Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
 - 123 Powerful Instructions Most Single Clock Cycle Execution
 - 32 x 8 General Purpose Working Registers
 - Fully Static Operation
- · Non-volatile Program and Data Memories
 - 2/4/8K Byte of In-System Programmable Program Memory Flash (ATtiny261/461/861)

Endurance: 10,000 Write/Erase Cycles

- 128/256/512 Bytes In-System Programmable EEPROM (ATtiny261/461/861)
 Endurance: 100,000 Write/Erase Cycles
- 128/256/512 Bytes Internal SRAM (ATtiny261/461/861)
- Programming Lock for Self-Programming Flash Program and EEPROM Data Security
- · Peripheral Features
 - 8/16-bit Timer/Counter with Prescaler
 - 8/10-bit High Speed Timer/Counter with Separate Prescaler
 3 High Frequency PWM Outputs with Separate Output Compare Registers
 Programmable Dead Time Generator
 - Universal Serial Interface with Start Condition Detector
 - 10-bit ADC
 - 11 Single Ended Channels
 - 16 Differential ADC Channel Pairs
 - 15 Differential ADC Channel Pairs with Programmable Gain (1x, 8x, 20x, 32x)
 - Programmable Watchdog Timer with Separate On-chip Oscillator
 - On-chip Analog Comparator
- Special Microcontroller Features
 - debugWIRE On-chip Debug System
 - In-System Programmable via SPI Port
 - External and Internal Interrupt Sources
 - Low Power Idle, ADC Noise Reduction, and Power-down Modes
 - Enhanced Power-on Reset Circuit
 - Programmable Brown-out Detection Circuit
 - Internal Calibrated Oscillator
- I/O and Packages
 - 16 Programmable I/O Lines
 - 20-pin SOIC, 32-pad MLF and 20-lead TSSOP
- · Operating Voltage:
 - 2.7 5.5V for ATtiny261/461/861
- Speed Grade:
 - ATtiny261/461/861: 0 8 MHz @ 2.7 5.5V, 0 16 MHz @ 4.5 5.5V
 - Operating temperature: Automotive (-40°C to +125°C)
- Low Power Consumption
 - Active Mode: 1 MHz, 2.7V: 380μA
 Power-down Mode: 0.1μA at 2.7V



8-bit **AVR**®
Microcontroller with 2/4/8K
Bytes In-System
Programmable
Flash

ATtiny261 ATtiny461 ATtiny861

Automotive

Preliminary

Summary

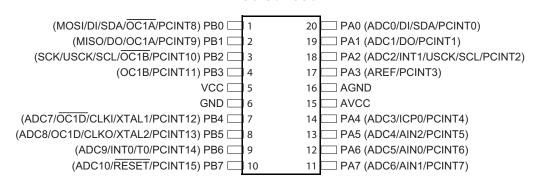


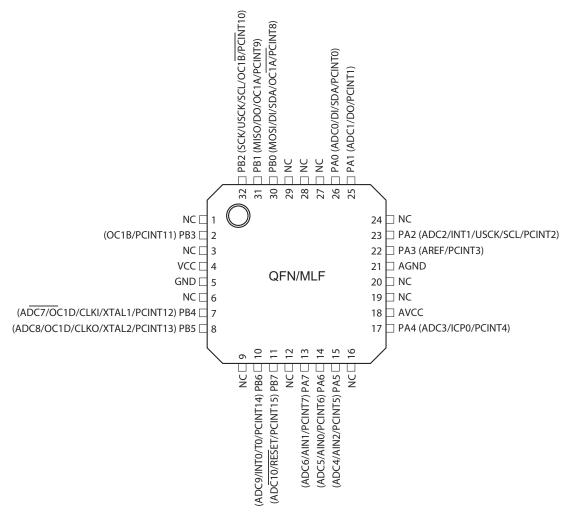


1. Pin Configurations

Figure 1-1. Pinout ATtiny261/461/861

SOIC / TSSOP





Note: The large center pad underneath the QFN/MLF package should be soldered to ground on the board to ensure good mechanical stability.

1.1 Disclaimer

Typical values contained in this data sheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology. Min and Max values will be available after the device is characterized.

