Appendix B - ATmega88 Automotive Specification at 1.8V

This document contains information specific to devices operating at voltage between 1.8V and 3.6V. Only deviations with standard operating characteristics are covered in this appendix, all other information can be found in the complete Automotive datasheet. The complete ATmega88 automotive datasheet can be found on www.atmel.com



8-bit **AVR**[®] Microcontroller with 8K Bytes In-System Programmable Flash

ATmega88

Appendix B

Preliminary

7738A-AVR-07/07





Electrical Characteristics

Absolute Maximum Ratings*

Operating Temperature55°C to +150°C
Storage Temperature
Voltage on any Pin except $\overline{\text{RESET}}$ with respect to Ground0.5V to $V_{\text{CC}}\text{+}0.5\text{V}$
Voltage on RESET with respect to Ground0.5V to +13.0V
Maximum Operating Voltage 6.0V
DC Current per I/O Pin 30.0 mA
DC Current V_{CC} and GND Pins

*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Characteristics

 $T_A = -40^{\circ}C$ to 85°C, $V_{CC} = 1.8V$ to 3.6V (unless otherwise noted)

Symbol	Parameter	Condition	Min.	Тур.	Max.	Units
V _{IL}	Input Low Voltage, except XTAL1 and $\overrightarrow{\text{RESET}}$ pin $V_{CC} = 1.8V - 3.6V$		-0.5		0.1V _{CC} ⁽¹⁾	V
V _{IH}	Input High Voltage, except XTAL1 and RESET pins	V _{CC} = 1.8V - 3.6V	0.75V _{CC} ⁽²⁾		V _{CC} + 0.5	V
V _{IL1}	Input Low Voltage, XTAL1 pin	V _{CC} = 1.8V - 3.6V	-0.5		0.1V _{CC} ⁽¹⁾	V
V _{IH1}	Input High Voltage, XTAL1 pin	V _{CC} = 1.8V - 3.6V	0.9V _{CC} ⁽²⁾		V _{CC} + 0.5	V
V _{IL2}	Input Low Voltage, RESET pin	V _{CC} = 1.8V - 3.6V	-0.5		0.1V _{CC} ⁽¹⁾	V
V _{IH2}	Input High Voltage, RESET pin	V _{CC} = 1.8V - 3.6V	0.9V _{CC} ⁽²⁾		V _{CC} + 0.5	V
V _{IL3}	Input Low Voltage, RESET pin as I/O	V _{CC} = 1.8V - 3.6V	-0.5		0.1V _{CC} ⁽¹⁾	V
V _{IH3}	Input High Voltage, RESET pin as I/O	V _{CC} = 1.8V - 3.6V	0.6V _{CC} ⁽²⁾		+0.7V _{CC}	V
V _{OL}	Output Low Voltage ⁽³⁾ , I/O pin except RESET	I _{OL} = 0.5mA, V _{CC} = 1.8V			0.25	V
V _{OH}	Output High Voltage ⁽⁴⁾ , I/O pin except RESET	I _{OH} = -0.5mA, V _{CC} = 1.8V	1.25			V
IIL	Input Leakage Current I/O Pin	V _{CC} = 3.6V, pin low (absolute value)			1	μA
I _{IH}	Input Leakage Current I/O Pin	V _{CC} = 3.6V, pin high (absolute value)			1	μA
R _{RST}	Reset Pull-up Resistor		30		60	kΩ
R _{PU}	I/O Pin Pull-up Resistor		20		50	kΩ

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Symbol	Parameter	Condition	Min.	Тур.	Max.	Units
I _{CC}	Power Supply Current ⁽⁵⁾	Active 2MHz, $V_{CC} = 1.8V$		0.8	1.2	mA
		Idle 2MHz, V _{CC} = 1.8V		0.2	0.4	mA
	Power-down mode	WDT disabled, $V_{CC} = 1.8V$ WDT enabled, $V_{CC} = 1.8V$		0.2 4	18 24	μΑ
V _{ACIO}	Analog Comparator Input Offset Voltage	$V_{CC} = 2.7V$ $V_{in} = V_{CC}/2$		<10	40	mV
I _{ACLK}	Analog Comparator Input Leakage Current	$V_{CC} = 2.7V$ $V_{in} = V_{CC}/2$	-50		50	nA
t _{ACPD}	Analog Comparator Propagation Delay	V _{CC} = 2.7V		500		ns

 T_{A} = -40°C to 85°C, V_{CC} = 1.8V to 3.6V (unless otherwise noted) (Continued)

Maximum Speed vs. $V_{\rm CC}$

Maximum frequency is dependent on V_{CC}. As shown in Figure 1, the Maximum Frequency vs. V_{CC} curve is linear between 1.8V < V_{CC} < 3.6V.









