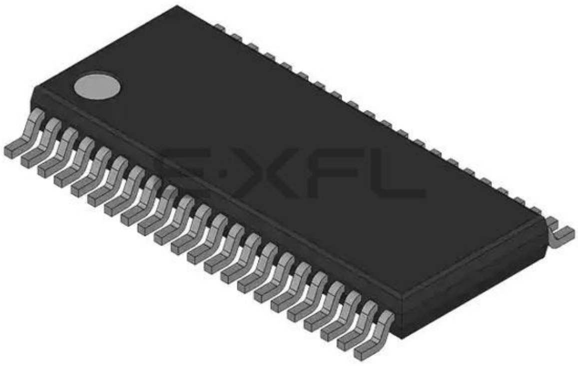

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What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	AVR
Core Size	8-Bit
Speed	8MHz
Connectivity	I²C, SPI
Peripherals	POR, WDT
Number of I/O	17
Program Memory Size	16KB (8K x 16)
Program Memory Type	FLASH
EEPROM Size	512 x 8
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	4V ~ 25V
Data Converters	A/D 7x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	44-TFSOP (0.173", 4.40mm Width)
Supplier Device Package	44-TSSOP
Purchase URL	https://www.e-xfl.com/product-detail/atmel/atmega16hvb-8x3r

1.2 Pin descriptions

1.2.1 VFET

High voltage supply pin. This pin is used as supply for the internal voltage regulator, described in ”Voltage regulator” on page 129.

1.2.2 VCLMP10

Internal 10V clamping of VFET voltage for external decoupling.

1.2.3 VCC

Digital supply voltage. Normally connected to VREG.

1.2.4 VREG

Output from the internal voltage regulator. Used for external decoupling to ensure stable regulator operation. For details, see ”Voltage regulator” on page 129.

1.2.5 VREF

Internal voltage reference for external decoupling. For details, see ”Voltage reference and temperature sensor” on page 122.

1.2.6 VREFGND

Ground for decoupling of internal voltage reference. For details, see ”Voltage reference and temperature sensor” on page 122. Do not connect to GND or SGND on PCB.

1.2.7 GND

Ground.

1.2.8 Port A (PA3..PA0)

Port A serves as a low-voltage 4-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). As inputs, Port A pins that are externally pulled low will source current if the pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port A also serves the functions of various special features of the Atmel ATmega16HVB/32HVB as listed in ”Alternate functions of Port A” on page 74.

1.2.9 Port B (PB7..PB0)

Port B is a low-voltage 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B also serves the functions of various special features of the ATmega16HVB/32HVB as listed in ”Alternate functions of Port B” on page 75.

1.2.10 Port C (PC5)

Port C (PC5) is a high voltage Open Drain output port.

1.2.11 Port C (PC4..PC0)

Port C is a 5-bit high voltage Open Drain bi-directional I/O port.

1.2.12 OC/OD

High voltage output to drive Charge/Discharge FET. For details, see ”FET driver” on page 145.

1.2.13 PI/NI

Filtered positive/negative input from external current sense resistor, used to by the Coulomb Counter ADC to measure charge/discharge currents flowing in the battery pack. For details, see ”Coulomb counter – Dedicated fuel gauging Sigma-Delta ADC” on page 108.

1.2.14 PPI/NNI

Unfiltered positive/negative input from external current sense resistor, used by the battery protection circuit, for over-current and short-circuit detection. For details, see ”Battery protection” on page 132.

1.2.15 NV/PV1/PV2/PV3/PV4

NV, PV1, PV2, PV3, and PV4 are the inputs for battery cells one, two, three and four, used by the Voltage ADC to measure each cell voltage. For details, see ”Voltage ADC – 7-channel general purpose 12-bit Sigma-Delta ADC” on page 116.

1.2.16 PVT

Defines the source voltage level for the Charge FET driver. For details, see ”FET driver” on page 145.

1.2.17 BATT

Input for detecting when a charger is connected. Defines the source voltage level for the Discharge FET driver. For details, see ”FET driver” on page 145.

