

# Atmega128

## Atmega128 주요 특징

### 1. 8-bit Microcontroller

- 8-bit / 16-bit / 32-bit MCU 중에 당연히 데이터 버스 폭이 넓은 MCU 이용하는 게 맞지 않는가 (다다익선???)
- 답은 프로젝트 규모에 맞게 MCU를 선정하는 게 맞다고 생각하나 8-bit MCU 선택한 주요 근거로 저전력 / 낮은 가격 등으로 들 수 있겠다.
- Atmega128은 8bit 아키텍처로 구성된 MCU이나 General Register에서 16bit-register로 사용가능하다. (X-, Y-, Z-registers)  
어셈블리어로 코드를 작성하게 되면

`ldi r16,0x34 ; load lower byte of 0x1234 into r16`

- `ldi r17,0x12 ; load upper byte of 0x1234 into r17`
- `movw r1:r0,r17:r16 ; copy the contents of r17:r16 into r1:r0`
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이런식으로 8-bit / 8bit 데이터를 16-bit register 이용해 옮길 수 있다.

<http://www.rjhcoding.com/avr-asm-registers.php>

<8-bit MCU vs 32-bit MCU article> (나중에 다시 읽어보기)

<https://www.electronicdesign.com/technologies/microcontrollers/article/21800448/8-bit-or-32-bit-choosing-your-next-designs-mcu>

<http://www.epnc.co.kr/news/articleView.html?idxno=23371>

<https://elsainmac.tistory.com/405>

<https://electronics.stackexchange.com/questions/106933/how-different-are-8-bit-microcontrollers-from-32-bit-microcontrollers-when-it-co>

2. Advanced RISC Architecture
3. High Endurance Non-volatile Memory segments
4. QTouch® library support
5. JTAG (IEEE std. 1149.1 Compliant) Interface
6. Peripheral Features
7. Special Microcontroller Features

8. I/O and Packages
9. Operating Voltages
10. Speed Grades

## Pin Descriptions

Atmega128의 경우 총 64개의 핀을 지원하긴 하나 하나의 핀이 2개 이상의 역할을 수행하는 경우가 많다.

DataSheet를 잘 확인해서 원하는 기능을 뽑아 사용하자

1. VCC - 전원 공급
2. GND - Ground
3. I/O Port (p67)
  - Port (A ~ F): 8bit 양방향 I/O 지원
  - Port G: 5bit 양방향 I/O 지원
  - 기본적으로 Port 핀들은 내부 Pull-Up 저항이 달려있다.
  - State (LOW, HIGH, Hi-Z)
  - **Table 25.** Port Pin Configurations

DDxn	PORTxn	PUD (in SFIOR)	I/O	Pull-up	Comment
0	0	X	Input	No	Tri-state (Hi-Z)
0	1	0	Input	Yes	Pxn will source current if ext. pulled low.
0	1	1	Input	No	Tri-state (Hi-Z)
1	0	X	Output	No	Output Low (Sink)
1	1	X	Output	No	Output High (Source)

DDxn 핀에 High 줬을 때 PORTxn에 High 주면 High 출력 / Low 주면 Low 출력

- 근데 이때, Low 준다고 0V가 출력되는것이 아님!  
(p318)

Symbol	Parameter	Condition	Min	Typ	Max
V <sub>OL</sub>	Output Low Voltage <sup>(3)</sup> (Ports A,B,C,D, E, F, G)	I <sub>OL</sub> = 20mA, V <sub>CC</sub> = 5V I <sub>OL</sub> = 10mA, V <sub>CC</sub> = 3V			0.7 0.5
V <sub>OH</sub>	Output High Voltage <sup>(4)</sup> (Ports A,B,C,D, E, F, G)	I <sub>OH</sub> = -20mA, V <sub>CC</sub> = 5V I <sub>OH</sub> = -10mA, V <sub>CC</sub> = 3V	4.2 2.2		

- Vcc에 5V가 제공된다는 가정하에 Vol이 0.7V 이하 전압값 출력  
Voh는 4.2V 이상 전압값 출력

I/O핀들 설정 따로 안하면 (DDxn == 0)

PORT A : 외부 메모리 인터페이스(하위 7비트)

**Table 27.** Port A Pins Alternate Functions

Port Pin	Alternate Function
PA7	AD7 (External memory interface address and data bit 7)
PA6	AD6 (External memory interface address and data bit 6)
PA5	AD5 (External memory interface address and data bit 5)
PA4	AD4 (External memory interface address and data bit 4)
PA3	AD3 (External memory interface address and data bit 3)
PA2	AD2 (External memory interface address and data bit 2)
PA1	AD1 (External memory interface address and data bit 1)
PA0	AD0 (External memory interface address and data bit 0)

