More than Compatibility

MassDuino

MD-328D

8-bit Microcontroller with 32K bytes In-System Programmable Flash

www.inhaos.com

Features:

More Fast Timers

Two 8bit Timer/Counter with independent prescaler

One 16bit Timer/Counter with independent prescaler

64MHz internal frequency for fast and high resolution PWM

Up to 6 channels PWM **with dead band** support

More accuracy analog modules

8-channel 12bit Analog to Digital Converter (ADC)

Internal independent power monitor channel (VCC/4)

Internal High resolution **1.25V/2.56V** ±**1%** voltage reference

2x Analog comparator with 2x 8bit DAC for internal reference

2x Fixed-gain, dual direction OPA frontend for ADC/AC

2-channel 8bit DAC output

More other improvements

High resolution internal **16MHz** ±**1%** RC oscillator

Low power 32KHz RC oscillator

Low power POR and 3-level Low voltage detector

More efficiency active and sleep power control

Digital Peripherals

SWD Two-wire On Chip Debug & Programming Interface

Programmable Watch dog timer

Async/Sync Universal Receiver/Transmitter (USART)

Master/Slave SPI Interface

Master/Slave Two-wire Interface (TWI), compatible with I2C

More Robust Working Environment

0~20MHz @ 1.8V ~ 5.5V

-40C ~ +85C

4000V HBM ESD

Features:

