

Clock settings for Atmel 328P				Columns below include bits 7 – 6			
AVR Atmega 328 / 328P LOW FUSE BYTE TABLE (CLOCK OPTIONS)				No CKDIV8 No CKOUT	CKDIV8 CKOUT	CKDIV8 No CKOUT	No CKDIV8 CKOUT
Full Description	Short	Binary 543210		Hex (7,6)=11	Hex (7,6=00)	Hex (7,6=01)	Hex (7,6=10)
<b>EXTERNAL CLOCK: 0-20Mhz (see notes)</b>		<b>XX0000</b>					
Ext. Clock:Start-up Time:6CK 14CK+0ms		000000		C0	00	40	80
Ext. Clock:Start-up Time:6CK 14CK+4ms		010000		D0	10	50	90
Ext. Clock:Start-up Time:6CK 14CK+65ms		100000	R	E0	20	60	A0
<b>INTERNAL CAL. RC OSC. 8Mhz (7.3-8.1Mhz)</b>		<b>XX0010</b>					
Int. RC Osc. Start-up Time:6CK 14CK+0ms		000010		C2	02	42	82
Int. RC Osc. Start-up Time:6CK 14CK+4.1ms		010010		D2	12	52	92
Int. RC Osc. Start-up Time:6CK 14CK+65ms		100010	R	E2	22	62	A2
<b>INTERNAL RC OSC. 128Khz</b>		<b>XX0011</b>					
Int. RC Osc. Start-up Time:6CK 14CK+0ms		000011		C3	03	43	83
Int. RC Osc. Start-up Time:6CK 14CK+4ms		010011		D3	13	53	93
Int. RC Osc. Start-up Time:6CK 14CK+64ms		100011	R	E3	23	63	A3
<b>Ext. LOW FREQ XTAL OSC 32.7Khz (see app note errata)</b>		<b>XX010X</b>					
Ext. Low-Freq Crystal Start-up Time 1K CK 14CK+0ms		000100	Not Rev A Devices. Need to calc Cap. ESR important.	C4	04	44	84
Ext. Low-Freq Crystal Start-up Time 1K CK 14CK+4.1ms		010100		D4	14	54	94
Ext. Low-Freq Crystal Start-up Time 1K CK 14CK+65ms		100100		E4	24	64	A4
Ext. Low-Freq Crystal Start-up Time 32K CK 14CK+0ms		000101		C5	05	45	85
Ext. Low-Freq Crystal Start-up Time 32K CK 14CK+4.1ms		010101		D5	15	55	95
Ext. Low-Freq Crystal Start-up Time 32K CK 14CK+65ms		100101		E5	25	65	A5
<b>Ext. FULL SWING XTAL OSC. 0.4-20Mhz (see notes)</b>		<b>XX011X</b>					
Ext. FS Crystal Start-up Time:258CK 14CK+4.1ms		000110		C6	06	46	86
Ext. FS Crystal Start-up Time:258CK 14CK+65ms		010110		D6	16	56	96
Ext. FS Crystal Start-up Time:1KCK 14CK+0ms		100110		E6	26	66	A6
Ext. FS Crystal Start-up Time:1KCK 14CK+4.1ms		110110		F6	36	76	B6
Ext. FS Crystal Start-up Time:1KCK 14CK+65ms		000111		C7	07	47	87
Ext. FS Crystal Start-up Time:16KCK 14CK+0ms		010111		D7	17	57	97
Ext. FS Crystal Start-up Time:16KCK 14CK+4.1ms		100111		E7	27	67	A7
Ext. FS Crystal Start-up Time:16KCK 14CK+65ms		110111	R	F7	37	77	B7
<b>Ext. LOW POWER XTAL OSC. 0.4-0.9Mhz</b>		<b>XX100X</b>					
Ext. LP Crystal Start-up Time 258CK 14CK+4.1ms		001000	Should only be used with Ceramic Resonators	C8	08	48	88
Ext. LP Crystal Start-up Time 258CK 14CK+65ms		011000		D8	18	58	98
Ext. LP Crystal Start-up Time 1KCK 14CK+0ms		101000		E8	28	68	A8
Ext. LP Crystal Start-up Time 1KCK 14CK+4.1ms		111000		F8	38	78	B8
Ext. LP Crystal Start-up Time 1KCK 14CK+65ms		001001		C9	09	49	89
Ext. LP Crystal Start-up Time 16KCK 14CK+0ms		011001		D9	19	59	99
Ext. LP Crystal Start-up Time 16KCK 14CK+4.1ms		101001		E9	29	69	A9
Ext. LP Crystal Start-up Time 16KCK 14CK+65ms		111001	R	F9	39	79	B9
