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: 380 μ A
 - Power-down Mode: 0.1 μ A 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



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.

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

 Table 1-1.
 Temperature Grade Identification for Automotive Products





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

4 ATtiny261/461/861

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	6	·		
ADD	Rd, Rr	Add two Registers	$Rd \leftarrow Rd + Rr$	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 ← Rd • Rr	Z,N,V	1
ANDI	Rd, K	Logical AND Register and Constant	$Rd \leftarrow Rd \bullet K$	Z,N,V	1
UR	Rd, Rr			Z,N,V	1
	Rd, K	Logical OR Register and Constant		Z,N,V	1
EUR	RU, RI Rd				1
NEG	Pd				1
SBR	Rd K	Set Bit(s) in Register	$Rd \leftarrow Rd \vee K$	Z,0,N,V,II	1
CBR	Rd K	Clear Bit(s) in Register	$Rd \leftarrow Rd \bullet (0xFE - K)$	Z,N,V	1
INC	Rd		$Rd \leftarrow Rd + 1$	Z.N.V	1
DEC	Rd	Decrement	$Rd \leftarrow Rd - 1$	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	$PC \leftarrow PC + k + 1$	None	2
IJMP		Indirect Jump to (Z)	$PC \leftarrow Z$	None	2
RCALL	k	Relative Subroutine Call	$PC \leftarrow PC + k + 1$	None	3
ICALL		Indirect Call to (Z)	$PC \leftarrow Z$	None	3
RET		Subroutine Return	$PC \leftarrow STACK$	None	4
RETI		Interrupt Return	$PC \leftarrow STACK$	1	4
CPSE	Rd,Rr	Compare, Skip if Equal	if (Rd = Rr) PC \leftarrow 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
	Ra,K Br.b	Compare Register with Immediate	RI - K if $(Pr(h)=0) PC \neq PC + 2 \text{ or } 2$	Z, N,V,C,H	1/2/2
SBRS	Rr b	Skip if Bit in Register is Set	if $(\operatorname{Rr}(b)=0) \to \operatorname{PC} \leftarrow \operatorname{PC} + 2 \text{ or } 3$	None	1/2/3
SBIC	P h	Skip if Bit in I/O Register Cleared	if $(P(h)=0) PC \leftarrow PC + 2 \text{ or } 3$	None	1/2/3
SBIS	P b	Skip if Bit in I/O Register is Set	if $(P(b)=1) PC \leftarrow PC + 2 \text{ or } 3$	None	1/2/3
BRBS	s. k	Branch if Status Flag Set	if (SREG(s) = 1) then $PC \leftarrow PC+k + 1$	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 \leftarrow PC + k + 1	None	1/2
BRNE	k	Branch if Not Equal	if (Z = 0) then PC \leftarrow PC + k + 1	None	1/2
BRCS	k	Branch if Carry Set	if (C = 1) then PC \leftarrow PC + k + 1	None	1/2
BRCC	k	Branch if Carry Cleared	if (C = 0) then PC \leftarrow PC + k + 1	None	1/2
BRSH	k	Branch if Same or Higher	if (C = 0) then PC \leftarrow PC + k + 1	None	1/2
BRLO	k	Branch if Lower	if (C = 1) then PC \leftarrow 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 \leftarrow 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	ĸ	Branch It Less Than Zero, Signed	If $(N \oplus V=1)$ then PC \leftarrow PC + k + 1	None	1/2
BRHS	ĸ	Branch if Half Carry Flag Set	If (H = 1) then PC \leftarrow PC + k + 1	None	1/2
BRHC	K	Branch if Half Carry Flag Cleared	If (H = U) then $PC \leftarrow PC + k + 1$	None	1/2
BRIS	K	Branch if T Flag Set	If $(T = 1)$ then PC \leftarrow PC + k + 1	None	1/2
BDVS	κ ν		$ii (1 - 0) iiieii PC \leftarrow PC + K + 1$ $if (V - 1) then PC \leftarrow PC + k + 1$	None	1/2
BRVC	r.	Branch if Overflow Flag is Cleared	$if (V = 1) \text{ then } PC \leftarrow PC + k + 1$	None	1/2
BRIE	k	Branch if Interrupt Enabled	if $(1 = 1)$ then PC \leftarrow PC + k + 1	None	1/2
BRID	k	Branch if Interrupt Disabled	if $(1 = 0)$ then PC \leftarrow PC + k + 1	None	1/2
BIT AND BIT-TEST	INSTRUCTIONS				174
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	1

ATtiny261/461/861

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	$SREG(s) \leftarrow 1$	SREG(s)	1
BCLR	s	Flag Clear	$SREG(s) \leftarrow 0$	SREG(s)	1
BST	Rr, b	Bit Store from Register to T	$T \leftarrow Rr(b)$	Т	1
BLD	Rd, b	Bit load from T to Register	$Rd(b) \leftarrow T$	None	1
SEC		Set Carry	C ← 1	С	1
CLC		Clear Carry	C ← 0	С	1
SEN		Set Negative Flag	N ← 1	N	1
CLN		Clear Negative Flag	N ← 0	N	1
SEZ		Set Zero Flag		Ζ	1
		Clear Zero Flag		<u>ک</u>	1
SEI		Global Interrupt Enable		1	1
SES		Set Signed Test Flag	I ← 0	9	1
CLS		Clear Signed Test Flag	S ~ 0	s	1
SEV		Set Twos Complement Overflow	$V \leftarrow 1$	V	1
CLV		Clear Twos Complement Overflow	$V \leftarrow 0$	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 IN	ISTRUCTIONS				
MOV	Rd, Rr	Move Between Registers	$Rd \leftarrow Rr$	None	1
MOVW	Rd, Rr	Copy Register Word	$Rd+1:Rd \leftarrow Rr+1:Rr$	None	1
LDI	Rd, K	Load Immediate	$Rd \leftarrow K$	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	R0, Z+	Load Indirect and Post-Inc.	$Rd \leftarrow (Z), Z \leftarrow Z+1$	None	2
	Ru, -Z	Load Indirect with Displacement	$Z \leftarrow Z - 1, Ru \leftarrow (Z)$	None	2
LDD	Ru, Z+y Rd k		$Ru \leftarrow (Z + q)$	None	2
ST	X Rr	Store Indirect	$(X) \leftarrow Br$	None	2
ST	X+ Rr	Store Indirect and Post-Inc	$(X) \leftarrow \operatorname{Rr} X \leftarrow X + 1$	None	2
ST	- X. Rr	Store Indirect and Pre-Dec.	$X \leftarrow X - 1$. (X) $\leftarrow Br$	None	2
ST	Y, Rr	Store Indirect	$(Y) \leftarrow Rr$	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	$(Z + q) \leftarrow Rr$	None	2
STS	k, Rr	Store Direct to SRAM	$(k) \leftarrow Rr$	None	2
LPM		Load Program Memory	$R0 \leftarrow (Z)$	None	3
LPM	Rd, Z	Load Program Memory	$Rd \leftarrow (Z)$	None	3
	Kd, Z+	Load Program Memory and Post-Inc	$Kd \leftarrow (\angle), \angle \leftarrow \angle +1$	None	3
SPIN		Store Program Memory		None	4
	RU, P D Dr	Out Port		None	1
PUSH	Pr	Push Register on Stack		None	2
POP	Rd	Pon Register from Stack		None	2
	TRUCTIONS			NOTIC	۷
NOP		No Operation		None	1
SLEEP		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





4. 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
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)
	I			
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)
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. $V_{\text{CC}}, \text{see Figure 23.3 on page 189}$

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.

ATtiny261/461/861

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

- 1. 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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