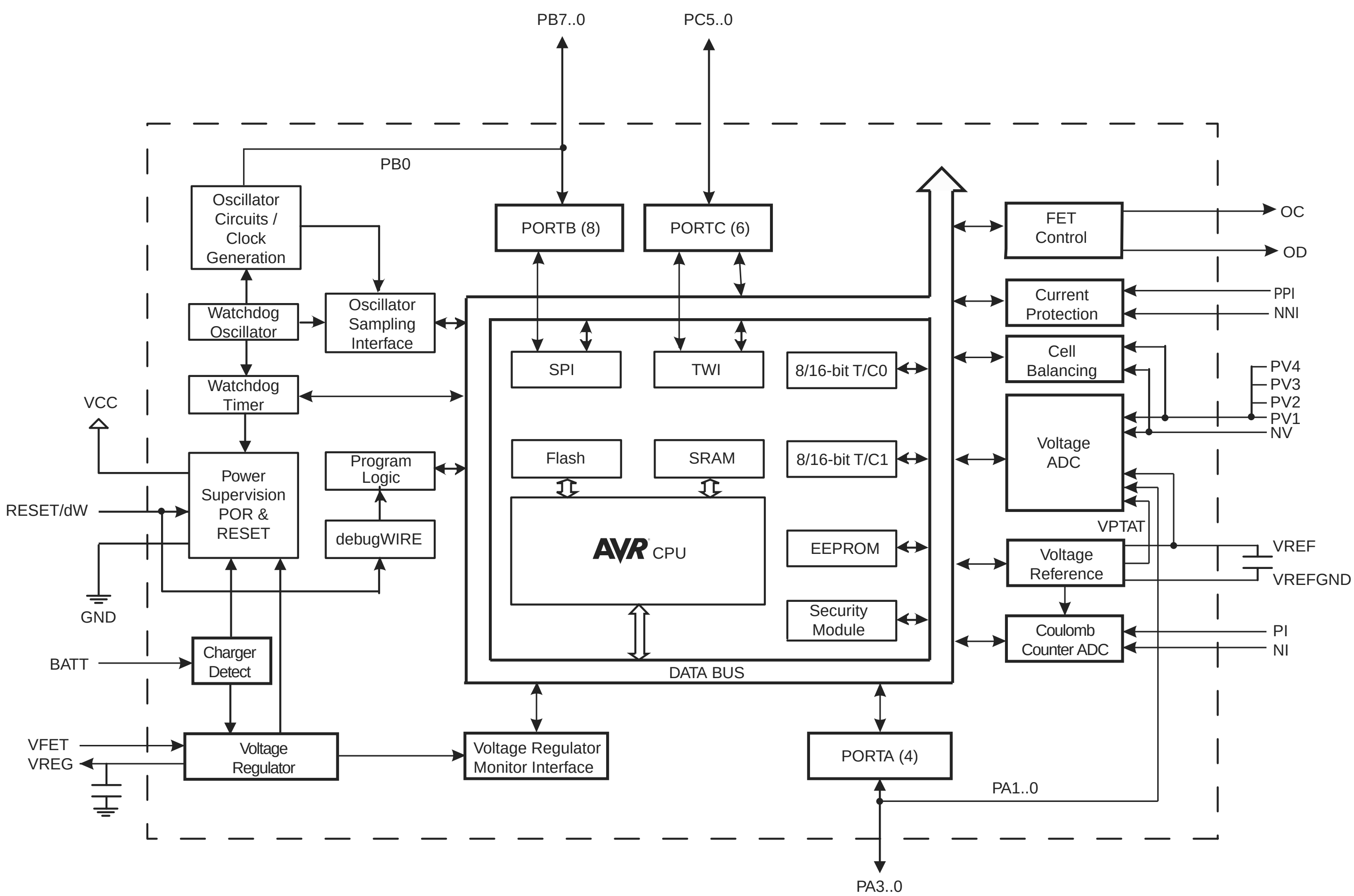
1.2.18 $\overline{\text{RESET}}$/dw

Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in Table 32-3 on page 227. Shorter pulses are not guaranteed to generate a reset. This pin is also used as debugWIRE communication pin.

2. Overview

The Atmel ATmega16HVB/32HVB is a monitoring and protection circuit for 3- and 4-cell Li-ion applications with focus on highest safety including safe authentication, low cost and high utilization of the cell energy. The device contains secure authentication features as well as autonomous battery protection during charging and discharging. The External Protection Input can be used to implement other battery protection mechanisms using external components, for example, protection against chargers with too high charge voltage can be easily implemented with a few low cost passive components. The feature set makes the ATmega16HVB/32HVB a key component in any system focusing on high security, battery protection, high system utilization and low cost.

Figure 2-1. Block diagram.



ATmega16HVB/32HVB provides the necessary redundancy on-chip to make sure that the battery is protected in critical failure modes. The chip is specifically designed to provide safety for the battery cells in case of pin shorting, loss of power (either caused by battery pack short or VCC short), illegal charger connection or software runaway. This makes ATmega16HVB/32HVB the ideal one-chip solution for applications with focus on high safety.

The ATmega16HVB/32HVB features an integrated voltage regulator that operates at a wide range of input voltages, 4 - 18 volts. This voltage is regulated to a constant supply voltage of nominally 3.3 volts for the integrated logic and analog functions. The regulator capabilities, combined with an extremely low power consumption in the power saving modes, greatly enhances the cell energy utilization compared to existing solutions.

The chip utilizes the Atmel patented Deep Under-voltage Recovery (DUVR) mode that supports pre-charging of deeply discharged battery cells without using a separate Pre-charge FET. DUVR mode cannot be used in 2-cell applications. Optionally, Pre-charge FETs are supported for integration into many existing battery charging schemes.

The battery protection monitors the charge and discharge current to detect illegal conditions and protect the battery from these when required. A 12-bit Voltage ADC allows software to monitor each cell voltage individually with high accuracy. The ADC also provides one internal input channel to measure on-chip temperature and two input channels intended for external thermistors. An 18-bit ADC optimized for Coulomb Counting accumulates charge and discharge currents and reports accumulated current with high resolution and accuracy. It can also be used to provide instantaneous current measurements with 13-bit resolution. Integrated Cell Balancing FETs allow cell balancing algorithms to be implemented in software.

The MCU provides the following features: 16K/32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512/1Kbytes EEPROM, 1K/2Kbytes SRAM. 32 general purpose working registers, 12 general purpose I/O lines, five general purpose high voltage open drain I/O lines, one general purpose super high voltage open drain output, debugWIRE for on-chip debugging and SPI for In-system Programming, a SM-Bus compliant TWI module, two flexible Timer/Counters with Input Capture and compare modes.

Internal and external interrupts, a 12-bit Sigma Delta ADC for voltage and temperature measurements, a high resolution Sigma Delta ADC for Coulomb Counting and instantaneous current measurements, integrated cell balancing FETs, Additional Secure Authentication Features, an autonomous Battery Protection module, a programmable Watchdog Timer with internal Oscillator, and software selectable power saving modes.

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 device is manufactured using the Atmel high voltage 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 and highly accurate analog front-end in a monolithic chip.

