

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

## BU34440

The BU34440 is a single-chip 4-bit microcontroller designed for CD-DA and contains parallel I/O, serial I/O, timer / counter and all other functions required for CD control in a single compact package.

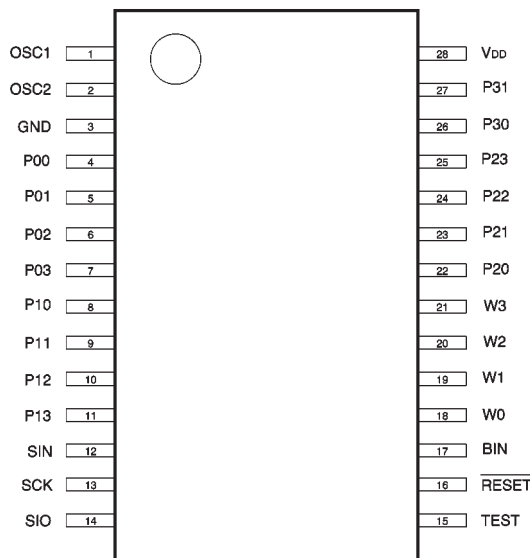
### ●Applications

Portable CD-DA devices, portable CD stereos

### ●Features

- 1) Low-voltage, high-speed operation ( $V_{DD}=2.3 \sim 5.5V$  at 4.4MHz).
- 2) 4k byte ROM, 256 nibble RAM.
- 3) Internal 8-bit SIO (LSB first).
- 4) 14 programmable pull-up input / outputs.
- 5) 5 programmable pull-up inputs.

### ●Pin assignments



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

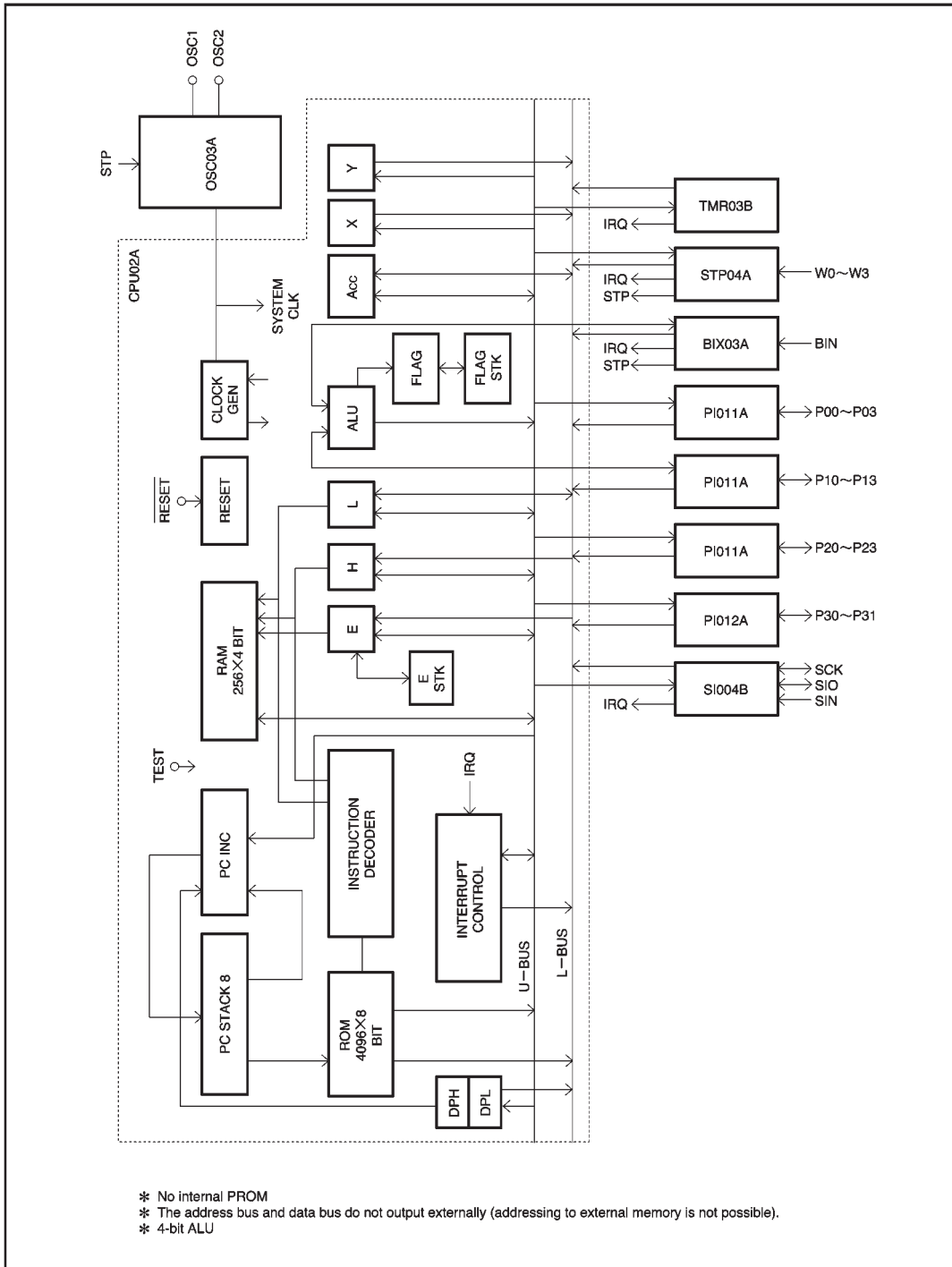
Parameter	Symbol	Limits	Unit
Power supply voltage	$V_{DD}$	$-0.3 \sim +7.0$	V
Power dissipation	$P_d$	500*	mW
Operating temperature	$T_{opr}$	$-25 \sim +75$	$^\circ C$
Storage temperature	$T_{stg}$	$-55 \sim +125$	$^\circ C$

