can be used simultaneously in text mode.
- (3) Graphic function
Color designation of each dot is possible.
- (4) Graphic display
Up to 256 colors can be displayed on the screen simultaneously (up to 16 colors in existing models). Two images can be switched over on the screen as fast as 1/30 second interval.
- (5) Pallet function
This unit has a 512 color pallet, which enables rapid color change. (N.B. This function is also available for composite video output).
- (6) Digitize function
A TV picture can be instantly adapted to a computer graphics picture.
- (7) Superimpose
Graphics and characters output by a computer can be superimposed on the TV screen.
- (8) Line command function
A line connecting 2 points can be drawn (using the built-in hardware logic function).

- (9) Move command function
Any part of an image can be separated and transferred to another position.
- (10) Splite moving image function
Up to 32 splite images can be displayed on one screen.
(Up to 8 splites can be displayed on the same line.)
- (11) Search command function
This function is to detect the boundary for a color space on the screen.
- (12) Connection circuits for a mouse and a light pen are incorporated.
- (13) The color pallet can be connected externally.

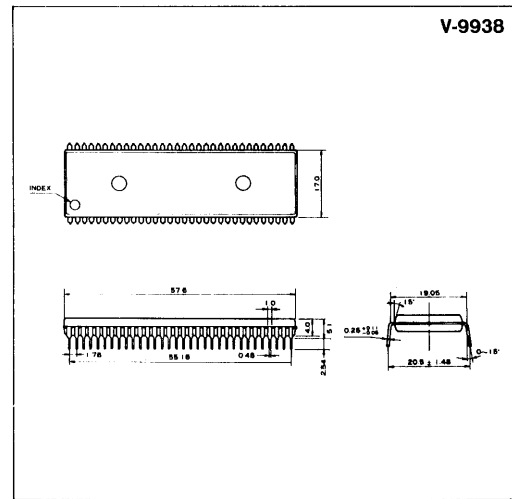
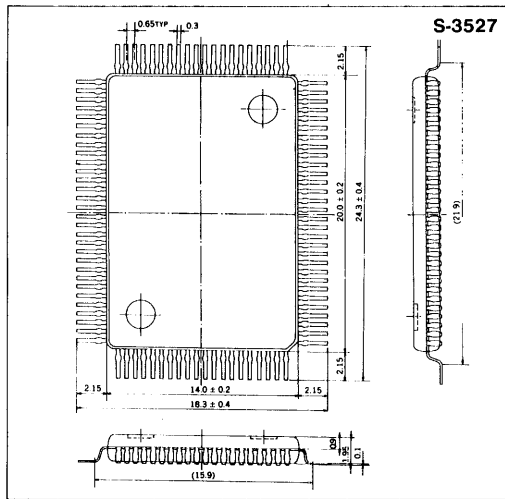
■ Possible Area of Markets

- Game machines
- Personal computer for Office Automation, and home use
- Videotex terminal, Captain (Rank 4) terminal
- Laser disk
- Electronic signboard
- TV recorder (for image storage)
- Editing of VTR

Specifications

Product No.	S-3527	V-9938
Item	(MSX-SYSTEM)	(MSX-VIDEO)
Chip design	CMOS	NMOS
Package type	100 pin plastic flat	64 pin plastic DIL (Shrink type)
Functions	Memory control for MSX + control VDP, keyboard, printer and other peripherals + SSG	Video · Display · Processor
Electric characteristics (Absolute maximum rating)		
Power supply voltage (Vdd) [V]	-0.3~ +7.0	-0.5~ +7.0
Input voltage (VI) [V]	-0.3~ Vdd+0.3	-0.5~ +7.0
Operating temperature (Top) [°C]	0~+70	0~+70
Storage temperature (Tstg) [°C]	-50~ +125	-50~ +125

■ External Dimensions



SOUND GENERATOR How the Sound is Generated

■ FM Sound Source

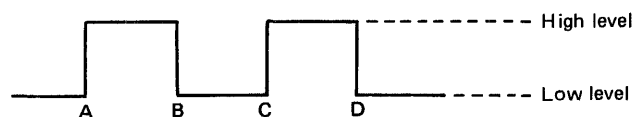
The tones generated by musical instruments are made up of various elements, and the basic characteristics are determined by the way in which the harmonics are included in the sound. In order to make optimum use of the harmonics in tuning musical instruments, Yamaha looked into the wide harmonic spectrum generated by frequency modulation. In other words, when a frequency is modulated with another frequency, various harmonic spectra can be generated according to the depth of the modulation or the interval between the frequencies.

In the FM sound generation system, modification of the complex and every-changing harmonic configurations is realized by a system which modifies the frequency modulation as a function of time.

