

# Single-chip 4-bit Microcontroller for CD-DA

## BU34381

The BU34381 is a 4-bit microcomputer designed for CD-DA players, and has a wide array of internal I/O components, including an 8-bit, 8-channel AD converter, pulse width counter (PWC), two serial I/O, and an LCD controller/driver capable of displaying up to 80 segments. All LCD segments are programmable for CMOS output. These I/O components allow for multifunction applications with a low number of pins.

### ●Applications

Portable CD-DA players, portable CD stereos

### ●Features

- 1) High speed operations and low voltage. ( $V_{DD} = 2.7 \sim 5.5V$  at 4.4MHz)
- 2) Internal 8-bit, 8-channel AD converter.
- 3) Internal pulse width counter.
- 4) Two internal serial input/outputs.
- 5) Internal 20-segment, 4-common LCD controller/driver. (usable with 3 commons)
- 6) All segments output by the LCD controller/driver are programmable for CMOS output.

### ●Absolute maximum ratings ( $T_a = 25^\circ C$ )

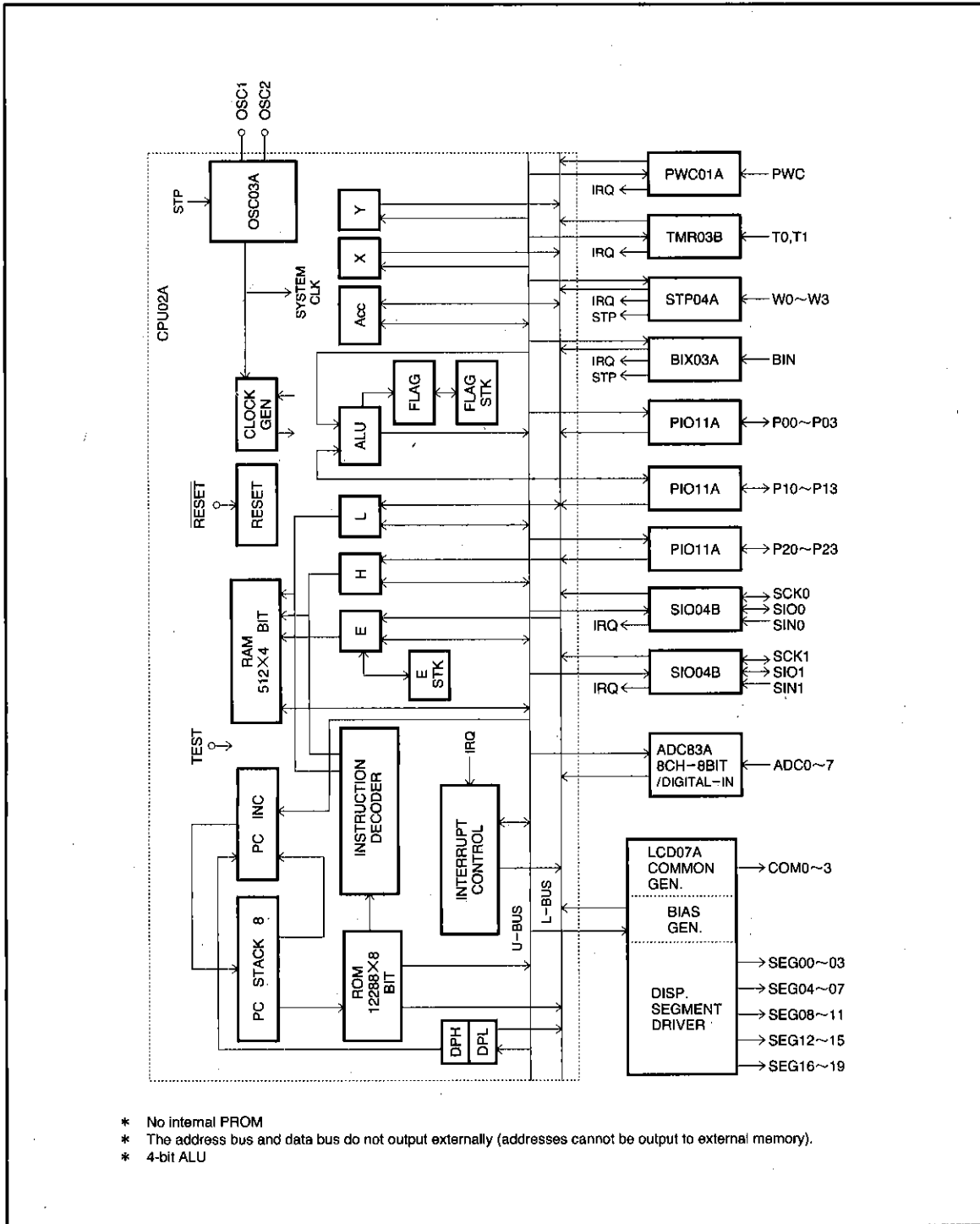
Parameter	Symbol	Limits	Unit
Power supply voltage	$V_{DD}$	$-0.3 \sim 7.0$	V
Power dissipation	$P_d$	500*	mW
Operating temperature	$T_{opr}$	$-25 \sim 75$	$^\circ C$
Storage temperature	$T_{stg}$	$-55 \sim 125$	$^\circ C$