1.2 Automotive Quality Grade

The ATtiny261/461/861 have been developed and manufactured according to the most stringent requirements of the international standard ISO-TS 16949. This data sheet contains limit values extracted from the results of extensive characterization (Temperature and Voltage). The quality and reliability of the ATtiny261/461/861 have been verified during regular product qualification as per AEC-Q100 grade 1.

As indicated in the ordering information paragraph, the product is available in only one temper ture grade, Table 1-2.

Table 1-1. Temperature Grade Identification for Automotive Products

Temperature	Temperature Identifier	Comments
-40; +125	Z	Full Automotive Temperature Range



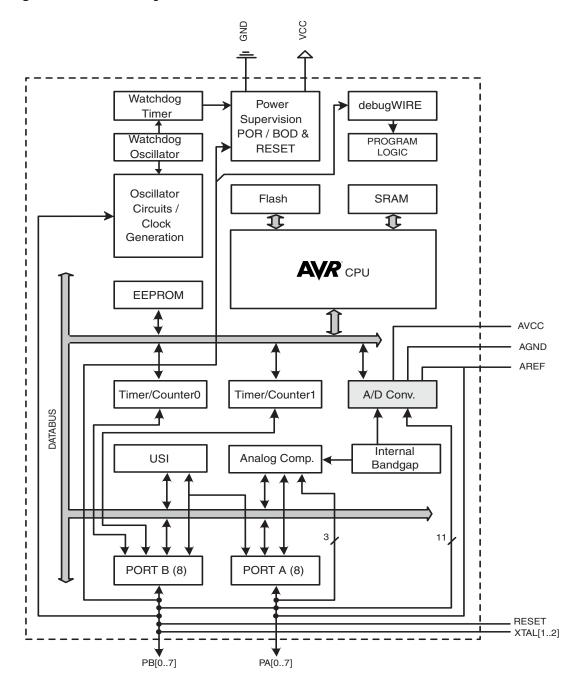


2. Overview

The ATtiny261/461/861 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATtiny261/461/861 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

2.1 Block Diagram

Figure 2-1. Block Diagram



The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATtiny261/461/861 provides the following features: 2/4/8K byte of In-System Programmable Flash, 128/256/512 bytes EEPROM, 128/256/512 bytes SRAM, 6 general purpose I/O lines, 32 general purpose working registers, one 8-bit Timer/Counter with compare modes, one 8-bit high speed Timer/Counter, Universal Serial Interface, Internal and External Interrupts, a 4-channel, 10-bit ADC, a programmable Watchdog Timer with internal Oscillator, and three software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counter, ADC, Analog Comparator, and Interrupt system to continue functioning. The Power-down mode saves the register contents, disabling all chip functions until the next Interrupt or Hardware Reset. The ADC Noise Reduction mode stops the CPU and all I/O modules except ADC, to minimize switching noise during ADC conversions.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the Program memory to be re-programmed In-System through an SPI serial interface, by a conventional non-volatile memory programmer or by an On-chip boot code running on the AVR core.

The ATtiny261/461/861 AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.





