AVR481: DB101 Hardware User's Guide

Features

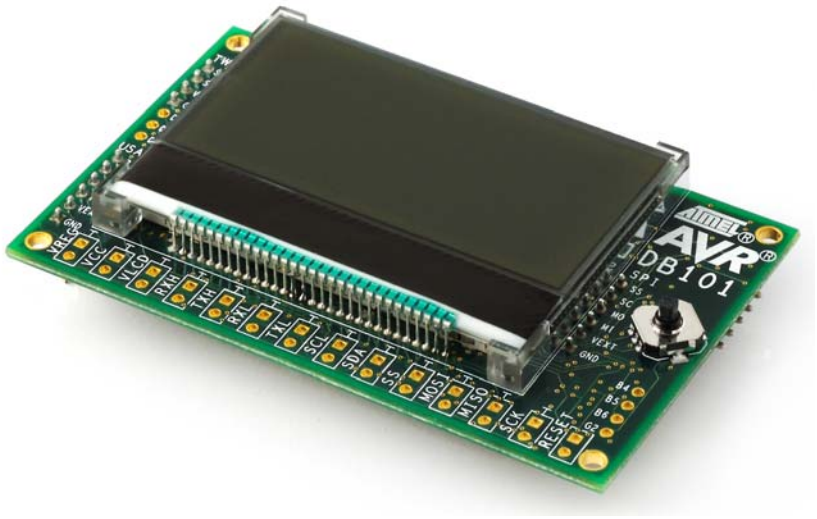
- **LCD module with RGB backlight**
- **UART, SPI and TWI with level converters**
- **RS232 interface**
- **Joystick for user input and menu navigation**
- **Piezo speaker**
- **Powered by Battery or external supply**
  - **1.8V to 5.5V external supply**
- **Buck-boost converter on power supply**

1 Introduction

The DB101 is a graphical LCD module. It demonstrates how to use an AVR® microcontroller to control a 128x64 pixel graphical LCD. It can be used as human-machine interface in conjunction with other application boards: To interface other application boards the DB101 features the most common communication interfaces UART, SPI and TWI, available on pin headers on the backside of the board.

This document provides a description of the DB101 board and application note AVR482 describes the application software.

Figure 1-1. Front-view of the DB101 LCD module.



8-bit AVR® Microcontrollers

Application Note

Rev. 8073B-AVR-09/07

2 Features overview

The schematics, and layout files (gerber format) are available in separate files distributed with this application note. The bill of material is found last in this document.

Figure 2-1. Assembly drawing of DB101 front – front view.

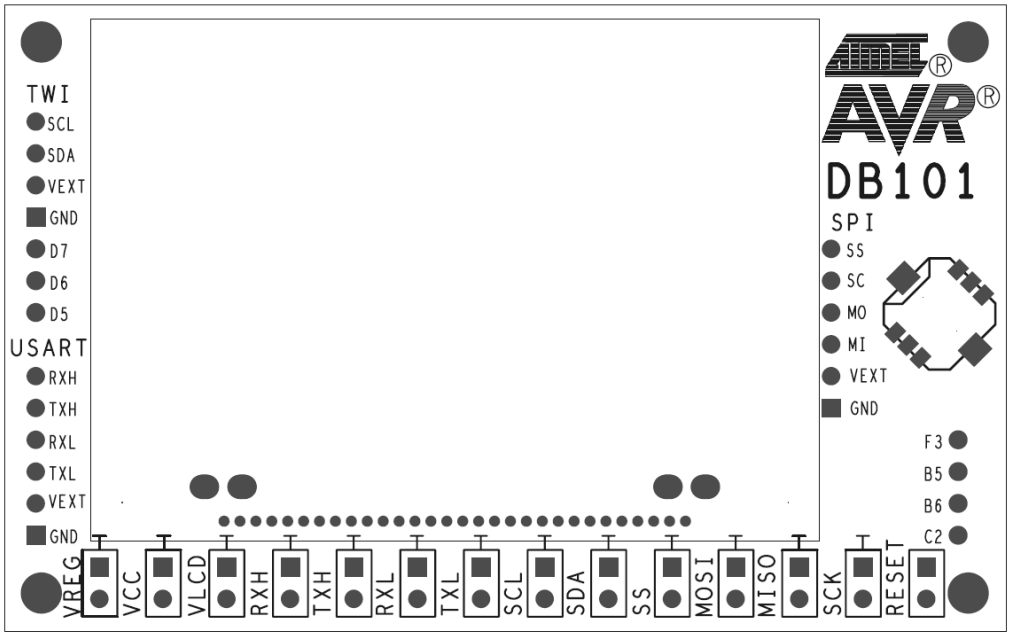
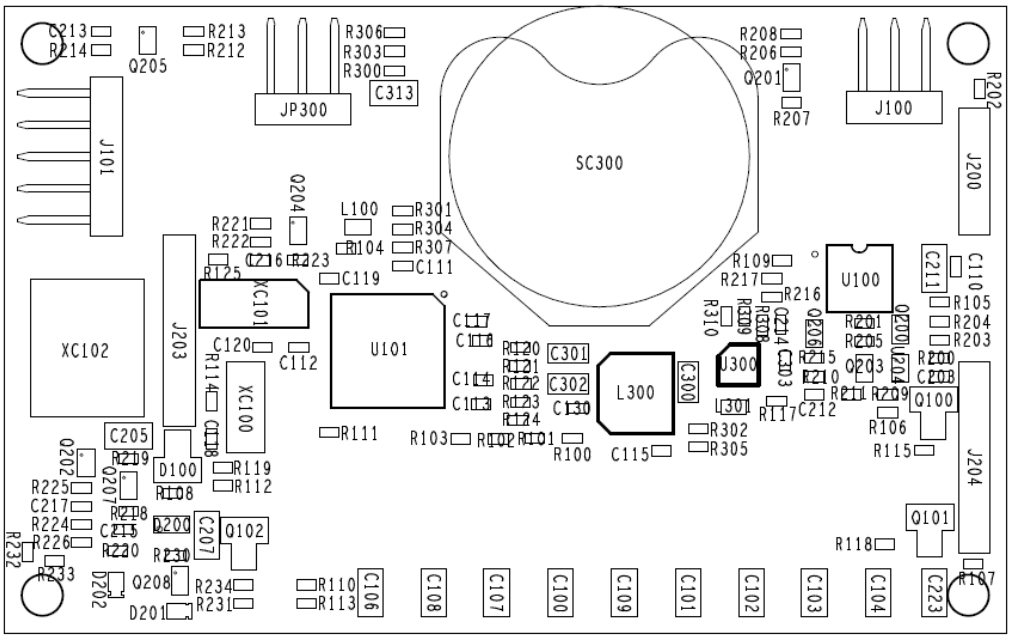


