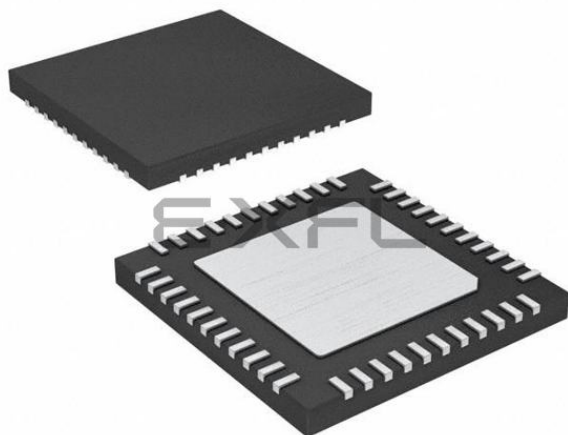




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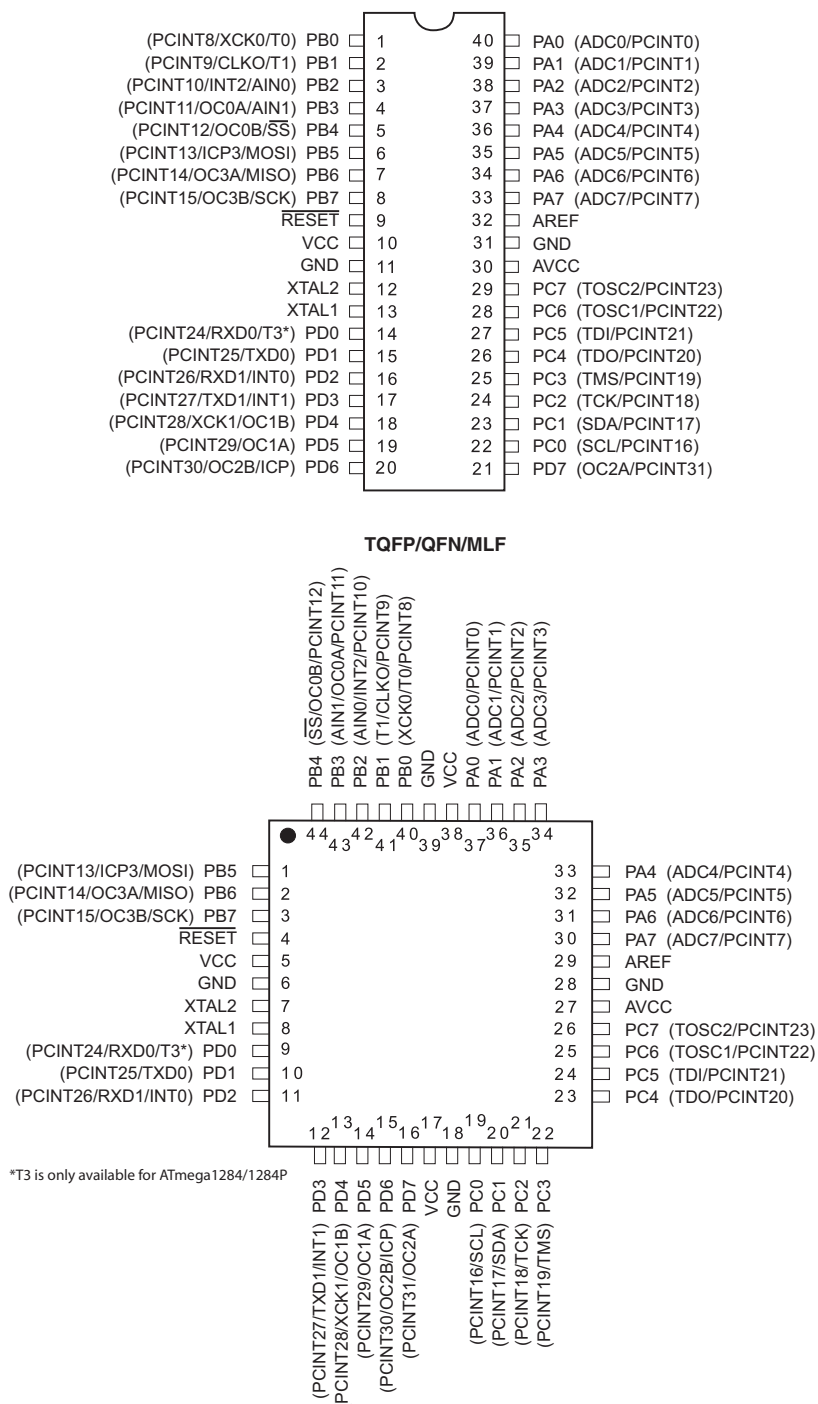
Details

Product Status	Active
Core Processor	AVR
Core Size	8-Bit
Speed	20MHz
Connectivity	I ² C, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	32
Program Memory Size	64KB (32K x 16)
Program Memory Type	FLASH
EEPROM Size	2K x 8
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 8x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	44-VFQFN Exposed Pad
Supplier Device Package	44-VQFN (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/atmega644a-mu

1. Pin configurations

1.1 Pinout - PDIP/TQFP/VQFN/QFN/MLF for ATmega164A/164PA/324A/324PA/644A/644PA/1284/1284P

Figure 1-1. Pinout.



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

1.2 Pinout - DRQFN for Atmel ATmega164A/164PA/324A/324PA

Figure 1-2. DRQFN - pinout.