\* 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
Power supply voltage	$V_{DD}$	2.3	—	5.5	V
Input high level voltage (without hysteresis)	$V_{IH}$	$0.7V_{DD}$	—	$V_{DD}$	V
Input low level voltage (without hysteresis)	$V_{IL}$	0	—	$0.3V_{DD}$	V
Input high level voltage (with hysteresis)	$V_{IHS}$	$0.75V_{DD}$	—	$V_{DD}$	V
Input low level voltage (with hysteresis)	$V_{ILS}$	0	—	$0.25V_{DD}$	V

● Block diagram



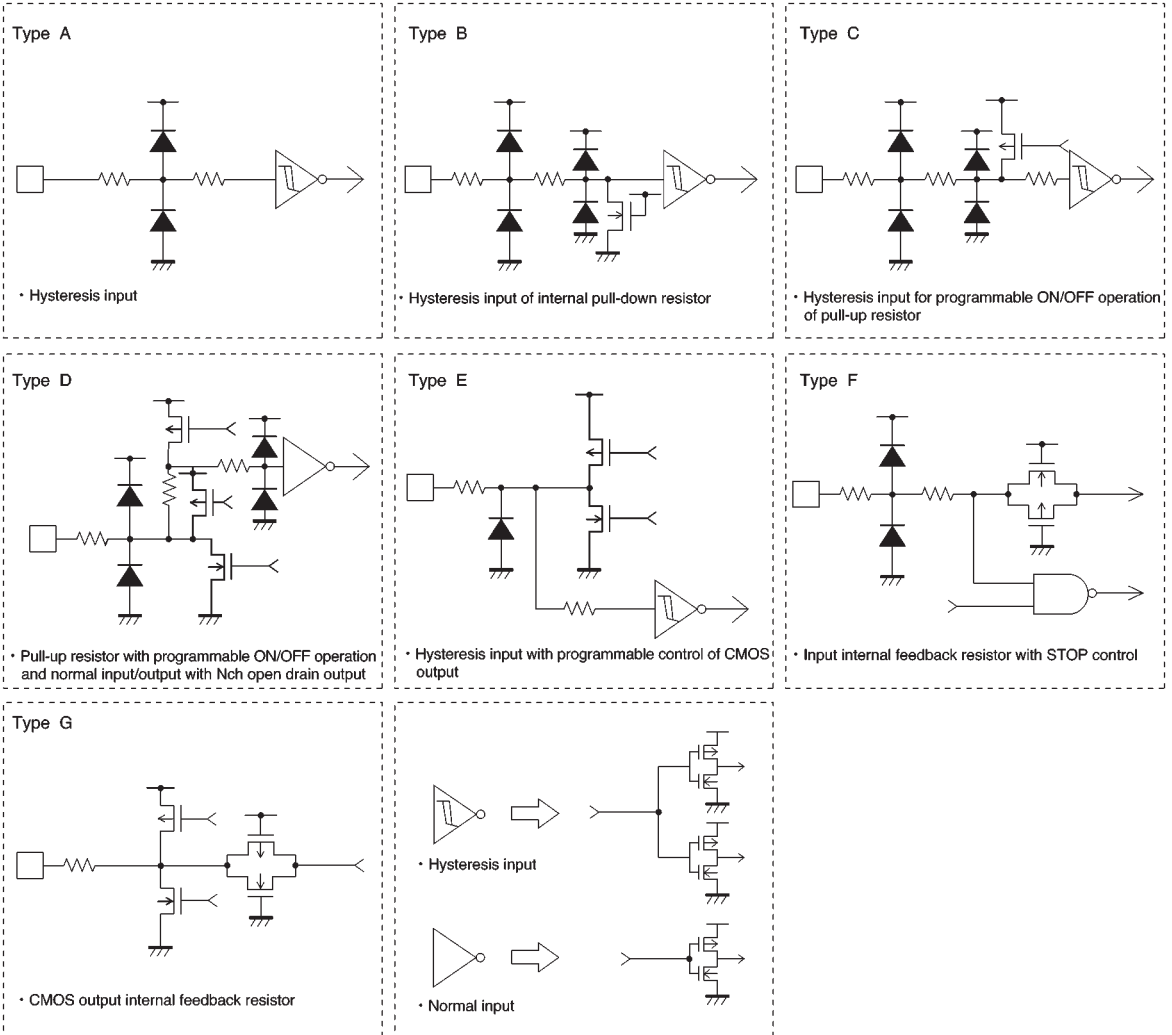
## ● Pin descriptions

Pin No.	Pin name	I/O	Function	Type
4~7 8~11 22~25	P00~P03 P10~P13 P20~P23 (block PI011A)	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.</li> </ul>	D
26~27	P30~P31 (block PI012)	I/O	<ul style="list-style-type: none"> <li>• 2-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
18~21	W0~W3 (block STP04A)	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
17	BIN (block BIX03A)	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
12	SIN	I	<ul style="list-style-type: none"> <li>• 8-bit serial data input.</li> </ul>	A
14	SIO	I/O	<ul style="list-style-type: none"> <li>• 8-bit serial data input/output.</li> <li>• Programmable selection of input/output.</li> </ul>	E
13	SCK (block SI004B)	I/O	<ul style="list-style-type: none"> <li>• Clock input/output for sending and receiving serial data.</li> <li>• Programmable selection from among 3 int. clocks and 1 ext. clock.</li> </ul>	E
1	OSC1	I	<ul style="list-style-type: none"> <li>• Oscillator input.</li> <li>• External clock input.</li> </ul>	F
2	OSC2 (block OSC03A)	O	<ul style="list-style-type: none"> <li>• Oscillator output.</li> </ul>	G
15	TEST	I	<ul style="list-style-type: none"> <li>• Test input (This is a chip test pin that contains an internal pull-down resistor and so should normally remain open.)</li> </ul>	B
16	RESET	I	<ul style="list-style-type: none"> <li>• Reset input (Setting this pin to LOW resets the CPU.)</li> </ul>	A
28	V <sub>DD</sub>	—	<ul style="list-style-type: none"> <li>• Power supply pin.</li> </ul>	—
3	GND	—	<ul style="list-style-type: none"> <li>• Ground pin.</li> </ul>	—

Type: Refer to "Input and output equivalent circuits."

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

