

NO.85- IO

YB95O

(MSX-AUDIO)

■ OUTLINE

The MSX-AUDIO is a sound, generator LSI developed as optional sound source for the MSX2 per­sonal computer, lb create realistic, exciting sounds, the MSX-AUDIO incorporates an FM sound generator, similar to that previously used in Yamaha Electones and the DX-7 synthesizer. This pro­duct also has ADPCM speech analysis/synthesis functions in addition to the composite sinusoidal modeling function of conventional FM sound generators.

This new function allows simplified sound data processing.

Either of the AD/DA converters built in the analysis/synthesis circuit can be usesd independently to process even analog data.

The MSX-AUDIO is equipped with input/output ports for a keyboard interface, as well as general­purpose input/output ports.

Consequently, one MSX-AUDIO unit allows you to perform a variety of data processing for sound production.

■FEATURES

* Realistic sound due to FM sound generator. The FM sound generator is compatible with the YM3526.
* Selection of two sound-generation modes: simultaneous sounding of nine tones or six melodies and five rhythms (compatible with the Character and Pattern Tblephone Access Information Network system and Tbletex)
* The vibrato and AM oscillators are built in.
* 4-bits ADPCM speech analysis/synthesis circuits are built-in.
* AD/DA converters are built in.
* External 256-Kbytes memory (ROM or RAM) can be connected (as ADPCM data stor­age or auxiliary CPU storage)
* 8-bits input/output ports are built in for keyboard scanning.
* Two built-in general-purpose timers
* TTL compatible input/output
* Si-gate CMOS LSI
* 5V single power supply

**NIPPON GAKKI CO., LTD.**

\*?n?No. LSI-218950X

Y8950

1. BLOCK DIAGRAM

INo —IN?

OUTo -OUT7

lOo ~IO3

TIMER

IRQ

Ao

WR



RD



BUS

CS



CONTROL

SP-OFF



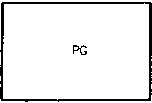
INPUT PORT

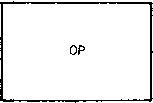
OUTPUT PORT

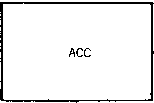


I/O BUFFER



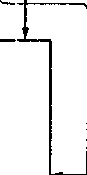


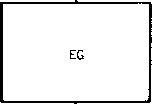




MO

REGISTER





ADPCM

AD

CONVERTER

TIMMING GEN.