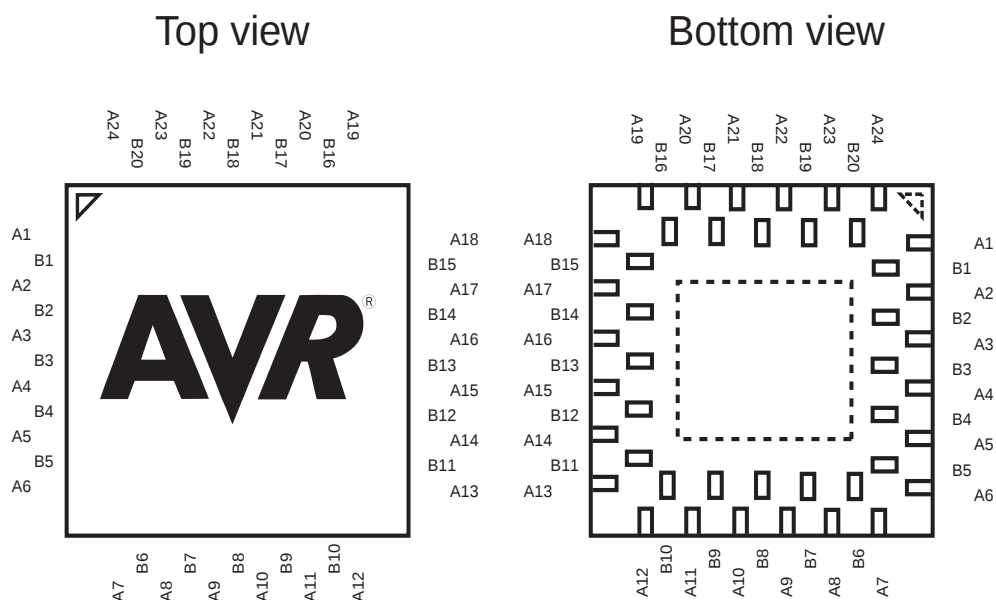
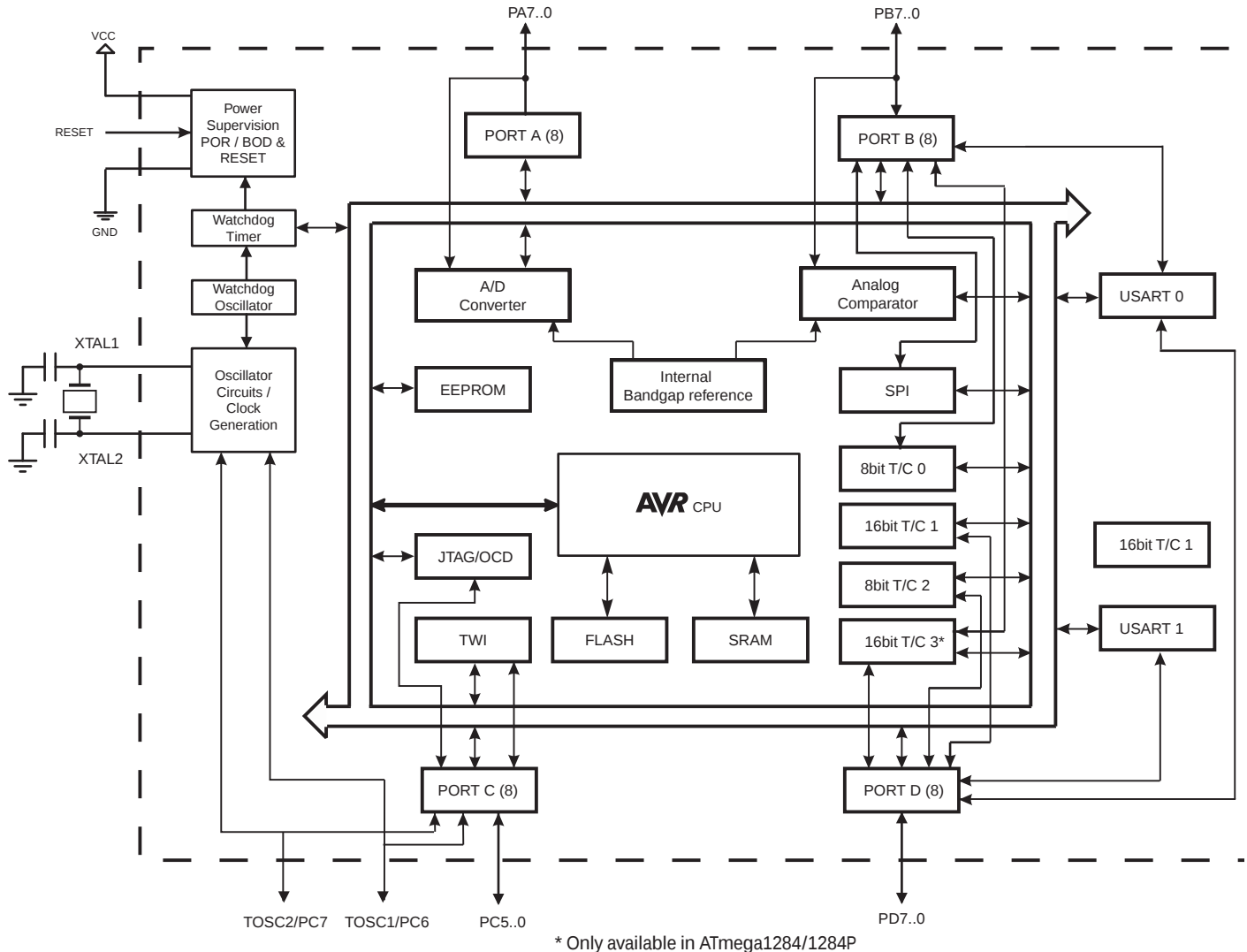


Table 1-1. DRQFN - pinout.

A1	PB5	A7	PD3	A13	PC4	A19	PA3
B1	PB6	B6	PD4	B11	PC5	B16	PA2
A2	PB7	A8	PD5	A14	PC6	A20	PA1
B2	RESET	B7	PD6	B12	PC7	B17	PA0
A3	VCC	A9	PD7	A15	AVCC	A21	VCC
B3	GND	B8	VCC	B13	GND	B18	GND
A4	XTAL2	A10	GND	A16	AREF	A22	PB0
B4	XTAL1	B9	PC0	B14	PA7	B19	PB1
A5	PD0	A11	PC1	A17	PA6	A23	PB2
B5	PD1	B10	PC2	B15	PA5	B20	PB3
A6	PD2	A12	PC3	A18	PA4	A24	PB4

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 Atmel ATmega164A/164PA/324A/324PA/644A/644PA/1284/1284P provide the following features:

16/32/64/128Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512/1K/2K/4Kbytes EEPROM, 1/2/4/16Kbytes SRAM, 32 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three (four for ATmega1284/1284P) flexible Timer/Counters with compare modes and PWM, 2 USARTs, a byte oriented two-wire Serial Interface, a 8-channel, 10-bit ADC with optional differential input stage with programmable gain, programmable Watchdog Timer with Internal Oscillator, an SPI serial port, IEEE std. 1149.1 compliant JTAG test interface, also used for accessing the On-chip Debug system and programming and six 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 continues to run, allowing the user to maintain a

timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer 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. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run.

Atmel offers the QTouch® library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression® (AKS™) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications.

The device is manufactured using Atmel's high-density nonvolatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile 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 ATmega164A/164PA/324A/324PA/644A/644PA/1284/1284P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.

