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- **Release History**

2014-7-23 : **V1.0** , UM-MASSDUINO-V01-EN
First released
2015-11-20 : **V2.5** , UM-MASSDUINO-V2.5-EN
1, Add MD-328D Support
2, Update MassDuino HSP
2016-04-11：**V3.0**, UM-MASSDUINO-V3.0-EN
Update new version Arduino IDE Support
2018-08-23：**V4.6**, UM-MASSDUINO-V4.6-EN
New chip support **MD-3248P**

- **Background**

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It is a very useful and applied tools. We can find many code and sharing information from internet. Arduino development board has good scalability/ compatibility, and a wide range for application. So we can extend from the Arduino board of the modules alls type what we need. It's intended for artists, designers, hobbyists and anyone interested in creating interactive objects or environments.

Arduino can be very easy to implement prototypes for the original design verification, but if you want a large-scale commercial applications, the price of Arduino is still too high, so there very little Arduino-based commercial products on the market.

So we released **MassDuino**, a new solution that is easy to use Arduino platform advantages, combined with low manufacturing costs , making the products which is developed on Arduino platform can be mass-produced immediately, quickly turn ideas into products.

- **What's MassDuino**

Massduino is a new product line, which combines the Arduino platform peripheral -rich, convenient and quick development, low-cost and easy to manufacture large-scale production advantages. Almost all of the Arduino code can be applied to MassDuino without modification (or very small modification), users do not need to learn any new knowledge, you can immediately begin using MassDuino to commercial product development.

MassDuino use a special custom MCU MD-8088 and MD-328D, those chips has a very unique and new design, ensuring high operating efficiency while providing a low cost of applications.

INHAOS upcoming a series of application modules which is based MassDuino. The application modules can be developed in the Arduino environment, and then direct used to commercial products, creative implementation and production time reduced to a minimum.

Stage






- **MassDuino Development Process**

This chapter describe how to development a product with MassDuino, We assume that you have some basic knowledge of electronic technology, and familiar with the Arduino development environment.

S1, Understand what is MassDuino, the MassDuino series products are highly compatible with standard Arduino UNO R3, So you can use MassDuino like the Arduino UNO R3.

S2, Download MassDuino HSP (Ardunio 3rd-party Hardware Support Package) from www.inhaos.com , At present the latest version of the HSP is V4.5, this version support chips is as follows:

MD-8088: 8KB Flash , 1KB SRAM, 10bit ADC
MD-328D: 32KB Flash , 2KB SRAM, 10/12/16 bit ADC
MD-3248P： 32K Flash， 2KB SRAM， 10/12/16bit ADC, 48Pin --- 2 Apr.2018 Add

MD-328D is highest compatible with the ATmgea328P, we recommended to use MD-328D, in most case the Arduino UNO sketch can be used for MD-328P without any modification.

S3, Get one UNO development board , write sketch , run and debug .
Currently we have below products:

MD-8088: MassDuino UNO R4
MD-328D: MassDuino UNO LC , MassDuino UNO LC Lite
MD-3248P： MassDuino UNO Pro, MassDuino UNO LC Pro, MassDuino UNO Core Pro --- 2 Apr.2018 Add

S4, After prototype verified, do the mass production design, we provided below services:

1, We can help you do the whole product design and fabrication
2, Or you can do the design , we will help you make the prototype / pilot run / and mass production
3, Or you can buy chip from us , we can pre-programmed the chip or leave blank chip to you , with very good price

Need above service , please contact: support@inhaos.com

- **MD-8088 and MD-328D specification**

MD-8088

- Hi performance,Low power consumption 8bit RISC MCU
- 8K bytes of in-system programmable FLASH
- 1K bytes SRAM on-chip
- 504 bytes of data FLASH, support byte read (simulate E2PROM)
- Can be edited in the Arduino environment, concise and easy to use
- Programmable synchronous / asynchronous USART
- Can work in master / slave mode SPI Serial Interface
- Up to 30 programmable I / O
- High-performance, low -power and low-cost
- I2C -compatible two-wire serial communication interface protocols , supporting master and slave device mode

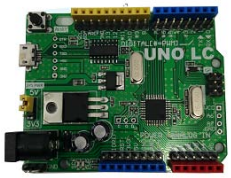
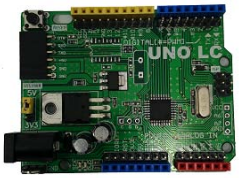
MD-328D

- Hi performance,Low power consumption 8bit RISC MCU
- 32K bytes of in-system programmable FLASH
- 2K bytes SRAM on-chip
- 1K bytes of data FLASH, support byte read (simulate E2PROM)
- Can be edited in the Arduino environment, concise and easy to use
- Programmable synchronous / asynchronous USART
- Can work in master / slave mode SPI Serial Interface
- Up to 30 programmable I / O
- High-performance, low -power and low-cost
- I2C -compatible two-wire serial communication interface protocols , supporting master and slave device mode
- 8-CH 10bit 250Ksps ADC
- 1.8 to 5.5V

MD-3248P

- Hi performance,Low power consumption 8bit RISC MCU
- 32K bytes of in-system programmable FLASH
- 2K bytes SRAM on-chip
- 1K bytes of data FLASH, support byte read (simulate E2PROM)
- Can be edited in the Arduino environment, concise and easy to use
- Programmable synchronous / asynchronous USART
- Can work in master / slave mode SPI Serial Interface
- High-performance, low -power and low-cost
- I2C -compatible two-wire serial communication interface protocols , supporting master and slave device mode
- 1.8 to 5.5V
- TQFP-48

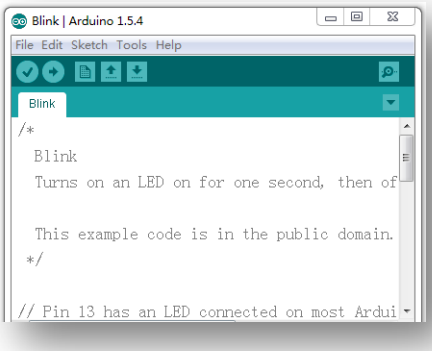
- **MassDuino UNO family selection guide**

No.	Items	BUONO UNO LC	MassDuino UNO R4	MassDuino UNO LC	MassDuino UNO LC Lite
1	Microcontroller	ATmega328P	MD-8088	MD328D	MD328D
2	Operation Voltage	3.3V or 5V	3.3V or 5V	3.3V or 5V	3.3V or 5V
3	Input Voltage (recommended)	7-24V	7-24V	7-24V	7-24V
4	Digital I/O Pins	14 (of which 6 provide PWM output)	14 (of which 6 provide PWM output)	14 (of which 6 provide PWM output)	14 (of which 6 provide PWM output)
5	Analog Input Pins	8 (A6/A7 in Extend)	8 (A6/A7 in Extend)	8 (A6/A7 in Extend)	8 (A6/A7 in Extend)
6	ADC Resolutions	10 bit	10 bit	10/12/16 bit	10/12/16 bit
7	Flash Memory	32 KB of which 0.5 KB used by bootloader	**8 KB** of which 1 KB used by bootloader	32 KB of which 1 KB used by bootloader	32 KB of which 1 KB used by bootloader
8	SRAM	2KB	**1KB**	2KB	2KB
9	EEPROM	1KB	**504B**	1KB Share with Flash Memory	1KB Share with Flash Memory
10	Clock Speed	16MHz	16MHz	16MHz	16MHz
11	Interface	Micro USB (CH341)	6Pin UART Serial Light	Micro USB (CH341)	6Pin UART Serial Light
12	Picture				
13	Main Advantage	USB UART interface ATmega328P Chipset Good cost performance Line Regulator, low noise	6Pin USB2Serial Light MD-8088 Chipset Very Good cost performance Line Regulator, low noise **WILL BE PHASE OUT SOON, NOT RECOMMEND!**	USB UART interface MD328D Chipset 10/12/16 bit ADC Very Good cost performance USB UART interface Ready for mass production	6Pin USB2Serial Light MD328D Chipset 10/12/16 bit ADC Very Good cost performance USB UART interface Ready for mass production

