Features

- High Performance, Low Power AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 130 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16 MHz
  - On-Chip 2-cycle Multiplier
- Non-volatile Program and Data Memories
  - 16K bytes of In-System Self-Programmable Flash
    Endurance: 10,000 Write/Erase Cycles
  - Optional Boot Code Section with Independent Lock Bits
    In-System Programming by On-chip Boot Program
    True Read-While-Write Operation
  - 512 bytes EEPROM
    Endurance: 100,000 Write/Erase Cycles
  - 1K byte Internal SRAM
  - Programming Lock for Software Security
- JTAG (IEEE std. 1149.1 compliant) Interface
  - Boundary-scan Capabilities According to the JTAG Standard
  - Extensive On-chip Debug Support
  - Programming of Flash, EEPROM, Fuses, and Loc Bits through the JTAG Interface
- Peripheral Features
  - 4 x 25 Segment LCD Driver
  - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Four PWM Channels
  - 8-channel, 10-bit ADC
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Universal Serial Interface with Start Condition Detector
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby
- I/O and Packages
  - 54 Programmable I/O Lines
  - 64-pad TQFP
- Speed Grade:
  - ATmega169P: 0 - 8 MHz @ 2.7 - 5.5V, 0 - 16 MHz @ 4.5 - 5.5V
- Temperature range:
  - -40°C to 85°C Automotive
- Ultra-Low Power Consumption
  - Active Mode:
    4 MHz, 3.0V: 2.5 mA (Typical value)
    8 MHz, 5.0V: 8 mA (Typical value)
  - Power-down Mode:
    0.4 µA at 5.0V