The ATmega164A/164PA/324A/324PA/644A/644PA/1284/1284P 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 Comparison between ATmega164A, ATmega164PA, ATmega324A, ATmega324PA, ATmega644A, ATmega644PA, ATmega1284 and ATmega1284P

Table 2-1. Differences between ATmega164A, ATmega164PA, ATmega324A, ATmega324PA, ATmega644A, ATmega644PA, ATmega1284 and ATmega1284P.

Device	Flash	EEPROM	RAM	Units
ATmega164A	16K	512	1K	bytes
ATmega164PA	16K	512	1K	
ATmega324A	32K	1K	2K	
ATmega324PA	32K	1K	2K	
ATmega644A	64K	2K	4K	
ATmega644PA	64K	2K	4K	
ATmega1284	128K	4K	16K	
ATmega1284P	128K	4K	16K	

2.3 Pin Descriptions¹¹

2.3.1 VC

Digital supply voltage.

2.3.2 GND

Ground.

7. Register summary

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0xFF)	Reserved	-	-	-	-	-	-	-	-	
(0xFE)	Reserved	-	-	-	-	-	-	-	-	
(0xFD)	Reserved	-	-	-	-	-	-	-	-	
(0xFC)	Reserved	-	-	-	-	-	-	-	-	
(0xFB)	Reserved	-	-	-	-	-	-	-	-	
(0xFA)	Reserved	-	-	-	-	-	-	-	-	
(0xF9)	Reserved	-	-	-	-	-	-	-	-	
(0xF8)	Reserved	-	-	-	-	-	-	-	-	
(0xF7)	Reserved	-	-	-	-	-	-	-	-	
(0xF6)	Reserved	-	-	-	-	-	-	-	-	
(0xF5)	Reserved	-	-	-	-	-	-	-	-	
(0xF4)	Reserved	-	-	-	-	-	-	-	-	
(0xF3)	Reserved	-	-	-	-	-	-	-	-	
(0xF2)	Reserved	-	-	-	-	-	-	-	-	
(0xF1)	Reserved	-	-	-	-	-	-	-	-	
(0xF0)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xEF)	Reserved	-	-	-	-	-	-	-	-	
(0xEE)	Reserved	-	-	-	-	-	-	-	-	
(0xED)	Reserved	-	-	-	-	-	-	-	-	
(0xEC)	Reserved	-	-	-	-	-	-	-	-	
(0xEB)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xEA)	Reserved	-	-	-	-	-	-	-	-	
(0xE9)	Reserved	-	-	-	-	-	-	-	-	
(0xE8)	Reserved	-	-	-	-	-	-	-	-	
(0xE7)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xE6)	Reserved	-	-	-	-	-	-	-	-	
(0xE5)	Reserved	-	-	-	-	-	-	-	-	
(0xE4)	Reserved	-	-	-	-	-	-	-	-	
(0xE3)	Reserved	-	-	-	-	-	-	-	-	
(0xE2)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xE1)	Reserved	-	-	-	-	-	-	-	-	
(0xE0)	Reserved	-	-	-	-	-	-	-	-	
(0xDF)	Reserved	-	-	-	-	-	-	-	-	
(0xDE)	Reserved	-	-	-	-	-	-	-	-	
(0xDD)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xDC)	Reserved	-	-	-	-	-	-	-	-	
(0xDB)	Reserved	-	-	-	-	-	-	-	-	
(0xDA)	Reserved	-	-	-	-	-	-	-	-	
(0xD9)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xD8)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xD7)	Reserved	-	-	-	-	-	-	-	-	
(0xD6)	Reserved	-	-	-	-	-	-	-	-	
(0xD5)	Reserved	-	-	-	Reserved	-	-	-	-	
(0xD4)	Reserved	-	-	Reserved	-	-	-	-	-	
(0xD3)	Reserved	-	-	-	-	-	-	-	-	
(0xD2)	Reserved	-	-	-	-	-	-	-	-	
(0xD1)	Reserved	-	-	-	-	-	-	-	-	
(0xD0)	Reserved	-	-	-	-	-	-	-	-	
(0xCF)	Reserved	-	-	-	-	-	-	-	-	
(0xCE)	UDR1	USART1 I/O Data Register								185
(0xCD)	UBRR1H	-	-	-	-	USART1 Baud Rate Register High Byte				189/202
(0xCC)	UBRR1L	USART1 Baud Rate Register Low Byte								189/202
(0xCB)	Reserved	-	-	-	-	-	-	-	-	
(0xCA)	UCSR1C	UMSEL11	UMSEL10	UPM11	UPM10	USBS1	UCSZ11/UDORD0 ⁽⁵⁾	UCSZ10/UCPHA0 ⁽⁵⁾	UCPOL1	187/201
(0xC9)	UCSR1B	RXCIE1	TXCIE1	UDRIE1	RXEN1	TXEN1	UCSZ12	RXB81	TXB81	186/200
(0xC8)	UCSR1A	RXC1	TXC1	UDRE1	FE1	DOR1	UPE1	U2X1	MPCM1	185/200
(0xC7)	Reserved	-	-	-	-	-	-	-	-	
(0xC6)	UDR0	USART0 I/O Data Register								185
(0xC5)	UBRR0H	-	-	-	-	USART0 Baud Rate Register High Byte				189/202
(0xC4)	UBRR0L	USART0 Baud Rate Register Low Byte								189/202
(0xC3)	Reserved	-	-	-	-	-	-	-	-	
(0xC2)	UCSR0C	UMSEL01	UMSEL00	UPM01	UPM00	USBS0	UCSZ01/UDORD0 ⁽⁵⁾	UCSZ00/UCPHA0 ⁽⁵⁾	UCPOL0	187/201
(0xC1)	UCSR0B	RXCIE0	TXCIE0	UDRIE0	RXEN0	TXEN0	UCSZ02	RXB80	TXB80	186/200