C

AD

DA



Do—D





</> M

</> SY SH

2. PIN LAYOUT

§

§

§

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MSX-AUDIO

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MEMORY CONTROL



DMo -DM 7

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1. **DESCRIPTION OF TERMINAL FUNCTIONS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pin No. | Signature | Description | | | |
| 1  33, 64 | AVcc Vcc | +5V power terminal | | | |
| 2 8,31,40 | AGND GND | Ground terminal | | | |
| 3  4  5 | DA AD C | Terminal for AD conversion, DA connects DAC output (reference data). AD is an analog input terminal and it is AD convertible within the range of Vcc/2 ± Vcc/4. C terminal is a capacity terminal to samplehold analog data. | | | |
| 6, 7  9, 10 | TOo~TU2 | General purpose IO ports. | | | |
| 11-18  56-63 | OUTo-OUTt INo~IN7 | Input ports (INo-IN?) and output ports (OUTo-OUT?) for keyboard scanning.  Input ports are pulled up and output ports are open drain type. | | | |
| 19 | SP-OFF | At AD conversion, DA converter is used as a reference voltage generator. For that, the amplifier and speaker must be disconnected and this terminal is a control terminal to be used then. | | | |
| 20  21  22 | SH MO  </> SY | MO is sound/speech output of MSX-AUDIO. As this output is 13 bits (Mantissa 10 bits, exponent 3 bits) serial data, it must be converted into analog value by means of 0 SY synchronous clock, SH synchronizing signal and DA converter (YM3014). | | | |
| 23 | IRQ | Interrupt signal output from two timers and ADPCM/memory control. Maskable depending on program. | | | |
| 24 | IC | Initializes MSX-AUDIO operation. | | | |
| 25  26  27  28 | Ao  WR RD OS | Controls Do — D? data bus. | | |  |
|  | CS RD WR Ao |  |  |
| 0 10 0  0 10 1  0 0 10  0 0 11 | Writes MSX-AUDIO address.  Wirtes MSX-AUDIO register contents.  Reads MSX-AUDIO status.  Reads MSX-AUDIO registger contents, (specific registger only) |
| 1 X X X | Do — D7 bus line becomes high impedance. |
|  |  | |  |
| 29  37  38 | WE CAS RAS | Control signal of the external memory. When the external memory is DRAM, it is connected to the terminal to which RAM corresponds and it becomes address latch signal (RAS-CAS) when the external memory is ROM. | | | |
| 30  32 | DTo As | As is an external memory address (As) and DTo is likewise data out (DOo). | | | |
| 34 | </>M | MSX-AUDIO master clock, with 3.57954 MHz as a standard. | | | |
| 35  36 | ROM-CS MDEN | Applies timing to take in the external memory data. When MDEN is “1 ”, it allows DRAM data on DMi-DM? and when ROM-CS is “0”, it allows ROM data on DMi — DM? (Data out 0 on DTo) | | | |
| 41-47 | DMo —DM? | Multiplexes the external memory address (Ao — *Ai),* data IN (Dio —DI7) and data out (DOi-DO?: DOo are different terminals) signals to each terminal of DMo-DM7. | | | |
| 56-63 | D0-D7 | 8 bits bi-directional data bus. Transmits and receives data with the processor. | | | |

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1. **ELECTRIC CHARACTERISTICS**
2. **Absolute Maximum Rating**

|  |  |  |
| --- | --- | --- |
| Item | Rated value | Unit |
| Terminal voltage | — 0.3 7.0 | V |
| Operating ambient temperature | 0-70 | °C |
| Storage temperature | — 50-125 | °C |

1. **Recommended Operating Conditions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item | Symbol | Minimum | Typical | Maximum | Unit |
| Power voltage | Vcc | 4.75 | 5.0 | 5.25 | V |
| Vss | 0 | 0 | 0 | V |

1. **DC Characteristics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | | Symbol | Condition | MIN. | TYR | MAX. | Unit |
| Input high-level voltage | Input except for INO-7 | Vi hi |  | 2.0 |  |  | V |
|  | INO-7 | VlH2 |  | 3.5 |  |  | V |
| Input low-level voltage | Input except for  INO - 7 | Vi li |  |  |  | 0.8 | V |
|  | INO-7 | VlL2 |  |  |  | 1.2 | V |
| Input leak current | Ao,WR,RD, DTO | III. | Vi.x = 0-5V | -10 |  | 10 | //A |
| Three-state (offset-state) | Do-D7,DMo -DM7 | Itsl | Vix = 0 —5V | -10 |  | 10 | /zA |
| input current | IO0-IO.3 |  |  |  |  |  |  |
| Output high-level voltage | Output except | VoHl | Ion 1 = 0.4mA | 2.4 |  |  | V |
|  | for IRQ, OUTO-7 | V()H2 | I0112 — 40/zA | 3.3 |  |  | V |
| Output low-level voltage | All output | Vol | Iol = 2mA |  |  | 0.4 | V |
| Output leak current (offset state) | IRQ, OUT..- 7 | Iol | Vo=0~5V | -10 |  | 10 | /zA |
| Analog input voltage | AD, DA | Va |  | Vcc/4 |  | 3Vcc/4 | V |
| Pull-up resistor | IC,IRQ | Rp 1 |  | 60 |  | 600 | KO |
|  | INo~7 | RP2 |  | 5 |  | 10 | KO |
| Input capacity | All input | ClN | f=lMHz |  |  | 10 | pF |
| Output capacity | All output | C.i | f=lMHz |  |  | 10 | pF |
| P’ower supply current |  | Icc |  |  |  | 70 | mA |

