

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 ($T_a = 25^\circ C$)

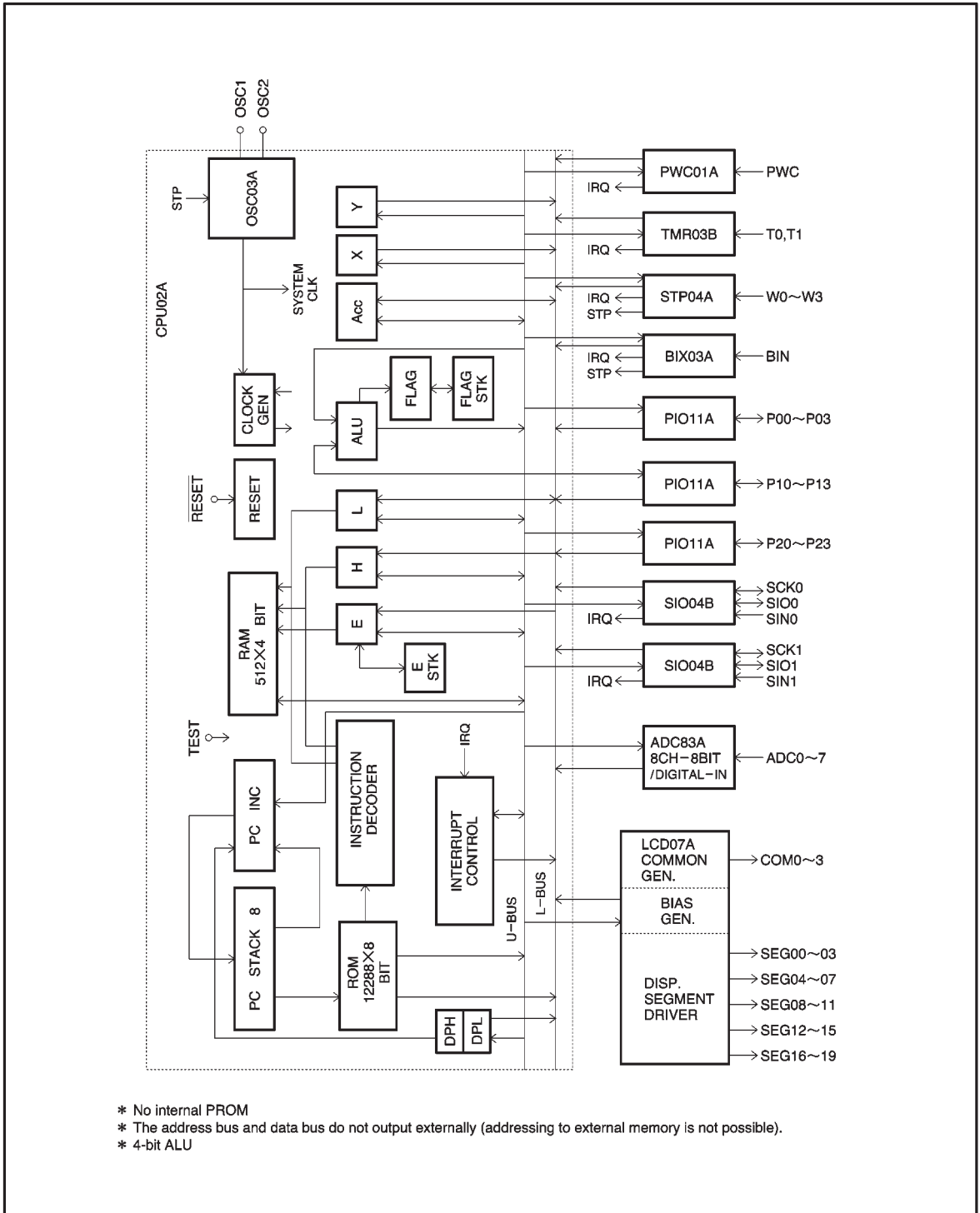
Parameter	Symbol	Limits	Unit
Applied voltage	V_{DD}	$-0.3 \sim +7.0$	V
Power dissipation	P_d	500*	mW
Operating temperature	T_{opr}	$-25 \sim +75$	$^\circ C$
Storage temperature	T_{stg}	$-55 \sim +125$	$^\circ C$

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

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

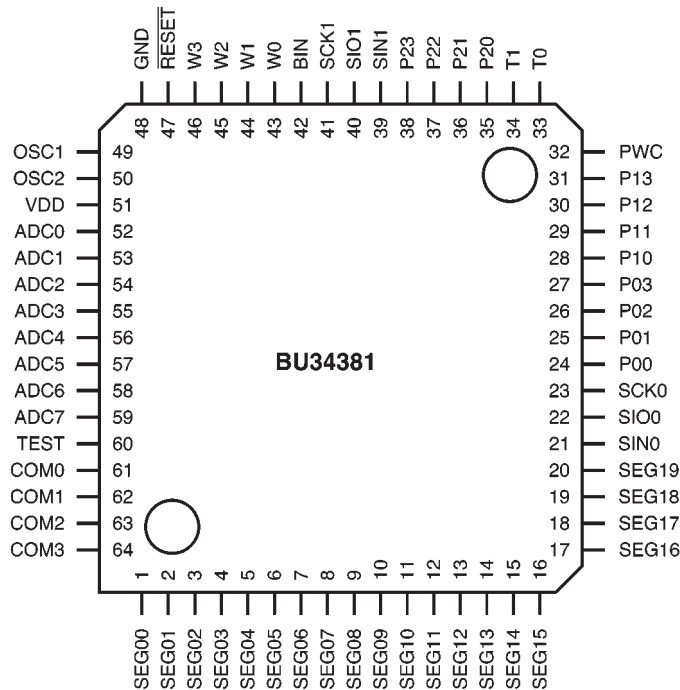
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{DD}	2.7	—	5.5	V
Input high level voltage (without hysteresis)	V_{IH}	$0.7V_{DD}$	—	V_{DD}	V
Input low level voltage (without hysteresis)	V_{IL}	0	—	$0.3V_{DD}$	V
Input high level voltage (with hysteresis)	V_{IHS}	$0.75V_{DD}$	—	V_{DD}	V
Input low level voltage (with hysteresis)	V_{ILS}	0	—	$0.25V_{DD}$	V

