Appendix A - ATtiny87/ATtiny167 Automotive Specification at 150°C

This document contains information specific to devices operating at temperatures up to 150°C. Only deviations are covered in this appendix, all other information can be found in the complete Automotive datasheet. The complete Automotive datasheet can be found on www.atmel.com

8-bit AVR® Microcontroller with 16K Bytes In-System Programmable Flash

ATtiny87
ATtiny167
Automotive

7792B–AVR–05/09

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 $\overline{\text{RESET}}$ with respect to Ground	–0.5 to V_{CC}+0.5	V
Voltage on $\overline{\text{RESET}}$ 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

T_A = –40°C to +150°C, V_{CC} = 4.5V to 5.5V (unless otherwise noted)

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Input Low Voltage, except XTAL1 and $\overline{\text{RESET}}$ pin	V_{CC} = 4.5V – 5.5V	V_{IL}	–0.5		$+0.2V_{CC}$(1)	V
Input High Voltage, except XTAL1 and $\overline{\text{RESET}}$ pins	V_{CC} = 4.5V – 5.5V	V_{IH}	$0.6V_{CC}$(2)		V_{CC} + 0.5	V
Input Low Voltage, XTAL1 pin	V_{CC} = 4.5V – 5.5V	V_{IL1}	–0.5		$+0.1V_{CC}$(1)	V
Input High Voltage, XTAL1 pin	V_{CC} = 4.5V – 5.5V	V_{IH1}	$0.7V_{CC}$(2)		V_{CC} + 0.5	V
Input Low Voltage, $\overline{\text{RESET}}$ pin	V_{CC} = 4.5V – 5.5V	V_{IL2}	–0.5		$0.2V_{CC}$(1)	V
Input High Voltage, $\overline{\text{RESET}}$ pin	V_{CC} = 4.5V – 5.5V	V_{IH2}	$0.9V_{CC}$(2)		V_{CC} + 0.5	V
Input Low Voltage, $\overline{\text{RESET}}$ pin as I/O	V_{CC} = 4.5V – 5.5V	V_{IL3}	–0.5		$0.2V_{CC}$(1)	V
Input High Voltage, $\overline{\text{RESET}}$ pin as I/O	V_{CC} = 4.5V – 5.5V	V_{IH3}	$0.8V_{CC}$(2)		V_{CC} + 0.5	V
Output Low Voltage(3), I/O pin except RESET	I_{OL} = 10mA, V_{CC} = 5V	V_{OL}			0.8	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
3. Although each I/O port can sink more than the test conditions (20 mA at V_{CC} = 5V) under steady state conditions (non-transient), the following must be observed:
   1] The sum of all IOL, for all ports, should not exceed 400 mA.
   2] The sum of all IOL, for ports C0 - C5, should not exceed 200 mA.
   3] The sum of all IOL, for ports C6, D0 - D4, should not exceed 300 mA.
   4] The sum of all IOL, for ports B0 - B7, D5 - D7, should not exceed 300 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.
4. For temperature range +125°C to +150°C only. For –40°C to +125°C, refer to ATtiny167automotive datasheet.

1.2 DC Characteristics (Continued)

T_A = –40°C to +150°C, V_{CC} = 4.5V to 5.5V (unless otherwise noted) (Continued)