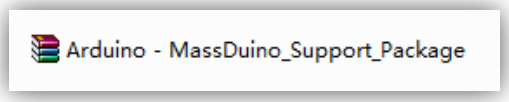
- **How to use**

We released an Ardunio 3rd-party hardware package for MassDuino , so you can download it from website (www.inhaos.com) before using it , and put it in the appropriate location , then you can use it like to use any other Arduino board. The installation process is as follows.

step1: Download the Arduino software from the official website and then install it on the computer.
(Surport Arduino 1.5.X and Arduino 1.6.x)



step2: Download the MassDuino surport package



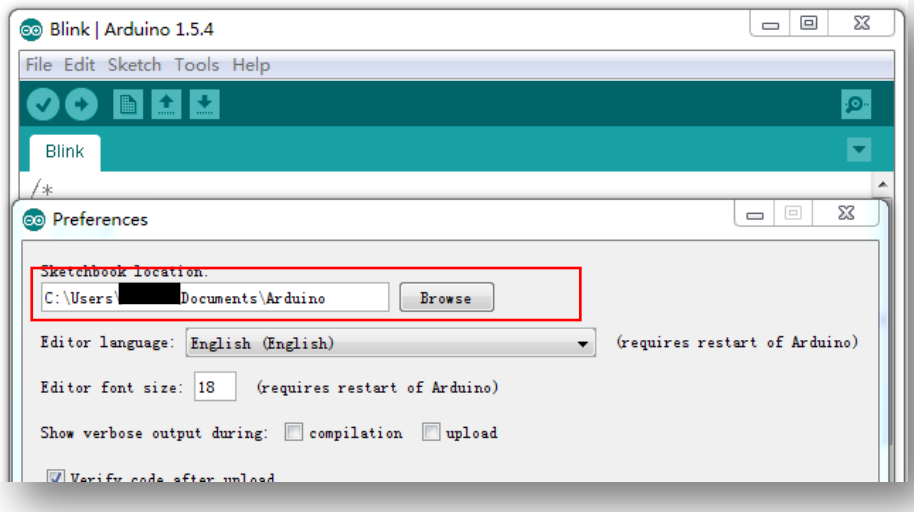
step3: Install MassDuino surport package to Arduino IDE

PS: Before do this, please make sure your Arduino IDE is closed.

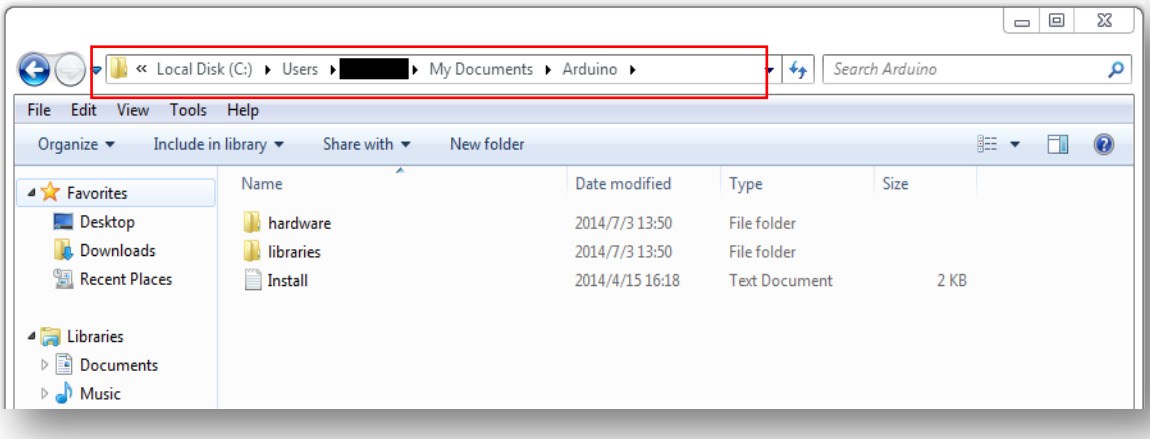
Unzip the support package file, and move the two Folders (libraries and hardware) to:

C:\Users\<USERNAME>\Documents\Arduino

You can check Arduino->File->Preferences to find your support file installation directory.

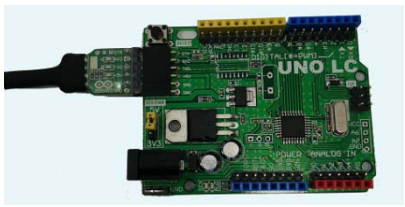


In my computer, the support package Installed here.



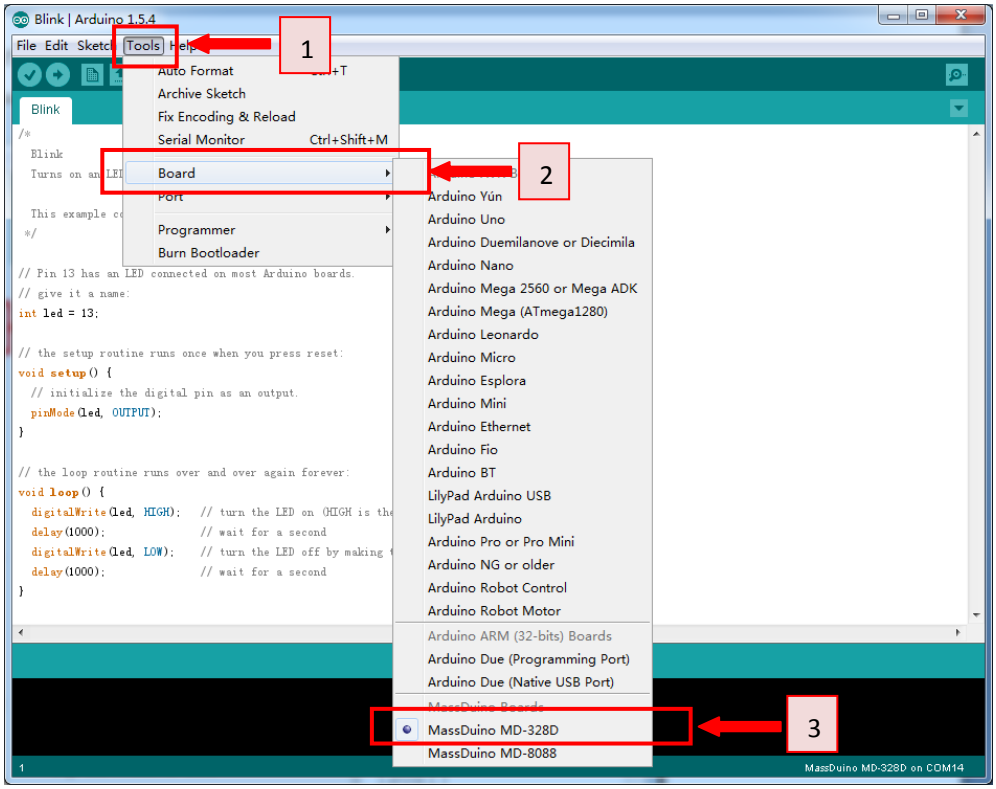
step4: Connect MassDuino board to your computer with a USB-Serial adapter and USB cable.

Used standard Arduino USB2Serial Light cable to upload sketch and communication.