<b>Ext. LOW POWER XTAL OSC. 0.9-3.0Mhz</b>		<b>XX101X</b>					
Ext. LP Crystal Start-up Time 258CK 14CK+4.1ms		001010		CA	0A	4A	8A
Ext. LP Crystal Start-up Time 258CK 14CK+65ms		011010		DA	1A	5A	9A
Ext. LP Crystal Start-up Time 1KCK 14CK+0ms		101010		EA	2A	6A	AA
Ext. LP Crystal Start-up Time 1KCK 14CK+4.1ms		111010		FA	3A	7A	BA
Ext. LP Crystal Start-up Time 1KCK 14CK+65ms		001011		CB	0B	4B	8B
Ext. LP Crystal Start-up Time 16KCK 14CK+0ms		011011		DB	1B	5B	9B
Ext. LP Crystal Start-up Time 16KCK 14CK+4.1ms		101011		EB	2B	6B	AB
Ext. LP Crystal Start-up Time 16KCK 14CK+65ms		111011	R	FB	3B	7B	BB
<b>Ext. LOW POWER XTAL OSC. 3.0-8.0Mhz</b>		<b>XX110X</b>					
Ext. LP Crystal Start-up Time 258CK 14CK+4.1ms		001100		CC	0C	4C	8C
Ext. LP Crystal Start-up Time 258CK 14CK+65ms		011100		DC	1C	5C	9C
Ext. LP Crystal Start-up Time 1KCK 14CK+0ms		101100		EC	2C	6C	AC
Ext. LP Crystal Start-up Time 1KCK 14CK+4.1ms		111100		FC	3C	7C	BC
Ext. LP Crystal Start-up Time 1KCK 14CK+65ms		001101		CD	0D	4D	8D
Ext. LP Crystal Start-up Time 16KCK 14CK+0ms		011101		DD	1D	5D	9D
Ext. LP Crystal Start-up Time 16KCK 14CK+4.1ms		101101		ED	2D	6D	AD
Ext. LP Crystal Start-up Time 16KCK 14CK+65ms		111101	R	FD	3D	7D	BD
<b>Ext. LOW POWER XTAL OSC. 8.0-16.0Mhz (see notes)</b>		<b>XX111X</b>					
Ext. LP Crystal Start-up Time 258CK 14CK+4.1ms		001110		CE	0E	4E	8E
Ext. LP Crystal Start-up Time 258CK 14CK+65ms		011110		DE	1E	5E	9E
Ext. LP Crystal Start-up Time 1KCK 14CK+0ms		101110		EE	2E	6E	AE
Ext. LP Crystal Start-up Time 1KCK 14CK+4.1ms		111110		FE	3E	7E	BE
Ext. LP Crystal Start-up Time 1KCK 14CK+65ms		001111		CF	0F	4F	8F
Ext. LP Crystal Start-up Time 16KCK 14CK+0ms		011111		DF	1F	5F	9F
Ext. LP Crystal Start-up Time 16KCK 14CK+4.1ms		101111		EF	2F	6F	AF
Ext. LP Crystal Start-up Time 16KCK 14CK+65ms		111111	R	FF	3F	7F	BF
<b>NOTES:</b> (Reference:Atmel-42735B-ATmega328/P_Datasheet_Complete-11/2016)							
<b>START-UP TIME:</b>							
Start-up Times result in an internal reset being held to allow the Clock to stabilise before executing code							
There are two start-up times, Startup time and Time out delay. Eg. the 16KCK & the 14CK+65ms above.							
When starting from reset / Power On reset both are used.							
When starting from "Power Save", or "Power down" (power saving) only Startup Time is used as it is assumed VCC is stable.							
<b>Note:</b> Recommended to use the longer delays unless good reason to shorten them (R)							
Normally VCC is not monitored so use of the Brown Out Detector (BOD) is recommended for shorter delays.							
The BOD holds a reset if VCC is below the set threshold.							
<b>CLOCK SPEED:</b>							
The system clock speed is limited by VCC. At 2.7v max = 10Mhz At 5v max = 20Mhz. Increased clock speed = increased power consumption							
There is an internal divide by 8 (default) for the system clock ie 8Mhz Osc. System clock = 1Mhz. see Lfuse bit 7.							