The Atmel ATmega16HVB/32HVB is a powerful microcontroller that provides a highly flexible and cost effective solution. It is part of the AVR Battery Management family that provides secure authentication, highly accurate monitoring and autonomous protection for Lithium-ion battery cells.

The ATmega16HVB/32HVB AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, and On-chip Debugger.

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)	BPPLR	–	–	–	–	–	–	BPPLE	BPPL	137
(0xFD)	BPCR	–	–	EPID	SCD	DOCD	COCD	DHCD	CHCD	138
(0xFC)	BPHCTR	–	–	HCPT[5:0]						140
(0xFB)	BPOCTR	–	–	OCPT[5:0]						139
(0xFA)	BPSCTR	–	SCPT[6:0]							139
(0xF9)	BPCHCD	CHCDL[7:0]								142
(0xF8)	BPDHCD	DHCDL[7:0]								142
(0xF7)	BPCOCD	COCDL[7:0]								142
(0xF6)	BPDOCD	DOCDL[7:0]								141
(0xF5)	BPSCD	SCDL[7:0]								141
(0xF4)	Reserved	–	–	–	–	–	–	–	–	
(0xF3)	BPIFR	–	–	–	SCIF	DOCIF	COCIF	DHCIF	CHCIF	144
(0xF2)	BPIMSK	–	–	–	SCIE	DOCIE	COCIE	DHCIE	CHCIE	143
(0xF1)	CBCR	–	–	–	–	CBE4	CBE3	CBE2	CBE1	152
(0xF0)	FCSR	–	–	–	–	DUVRD	CPS	DFE	CFE	149
(0xEF)	Reserved	–	–	–	–	–	–	–	–	
(0xEE)	Reserved	–	–	–	–	–	–	–	–	
(0xED)	Reserved	–	–	–	–	–	–	–	–	
(0xEC)	Reserved	–	–	–	–	–	–	–	–	
(0xEB)	Reserved	–	–	–	–	–	–	–	–	
(0xEA)	CADRDC	CADRDC[7:0]								115
(0xE9)	CADRCC	CADRCC[7:0]								114
(0xE8)	CADCSRC	-	-	-	-	-	-	-	CADVSE	114
(0xE7)	CADCSRB	–	CADACIE	CADRCIE	CADICIE	–	CADACIF	CADRCIF	CADICIF	112
(0xE6)	CADCSRA	CADEN	CADPOL	CADUB	CADAS[1:0]		CADSI[1:0]		CADSE	111
(0xE5)	CADICH	CADIC[15:8]								114
(0xE4)	CADICL	CADIC[7:0]								114
(0xE3)	CADAC3	CADAC[31:24]								114
(0xE2)	CADAC2	CADAC[23:16]								114
(0xE1)	CADAC1	CADAC[15:8]								114
(0xE0)	CADAC0	CADAC[7:0]								114
(0xDF)	Reserved	–	–	–	–	–	–	–	–	
(0xDE)	Reserved	–	–	–	–	–	–	–	–	
(0xDD)	Reserved	–	–	–	–	–	–	–	–	
(0xDC)	Reserved	–	–	–	–	–	–	–	–	
(0xDB)	Reserved	–	–	–	–	–	–	–	–	
(0xDA)	Reserved	–	–	–	–	–	–	–	–	
(0xD9)	Reserved	–	–	–	–	–	–	–	–	
(0xD8)	Reserved	–	–	–	–	–	–	–	–	
(0xD7)	Reserved	–	–	–	–	–	–	–	–	
(0xD6)	Reserved	–	–	–	–	–	–	–	–	
(0xD5)	Reserved	–	–	–	–	–	–	–	–	
(0xD4)	CHGDCSR	–	–	–	BATTPVL	CHGDISC1	CHGDISC1	CHGDIF	CHGDIE	128
(0xD3)	Reserved	–	–	–	–	–	–	–	–	
(0xD2)	BGCSR	–	–	BGD	BGSCDE	–	–	BGSCDIF	BGSCDIE	125
(0xD1)	BGCRR	BGCR[7:0]								124
(0xD0)	BGCCR	–	–	BGCC[5:0]						9
(0xCF)	Reserved	–	–	–	–	–	–	–	–	
(0xCE)	Reserved	–	–	–	–	–	–	–	–	
(0xCD)	Reserved	–	–	–	–	–	–	–	–	
(0xCC)	Reserved	–	–	–	–	–	–	–	–	
(0xCB)	Reserved	–	–	–	–	–	–	–	–	
(0xCA)	Reserved	–	–	–	–	–	–	–	–	
(0xC9)	Reserved	–	–	–	–	–	–	–	–	
(0xC8)	ROCR	ROCS	–	–	ROCD	–	–	ROCWIF	ROCWIE	131
(0xC7)	Reserved	–	–	–	–	–	–	–	–	
(0xC6)	Reserved	–	–	–	–	–	–	–	–	
(0xC5)	Reserved	–	–	–	–	–	–	–	–	
(0xC4)	Reserved	–	–	–	–	–	–	–	–	
(0xC3)	Reserved	–	–	–	–	–	–	–	–	
(0xC2)	Reserved	–	–	–	–	–	–	–	–	
(0xC1)	Reserved	–	–	–	–	–	–	–	–	
(0xC0)	Reserved	–	–	–	–	–	–	–	–	