3. Instruction Set Summary

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ARITHMETIC AND L	OGIC INSTRUCTIONS	3		•	•
ADD	Rd, Rr	Add two Registers	Rd ← Rd + Rr	Z,C,N,V,H	1
ADC	Rd, Rr	Add with Carry two Registers	$Rd \leftarrow Rd + Rr + C$	Z,C,N,V,H	1
ADIW	Rdl,K	Add Immediate to Word	Rdh:Rdl ← Rdh:Rdl + K	Z,C,N,V,S	2
SUB	Rd, Rr	Subtract two Registers	$Rd \leftarrow Rd - Rr$	Z,C,N,V,H	1
SUBI	Rd, K	Subtract Constant from Register	$Rd \leftarrow Rd - K$	Z,C,N,V,H	1
SBC	Rd, Rr	Subtract with Carry two Registers	$Rd \leftarrow Rd - Rr - C$	Z,C,N,V,H	1
SBCI	Rd, K	Subtract with Carry Constant from Reg.	$Rd \leftarrow Rd - K - C$	Z,C,N,V,H	1
SBIW	Rdl,K	Subtract Immediate from Word	Rdh:Rdl ← Rdh:Rdl - K	Z,C,N,V,S	2
AND	Rd, Rr	Logical AND Registers	$Rd \leftarrow Rd \bullet Rr$	Z,N,V	1
ANDI	Rd, K	Logical AND Register and Constant	$Rd \leftarrow Rd \bullet K$	Z,N,V	1
OR	Rd, Rr	Logical OR Registers	$Rd \leftarrow Rd v Rr$	Z,N,V	1
ORI	Rd, K	Logical OR Register and Constant	$Rd \leftarrow Rd \vee K$	Z,N,V	1
EOR	Rd, Rr	Exclusive OR Registers	$Rd \leftarrow Rd \oplus Rr$	Z,N,V	1
COM	Rd	One's Complement	$Rd \leftarrow 0xFF - Rd$	Z,C,N,V	1
NEG	Rd	Two's Complement	Rd ← 0x00 – Rd	Z,C,N,V,H	1
SBR	Rd,K	Set Bit(s) in Register	$Rd \leftarrow Rd \vee K$	Z,N,V	1
CBR	Rd,K	Clear Bit(s) in Register	$Rd \leftarrow Rd \bullet (0xFF - K)$	Z,N,V	1
INC	Rd	Increment	Rd ← Rd + 1	Z,N,V	1
DEC	Rd	Decrement	Rd ← Rd – 1	Z,N,V	1
TST	Rd	Test for Zero or Minus	$Rd \leftarrow Rd \bullet Rd$	Z,N,V	1
CLR	Rd	Clear Register	$Rd \leftarrow Rd \oplus Rd$	Z,N,V	1
SER	Rd	Set Register	$Rd \leftarrow 0xFF$	None	1
BRANCH INSTRUCT	TIONS				
RJMP	k	Relative Jump	PC ← PC + k + 1	None	2
IJMP		Indirect Jump to (Z)	PC ← Z	None	2
RCALL	k	Relative Subroutine Call	PC ← PC + k + 1	None	3
ICALL		Indirect Call to (Z)	PC ← Z	None	3
RET		Subroutine Return	PC ← STACK	None	4
RETI		Interrupt Return	PC ← STACK	1	4
CPSE	Rd,Rr	Compare, Skip if Equal	if (Rd = Rr) PC ← PC + 2 or 3	None	1/2/3
CP	Rd,Rr	Compare	Rd – Rr	Z, N,V,C,H	1
CPC	Rd,Rr	Compare with Carry	Rd – Rr – C	Z, N,V,C,H	1
CPI	Rd,K	Compare Register with Immediate	Rd – K	Z, N,V,C,H	1
SBRC	Rr, b	Skip if Bit in Register Cleared	if (Rr(b)=0) PC ← PC + 2 or 3	None	1/2/3