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**(4) AC Characteristics**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item |  | Symbol | Condition | MIN. | TYP. | MAX. | Unit |
| Input clock frequency | </>M | fc | A-l | 3 | 3.58 | 4 | MHz |
| Input clock duty | <Z>M |  |  | 40 | 50 | 60 | *%* |
| Input clock rise time | <Z>M | Ten | A-l |  |  | 50 | ns |
| Input clock fall time | </>M | Ter | A-l |  |  | 50 | ns |
| Address setup time | Ao | Tas | A-2.A-3 | 10 |  |  | ns |
| Address hold time | Ao | Tah | A-2.A-3 | 10 |  |  | ns |
| Chip select write width | cs | Tcsw | A-2 | 380 |  |  | ns |
| Chip select read width | cs | Tcsn | A-3 | 380 |  |  | ns |
| Write pulse write width | WR | T\vw | A-2 | 380 |  |  | ns |
| Write data setup time | D0-D7 | T\vds | A-2 | 10 |  |  | ns |
| Write data hold time | Do D7 | Twdh | A-2 | 30 |  |  | ns |
| Read pulse width | RD | Tmv | A-3 | 380 |  |  | ns |
| Read data access time | Do' D7 | Tacc | A-3 |  |  | 380 | ns |
| Read data hold time | Do- D7 | Tkdh | A-3 | 10 |  |  | ns |
| Output port fall time | OUTo-7 | Tori' | Ci. = 500pF(Note) | 20 |  |  | /zs |
| Memory data set time | DMi~7, DTo | Tmds | A-6 | 70 |  |  | ns |
| Memory data hold time | DM 17. DTo | Tmdii | A-6 | 10 |  |  | ns |
| Output rise time | DMo ~7.RAS.CAS.  WE.A8.MDEN.  ROM-CS. 0sy | Tom | A-4 |  |  | 100 | ns |
|  | SH. MO | T()R2 | A-4 |  |  | 150 | ns |
| Output fall time | DMq~7. RAS. CAS.  WE.Ab.MDEN.  ROM-CS. 0sy | Toi’i | A-4 |  |  | 100 | ns |
|  | SH.MO | T()E2 | A-4 |  |  | 150 | ns |
| Reset pulse width | IC | Nic | A-5 | 80 |  |  | cycle |

(Note)

A time period from when the output request was issued through the output ports until the output port voltage becomes 1.0 V.

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1. MAJOR FEATURES

The MSX-AUDIO has such major operating features as the FM sound generator, ADPCM speech analysis/synthesis, external memory control, AD/DA converters and input/output ports for keyboard scanning.

1. FM sound generator

The FM sound generator has three sounding modes: simultaneous generation of nine tones, genera­tion of six melodies and five rhythms, and composite sinusoidal modeling. One of the three modes is selected by software according to the application. Because this FM sound generator is equivalent to that of the OPL (YM3526), the software for the OPL can be used with the MSX-AUDIO.

•Simultaneous nine-tone generation:

This mode simultaneously generates nine FM sounds of FM sounds of different tone colors. Both the rhythm selection bit (R) and composite sinusoidal modeling bit (CSM) should be specified with “0” for this mode.

• Six-inelodies/five-rhythms sounding:

This five available rhythmic sounds are bass drum, snare drum, tom-tom, high-hat cymbals, and top cymbal.

•Composite sinusoidal modeling:

This is a speech synthesis mode to simulate sounds by using three to six sine waves.

1. ADPCM speech analysis/synthesis

This function provides the speech analysis and synthesis using 4-bits ADPCM. The sampling rate for modulation can be arbitrarily programmed within 1.8 KHz—16 KHz (analysis) and 1.8 KHz—50 KHz (synthesis). Analysis results and synthesis data can be stored in either external memory (ROM or RAM) or the processor’s storage.