Figure 2-2. Assembly drawing of DB101 backside – backside view.



2.1 AVR microcontroller

The LCD is controlled by an ATmega1281, which has 64 pins, 128kB of Flash memory and 8kB of SRAM. The AVR is running from external 7.37MHz ceramic resonator. The system clock can be scaled down internally to reduce power consumption.

2.2 LCD display

DB101 features a Display Tech, 128x64 pixel graphical LCD (64128 COG) with RGB backlight. The LCD can be accessed in both parallel and serial mode. In serial mode the LCD's built in RAM memory can only be written to, while in parallel mode it can be both written and read back. Therefore, to take full advantage of the LCD's RAM the parallel mode is used.

2.3 Joystick

A four-way joystick with push button function is placed on the right-hand side of the DB101. This allows the user to navigate in menus and make selections.

The joystick is connected to the mega1281's port C, pins 3 through 7, and to port B pin 4, which is connected to an external interrupt (can wake up the device from sleep).

2.4 Piezo speaker

To allow audio feedback to the user a miniature piezo speaker is included on the DB101.

The Piezo is connected to the mega1281 on pin 17 – OC1C, the output compare channel C on timer 1. This makes it possible to control the sound generation using the PWM output of OC1C.

2.5 Power supply - battery

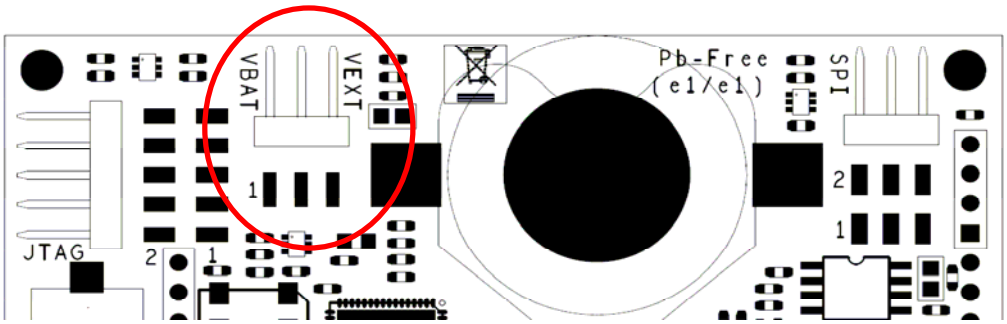
The DB101 can be powered from and external voltage source or from an on-board coin-cell lithium battery. When running from the battery it is recommended to scale down the system clock and not use the LCD backlight, as this can exceed the recommended maximum current drawn from the battery. If high current is drawn from the battery, the battery life-time can be very limited. Even with the backlight off, the battery can be drained rather fast.

