

Using Compatible Arduino Uno R3 and Nano ATmega328PB model IC with Arduino IDE



Introduction:

Due to Arduino's open-source nature, many companies and individuals have created their own compatible boards. These boards often offer additional features or performance improvements while maintaining compatibility with the Arduino IDE.

Some popular Arduino board examples include:

Arduino Uno Rev3
 Arduino Nano
 Arduino Mega

A). USB Driver Issues

The compatible Arduino models might use slightly different components to cut the product cost. Most manufacturers use the 3rd party USB to serial chip. This different chip requires different drivers to work. OS like Windows 10 and 11 will automatically install the driver once connected to the internet through Windows Update. Official Arduino Uno and Mega boards use the Atmel **ATmega16U2** chip, and the driver usually get installed automatically with the **Arduino IDE**.

Mostly used USB to Serial chip and driver:

- ATmega16U2 (Atmel) <u>https://www.arduino.cc/en/software</u> (Driver comes with IDE)
- CH340 Series (WCH) https://www.wch-ic.com/downloads/CH341SER_ZIP.html
- CP2102 (Silicon Labs) <u>https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers</u>
- FT232RL (FTDI Chip) <u>https://ftdichip.com/drivers/vcp-drivers/</u>
- CH9102 (WCH) https://www.wch-ic.com/downloads/CH343SER_ZIP.html



B). Type of IC model

Official **Arduino Uno Rev3** and **SMD** edition MCU boards launch with **ATmega328P**, this IC commonly comes in **DIP-28P3** and **SMD-32A** package. Some **Arduino Uno** and **Nano compatible boards** use the newer IC model such as **ATmega328PB** in **SMD package**.

This IC is not a drop-in replacement for **ATmega328P**, but a newer device. However, the functions are backward compatible with the existing **ATmega328** series functions according to <u>Atmel</u>. This newer model also comes with **four additional GPIO's Pin** functionalities.

C). Bootloader Issues

By using this ATmega328PB IC, user cannot flash the default ATmega328P based on 'Optiboot' bootloader. This is because the Signature bytes address ID for both types of ATmega328's IC is different; the flashing process will be aborted. The programmer that Arduino IDE used, which is AVRDUDE will read the Signature byte ID to identify which IC being programmed or flashed. Since ATmega328PB never intended to being used with the official Arduino boards, they never released the official bootloader for this IC.

Boards	IC	Signature bytes address ID
*Standalone IC (no board)	ATmega328	0x1E95 <mark>14</mark>
Official Uno Rev3 & Nano	ATmega328P	0x1E95 <mark>0F</mark>
Compatible Uno & Nano	ATmega328PB	0x1E95 <mark>16</mark>

There are two custom bootloader that can be used with ATmega328PB based IC, the "<u>ATmega328PB with bootloader</u>" and "<u>MiniCore</u>". The "<u>ATmega328PB with bootloader</u>" are based on the official **Optiboot** bootloader, while the "<u>MiniCore</u>" are based on the newer **Urboot** bootloader. Both are tested with <u>Arduino IDE</u> version **1.8.19 (Legacy)** and 2.3.2 (**New**). Before flashing the bootloader, **custom board installation** thru Arduino IDE must be done.

Differences					
ATmega328PB with bootloader	MiniCore				
Based on Optiboot	Based on Urboot				
No extra features (work as standard IC)	Unlock few additional IC extra features				
Most compatible (direct port)	Actively in development				
Only for ATmega328PB	All ATmega8, 48, 88, 168,328P, 328PB				



D). Flashing Bootloader, requirements

- 1. PC (with internet connection to download & install MiniCore)
- 2. Arduino Uno / Nano / Mega (any Arduino AVR base board as Programmer)
- 3. Arduino Uno / Nano (to be flashed, as a Target comes with ATmega328PB)
- Jumper Wires (via ICSP = Female to Female x 5pcs + Male to Female x 1pcs) (via Digital + Power Pin = Male to Male x 6pcs only)

E). Installing the Custom Board or Bootloader into Arduino IDE

 Download and install the Arduino IDE program. (Arduino IDE v1.8.19 legacy or newer v2.3.2+)





 Once installed, launch the Arduino IDE. Navigate to toolbar, select File > Preferences.



- 3. Once the **Preferences** tab shows up. Follow the setting from image attached below.
 - a. Check the **Show verbose output** check box on **Compilation** and **Upload**. This option is good for troubleshooting.
 - b. Click the icon next to Additional Board Manager URLs, paste the GitHub repo link and click on OK: -

(i). ATmega328PB with bootloader -

"<u>https://raw.githubusercontent.com/0x6470/ATmega328PB-Arduino-Nano-Clone-</u> with-Bootloader/master/package_m328pb_index.json"

or

(ii). MiniCore -

"https://mcudude.github.io/MiniCore/package_MCUdude_MiniCore_index.json"

- c. **Display line numbers** and **Enable Code Folding** is optional, but it does help when the code is too long.
- d. **Sketchbook location** allows user to change the default compiled code location. Normally saved in user Document folder.