\* Reduced by 5.0 mW for each increase in  $T_a$  of  $1^\circ C$  over  $25^\circ C$ .

### ●Recommended operating conditions ( $T_a = 25^\circ C$ )

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	$V_{DD}$	2.7	—	5.5	V
Input voltage, HIGH (without hysteresis)	$V_{IH}$	$0.7V_{DD}$	—	$V_{DD}$	V
Input voltage, LOW (without hysteresis)	$V_{IL}$	0	—	$0.3V_{DD}$	V
Input voltage, HIGH (with hysteresis)	$V_{IHs}$	$0.75V_{DD}$	—	$V_{DD}$	V
Input voltage, LOW (with hysteresis)	$V_{ILs}$	0	—	$0.25V_{DD}$	V

● Block diagram

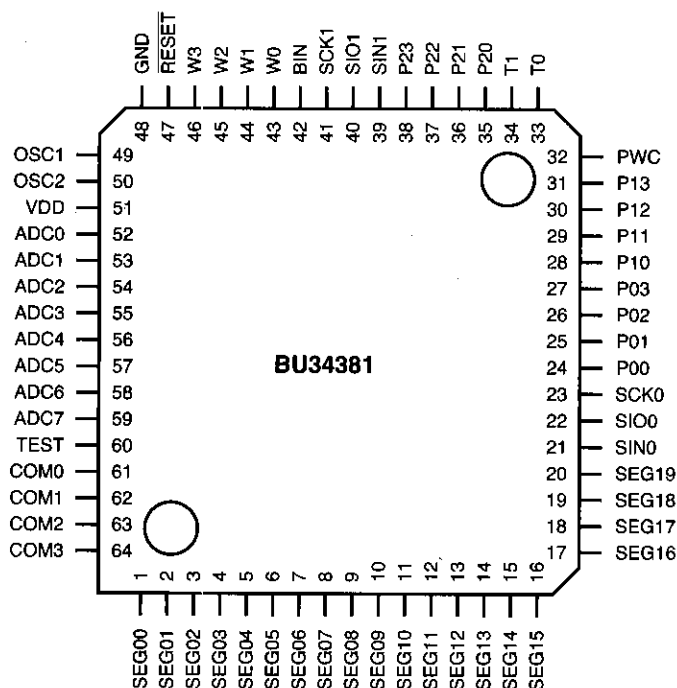


Optical Disc ICs

System Control Microcontrollers for CD

For CDs/CD-ROMs

●Pin arrangement



●Pin description

Pin name	Pin No.	I/O	Function	Type
P00~P03 P10~P13 P20~P23 (PI011A block)	24~27 28~31 35~38	I/O	<ul style="list-style-type: none"> <li>• 4-bit input and output</li> <li>• Each bit is programmable for input or output (open drain output N-channel)</li> <li>• Pull-up resistor ON/OFF operation is programmable (each bit can be set separately).</li> <li>• Resetting turns the pull-up resistors off via input. *1</li> </ul>	D
W0~W3 (STP04A block)	43~46	I	<ul style="list-style-type: none"> <li>• Standard 4-bit input</li> <li>• Programmable for stop cancel input or interrupt request signal output (each bit can be set separately).</li> <li>• Pull-up resistor ON/OFF operation is programmable (each bit can be set separately).</li> <li>• Resetting turns the pull-up resistors off.</li> </ul>	C
BIN (BIX03A block)	42	I	<ul style="list-style-type: none"> <li>• Standard 1-bit input</li> <li>• Programmable for stop cancel input or interrupt request signal output.</li> <li>• Pull-up resistor ON/OFF operation is programmable.</li> <li>• Resetting turns the pull-up resistors off.</li> </ul>	C

\*1 Because these pins reach high impedance immediately after resetting, some applications may require pin processing.