It is therefore recommended to connect an external supply whenever working/developing with the DB101.

When using external power supply the DB101 can be supplied from anywhere between 1.8V and 5.5V. This is possible since the DB101 features a buck-boost converter, which will provide 3.3V to the AVR and the LCD regardless of the input voltage.

Jumper J306 controls whether the DB101 is powered from an external power source or from the on-board battery. Shorting the jumper pins 1 and 2 will connect the battery (default from factory), while shorting the pins 2 and 3 will connect the external supply.

Figure 2-3. Jumper J306, controlling supply voltage of the DB101.



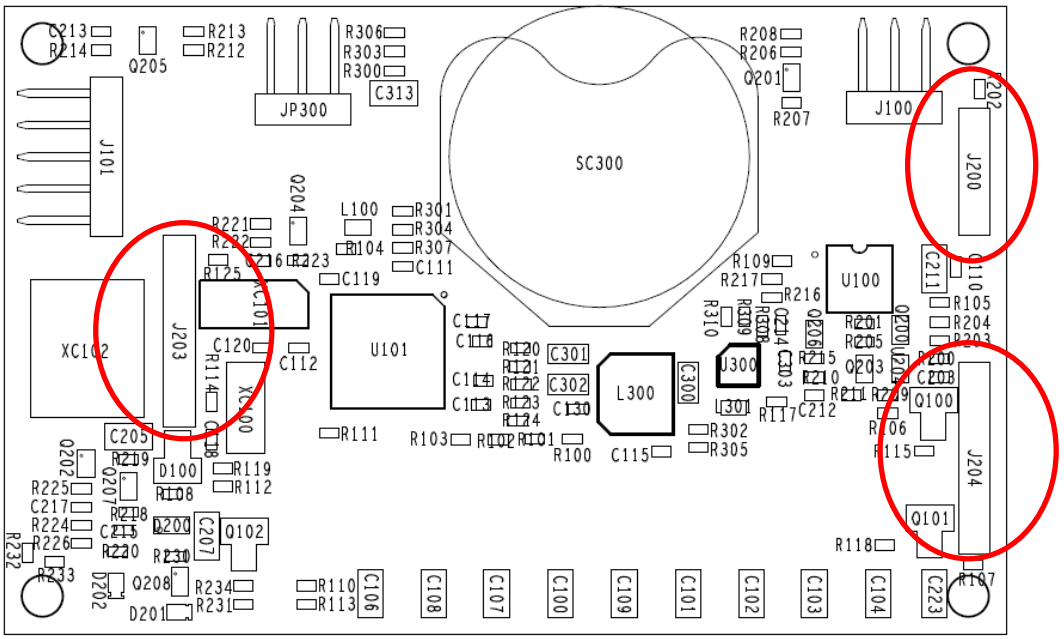
It is possible to sense whether the mega1281 runs from external supply or from battery as these voltages sources are connected to internal ADC of the mega1281. The ADC channels 0 to 4 (pins F0 to 4) are connected to various parts of the power supply network. Please refer to the schematics for more details on these connections.

2.6 Communication interfaces

To be able to interface other application boards, e.g. by piggy-backing the DB101 on another application board, level converters are placed on all communication interfaces. This means that not only can the DB101 be supplied from another application board, but it can also communicate with it regardless of the logic levels of the application board.

All communication interfaces are available on 2.54mm pin headers on the backside of the DB101. The supply pins (VEXT and GND) on the communication pin headers must be connected to the application board voltage supply for the level converters to work.

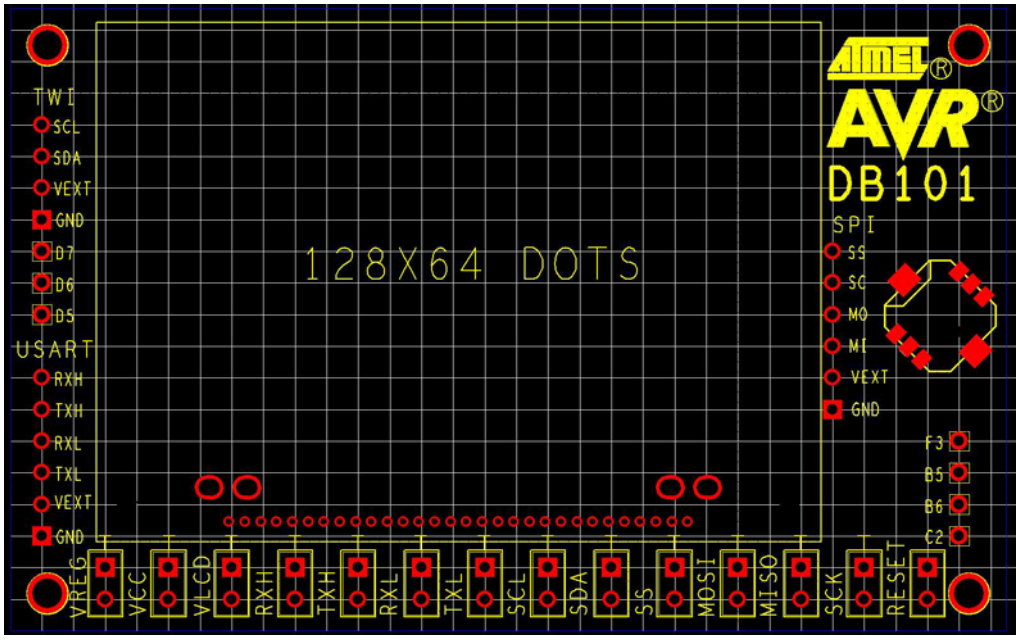
Figure 2-4. Communication headers – backside view.