■ Rectangular Wave System

There are only two output voltages involved with the rectangular wave: high level and low level. In SSG, duty cycle of the rectangular wave is 50%, i.e. the times AB and BC are equal. As this waveform includes many odd number level harmonics (frequency equivalent to a reciprocal of an odd number of times for AC), various tones can be obtained with an external filter.

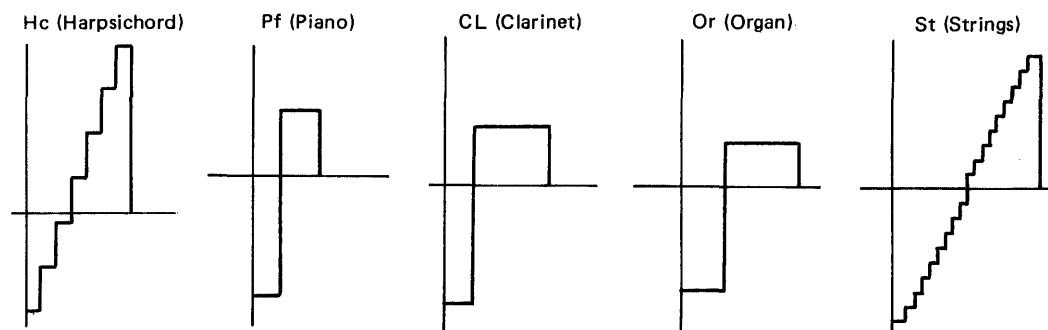
In SSG, three types of rectangular waves of different frequency and level can be output, as well as a noise. By mixing these outputs, complex sounds can be created.



■ Wave Memory

This is a sound source system where internal units store standard waveforms as elements to determine the tone of a musical sound and generate musical sounds through an envelope or external filter.

The DSG, for example, has the following five musical sound waveform memories.

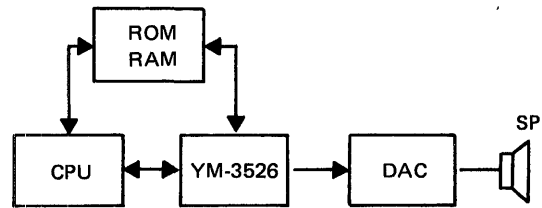
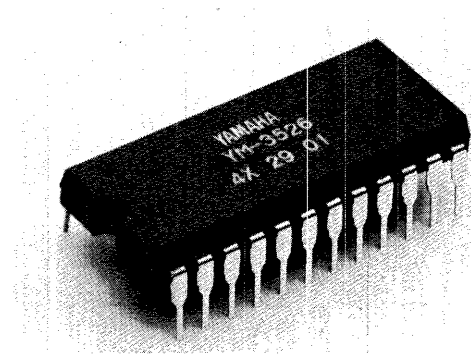


OPL YM-3526

This is a digital sound generator system which is able to respond to the demands for faithful sound reproduction of a full orchestra, and to the needs of equipment for the videotax system or teletext system.

■ Principal Role of the OPL

With Yamaha's unique FM sound source system, the realistic sounds can be synthesized.



■ OPL Offers Many Benefits With Its Excellent Performance and Functions

(1) Special Features

- An FM sound generation system which can reproduce sounds realistically.
 - *The musical tones generated by ordinary musical instruments are reproduced as they are.
 - *Various sound effects can be generated.
 - *The human voice (synthesized from compound sinocidal waves method – CSM) can be generated.
- The mode select function enables simultaneous generation of up to 9 sounds in the melody block.
- The mode select function enables simultaneous generation of up to 6 sounds in the melody block and 5 sounds in the rhythm block. (This function also meets the specifications for the Captain system or teletext system.)
- A circuit for generating a vibrato effect is incorporated.
- Swelling sounds can be generated with the built-in amplitude modulating circuit.

(2) Sales points

- Two programmable times required in playing music are built-in.
- The rhythm block incorporates sound sources featuring sounds and tones generated by a bass drum (BD), snare drum (SD), high-hat cymbal (HH), top cymbal (TC), or tom-tom (TOM).
- The TTL level compatible function enables this unit to be used for various applications.

(3) Functions that satisfy users' needs.

- It can be used as a sound source system for Captain system or teletext.

The mode select function enables simultaneous generation of up to 6 sounds in the melody block, and up to 5 sounds in the rhythm block with different tones for each sound. (i.e. Sounds of a piano, guitar, and drum can also be generated simultaneously.)