## ● Pin description

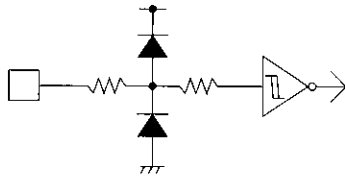
Pin name	Pin No.	I/O	Function	Type
SIN0, SIN1	21, 39	I	• 8-bit serial data input	A
SIO0, SIO1	22, 40	I/O	• 8-bit serial data input/output • Programmable for input or output	E
SCK0, SCK1 (SIO04B block)	23, 41	I/O	• Clock input/output for serial data transmission and reception • Programmable selection from among 3 internal clocks and 1 external clock	E
ADC0~ADC7 (ADC83A block)	52~59	I	• Analog data input • Each bit programmable for digital data input • Resetting returns all pins to analog input.	G
SEG00~03 SEG04~07 SEG08~11 SEG12~15 SEG16~19	1~4 5~8 9~12 13~16 17~20	O	• Programmable for LCD segment output or CMOS small-current output (set in 4-pin groups) • Resetting returns all pins to CMOS small-current output (LOW polarity output)	F
COM0~COM3 (LCD07A block)	61~64	O	• LCD common output • During 1/3 duty, COM3 outputs the ground level	F
PWC (PWC01A block)	32	I	• Pulse input	A
T0, T1 (TMR03B block)	33, 34	I	• External count clock input • Usable for 1-bit input	J
OSC1	49	I	• Oscillator input • External clock input	H
OSC2 (OSC03A block)	50	O	• Oscillator output	I
TEST	60	I	• Test input (This is a chip test pin that contains an internal pull-down resistor and so should normally remain open.)	B
RESET	47	I	• Reset input (Setting this pin to LOW resets the CPU.)	A
V <sub>DD</sub>	51	—	• Power supply pin	—
GND	48	—	• Ground pin	—

System Control Microcontrollers for CD

For CDs/CD-ROMs

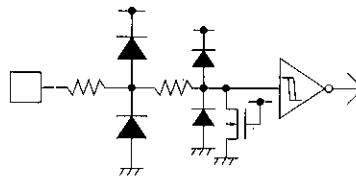
● Input/output circuits

TYPE A



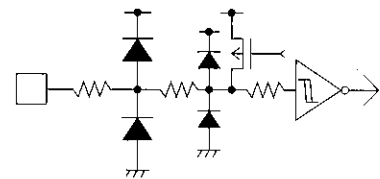
• Hysteresis input

TYPE B



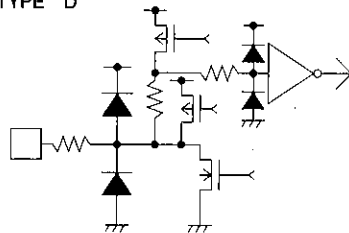
• Pull-down resistor's internal hysteresis input

TYPE C



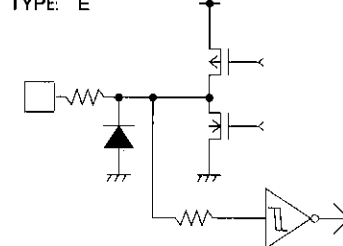
• Hysteresis input for programmable ON/OFF operation of pull-up resistor

TYPE D



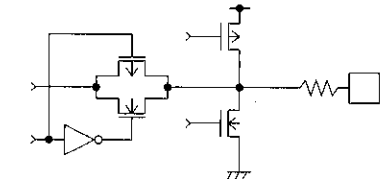
• Pull-up resistor with programmable ON/OFF operation and normal input/output with Nch open drain output

TYPE E



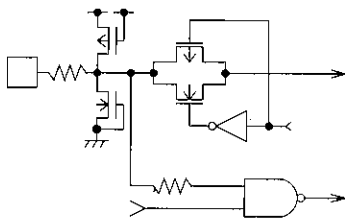
• Hysteresis input with programmable control of CMOS output

TYPE F



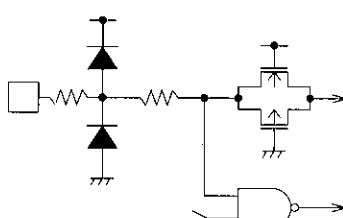
• LCD driver output (CMOS output possible for SEG only)

TYPE G



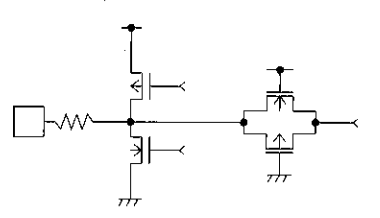
• Programmable control of AD input with digital input

