

Atmel ATmega88 Automotive

Appendix B - ATmega88 Automotive Specification at 1.8V

DATASHEET

Description

This document contains information specific to devices operating at voltage between 1.8V and 5.5V. 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

1. Electrical Characteristics

1.1 Absolute Maximum Ratings

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 any 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.

Parameters	Test Conditions	Unit
Operating Temperature	–55 to +150	°C
Storage Temperature	-65 to +175	°C
Voltage on any Pin except RESET with respect to Ground	–0.5 to V_{CC} +0.5	V
Voltage on RESET with respect to Ground	-0.5 to +13.0	V
Maximum Operating Voltage	6.0	V
DC Current per I/O Pin DC Current V _{CC} and GND	30 200.0	mA

1.2 DC Characteristics

Parameters	Test Conditions	Symbol	Min.	Тур.	Max.	Unit
Input Low Voltage, except XTAL1 and RESET pin	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IL}	-0.5		0.1V _{CC} ⁽¹⁾	V
Input High Voltage, except XTAL1 and RESET pins	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IH}	0.75V _{CC} ⁽²⁾		V _{CC} + 0.5	V
Input Low Voltage, XTAL1 pin	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IL1}	-0.5		+0.1V _{CC} ⁽¹⁾	V
Input High Voltage, XTAL1 pin	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IH1}	0.9V _{CC} ⁽²⁾		V _{CC} + 0.5	V
Input Low Voltage, RESET pin	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IL2}	-0.5		+0.1V _{CC} ⁽¹⁾	V
Input High Voltage, RESET pin	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IH2}	0.9V _{CC} ⁽²⁾		V _{CC} + 0.5	V
Input Low Voltage, RESET pin as I/O	$V_{\rm CC}$ = 1.8V to 5.5V	V _{IL3}	-0.5		+0.1V _{CC} ⁽¹⁾	V
Input High Voltage, RESET pin as I/O	V _{CC} = 1.8V to 5.5V	V _{IH3}	0.6V _{CC} ⁽²⁾		0.7V _{CC}	V

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 50mA.

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 V_{CC} = 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 50mA.

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.



1.2 DC Characteristics (Continued)

 $T_A = -40^{\circ}C$ to +85°C, $V_{CC} = 1.8V$ to 5.5V (unless otherwise noted) (Continued)

Parameters	Test Conditions	Symbol	Min.	Тур.	Max.	Unit
Output Low Voltage ⁽³⁾ , I/O pin except RESET	I _{OL} = 0.5mA, V _{CC} = 1.8V	V _{OL}			0.25	V
Output High Voltage ⁽⁴⁾ , I/O pin except RESET	I _{OH} = -0.5mA, V _{CC} = 1.8V	V _{OH}	1.25			V
Input Leakage Current I/O Pin	V _{CC} = 5.5V, pin low (absolute value)	I _{IL}			1	μΑ
Input Leakage Current I/O Pin	V _{CC} = 5.5V, pin high (absolute value)	I _{IH}			1	μΑ
Reset Pull-up Resistor		R _{RST}	30		60	kΩ
I/O Pin Pull-up Resistor		R _{PU}	20		50	kΩ
Power Supply Current ⁽⁵⁾	Active 2MHz, V_{CC} = 1.8V			0.8	1.2	mA
	Idle 2MHz, V_{CC} = 1.8V	I _{cc}		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
Analog Comparator Input Offset Voltage	$V_{CC} = 2.7V$ $V_{in} = V_{CC}/2$	V _{ACIO}		<10	40	mV
Analog Comparator Input Leakage Current	$V_{CC} = 2.7V$ $V_{in} = V_{CC}/2$	I _{ACLK}	-50		+50	nA
Analog Comparator Propagation Delay	V _{CC} = 2.7V	t _{ACPD}		500		ns

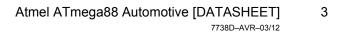
Notes: 1. "Max" means the highest value where the pin is guaranteed to be read as low

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

- 3. 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 50mA.
 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.
- 4. Although each I/O port can source 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 IOH, for ports B0 B5 should not exceed 50mA.

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.

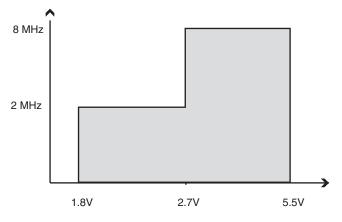
5. Minimum V_{CC} for Power-down is 2.5V.



1.3 Maximum Speed versus V_{CC}

Maximum frequency is dependent on $\ensuremath{\mathsf{V}_{\text{CC}}}$.