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

ATmega169P

Automotive

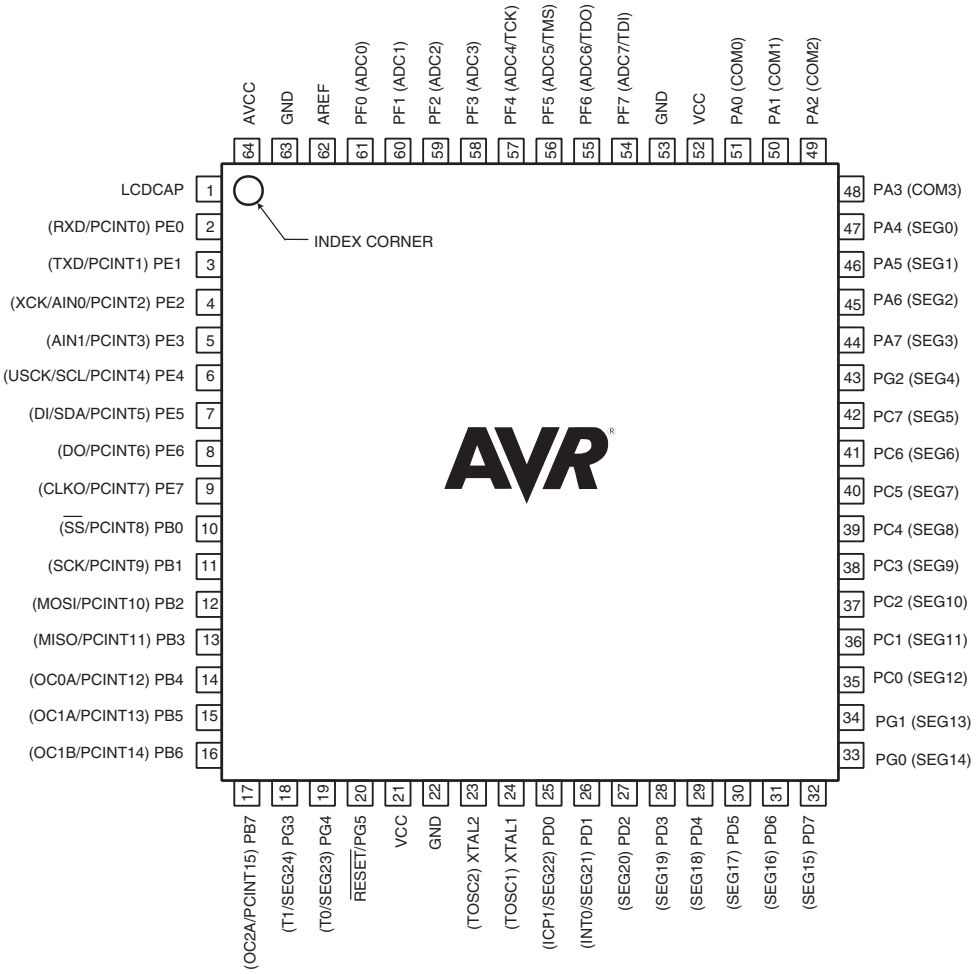
Preliminary

Summary

7735B–AVR–12/07

1. Pin Configurations

Figure 1-1. Pinout ATmega169P



1.1 Disclaimer

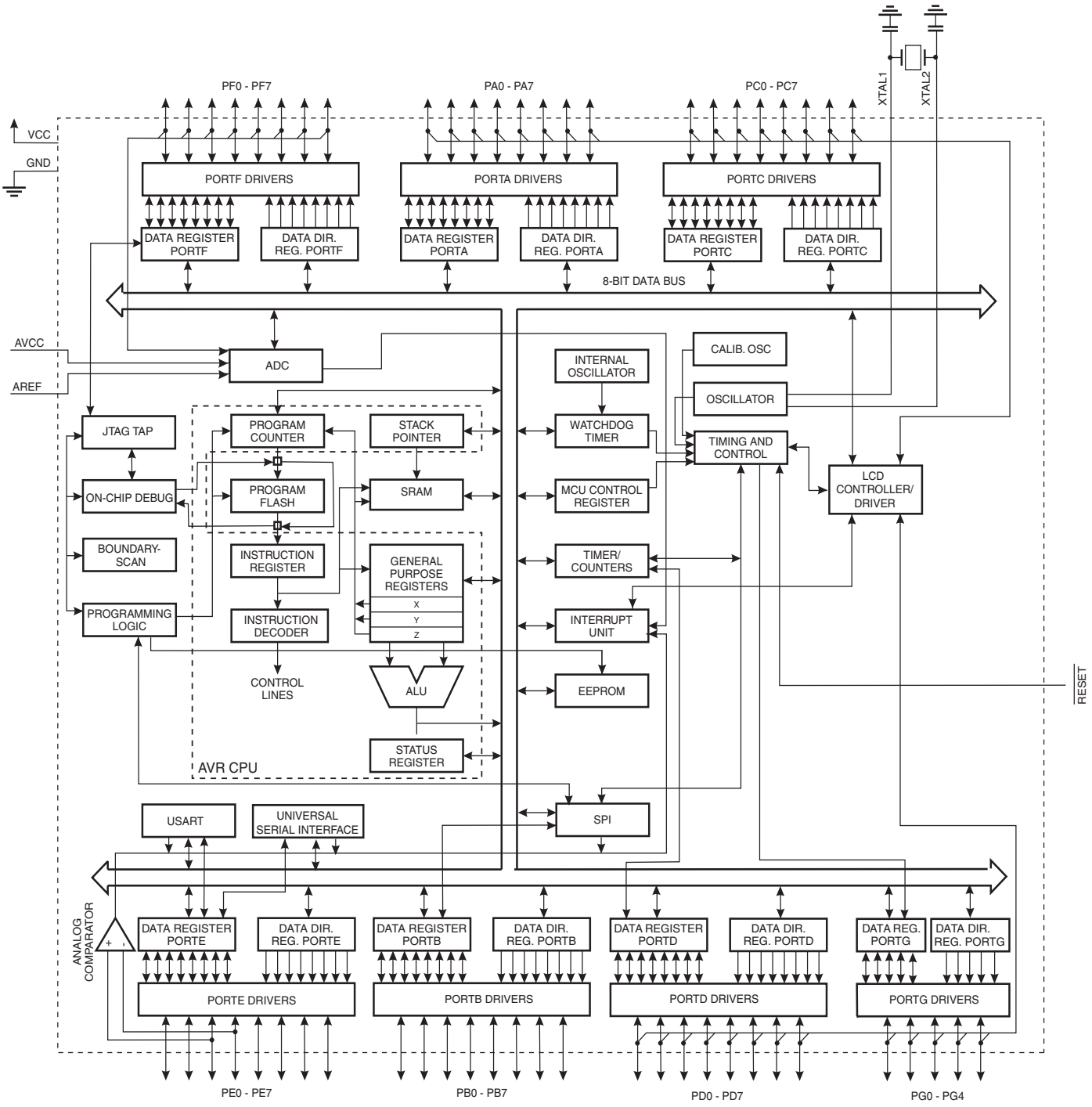
Typical values contained in this datasheet are based on simulations and characterization of other AVR microcontrollers manufactured on the same process technology. Min and Max values will be available after the device is characterized.

2. Overview

The ATmega169P 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 ATmega169P 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 ATmega169P provides the following features: 16K bytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes EEPROM, 1K byte SRAM, 53 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary-scan, On-chip Debugging support and programming, a complete On-chip LCD controller with internal step-up voltage, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, Universal Serial Interface with Start Condition Detector, an 8-channel, 10-bit ADC, a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer and the LCD controller continues to run, allowing the user to maintain a timer base and operate the LCD display while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer, LCD controller and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega169P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega169P 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.