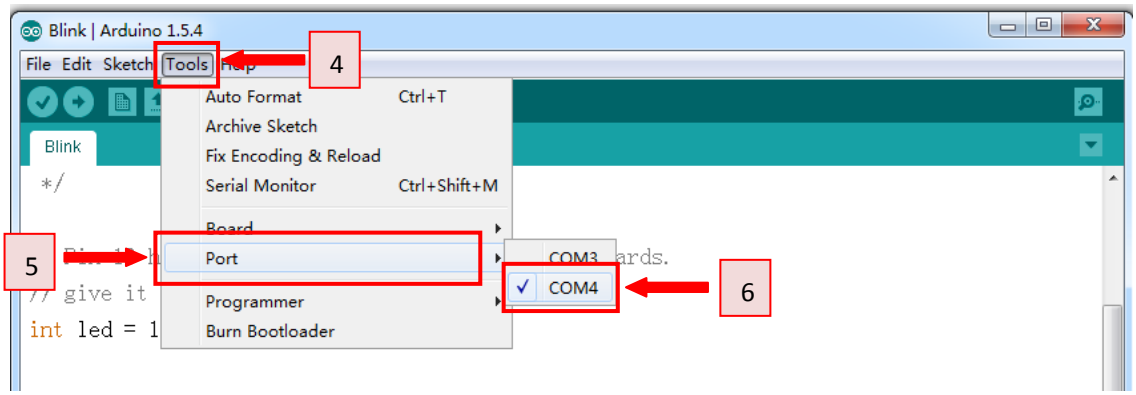


- **My first MassDuino sketch**

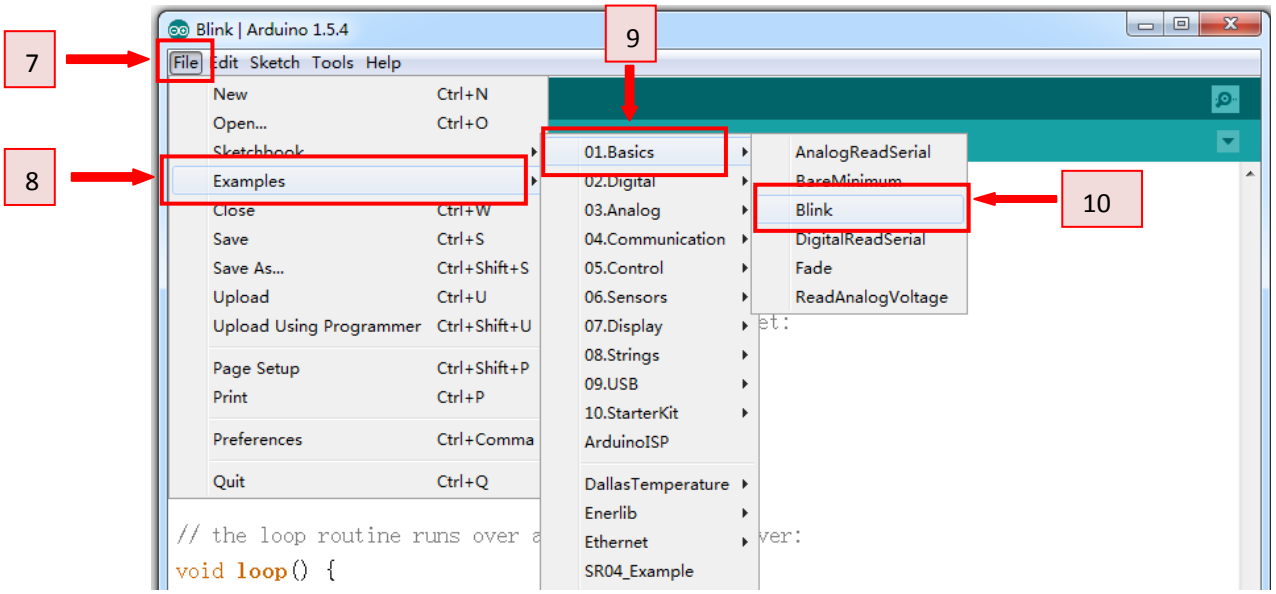
1) Open the Arduino IDE. Select the board: Click Tools -> Board -> MassDuino UNO R4.0



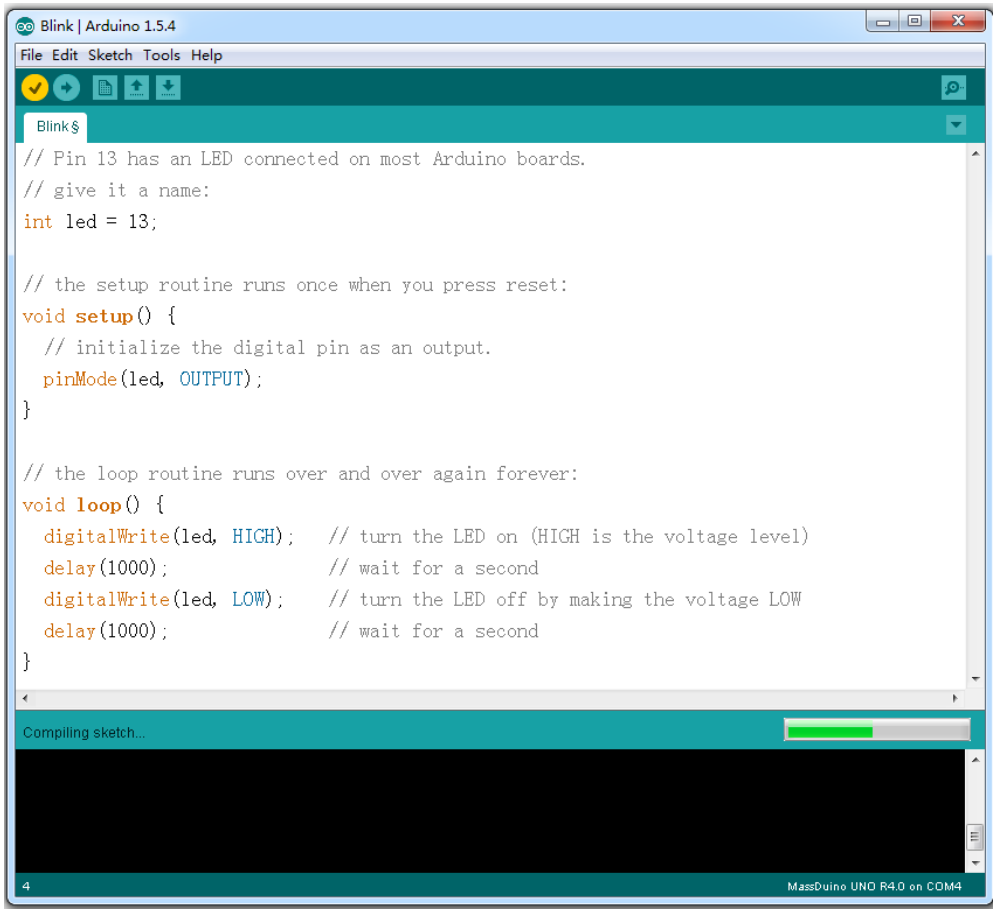
2) Select the COM: Click Tools -> Serial Port -> COM4(which connected with MassDuino.)



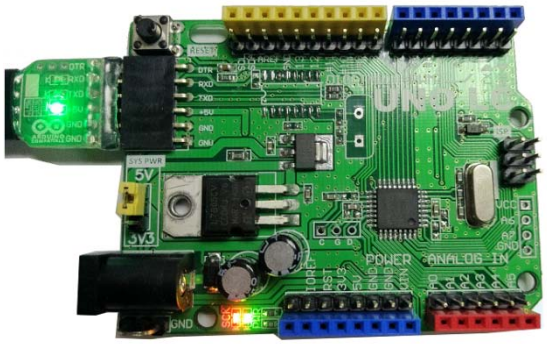
3) step6: An example of program: Click File -> Examples -> which you want.