■ Possible Area of Markets

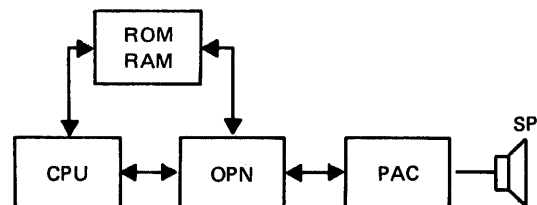
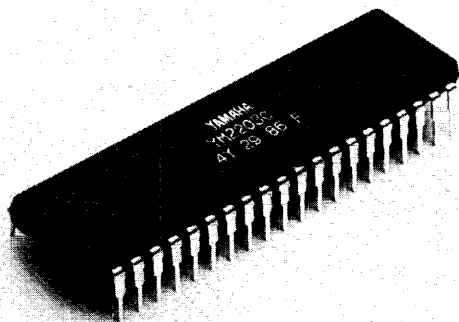
- Personal computer
- Equipment for games
- Terminal for Captain system
- Equipment for multiple character broadcasting

OPN YM-2203

This is the LSI for a digital sound source which can respond to the needs of personal computers

■ Principal Role of OPN

- A synthesizer which incorporates an FM sound source unique to Yamaha.
- Rectangular wave sound and noise can be generated.



■ The OPN Offers Many Benefits With its Excellent Performance and Functions

(1) Special Features

- The FM sound source system can generate 3 sounds simultaneously.
 - *3 sounds can be set to different tones respectively.
 - *One of the 3 sounds can be set to sound effect mode.
 - *One of the 3 sounds can be set to human voice mode.
(Synthesized from compound sinusoidal waves method)

- In addition to the FM sound, 3 types of rectangular waves can be generated simultaneously.
- White noise can be generated.

(2) Sales points

- Two 8-bit multi-purpose I/O ports are built-in.
- This unit incorporates 2 timers to scan the sound tempo counter and the keyboard.
- Application softwares such as YM-2149, GI AY-3-8910, and GI AY-3-8912 are compatible for this unit.

(3) Functions that satisfy users' needs

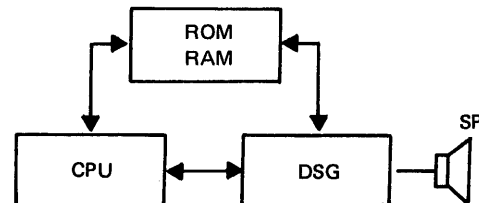
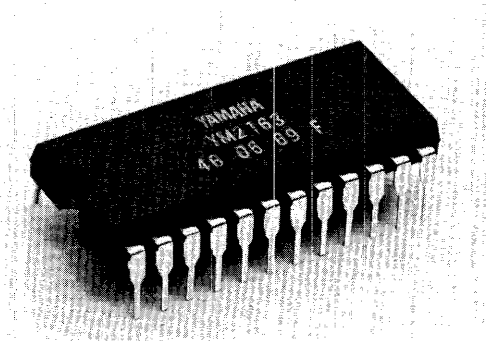
- This unit has a wide operating frequency band width because of the built-in clock divider, and will always generate the same sound regardless of the CPU it is connected to.
- The rectangular wave sound source and noise generator provide analog output with the built-in DAC.
- It incorporates a temporary memory circuit to store tone information, which can be accessed by the CPU.

DSG YM-2163

This LSI generates musical sounds by only setting a step and tone in the register array incorporated in the DSG from the CPU.

■ Principal Role of the DSG

- The wave memory system can generate real musical sounds and rhythm sound.



■ **The DSG Offers Many Benefits With its Excellent Performance and Functions**

(1) Special features

- The waveform memory system can generate 5 types of musical sound and 4 types of rhythm sound.
- A 5-bit envelope generator to attenuate sound smoothly is built-in.
- This unit has a wide sound generation bandwidth of 4 octaves.

(2) Sales points

- The DSG works by merely connecting it to an 8-bit or 16-bit CPU.
- It incorporates a 14-bit timer to be used for reference signals such as a tempo clock.
- The compatible function with TTL level enables this unit to be used for multiple purposes.

(3) Functions satisfying users' needs

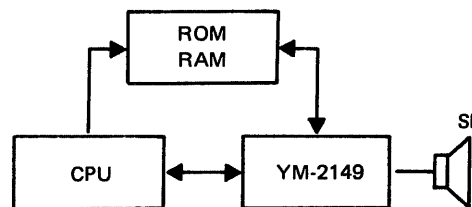
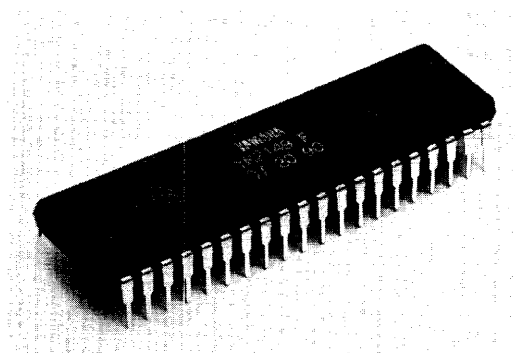
- Output of musical sounds (such as those produced by an orchestra) is converted to 4 series of analog output by the 7-bit DAC.
- The output of rhythm sound is converted to 2 series of analog output by the 7-bit DAC.