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0xBF)	Reserved	–	–	–	–	–	–	–	–	
(0xBE)	TWBCSR	TWBCIF	TWBCIE	–	–	–	TWBDT1	TWBDT0	TWBCIP	184
(0xBD)	TWAMR	TWAM[6:0]							–	184
(0xBC)	TWCR	TWINT	TWEA	TWSTA	TWSTO	TWWC	TWEN	–	TWIE	181
(0xBB)	TWDR	2–wire Serial Interface Data Register								183
(0xBA)	TWAR	TWA[6:0]							TWGCE	183
(0xB9)	TWSR	TWS[7:3]					–	TWPS1	TWPS0	182
(0xB8)	TWBR	2–wire Serial Interface Bit Rate Register								181
(0xB7)	Reserved	–		–	–	–	–	–	–	
(0xB6)	Reserved	–	–	–	–	–	–	–	–	
(0xB5)	Reserved	–	–	–	–	–	–	–	–	
(0xB4)	Reserved	–	–	–	–	–	–	–	–	
(0xB3)	Reserved	–	–	–	–	–	–	–	–	
(0xB2)	Reserved	–	–	–	–	–	–	–	–	
(0xB1)	Reserved	–	–	–	–	–	–	–	–	
(0xB0)	Reserved	–	–	–	–	–	–	–	–	
(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)	Reserved	–	–	–	–	–	–	–	–	
(0x8A)	Reserved	–	–	–	–	–	–	–	–	
(0x89)	OCR1B	Timer/Counter1 – Output Compare Register B								95
(0x88)	OCR1A	Timer/Counter1 – Output Compare Register A								95
(0x87)	Reserved	–	–	–	–	–	–	–	–	
(0x86)	Reserved	–	–	–	–	–	–	–	–	
(0x85)	TCNT1H	Timer/Counter1 (8 Bit) High Byte								95
(0x84)	TCNT1L	Timer/Counter1 (8 Bit) Low Byte								95
(0x83)	Reserved	–	–	–	–	–	–	–	–	
(0x82)	Reserved	–	–	–	–	–	–	–	–	
(0x81)	TCCR1B	–	–	–	–	–	CS12	CS11	CS10	81
(0x80)	TCCR1A	TCW1	ICEN1	ICNC1	ICES1	ICS1	–	–	WGM10	94
(0x7F)	Reserved	–	–	–	–	–	–	–	–	
(0x7E)	DIDR0	–	–	–	–	–	–	PA1DID	PA0DID	121

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
(0x7D)	Reserved	–	–	–	–	–	–	–	–	
(0x7C)	VADMUX	–	–	–	–	VADMUX[3:0]				119
(0x7B)	Reserved	–	–	–	–	–	–	–	–	
(0x7A)	VADCSR	–	–	–	–	VADEN	VADSC	VADCCIF	VADCCIE	119
(0x79)	VADCH	–	–	–	–	VADC Data Register High byte				120
(0x78)	VADCL	VADC Data Register Low byte								120
(0x77)	Reserved	–	–	–	–	–	–	–	–	
(0x76)	Reserved	–	–	–	–	–	–	–	–	
(0x75)	Reserved	–	–	–	–	–	–	–	–	
(0x74)	Reserved	–	–	–	–	–	–	–	–	
(0x73)	Reserved	–	–	–	–	–	–	–	–	
(0x72)	Reserved	–	–	–	–	–	–	–	–	
(0x71)	Reserved	–	–	–	–	–	–	–	–	
(0x70)	Reserved	–	–	–	–	–	–	–	–	
(0x6F)	TIMSK1	–	–	–	–	ICIE1	OCIE1B	OCIE1A	TOIE1	96
(0x6E)	TIMSK0	–	–	–	–	ICIE0	OCIE0B	OCIE0A	TOIE0	96
(0x6D)	Reserved	–	–	–	–	–	–	–	–	
(0x6C)	PCMSK1	PCINT[15:8]								60
(0x6B)	PCMSK0	–	–	–	–	PCINT[3:0]				61
(0x6A)	Reserved	–	–	–	–	–	–	–	–	
(0x69)	EICRA	ISC31	ISC30	ISC21	ISC20	ISC11	ISC10	ISC01	ISC00	58
(0x68)	PCICR	–	–	–	–	–	–	PCIE1	PCIE0	60
(0x67)	Reserved	–	–	–	–	–	–	–	–	
(0x66)	FOSCCAL	Fast Oscillator Calibration Register								32
(0x65)	Reserved	–	–	–	–	–	–	–	–	
(0x64)	PRR0	–	PRTWI	PRVRM	–	PRSPI	PRTIM1	PRTIM0	PRVADC	40
(0x63)	Reserved	–	–	–	–	–	–	–	–	
(0x62)	Reserved	–	–	–	–	–	–	–	–	
(0x61)	CLKPR	CLKPCE	–	–	–	–	–	CLKPS1	CLKPS0	32
(0x60)	WDTCSR	WDIF	WDIE	WDP3	WDCE	WDE	WDP2	WDP1	WDP0	49
0x3F (0x5F)	SREG	I	T	H	S	V	N	Z	C	10
0x3E (0x5E)	SPH	SP15	SP14	SP13	SP12	SP11	SP10	SP9	SP8	13
0x3D (0x5D)	SPL	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	13
0x3C (0x5C)	Reserved	–	–	–	–	–	–	–	–	
0x3B (0x5B)	Reserved	–	–	–	–	–	–	–	–	
0x3A (0x5A)	Reserved	–	–	–	–	–	–	–	–	
0x39 (0x59)	Reserved	–	–	–	–	–	–	–	–	
0x38 (0x58)	Reserved	–	–	–	–	–	–	–	–	
0x37 (0x57)	SPMCSR	SPMIE	RWWSB	SIGRD	CTPB	RFLB	PGWRT	PGERS	SPMEN	202
0x36 (0x56)	Reserved	–	–	–	–	–	–	–	–	
0x35 (0x55)	MCUCR	–	–	CKOE	PUD	–	–	IVSEL	IVCE	78/32
0x34 (0x54)	MCUSR	–	–	–	OCDRF	WDRF	BODRF	EXTRF	PORF	49
0x33 (0x53)	SMCR	–	–	–	–	SM[2:0]			SE	39
0x32 (0x52)	Reserved	–	–	–	–	–	–	–	–	
0x31 (0x51)	DWDR	debugWIRE Data Register								187
0x30 (0x50)	Reserved	–	–	–	–	–	–	–	–	
0x2F (0x4F)	Reserved	–	–	–	–	–	–	–	–	
0x2E (0x4E)	SPDR	SPI Data Register								107
0x2D (0x4D)	SPSR	SPIF	WCOL	–	–	–	–	–	SPI2X	106
0x2C (0x4C)	SPCR	SPIE	SPE	DORD	MSTR	CPOL	CPHA	SPR1	SPR0	105
0x2B (0x4B)	GPIOR2	General Purpose I/O Register 2								24
0x2A (0x4A)	GPIOR1	General Purpose I/O Register 1								24
0x29 (0x49)	OCR0B	Timer/Counter0 Output Compare Register B								95
0x28 (0x48)	OCR0A	Timer/Counter0 Output Compare Register A								95
0x27 (0x47)	TCNT0H	Timer/Counter0 (8 Bit) High Byte								95
0x26 (0x46)	TCNT0L	Timer/Counter0 (8 Bit) Low Byte								95
0x25 (0x45)	TCCR0B	–	–	–	–	–	CS02	CS01	CS00	81
0x24 (0x44)	TCCR0A	TCW0	ICEN0	ICNC0	ICES0	ICS0	–	–	WGM00	94
0x23 (0x43)	GTCCR	TSM	–	–	–	–	–	–	PSRSYNC	
0x22 (0x42)	EEARH	–	–	–	–	–	–	EEPROM High byte		20
0x21 (0x41)	EEARL	EEPROM Address Register Low Byte								20
0x20 (0x40)	EEDR	EEPROM Data Register								20
0x1F (0x3F)	EECR	–	–	EEPM1	EEPM0	EERIE	EEMPE	EEPE	EERE	21
0x1E (0x3E)	GPIOR0	General Purpose I/O Register 0								24
0x1D (0x3D)	EIMSK	–	–	–	–	INT3	INT2	INT1	INT0	59
0x1C (0x3C)	EIFR	–	–	–	–	INTF3	INTF2	INTF1	INTF0	59

