

ATmega128

; 가 AVR
AVR
가



- 1) Flash Lock Bit:
- 2) Boot Lock Bit:
- 3) Fuse Bit(s):

⚡ :
== '0' ==
== '1' ==



- 1) Flash Lock Bit

Lock Mode	LB2(Lock2)	LB1(Lock1)	
1	1	1	가 (Flash Rom, EEPROM, Fuse Bit)
2	1	0	Flash EEPROM (Lock)
3	0	0	Mod2 Verification

- (1) 1 가
- (2) 2, 3 ...

940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000
940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000
940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000
940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000 940C 0000
940C 0000 940C 0000 0D0A 4420 6361 5028 6D77 2029 6554 7473 5020 6F72
0020 0D0A 5620 6C61 6575 6F20 2066 7750 3A6D 2520 0064 0D0A 5620 6C61
2066 7750 3A6D 2520 0064 2710 03E8 0064 000A 0001 1000 0100 0010 0001
27EE B8EC E0F1 8FF5 BFE5 93E0 006C BFE8 E1F8 BDF1 E1F0 B0F1 E08D E0A2
958A F7E9 E080 E190 E0A0 E0B1 93ED 9701 F7E9 EEE0 E0F0 9005 9015 01BF
F051 91A5 91B5 9185 9195 9005 920D 9701 F7E1 01FB CFF0 EFEF BFED E1E0
E0D5 940C 0100 27EE B8EB BBEA BBE8 E2E0 BBE7 27EE BBE5 BBE4 BBE2 BBE1
93E0 0062 93E0 0061 93E0 0065 93E0 0064 BFE3 940E 02C5 BFE2 27EE BFE1
E0E2 BDEE 27EE BDED BDEC BDEB BDEA BDE9 BDE8 93E0 0079 93E0 0078 BDE5
BDE4 27EE BDE3 93E0 008B 93E0 008A 93E0 0089 93E0 0088 93E0 0087 93E0
0085 93E0 0084 93E0 0083 93E0 0082 93E0 006A BFEA BFE9 BFE7 93E0 007D
B9EA E0E6 93E0 0095 E6E7 B9E9 27EE 93E0 0090 E8E0 B9E8 27EE BDE0 9508
940E 00A5 E8EC E0F0 93FA 93EA E080 940E 02A7 9622 BD2B BD1A EAE6 E0F0
E084 940E 02A7 9626 D042 2F0E 2FE0 33E1 F461 5F1F 4F2F EFEF E0F0 17E1
E010 E020 BD2B BD1A C028 33E2 F459 2E01 2A02 F419 EF1F E020 C002 5011
BD1A C018 33E3 F461 5F16 4F2F EFEF E0F0 17E1 07F2 F414 E010 E020 BD2B
33E4 F459 301A E0E0 072E F41C EF1F E020 C002 501A 4020 BD2B BD1A EBEA
02C8 E084 940E 02A7 9626 CFBE CFFF 9B5F CFFE B1EC 9508 9B5D CFFE 81E8
9508 81A8 81B9 940E 0317 9730 F051 940E 0317 9631 93ED 93FC 9731 01DF
C004 81EA 93EA 940E 015D 9623 9508 9726 940E 032A E000 89E8 89F9 9631
9731 91E4 2F3E 30E0 F411 940C 02A3 2FE0 30E0 F439 3235 F411 E001 C002

```

00 00 01 01 02 02 03 03 - 04 04 05 05 06 06 07 07
08 08 09 09 0A 0A 0B 0B - 0C 0C 0D 0D 0E 0E 0F 0F
10 10 11 11 12 12 13 13 - 14 14 15 15 16 16 17 17
18 18 19 19 1A 1A 1B 1B - 1C 1C 1D 1D 1E 1E 1F 1F
20 20 21 21 22 22 23 23 - 24 24 25 25 26 26 27 27
28 28 29 29 2A 2A 2B 2B - 2C 2C 2D 2D 2E 2E 2F 2F
30 30 31 31 32 32 33 33 - 34 34 35 35 36 36 37 37
38 38 39 39 3A 3A 3B 3B - 3C 3C 3D 3D 3E 3E 3F 3F
40 40 41 41 42 42 43 43 - 44 44 45 45 46 46 47 47
48 48 49 49 4A 4A 4B 4B - 4C 4C 4D 4D 4E 4E 4F 4F
50 50 51 51 52 52 53 53 - 54 54 55 55 56 56 57 57
58 58 59 59 5A 5A 5B 5B - 5C 5C 5D 5D 5E 5E 5F 5F
60 60 61 61 62 62 63 63 - 64 64 65 65 66 66 67 67
68 68 69 69 6A 6A 6B 6B - 6C 6C 6D 6D 6E 6E 6F 6F
70 70 71 71 72 72 73 73 - 74 74 75 75 76 76 77 77
78 78 79 79 7A 7A 7B 7B - 7C 7C 7D 7D 7E 7E 7F 7F
80 80 81 81 82 82 83 83 - 84 84 85 85 86 86 87 87
88 88 89 89 8A 8A 8B 8B - 8C 8C 8D 8D 8E 8E 8F 8F
90 90 91 91 92 92 93 93 - 94 94 95 95 96 96 97 97
98 98 99 99 9A 9A 9B 9B - 9C 9C 9D 9D 9E 9E 9F 9F
A0 A0 A1 A1 A2 A2 A3 A3 - A4 A4 A5 A5 A6 A6 A7 A7
A8 A8 A9 A9 AA AA AB AB - AC AC AD AD AE AE AF AF
B0 B0 B1 B1 B2 B2 B3 B3 - B4 B4 B5 B5 B6 B6 B7 B7
B8 B8 B9 B9 BA BA BB BB - BC BC BD BD BE BE BF BF
C0 C0 C1 C1 C2 C2 C3 C3 - C4 C4 C5 C5 C6 C6 C7 C7