SSG YM-2149

This LSI generates musical sounds by only setting from CPU a step and tone in the register array incorporated in the SSG.

■ **Principal Role of the SSG**

- The rectangular wave sound, noise sound, and envelope generators can generate complex sounds.



■ **The SSG Offers Many Benefits With its Excellent Performance and Functions**

(1) Special features

- 3 series of rectangular wave generators are incorporated.
- 1 series of noise generator is incorporated.
- Built-in 5-bit envelope generator to attenuate sound smoothly.
- This unit has a wide sound range of 8 octave like that of a piano.
- The clock divider doubles clock frequency, which enables easy connection to the Z-80.

(2) Sales points

- The SSG operates when connected to an 8-bit or 16-bit CPU.
- The TTL compatible level enables this unit to be used in a very wide range of applications.
- Incorporates 2 series of I/O ports which can easily be connected to external systems, such as memory, ROM, RAM, etc. (8 bits)
- This unit has functions compatible with the AY-3-8910 which is an application software developed by GI.

(3) Functions satisfying users' needs

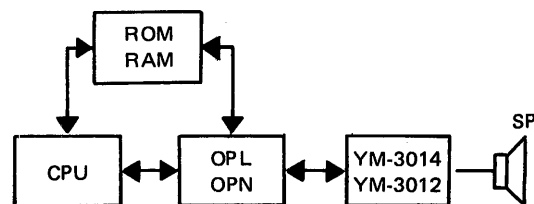
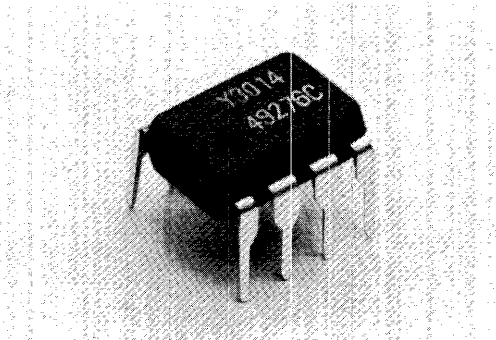
- Built-in DAC which converts digital signals to analog signals for audio output.

DAC-SS YM-3014/DAC-MS YM-3012

These D/A convertor LSI can be used for various sound sources and converts digital signals to analog signals.

■ **Principal Role of the DAC-SS and DAC-MS**

- When combined to the “YM3526” or the “YM-2203”, the DAC-SS or DAC-MS can form a sound generator circuit with only very few components.



■ **The DAC-SS Offers Many Merits With its Excellent Performance and Functions**

(1) Special features

- The DAC-SS can easily provide analog output when a buffer amplifier is connected.
- This unit has a resolution of 16 bits to produce high quality sounds.
- Little distortion rate in the low sound area, which ensures high quality reproduction.
- Competitive price which is attractive to users.

(2) Sales points

- Sample-hold is not necessary. (However, the 3012 is a 2 channel type, and incorporates an analog switch for sample-hold.)

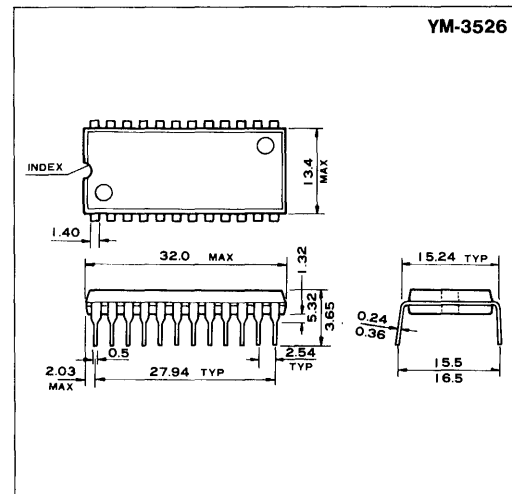
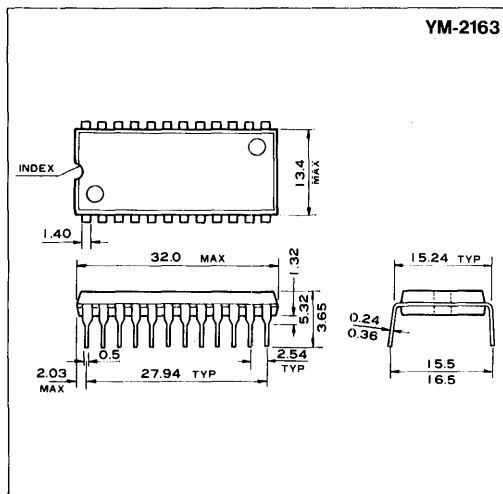
(3) Functions satisfying users' needs

- Excellent temperature characteristics make this unit durable against rough use.
- Peripheral devices such as capacitors are not necessary, which enables compact design.
- This unit can operate with single power supply.