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0xC0)	UCSR0A	RXC0	TXC0	UDRE0	FE0	DOR0	UPE0	U2X0	MPCM0	185/200
(0xBF)	Reserved	-	-	-	-	-	-	-	-	
(0xBE)	Reserved	-	-	-	-	-	-	-	-	
(0xBD)	TWAMR	TWAM6	TWAM5	TWAM4	TWAM3	TWAM2	TWAM1	TWAM0	-	231
(0xBC)	TWCR	TWINT	TWEA	TWSTA	TWSTO	TWWC	TWEN	-	TWIE	228
(0xBB)	TWDR	two-wire Serial Interface Data Register								230
(0xBA)	TWAR	TWA6	TWA5	TWA4	TWA3	TWA2	TWA1	TWA0	TWGCE	231
(0xB9)	TWSR	TWS7	TWS6	TWS5	TWS4	TWS3	-	TWPS1	TWPS0	229
(0xB8)	TWBR	two-wire Serial Interface Bit Rate Register								228
(0xB7)	Reserved	-	-	-	-	-	-	-	-	
(0xB6)	ASSR	-	EXCLK	AS2	TCN2UB	OCR2AUB	OCR2BUB	TCR2AUB	TCR2BUB	155
(0xB5)	Reserved	-	-	-	-	-	-	-	-	
(0xB4)	OCR2B	Timer/Counter2 Output Compare Register B								155
(0xB3)	OCR2A	Timer/Counter2 Output Compare Register A								155
(0xB2)	TCNT2	Timer/Counter2 (8 Bit)								154
(0xB1)	TCCR2B	FOC2A	FOC2B	-	-	WGM22	CS22	CS21	CS20	153
(0xB0)	TCCR2A	COM2A1	COM2A0	COM2B1	COM2B0	-	-	WGM21	WGM20	151
(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)	OCR3BH	Timer/Counter3 - Output Compare Register B High Byte ⁽⁷⁾								132
(0x9A)	OCR3BL	Timer/Counter3 - Output Compare Register B Low Byte ⁽⁷⁾								132
(0x99)	OCR3AH	Timer/Counter3 - Output Compare Register A High Byte ⁽⁷⁾								132
(0x98)	OCR3AL	Timer/Counter3 - Output Compare Register A Low Byte ⁽⁷⁾								132
(0x97)	ICR3H	Timer/Counter3 - Input Capture Register High Byte ⁽⁷⁾								133
(0x96)	ICR3L	Timer/Counter3 - Input Capture Register Low Byte ⁽⁷⁾								133
(0x95)	TCNT3H	Timer/Counter3 - Counter Register High Byte ⁽⁷⁾								132
(0x94)	TCNT3L	Timer/Counter3 - Counter Register Low Byte ⁽⁷⁾								132
(0x93)	Reserved	-	-	-	-	-	-	-	-	
(0x92)	TCCR3C	FOC3A	FOC3B	-	-	-	-	-	-	131
(0x91)	TCCR3B	ICNC3	ICES3	-	WGM33	WGM32	CS32	CS31	CS30	130
(0x90)	TCCR3A	COM3A1	COM3A0	COM3B1	COM3B0	-	-	WGM31	WGM30	128
(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	234
(0x7E)	DIDR0	ADC7D	ADC6D	ADC5D	ADC4D	ADC3D	ADC2D	ADC1D	ADC0D	253
(0x7D)	Reserved	-	-	-	-	-	-	-	-	

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0x7C)	ADMUX	REFS1	REFS0	ADLAR	MUX4	MUX3	MUX2	MUX1	MUX0	249
(0x7B)	ADCSRB	-	ACME	-	-	-	ADTS2	ADTS1	ADTS0	233
(0x7A)	ADCSRA	ADEN	ADSC	ADATE	ADIF	ADIE	ADPS2	ADPS1	ADPS0	250
(0x79)	ADCH	ADC Data Register High byte								251
(0x78)	ADCL	ADC Data Register Low byte								251
(0x77)	Reserved	-	-	-	-	-	-	-	-	
(0x76)	Reserved	-	-	-	-	-	-	-	-	
(0x75)	Reserved	-	-	-	-	-	-	-	-	
(0x74)	Reserved	-	-	-	-	-	-	-	-	
(0x73)	PCMSK3	PCINT31	PCINT30	PCINT29	PCINT28	PCINT27	PCINT26	PCINT25	PCINT24	70
(0x72)	Reserved	-	-	-	-	-	-	-	-	
(0x71)	TIMSK3	-	-	ICIE3	-	-	OCIE3B	OCIE3A	TOIE3	134
(0x70)	TIMSK2	-	-	-	-	-	OCIE2B	OCIE2A	TOIE2	156
(0x6F)	TIMSK1	-	-	ICIE1	-	-	OCIE1B	OCIE1A	TOIE1	134
(0x6E)	TIMSK0	-	-	-	-	-	OCIE0B	OCIE0A	TOIE0	105
(0x6D)	PCMSK2	PCINT23	PCINT22	PCINT21	PCINT20	PCINT19	PCINT18	PCINT17	PCINT16	70
(0x6C)	PCMSK1	PCINT15	PCINT14	PCINT13	PCINT12	PCINT11	PCINT10	PCINT9	PCINT8	70
(0x6B)	PCMSK0	PCINT7	PCINT6	PCINT5	PCINT4	PCINT3	PCINT2	PCINT1	PCINT0	71
(0x6A)	Reserved	-	-	-	-	-	-	-	-	
(0x69)	EICRA	-	-	ISC21	ISC20	ISC11	ISC10	ISC01	ISC00	67
(0x68)	PCICR	-	-	-	-	PCIE3	PCIE2	PCIE1	PCIE0	69
(0x67)	Reserved	-	-	-	-	-	-	-	-	
(0x66)	OSCCAL	Oscillator Calibration Register								40
(0x65)	PRR1	-	-	-	-	-	-	-	--PRTIM3	49
(0x64)	PRR0	PRTWI	PRTIM2	PRTIM0	PRUSART1	PRTIM1	PRSPI	PRUSART0	PRADC	48
(0x63)	Reserved	-	-	-	-	-	-	-	-	
(0x62)	Reserved	-	-	-	-	-	-	-	-	
(0x61)	CLKPR	CLKPCE	-	-	-	CLKPS3	CLKPS2	CLKPS1	CLKPS0	40
(0x60)	WDTCR	WDIF	WDIE	WDP3	WDCE	WDE	WDP2	WDP1	WDP0	59
0x3F (0x5F)	SREG	I	T	H	S	V	N	Z	C	11
0x3E (0x5E)	SPH	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	12
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	12
0x3C (0x5C)	Reserved	-	-	-	-	-	-	-	-	
0x3B (0x5B)	Reserved	-	-	-	-	-	-	-	-	
0x3A (0x5A)	Reserved	-	-	-	-	-	-	-	-	
0x39 (0x59)	Reserved	-	-	-	-	-	-	-	-	
0x38 (0x58)	Reserved	-	-	-	-	-	-	-	-	
0x37 (0x57)	SPMCSR	SPMIE	RWWSB	SIGRD	RWWSRE	BLBSET	PGWRT	PGERS	SPMEN	285
0x36 (0x56)	Reserved	-	-	-	-	-	-	-	-	
0x35 (0x55)	MCUCR	JTD	BODS ⁽⁶⁾	BODSE ⁽⁶⁾	PUD	-	-	IVSEL	IVCE	89/268
0x34 (0x54)	MCUSR	-	-	-	JTRF	WDRF	BORF	EXTRF	PORF	58/268
0x33 (0x53)	SMCR	-	-	-	-	SM2	SM1	SM0	SE	47
0x32 (0x52)	Reserved	-	-	-	-	-	-	-	-	
0x31 (0x51)	OCDR	On-Chip Debug Register								259
0x30 (0x50)	ACSR	ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0	250
0x2F (0x4F)	Reserved	-	-	-	-	-	-	-	-	
0x2E (0x4E)	SPDR	SPI 0 Data Register								166
0x2D (0x4D)	SPSR	SPIF0	WCOL0	-	-	-	-	-	SPI2X0	165
0x2C (0x4C)	SPCR	SPIE0	SPE0	DORD0	MSTR0	CPOL0	CPHA0	SPR01	SPR00	164
0x2B (0x4B)	GPOR2	General Purpose I/O Register 2								29
0x2A (0x4A)	GPOR1	General Purpose I/O Register 1								29
0x29 (0x49)	Reserved	-	-	-	-	-	-	-	-	
0x28 (0x48)	OCR0B	Timer/Counter0 Output Compare Register B								105
0x27 (0x47)	OCR0A	Timer/Counter0 Output Compare Register A								105
0x26 (0x46)	TCNT0	Timer/Counter0 (8 Bit)								105
0x25 (0x45)	TCCR0B	FOC0A	FOC0B	-	-	WGM02	CS02	CS01	CS00	104
0x24 (0x44)	TCCR0A	COM0A1	COM0A0	COM0B1	COM0B0	-	-	WGM01	WGM00	105
0x23 (0x43)	GTCCR	TSM	-	-	-	-	-	PSRASY	PSRSYNC	157
0x22 (0x42)	EEARH	-	-	-	-	EEPROM Address Register High Byte				24
0x21 (0x41)	EEARL	EEPROM Address Register Low Byte								24
0x20 (0x40)	EEDR	EEPROM Data Register								24
0x1F (0x3F)	EECR	-	-	EEPМ1	EEPМ0	EERIE	EEMPE	EEPE	EERE	24
0x1E (0x3E)	GPOR0	General Purpose I/O Register 0								29
0x1D (0x3D)	EIMSK	-	-	-	-	-	INT2	INT1	INT0	68
0x1C (0x3C)	EIFR	-	-	-	-	-	INTF2	INTF1	INTF0	68
0x1B (0x3B)	PCIFR	-	-	-	-	PCIF3	PCIF2	PCIF1	PCIF0	69
0x1A (0x3A)	Reserved	-	-	-	-	-	-	-	-	
0x19 (0x39)	Reserved	-	-	-	-	-	-	-	-	