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Output High Voltage[4], I/O pin except RESET	I_{OH} = –10 mA, V_{CC} = 5V	V_{OH}	4.0			V
Input Leakage Current I/O Pin	V_{CC} = 5.5V, pin low (absolute value)	I_{IL}			1	µA
Input Leakage Current I/O Pin	V_{CC} = 5.5V, pin high (absolute value)	I_{IH}			1	µA
Reset Pull-up Resistor		R_{RST}	35		65	kΩ
I/O Pin Pull-up Resistor		R_{PU}	20		50	kΩ
Power Supply Current Active mode	16 MHz, Vcc = 5V	I_{CC}		10	15	mA
	8 MHz, Vcc = 5V	I_{CC}		5.5	8.0	mA
	8 MHz, Vcc = 3V	I_{CC}		2.8	4.0	mA
	4 MHz, Vcc = 3V	I_{CC}		1.8	3.0	mA
Power Supply Current Idle mode	16 MHz, Vcc = 5V	I_{CC}		3.5	6.0	mA
	8 MHz, Vcc = 5V	I_{CC}		1.8	3.0	mA
	8 MHz, Vcc = 3V	I_{CC}		1.0	2.0	mA
	4 MHz, Vcc = 3V	I_{CC}		0.5	1.0	mA
Power Supply Current Power-down mode	WDT enabled, Vcc = 5V	I_{CC}		7	150	µA
	WDT disabled, Vcc = 5V	I_{CC}		0.18	150	µA
	WDT enabled, Vcc = 3V	I_{CC}		5	150	µA
	WDT disabled, Vcc = 3V	I_{CC}		0.15	100	µA
Analog Comparator Input Leakage Current	V_{CC} = 5V V_{in} = V_{CC}/2	I_{ACLK}	–50		+50	nA
Analog Comparator Propagation Delay	V_{CC} = 4.0V	t_{ACPD}		180		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 (20 mA at V_{CC} = 5V) under steady state conditions (non-transient), the following must be observed:
   1] The sum of all IOL, for all ports, should not exceed 400 mA.
   2] The sum of all IOL, for ports C0 - C5, should not exceed 200 mA.
   3] The sum of all IOL, for ports C6, D0 - D4, should not exceed 300 mA.
   4] The sum of all IOL, for ports B0 - B7, D5 - D7, should not exceed 300 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.
4. For temperature range +125°C to +150°C only. For –40°C to +125°C, refer to ATtiny167automotive datasheet.

1.3 ADC Characteristics

T_A = –40°C to +150°C, V_{CC} = 4.5V to 5.5V (unless otherwise noted)

Parameters	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Resolution	Single ended			10		Bit
Absolute accuracy	Vcc = 4V, VRef = 4V, ADC clock = 200 kHz	TUE		2.0	3.5	LSB
Integral non linearity	Vcc = 4V, VRef = 4V, ADC clock = 200 kHz	INL		0.6	2.0	LSB
Differential non linearity	Vcc = 4V, VRef = 4V, ADC clock = 200 kHz, Temp = –40°C to +150°C	DNL		0.4	1.5	LSB
Gain error	Vcc = 4V, VRef = 4V, ADC clock = 200 kHz, Temp = –40°C to +150°C		–6.0	–2.5	+2.0	LSB
Offset error	Vcc = 4V, VRef = 4V, ADC clock = 200 kHz, Temp = –40°C to +150°C		–3.5	+1.5	+3.5	LSB
Ref voltage		V_{REF}	2.56		AVCC	V

1.4 Memory Endurance

EEPROM endurance: 50,000 Write/Erase cycles.

Flash endurance: 10,000 Write/Erase cycles.