● Input / output circuits



●Electrical characteristics (unless otherwise noted, Ta = 25°C, V<sub>DD</sub> = 5V)

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>		—	1	—	mA	• HALT mode • f <sub>OSC</sub> = 4.4MHz
Operating supply current	I <sub>DDOP</sub>		—	4	—	mA	• f <sub>OSC</sub> = 4.4MHz
Clock frequency	f <sub>OSC</sub>	OSC1, OSC2	2	—	4.4	MHz	
Input high level voltage 1	V <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, P30~P31	3.5	—	—	V	• Pxx = input
Input high level voltage 2	V <sub>IH2</sub>	W0~W3, BIN, SIN, SIO, SCK, TEST, RESET	3.75	—	—	V	• Hysteresis input • SIO, SCK = input
Input high level voltage 3	V <sub>IH3</sub>	OSC1	3.9	—	—	V	• External clock input
Input low level voltage 1	V <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31	—	—	1.5	V	• Pxx = input
Input low level voltage 2	V <sub>IL2</sub>	W0~W3, BIN, SIN, SIO, SCK, TEST, RESET	—	—	1.25	V	• Hysteresis input • SIO, SCK = input
Input low level voltage 3	V <sub>IL3</sub>	OSC1	—	—	1.1	V	• External clock input
Input high level current 1	I <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN, SIN, SIO, SCK, RESET	—	—	1	μA	• No pull-down resistor • Pxx, SIO, SCK=input • V <sub>IN</sub> = V <sub>DD</sub>
Input high level current 2	I <sub>IH2</sub>	TEST	35	70	140	μA	• Internal pull-down resistor • V <sub>IN</sub> = V <sub>DD</sub>
Input low level current 1	I <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN, SIN, SIO, SCK, RESET, TEST	—	—	−1	μA	• No pull-up resistor • Pxx, SIO, SCK=input • V <sub>IN</sub> = GND
Input low level current 2	I <sub>IL2</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN	−90	−125	−160	μA	• Internal pull-up resistor • V <sub>IN</sub> = GND
Output high level voltage 1	V <sub>OH1</sub>	SIO, SCK	4.5	—	—	V	• SIO, SCK = output • I <sub>OH</sub> = −500 μA
Output low level voltage 1	V <sub>OL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, SIO, SCK	—	—	0.4	V	• Pxx, SIO, SCK = output • I <sub>OL</sub> = 1.6mA
Output leakage current	I <sub>L</sub>	P00~P03, P10~P13, P20~P23, P30~P31	—	—	1	μA	• Pxx = high-impedance output
OSC feedback current	I <sub>FO</sub>	OSC1, OSC2	−4.0	−10	−14	μA	• Approx. 500 kΩ