2.2 Automotive Quality Grade

The ATmega169P 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 ATmega169P have been verified during regular product qualification as per AEC-Q100 grade 3.

As indicated in the ordering information paragraph, the products are available in industrial temperature grades, but with equivalent automotive quality and reliability objectives. Different temperature identifiers have been defined as listed in Table 2-1.

Table 2-1. Temperature Grade Identification for Automotive Products

Temperature	Temperature Identifier	Comments
-40 to +85°C	T	Similar to Industrial Temperature Grade but with Automotive Quality

3. Register Summary

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0xFF)	Reserved	–	–	–	–	–	–	–	–	
(0xFE)	LCDDR18	–	–	–	–	–	–	–	SEG324	248
(0xFD)	LCDDR17	SEG323	SEG322	SEG321	SEG320	SEG319	SEG318	SEG317	SEG316	248
(0xFC)	LCDDR16	SEG315	SEG314	SEG313	SEG312	SEG311	SEG310	SEG309	SEG308	248
(0xFB)	LCDDR15	SEG307	SEG306	SEG305	SEG304	SEG303	SEG302	SEG301	SEG300	248
(0xFA)	Reserved	–	–	–	–	–	–	–	–	
(0xF9)	LCDDR13	–	–	–	–	–	–	–	SEG224	248
(0xF8)	LCDDR12	SEG223	SEG222	SEG221	SEG220	SEG219	SEG218	SEG217	SEG216	248
(0xF7)	LCDDR11	SEG215	SEG214	SEG213	SEG212	SEG211	SEG210	SEG209	SEG208	248
(0xF6)	LCDDR10	SEG207	SEG206	SEG205	SEG204	SEG203	SEG202	SEG201	SEG200	248
(0xF5)	Reserved	–	–	–	–	–	–	–	–	
(0xF4)	LCDDR8	–	–	–	–	–	–	–	SEG124	248
(0xF3)	LCDDR7	SEG123	SEG122	SEG121	SEG120	SEG119	SEG118	SEG117	SEG116	248
(0xF2)	LCDDR6	SEG115	SEG114	SEG113	SEG112	SEG111	SEG110	SEG109	SEG108	248
(0xF1)	LCDDR5	SEG107	SEG106	SEG105	SEG104	SEG103	SEG102	SEG101	SEG100	248
(0xF0)	Reserved	–	–	–	–	–	–	–	–	
(0xEF)	LCDDR3	–	–	–	–	–	–	–	SEG024	248
(0xEE)	LCDDR2	SEG023	SEG022	SEG021	SEG020	SEG019	SEG018	SEG017	SEG016	248
(0xED)	LCDDR1	SEG015	SEG014	SEG013	SEG012	SEG011	SEG010	SEG09	SEG008	248
(0xEC)	LCDDR0	SEG007	SEG006	SEG005	SEG004	SEG003	SEG002	SEG001	SEG000	248
(0xEB)	Reserved	–	–	–	–	–	–	–	–	
(0xEA)	Reserved	–	–	–	–	–	–	–	–	
(0xE9)	Reserved	–	–	–	–	–	–	–	–	
(0xE8)	Reserved	–	–	–	–	–	–	–	–	
(0xE7)	LCDCCR	LCDDC2	LCDDC1	LCDDC0	LCDMDT	LCDCC3	LCDCC2	LCDCC1	LCDCC0	247
(0xE6)	LCDFRR	–	**LCDPS2**	**LCDPS1**	**LCDPS0**	–	**LCDCD2**	**LCDCD1**	**LCDCD0**	245
(0xE5)	LCDCRB	**LCDCS**	**LCD2B**	**LCDMUX1**	**LCDMUX0**	–	**LCDPM2**	**LCDPM1**	**LCDPM0**	244
(0xE4)	LCDCRA	**LCDEN**	**LCDAB**	**–**	**LCDIF**	**LCDIE**	LCDBD	LCDCCD	**LCDBL**	243
(0xE3)	Reserved	–	–	–	–	–	–	–	–	
(0xE2)	Reserved	–	–	–	–	–	–	–	–	
(0xE1)	Reserved	–	–	–	–	–	–	–	–	
(0xE0)	Reserved	–	–	–	–	–	–	–	–	
(0xDF)	Reserved	–	–	–	–	–	–	–	–	
(0xDE)	Reserved	–	–	–	–	–	–	–	–	
(0xDD)	Reserved	–	–	–	–	–	–	–	–	
(0xDC)	Reserved	–	–	–	–	–	–	–	–	
(0xDB)	Reserved	–	–	–	–	–	–	–	–	
(0xDA)	Reserved	–	–	–	–	–	–	–	–	
(0xD9)	Reserved	–	–	–	–	–	–	–	–	
(0xD8)	Reserved	–	–	–	–	–	–	–	–	
(0xD7)	Reserved	–	–	–	–	–	–	–	–	
(0xD6)	Reserved	–	–	–	–	–	–	–	–	
(0xD5)	Reserved	–	–	–	–	–	–	–	–	
(0xD4)	Reserved	–	–	–	–	–	–	–	–	
(0xD3)	Reserved	–	–	–	–	–	–	–	–	
(0xD2)	Reserved	–	–	–	–	–	–	–	–	
(0xD1)	Reserved	–	–	–	–	–	–	–	–	
(0xD0)	Reserved	–	–	–	–	–	–	–	–	
(0xCF)	Reserved	–	–	–	–	–	–	–	–	
(0xCE)	Reserved	–	–	–	–	–	–	–	–	
(0xCD)	Reserved	–	–	–	–	–	–	–	–	
(0xCC)	Reserved	–	–	–	–	–	–	–	–	
(0xCB)	Reserved	–	–	–	–	–	–	–	–	
(0xCA)	Reserved	–	–	–	–	–	–	–	–	
(0xC9)	Reserved	–	–	–	–	–	–	–	–	
(0xC8)	Reserved	–	–	–	–	–	–	–	–	
(0xC7)	Reserved	–	–	–	–	–	–	–	–	
(0xC6)	UDR0	USART0 I/O Data Register								190
(0xC5)	UBRRH0					USART0 Baud Rate Register High				194
(0xC4)	UBRRL0	USART0 Baud Rate Register Low								194
(0xC3)	Reserved	–	–	–	–	–	–	–	–	
(0xC2)	UCSR0C	–	UMSEL0	UPM01	UPM00	USBS0	UCSZ01	UCSZ00	UCPOL0	190
(0xC1)	UCSR0B	RXCIE0	TXCIE0	UDRIE0	RXEN0	TXEN0	UCSZ02	RXB80	TXB80	190
(0xC0)	UCSR0A	RXC0	TXC0	UDRE0	FE0	DOR0	UPE0	U2X0	MPCM0	190