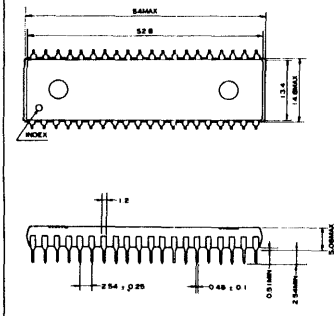
Specifications

Product No.	YM-2163	YM-3526	YM-2203	YM-2149	YM-3012 YM-3014
Item	(DSG)	(OPL)	(OPN)	(SSG)	(DAC-MS) (DAC-SS)
Chip design	NMOS	CMOS	NMOS	NMOS	CMOS
Package type	24 pin plastic DIL	24 pin plastic DIL	40 pin plastic DIL	40 pin plastic DIL	8 pin plastic DIL (DAC-SS) 16 pin plastic DIL (DAC-MS)
Sound source system	Wave memory system (4 types of musical sound + 4 types of rhythm sound)	FM sound source system (Simultaneous generation of 9 sounds or 6 types of musical sound + 5 types of rhythm sound or synthesized voice sound)	FM sound source system (Simultaneous generation of 3 types sound + synthesized audio sound + SSG)	Rectangular wave system (3 series of rectangular wave + 1 series of noise)	(Function) Floating serial input, D/A converter 3012: Stereo output
Electric characteristics (Absolute maximum rating)					
Power supply voltage (Vdd) [V]	+4.5~+5.5	+4.5~+5.5	+4.75~+5.25	+4.75~+5.25	-0.3~+15.0
Input voltage (Vi) [V]	-0.3~+7	-0.3~+7	-0.3~+7	-0.3~+7	-0.3~Vdd+0.3
Operating temperature (Top) [°C]	0~+70	0~+70	0~+70	0~+70	0~+70
Storage temperature (Tstg) [°C]	-50~+125	-50~+125	-50~+125	-50~+125	-50~+125

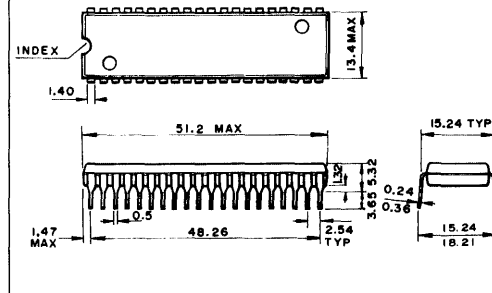
■ External Dimensions



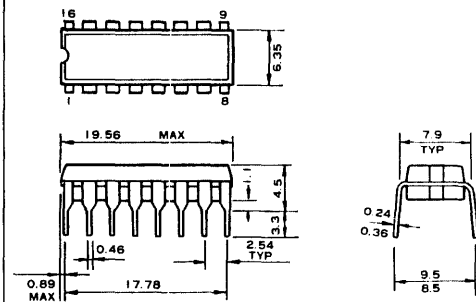
YM-2203



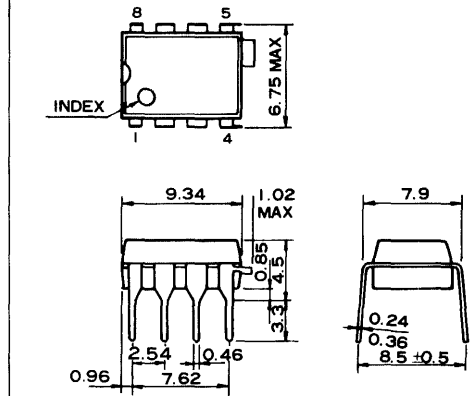
YM-2149



YM-3012



YM-3014



Comparison with Products from Competitors

	YAMAHA	GI (General Instrument)	
	YM-2149 (SSG)	AY-3-8910	AY-3-8912
Rectangular wave generator	3	←	←
Noise generator	1	←	←
Envelope generator	1	←	←
Clock division frequency	○	×	×
D/A converter	5 bits	4 bits	4 bits
Multi-purpose I/O port	2	2	1