SBRS	Rr, b	Skip if Bit in Register is Set	if (Rr(b)=1) PC ← PC + 2 or 3	None	1/2/3
SBIC	P, b	Skip if Bit in I/O Register Cleared	if (P(b)=0) PC ← PC + 2 or 3	None	1/2/3
SBIS	P, b	Skip if Bit in I/O Register is Set	if (P(b)=1) PC ← PC + 2 or 3	None	1/2/3
BRBS	s, k	Branch if Status Flag Set	if (SREG(s) = 1) then PC←PC+k + 1	None	1/2
BRBC	s, k	Branch if Status Flag Cleared	if (SREG(s) = 0) then $PC \leftarrow PC + k + 1$	None	1/2
BREQ	k	Branch if Equal	if (Z = 1) then PC ← PC + k + 1	None	1/2
BRNE	k	Branch if Not Equal	if (Z = 0) then PC ← PC + k + 1	None	1/2
BRCS	k	Branch if Carry Set	if (C = 1) then PC ← PC + k + 1	None	1/2
BRCC	k	Branch if Carry Cleared	if (C = 0) then PC ← PC + k + 1	None	1/2
BRSH	k	Branch if Same or Higher	if (C = 0) then PC ← PC + k + 1	None	1/2
BRLO	k	Branch if Lower	if (C = 1) then PC ← PC + k + 1	None	1/2
BRMI	k	Branch if Minus	if (N = 1) then PC \leftarrow PC + k + 1	None	1/2
BRPL	k	Branch if Plus	if (N = 0) then PC ← PC + k + 1	None	1/2
BRGE	k	Branch if Greater or Equal, Signed	if (N \oplus V= 0) then PC \leftarrow PC + k + 1	None	1/2
BRLT	k	Branch if Less Than Zero, Signed	if $(N \oplus V= 1)$ then $PC \leftarrow PC + k + 1$	None	1/2
BRHS	k	Branch if Half Carry Flag Set	if (H = 1) then PC ← PC + k + 1	None	1/2
BRHC	k	Branch if Half Carry Flag Cleared	if (H = 0) then PC ← PC + k + 1	None	1/2
BRTS	k	Branch if T Flag Set	if (T = 1) then PC ← PC + k + 1	None	1/2
BRTC	k	Branch if T Flag Cleared	if (T = 0) then PC ← PC + k + 1	None	1/2
BRVS	k	Branch if Overflow Flag is Set	if (V = 1) then PC ← PC + k + 1	None	1/2
BRVC	k	Branch if Overflow Flag is Cleared	if (V = 0) then PC ← PC + k + 1	None	1/2
BRIE	k	Branch if Interrupt Enabled	if (I = 1) then PC ← PC + k + 1	None	1/2
BRID	k	Branch if Interrupt Disabled	if (I = 0) then PC ← PC + k + 1	None	1/2
BIT AND BIT-TEST I				T.	T
SBI	P,b	Set Bit in I/O Register	I/O(P,b) ← 1	None	2
CBI	P,b	Clear Bit in I/O Register	I/O(P,b) ← 0	None	2
LSL	Rd	Logical Shift Left	$Rd(n+1) \leftarrow Rd(n), Rd(0) \leftarrow 0$	Z,C,N,V	1
LSR	Rd	Logical Shift Right	$Rd(n) \leftarrow Rd(n+1), Rd(7) \leftarrow 0$	Z,C,N,V	1
ROL	Rd	Rotate Left Through Carry	$Rd(0)\leftarrow C,Rd(n+1)\leftarrow Rd(n),C\leftarrow Rd(7)$	Z,C,N,V	