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
0x18 (0x38)	TIFR3	-	-	ICF3	-	-	OCF3B	OCF3A	TOV3	136
0x17 (0x37)	TIFR2	-	-	-	-	-	OCF2B	OCF2A	TOV2	156
0x16 (0x36)	TIFR1	-	-	ICF1	-	-	OCF1B	OCF1A	TOV1	135
0x15 (0x35)	TIFR0	-	-	-	-	-	OCF0B	OCF0A	TOV0	106
0x14 (0x34)	Reserved	-	-	-	-	-	-	-	-	
0x13 (0x33)	Reserved	-	-	-	-	-	-	-	-	
0x12 (0x32)	Reserved	-	-	-	-	-	-	-	-	
0x11 (0x31)	Reserved	-	-	-	-	-	-	-	-	
0x10 (0x30)	Reserved	-	-	-	-	-	-	-	-	
0x0F (0x2F)	Reserved	-	-	-	-	-	-	-	-	
0x0E (0x2E)	Reserved	-	-	-	-	-	-	-	-	
0x0D (0x2D)	Reserved	-	-	-	-	-	-	-	-	
0x0C (0x2C)	Reserved	-	-	-	-	-	-	-	-	
0x0B (0x2B)	PORTD	PORTD7	PORTD6	PORTD5	PORTD4	PORTD3	PORTD2	PORTD1	PORTD0	90
0x0A (0x2A)	DDRD	DDD7	DDD6	DDD5	DDD4	DDD3	DDD2	DDD1	DDD0	90
0x09 (0x29)	PIND	PIND7	PIND6	PIND5	PIND4	PIND3	PIND2	PIND1	PIND0	90
0x08 (0x28)	PORTC	PORTC7	PORTC6	PORTC5	PORTC4	PORTC3	PORTC2	PORTC1	PORTC0	90
0x07 (0x27)	DDRC	DDC7	DDC6	DDC5	DDC4	DDC3	DDC2	DDC1	DDC0	90
0x06 (0x26)	PINC	PINC7	PINC6	PINC5	PINC4	PINC3	PINC2	PINC1	PINC0	90
0x05 (0x25)	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	89
0x04 (0x24)	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	89
0x03 (0x23)	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	90
0x02 (0x22)	PORTA	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	89
0x01 (0x21)	DDRA	DDA7	DDA6	DDA5	DDA4	DDA3	DDA2	DDA1	DDA0	89
0x00 (0x20)	PINA	PINA7	PINA6	PINA5	PINA4	PINA3	PINA2	PINA1	PINA0	89

- Notes:
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 \$00 - \$1F 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 the CBI and SBI instructions will operate on all bits in the I/O register, writing a one back into any flag read as set, thus clearing the flag. 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 \$00 - \$3F must be used. When addressing I/O registers as data space using LD and ST instructions, \$20 must be added to these addresses.
The ATmega164A/164PA/324A/324PA/644A/644PA/1284/1284P 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 \$60 - \$FF, only the ST/STS/STD and LD/LDS/LDD instructions can be used.
 5. USART in SPI Master Mode.
 6. Only available in the ATmega164PA/324PA/644PA/1284P.
 7. Only available in the ATmega1284/1284P

9.2 Atmel ATmega164PA

Speed [MHz] ⁽³⁾	Power supply	Ordering code ⁽²⁾	Package ⁽¹⁾	Operational range
20	1.8 - 5.5V	ATmega164PA-AU	44A	Industrial (-40°C to 85°C)
		ATmega164PA-AUR ⁽⁵⁾	44A	
		ATmega164PA-PU	40P6	
		ATmega164PA-MU	44M1	
		ATmega164PA-MUR ⁽⁵⁾	44M1	
		ATmega164PA-MCH ⁽⁴⁾	44MC	
		ATmega164PA-MCHR ⁽⁴⁾⁽⁵⁾	44MC	
		ATmega164PA-CU	49C2	
		ATmega164PA-CUR ⁽⁵⁾	49C2	
20	1.8 - 5.5V	ATmega164PA-AN	44A	Industrial (-40°C to 105°C)
		ATmega164PA-ANR ⁽⁵⁾	44A	
		ATmega164PA-PN	40P6	
		ATmega164PA-MN	44M1	
		ATmega164PA-MNR ⁽⁵⁾	44M1	

- 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 ["Speed grades" on page 324](#).
 4. NiPdAu Lead Finish.
 5. Tape & Reel.