● Block diagram



- * No internal PROM
- * The address bus and data bus do not output externally (addressing to external memory is not possible).
- * 4-bit ALU

● Pin assignments



● Pin descriptions

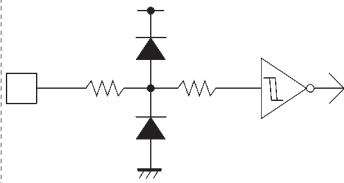
Pin No.	Pin name	I / O	Function	Type
24~27 28~31 35~38	P00~P03 P10~P13 P20~P23 (PI011A block)	I / O	<ul style="list-style-type: none"> • 4-bit input and output • Each bit is programmable for input or output (open drain output N-channel) • Pull-up resistor ON/OFF operation is programmable (each bit can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

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

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

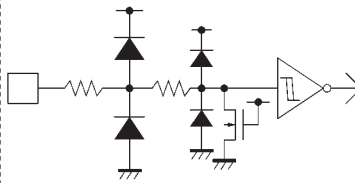
● Input / output circuits

TYPE A



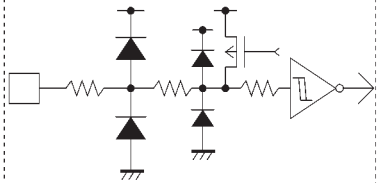
• Hysteresis input

TYPE B



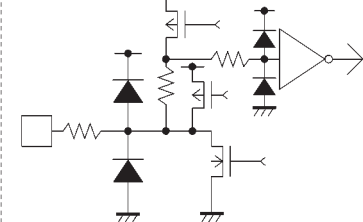
• Hysteresis input of internal pull-down resistor

TYPE C



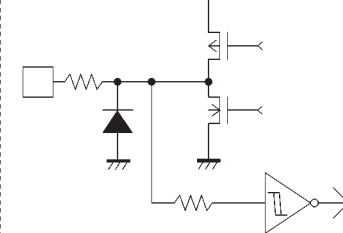
• Hysteresis input for programmable ON/OFF operation of pull-up resistor

TYPE D



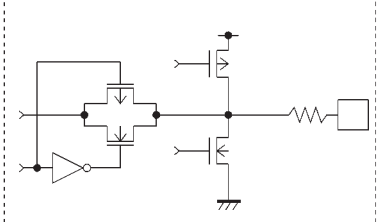
• Pull-up resistor with programmable ON/OFF operation and normal input/output with Nch open drain output

TYPE E



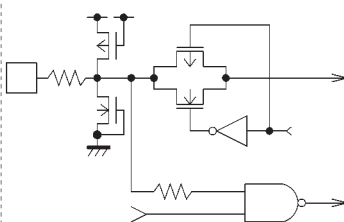
• Hysteresis input with programmable control of CMOS output

TYPE F



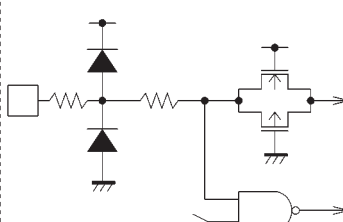
• LCD driver output (CMOS output possible for SEG only)

TYPE G



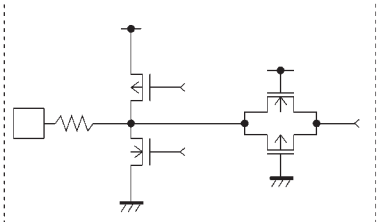
• Programmable control of AD input with digital input

TYPE H



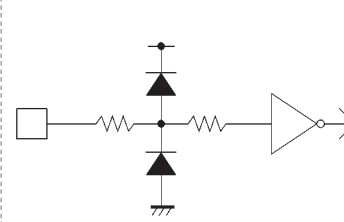
• Input in feedback resistor with STOP control

TYPE I

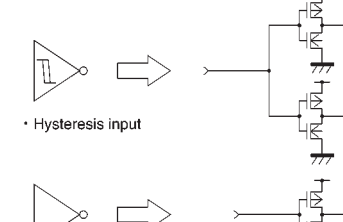


• CMOS output in feedback resistor

TYPE J



• Normal input



• Hysteresis input

• Normal input

●Electrical characteristics (at 5V) (unless otherwise noted, Ta = 25°C, V_{DD} = 5V)

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

Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
A/D conversion resolution	RES	ADC0~ADC7	—	8	—	bits	
A/D conversion settling time	ts	ADC0~ADC7	—	25	—	MC	MC: machine cycle *
A/D conversion linearity error	EL	ADC0~ADC7	—	—	±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

●Electrical characteristics (at 3V) (unless otherwise noted, Ta = 25°C, V_{DD} = 3V)

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

Parameter	Symbol	Pin	Min.	Typ.	Max.	Unit	Conditions
A/D conversion resolution	RES	ADC0~ADC7	—	8	—	bits	
A/D conversion settling time	ts	ADC0~ADC7	—	25	—	MC	MC: machine cycle *
A/D conversion linearity error	EL	ADC0~ADC7	—	—	±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 descriptions

- (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)
1.5μsec: (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. 50kΩ)
- (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)