```

가

(3) 2 3
2 Verify Success가 , 3 Fail
가 3



(1) 2, 3 ?
- 'Erase' 가
(2) 2, 3 가 가 가
가 ?

- ... ,

2) Boot Lock Bit

^^;

3) Fuse Bit

; ...

(1)

가

① Extended Fuse Byte: 2

M103C, WDTON

② Fuse High Byte: 8

OCDEN, JTAGEN, SPIEN, CKOPT, EESAVE, BOOTSZ1, BOOTSZ0, BOOTRST

③ Fuse Low Byte: 8

BODLEVEL, BODEN, SUT1, SUT0, CKSEL3, CKSEL2, CKSEL1, CKSELO

(2)

①

			Default Value
Extended Fuse Byt	M103C	ATmega103	0 (programmed)
	WDTON	Watchdog timer always on	1 (unprogrammed)
Fuse High Byte:	OCDEN	Enable OCD	1 (unprogrammed, OCD disabled)
	JTAGEN	Enable JTAG	0 (programmed, JTAG enabled)
	SPIEN	Enable Serial Program and Data Downloading	0 (programmed, SPI prog. enabled)
	CKOPT	Oscillator options	1 (unprogrammed)
	EESAVE	EEPROM memory is preserved through the Chip Erase	1 (unprogrammed, EEPROM not preserved)
	BOOTSZ1..0	Select Boot Size	0 (programmed)
	BOOTRST	Select reset vector	1 (unprogrammed)
Fuse Low Byte	BODLEVEL	Brown out detector trigger level	1 (unprogrammed)
	BODEN	Brown out detector enable	1 (unprogrammed, BOD disabled)
	SUT1..0	Select start-up time	1..0
	CKSEL3..0	Select Clock source	0

② 가

- ```

- M103C: 103 ' 0 '
 가
 ATmega103 (Hex)
 ... 가
- WDTON: Watchdog가
- OCDEN: OCD가
 JTAG
- JTAGEN: JTAG
- SPIEN:
 ISP 가 가
 가 가
- CKOPT:
- EESAVE: ' 0 ' Erase EEPROM
- BOOTSZ1..0:
- BOOTRST: Select reset vector
- BODLEVEL:Brown-out detector Level 가
 ' 1 ' 2.7V , ' 0 ' 4.0V
 가 가
- BODEN: Brown-out detector 가 Level
- SUT1..0:

```

- CKSEL3..0:

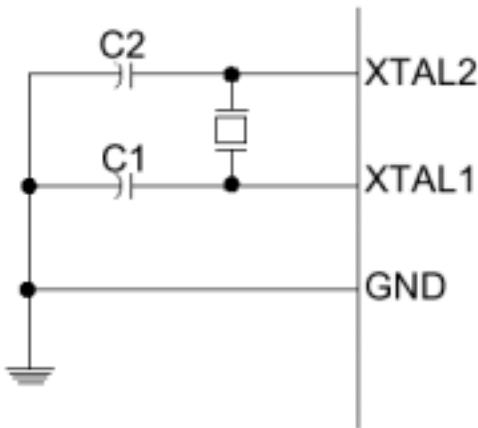


- CKSEL3..0:
- SUT1..0:
- CKOPT: Oscillator Option

|                                    |             |
|------------------------------------|-------------|
| 클럭소스                               | CKSEL3.0    |
| External Crystal/Ceramic Resonator | 1111 - 1010 |
| Exteral Low-frequency Crystal      | 1001        |
| External RC Oscillator             | 1000 - 0101 |
| Calibrated Inernal RC Oscillator   | 0100 - 0001 |
| External Clock                     | 0000        |

1) Crystal Oscillator

Crystal Oscillator Connections



| CKOPT | CKSEL3..1     | Frequency Range(MHz) | C1, C2      |
|-------|---------------|----------------------|-------------|
| 1     | 101           | 0.4 - 0.9            | -           |
| 1     | 110           | 0.9 - 3.0            | 12pF - 22pF |
| 1     | 111           | 3.0 - 8.0            | 12pF - 22pF |
| 0     | 101, 110, 111 | 8.0 -                | 12pF - 22pF |

... 8MHz 가 CKOPT ' 1 ' 가 8MHz 가 ' 0 ' 가 8MHz 가 ' 1 ' 가 8MHz 가

Start-up

가 가 ... .... ' 1 ' 가 ... 가 ...

| CKSEL0 | SUT1..0 | Start-up Time from Power-down and Power-save | Additional Delay from Reset ( $V_{CC} = 5.0V$ ) | Recommended Usage                       |
|--------|---------|----------------------------------------------|-------------------------------------------------|-----------------------------------------|
| 0      | 00      | 258 CK <sup>(1)</sup>                        | 4 ms                                            | Ceramic resonator, fast rising power    |
| 0      | 01      | 258 CK <sup>(1)</sup>                        | 64 ms                                           | Ceramic resonator, slowly rising power  |
| 0      | 10      | 1K CK <sup>(2)</sup>                         | –                                               | Ceramic resonator, BOD enabled          |
| 0      | 11      | 1K CK <sup>(2)</sup>                         | 4 ms                                            | Ceramic resonator, fast rising power    |
| 1      | 00      | 1K CK <sup>(2)</sup>                         | 64 ms                                           | Ceramic resonator, slowly rising power  |
| 1      | 01      | 16K CK                                       | -                                               | Crystal oscillator, BOD enabled         |
| 1      | 10      | 16K CK                                       | 4 ms                                            | Crystal oscillator, fast rising power   |
| 1      | 11      | 16K CK                                       | 64 ms                                           | Crystal oscillator, slowly rising power |

## 2) Low-frequency Crystal Oscillator

; 32.768KHz

'CKOPT'

Capacitor

'0'

Capacitor

, '1'

Capacitor

. C

36pF

. << ...