Package Type	
44A	44-lead, Thin (1.0mm) Plastic Gull Wing Quad Flat Package (TQFP)
40P6	40-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44M1	44-pad, 7 × 7 × 1.0mm body, lead pitch 0.50mm, Thermally Enhanced Plastic Very Thin Quad Flat No-Lead (VQFN)
44MC	44-lead (2-row Staggered), 5 × 5 × 1.0mm body, 2.60 × 2.60mm Exposed Pad, Quad Flat No-Lead Package (QFN)
49C2	49-ball, (7 × 7 Array) 0.65mm Pitch, 5 × 5 × 1mm, Very Thin, Fine-Pitch Ball Grid Array Package (VFBGA)

9.3 Atmel ATmega324A

Speed [MHz] ⁽³⁾	Power supply	Ordering code ⁽²⁾	Package ⁽¹⁾	Operational range
20	1.8 - 5.5V	ATmega324A-AU ATmega324A-AUR ⁽⁵⁾ ATmega324A-PU ATmega324A-MU ATmega324A-MUR ⁽⁵⁾ ATmega324A-MCH ⁽⁴⁾ ATmega324A-MCHR ⁽⁴⁾⁽⁵⁾ ATmega324A-CU ATmega324A-CUR ⁽⁵⁾	44A 44A 40P6 44M1 44M1 44MC 44MC 49C2 49C2	Industrial (-40°C to 85°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 ["Speed grades" on page 324](#).
 4. NiPdAu Lead Finish.
 5. Tape & Reel.

Package Type	
44A	44-lead, Thin (1.0mm) Plastic Gull Wing Quad Flat Package (TQFP)
40P6	40-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44M1	44-pad, 7 × 7 × 1.0mm body, lead pitch 0.50mm, Thermally Enhanced Plastic Very Thin Quad Flat No-Lead (VQFN)
44MC	44-lead (2-row Staggered), 5 × 5 × 1.0mm body, 2.60 × 2.60mm Exposed Pad, Quad Flat No-Lead Package (QFN)
49C2	49-ball, (7 × 7 Array) 0.65mm Pitch, 5 × 5 × 1mm, Very Thin, Fine-Pitch Ball Grid Array Package (VFBGA)

9.4 Atmel ATmega324PA

Speed [MHz] ⁽³⁾	Power supply	Ordering code ⁽²⁾	Package ⁽¹⁾	Operational range
20	1.8 - 5.5V	ATmega324PA-AU	44A	Industrial (-40°C to 85°C)
		ATmega324PA-AUR ⁽⁵⁾	44A	
		ATmega324PA-PU	40P6	
		ATmega324PA-MU	44M1	
		ATmega324PA-MUR ⁽⁵⁾	44M1	
		ATmega324PA-MCH ⁽⁴⁾	44MC	
		ATmega324PA-MCHR ⁽⁴⁾⁽⁵⁾	44MC	
		ATmega324PA-CU	49C2	
20	1.8 - 5.5V	ATmega324PA-CUR ⁽⁵⁾	49C2	Industrial (-40°C to 105°C)
		ATmega324PA-AN	44A	
		ATmega324PA-ANR ⁽⁵⁾	44A	
		ATmega324PA-PN	40P6	
		ATmega324PA-MN	44M1	
		ATmega324PA-MNR ⁽⁵⁾	44M1	

- 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 ["Speed grades" on page 324](#).
 4. NiPdAu Lead Finish.
 5. Tape & Reel.

Package Type	
44A	44-lead, Thin (1.0mm) Plastic Gull Wing Quad Flat Package (TQFP)
40P6	40-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44M1	44-pad, 7 × 7 × 1.0mm body, lead pitch 0.50mm, Thermally Enhanced Plastic Very Thin Quad Flat No-Lead (VQFN)
44MC	44-lead (2-row Staggered), 5 × 5 × 1.0mm body, 2.60 × 2.60mm Exposed Pad, Quad Flat No-Lead Package (QFN)
49C2	49-ball, (7 × 7 Array) 0.65mm Pitch, 5 × 5 × 1mm, Very Thin, Fine-Pitch Ball Grid Array Package (VFBGA)

9.6 Atmel ATmega644PA

Speed [MHz] ⁽³⁾	Power supply	Ordering code ⁽²⁾	Package ⁽¹⁾	Operational range
20	1.8 - 5.5V	ATmega644PA-AU ATmega644PA-AUR ⁽⁴⁾ ATmega644PA-PU ATmega644PA-MU ATmega644PA-MUR ⁽⁴⁾	44A 44A 40P6 44M1 44M1	Industrial (-40°C to 85°C)
20	1.8 - 5.5V	ATmega644PA-AN ATmega644PA-ANR ⁽⁴⁾ ATmega644PA-PN ATmega644PA-MN ATmega644PA-MNR ⁽⁴⁾	44A 44A 40P6 44M1 44M1	Industrial (-40°C to 105°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 ["Speed grades" on page 324](#).
 4. Taper & Reel.