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Page
0x1B (0x3B)	PCIFR	–	–	–	–	–	–	PCIF1	PCIF0	60
0x1A (0x3A)	Reserved	–	–	–	–	–	–	–	–	
0x19 (0x39)	Reserved	–	–	–	–	–	–	–	–	
0x18 (0x38)	Reserved	–	–	–	–	–	–	–	–	
0x17 (0x37)	OSICSR	–	–	–	OSISEL0	–	–	OSIST	OSIEN	33
0x16 (0x36)	TIFR1	–	–	–	–	ICF1	OCF1B	OCF1A	TOV1	96
0x15 (0x35)	TIFR0	–	–	–	–	ICF0	OCF0B	OCF0A	TOV0	96
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)	Reserved	–	–	–	–	–	–	–	–	
0x0A (0x2A)	Reserved	–	–	–	–	–	–	–	–	
0x09 (0x29)	Reserved	–	–	–	–	–	–	–	–	
0x08 (0x28)	PORTC	–	–	PORTC5	PORTC4	PORTC3	PORTC2	PORTC1	PORTC0	66
0x07 (0x27)	Reserved	–	–	–	–	–	–	–	–	
0x06 (0x26)	PINC	–	–	–	PINC4	PINC3	PINC2	PINC1	PINC0	66
0x05 (0x25)	PORTB	PORTB7	PORTB6	PORTB5	PORTB4	PORTB3	PORTB2	PORTB1	PORTB0	78
0x04 (0x24)	DDRB	DDB7	DDB6	DDB5	DDB4	DDB3	DDB2	DDB1	DDB0	78
0x03 (0x23)	PINB	PINB7	PINB6	PINB5	PINB4	PINB3	PINB2	PINB1	PINB0	78
0x02 (0x22)	PORTA	–	–	–	–	PORTA3	PORTA2	PORTA1	PORTA0	78
0x01 (0x21)	DDRA	–	–	–	–	DDA3	DDA2	DDA1	DDA0	78
0x00 (0x20)	PINA	–	–	–	–	PINA3	PINA2	PINA1	PINA0	78

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 Atmel ATmega16HVB/32HVB 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 in SRAM, only the ST/STS/STD and LD/LDS/LDD instructions can be used.