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0xBF)	Reserved	–	–	–	–	–	–	–	–	
(0xBE)	Reserved	–	–	–	–	–	–	–	–	
(0xBD)	Reserved	–	–	–	–	–	–	–	–	
(0xBC)	Reserved	–	–	–	–	–	–	–	–	
(0xBB)	Reserved	–	–	–	–	–	–	–	–	
(0xBA)	USIDR	USI Data Register								207
(0xB9)	USISR	USISIF	USIOIF	USIPF	USIDC	USICNT3	USICNT2	USICNT1	USICNT0	207
(0xB8)	USICR	USISIE	USIOIE	USIWM1	USIWM0	USICS1	USICS0	USICLK	USITC	208
(0xB7)	Reserved	–		–	–	–	–	–	–	
(0xB6)	ASSR	–	–	–	EXCLK	AS2	TCN2UB	OCR2UB	TCR2UB	156
(0xB5)	Reserved	–	–	–	–	–	–	–	–	
(0xB4)	Reserved	–	–	–	–	–	–	–	–	
(0xB3)	OCR2A	Timer/Counter2 Output Compare Register A								155
(0xB2)	TCNT2	Timer/Counter2 (8-bit)								155
(0xB1)	Reserved	–	–	–	–	–	–	–	–	
(0xB0)	TCCR2A	FOC2A	WGM20	COM2A1	COM2A0	WGM21	CS22	CS21	CS20	153
(0xAF)	Reserved	–	–	–	–	–	–	–	–	
(0xAE)	Reserved	–	–	–	–	–	–	–	–	
(0xAD)	Reserved	–	–	–	–	–	–	–	–	
(0xAC)	Reserved	–	–	–	–	–	–	–	–	
(0xAB)	Reserved	–	–	–	–	–	–	–	–	
(0xAA)	Reserved	–	–	–	–	–	–	–	–	
(0xA9)	Reserved	–	–	–	–	–	–	–	–	
(0xA8)	Reserved	–	–	–	–	–	–	–	–	
(0xA7)	Reserved	–	–	–	–	–	–	–	–	
(0xA6)	Reserved	–	–	–	–	–	–	–	–	
(0xA5)	Reserved	–	–	–	–	–	–	–	–	
(0xA4)	Reserved	–	–	–	–	–	–	–	–	
(0xA3)	Reserved	–	–	–	–	–	–	–	–	
(0xA2)	Reserved	–	–	–	–	–	–	–	–	
(0xA1)	Reserved	–	–	–	–	–	–	–	–	
(0xA0)	Reserved	–	–	–	–	–	–	–	–	
(0x9F)	Reserved	–	–	–	–	–	–	–	–	
(0x9E)	Reserved	–	–	–	–	–	–	–	–	
(0x9D)	Reserved	–	–	–	–	–	–	–	–	
(0x9C)	Reserved	–	–	–	–	–	–	–	–	
(0x9B)	Reserved	–	–	–	–	–	–	–	–	
(0x9A)	Reserved	–	–	–	–	–	–	–	–	
(0x99)	Reserved	–	–	–	–	–	–	–	–	
(0x98)	Reserved	–	–	–	–	–	–	–	–	
(0x97)	Reserved	–	–	–	–	–	–	–	–	
(0x96)	Reserved	–	–	–	–	–	–	–	–	
(0x95)	Reserved	–	–	–	–	–	–	–	–	
(0x94)	Reserved	–	–	–	–	–	–	–	–	
(0x93)	Reserved	–	–	–	–	–	–	–	–	
(0x92)	Reserved	–	–	–	–	–	–	–	–	
(0x91)	Reserved	–	–	–	–	–	–	–	–	
(0x90)	Reserved	–	–	–	–	–	–	–	–	
(0x8F)	Reserved	–	–	–	–	–	–	–	–	
(0x8E)	Reserved	–	–	–	–	–	–	–	–	
(0x8D)	Reserved	–	–	–	–	–	–	–	–	
(0x8C)	Reserved	–	–	–	–	–	–	–	–	
(0x8B)	OCR1BH	Timer/Counter1 - Output Compare Register B High Byte								132
(0x8A)	OCR1BL	Timer/Counter1 - Output Compare Register B Low Byte								132
(0x89)	OCR1AH	Timer/Counter1 - Output Compare Register A High Byte								132
(0x88)	OCR1AL	Timer/Counter1 - Output Compare Register A Low Byte								132
(0x87)	ICR1H	Timer/Counter1 - Input Capture Register High Byte								133
(0x86)	ICR1L	Timer/Counter1 - Input Capture Register Low Byte								133
(0x85)	TCNT1H	Timer/Counter1 - Counter Register High Byte								132
(0x84)	TCNT1L	Timer/Counter1 - Counter Register Low Byte								132
(0x83)	Reserved	–	–	–	–	–	–	–	–	
(0x82)	TCCR1C	FOC1A	FOC1B	–	–	–	–	–	–	131
(0x81)	TCCR1B	ICNC1	ICES1	–	WGM13	WGM12	CS12	CS11	CS10	130
(0x80)	TCCR1A	COM1A1	COM1A0	COM1B1	COM1B0	–	–	WGM11	WGM10	128
(0x7F)	DIDR1	–	–	–	–	–	–	AIN1D	AIN0D	214
(0x7E)	DIDR0	ADC7D	ADC6D	ADC5D	ADC4D	ADC3D	ADC2D	ADC1D	ADC0D	231