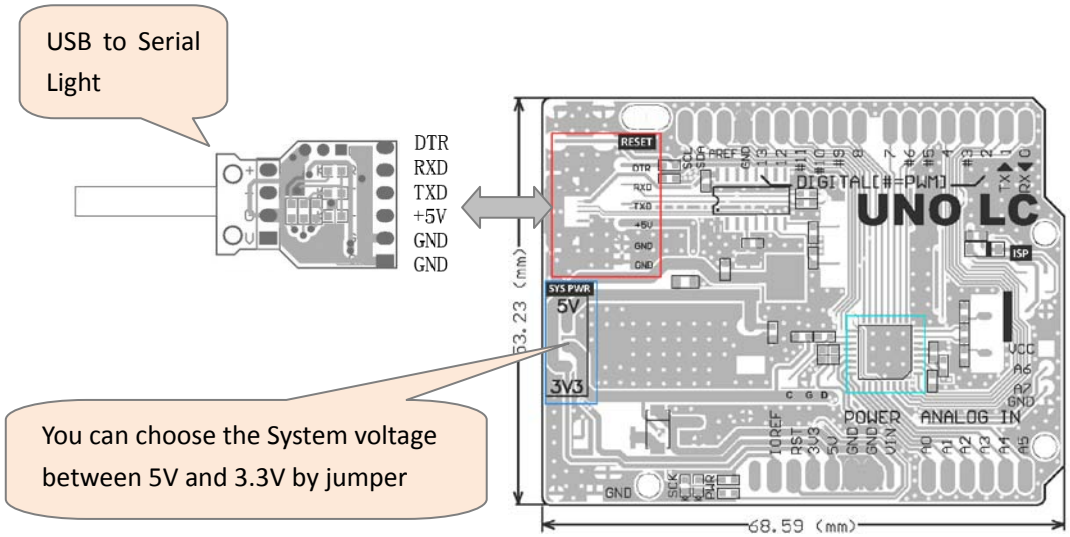


4) step7: Upload the blink example to MassDuino.



5) Now you can see the LED is blinking according to the arduino code.





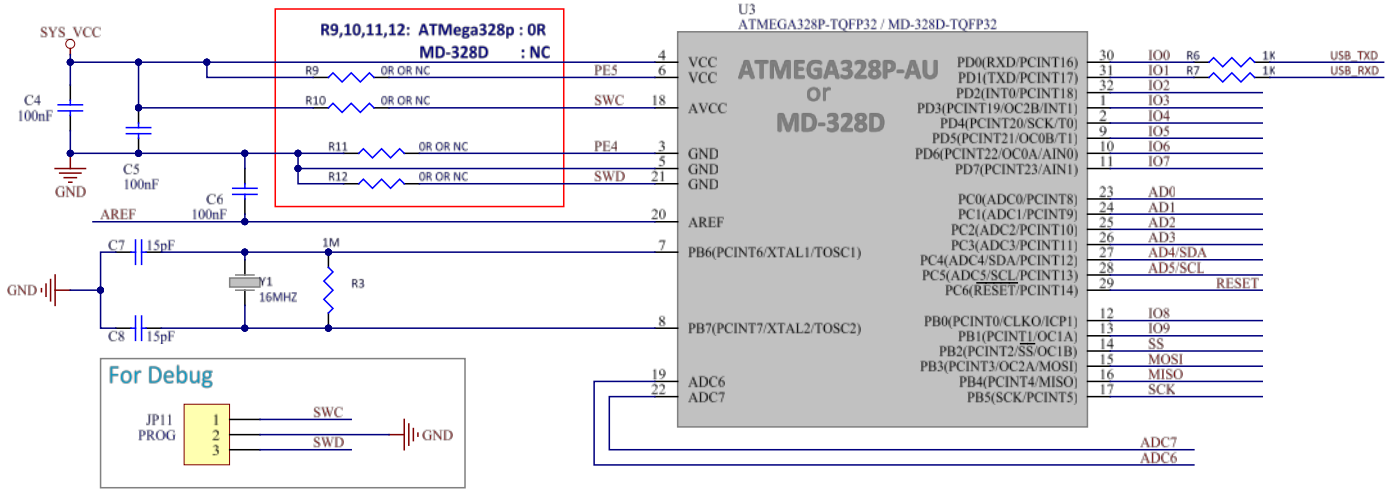
- **About the analogRead speed for MassDuino MD-328D**

The MassDuino MD-328D support 3 kinds of analogRead mode:

Mode	Resolution	Function	Time takes
1	10	analogRead()	300us
2	12	analogRead_12bits()	768us
3	16	analogRead_16bits()	8ms

So the higher resolution it outputs the longer time it takes, please select the appropriate output resolution according to your specific application.

- **How to use MD-328D to replaced ATMega328P in Arduino system**



The schematic showed the hardware difference between MD-328D and ATMega328P, here only 4pins need to difference connection:

No.	Pin Number	ATMega328P pin Function	MD-328D pin Function	Remark
1	3	GND	PE4	R11
2	6	VCC	PE5	R9
3	18	AVCC	SWC	R10
4	21	GND	SWD	R12

INHAOS Arduino UNO LC design support both ATMEGA328P and MD-328D , the difference of them is the resistor , R9,R10,R11,R12, if user want use MD-328D to design his own project , just reference the schematic show above.

INHAOS also sell MD-328D with very good price, please contact : support@inhaos.com

- **MD-3248P --- new chip released on 2018**

We release two new chip MD-3248P, below is the new feature of MD-3248P. to use MD-3248P, please go to www.inhaos.com download the newest version of Arduino support package , the MD-3248P will be supported start from V4.0.

Below are some feature function which supported for MD-3248P

1. digitalToggle( )

Description

This function is used to toggle the specified pin.

Syntax

digitalToggle(pin)

Parameters

pin: the number

Returns

Nothing

Example Code

```
void setup() {
    pinMode ( 13 , OUTPUT ) ;
}

void loop() {
    digitalToggle(13);          // Toggle the pin status
    delay(1000);                // waits for a second
}
```

2. fastioMode( )

fastioToggle( )
fastioWrite( )
fastioRead( )

Description

This function is used to fast operation the specified pin.

Syntax

```
fastioMode( pin , dir )              // like pinMode( pin ) function
fastioToggle ( pin )                 // toggle the pin status
fastioWrite ( pin , value )          // like digitalWrite( pin ) function
fastioRead ( pin )                 // like digitalRead( pin ) function
```

Parameters

fastioMode(pin , dir) // like pinMode(pin) function
- pin: the pin number
- dir: INPUT or OUTPUT

fastioToggle(pin) // toggle the pin status
- pin: the pin number

fastioWrite(pin , value) // like digitalWrite(pin) function
- pin: the pin number
- dir: HIGH or LOW

fastioRead(pin) // like digitalRead(pin) function
- pin: the pin number

Returns

fastioMode(pin , dir) // like pinMode(pin) function
- nothing

fastioToggle(pin) // toggle the pin status
- nothing

fastioWrite(pin , value) // like digitalWrite(pin) function
- nothing

fastioRead(pin) // like digitalRead(pin) function
- HIGH or LOW

Example Code

```
void setup() {
    fastioMode ( 13 , OUTPUT ) ;
}

void loop() {
    fastioToggle( 13 );         // Toggle the pin status
}
```

3. sysClock ( )