8. Instruction set summary

Mnemonics	Operands	Description	Operation	Flags	#Clocks
ARITHMETIC AND LOGIC INSTRUCTIONS					
ADD	Rd, Rr	Add two Registers	Rd ← Rd + Rr	Z, C, N, V, H	1
ADC	Rd, Rr	Add with Carry two Registers	Rd ← 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 ← Rd - Rr	Z, C, N, V, H	1
SUBI	Rd, K	Subtract Constant from Register	Rd ← Rd - K	Z, C, N, V, H	1
SBC	Rd, Rr	Subtract with Carry two Registers	Rd ← Rd - Rr - C	Z, C, N, V, H	1
SBCI	Rd, K	Subtract with Carry Constant from Reg.	Rd ← 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 ← Rd • K	Z, N, V	1
OR	Rd, Rr	Logical OR Registers	Rd ← Rd v Rr	Z, N, V	1
ORI	Rd, K	Logical OR Register and Constant	Rd ← Rd v K	Z, N, V	1
EOR	Rd, Rr	Exclusive OR Registers	Rd ← Rd ⊕ Rr	Z, N, V	1
COM	Rd	One's Complement	Rd ← 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 ← Rd v K	Z, N, V	1
CBR	Rd, K	Clear Bit(s) in Register	Rd ← Rd • (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 ← Rd • Rd	Z, N, V	1
CLR	Rd	Clear Register	Rd ← Rd ⊕ Rd	Z, N ,V	1
SER	Rd	Set Register	Rd ← 0xFF	None	1
MUL	Rd, Rr	Multiply Unsigned	R1:R0 ← Rd x Rr	Z, C	2
MULS	Rd, Rr	Multiply Signed	R1:R0 ← Rd x Rr	Z, C	2
MULSU	Rd, Rr	Multiply Signed with Unsigned	R1:R0 ← Rd x Rr	Z, C	2
FMUL	Rd, Rr	Fractional Multiply Unsigned	R1:R0 ← (Rd x Rr) << 1	Z, C	2
FMULS	Rd, Rr	Fractional Multiply Signed	R1:R0 ← (Rd x Rr) << 1	Z, C	2
FMULSU	Rd, Rr	Fractional Multiply Signed with Unsigned	R1:R0 ← (Rd x Rr) << 1	Z, C	2
BRANCH INSTRUCTIONS					
RJMP	k	Relative Jump	PC ← PC + k + 1	None	2
IJMP		Indirect Jump to (Z)	PC ← Z	None	2
JMP	k	Direct Jump	PC ← k	None	3
RCALL	k	Relative Subroutine Call	PC ← PC + k + 1	None	3
ICALL		Indirect Call to (Z)	PC ← Z	None	3
CALL	k	Direct Subroutine Call	PC ← k	None	4
RET		Subroutine Return	PC ← STACK	None	4
RETI		Interrupt Return	PC ← STACK	I	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←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 ← 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 ⊕ V= 0) then PC ← PC + k + 1	None	1/2
BRLT	k	Branch if Less Than Zero, Signed	if (N ⊕ V= 1) then PC ← 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

8. Instruction set summary (Continued)

Mnemonics	Operands	Description	Operation	Flags	#Clocks
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 INSTRUCTIONS					
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) ← Rd(n), Rd(0) ← 0	Z, C, N, V	1
LSR	Rd	Logical Shift Right	Rd(n) ← Rd(n+1), Rd(7) ← 0	Z, C, N, V	1
ROL	Rd	Rotate Left Through Carry	Rd(0)←C,Rd(n+1)← Rd(n),C←Rd(7)	Z, C, N, V	1
ROR	Rd	Rotate Right Through Carry	Rd(7)←C,Rd(n)← Rd(n+1),C←Rd(0)	Z, C, N, V	1
ASR	Rd	Arithmetic Shift Right	Rd(n) ← Rd(n+1), n=0..6	Z, C, N, V	1
SWAP	Rd	Swap Nibbles	Rd(3..0)←Rd(7..4),Rd(7..4)←Rd(3..0)	None	1
BSET	s	Flag Set	SREG(s) ← 1	SREG(s)	1
BCLR	s	Flag Clear	SREG(s) ← 0	SREG(s)	1
BST	Rr, b	Bit Store from Register to T	T ← Rr(b)	T	1
BLD	Rd, b	Bit load from T to Register	Rd(b) ← T	None	1
SEC		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		Global Interrupt Enable	I ← 1	I	1
CLI		Global Interrupt Disable	I ← 0	I	1
SES		Set Signed Test Flag	S ← 1	S	1
CLS		Clear Signed Test Flag	S ← 0	S	1
SEV		Set Twos Complement Overflow.	V ← 1	V	1
CLV		Clear Twos Complement Overflow	V ← 0	V	1
SET		Set T in SREG	T ← 1	T	1
CLT		Clear T in SREG	T ← 0	T	1
SEH		Set Half Carry Flag in SREG	H ← 1	H	1
CLH		Clear Half Carry Flag in SREG	H ← 0	H	1
DATA TRANSFER INSTRUCTIONS					
MOV	Rd, Rr	Move Between Registers	Rd ← 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 ← (X)	None	2
LD	Rd, X+	Load Indirect and Post-Inc.	Rd ← (X), X ← X + 1	None	2
LD	Rd, - X	Load Indirect and Pre-Dec.	X ← X - 1, Rd ← (X)	None	2
LD	Rd, Y	Load Indirect	Rd ← (Y)	None	2
LD	Rd, Y+	Load Indirect and Post-Inc.	Rd ← (Y), Y ← Y + 1	None	2
LD	Rd, - Y	Load Indirect and Pre-Dec.	Y ← Y - 1, Rd ← (Y)	None	2
LDD	Rd, Y+q	Load Indirect with Displacement	Rd ← (Y + q)	None	2
LD	Rd, Z	Load Indirect	Rd ← (Z)	None	2
LD	Rd, Z+	Load Indirect and Post-Inc.	Rd ← (Z), Z ← Z+1	None	2
LD	Rd, -Z	Load Indirect and Pre-Dec.	Z ← Z - 1, Rd ← (Z)	None	2
LDD	Rd, Z+q	Load Indirect with Displacement	Rd ← (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) ← Rr, X ← X + 1	None	2
ST	- X, Rr	Store Indirect and Pre-Dec.	X ← X - 1, (X) ← Rr	None	2
ST	Y, Rr	Store Indirect	(Y) ← Rr	None	2
ST	Y+, Rr	Store Indirect and Post-Inc.	(Y) ← Rr, Y ← Y + 1	None	2
ST	- Y, Rr	Store Indirect and Pre-Dec.	Y ← Y - 1, (Y) ← Rr	None	2
STD	Y+q, Rr	Store Indirect with Displacement	(Y + q) ← Rr	None	2
ST	Z, Rr	Store Indirect	(Z) ← Rr	None	2
ST	Z+, Rr	Store Indirect and Post-Inc.	(Z) ← Rr, Z ← Z + 1	None	2
ST	-Z, Rr	Store Indirect and Pre-Dec.	Z ← Z - 1, (Z) ← 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 ← (Z)	None	3
LPM	Rd, Z+	Load Program Memory and Post-Inc	Rd ← (Z), Z ← Z+1	None	3
SPM		Store Program Memory	(Z) ← R1:R0	None	-
IN	Rd, P	In Port	Rd ← P	None	1