CD

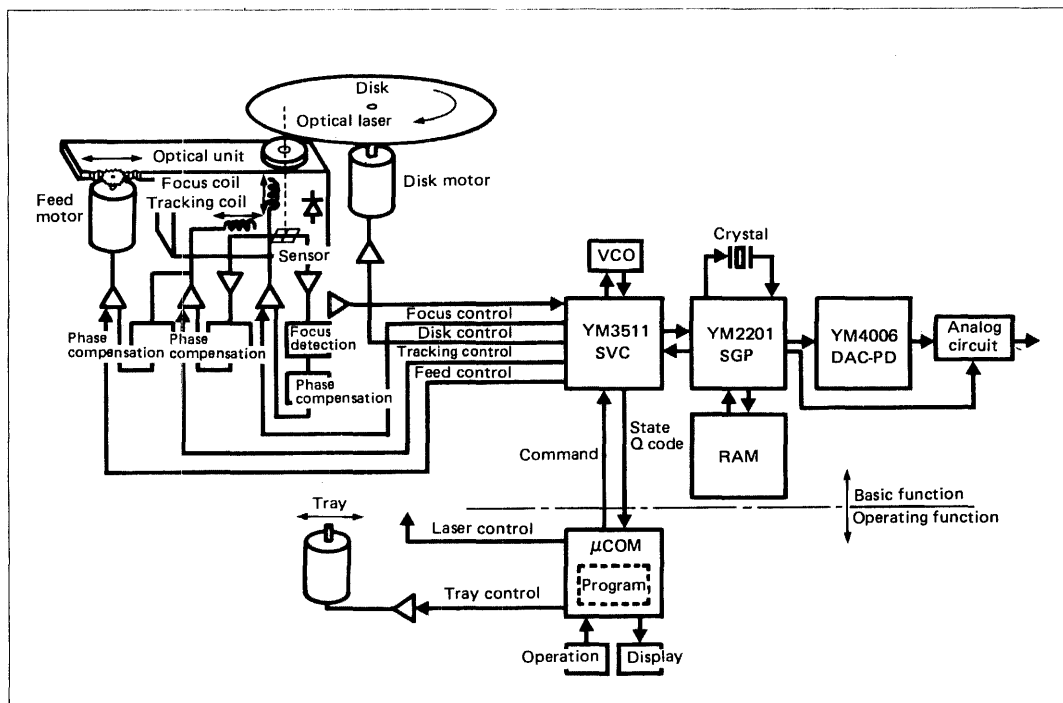
LSI for Yamaha CD Player

The compact disk offers a hi-fi performance superior to that of existing hi-fi audio devices using an ordinary record disk with a diameter of 12 inches.

The rainbow-colored disk with a 5 inches diameter has small pits laid out in series at micro intervals of only $1.6 \mu\text{m}$, and each pit expresses an EFM signal [1] or [0]. These high density pits are scanned by a laser beam.

The role of the YM-3511 and the YM-2201 is to demodulate EFM signals, servo-control, detection and correction of errors to take out digital signals. The digital signals are converted to analog signals by the YM-4006, and are output to an external amplifier.

Thus, the Yamaha compact disk player uses LSI in 90% of its digital circuits, to achieve excellent cost performance with high reliability and high quality sound. Yamaha's goal is to develop digital and analog circuits composed of only LSI through high degree integration of semi-conductors.

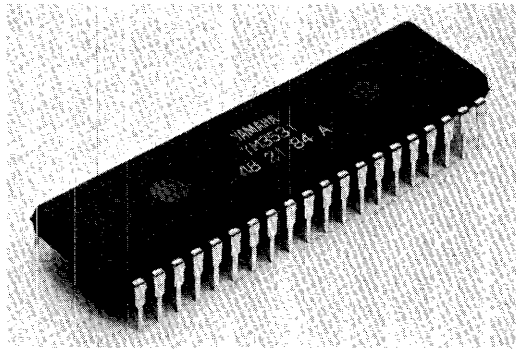


SVC YM-3511, 3531

This LSI performs demodulation of EFM signals for the compact disk player and servo-control.

■ Principal Role of SVC

- Regeneration of clock
- Demodulation of EFM signals
- Picks up subcodes
- Performs 4 types of servo control (focus control, disk control, tracking control, and feed control).



■ SVC Offers Many Benefits With its Excellent Performance and Functions

(1) Special features

- This unit picks up the Q subcode from the EFM signal and performs error detection.
- Outputs displacement signal indicating change of rotation speed depending on the regeneration clock and the standard clock, and controls the rotation speed of the disk motor.
- Performs music search, tracking for rapid feeding, and controls the feed motor.