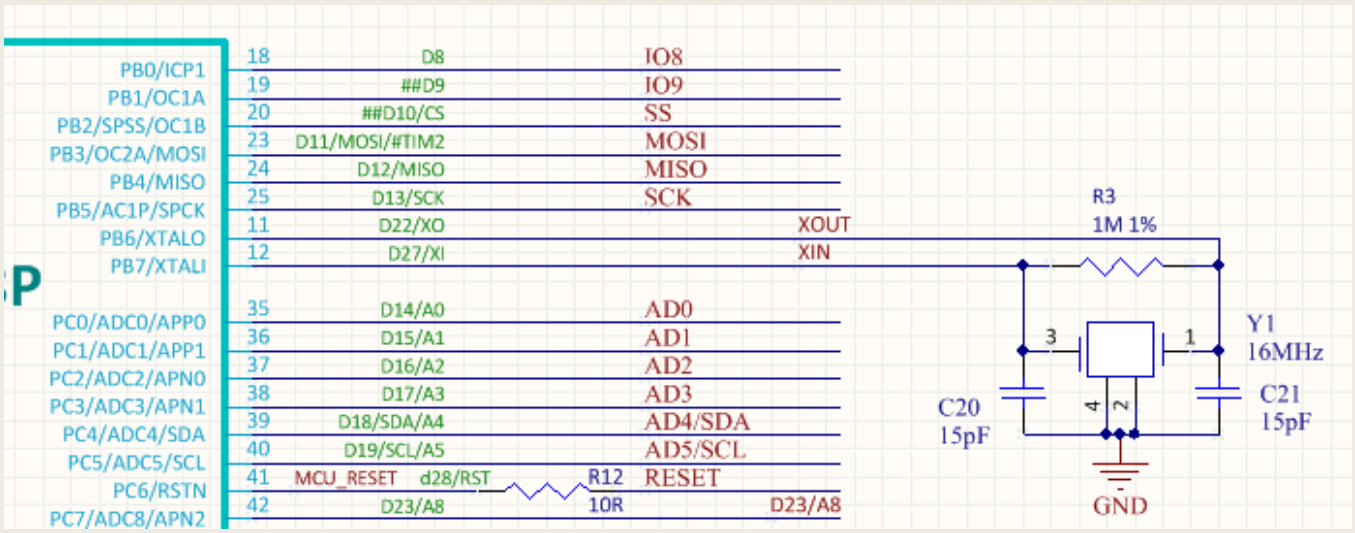
Description

This function is used to switch clock source between internal or external.

The MD-328D and MD-3248P have build in 16MHz RC clock source , the MCU will be default to use internal clock source , in some usage , user need to switch to extnal clock source , use this function to switch clock source to extnal source.

Notice: the Ext OSC driver using IO PB6 and PB7 , the PB6 is mapping to Arduino digital IO D22 , and PB7 is mapping to Arduino digital IO D27.

Both D22 and D27 only available with INT_OSC, if you using EXT_OSC , do not operation D22 and D27 , otherwise it will switch the system click source to INT_OSC.



Syntax

sysClock (clk_Source)

Parameters

clk_Source: **INT_OSC** or **EXT_OSC**

Returns

Nothing

Example Code

```
void setup() {
    sysClock(EXT_OSC);
    pinMode (13, OUTPUT);
}

void loop() {
    digitalToggle(13);          // Toggle the pin status
    delay(1000);                // waits for a second
}
```

4. getBootResetFlag ( )

Description

Get system reset source.

Syntax

getBootResetFlag( )

Parameters

Nothing

Returns

0x 07 : Power on Reset

0x 08 : Watchdog Reset

notice: when press Hardware reset pin to reset , the MCU will entry bootloader code area and will jump to application code area by WDT reset , so in this case it also will get WDT reset.

Example Code

```
void setup() {
    Serial.begin(115200);
    Serial.print("inited,");
    Serial.print("resetFlag:");
    Serial.println(getBootResetFlag(), HEX); //Get reset flag.
}

void loop() {
    // put your main code here, to run repeatedly:
}
```

5. wdt_enable ( )

wdt_disable( )
wdt_reset ( )

Description

In default setting of Arduino , the WDT (Watchdog) was disable , you can enable watchdog to make your code much stable , use this function to enable the WDT.

Notice: you must put wdt_reset in appropriate location to ensure the WDT will not be overflow in normal case. normally we put it in main loop.

Syntax

wdt_enable (timeout) // enable WDT , the max count is define by timeout parmeter
wdt_disable ( ) // disable WDT
wdt_reset ( ) // Reset the WDT count , must add in main loop if you enable the WDT.

Parameters

timeout: unit: mS , **MD-3248P** support bleow timeout:
WTO_64MS , WTO_128MS , WTO_256MS , WTO_512MS , WTO_1S , WTO_2S , WTO_4S , WTO_8S , WTO_16S , WTO_32S
MD-328D support below timeout:
WTO_1MS , WTO_2MS , WTO_4MS , WTO_8MS , WTO_16MS , WTO_64MS , WTO_128MS , WTO_256MS , WTO_512MS

Returns

Nothing

Example Code

```
#include <WDT.h>

void setup() {
    // put your setup code here, to run once:
    pinMode(13, OUTPUT);
    wdt_enable(WTO_256MS);
}

void loop() {
    // put your main code here, to run repeatedly:
    //wdt_reset();
    //wdt_disable();
    digitalToggle(13);
    delay(10);
}
```

6. analogRead ( )

analogRead_11bits ( )
analogRead_12bits ( )
analogRead_13bits ( )
analogRead_14bits ( )
analogRead_15bits ( )
analogRead_16bits ( )

Description

Massduino support 10~16 bit ADC resolutions.

Syntax

#include <analogFuncs.h>

analogRead(pin)

Parameters

pin: the number of the analog input pin.

MD-3248P have 12ch ADC, the digital pin number and Analog pin number is below:

A0 = D14 , **A1** = D15 , **A2** = D16 , **A3** = D17 , **A4** = D18 , **A5** = D19 , **A6** = D20 , **A7** = D21

A8 = D23 , **A9** = D24 , **A10** = D25 , **A11** = D26

MD-328D have 8ch ADC, the digital pin number and Analog pin number is below:

A0 = D14 , **A1** = D15 , **A2** = D16 , **A3** = D17 , **A4** = D18 , **A5** = D19 , **A6** = D20 , **A7** = D21

Returns

10/12/16 bit ADC value.

Sample Rate:

Mode	Resolution	Function	Time takes	Sample (SPS)
1	10	analogRead()	240us	4.174 Ksps
2	12	analogRead_12bits()	340us	2.941 Ksps
3	16	analogRead_16bits()	3.1ms	322.6 sps

Example Code

```
#include <analogFuncs.h>
unsigned int ADValue = 0 ;
double Voltage = 0 ;

void setup() {
    analogReference ( EXTERNAL ) ; // External reference source = 4.096V
    Serial.begin(115200);
```

```
}

void loop() {
    // 10bit read
    ADValue = analogRead (A0) ;
    Voltage = (double)ADValue * 4  ;
    Serial.print ( Voltage );
    Serial.print ( "," );

    // 12bit read
    ADValue = analogRead_12bits (A0) ;
    Voltage = (double)ADValue  ;
    Serial.print ( Voltage );
    Serial.print ( "," );

    // 16bit read
    ADValue = analogRead_16bits (A0) ;
    Voltage = (double)ADValue / 16 ;
    Serial.println( Voltage );

    delay(50);
}
```

7. analogReference ()

Description

Configures the reference voltage used for analog input and analog output.

Syntax

analogReference(type)

Parameters

type: which type of reference to use.

