



Embedded Software

CS 145/145L



Caio Batista de Melo



If you're not using Microchip Studio or MPLAB X (and you don't know anyone that is, and can set fuse bits for you), you'll need to use a program called avrdude to do that.



Warnings



If you set the wrong fuse bits in your microcontroller, you might get locked out!
(i.e., it won't work or connect to your computer)

So double/triple check everything before running any commands!

If you *do* get locked out, **DO NOT** try doing the same thing with your 2nd chip!!
Instead, use that one to fix your locked chip:

- <https://www.avrfreaks.net/forum/help-need-help-resetting-clock-fuse-atmega32a>
- <https://www.avrfreaks.net/forum/tutsoft-recovering-locked-out-avr>



Install avrdude



- <https://github.com/avrdudes/avrdude>
- <https://formulae.brew.sh/formula/avrdude>



avrdude Command Template



avrdude

-p (platform):

m32 (ATmega32)

-c (programmer):

atmelice_isp (ATATMEL-ICE-BASIC)

-P (port):

usb



Fuse Bits Calculators



- <http://elecceleator.com/fusecalc/fusecalc.php?chip=atmega32>
- <https://www.engbedded.com/fusecalc/>



Example (Ext. Crystal) - Calculator



Select Chip: ATmega32 (current) Go

LOW Fuse Presets:

- Brown-out detection enabled; [BODEN=0]
- Brown-out detection level at VCC=2.7 V; [BODLEVEL=1]

Ext. Crystal/Resonator High Freq.; Start-up time: 16K CK + 64 ms; [CKSEL=1111 SUT=11]

← 1: choose settings

HIGH Fuse Presets:

Boot Flash section size=2048 words Boot start address=\$3800; [BOOTSZ=00]; default value

- Boot Reset vector Enabled (default address=\$0000); [BOOTRST=0]
- CKOPT fuse (operation dependent of CKSEL fuses); [CKOPT=0]
- JTAG Interface Enabled; [JTAGEN=0]
- On-Chip Debug Enabled; [OCDEN=0]
- Preserve EEPROM memory through the Chip Erase cycle; [EESAVE=0]
- Serial program downloading (SPI) enabled; [SPIEN=0] *

LOCKBIT Fuse Presets:

Application Protection Mode 1: No lock on SPM and LPM in Application Section

Boot Loader Protection Mode 1: No lock on SPM and LPM in Boot Loader Section

Mode 1: No memory lock features enabled

2: copy command parameter

Manual Fuse Bit Manipulation

Remember: = programmed = 0; = unprogrammed = 1

Bit	LOW	HIGH	LOCKBIT
7	<input type="checkbox"/> BODLEVEL	<input type="checkbox"/> OCDEN	<input type="checkbox"/> Bit 7
6	<input type="checkbox"/> BODEN	<input checked="" type="checkbox"/> JTAGEN	<input type="checkbox"/> Bit 6
5	<input type="checkbox"/> Bit 5	<input checked="" type="checkbox"/> SPIEN *	<input type="checkbox"/> Bit 5
4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4
3	<input type="checkbox"/> CKSEL3	<input type="checkbox"/> EESAVE	<input type="checkbox"/> Bit 3
2	<input type="checkbox"/> CKSEL2	<input checked="" type="checkbox"/> BOOTSZ1	<input type="checkbox"/> Bit 2
1	<input type="checkbox"/> CKSEL1	<input checked="" type="checkbox"/> BOOTSZ0	<input type="checkbox"/> Bit 1
0	<input type="checkbox"/> CKSEL0	<input type="checkbox"/> BOOTRST	<input type="checkbox"/> Bit 0
Default	0xF1	0x99	0xFF
Apply	0x FF	0x 99	0x FF



AVRDUDE -U lfuse:w:0xFF:m -U hfuse:w:0x99:m -U lock:w:0xFF:m

Perma-Link: <http://eleccelerator.com/fusecalc/fusecalc.php?chip=atmega32&LOW=FF&HIGH=99&LOCKBIT=FF>



Example (Ext. Crystal) - Resulting Command



```
avrdude -p m32 -c atmelice_isp -P usb -U lfuse:w:0xFF:m
```

from template

from calculator

Note that since we only modified the Low Bits in the calculator, we only set those!



Example (JTAG) - Calculator



Select Chip: ATmega32 (current) Go

LOW Fuse Presets:

- Brown-out detection enabled; [BODEN=0]
- Brown-out detection level at VCC=2.7 V; [BODLEVEL=1]

Ext. Crystal/Resonator High Freq.; Start-up time: 16K CK + 64 ms; [CKSEL=1111 SUT=11]

HIGH Fuse Presets:

Boot Flash section size=2048 words Boot start address=\$3800; [BOOTSZ=00]; default value

- Boot Reset vector Enabled (default address=\$0000); [BOOTRST=0]
- CKOPT fuse (operation dependent of CKSEL fuses); [CKOPT=0]
- JTAG Interface Enabled; [JTAGEN=0]
- On-Chip Debug Enabled; [OCDEN=0]
- Preserve EEPROM memory through the Chip Erase cycle; [EESAVE=0]
- Serial program downloading (SPI) enabled; [SPIEN=0] *