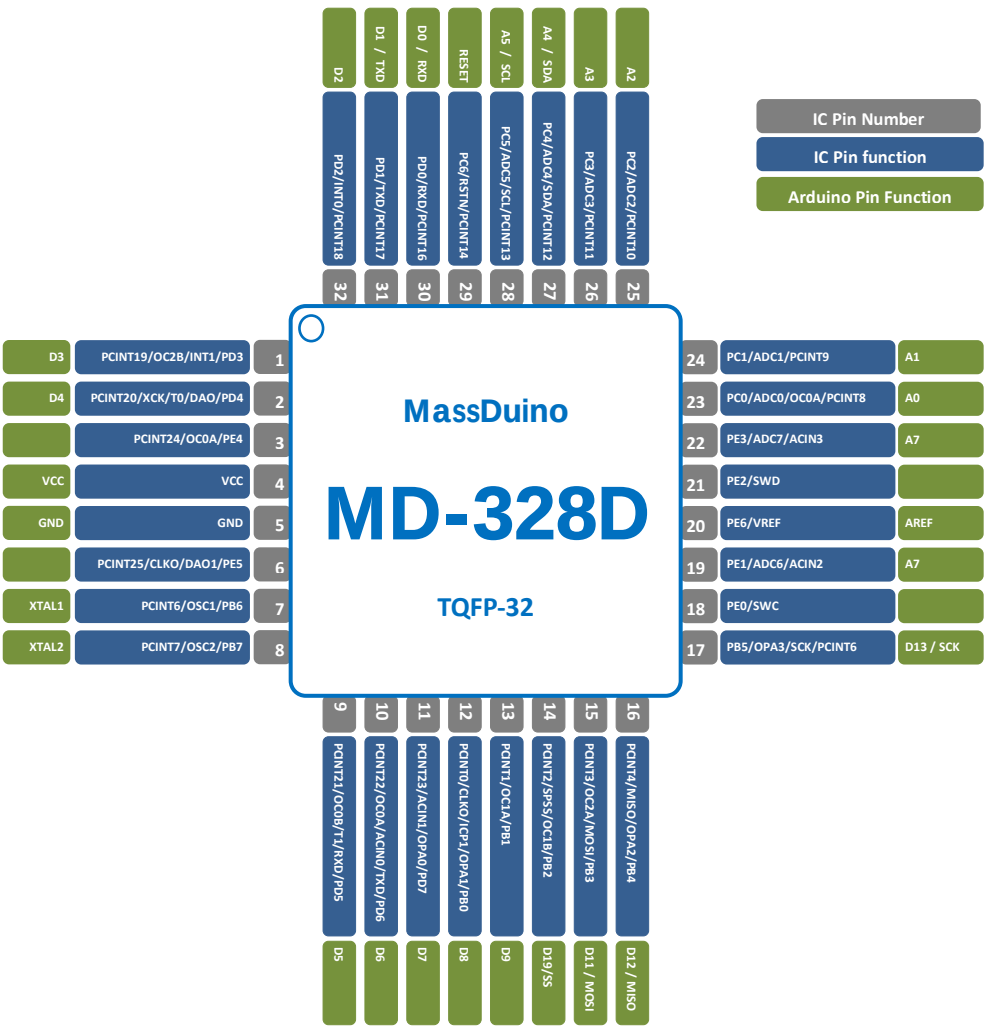
More useful analog modules

- Internal voltage reference for ADC and source of DAC
- 8bit DAC output to one channel of Analog comparator
- Each OPA support up to 2 external input channels
- OPA support x12 gain in normal mode and x11 in input-inverting mode
- OPA output can be sampled by ADC
- Analog comparator support flexible filter backend
- Comparator output can be used to disable PWM output automatically
- AC combined with OPA can be used to implement flexible over-current and over-voltage circuits

More fast timer and PWM

- Internal frequency double generate 64MHz clock for fast timer application
- Up to 500KHz@7bit high resolution PWM
- Dead cycle inserted to protect external MOSFET driver
- PWM can be disabled automatically by analog comparator or other sources
- Up to 6 channel PWM output
- Up to 4 channel support fast PWM and dead cycle insertion

Pin Configurations:

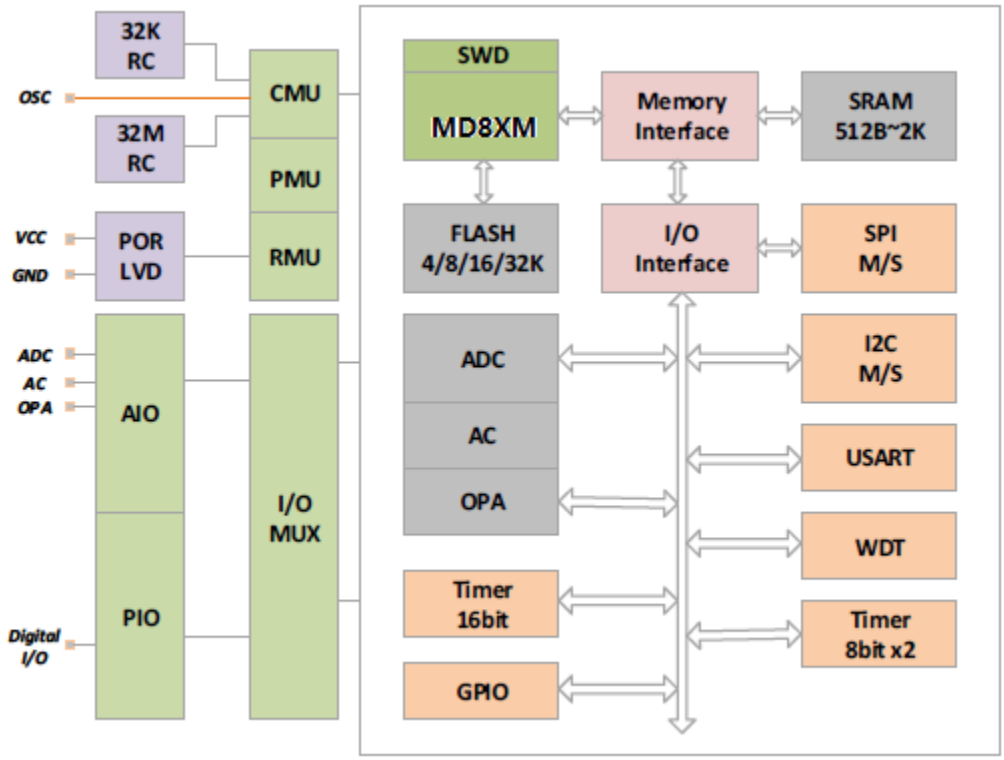


Top View

Pin Description:

No.	IC Pin Function	Description
1	VCC	Supply voltage , DC 1.8-5.5V
2	GND	Ground
3	Port B (PB7:0) XTAL1/XTAL2/TOSC1/TOSC2	Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.
4	Port C (PC5:0)	Port C is a 7-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The PC5..0 output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running.
5	PC6/RESET	If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical characteristics of PC6 differ from those of the other pins of Port C.
6	Port D (PD7:0)	Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.
7	AREF	AREF is the analog reference pin for the A/D Converter.
8	ADC7:6	ADC7:6 serve as analog inputs to the A/D converter.
9	PE0,PE2,PE4,PE4	Port E is a bi-directional I/O port with internal pull-up resistors (selected for each bit) Those pins is power supply on ATMega328P , for PCB level compatible , put 4pcs 0R resistors on the pins and the PCB can be use ATMega328P and MD-328D by configuration those resistors.