MD-3248P support reference type below:

EXTERNAL: the voltage applied to the AREF pin is used as the reference

DEFAULT: the default analog reference is the voltage of AVCC , for Massduino UNO board , the AVCC is follow the VCC_SYS , which can be switch between 3.3V and 5V by a jumper.

INTERNAL2V048: a built-in 2.048V reference.

INTERNAL4V096: a built-in 4.096V reference.

MD-328D support reference type below:

EXTERNAL: the voltage applied to the AREF pin is used as the reference

DEFAULT: the default analog reference is the voltage of AVCC , for Massduino UNO board , the AVCC is follow the VCC_SYS , which can be switch between 3.3V and 5V by a jumper.

INTERNAL2V56: a built-in 2.56V reference.

Returns

nothing.

Example Code

```
double Voltage = 0 ;

void setup() {
    analogReference ( DEFAULT ) ;
    Serial.begin(115200);
}

void loop() {
    // 12bit read
    Voltage = (double)analogRead_12bits (A0)  ;
    Serial.println ( Voltage );

    delay(100);
}
```

8. pwmMode ( )

pwmResolution ( )
pwmFrequency ( )
pwmWrite ( )
pwmTurnOff ( )

Description

The PWM signal is very useful function , PWM pin will generate a steady square wave of the specified duty cycle , Arduino used analogWrite() to write an analog value to a pin , but the resolution and frequency can not be setting . now we provide ways to configure the PWM frequency and resolution.

MD-3248P have 4 timers (MD-328D and ATMega328P have only 3 timers).
Timer0: 8bit , used for general timekeeping (delay() , millis() ... etc)
Timer1: 16bit
Timer2: 8bit , used for some system function (Tone () ... etc)
Timer3: 16bit

The corresponding PWM pin is as follows:
Timer0: OC0A: D6,D31 , OC0B: D5,D35
Timer1: OC1A: D9,D37 , OC1B: D10,D36
Timer2: OC2A: D11,D38 , OC2B: D3,D39
Timer3: OC3A: D33 , OC3B: D34 , OC3B: D35 (Multiplexed with OC0B)

Those function only support to Timer1 and Timer3, There are pins related to D9,D37,D10,D36,D33,D35,D35.
Each timer mapped two digital pins , in the same time , you can only use one of them , *for example:*
OC0A mapped to **D6** and **D31** share **OC0A** ,so you can not use D6 and D31 as PWM at the same time.
We also provide MsTimer1 and MsTimer3 function to used the Timer1 and Timer3 programming.

Syntax

```
#include <pwmFuncs.h>
pwmMode (pin , wmode ,fmode , dband)
pwmResolution (pin , resBits )
pwmFrequency (pin , fhz)
pwmWrite (pin , value )
pwmTurnOff (pin)
```

Parameters

pwmMode (pin , wmode ,fmode , dband)

pin : the pin to write to.
wmode : PWM_MODE_NORMAL
fmode : **PWM _FREQ_BOOST** : enable frequency boost x4 mode
PWM_FREQ_FAST: freq prescale = 1 (fast mode)
PWM_FREQ_NORMAL: freq prescale = 64 (default)
PWM_FREQ_SLOW : freq prescale = 1024 (slow mode)

dband: 0

pwmResolution (pin , resBits)

pin : the pin to write to.

resBits : pwm resolution , value in 1 to 16.

Notice , the difference resolution setting support difference frequency , this function will be return a frequency show what frequency will be used with this resolution.

pwmFrequency (pin , fhz)

pin : the pin to write to.

fhz : pwm frequency

Notice , the difference resolution setting support difference frequency , this function will be return a frequency show what resolution will be used with this frequency.

pwmWrite (pin , value)

pin : the pin to write to.

value : the duty cycle tetween 0 to the resolutions.

pwmTurnOff (pin)

pin : turn off the PWM function , and then operation as GPIO..

To avoid frequency and resolution setting is not match , so please do not configure the frequency and resolution at the same time.

Returns

pwmMode (pin , wmode ,fmode , dband)

nothing

pwmResolution (pin , resBits)

The frequency which match with the specified resolution.

pwmFrequency (pin , fhz)

The resolution which match with the specified frequency.

pwmWrite (pin , value)

nothing

pwmTurnOff (pin)

nothing

Remark

/* the pwm freq and max duty table: with setting:

pwmMode(PWM_PIN, PWM_MODE_NORMAL, PWM_FREQ_FAST, 0);

freq:100, maxDuty:65535 freq:200, maxDuty:65535 freq:300, maxDuty:53333 freq:400, maxDuty:40000
freq:500, maxDuty:32000 freq:600, maxDuty:26666 freq:700, maxDuty:22857 freq:800, maxDuty:20000

```
freq:900, maxDuty:17777    freq:1000, maxDuty:16000    freq:1100, maxDuty:14545    freq:1200, maxDuty:13333
freq:1300, maxDuty:12307    freq:1400, maxDuty:11428    freq:1500, maxDuty:10666    freq:1600, maxDuty:10000
freq:1700,  maxDuty:9411     freq:1800,  maxDuty:8888     freq:1900,  maxDuty:8421     freq:2000,  maxDuty:8000
freq:2100,  maxDuty:7619     freq:2200,  maxDuty:7272     freq:2300,  maxDuty:6956     freq:2400,  maxDuty:6666
freq:2500, maxDuty:6400    freq:2600, maxDuty:6153    freq:2700, maxDuty:5925    freq:2800, maxDuty:5714
freq:2900,  maxDuty:5517     freq:3000,  maxDuty:5333     freq:3100,  maxDuty:5161     freq:3200,  maxDuty:5000
freq:3300, maxDuty:4848    freq:3400, maxDuty:4705    freq:3500, maxDuty:4571    freq:3600, maxDuty:4444
freq:3700, maxDuty:4324    freq:3800, maxDuty:4210    freq:3900, maxDuty:4102    freq:4000, maxDuty:4000
freq:4100, maxDuty:3902    freq:4200, maxDuty:3809    freq:4300, maxDuty:3720    freq:4400, maxDuty:3636
freq:4500, maxDuty:3555    freq:4600, maxDuty:3478    freq:4700, maxDuty:3404    freq:4800, maxDuty:3333
freq:4900, maxDuty:3265    freq:5000, maxDuty:3200    freq:5100, maxDuty:3137    freq:5200, maxDuty:3076
freq:5300, maxDuty:3018    freq:5400, maxDuty:2962    freq:5500, maxDuty:2909    freq:5600, maxDuty:2857
freq:5700, maxDuty:2807    freq:5800, maxDuty:2758    freq:5900, maxDuty:2711    freq:6000, maxDuty:2666
freq:6100, maxDuty:2622    freq:6200, maxDuty:2580    freq:6300, maxDuty:2539    freq:6400, maxDuty:2500
freq:6500, maxDuty:2461    freq:6600, maxDuty:2424    freq:6700, maxDuty:2388    freq:6800, maxDuty:2352
freq:6900, maxDuty:2318    freq:7000, maxDuty:2285    freq:7100, maxDuty:2253    freq:7200, maxDuty:2222
freq:7300, maxDuty:2191    freq:7400, maxDuty:2162    freq:7500, maxDuty:2133    freq:7600, maxDuty:2105
freq:7700, maxDuty:2077    freq:7800, maxDuty:2051    freq:7900, maxDuty:2025    freq:8000, maxDuty:2000
freq:8100, maxDuty:1975    freq:8200, maxDuty:1951    freq:8300, maxDuty:1927    freq:8400, maxDuty:1904
freq:8500, maxDuty:1882    freq:8600, maxDuty:1860    freq:8700, maxDuty:1839    freq:8800, maxDuty:1818
freq:8900, maxDuty:1797    freq:9000, maxDuty:1777    freq:9100, maxDuty:1758    freq:9200, maxDuty:1739
freq:9300, maxDuty:1720    freq:9400, maxDuty:1702    freq:9500, maxDuty:1684    freq:9600, maxDuty:1666
freq:9700, maxDuty:1649    freq:9800, maxDuty:1632    freq:9900, maxDuty:1616    freq:10000, maxDuty:1600
 */
```