PORT B: PWM 출력 및 SPI 통신 핀

Timer/Counter0: 8-bit Timer/Counter

Timer/Counter1: 16-bit Timer/Counter

**Table 30.** Port B Pins Alternate Functions

Port Pin	Alternate Functions
PB7	OC2/OC1C <sup>(1)</sup> (Output Compare and PWM Output for Timer/Counter2 or Output Compare and PWM Output C for Timer/Counter1)
PB6	OC1B (Output Compare and PWM Output B for Timer/Counter1)
PB5	OC1A (Output Compare and PWM Output A for Timer/Counter1)
PB4	OC0 (Output Compare and PWM Output for Timer/Counter0)
PB3	MISO (SPI Bus Master Input/Slave Output)
PB2	MOSI (SPI Bus Master Output/Slave Input)
PB1	SCK (SPI Bus Serial Clock)
PB0	$\overline{SS}$ (SPI Slave Select input)

PORT C : 외부 메모리 인터페이스(상위 7비트)

**Table 33.** Port C Pins Alternate Functions

Port Pin	Alternate Function
PC7	A15
PC6	A14
PC5	A13
PC4	A12
PC3	A11
PC2	A10
PC1	A9
PC0	A8

PORT D : 타이머카운터 + 외부 인터럽트 핀 + UART1핀

**Table 36.** Port D Pins Alternate Functions

Port Pin	Alternate Function
PD7	T2 (Timer/Counter2 Clock Input)
PD6	T1 (Timer/Counter1 Clock Input)
PD5	XCK1 <sup>(1)</sup> (USART1 External Clock Input/Output)
PD4	ICP1 (Timer/Counter1 Input Capture Pin)
PD3	INT3/TXD1 <sup>(1)</sup> (External Interrupt3 Input or UART1 Transmit Pin)
PD2	INT2/RXD1 <sup>(1)</sup> (External Interrupt2 Input or UART1 Receive Pin)
PD1	INT1/SDA <sup>(1)</sup> (External Interrupt1 Input or TWI Serial Data)
PD0	INT0/SCL <sup>(1)</sup> (External Interrupt0 Input or TWI Serial CLock)

PORT E : 외부 인터럽트 + 타이머카운터 + PWM 출력 핀+ UART0핀

Timer/Counter3: 16-bit Timer/Counter

=> PORT E는 남는 기능을 다 넣은 느낌인 거 같다. 최대한 앞에 있는 GPIO 핀들을 활용하자

**Table 39.** Port E Pins Alternate Functions

Port Pin	Alternate Function
PE7	INT7/ICP3 <sup>(1)</sup> (External Interrupt 7 Input or Timer/Counter3 Input Capture Pin)
PE6	INT6/ T3 <sup>(1)</sup> (External Interrupt 6 Input or Timer/Counter3 Clock Input)
PE5	INT5/OC3C <sup>(1)</sup> (External Interrupt 5 Input or Output Compare and PWM Output C for Timer/Counter3)
PE4	INT4/OC3B <sup>(1)</sup> (External Interrupt4 Input or Output Compare and PWM Output B for Timer/Counter3)
PE3	AIN1/OC3A <sup>(1)</sup> (Analog Comparator Negative Input or Output Compare and PWM Output A for Timer/Counter3)
PE2	AIN0/XCK0 <sup>(1)</sup> (Analog Comparator Positive Input or USART0 external clock input/output)
PE1	PDO/TXD0 (Programming Data Output or UART0 Transmit Pin)
PE0	PDI/RXD0 (Programming Data Input or UART0 Receive Pin)

PORT F : ADC 및 JTAG 핀

**Table 42.** Port F Pins Alternate Functions

Port Pin	Alternate Function
PF7	ADC7/TDI (ADC input channel 7 or JTAG Test Data Input)
PF6	ADC6/TDO (ADC input channel 6 or JTAG Test Data Output)
PF5	ADC5/TMS (ADC input channel 5 or JTAG Test Mode Select)
PF4	ADC4/TCK (ADC input channel 4 or JTAG Test Clock)
PF3	ADC3 (ADC input channel 3)
PF2	ADC2 (ADC input channel 2)
PF1	ADC1 (ADC input channel 1)
PF0	ADC0 (ADC input channel 0)

PORT G: 외부 타이머 클럭(TOSC) 및 외부 메모리 스트로브 신호 제공  
스트로브 신호: 비동기 시스템 간 데이터 전송할 때 전송된 것을 알려주는 신호  
(TCP/IP에서의 ACK와 비슷한가..?)

**Table 45.** Port G Pins Alternate Functions

Port Pin	Alternate Function
PG4	TOSC1 (RTC Oscillator Timer/Counter0)
PG3	TOSC2 (RTC Oscillator Timer/Counter0)
PG2	ALE (Address Latch Enable to external memory)
PG1	$\overline{RD}$ (Read strobe to external memory)
PG0	$\overline{WR}$ (Write strobe to external memory)