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0x7D)	Reserved	–	–	–	–	–	–	–	–	
(0x7C)	ADMUX	REFS1	REFS0	ADLAR	MUX4	MUX3	MUX2	MUX1	MUX0	227
(0x7B)	ADCSRB	–	ACME	–	–	–	ADTS2	ADTS1	ADTS0	213, 231
(0x7A)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	229
(0x79)	ADCH	ADC Data Register High byte								230
(0x78)	ADCL	ADC Data Register Low byte								230
(0x77)	Reserved	–	–	–	–	–	–	–	–	
(0x76)	Reserved	–	–	–	–	–	–	–	–	
(0x75)	Reserved	–	–	–	–	–	–	–	–	
(0x74)	Reserved	–	–	–	–	–	–	–	–	
(0x73)	Reserved	–	–	–	–	–	–	–	–	
(0x72)	Reserved	–	–	–	–	–	–	–	–	
(0x71)	Reserved	–	–	–	–	–	–	–	–	
(0x70)	TIMSK2	–	–	–	–	–	–	OCIE2A	TOIE2	156
(0x6F)	TIMSK1	–	–	ICIE1	–	–	OCIE1B	OCIE1A	TOIE1	133
(0x6E)	TIMSK0	–	–	–	–	–	–	OCIE0A	TOIE0	104
(0x6D)	Reserved	–	–	–	–	–	–	–	–	
(0x6C)	PCMSK1	PCINT15	PCINT14	PCINT13	PCINT12	PCINT11	PCINT10	PCINT9	PCINT8	63
(0x6B)	PCMSK0	PCINT7	PCINT6	PCINT5	PCINT4	PCINT3	PCINT2	PCINT1	PCINT0	64
(0x6A)	Reserved	–	–	–	–	–	–	–	–	
(0x69)	EICRA	–	–	–	–	–	–	ISC01	ISC00	62
(0x68)	Reserved	–	–	–	–	–	–	–	–	
(0x67)	Reserved	–	–	–	–	–	–	–	–	
(0x66)	OSCCAL	Oscillator Calibration Register								38
(0x65)	Reserved	–	–	–	–	–	–	–	–	
(0x64)	PRR	–	–	–	PRLCD	PRTIM1	PRSPI	PRUSART0	PRADC	45
(0x63)	Reserved	–	–	–	–	–	–	–	–	
(0x62)	Reserved	–	–	–	–	–	–	–	–	
(0x61)	CLKPR	CLKPCE	–	–	–	CLKPS3	CLKPS2	CLKPS1	CLKPS0	38
(0x60)	WDTCR	–	–	–	WDCE	WDE	WDP2	WDP1	WDP0	54
0x3F (0x5F)	SREG	I	T	H	S	V	N	Z	C	13
0x3E (0x5E)	SPH	–	–	–	–	–	SP10	SP9	SP8	15
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	15
0x3C (0x5C)	Reserved									
0x3B (0x5B)	Reserved									
0x3A (0x5A)	Reserved									
0x39 (0x59)	Reserved									
0x38 (0x58)	Reserved									
0x37 (0x57)	SPMCSR	SPMIE	RWWSB	–	RWWSRE	BLBSET	PGWRT	PGERS	SPMEN	291
0x36 (0x56)	Reserved	–	–	–	–	–	–	–	–	
0x35 (0x55)	MCUCR	JTD	–	–	PUD	–	–	IVSEL	IVCE	60, 88, 276
0x34 (0x54)	MCUSR	–	–	–	JTRF	WDRF	BORF	EXTRF	PORF	276
0x33 (0x53)	SMCR	–	–	–	–	SM2	SM1	SM0	SE	45
0x32 (0x52)	Reserved	–	–	–	–	–	–	–	–	
0x31 (0x51)	OCDR	IDRD/OCDR7	OCDR6	OCDR5	OCDR4	OCDR3	OCDR2	OCDR1	OCDR0	255
0x30 (0x50)	ACSR	ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0	213
0x2F (0x4F)	Reserved	–	–	–	–	–	–	–	–	
0x2E (0x4E)	SPDR	SPI Data Register								167
0x2D (0x4D)	SPSR	SPIF	WCOL	–	–	–	–	–	SPI2X	166
0x2C (0x4C)	SPCR	SPIE	SPE	DORD	MSTR	CPOL	CPHA	SPR1	SPR0	165
0x2B (0x4B)	GPIOR2	General Purpose I/O Register 2								29
0x2A (0x4A)	GPIOR1	General Purpose I/O Register 1								29
0x29 (0x49)	Reserved	–	–	–	–	–	–	–	–	
0x28 (0x48)	Reserved	–	–	–	–	–	–	–	–	
0x27 (0x47)	OCR0A	Timer/Counter0 Output Compare Register A								104
0x26 (0x46)	TCNT0	Timer/Counter0 (8 Bit)								104
0x25 (0x45)	Reserved	–	–	–	–	–	–	–	–	
0x24 (0x44)	TCCR0A	FOC0A	WGM00	COM0A1	COM0A0	WGM01	CS02	CS01	CS00	102
0x23 (0x43)	GTCCR	TSM	–	–	–	–	–	PSR2	PSR10	137, 157
0x22 (0x42)	EEARH	–	–	–	–	–	–	–	EEAR8	27
0x21 (0x41)	EEARL	EEPROM Address Register Low Byte								27
0x20 (0x40)	EEDR	EEPROM Data Register								27
0x1F (0x3F)	EECR	–	–	–	–	EERIE	EEMWE	EEWE	EERE	27
0x1E (0x3E)	GPIOR0	General Purpose I/O Register 0								29
0x1D (0x3D)	EIMSK	PCIE1	PCIE0	–	–	–	–	–	INT0	62
0x1C (0x3C)	EIFR	PCIF1	PCIF0	–	–	–	–	–	INTF0	63