1. External-memory control

This function controls the external memory used to store the anylysis/synthesis data processed through ADPCM. Available external memories are 256 K-bytes DRAM, 64 K-bytes DRAM, and the ROMs accessible in units of byte. The maximum storage capacity is 256 K-bytes (both RAM and ROM).

1. AD/DA converters

The AD/DA converers in the ADPCM unit can be operated independently.

In this AD/DA conversion mode, FM sound generation and ADPCM speech analysis/synthesis are ineffective.

1. Keyboard input/output ports

These are 8-bit input/output ports for external keyboard scanning.

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W/Mfl

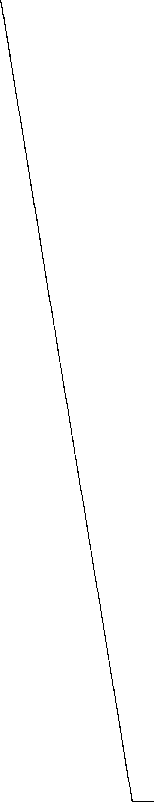
In addition to the above-mentioned functions, the MSX-AUDIO is equipped with vibrato and amplitude­modulation oscillators for further natural sound generation, two general-purpose timers for various inter­face signals, and general-purpose 4-bits input/output ports.

6. ADDRESS MAP

1. Address d7 d6 d5 d4 d3 d2 d, d0

2. Address d7 d6 d5 d4 d3 d2 Di d0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| — CONTROL - | | | | | | |
| A M | V 1 B | EG—TYD | K S R | MULTI | | |
| KSL | | T L | | | | |
| A R | | | | D R | | |
| S L | | | | R R | | |
| F—Number( L) | | | | | | |
|  | | KON | Block | | F—Num  (H) | |
| AM  DEP | VIB  DEP | R | BD | SD TOM | TC | HH |
|  | | | | F B | | C |



|  |  |
| --- | --- |
| — ' ' | |
| TEST | |
| TIMER 1 | |
| TIMER 2 | |
| IRQ RST | Tl T2 EOS BR QT9 QTI  MSK MSK MSK MSK / Ol 1 |
| Key Board IN | |
| Key Board OUT | |
| STA  RT | REC dMaEtMa REPT 0SfPf RST |
| CSM | NS°ETLESp? AD 64K R0M |
| START ADD ( L) | |
| START ADD ( H) | |
| STOP ADD ( L) | |
| STOP ADD ( H ) | |
| PRESCALE ( L ) | |
| PRESCALE ( H) | |
| ADPCM— DATA | |
| DELTA—N ( L ) | |
| DELTA—N ( H ) | |
| EG-CTRL | |
|  | |
| DAC DATA ( H) | |
| DAC | DATA \_\_\_ " |
| (L) | |
|  | SHI FT |
|  | —— 2 1 0 |
| 1 / 0 —CTRL | |
| 1 /—DATA | |
| PCM—DATA | |
|  | |

3. \* Accessible register

STATUS—

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| INT | Tl | T2 | EOS | BUF  RD" |  | PCM  BSY |

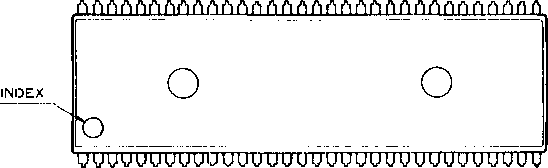
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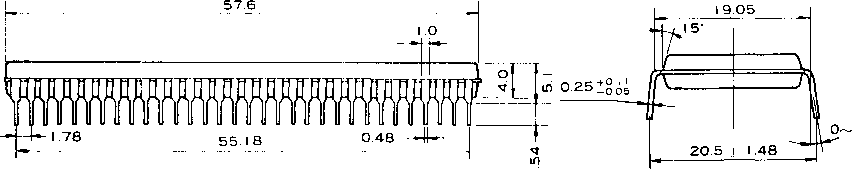
Y8950

PACKAGE DIMENSIONS

Y8950

1. 64-pin shrink DIL





(Note) Specifications of this product are subject to change for purpose of improvement without

prior notice.

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