Block Diagram:



No.	Module Name	Module Function
1	SWD	Debugging module , implemented In system debugging and In system programmed function
2	MD8XM	8-bit High performance RISC core
3	CMU	Timer manage module , generation all timing for each module in the system
4	PMU	Power consumption manage module
5	POR/LVD	Power Up reset and low voltage detect circuit
6	ADC	8CH 12bit AD converter , **it support 10bit / 12bit / 16bit ADC resolution in Arduino System**
7	AC	Analog Comparators
8	OPA	Operation Amplifiers
9	Timer	Timer / Counter
10	WDT	Watch dog reset module
11	SPI M/S	SPI Master and Slave Controller
12	I2C M/S	I2C Master and Slave Controller
13	USART	Synchronous / asynchronous serial transceivers
14	AIO	Analog Input Channels
15	PIO	Programmable digital I / O

Electrical Characteristics:

Absolute Maximum Ratings*

No.	Item	Ratings
1	Operating Temperature	-40° C to +85° C
2	Storage Temperature	-55° C to +125° C
3	Voltage on any Pin except RESET with respect to Ground	0 to +VCC
4	Maximum Operating Voltage	6.0V
5	DC Current per I/O Pin	30.0 mA
6	DC Current VCC and GND Pins	200.0 mA
7	ESD Voltage	≥±4KV

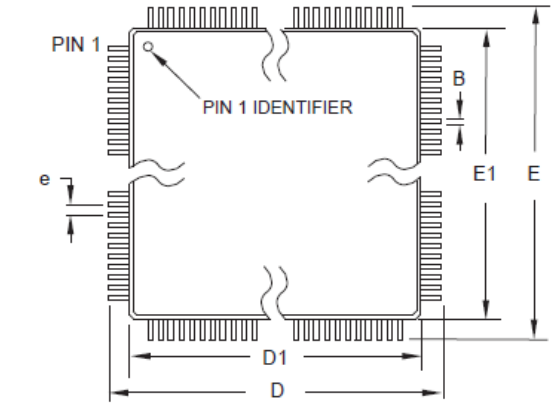
***NOTICE:** Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

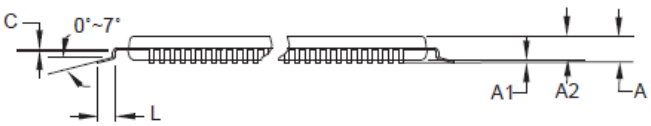
DC Characteristics

TA = -40°C to 85°C, VCC = 1.8V to 5.5V (unless otherwise noted)

Symbol	Parameter	Condiction	Min	Typ.	Max	Unit
VIL	Input Low Voltage, except XTAL1 and RESET pin			VCC/3		V
VIH	Input High Voltage, except XTAL1 and RESET pins			VCC/2		V
VOL	Output Low Voltage(3) except RESET pin	IOL=40mA, VCC=5V			0.8	V
		IOL=25mA, VCC=3.3V			0.7	
VOH	Output High Voltage except Reset pin	IOH=20mA, VCC=5V	4.4			V
		IOH=12mA, VCC=3.3V	2.6			
IIL	Input Leakage Current I/O Pin				1	uA
IIH	Input Leakage Current I/O Pin				1	uA
RWPU	I/O Pin Weak Pull-up Resistor			80K		Ω
RPU	I/O Pin Pull-up Resistor			15K		Ω
ICC	Active	1MHz @ 3.3V		0.56		mA
		4MHz @ 3.3V		1.25		
	IDLE	4MHz @ 3.3V		0.30		mA
	Power/Off S0	4MHz @ 3.3V		12.0		uA
	Power/Off S1	VCC=3.3V		7.4		uA

Package Information:





COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
A2	0.95	1.00	1.05	
D	8.75	9.00	9.25	
D1	6.90	7.00	7.10	Note 2
E	8.75	9.00	9.25	
E1	6.90	7.00	7.10	Note 2
B	0.30	–	0.45	
C	0.09	–	0.20	
L	0.45	–	0.75	
e	0.80 TYP			

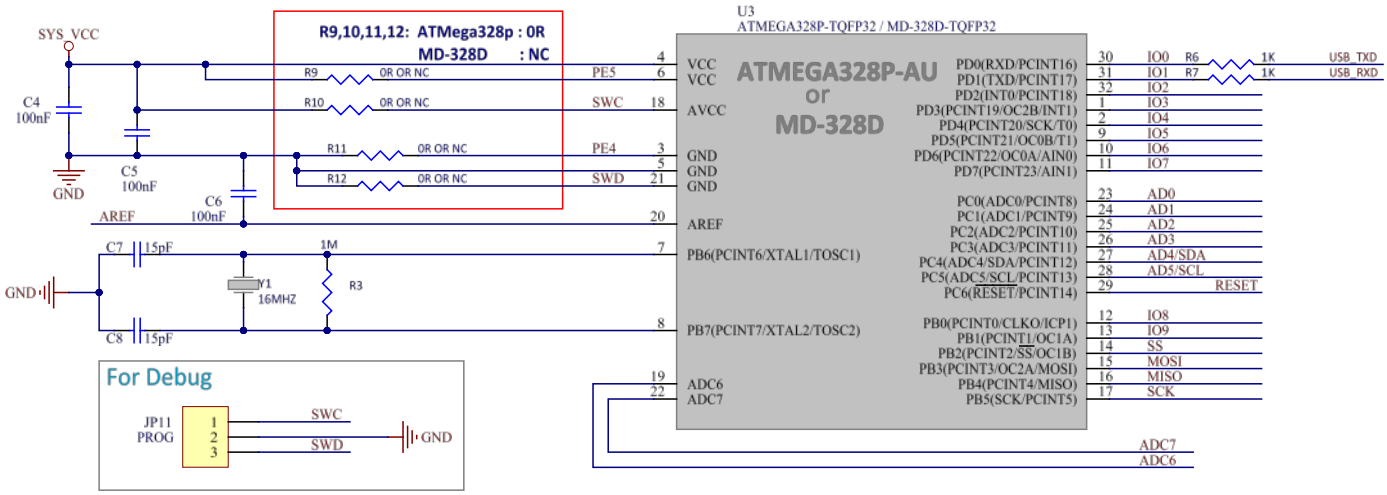
Notes:
1. This package conforms to JEDEC reference MS-026, Variation ABA.
2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is 0.25 mm per side. Dimensions D1 and E1 are maximum plastic body size dimensions including mold mismatch.
3. Lead coplanarity is 0.10 mm maximum.

10/5/2001

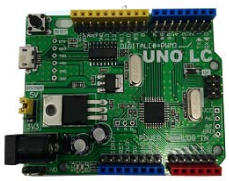
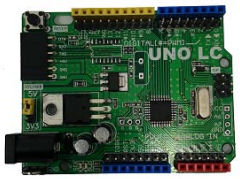
Order Information:

No.	Part Number	Description
1	MD-328D-BK	MD-328D TQFP-32 Blank Chip
2	MD-328D	MD-328D TQFP-32, Arduino Bootloader pre-programmed

Minimal system reference:



Application Product:

No.	Product Name	Picture	Main Feature
1	**MassDuino UNO LC**		Low cost Arduino IDE USB Connection Full compatible with Arduino UNO
2	**MassDuino UNO LC Lite**		Low cost Arduino IDE Full compatible with Arduino UNO
3	**MassDuino UNO Core**		Low cost Arduino IDE Mini Size
3	**MassDuino RF UNO Core**		Low cost Arduino IDE Mini Size 2.4GHz RF UART onboard Remote sketch uploading

Notes:

INHAOS Headquarter：
1111 Oakmont Drive #C, San Jose, CA 95117
E-mail ： support@inhaos.com

INHAOS China office：
No.6 Building,Songke Estate,Songshan Lake National Hi-tech Industrial Development Zone,Dongguan,Guangdong Province，523808,China

E-mail：Support@inhaos.com