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
0x1B (0x3B)	Reserved	–	–	–	–	–	–	–	–	
0x1A (0x3A)	Reserved	–	–	–	–	–	–	–	–	
0x19 (0x39)	Reserved	–	–	–	–	–	–	–	–	
0x18 (0x38)	Reserved	–	–	–	–	–	–	–	–	
0x17 (0x37)	TIFR2	–	–	–	–	–	–	OCF2A	TOV2	156
0x16 (0x36)	TIFR1	–	–	ICF1	–	–	OCF1B	OCF1A	TOV1	134
0x15 (0x35)	TIFR0	–	–	–	–	–	–	OCF0A	TOV0	105
0x14 (0x34)	PORTG	–	–	PORTG5	PORTG4	PORTG3	PORTG2	PORTG1	PORTG0	90
0x13 (0x33)	DDRG	–	–	DDG5	DDG4	DDG3	DDG2	DDG1	DDG0	90
0x12 (0x32)	PING	–	–	PING5	PING4	PING3	PING2	PING1	PING0	90
0x11 (0x31)	PORTF	PORTF7	PORTF6	PORTF5	PORTF4	PORTF3	PORTF2	PORTF1	PORTF0	90
0x10 (0x30)	DDRF	DDF7	DDF6	DDF5	DDF4	DDF3	DDF2	DDF1	DDF0	90
0x0F (0x2F)	PINF	PINF7	PINF6	PINF5	PINF4	PINF3	PINF2	PINF1	PINF0	90
0x0E (0x2E)	PORTE	PORTE7	PORTE6	PORTE5	PORTE4	PORTE3	PORTE2	PORTE1	PORTE0	89
0x0D (0x2D)	DDRE	DDE7	DDE6	DDE5	DDE4	DDE3	DDE2	DDE1	DDE0	89
0x0C (0x2C)	PINE	PINE7	PINE6	PINE5	PINE4	PINE3	PINE2	PINE1	PINE0	90
0x0B (0x2B)	PORTD	PORTD7	PORTD6	PORTD5	PORTD4	PORTD3	PORTD2	PORTD1	PORTD0	89
0x0A (0x2A)	DDRD	DDD7	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0	89
0x09 (0x29)	PIND	PIND7	PIND6	PIND5	PIND4	PIND3	PIND2	PIND1	PIND0	89
0x08 (0x28)	PORTC	PORTC7	PORTC6	PORTC5	PORTC4	PORTC3	PORTC2	PORTC1	PORTC0	89
0x07 (0x27)	DDRC	DDC7	DDC6	DDC5	DDC4	DDC3	DDC2	DDC1	DDC0	89
0x06 (0x26)	PINC	PINC7	PINC6	PINC5	PINC4	PINC3	PINC2	PINC1	PINC0	89
0x05 (0x25)	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	88
0x04 (0x24)	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	88
0x03 (0x23)	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	88
0x02 (0x22)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	88
0x01 (0x21)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0	88
0x00 (0x20)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0	88