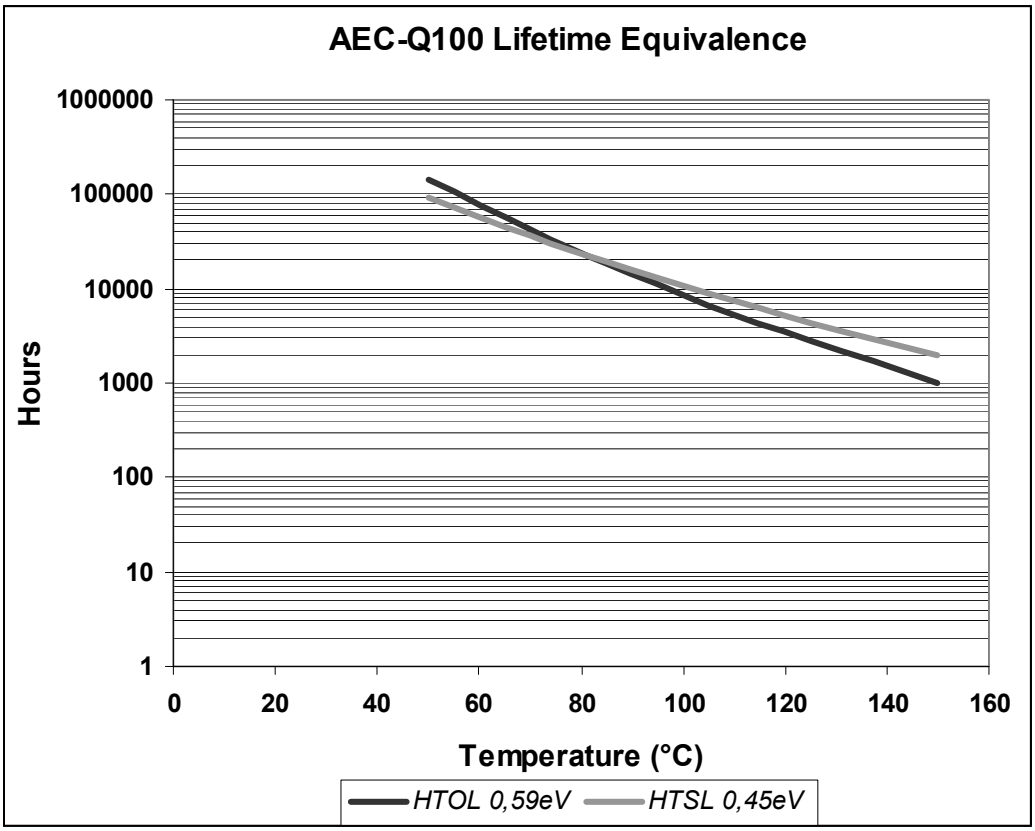
2. Grade 0 Qualification

The ATtiny87/ATtiny167 has been developed and manufactured according to the most stringent quality assurance requirements of ISO-TS-16949 and verified during product qualification as per AEC-Q100 grade 0.

AEC-Q100 qualification relies on temperature accelerated stress testing. High temperature field usage however may result in less significant stress test acceleration. In order to prevent the risk that ATtiny87/ATtiny167 lifetime would not satisfy the application end-of-life reliability requirements, Atmel® has extended the testing, whenever applicable (High Temperature Operating Life Test, High Temperature Storage Life, Data Retention, Thermal Cycles), far beyond the AEC-Q100 requirements. Thereby, Atmel verified the ATtiny87/ATtiny167 has a long safe lifetime period after the grade 0 qualification acceptance limits.

The valid domain calculation depends on the activation energy of the potential failure mechanism that is considered. Therefore any temperature mission profile which could exceed the AEC-Q100 equivalence domain shall be submitted to Atmel for a thorough reliability analysis