TYPE H



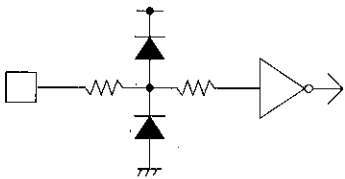
• Input in feedback resistor with STOP control

TYPE I



• CMOS output in feedback resistor

TYPE J



• Normal input

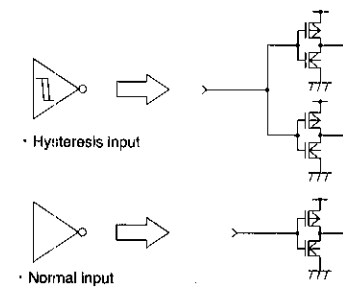


Fig. 1

## ●Electrical characteristics (at 5V) (unless otherwise noted, Ta=25°C, VDD=5V)

Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
STOP circuit current	I <sub>DST</sub>		—	—	1	μA	• STOP mode
HALT circuit current	I <sub>DHT</sub>		—	1	—	mA	• HALT mode • f <sub>osc</sub> =4.4MHz
Operational circuit current	I <sub>DOP</sub>		—	4	—	mA	• f <sub>osc</sub> =4.4MHz
Clock frequency	f <sub>osc</sub>	OSC1, OSC2	2	—	4.4	MHz	
Input voltage 1, HIGH	V <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, T0, T1, ADC0~ADC7	3.5	—	—	V	• P = input • ADC = digital input
Input voltage 2, HIGH	V <sub>IH2</sub>	W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, PWC, TEST, RESET	3.75	—	—	V	• Hysteresis input • SIO, SCK = input
Input voltage 3, HIGH	V <sub>IH3</sub>	OSC1	3.9	—	—	V	• External clock input
Input voltage 1, LOW	V <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, T0, T1, ADC0~ADC7	—	—	1.5	V	• P = input • ADC = digital input
Input voltage 2, LOW	V <sub>IL2</sub>	W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, PWC, TEST, RESET	—	—	1.25	V	• Hysteresis input • SIO, SCK = input
Input voltage 3, LOW	V <sub>IL3</sub>	OSC1	—	—	1.1	V	• External clock input
Input current 1, HIGH	I <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, ADC0~ADC7, PWC, T0, T1, RESET	—	—	1	μA	• No pull-down resistor • P, SIO, SCK = input • V <sub>IN</sub> = V <sub>DD</sub>
Input current 2, HIGH	I <sub>IH2</sub>	TEST	35	70	140	μA	• Internal pull-down resistor • V <sub>IN</sub> =V <sub>DD</sub>
Input current 1, LOW	I <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, ADC0~ADC7, PWC, T0, T1, RESET, TEST	—	—	-1	μA	• No pull-down resistor • P, SIO, SCK = input • V <sub>IN</sub> =GND
Input current 2, LOW	I <sub>IL2</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN,	-90	-125	-160	μA	• Internal pull-down resistor • V <sub>IN</sub> =GND
Output voltage 1, HIGH	V <sub>OH1</sub>	SIO0, SIO1, SCK0, SCK1	4.5	—	—	V	• SIO, SCK = output • I <sub>OH</sub> =-500 μA
Output voltage 2, HIGH	V <sub>OH2</sub>	SEG00~SEG19, COM0~COM3	4.5	—	—	V	• I <sub>OH</sub> =-250 μA
Output voltage 1, LOW	V <sub>OL1</sub>	P00~P03, P10~P13, P20~P23, SIO0, SIO1, SCK0, SCK1	—	—	0.4	V	• P, SIO, SCK = output • I <sub>OL</sub> =1.6mA
Output voltage 2, LOW	V <sub>OL2</sub>	SEG00~SEG19, COM0~COM3	—	—	0.7	V	• I <sub>OL</sub> =1.0mA
Output leak current	I <sub>L</sub>	P00~P03, P10~P13, P20~P23, SIO0, SIO1, SCK0, SCK1	—	—	1	μA	• P, SIO, SCK = high-impedance output
OSC feedback current	I <sub>FO</sub>	OSC1, OSC2	-4.0	-10	-14	μA	• Approx. 500 kW

Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
A/D conversion resolution	RES	ADC0~ADC7	—	8	—	bits	
A/D conversion settling time	$t_s$	ADC0~ADC7	—	25	—	MC	MC: machine cycle *
A/D conversion linearity error	$E_L$	ADC0~ADC7	—	—	$\pm 3$	LSB	
LCD 2/3 level voltage	$V_1$	COM0~COM3 SEG00~SEG19	—	3.3	—	V	
LCD 2/3 level voltage	$V_2$	COM0~COM3 SEG00~SEG19	—	1.6	—	V	

\* 1 machine cycle = 1/6 oscillation frequency

●Electrical characteristics (at 3V) (unless otherwise noted, Ta=25°C, V<sub>DD</sub>=3V)

Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
STOP circuit current	I <sub>DDST</sub>		—	—	1	μA	• STOP mode
HALT circuit current	I <sub>DDHT</sub>		—	0.4	—	mA	• HALT mode • f <sub>osc</sub> =4.4MHz
Operational circuit current	I <sub>DDOP</sub>		—	1.5	—	mA	• f <sub>osc</sub> =4.4MHz
Clock frequency	f <sub>osc</sub>	OSC1, OSC2	2	—	4.4	MHz	
Input voltage 1, HIGH	V <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, T0, T1, ADC0~ADC7	2.1	—	—	V	• P = input • ADC = digital input
Input voltage 2, HIGH	V <sub>IH2</sub>	W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, PWC, TEST, RESET	2.25	—	—	V	• Hysteresis input • SIO, SCK = input
Input voltage 3, HIGH	V <sub>IH3</sub>	OSC1	2.4	—	—	V	• External clock input
Input voltage 1, LOW	V <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, T0, T1, ADC0~ADC7	—	—	0.9	V	• P = input • ADC = digital input
Input voltage 2, LOW	V <sub>IL2</sub>	W0~W3, BIN, SIO0, SIN1, SIO0, SIO1, SCK0, SCK1, PWC, TEST, RESET	—	—	0.75	V	• Hysteresis input • SIO, SCK = input
Input voltage 3, LOW	V <sub>IL3</sub>	OSC1	—	—	0.65	V	• External clock input
Input current 1, HIGH	I <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN, SIO0, SIN1, SIO0 SIO1, SCK0, SCK1, ADC0~ADC7, PWC, T0 T1, RESET	—	—	1	μA	• No pull-down resistor • P, SIO, SCK = input • V <sub>IN</sub> =V <sub>DD</sub>
Input current 2, HIGH	I <sub>IH2</sub>	TEST	10	20	35	μA	• Internal pull-down resistor • V <sub>IN</sub> =V <sub>DD</sub>
Input current 1, LOW	I <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN, SIO0, SIN1, SIO0 SIO1, SCK0, SCK1, ADC0~ADC7, PWC, T0 T1, RESET, TEST	—	—	-1	μA	• No pull-down resistor • P, SIO, SCK = input • V <sub>IN</sub> =GND
Input current 2, LOW	I <sub>IL2</sub>	P00~P03, P10~P13, P20~P23, W0~W3, BIN,	-20	-40	-60	μA	• Internal pull-up resistor • V <sub>IN</sub> =GND
Output voltage 1, HIGH	V <sub>OH1</sub>	SIO0, SIO1, SCK0, SCK1	2.5	—	—	V	• SIO, SCK = output • I <sub>OH</sub> =-500 μA
Output voltage 2, HIGH	V <sub>OH2</sub>	SEG00~SEG19, COM0~COM3	2.5	—	—	V	• I <sub>OH</sub> =-250 μA
Output voltage 1, LOW	V <sub>OL1</sub>	P00~P03, P10~P13, P20~P23, SIO0, SIO1, SCK0, SCK1	—	—	0.6	V	• P,SIO,SCK = output • I <sub>OL</sub> =1.6mA
Output voltage 2, LOW	V <sub>OL2</sub>	SEG00~SEG19, COM0~COM3	—	—	0.7	V	• I <sub>OL</sub> =0.8mA
Output leak current	I <sub>L</sub>	P00~P03, P10~P13, P20~P23, SIO0, SIO1, SCK0, SCK1	—	—	1	μA	• P, SIO, SCK = high- impedance output
OSC feedback current	I <sub>FO</sub>	OSC1, OSC2	-1.5	-3	-5	μA	• Approx. 1 MΩ