Figure 1-1. Maximum Frequency versus V_{CC}



1.4 ADC Characteristics

$T_A = -40^{\circ}$ C to +85°C, $V_{CC} = 1.8$ V to 5.5V (unless	otherwise noted)
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Parameters	Test Conditions	Symbol	Min	Тур	Max	Unit
Resolution	–40°C to +85°C - 1.8V to 2.7V ADC clock = 125kHz			10		Bits
Resolution	–40°C to +85°C - 2.7V to 5.5V ADC clock = 200kHz			10		Bits
Absolute accuracy	V_{CC} = 1.8V, V_{Ref} = 1.8V	TUE		2.2	3.5	LSB
Absolute accuracy	V_{CC} = 4.0V, V_{Ref} = 4.0V	TUL		2.1	3.5	LSB
Integral Non Linearity	V_{CC} = 1.8V, V_{Ref} = 1.8V	INL		0.6	2.0	LSB
Integral Non Linearity	V_{CC} = 4.0V, V_{Ref} = 4.0V			0.5	1.5	LSB
Differential Non Linearity	V_{CC} = 1.8V, V_{Ref} = 1.8V	DNL		0.4	1.0	LSB
	V_{CC} = 4.0V, V_{Ref} = 4.0V	DINL		0.3	0.7	LSB
Gain error			-3.5	-1.5	3.5	LSB
Offset error			-3.5	2.0	3.5	LSB
Clock frequency	$V_{\rm CC}$ = 1.8V to 2.7V		50		125	kHz
Clock inequency	V_{CC} = 2.7V to 5.5V		50		200	kHz
Analog Supply Voltage		AV_{CC}	$V_{\rm CC} - 0.3$		V _{CC} + 0.3	V
Reference Voltage		V _{REF}	1.0		AV _{CC}	V
Input Voltage		V _{IN}	GND		V _{REF} – 50mV	V
Input Bandwidth				38.5		kHz
Internal Voltage Reference		V _{INT}	1.0	1.1	1.2	V
Reference Input Resistance		R _{REF}	22.4	32	41.6	kΩ
Analog Input Resistance		R _{AIN}		100		MΩ



2. Ordering Information

Table 2-1. ATmega88

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Speed (MHz)	Power Supply	ISP Flash	Ordering Code	Package	Operation Range
2-8	1.8V to 5.5V	8 KB	ATmega88V-15MT	PN	Automotive (–40°C to +85°C)
2-8	1.8V to 5.5V	8 KB	ATmega88V-15AT	MA	Automotive (–40°C to +85°C)

3. Package Information

Table 3-1. Package Types

	Package Type
PN	32-pad, $5 \times 5 \times 1.0$ mm body, lead pitch 0.50 mm, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF): E2/D2 3.1 ±0.1 mm
MA	MA, 32 - Lead, 7 \times 7 mm Body Size, 1.0 mm Body Thickness 0.5 mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)



Figure 3-1. PN

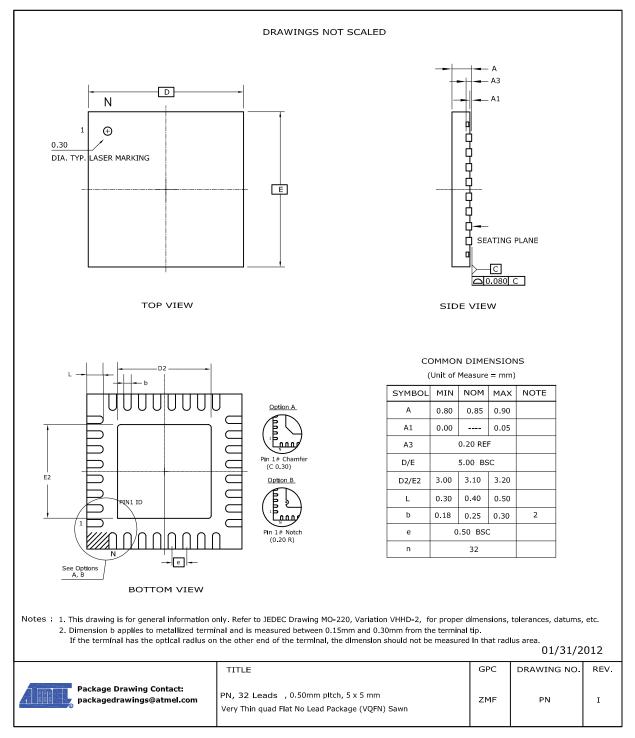
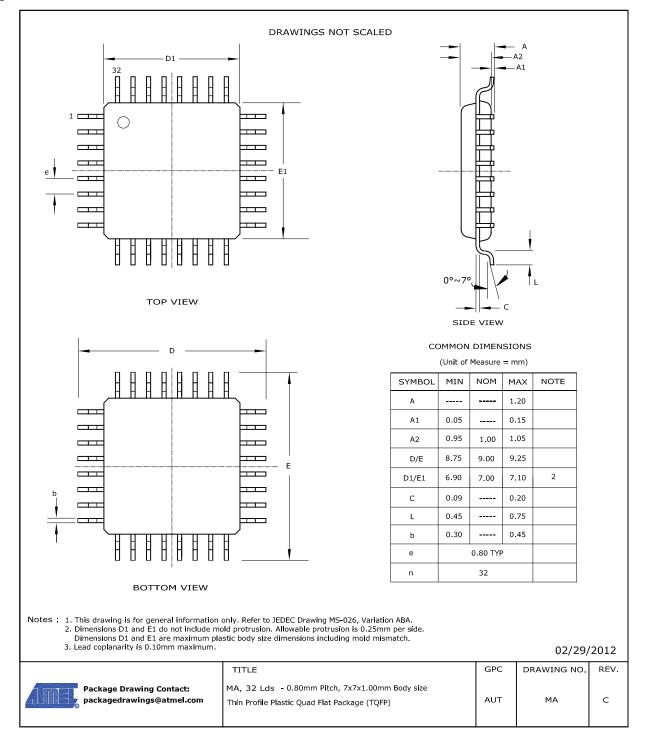




Figure 3-2. MA





4. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History
7738D-AVR-03/12	Package PN updated
7730D-AVR-03/12	Package MA updated
7738C-AVR-11/09	ADC specification updates
7738B-AVR-07/09	Package MA updated
7738A-AVR-07/07	Document Creation





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