Note:
1. For compatibility with future devices, reserved bits should be written to zero if accessed. Reserved I/O memory addresses should never be written.
2. I/O Registers within the address range 0x00 - 0x1F are directly bit-accessible using the SBI and CBI instructions. In these registers, the value of single bits can be checked by using the SBIS and SBIC instructions.
3. Some of the Status Flags are cleared by writing a logical one to them. Note that, unlike most other AVRs, the CBI and SBI instructions will only operate on the specified bit, and can therefore be used on registers containing such Status Flags. The CBI and SBI instructions work with registers 0x00 to 0x1F only.
4. When using the I/O specific commands IN and OUT, the I/O addresses 0x00 - 0x3F must be used. When addressing I/O Registers as data space using LD and ST instructions, 0x20 must be added to these addresses. The ATmega169P is a complex microcontroller with more peripheral units than can be supported within the 64 location reserved in Opcode for the IN and OUT instructions. For the Extended I/O space from 0x60 - 0xFF in SRAM, only the ST/STS/STD and LD/LDS/LDD instructions can be used.

4. Ordering Information

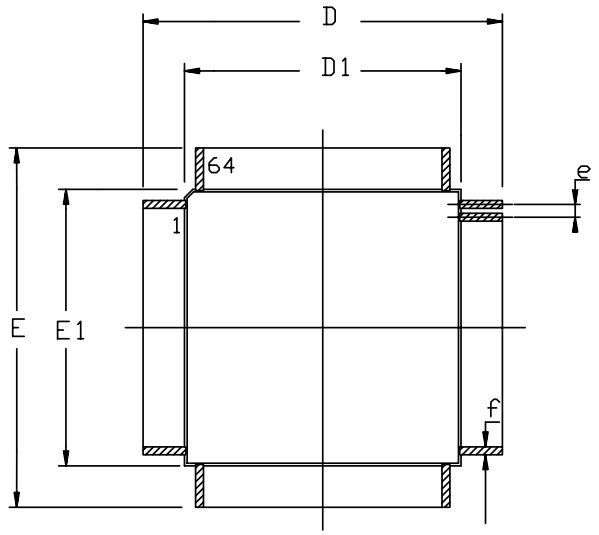
Speed (MHz)[2]	Power Supply	Ordering Code	Package[2]	Operation Range
16	2.7 - 5.5V	ATmega169P-15AT	MD	Automotive (-40°C to 85°C)