System Control Microcontrollers for CD

For CDs/CD-ROMs



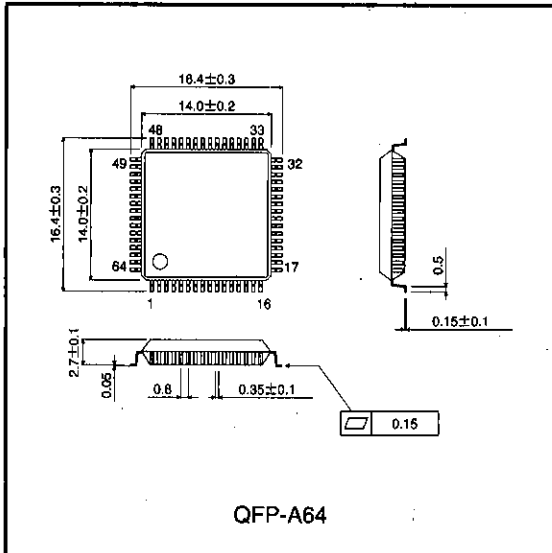
Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
A/D conversion resolution	RES	ADC0~ADC7	—	8	—	bits	
A/D conversion settling time	$t_s$	ADC0~ADC7	—	25	—	MC	MC: machine cycle *
A/D conversion linearity error	EL	ADC0~ADC7	—	—	$\pm 3$	LSB	
LCD 2/3 level output voltage	$V_1$	COM0~COM3 SEG00~SEG19	—	2	—	V	
LCD 2/3 level output voltage	$V_2$	COM0~COM3 SEG00~SEG19	—	1	—	V	

\* 1 machine cycle = 1/6 oscillation frequency

#### ● Hardware description

- (1) Operates on a single power supply ( $V_{DD}=2.7\sim 5.5V$ )
- (2) Memory size
  - ROM : 12288×8 bits
  - RAM : 512×4 bits
  - LCD display RAM : 20×4 bits
- (3) Instruction execution time (1 cycle instruction)
  - 1.5  $\mu$ sec : (at 4MHz)
- (4) Subroutine nesting : 8 levels
- (5) Interrupts : 6 factors
  - External : 3 factors
  - Internal (time counter, serial I/O) : 3 factors
- (6) ROM data table function (data table area : 12KB)
- (7) Two energy-saving modes (STOP/HALT)
- (8) Internal 20-segment LCD driver adaptable for various types of displays
  - Bias : 1/3
  - Duty settings : 1/3, 1/4 (programmable)
  - Internal bias resistor (3 stages, approx. 50k $\Omega$ )
- (9) LCD segment output is program-switchable to CMOS output
  - All 20 segments can be selected in 4-bit groups
  - Resetting : CMOS small-current output port, LOW polarity
- (10) Internal remote control receiver (pulse width counter)
- (11) Internal 8-channel, 8-bit A/D converter
- (12) A/D input is programmable in 1-bit units as digital input
- (13) Internal 8-bit timer counter (also used as event counter)
- (14) Two internal serial input/outputs (LSB fast) that simplify interface with external LSI chips
- (15) 12 input/outputs (programmable pull-up)
- (16) 5 inputs (programmable pull-up)

● External dimensions (Units: mm)



System Control Microcontrollers for CD

For CDs / CD-ROMs

## Notes

- The contents described in this catalogue are correct as of March 1997.
- No unauthorized transmission or reproduction of this book, either in whole or in part, is permitted.
- The contents of this book are subject to change without notice. Always verify before use that the contents are the latest specifications. If, by any chance, a defect should arise in the equipment as a result of use without verification of the specifications, ROHM CO., LTD., can bear no responsibility whatsoever.
- Application circuit diagrams and circuit constants contained in this data book are shown as examples of standard use and operation. When designing for mass production, please pay careful attention to peripheral conditions.
- Any and all data, including, but not limited to application circuit diagrams, information, and various data, described in this catalogue are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO., LTD., disclaims any warranty that any use of such device shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes absolutely no liability in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices; other than for the buyer's right to use such devices itself, resell or otherwise dispose of the same; no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by ROHM CO., LTD., is granted to any such buyer.
- The products in this manual are manufactured with silicon as the main material.
- The products in this manual are not of radiation resistant design.

The products listed in this catalogue are designed to be used with ordinary electronic equipment or devices (such as audio-visual equipment, office-automation equipment, communications devices, electrical appliances, and electronic toys). Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers, or other safety devices) please be sure to consult with our sales representatives in advance.

- Notes when exporting
  - It is essential to obtain export permission when exporting any of the above products when it falls under the category of strategic material (or labor) as determined by foreign exchange or foreign trade control laws.
  - Please be sure to consult with our sales representatives to ascertain whether any product is classified as a strategic material.