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	Preferences			×
	Settings Network			
	Sketchbook location:			
	C:\Users\TECH\Documents\	Browse		
	Editor language:	System Default	 (requires restart of Arduino) 	
	Editor font size:	14		
	Interface scale:	Automatic 100 + % (requires restart of	of Arduino)	
	Theme:	Default theme v (requires restart of Arduing	o)	
	Show verbose output during	: 🗹 compilation 🗹 upload		
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	Display line numbers		Enable Code Folding	
	Verify code after upload	i	Use external editor	
	Check for updates on st	artup	Save when verifying or uploading	
	Use accessibility feature	:S		
	Additional Boards Manager U	JRLs: _MCUdude_MiniCore_index.json,https://esp	pressif.github.io/arduino-esp32/package_esp32_index.json	
	More preferences can be edi	ited directly in the file		
1	C:\Users\TECH\AppData\Loo	:al\Arduino 15\preferences.txt		
	(edit only when Arduno is no	st running)		
			ОК	Cancel
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https://ardu	uino.esp8266.com/st	able/package_esp8266com_index.	json	^
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https://raw.	.githubusercontent.	com/sparkfun/Arduino_Boards/ma	in/IDE_Board_Manager/package_sparkfun_ind	dex.json
https://raw.	.githubusercontent.	com/0x6470/ATmega328PB-Arduino	-Nano-Clone-with-Bootloader/master/packag	ge m328pb index.json
https://mcud	dude.github.io/Mini	Core/package_MCUdude_MiniCore	index.json	
Click for a list of und	official boards support URLs			•
				OK Cancel

- 4. Once setting changes have been made, click on **OK** to close and save the preferences. It is recommended for users to restart the IDE when modifying the preferences parameter.
- 5. Make sure the PC is connected to the Internet. Then, click on the toolbar > Tools > Boards: > Boards manager...
- 6. New windows will pop-up (Boards Manager), on the search bar type in "MiniCore" or "ATmega328PB" and click on Install button. The board will begin download and get installed automatically.



🐵 Boards Manager	×
Type All V ATmega328	
ATmega328PB	
by 0x6470 version 0.1.0 INSTALLED Boards included in this package:	
ATmega328PB.	
Soards Manager	×
Type All 🗸 MiniCore	
MiniCore	^
by MCUdude version 3.0.2 INSTALLED Boards included in this parkage:	
ATmega328/P/PA/A/PB, ATmega168/P/PA/A/PB, ATmega88/P/PA/A/PB, ATmega48/P/PA/A/PB, ATmega8.	
More Info	
Select version V Install	Remove
-	
	~
	Close

 Once installed, close the Boards Manager window and restart the Arduino IDE. The MiniCore and ATmega328PB with bootloader option will appear on board selection menu. Toolbar > Tools > Board:

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156	#define	Serial Plotter	Ctrl+Shift+	L			
157	#define	MCETOL CARENUMA Electronic Harden					
158		WIFITOT / WIFININA FIRMware Opdater					
159	void pu	Board: "Arduino Uno"		>	Board	s Manager	
160	#ifdof	Port		;	Adafr	uit Boards	>
162	#inclu	Get Board Info			Ardui	no AVR Boards	>
163	#else	Drogrammer "AVP ICD"			ATme	ga328PB	>
164		Programmer: AVK ISP		1	ESP32	Arduino	>
165	#define			\mathbf{N}	ESP82	66 Boards (3.1.2)	>
166					MiniC	ore	>
167	<pre>#if !de</pre>	fined(ARDUINO_API_VERSION)	ARDUINO	AF	Spark	Fun AVR Boards	>
168 -	lalage 9	DISattinge /					_



F). Wiring setup

Flashing bootloader requires 2 Arduino AVR board or AVR Programmer.

 Upload the ArduinoISP code to the 'Programmer' Arduino. Navigate to the Toolbar > File > Examples > 11. ArduinoISP > ArduinoISP.