(2) Sales points

- All the processes such as target setting, error calculation, servo operation control, and realization of the target which have been performed by a micro computer, are now executed by the SSG.

(3) Functions satisfying users' needs

- The SVC now performs most of functions played by peripheral devices, which has greatly reduced the number of parts used in a set as a whole.
- All the mechanical operations are performed by the SVC. When the specifications are modified, you can respond to it merely by changing your personal computer.
- The P through W subcodes pick-up terminal for extension and multi-purpose use is built-in.

■ **These Points Make the Device More Attractive**

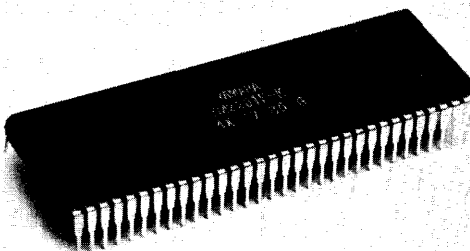
- The load on a micro-computer externally connected has been greatly reduced. This device incorporates servo sequence control which otherwise might need to be performed by a 4-bit microcomputer device.
- This device is remarkably compact. Peripheral parts are integrated in 1 chip. Furthermore, the simplified design ensures extremely high reliability.

SGP YM-2201 [K]

This LSI has a digital signal correction processing function for compact disk players, and the world's first digital filtering function developed by Yamaha.

■ **Principal Role of SGP**

- Performs digital signal error detection and correction processing.
- Performs digital filtering function for higher quality sound reproduction.



■ **SGP Offers Many Benefits With its Excellent Performance and Functions**

(1) Special features

- This unit oscillates the standard clock and generates all the required timing signals by merely connecting a quartz oscillator externally, which generates basic frequency.
- Jitter up to ± 4 frames can be absorbed.
- Both C1 and C2 can detect up to double signal errors.
- This unit has the function of average value interleaving compensate a data average by means of a flagging and the previous value hold function.

(2) Sales points

- Sound volume can be automatically controlled by command entry.

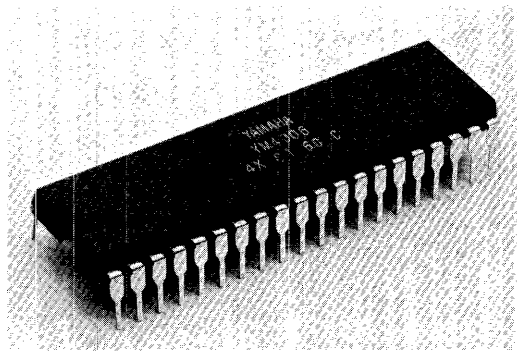
- Synchronizing signal to the SVC and timing signal to the audio circuit can be transmitted.
 - A serial terminal for DAC connection.
- (3) Functions satisfying users' needs
- The analog filter generates reproduced sound clearly by only the 7 level low pass filter.
 - High integrity not normally found in conventional products.

DAC-PD YM-4006

This is a D/A convertor LSI dedicated to a compact disk player.

■ Principal Role of DAC-PD

- The DAC-PD forms the central integration of compact disk players in combination with the "YM-3511" and the "YM-2201".



■ The DAC-PD Offers Many Benefits With its Excellent Performance and Functions

(1) Special features

- Minimal distortion rate of sounds from high level to low level, so that sounds close to the original ones can be reproduced.
- The built-in operational amplifier enables voltage output settling time of up to 2.7 μ sec.

(2) Sales points

- Available with both voltage and current output.
Particularly when high speed settling time is required, this unit can be used with current output.

(3) Functions satisfying users' needs

- The built-in operational amplifier simplifies and minimizes the signal path, which means less space is required for installation.
- The number of capacitors connected externally has been reduced, and a high degree of reliability achieved.

■ These Points Make the Device More Attractive

- Output can be selected according to each application.

When this unit is used for a compact disk, it is more convenient to build up the voltage output through the built-in operational amplifier. In an application where high speed conversion is required, the current output may be useful.