Example Code

```
#include <pwmFuncs.h>
#define PWM_PIN    9

void setup() {
    pwmMode(PWM_PIN, PWM_MODE_NORMAL, PWM_FREQ_FAST, 0);
    pwmResolution(PWM_PIN, 16);
}

void loop() {
    for ( unsigned long i = 0 ; i <= 60000u ; i += 1000 ) {
        pwmWrite ( PWM_PIN, i ) ;
        delay (5);
    }
    pwmTurnOff ( PWM_PIN ); // trun off the PWM function
    delay(100);
    digitalWrite ( PWM_PIN , HIGH ) ;// Control as a digital IO
    delay(50);
    digitalWrite ( PWM_PIN , LOW ) ; // Control as a digital IO
    delay(50);
}
```

9. MsTimer1.setMicros ( )

MsTimer1.set ( )
MsTimer1.start( )
MsTimer1.stop( )

MsTimer3. setMicros ( )
MsTimer3.set ( )
MsTimer3.start( )
MsTimer3.stop( )

Description

MD-3248P have 4 timers (MD-328D and ATMega328P have only 3 timers).

Timer0: 8bit , used for some system function (delay() , millis() ... etc)

Timer1: 16bit

Timer2: 8bit , used for some system function (Tone () ... etc)

Timer3: 16bit

Those function will help user to use Timer1 and Timer3.

Syntax

```
MsTimer1 setMicros (unsigned long uS, void (*f)() )
MsTimer1. set (unsigned long mS, void (*f)() )

MsTimer3. setMicros (unsigned long uS, void (*f)() )
MsTimer3. set (unsigned long mS, void (*f)() )

MsTimer1.start () // start the timer1
MsTimer3.start () // start the timer3

MsTimer1.stop () // stop the timer1
MsTimer3.stop () // stop the timer3
```

Parameters

type:

unsigned long uS: the time on uS for the overflow

f(): "f" is the function which will be called when each overflow. "f" has to be declared void with no parmeters.

Notice: with MsTimer.SetMicros() function , the overflow range must limit to 10uS to 4095uS.

Returns

nothing.

Example Code

```
#include <MsTimer1.h>
#include <MsTimer2.h>
#include <MsTimer3.h>

void D13_flash() {
    fastioToggle(13);
}

void D11_flash() {
    fastioToggle(11);
}

void D10_flash() {
    fastioToggle(10);
}

void setup() {
    fastioMode(13, OUTPUT);
    fastioMode(11, OUTPUT);
    fastioMode(10, OUTPUT);
    fastioMode ( 5 , INPUT );
    fastioWrite ( 5 , HIGH ) ;
    fastioMode ( 7 , INPUT );
    fastioWrite ( 7 , HIGH ) ;
    fastioMode ( 6 , INPUT );
    fastioWrite ( 6 , HIGH ) ;
    fastioMode ( 7 , INPUT );
    fastioWrite ( 7 , HIGH ) ;

    //MsTimer1.set(20, flash); // 20ms period
    MsTimer1.setMicros(30, D13_flash);  //30us
    MsTimer2::set(1, D10_flash);  //1mS
    MsTimer3.setMicros(20, D11_flash);  //20us
    MsTimer1.start();
    MsTimer2::start();
    MsTimer3.start();
}

void loop() {
    if ( ! fastioRead (5 )) MsTimer1.stop();
    if ( ! fastioRead ( 6 )) MsTimer2::stop();
    if ( ! fastioRead ( 7 )) MsTimer3.stop();
}
```

10. DAC usage

Description

MD-3248P have 1CH 8bit DAC, to use this DAC , user can be do below step:

S1: set analog reference : analogReference (DEFAULT);

S2: Set DAC output pin mode: pinMode (4 , ANALOG) ;

S3: write DAC value by function : analogWrite (4 , 100) ;

Syntax

Parameters

Returns

nothing.

Notice: Limited by the cost , the DAC's resolution and linearity is not so good , for high performance request application , user can be use PWM + LPF to get very good DAC function.

Example Code

```
void setup() {
    analogReference ( EXTERNAL ) ;
    pinMode( 4, ANALOG );
}

void loop() {
    for ( int i = 0 ; i <= 255 ; i++ ) {
        analogWrite( 4, i );
        delay( 20 );
    }
}
```

11. PMU (Power Management Unit)

Description

MD-3248P provided rich power management function , this is very good in low power application (eg. battery powered application.)

To use PMU function , you need to add headed file <PMU.h>

Syntax

PMU.sleep(mode , period);

Parameters

mode:

PM_IDLE: IDLE mode, turn off the core clock, reduced power consumption is very small.

PM_POWERDOWN: turn off all clock , wakeup source : pin change int , external int , WDT overflow , TMR2 overflow

PM_POFFS0: PowerOff mode 0 , wake up source : wakeup source : pin change int , external int , WDT overflow , TMR2 overflow

PM_POFFS1: PowerOff mode 1 , wake up source : wakeup source : pin change int , external int , TMR2 overflow

period:

SLEEP_64MS	SLEEP_64MS = 0	SLEEP_128MS
SLEEP_256MS	SLEEP_512MS	SLEEP_1S
SLEEP_2S	SLEEP_4S	SLEEP_8S
SLEEP_16S	SLEEP_32S	SLEEP_FOREVER

Returns

nothing.

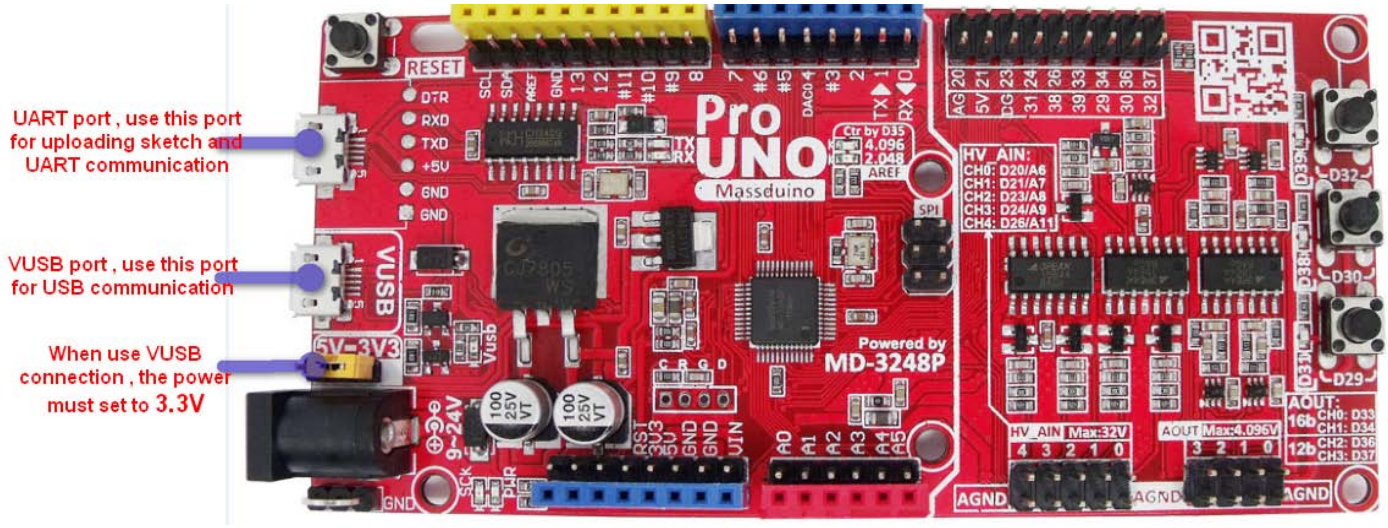
Example Code

```
#include <PMU.h>

volatile uint8_t g_LastState;
volatile uint8_t g_IntFlag;

void setup()
   {
      Serial.begin(9600);
      pinMode(2, INPUT);
      digitalWrite(2, HIGH);
      attachInterrupt(0, donothing, FALLING);
      g_LastState = digitalRead(2);
```

```
            g_IntFlag = 0;
        }

    void loop()
        {
            Serial.write("hello, I am working!\n");

        // power/down mode
            if (g_LastState == HIGH)
                {
                    Serial.println("Change to falling");
                    attachInterrupt(0, donothing, FALLING);
                }
             else
                {
                    Serial.println("Change to rising");
                    attachInterrupt(0, donothing, RISING);
                }

                Serial.flush();

                PMU.sleep(PM_POFFS1, SLEEP_4S);
                g_LastState = digitalRead(2);
        }

    void donothing()
        {
            //g_IntFlag = 1;
        }
```