8. Instruction set summary (Continued)

Mnemonics	Operands	Description	Operation	Flags	#Clocks
OUT	P, Rr	Out Port	P ← Rr	None	1
PUSH	Rr	Push Register on Stack	STACK ← Rr	None	2
POP	Rd	Pop Register from Stack	Rd ← STACK	None	2
MCU CONTROL INSTRUCTIONS					
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

9. Ordering information

9.1 The Atmel ATmega16HVB

Speed (MHz)	Power supply	Ordering code	Package	Operation range
1MHz - 8MHz	4V - 18V	ATMEGA16HVB-8X3	44X1	-40°C to 85°C

Package type	
44X1	44-lead, 4.4mm body width, plastic thin shrink small outline package (TSSOP)

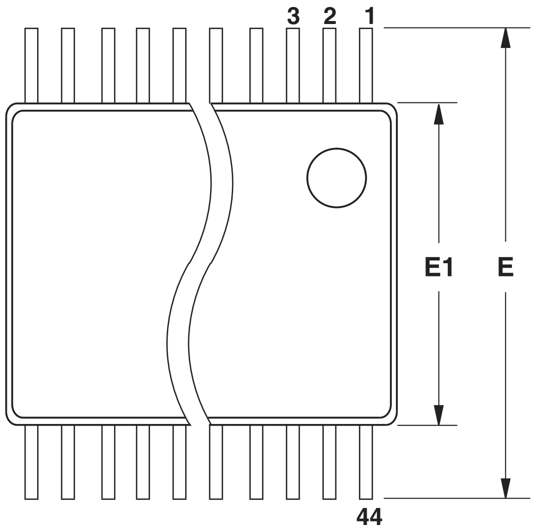
9.2 The Atmel ATmega32HVB

Speed (MHz)	Power supply	Ordering code	Package	Operation range
1MHz - 8MHz	4V - 18V	ATMEGA32HVB-8X3	44X1	-40°C to 85°C

Package type	
44X1	44-lead, 4.4mm body width, plastic thin shrink small outline package (TSSOP)

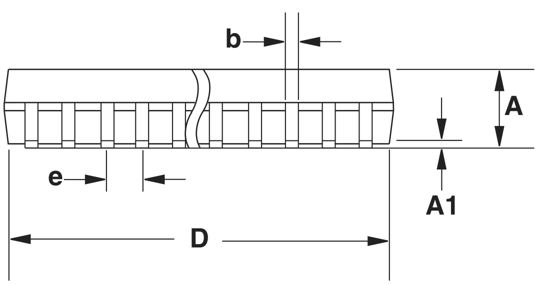
10. Packaging information

10.1 44X1



Top View

End View



Side View

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	–	–	1.20	
A1	0.05	–	0.15	
b	0.17	–	0.27	
C	0.09	–	0.20	
D	10.90	11.00	11.10	
E1	4.30	4.40	4.50	
E	6.20	6.40	6.60	
e		0.50 TYP		
L	0.50	0.60	0.70	
ø	0°	–	8°	

Note: These drawings are for general information only. Refer to JEDEC Drawing MO-153BE.

5/16/07

	TITLE	DRAWING NO.	REV.
ATMEL 2325 Orchard Parkway San Jose, CA 95131	**44X1**, 44-lead, 4.4mm Body Width, Plastic Thin Shrink Small Outline Package (TSSOP)	44X1	A

11. Errata

11.1 The Atmel ATmega16HVB

11.1.1 Rev. E

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.1.2 Rev. D

Not sampled.

11.1.3 Rev. C

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.1.4 Rev. B

Stack pointer initial value

The stack pointer in ATmega16HVB is incorrectly initialized to 0x08ff instead of 0x04ff.

Problem fix/workaround

Initialize the stack pointer in software before the stack is used. Most C-compilers does initialize the stack pointer without manual intervention.

Assembly Code Example:

ldi r16,high(RAMEND); Main program start out SPH,r16 ; Set Stack Pointer to top of RAM ldi r16,low(RAMEND) out SPL,r16 C Code Example (if required): SP = RAMEND;

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.1.5 Rev. A

Not sampled.

11.2 The Atmel ATmega32HVB

11.2.1 Rev. E

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.2.2 Rev. D

Not sampled.

11.2.3 Rev. C

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.2.4 Rev. B

TWI bus can get stuck if TWI STOP condition bit is set in slave mode

If the TWSTO bit in TWCR is set while the TWI starts to receive data in slave mode, it can result in pulling the SCL pin low and then the TWI bus will get stuck. To release the SCL pin and get out of this situation the TWI module needs to be disabled and then re-enabled.

Problem fix/workaround

While in slave mode the TWSTO bit should be written only to recover from an error condition and then cleared before a data transfer starts.

11.2.5 Rev. A

Not sampled.

12. 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.