ADC Characteristics⁽⁶⁾ Preliminary

Symbol	Parameter	Condition	Min	Тур	Max	Units	
	Resolution			8		Bits	
	Absolute accuracy (Including INL, DNL, quantization error, gain and offset error)	$V_{\text{REF}} = 2.7 \text{V}, V_{\text{CC}} = 2.7 \text{V},$ ADC clock = 200 kHz		2	3.5	LSB	
		$V_{REF} = 2.7V, V_{CC} = 2.7V,$ ADC clock = 200 kHz Noise Reduction Mode		2	3.5	LSB	
	Integral Non-Linearity (INL)	$V_{REF} = 2.7V, V_{CC} = 2.7V,$ ADC clock = 200 kHz		0.6	2.5	LSB	
	Differential Non-Linearity (DNL)	$V_{\text{REF}} = 2.7 \text{V}, V_{\text{CC}} = 2.7 \text{V},$ ADC clock = 200 kHz		0.30	1.0	LSB	
	Gain Error	$V_{\text{REF}} = 2.7 \text{V}, V_{\text{CC}} = 2.7 \text{V},$ ADC clock = 200 kHz	-3.5	-1.3	3.5	LSB	
	Offset Error	$V_{\text{REF}} = 2.7 \text{V}, V_{\text{CC}} = 2.7 \text{V},$ ADC clock = 200 kHz		1.8	3.5	LSB	
	Conversion Time	Free Running Conversion	13 cycles			μs	
	Clock Frequency		50		200	kHz	
AV_{CC}	Analog Supply Voltage		V _{CC} - 0.3		V _{CC} + 0.3	V	
V_{REF}	Reference Voltage		1.0		AV _{CC}	V	
V _{IN}	Input Voltage		GND		V _{REF} -50mV	V	
	Input Bandwidth			38.5		kHz	
V _{INT}	Internal Voltage Reference		1.0	1.1	1.2	V	
R _{REF}	Reference Input Resistance		22.4	32	41.6	kΩ	
R _{AIN}	Analog Input Resistance			100		MΩ	

 $T_A = -40^{\circ}C$ to 85°C, $V_{CC} = 1.8V$ to 3.6V (unless otherwise noted)

Notes: 1. "Max" means the highest value where the pin is guaranteed to be read as low

2. "Min" means the lowest value where the pin is guaranteed to be read as high

Although each I/O port can sink more than the test conditions (0.5mA at V_{CC} = 1.8V) under steady state conditions (non-transient), the following must be observed:

1] The sum of all IOL, for ports B0 - B5, should not exceed 50 mA.

If IOL exceeds the test condition, VOL may exceed the related specification. Pins are not guaranteed to sink current greater than the listed test condition.

Although each I/O port can source more than the test conditions (0.5mA at Vcc = 1.8V) under steady state conditions (non-transient), the following must be observed:

1] The sum of all IOH, for ports B0 - B5 should not exceed 50 mA.

If IOH exceeds the test condition, VOH may exceed the related specification. Pins are not guaranteed to source current greater than the listed test condition.

5. Minimum V_{CC} for Power-down is 2.5V.

6. Based on standard voltage range (2.7V - 5.5V) characterization results. To be confirmed after actual silicon characterization.

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Ordering Information

Power Supply	Speed (MHz)	ISP Flash	Ordering Code	Package	Operation Range
1.8 - 3.6V	2-8	8KB	ATmega88V-15AT	MA	Automotive (-40℃ to +85℃)
1.8 - 3.6V	2-8	8KB	ATmega88V-15MT	PN	Automotive (-40 °C to +85 °C)

Package Type				
МА	32-lead, Thin (1.0 mm) Plastic Quad Flat Package (TQFP)			
PN	32-pad, 5 x 5 x 1.0 body, Lead Pitch 0.50 mm Quad Flat No Lead (QFN): E2/D2 3.1 +/- 0.1mm			

:





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