12. Virtual USB HID sample

UNO Pro have onboard VUSB interface , user can be programming UNO Pro as an USB HID device such as keyboard / mice / etc…



We provide below sample code for fast VUSB coding.

VUsbAllInOne:

Implement USB keyboard / Mouse / HID communication

VUsbDatInOut:

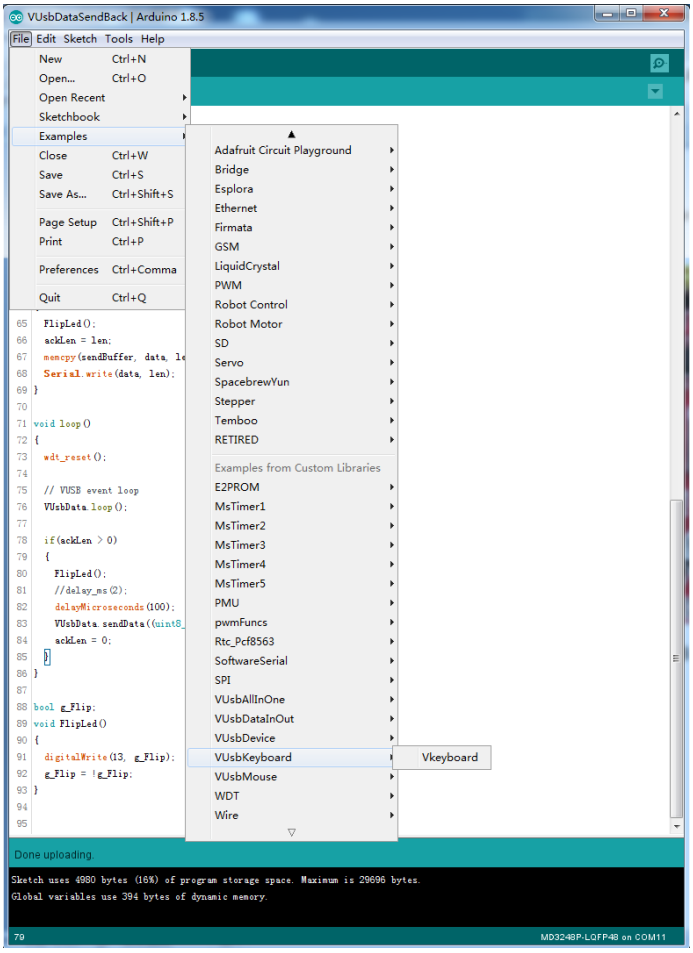
Implement USB HID communication

VUsbKeyboard:

Implement an USB keyboard

VUsbMouse:

Implement a USB mouse



Note , to use VUSB communication , you need to set the power jumper to 3.3V.

VUsbAllInOne:

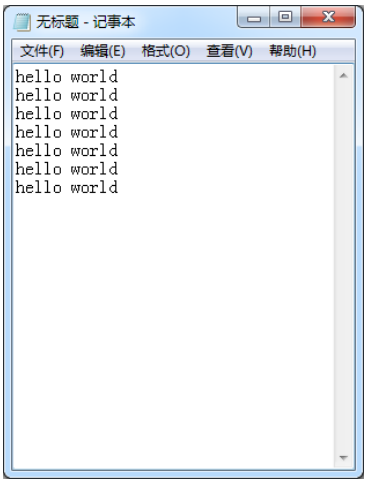
This code implement USB keyboard / Mouse / HID communication, to use this code with below step:

1, Connected UART port to PC , and upload the sketch.

2, Change USB cable connected to VUSB port.

3, Open Notepad or text editor, move cursor to edit area.

4, press and hold “D30” button , you will see the text input on the app.

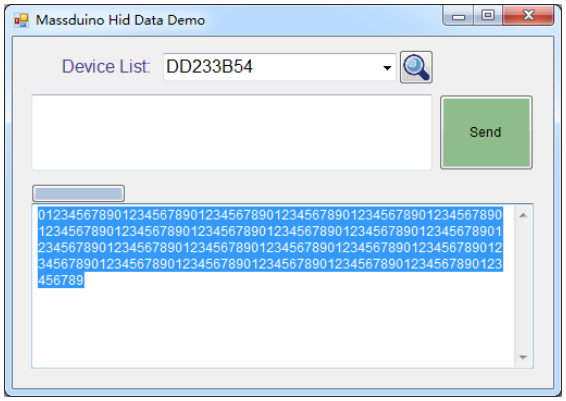


5, press and hold “D32” button , you will see the cursor draw circle on the screen.

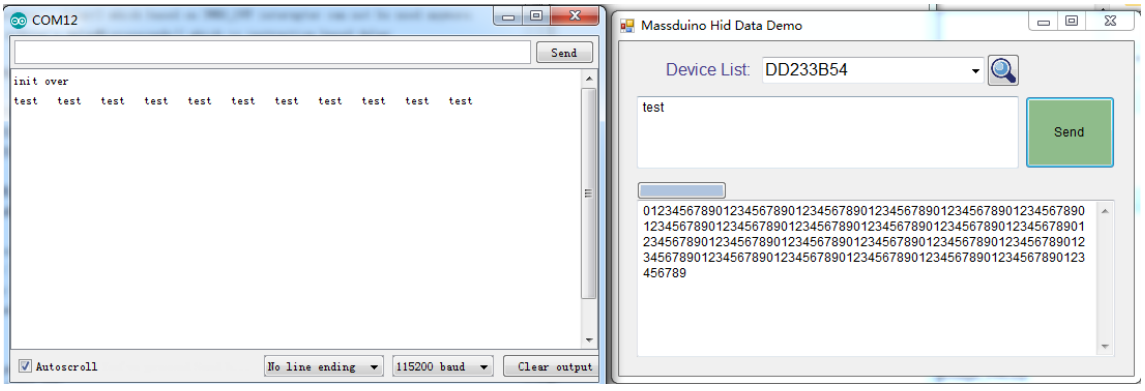
6, Open “MassduinoHidDataDemo.exe” which attached in the Arduino - Massduino_Support_Package_V46r1 .

7, press “D29” button , you will see the data which the UNO Pro sent to PC via USB port .

Be notice that HID communication support half-duplex only which means you need to make a protocol to avoid host and device sent data at the same time.



8, Connected both UART and VUSB port , open “Serial Monitor” in Arduino IDE , then you send data and it will sent back to PC via UARY port.



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