- Attractive low price

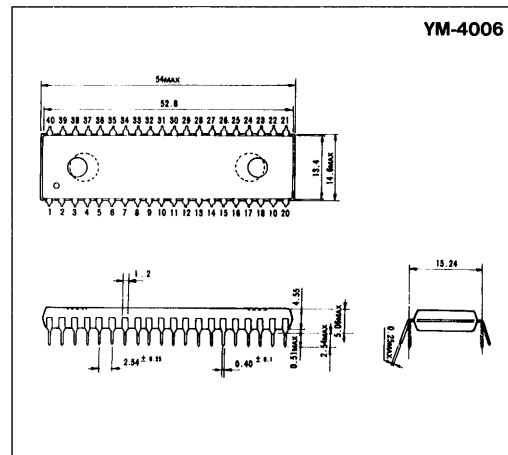
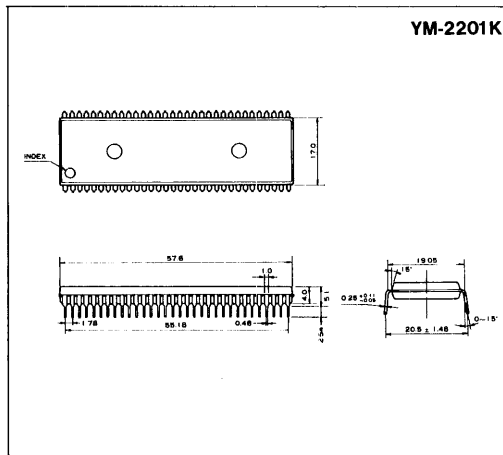
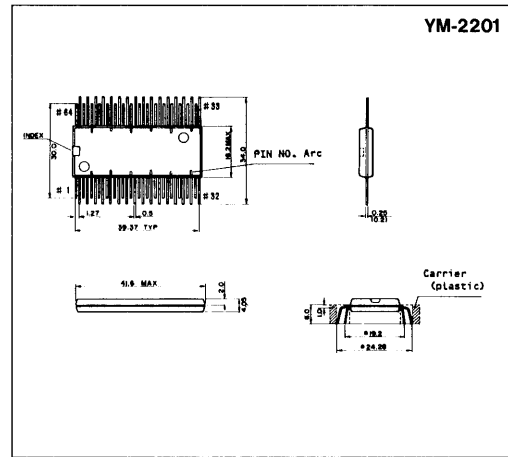
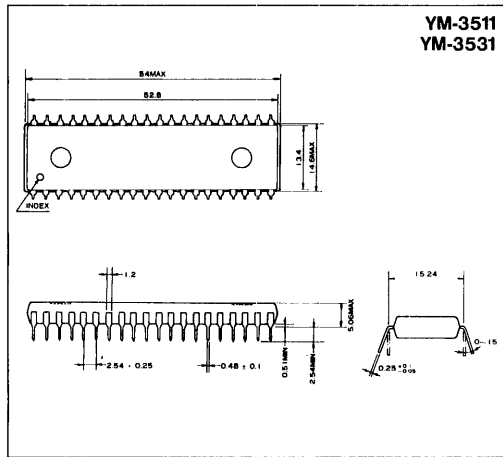
Production without fine tuning is possible by combining the high precision DEM method in conjunction with the R-2R resistor ladder system, thus enabling products to be made at lower cost.

- Low distortion rate, which enables the high quality sound reproduction.

Specifications

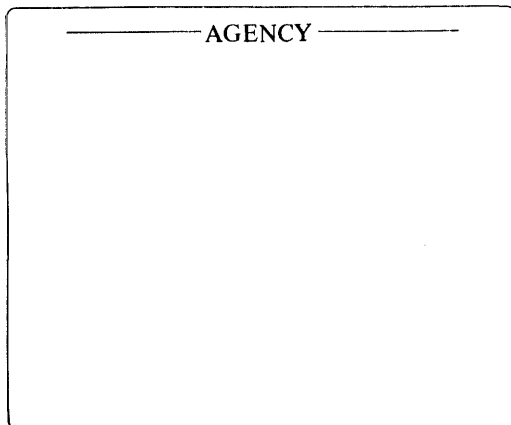
Product No.	YM-3511/YM-3531	YM-2201 (K)	YM-4006
Item	(SVC)/(SVC-II)	(SGP)	(DAC-PD)
Chip design	C M O S	N M O S	Bipolar
Package type	40 pin plastic DIL	64 pin plastic QIL (YM2201) 64 pin plastic DIL (YM2201K)	40 pin plastic DIL
Functions	Servo control circuit for compact disk player	Signal processor for compact disk player	16 bit/parallel input current output model D/A convertor based on DEM system
Electric rating			
Power supply voltage (Vdd) [V]	-0.3 ~ +7.0	-0.3 ~ +7.0	+7
Input voltage (VI) [V]	-0.3 ~ Vdd+0.5	-0.3 ~ +7.0	-1 ~ Vdd
Operating temperature (Top) [°C]	0 ~ +70	0 ~ +70	0 ~ +70
Storage temperature (Tstg) [°C]	-50 ~ +125	-50 ~ +125	-50 ~ +125

■ External Dimensions



MEMO

Note: Specifications are subject to change without prior notice.



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