Figure 2-1. AEC-Q100 Lifetime Equivalence



3. Ordering Information

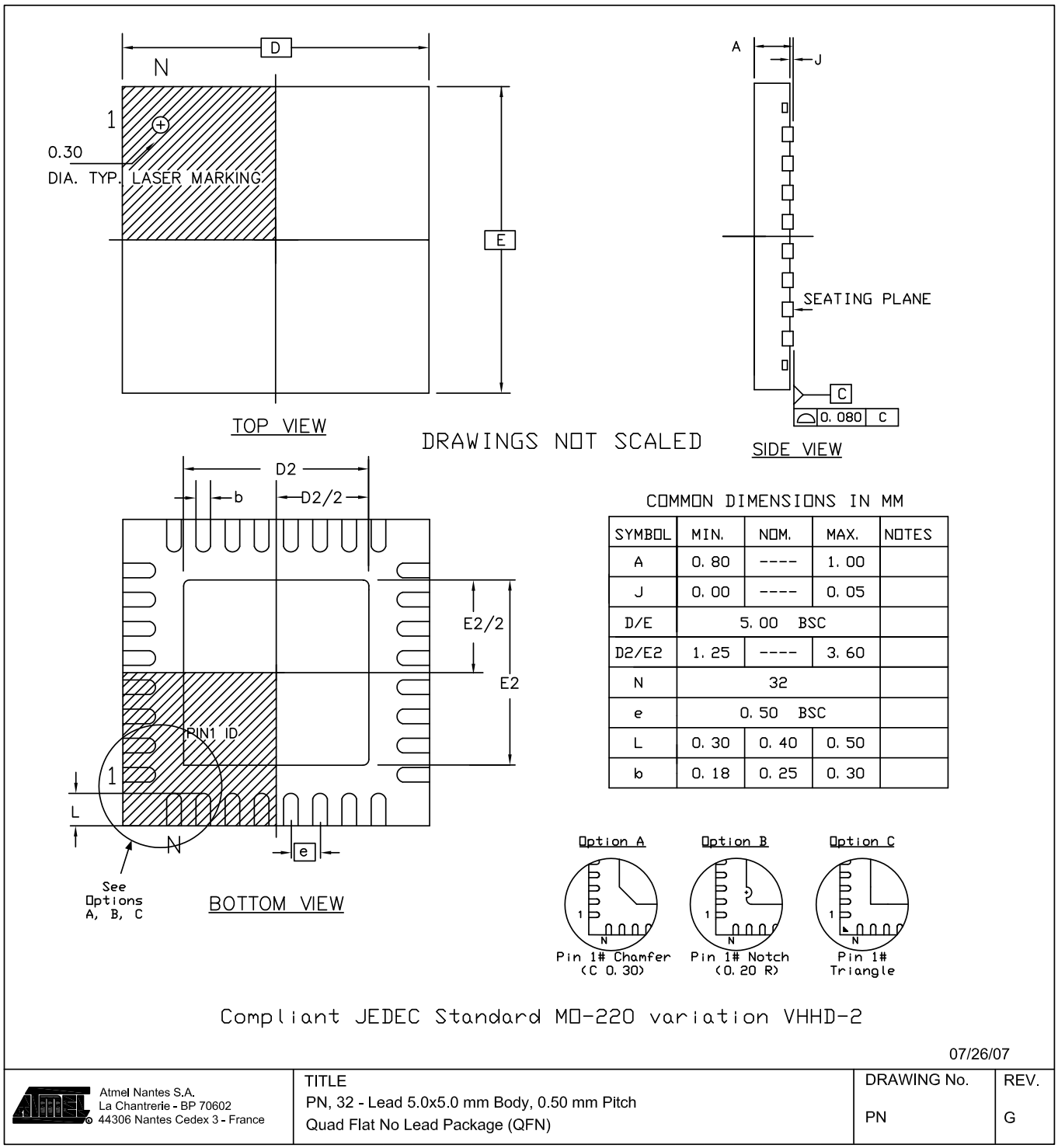
Speed (MHz)	Power Supply	Ordering Code	Package[1]	Operation Range
16[2]	4.5V - 5.5V	ATtiny87-15MD	PN	Extended (–40°C to +150°C)
16[2]	4.5V - 5.5V	ATtiny87-15XD	6G	Extended (–40°C to +150°C)
16[2]	4.5V - 5.5V	ATtiny167-ESMD[3]	PN	Engineering samples
16[2]	4.5V - 5.5V	ATtiny167-ESXD[3]	6G	Engineering samples
16[2]	4.5V - 5.5V	ATtiny167-15MD	PN	Extended (–40°C to +150°C)
16[2]	4.5V - 5.5V	ATtiny167-15XD	6G	Extended (–40°C to +150°C)

Notes:
1. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
2. For Speed versus V_{cc}, see complete datasheet.
3. RevA engineering samples P/N given for reference. For RevB samples, order ATtiny167-15MD, ATtiny15XD.