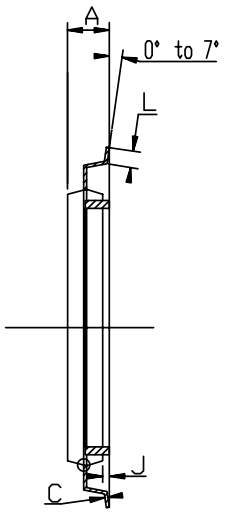
Notes: 1. Pb-free packaging, complies to the European Directive for Restriction of Hazardous Substances (RoHS directive). Also Halide free and fully Green.
2. For Speed vs. V_{CC}, see Figure 27-1 on page 327.

Package Type	
MD	64-Lead, Thin (1.0 mm) Profile Plastic Gull Wing Quad Flat Package (TQFP)

5. Packaging Information

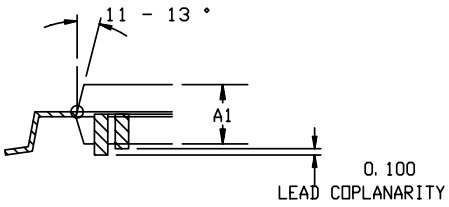
5.1 64A





COMMON DIMENSIONS IN MM

SYMBOL	Min	Max	NOTES
A	----	1.20	
A1	0.95	1.05	
C	0.09	0.20	
D	16.00 BSC		
D1	14.00 BSC		
E	16.00 BSC		
E1	14.00 BSC		
J	0.05	0.15	
L	0.45	0.75	
e	0.80 BSC		
f	0.30	0.45	



07/26/07

	TITLE	DRAWING No.	REV.
Atmel Nantes S.A. La Chantrerie - BP 70602 44306 Nantes Cedex 3 - France	MD, 64 - Lead, 14x14 mm Body Size, 1.0 mm Body Thickness 0.8 mm Lead Pitch, Thin Profile Plastic Quad Flat Package (TQFP)	MD	F

6. Errata

6.1 ATmega169P Rev. G

No known errata.

6.2 ATmega169P Rev. A to F

Not sampled.

7. Datasheet Revision History

Please note that the referring page numbers in this section are referring to this document. The referring revision in this section are referring to the document revision.

7.1 7735B

1. Remove ADC differential mode (Not validated for Automotive grade).
2. Update to electrical characteristics after product characterization.

7.2 7735A

New document number for automotive

1. Datasheet adapted to the Automotive grade (+85 ; -40°C) derived from ATmega169 industrial version.

   Automotive quality grade paragraph added.

   DC parameters changed to reflect actual silicon characterization results.

   Part numbering adapted with automotive -40°C; +85°C variants.

Atmel Corporation

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 487-2600

Regional Headquarters

Europe

Atmel Sarl
Route des Arsenaux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
Tel: (41) 26-426-5555
Fax: (41) 26-426-5500

Asia

Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimshatsui
East Kowloon
Hong Kong
Tel: (852) 2721-9778
Fax: (852) 2722-1369

Japan

9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
Tel: (81) 3-3523-3551
Fax: (81) 3-3523-7581

Atmel Operations

Memory

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

Microcontrollers

2325 Orchard Parkway
San Jose, CA 95131, USA
Tel: 1(408) 441-0311
Fax: 1(408) 436-4314

La Chantrerie
BP 70602
44306 Nantes Cedex 3, France
Tel: (33) 2-40-18-18-18
Fax: (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards

Zone Industrielle
13106 Rousset Cedex, France
Tel: (33) 4-42-53-60-00
Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Scottish Enterprise Technology Park
Maxwell Building
East Kilbride G75 0QR, Scotland
Tel: (44) 1355-803-000
Fax: (44) 1355-242-743

RF/Automotive

Theresienstrasse 2
Postfach 3535
74025 Heilbronn, Germany
Tel: (49) 71-31-67-0
Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd.
Colorado Springs, CO 80906, USA
Tel: 1(719) 576-3300
Fax: 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/
High Speed Converters/RF Datacom

Avenue de Rochepleine
BP 123
38521 Saint-Egreve Cedex, France
Tel: (33) 4-76-58-30-00
Fax: (33) 4-76-58-34-80

Literature Requests
www.atmel.com/literature

Printed on recycled paper.

7735B–AVR–12/07 xM