2. In this guide the **programmer** Arduino used is **Arduino Uno**, so the board selection should be **Arduino Uno**.

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155	#define		Serial Monitor	Ctrl+Shift	+M		
156	#define		Serial Plotter	Ctrl+Shift	+L		
157	#define						
158			WiFi101 / WiFiNINA Firmware Updater				
159	void pu		Board: "Arduino Uno"		>		
160			Port: "COM7 (Arduino Uno)"		>		
161	#ifdef		Cet Based lafe		·		
162	#inclu		Ger board into				
163	#else		Programmer: "AVRISP mkll"		>		
164			Burn Bootloader				
165	#define		T_HODEO OXOO				



- 3. Once code uploaded to **Programmer** Arduino, there are 2 options for User to choose for Wiring both Arduino's.
 - a. Wiring thru Digital and Power Pin
 - i. Programmer = Uno





Example wiring between both Arduino Uno via Digital Pin



Example wiring between Arduino Uno and Nano via Digital Pin



Target = Uno

b. Wiring thru ICSP Header





Example wiring between both Arduino Uno via ICSP Pin

ii. Programmer = Uno

Target = Nano



Example wiring between Arduino Uno and Nano via ICSP Pin



4. Wiring table & ICSP Pinout



Programmer Board	Target Board		
D10	RESET		
COPI / MOSI / D11	COPI / MOSI / D11		
CIPO / MISO / D12	CIPO / MISO / D12		
SCK / D13	SCK / D13		
5V	5V		
GND	GND		

G-A). Flashing the MiniCore bootloader

Normally, flashing bootloader is only required when the bootloader is corrupted.

- Once wiring setup is finished, select the ATmega328 from Arduino IDE by navigate to toolbar > Tools > Board: "..." > MiniCore > ATmega328.
- 2. Follow the board setting as image below. Tools > Variant: "328PB" > select 328PB.





3. Then, again on the toolbar select Tools > Programmer > Arduino as ISP. Connect only the programmer Arduino to PC. The target Arduino will get supply power from the programmer and both boards should be powered ON.



 Make sure to select correct COM Port (your programmer Arduino), click on Burn Bootloader to begin flashing process. Click on Toolbar > Tools > Burn Bootloader.

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File Ed	it Sketch	Fools Help						
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Ardu	inolSP	Fix Encoding & Reload						
154	#define	Manage Libraries	Ctrl+Shift+I					
155	#define	Serial Monitor	Ctrl+Shift+M					
156	#defin@	Serial Plotter	Ctrl+Shift+L					
157	#define							
158		WIFI101 / WIFININA Firmware Updater						
159	void p	Board: "ATmega328"	>					
160	4:53-5	Clock: "External 16 MHz"	>					
161	#includ	BOD: "BOD 2.7V"	>					
163	#inciuc #else	EEPROM: "EEPROM retained"	>					
164	#CIDC	Compiler LTO: "LTO enabled"	>					
165	#define	Variant: "328PB"	>					
166		Bootloader: "Yes (UART0)"	>					
167	#if !de	Baud rate: "Default"	>					
168E	class :	Port	>					
169	publ:	Get Board Info						
170	- 11							
1710	SP:	Programmer: "Arduino as ISP"	>					
172		Burn Bootloader						



5. The flashing process should take around **3 to 10 seconds** to finish. Once finished, the status bar will show **"Done burning bootloader"**. **Done**! Disconnect both Arduino.



G-B). Flashing the ATmega328PB bootloader

 Once wiring setup is finished, select the ATmega328 from Arduino IDE by navigate to toolbar > Tools > Board: "..." > ATmega328PB > ATmega328PB.





 Then, again on the toolbar select Tools > Programmer > Arduino as ISP. Connect only the programmer Arduino to PC. The target Arduino will get supply power from the programmer and both boards should be powered ON.

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3 // II] 4 // http	Serial Plotter	Ctrl+Shift+L	hp
5 //	WiFi101 / WiFiNINA Firmware U	odater	
6 // Thi:		Junci	sing
7 //	Board: "ATmega328PB"	>	
9 // Pin	Port: "COM4"	>	OILS:
10 // By (Get Board Info		and :
11 // with	Programmer: "AVRISP mkll"	>	AVR ISP
12 // on	Burn Bootloader		AVRISP mkll
13 //	MISO ° 5V (!) Avaid this pi	USBtinyISP
15 //	SCK MOSI		ArduinoISP
16 //	GND		ArduinoISP.org
17 //	Durbuinen (IInn) -	AND NOST NESS	USBasp
		ins h031, h130	Parallel Programmer
			Arduino as ISP
			Arduino as ISP (ATmega32U4)
			Arduino Gemma
			BusPirate as ISP
			Atmel STK500 development board
1		ATmega328PB c	Atmel JTAGICE3 (ISP mode)
			Atmel JTAGICE3 (JTAG mode)
			Atmel-ICE (AVR)

 Make sure to select correct COM Port (your programmer Arduino), click on Burn Bootloader to begin flashing process. Click on Toolbar > Tools > Burn Bootloader.