4. Package Information

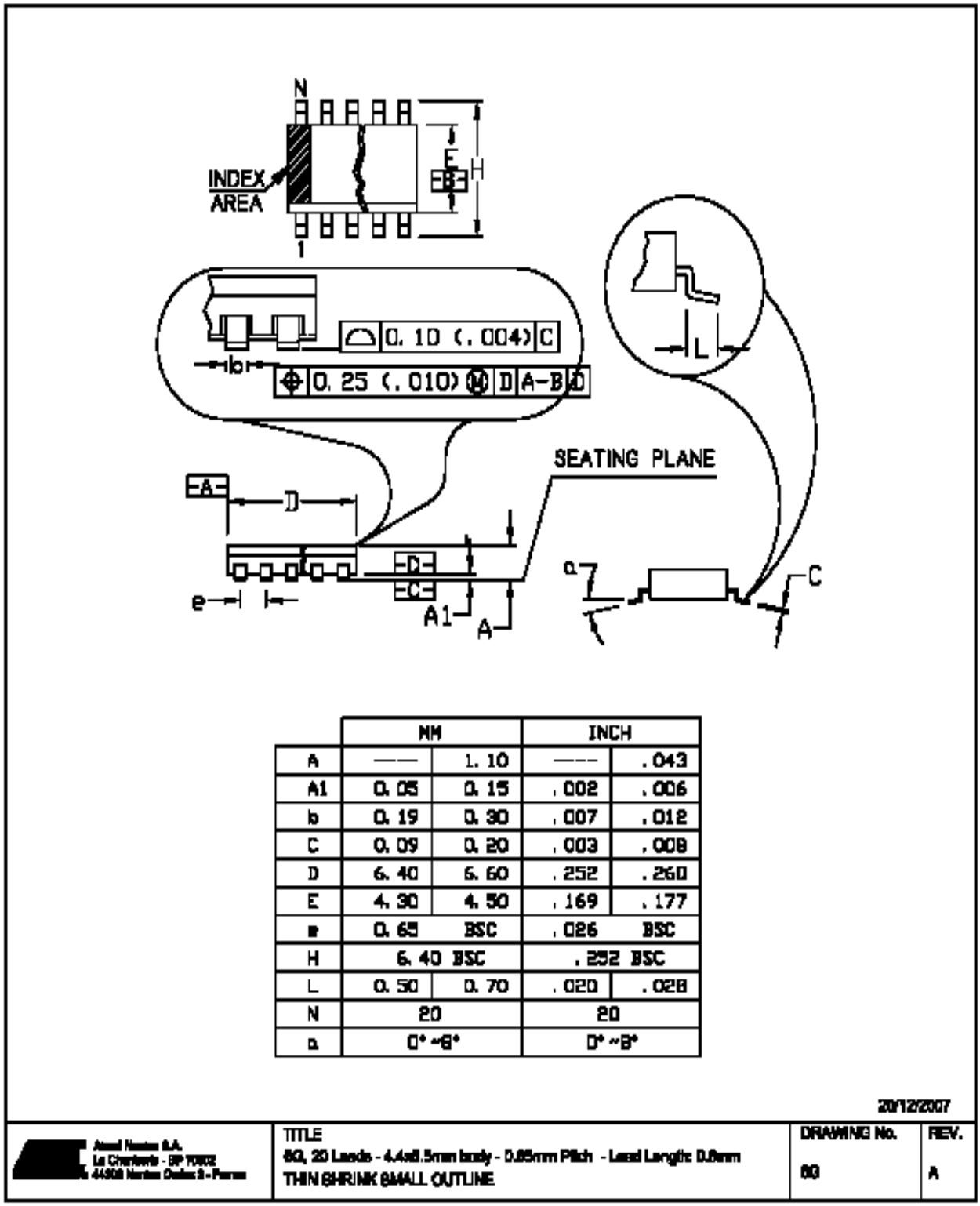
	Package Type
PN	32-pad, 5 × 5 × 1.0 mm body, lead pitch 0.50 mm, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF): E2/D2 3.1 ±0.1 mm
6G	20-leads, 4.4 × 6.5 mm body - 0.65 mmPitch - Lead Length: 0.6 mm, Thin Shrink Small Outline Package (TSSOP)

Figure 4-1. PN



SYMBOL	MIN.	NOM.	MAX.	NOTES
A	0.80	----	1.00	
J	0.00	----	0.05	
D/E		5.00 BSC		
D2/E2	1.25	----	3.60	
N		32		
e		0.50 BSC		
L	0.30	0.40	0.50	
b	0.18	0.25	0.30	

Figure 4-2. 6G



	MM		INCH	
A	---	1.10	---	.043
A1	0.05	0.15	.002	.006
b	0.19	0.30	.007	.012
C	0.09	0.20	.003	.008
D	6.40	6.60	.252	.260
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.40 BSC		.252 BSC	
L	0.50	0.70	.020	.028
N	20		20	
a	0°~8°		0°~8°	

20/12/2007

	TITLE	DRAWING No.	REV.
Atmel Nantes S.A. Le Cheviere - BP 70602 44606 Nantes Cedex 3 - France	6G, 20 Leads - 4.4x6.5mm body - 0.65mm Pitch - Lead Length: 0.6mm THIN SHRINK SMALL OUTLINE	6G	A

5. Revision History

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

5.1 7792A-AVR-05/08

- Document creation

5.2 7792B-AVR-05/09

- Section 1 “Electrical Characteristics” on pages 2 to 4 updated

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