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ROR	Rd	Rotate Right Through Carry	$Rd(7)\leftarrow C,Rd(n)\leftarrow Rd(n+1),C\leftarrow Rd(0)$	Z,C,N,V	1
ASR	Rd	Arithmetic Shift Right	$Rd(n) \leftarrow Rd(n+1), n=06$	Z,C,N,V	1
SWAP	Rd	Swap Nibbles	Rd(30)←Rd(74),Rd(74)←Rd(30)	None	1
BSET	s	Flag Set	SREG(s) ← 1	SREG(s)	1
BCLR	s	Flag Clear	$SREG(s) \leftarrow 0$	SREG(s)	1
BST	Rr, b	Bit Store from Register to T	$T \leftarrow Rr(b)$	T	1
BLD	Rd, b	Bit load from T to Register	$Rd(b) \leftarrow T$	None	1
SEC	, 5	Set Carry	C ← 1	C	1
CLC		Clear Carry	C ← 0	C	1
SEN		Set Negative Flag	N ← 1	N	1
CLN		Clear Negative Flag	N ← 0	N	1
SEZ		Set Zero Flag	Z ← 1	Z	1
CLZ		Clear Zero Flag	Z ← 0	Z	1
SEI		-			1
		Global Interrupt Enable	1 ← 1	+ -	1
CLI		Global Interrupt Disable	1←0	0	1
SES		Set Signed Test Flag	S ← 1	S	1
CLS		Clear Signed Test Flag	S ← 0	S	1
SEV	1	Set Twos Complement Overflow.	V ← 1	V	1
CLV	ļ	Clear Twos Complement Overflow	V ← 0	V	1
SET		Set T in SREG	T ← 1	Т	1
CLT		Clear T in SREG	T ← 0	Т	1
SEH		Set Half Carry Flag in SREG	H ← 1	Н	1
CLH		Clear Half Carry Flag in SREG	H ← 0	Н	1
DATA TRANSFER I	NSTRUCTIONS				
MOV	Rd, Rr	Move Between Registers	$Rd \leftarrow Rr$	None	1
MOVW	Rd, Rr	Copy Register Word	Rd+1:Rd ← Rr+1:Rr	None	1
LDI	Rd, K	Load Immediate	Rd ← K	None	1
LD	Rd, X	Load Indirect	$Rd \leftarrow (X)$	None	2
LD	Rd, X+	Load Indirect and Post-Inc.	$Rd \leftarrow (X), X \leftarrow X + 1$	None	2
LD	Rd, - X	Load Indirect and Pre-Dec.	$X \leftarrow X - 1$, $Rd \leftarrow (X)$	None	2
LD	Rd, Y	Load Indirect	$Rd \leftarrow (Y)$	None	2
LD	Rd, Y+	Load Indirect and Post-Inc.	$Rd \leftarrow (Y), Y \leftarrow Y + 1$	None	2
LD	Rd, - Y	Load Indirect and Pre-Dec.	$Y \leftarrow Y - 1$, $Rd \leftarrow (Y)$	None	2
LDD	Rd,Y+q	Load Indirect with Displacement	$Rd \leftarrow (Y + q)$	None	2
LD	Rd, Z	Load Indirect	$Rd \leftarrow (Z)$	None	2
LD	Rd, Z+	Load Indirect and Post-Inc.			2
LD		1	$Rd \leftarrow (Z), Z \leftarrow Z+1$	None	2
	Rd, -Z	Load Indirect and Pre-Dec.	$Z \leftarrow Z - 1$, $Rd \leftarrow (Z)$	None	+
LDD	Rd, Z+q	Load Indirect with Displacement	$Rd \leftarrow (Z + q)$	None	2
LDS	Rd, k	Load Direct from SRAM	Rd ← (k)	None	2
ST	X, Rr	Store Indirect	(X) ← Rr	None	2
ST	X+, Rr	Store Indirect and Post-Inc.	$(X) \leftarrow Rr, X \leftarrow X + 1$	None	2
ST	- X, Rr	Store Indirect and Pre-Dec.	$X \leftarrow X - 1$, $(X) \leftarrow Rr$	None	2
ST	Y, Rr	Store Indirect	(Y) ← Rr	None	2
ST	Y+, Rr	Store Indirect and Post-Inc.	$(Y) \leftarrow Rr, Y \leftarrow Y + 1$	None	2
ST	- Y, Rr	Store Indirect and Pre-Dec.	$Y \leftarrow Y - 1$, $(Y) \leftarrow Rr$	None	2
STD	Y+q,Rr	Store Indirect with Displacement	$(Y + q) \leftarrow Rr$	None	2
ST	Z, Rr	Store Indirect	(Z) ← Rr	None	2
ST	Z+, Rr	Store Indirect and Post-Inc.	$(Z) \leftarrow Rr, Z \leftarrow Z + 1$	None	2
ST	-Z, Rr	Store Indirect and Pre-Dec.	$Z \leftarrow Z - 1$, $(Z) \leftarrow Rr$	None	2
STD	Z+q,Rr	Store Indirect with Displacement	(Z + q) ← Rr	None	2
STS	k, Rr	Store Direct to SRAM	(k) ← Rr	None	2
LPM		Load Program Memory	R0 ← (Z)	None	3
LPM	Rd, Z	Load Program Memory	$Rd \leftarrow (Z)$	None	3
LPM	Rd, Z+	Load Program Memory and Post-Inc	$Rd \leftarrow (Z), Z \leftarrow Z+1$	None	3
SPM	1	Store Program Memory	(z) ← R1:R0	None	
IN	Rd, P	In Port	Rd ← P	None	1
OUT	P, Rr	Out Port	P ← Rr	None	1
PUSH	Rr				2
		Push Register on Stack	STACK ← Rr	None	
POP	Rd	Pop Register from Stack	Rd ← STACK	None	2
MCU CONTROL INS	STRUCTIONS	I was a		T	1 .
NOP	 	No Operation		None	1
SLEEP	<u> </u>	Sleep	(see specific descr. for Sleep function)	None	1
WDR		Watchdog Reset	(see specific descr. for WDR/Timer)	None	1
BREAK		Break	For On-chip Debug Only	None	N/A