12.1 Rev. 8042E-09/2013

1. Updated ”Errata” on page 19:
   ATmega16HVB: Added errata sections for “Rev. C” , “Rev. D” and “Rev. E” .
   ATmega32HVB: Added errata sections for “Rev. B” , “Rev. C” , “Rev. D” and “Rev. E” .

12.2 Rev. 8042D-10/2011

1. Operating voltage has been changed from 4V - 25V to 4V - 18V
2. The methods for determing the actual clock period of the ULP Oscillator i Section 9.2.3 on page 27 have been changed
3. In ”Bit 1:0 – CLKPS[1:0]: Clock Prescaler select Bit[1:0]” on page 33 new text has been inserted in and the text “If CKDIBV8 is programmed” has been corrected to “If CKDIV8 is programmed”
4. Note 2 in ”Bit 0 – OSIEN: Oscillator sampling interface enable” on page 34 has been deleted
5. Figure 11-1 on page 43 has been corrected
6. New Note 2 has been added below Table 11-2 on page 51
7. The last sentence in Section 21.5 on page 123 has been corrected
8. The text in Section 25.3.1 on page 146 below Figure 25-2 has been corrected several places
9. V_{CC} in Figure 28-1 on page 186 has been corrected
10. Bit no 4 in Table 30-3 on page 205 has been corrected
11. Note 1 below Table 30-3 on page 205 has been corrected
12. The text in point 4 and 5 in Section 30.6.1 on page 208 has been corrected
13. The V_{FET} value in Figure 30-3 on page 212 has been corrected
14. The table in Section 32.1 on page 225 hase been updated with several new values
15. I_{LOAD} in Table 32-2 on page 226 has been added
16. Note 1 below Table 32-2 on page 226 has been added
17. The maximum value for V_{BOT} in Table 32-3 on page 227 has been added
18. In Table 32-4 on page 227 the maximum value for V_{RSCL} has been corrected and the maximum value for V_{REG} pin has been added
19. In Table 32-7 on page 229 the typical and maximum values for INL has been corrected
20. In Table 32-8 on page 229 the typical value for frequency prediction error (slow RC oscillator) has been corrected
21. In Table 32-10 on page 230 the text below “Parameter” has been corrected
22. In Table 32-12 on page 231 Note 5 has been added

23. In Table 32-18 on page 236 the maximum value for t_{WLRH_CE} has been corrected
24. The former figure "Active supply current vs. V_{VFET}, WDT, V_{REF}, CBP, OC/OD and CC-ADC enabled" on page 238 has been removed
25. In Table 33-1 on page 243 the text "CC-OD" has benn changed to "OC-OD" and below "Typical current consumption" the value "55µA" has been changed to "85µA"
26. New text is added below the two notes for Table 33-1 on page 243
27. New Figure 33-11 on page 245 "Power-save supply current vs. V_{VFET}, WDT, V_{REF}, CBP, OC/OD, and CC-ADC enabled" is added
28. The plot in Figure 33-13 on page 246 has been updated
29. The plot in Figure 33-14 on page 246 has been updated
30. New Figure 33-15 on page 247 has been added
31. New Figure 33-21 on page 250 has been added
32. Heading in Figure 33-27 on page 253 has been corrected
33. The power supply voltage in the table in Section 9.1 on page 16 has been corrected
34. The power supply voltage in the table in Section 9.2 on page 17 has been corrected
35. The Section 11. on page 19 has been corrected by adding an errata for "all revisions"
36. The text "...clock period of the Slow RC Oscillator..." in point 2 in Section 9.2.3 on page 27 has been corrected to "...clock period of the ULP RC Oscillator..."
37. Note 1 below Table 19-1 on page 112 has been corrected
38. Note 1 below Table 19-2 on page 112 has been corrected
39. Figure 31-1 on page 220 has been updated
40. Figure 31-2 on page 221 has been updated
41. Figure 31-3 on page 222 has been updated
42. Table 31-1 on page 223 has been updated according to the changes in Figure 31-1 on page 220, Figure 31-2 on page 221, and Figure 31-3 on page 222

12.3 Rev. 8042C-06/2011

1. The columns "Minimum" and "Maximum" in Table 24-5 on page 142 are deleted
2. A new row ("Device lot ID and position") in Table 29-3 on page 196 is added
3. A new note ("Note 16") in Table 29-3 on page 196 is added
4. In "Absolute maximum ratings*" on page 225 the following values have been changed: "Voltage on OC and OD with respect to ground", "Voltage on PC5, BATT, PVT, VFET, PV4, PV3, and PV2 with respect to ground", and "Maximum operating voltage on VFET"
5. In Table 32-1 on page 225 the values for "Typical" and "Maximum" in the row "VFET = 16V, WDT, CC-ADC, OC, OD, and battery protection enabled, DUVR mode disabled" are added
6. "Frequency drift" for "Slow RC oscillator" in Table 32-8 on page 229 is deleted
7. A new note ("Note 4") in Table 32-8 on page 229 is added
8. Table 32-10 on page 230 is updated and corrected

9. The text “C_{EQ} = 4.7nF, VFET = 16V” is added to “Condition” for t_f,OC and t_f,OD in Table 32-2 on page 226
10. New Figure 33-1 on page 238 is added
11. Corrected formula in Table 32-15 on page 232
12. Corrected and added some short-cuts in addition to general update and some minor corrections in text

12.4 Rev. 8042B-06/2010

1. Removed direction arrow in Figure 17-1 on page 82.
2. Updated ”Configuring PA1 and PA0 for V-ADC operation” on page 117.
3. Updated ”Operating circuit” on page 220, with correct naming convention for thermistors RT32 and RT33.

12.5 Rev. 8042A-08/2009

1. Initial revision

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