\*1 machine cycle = 1/6 oscillation frequency

●Electrical characteristics (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
Operating supply 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 high level voltage 1	V <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, P30~P31	2.1	—	—	V	• Pxx = input • ADC = digital input
Input high level voltage 2	V <sub>IH2</sub>	W0~W3, BIN, SIN, SIO, SCK, TEST, RESET	2.25	—	—	V	• Hysteresis input • SIO, SCK = input
Input high level voltage 3	V <sub>IH3</sub>	OSC1	2.4	—	—	V	• External clock input
Input low level voltage 1	V <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31	—	—	0.9	V	• Pxx = input • ADC = digital input
Input low level voltage 2	V <sub>IL2</sub>	W0~W3, BIN, SIN, SIO, SCK, TEST, RESET	—	—	0.75	V	• Hysteresis input • SIO, SCK = input
Input low level voltage 3	V <sub>IL3</sub>	OSC1	—	—	0.65	V	• External clock input
Input high level current 1	I <sub>IH1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN, SIN, SIO, SCK, RESET	—	—	1	μA	• No pull-down resistor • Pxx, SIO, SCK=input • V <sub>IN</sub> =V <sub>DD</sub>
Input high level current 2	I <sub>IH2</sub>	TEST	10	20	35	μA	• Internal pull-down resistor • V <sub>IN</sub> =V <sub>DD</sub>
Input low level current 1	I <sub>IL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN, SIN, SIO, SCK, RESET, TEST	—	—	-1	μA	• No pull-up resistor • Pxx, SIO, SCK=input • V <sub>IN</sub> =GND
Input low level current 2	I <sub>IL2</sub>	P00~P03, P10~P13, P20~P23, P30~P31, W0~W3, BIN	-20	-40	-60	μA	• Internal pull-up resistor • V <sub>IN</sub> =GND
Output high level voltage 1	V <sub>OH1</sub>	SIO, SCK	2.5	—	—	V	• SIO, SCK = output • I <sub>OH</sub> =-500 μA
Output low level voltage 1	V <sub>OL1</sub>	P00~P03, P10~P13, P20~P23, P30~P31, SIO, SCK	—	—	0.6	V	• Pxx, SIO, SCK = output • I <sub>OL</sub> =1.6mA
Output leakage current	I <sub>L</sub>	P00~P03, P10~P13, P20~P23, P30~P31	—	—	1	μA	• Pxx = high-impedance output
OSC feedback current	I <sub>Fo</sub>	OSC1, OSC2	-1.5	-3	-5	μA	• Approx. 1 MΩ

\*1 machine cycle = 1 / 6 oscillation frequency

● Hardware descriptions

- (1) Operates on a single power supply ( $V_{DD}=2.3 \sim 5.5V$ ).
- (2) Memory size  
ROM:  $4096 \times 8$  bits  
RAM:  $256 \times 4$  bits
- (3) Instruction execution time (1 cycle instruction)  
 $1.5\mu\text{sec}$ : (at 4MHz)
- (4) Subroutine nesting : 8 levels
- (5) Interrupts: 4 factors  
External: 2 factors  
Internal (timer / counter, serial I / O)  
: 2 factors
- (6) ROM data table function (data table area : 4kB)
- (7) Two energy-saving modes (STOP / HALT)
- (8) Internal 8-bit timer counter
- (9) Internal serial I / O, simplifying interface with attached LSIs (LSB first)
- (10) 14 programmable pull-up input / outputs
- (11) 5 programmable pull-up inputs

● External dimensions (Units: mm)