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		Archive Sketch			
Ardu	inolSP	Fix Encoding & Reload			
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2	// Cop	^{p1} Serial Monitor	Ctrl+Shift+M	м	
3	// If	Serial Plotter	Ctrl+Shift+l	L	1
5	// 110				<u>mp</u>
6	// Th:	WiHI101 / WIFININA Firmware Updater			sing
7	11	Board: "ATmega328PB"		>	
8	// Pir	n Port: "COM5 (Arduino Uno)"		>	olle:
9	//	Get Board Info			
11	// Dy				can l
12	// on	Programmer: "Arduino as ISP"		>	
13	11	Burn Bootloader			
14	11	MISO ° 5V (!) Av	oid this	pir	1 on 1
15	11	SCK MOSI			
17	11	GND			
18	// On	some Arduinos (Uno,), pins	MOSI, MIS	50 a	and S
1			ATmega328	PB or	COM5



4. The flashing process should take around **3 to 10 seconds** to finish. Once finished, the status bar will show **"Done burning bootloader"**. **Done**! Disconnect both Arduino.





H). Uploading the code to the board that uses custom bootloader.

Based on which types of bootloaders that user flashed before, to upload the code user must select that type or it will fail.

MiniCore

If MiniCore bootloader was flashed before, select the Board: "..." > MiniCore > ATmega328" and make sure the Variant is selected correctly as "328PB".



Make sure to select the 328PB variant from the toolbar, Tools > Variant: "..." > 328PB. Make sure to select the correct COM Port for your Arduino, each PC assigns the COM port number differently.





3. Click the **Upload** button as usual after selecting the board & COM port. Once code uploaded the Arduino IDE should display **Done Uploading**. Done! Your Arduino should run the latest code.

Slink Arduino 1.8.19 —	×
File Edit Sketch Tools Help	
	ø
Blink	
1 🛨 / *	
24	
25 // the setup function runs once when you press reset or power the	boa
26 void setup() {	
27 // initialize digital pin LED_BUILTIN as an output.	
<pre>28 pinMode(LED_BUILTIN, OUTPUT);</pre>	
29 }	
30	
31 // the loop function runs over and over again forever	
32 void loop() {	
<pre>33 digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is</pre>	the
34 delay(1000); // wait for a second	
35 digitalWrite(LED_BUILTIN, LOW); // turn the LED off by makin	gth
36 delay(1000); // wait for a second	
37 }	
Done uploading.	
avrdude.exe done. Thank you.	
draddelene doner indin jour	
	1
—	
1 ATmega328, Yes (UARTO), EEPROM retained, Default, 328PB, BOD 2.7V, LTO enabled, External 16 MHz on (сом7

ATmega328PB

 If ATmega328PB bootloader was flashed before, select the Board: "..." > ATmega328PB > ATmega328PB.

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24	Serial Monitor	Ctrl+Shift+M					
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27 // in: 28 pinMod	WiFi101 / WiFiNINA Firmware Update	er	put.				
29 }	Board: "ATmega328PB"	>	Boar	ds Manager			
30	Port: "COM7"	>	Ardu	ino AVR Board	ls ≻		
32 77 the .	Get Board Info		ATm	ega328PB	>	•	ATmega328PB
33 digita	Programmer: "AVRISP mkll"	2	ESP3	2 Arduino	>		
34 delay	Burn Bootloader		ESP8	266 Boards (3.1	1.2) >		
35 digita	(1000) :	// mit for	Mini	Core	>		
37 }	(1000);	// Walt IOF	Sparl	kFun AVR Boar	ds >		
Done uploading.	done. Thank you.						
_							
1		ATmega328PB o	n COM7				



2. Make sure to select the correct **COM Port** for your Arduino, each PC assigns the COM port number differently.



 Click the Upload button as usual after selecting the board & COM port. Once code uploaded the Arduino IDE should display Done Uploading. Done! Your Arduino should run the latest code.

🕺 Blink Arduino 1.8.19	-		×
File Edit Sketch Tools Help			
💽 🕑 🗈 🔛 Upload Using Programmer			Ø
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1 🗄 🖊 *			
24			
25 // the setup function runs once when you	u pre	ss res	et 🤇
26 void setup() {			
27 // initialize digital pin LED_BUILTIN	as a	n outp	ut.
<pre>28 pinMode(LED_BUILTIN, OUTPUT);</pre>			
29 }			
30			
31 // the loop function runs over and over	agai	n fore	ver
32 void loop() {			
<pre>33 digitalWrite(LED_BUILTIN, HIGH); //</pre>	turn	the I	ED (
34 delay(1000); //	wait	for a	se(
<pre>35 digitalWrite(LED_BUILTIN, LOW); //</pre>	turn	the I	ED (
36 delay(1000); //	wait	for a	se(
37 }			
Departmenting			
Done uproauling.			
avrdude.exe done. Thank you.			
			1
—			
1 AT	l mega32	28PB on (COM7