1: choose settings

LOCKBIT Fuse Presets:

Application Protection Mode 1: No lock on SPM and LPM in Application Section

Boot Loader Protection Mode 1: No lock on SPM and LPM in Boot Loader Section

Mode 1: No memory lock features enabled

Manual Fuse Bit Manipulation

Remember: = programmed = 0; = unprogrammed = 1

Bit	LOW	HIGH	LOCKBIT
7	<input type="checkbox"/> BODLEVEL	<input type="checkbox"/> OCDEN	<input type="checkbox"/> Bit 7
6	<input type="checkbox"/> BODEN	<input type="checkbox"/> JTAGEN	<input type="checkbox"/> Bit 6
5	<input type="checkbox"/> Bit 5	<input checked="" type="checkbox"/> SPIEN *	<input type="checkbox"/> Bit 5
4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4
3	<input type="checkbox"/> CKSEL3	<input type="checkbox"/> EESAVE	<input type="checkbox"/> Bit 3
2	<input type="checkbox"/> CKSEL2	<input checked="" type="checkbox"/> BOOTSZ1	<input type="checkbox"/> Bit 2
1	<input type="checkbox"/> CKSEL1	<input checked="" type="checkbox"/> BOOTSZ0	<input type="checkbox"/> Bit 1
0	<input type="checkbox"/> CKSEL0	<input type="checkbox"/> BOOTRST	<input type="checkbox"/> Bit 0
Default	0xF1	0x99	0xFF
Apply	0x FF	0x D9	0x FF

2: copy parameter

AVRDUDE -U lfuse:w:0xFF:m -U hfuse:w:0xD9:m -U lock:w:0xFF:m

Perma-Link: <http://eleccalculator.com/fusecalc/fusecalc.php?chip=atmega32&LOW=FF&HIGH=D9&LOCKBIT=FF>



Example (JTAG) - Resulting Command



```
avrdude -p m32 -c atmelice_isp -P usb -U hfuse:w:0xD9:m
```

from template

from calculator

Note that since we only modified the High Bits in the calculator, we only set those!



Example (Defaults) - Calculator



Select Chip: ATmega32 (current) Go

LOW Fuse Presets:

- Brown-out detection enabled; [BODEN=0]
- Brown-out detection level at VCC=2.7 V; [BODLEVEL=1]

Undefined Preset 2: 0x31 0b00110001

HIGH Fuse Presets:

Boot Flash section size=2048 words Boot start address=\$3800; [BOOTSZ=00]; default value

- Boot Reset vector Enabled (default address=\$0000); [BOOTRST=0]
- CKOPT fuse (operation dependent of CKSEL fuses); [CKOPT=0]
- JTAG Interface Enabled; [JTAGEN=0]
- On-Chip Debug Enabled; [OCDEN=0]
- Preserve EEPROM memory through the Chip Erase cycle; [EESAVE=0]
- Serial program downloading (SPI) enabled; [SPIEN=0] *

LOCKBIT Fuse Presets:

Application Protection Mode 1: No lock on SPM and LPM in Application Section

Boot Loader Protection Mode 1: No lock on SPM and LPM in Boot Loader Section

Mode 1: No memory lock features enabled

Manual Fuse Bit Manipulation
Remember: = programmed = 0; = unprogrammed = 1

Bit	LOW	HIGH	LOCKBIT
7	<input type="checkbox"/> BODLEVEL	<input type="checkbox"/> OCDEN	<input type="checkbox"/> Bit 7
6	<input type="checkbox"/> BODEN	<input checked="" type="checkbox"/> JTAGEN	<input type="checkbox"/> Bit 6
5	<input type="checkbox"/> Bit 5	<input checked="" type="checkbox"/> SPIEN *	<input type="checkbox"/> Bit 5
4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4	<input type="checkbox"/> Bit 4
3	<input checked="" type="checkbox"/> CKSEL3	<input type="checkbox"/> EESAVE	<input type="checkbox"/> Bit 3
2	<input checked="" type="checkbox"/> CKSEL2	<input checked="" type="checkbox"/> BOOTSZ1	<input type="checkbox"/> Bit 2
1	<input checked="" type="checkbox"/> CKSEL1	<input checked="" type="checkbox"/> BOOTSZ0	<input type="checkbox"/> Bit 1
0	<input type="checkbox"/> CKSEL0	<input type="checkbox"/> BOOTRST	<input type="checkbox"/> Bit 0
Default	0xF1	0x99	0xFF
Apply	0x F1	0x 99	0x FF

AVRDUDE -U lfuse:w:0xF1:m -U hfuse:w:0x99:m -U lock:w:0xFF:m

Perma-Link: <http://eleccelerator.com/fusecalc/fusecalc.php?chip=atmega32&LOW=F1&HIGH=99&LOCKBIT=FF>

1: click to restore default values

2: copy command parameters



Example (Defaults) - Resulting Command



```
avrdude -p m32 -c atmelice_isp -P usb -U lfuse:w:0xF1:m -U hfuse:w:0x99:m
```

from template

from calculator

Note that in this case we can set both high and low fuse bits with a single command.



See you next time :)

Q & A