Ordering Information

Table 4-1. Engineering Samples Delivery only

Ordering Code ⁽²⁾	Speed (MHz) ⁽³⁾	Power Supply (V)	Package ⁽¹⁾	Operation Range
ATtiny261-ESSZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny261-ESMZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny261-ESXZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)
ATtiny461-ESSZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny461-ESMZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny461-ESXZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)
ATtiny861-ESSZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny861-ESMZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny861-ESXZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)

Table 4-2. Available Product Offering

Ordering Code ⁽²⁾	Speed (MHz)(3)	Power Supply (V)	Package ⁽¹⁾	Operation Range
3	,		3	
ATtiny261-15SZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny261-15MZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny261-15XZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)
ATtiny461-15SZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny461-15MZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny461-15XZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)
-l	,		1	
ATtiny861-15SZ	16	2.7 - 5.5	TG	Automotive (-40° to +125°C)
ATtiny861-15MZ	16	2.7 - 5.5	PN	Automotive (-40° to +125°C)
ATtiny861-15XZ	16	2.7 - 5.5	6G	Automotive (-40° to +125°C)

- Notes: 1. This device can also be supplied in wafer form. Please contact your local Atmel sales office for detailed ordering information and minimum quantities.
 - 2. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
 - 3. For Speed vs. V_{CC} ,see Figure 23.3 on page 189

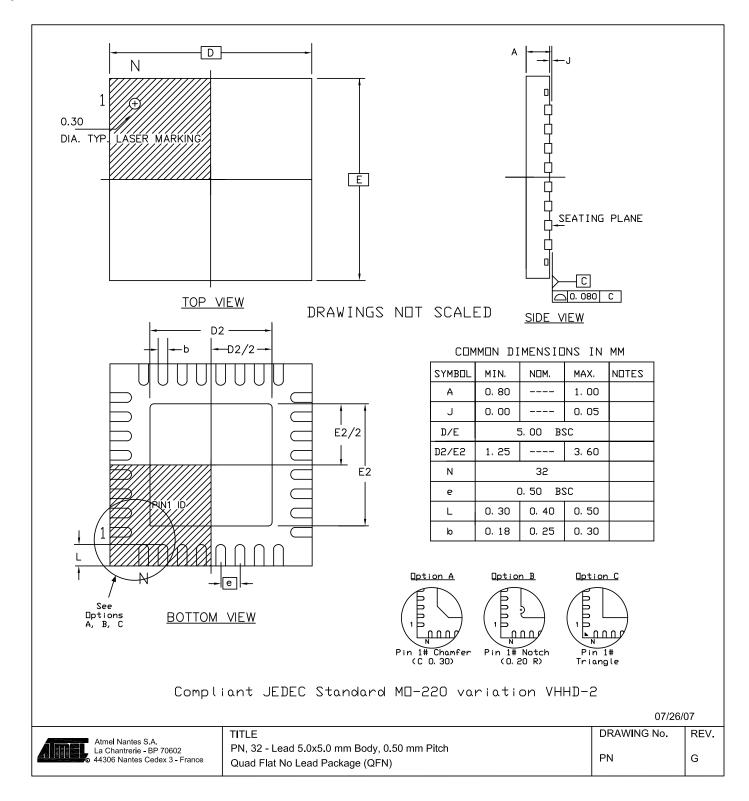
Package Type		
PN	32-pad, 5.0 x 5.0 mm Body, Lead Pitch 0.50 mm, Quad Flat No Lead Package (QFN)	
TG	20-lead, 0.300" Wide Body Lead, Plastic Gull Wing Small Outline Package (SOIC)	
6G	20-leads, 4.4x6.5mm body - 0.65mm Pitch - Lead Length: 0.6mm Thin Shrink Small Outline Package (TSSOP)	