.>>

## Start-up

| SUT1..0 | Start-up Time from Power-down and Power-save | Additional Delay from Reset ( $V_{CC} = 5.0V$ ) | Recommended Usage                |
|---------|----------------------------------------------|-------------------------------------------------|----------------------------------|
| 00      | 1K CK <sup>(1)</sup>                         | 4 ms                                            | Fast rising power or BOD enabled |
| 01      | 1K CK <sup>(1)</sup>                         | 64 ms                                           | Slowly rising power              |
| 10      | 32K CK                                       | 64 ms                                           | Stable frequency at start-up     |
| 11      | Reserved                                     |                                                 |                                  |

## 3) External RC Oscillator

$$f = 1/(3RC)$$

C

22pF

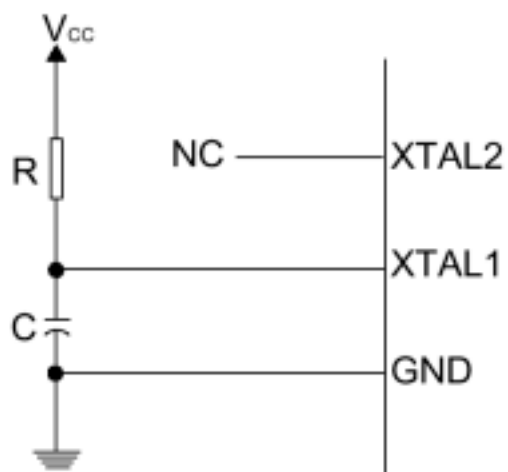
. RC

'CKOPT'

Capacitor

36pF

| CKSEL3..0 | Frequency Range (MHz) |
|-----------|-----------------------|
| 0101      | - 0.9                 |
| 0110      | 0.9 - 3.0             |
| 0111      | 3.0 - 8.0             |
| 1000      | 8.0 - 12.0            |



Start-up

| SUT1..0 | Start-up Time from Power-down and Power-save | Additional Delay from Reset ( $V_{CC} = 5.0V$ ) | Recommended usage                |
|---------|----------------------------------------------|-------------------------------------------------|----------------------------------|
| 00      | 18 CK                                        | -                                               | BOD enabled                      |
| 01      | 18 CK                                        | 4 ms                                            | Fast rising power                |
| 10      | 18 CK                                        | 64 ms                                           | Slowly rising power              |
| 11      | 6 CK <sup>(1)</sup>                          | 4 ms                                            | Fast rising power or BOD enabled |

#### 4) Calibrated Internal RC Oscillator

; RC Oscillator 1, 2, 4, 8MHz  
가 5V(25 ) 가 , "Calibration Byte"

가

RC Oscillator

'CKOPT'

'1'

**Table 13.** Internal Calibrated RC Oscillator Operating Modes

| CKSEL3..0           | Nominal Frequency (MHz) |
|---------------------|-------------------------|
| 0001 <sup>(1)</sup> | 1.0                     |
| 0010                | 2.0                     |
| 0011                | 4.0                     |
| 0100                | 8.0                     |

Start-up

Table 14. Start-up Times for the Internal Calibrated RC Oscillator Clock Selection

| SUT1..0           | Start-up Time from Power-down and Power-save | Additional Delay from Reset ( $V_{CC} = 5.0V$ ) | Recommended Usage   |
|-------------------|----------------------------------------------|-------------------------------------------------|---------------------|
| 00                | 6 CK                                         | -                                               | BOD enabled         |
| 01                | 6 CK                                         | 4 ms                                            | Fast rising power   |
| 10 <sup>(1)</sup> | 6 CK                                         | 64 ms                                           | Slowly rising power |
| 11                | Reserved                                     |                                                 |                     |

5) External Clock

Table 16. Start-up Times for the External Clock Selection

| SUT1..0 | Start-up Time from Power-down and Power-save | Additional Delay from Reset ( $V_{CC} = 5.0V$ ) | Recommended Usage   |
|---------|----------------------------------------------|-------------------------------------------------|---------------------|
| 00      | 6 CK                                         | -                                               | BOD enabled         |
| 01      | 6 CK                                         | 4 ms                                            | Fast rising power   |
| 10      | 6 CK                                         | 64 ms                                           | Slowly rising power |
| 11      | Reserved                                     |                                                 |                     |

... , CKSEL ' 1 ' 가 가 가 ... 가 가