Package Type	
44A	44-lead, Thin (1.0mm) Plastic Gull Wing Quad Flat Package (TQFP)
40P6	40-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44M1	44-pad, 7 × 7 × 1.0mm body, lead pitch 0.50mm, Thermally Enhanced Plastic Very Thin Quad Flat No-Lead (VQFN)

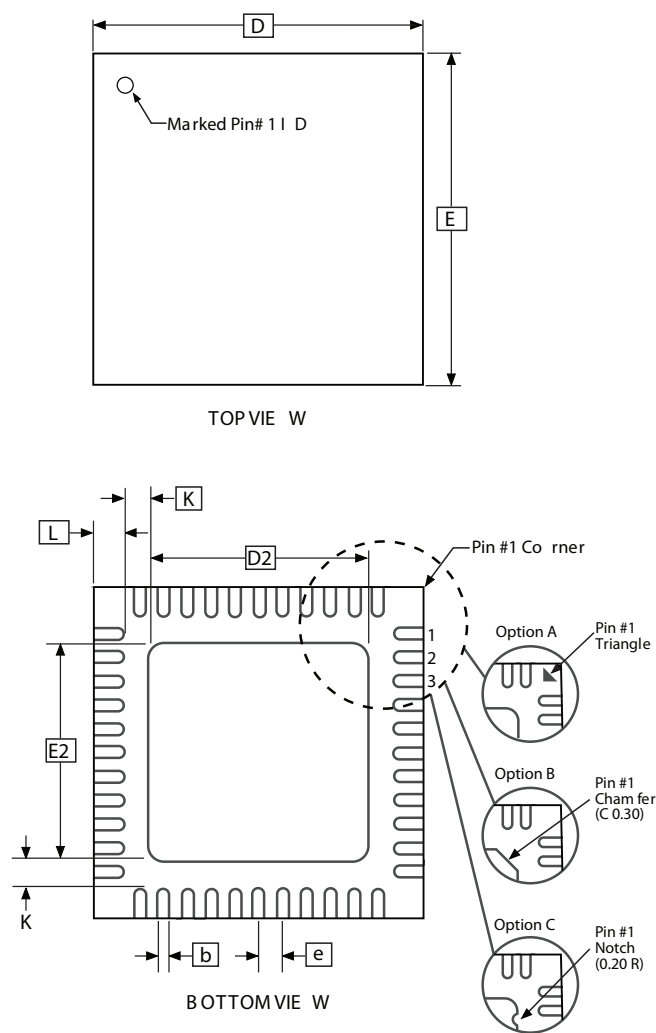
9.8 Atmel ATmega1284P

Speed [MHz] ⁽³⁾	Power supply	Ordering code ⁽²⁾	Package ⁽¹⁾	Operational range
20	1.8 - 5.5V	ATmega1284P-AU ATmega1284P-AUR ⁽⁴⁾ ATmega1284P-PU ATmega1284P-MU ATmega1284P-MUR ⁽⁴⁾	44A 44A 40P6 44M1 44M1	Industrial (-40°C to 85°C)
20	1.8 - 5.5V	ATmega1284P-AN ATmega1284P-ANR ⁽⁴⁾ ATmega1284P-PN ATmega1284P-MN ATmega1284P-MNR ⁽⁴⁾	44A 44A 40P6 44M1 44M1	Industrial (-40°C to 105°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 ["Speed grades" on page 324](#).
 4. Tape & Reel.

Package Type	
44A	44-lead, Thin (1.0mm) Plastic Gull Wing Quad Flat Package (TQFP)
40P6	40-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)
44M1	44-pad, 7 × 7 × 1.0mm body, lead pitch 0.50mm, Quad Flat No-Lead/Micro Lead Frame Package (QFN/MLF)

10.3 44M1



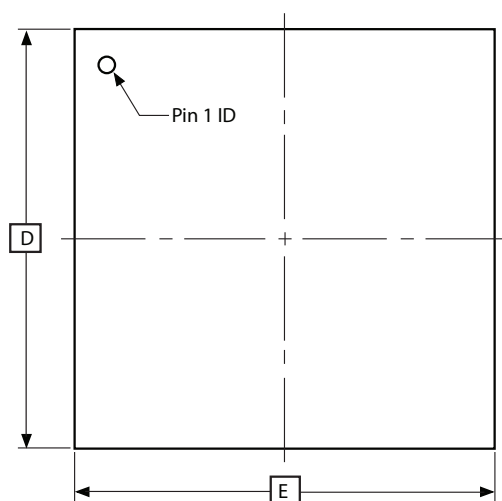
Note: JEDEC Standard MO-220, Fig . 1 (S AW Singulation) VKKD-3 .

COMMON DIMENSIONS (Unit of Measure = mm)				
SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.90	1.00	
A1	–	0.02	0.05	
A3	0.20 REF			
b	0.18	0.23	0.30	
D	6.90	7.00	7.10	
D2	5.00	5.20	5.40	
E	6.90	7.00	7.10	
E2	5.00	5.20	5.40	
e	0.50 BSC			
L	0.59	0.64	0.69	
K	0.20	0.26	0.41	

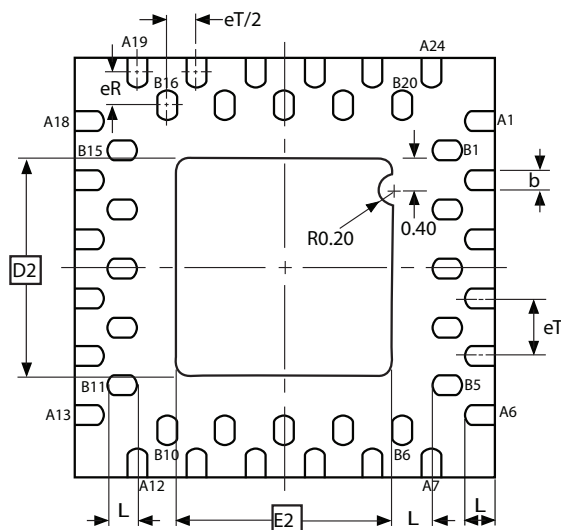
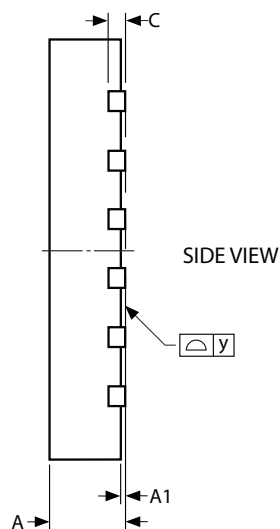
9/26/08

 Package Drawing Contact: avr@atmel.com	TITLE 44M1, 44-pad, 7 x 7 x 1.0mm body, lead pitch 0.50mm, 5.20mm exposed pad, thermally enhanced plastic very thin quad flat no lead package (VQFN)	GPC	DRAWING NO.	REV.
		ZWS	44M1	H

10.4 44MC



TOP VIEW



BOTTOM VIEW

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.90	1.00	
A1	0.00	0.02	0.05	
b	0.18	0.23	0.30	
C	0.20 REF			
D	4.90	5.00	5.10	
D2	2.55	2.60	2.65	
E	4.90	5.00	5.10	
E2	2.55	2.60	2.65	
eT	–	0.70	–	
eR	–	0.40	–	
K	0.45	–	–	
L	0.30	0.35	0.40	
y	0.00	–	0.075	

Note: 1. The terminal #1 ID is a Laser-marked Feature.