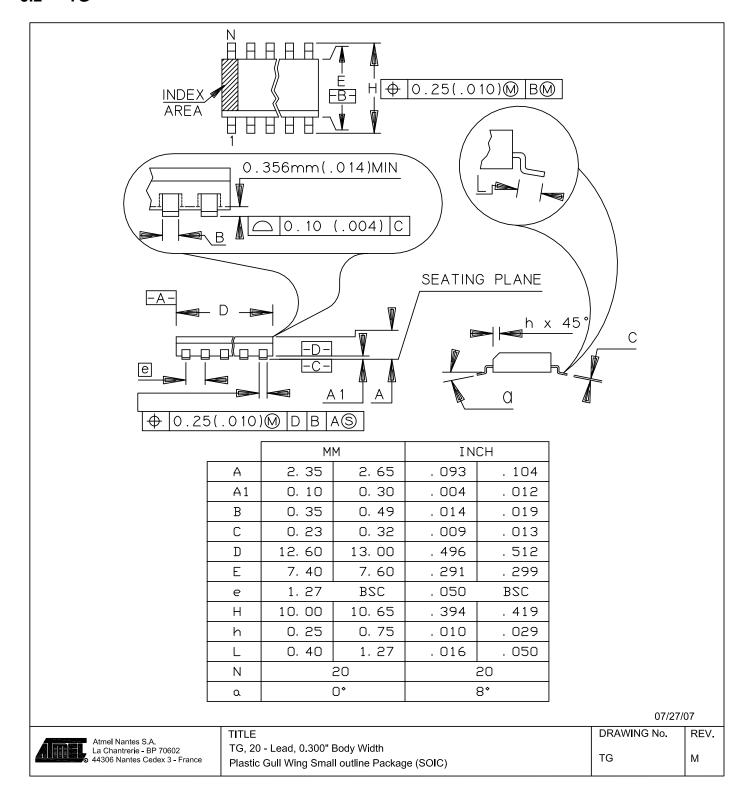


5. Packaging Information

5.1 PN



5.2 TG





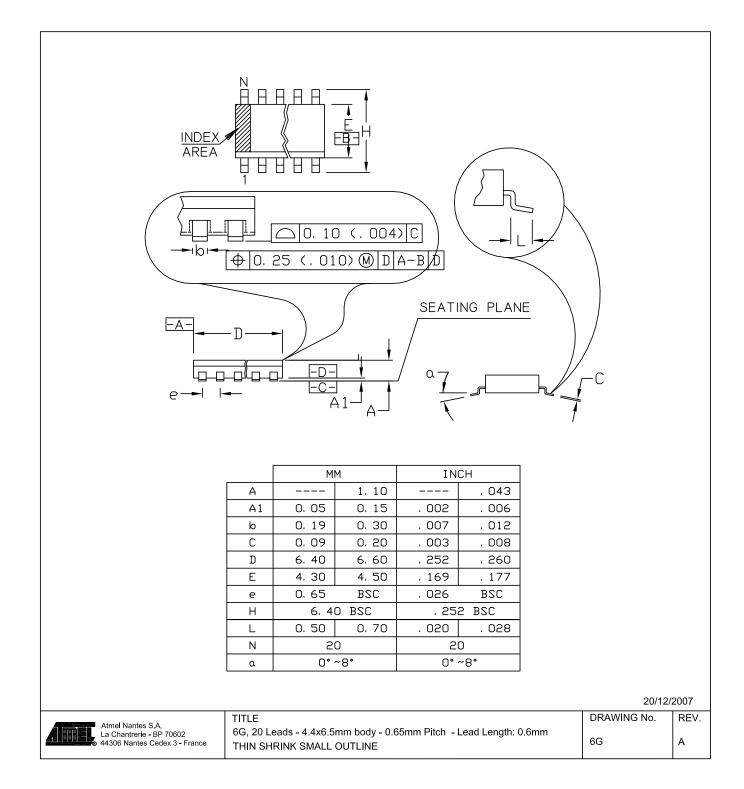


NOTES: SOIC STANDARD NOTES

- 1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M. 1982.
- 2. "D" AND "E" DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTUSIONS.

 MOLD FLASH OR PROTUSIONS SHALL NOT EXCEED 0.15mm (0.006 INCH) PER SIDE.
- 3. THE CHAMFER "h" IS OPTIONAL.

5.3 6G







6. Errata

6.1 Errata ATtiny261

The revision letter in this section refers to the revision of the ATtiny261 device.

6.1.1 Rev A

No known errata.

6.2 Errata ATtiny461

The revision letter in this section refers to the revision of the ATtiny461 device.

6.2.1 Rev B

No known errata.

6.3 Errata ATtiny861

The revision letter in this section refers to the revision of the ATtiny861 device.

6.3.1 Rev B

No known errata.

7. Datasheet Revision History

7.1 Rev. 7753A - 11/07

 First Datasheet Draft - Initial Automotive Version. Started from Industrial Datasheet doc2588 rev.B - 01/07

7.2 Rev. 7753B - 08/08

1. Added 6G product offering to Ordering Information.





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