9/13/07



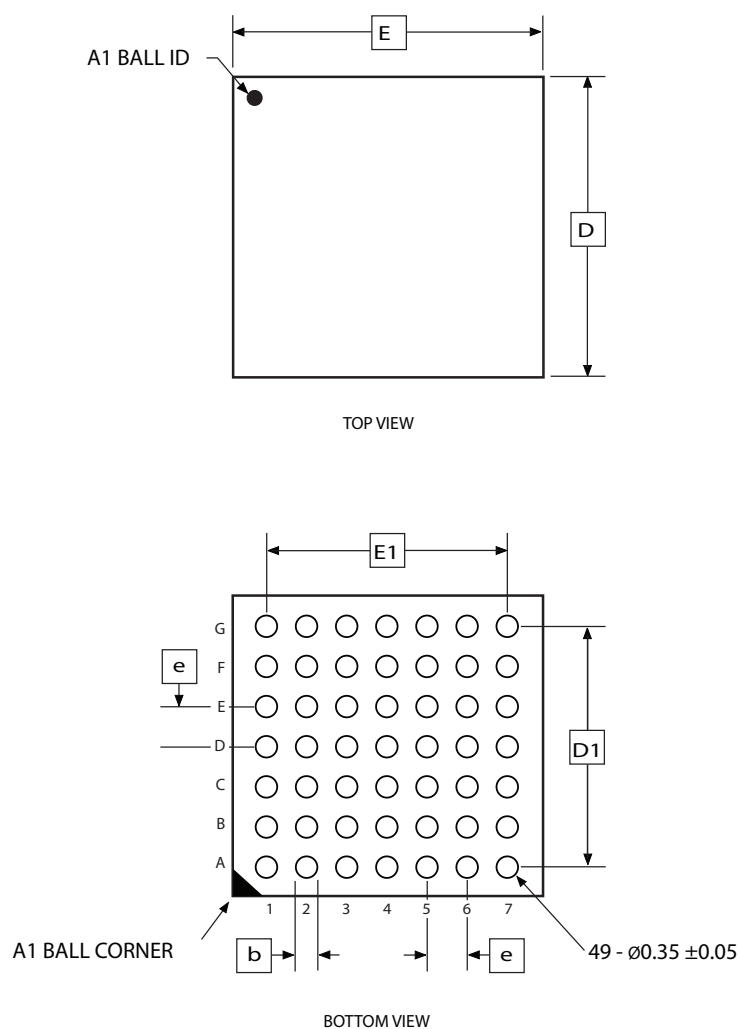
Package Drawing Contact:
packagedrawings@atmel.com

TITLE
44MC, 44QFN (2-Row Staggered), 5 x 5 x 1.00 mm Body,
2.60 x 2.60 mm Exposed Pad, Quad Flat No Lead Package

DRAWING NO .
44MC

REV .
A

10.5 49C2



COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.00	
A1	0.20	–	–	
A2	0.65	–	–	
D	4.90	5.00	5.10	
D1	3.90 BSC			
E4.90	5.00	5.10		
E1	3.90 BSC			
b	0.30	0.35	0.40	
e	0.65 BSC			

3/14/08



Package Drawing Contact:
packagedrawings@atmel.com

TITLE
49C2, 49-ball (7 x 7 array), 0.65mm pitch,
5.0 x 5.0 x 1.0mm, very thin, fine-pitch
ball grid array package (VFBGA)

GPC
CBD

DRAWING NO.
49C2

REV.
A

11. Errata

11.1 Errata for ATmega164A

11.1.1 Rev. E

No known Errata.

11.2 Errata for ATmega164PA

11.2.1 Rev. E

No known Errata.

11.3 Errata for ATmega324A

11.3.1 Rev. F

No known Errata.

11.4 Errata for ATmega324PA

11.4.1 Rev. F

No known Errata.

11.5 Errata for ATmega644A

11.5.1 Rev. F

No known Errata.

11.6 Errata for ATmega644PA

11.6.1 Rev. F

No known Errata.

11.7 Errata for ATmega1284

11.7.1 Rev. B

No known Errata.

11.8 Errata for ATmega1284P

11.8.1 Rev. B

No known Errata.

12. Added "OCR3AH and OCR3AL – Output Compare Register3 A" on page 133
13. Added "OCR3BH and OCR3BL – Output Compare Register3 B" on page 133
14. Added "TIMSK3 – Timer/Counter3 Interrupt Mask Register" on page 134
15. Updated All "SPI – Serial Peripheral Interface" "Register description" to reflect ATmega1284 and ATmega1284P.
16. Updated "Addressing the Flash During Self-Programming" on page 274 to include RAMPZ register.
17. Updated Table 27-16 on page 303. t_{WD_EEPROM} is 3.6ms instead of 9ms.
18. BODS and BODSE bits denoted as R/W
19. Description of external pin modes below table 16-9 removed.
20. Updated "Register summary" on page 10 to include Timer/Counter3.
21. Updated the datasheet with Atmel new style guide.

12.7 Rev. 8272A - 01/10

1. Initial revision (Based on the ATmega164PA/324PA/644PA/1284P datasheet 8252G-AVR-11/09 and on the ATmega644 datasheet 2593N-AVR-09/09).
2. Changes done:
 - Non-picoPower devices added: ATmega164A/324A/644A/1284
 - Updated Table 2-1 on page 7
 - Updated Table 10-1 on page 42
 - Updated "Sleep Modes" on page 42 and "BOD disable⁽¹⁾" on page 43
 - Updated "Register description" on page 67
 - Updated "USART" on page 167 and "USART in SPI mode" on page 194
 - Updated "Signature Bytes" on page 290 and "Page Size" on page 290
 - Added "DC Characteristics" on page 318 for non-picoPower devices.
 - Added "Atmel ATmega164A typical characteristics" on page 333
 - Added "Atmel ATmega324A typical characteristics" on page 386
 - Added "Atmel ATmega644A typical characteristics" on page 438
 - Added "ATmega1284 typical characteristics" on page 490
 - Added "Ordering information" on page 17 for non-picoPower devices
 - Added "Errata for ATmega164A" on page 30
 - Added "Errata for ATmega324A" on page 30
 - Added "Errata for ATmega644PA" on page 30
 - Added "Errata for ATmega1284" on page 30