2.6.1 Headers on 100mil grid

All communication pin headers and IO connections along the edge of the board are placed on a 100-mil grid to make it easy to implement a motherboard layout that the DB101 fits onto. The header/connection coordinates can be determined from Figure 2-5, which shows the 100 mil grid over the DB101 layout.

Figure 2-5. DB101 layout and 100 mil grid – front view.



2.6.2 UART

The mega1281 UART1 is connected to pin header J204, which can be found on the lower right-hand side on Figure 2-4. The level converted RxD and TxD lines are available on the header – the pins are marked with silkscreen labels RXL and TXL. The RS232 converted RxD and TxD signals are available on the same header, where the pins are marked with silkscreen labels RXH and TXH. Please refer to Figure 2-1. The RS232 driver circuit uses the RS232 RxD line voltage to generate the correct TxD levels. Therefore, when using the RS232 driver the UART is half duplex only.

2.6.3 SPI

The level converted SPI lines are available on pin header J200, which can be found on the upper right-hand side on Figure 2-4.

2.6.4 TWI

The level converted TWI lines are available on J203, which can be found on the middle left-hand side on Figure 2-4.

2.7 Dataflash®

An Atmel AT45DB161D dataflash is available on the DB101. This can be used to store display fonts, graphics, sound and other data, which will be persistent regardless of reprogramming the mega1281 internal flash memory.

The dataflash is connected to the mega1281's USART0, which can operate in SPI master mode. The USART0 SPI master communication uses port E, pins 0 to 2. Port G, pin 5, is used as Chip Select (Slave Select) for the dataflash.

The dataflash is programmed through the mega1281. Please refer to the application note AVR482 for more information.

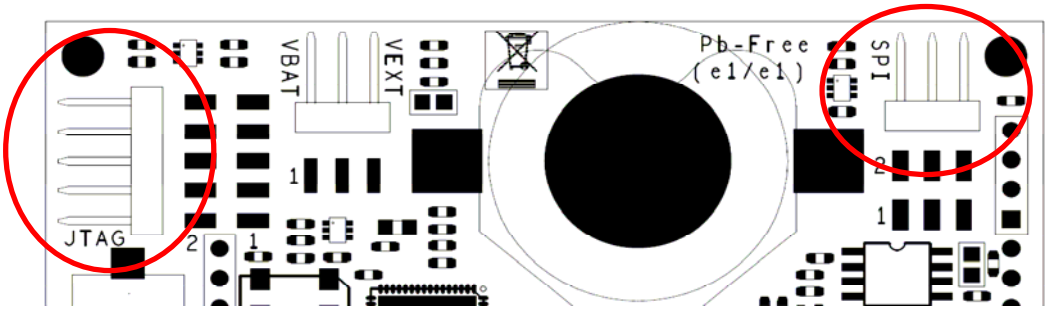
2.8 Programming and debugging interface

The mega1281 can be programmed using either the JTAG or ISP interface.

JTAG programming and debugging can be performed by connecting a JTAGICE mkII to the 90 degrees pin header J101.

ISP programming can be performed by connecting an ISP enabled AVR programming tool to the 90 degrees pin header J100. AVR tools like STK500, AVRISP mkII, AVR Dragon and JTAGICE mkII can be used for this.

Figure 2-6. Pin headers for JTAG (J100) and SPI programming (J101).



2.9 Real time clock

A 32kHz crystal is connected to the asynchronous timer of the mega1281. This allows an application to implement a real time clock (RTC) to keep track of time though sleep modes are used to reduce the power consumption.

2.10 GPIO pins

The mega1281 is a high pin count device, and a number of pins are not used. These are available along the lower edge of the PCB. Be aware that these do NOT have level converters and should thus not be connected directly to an application board running on a different voltage level than the DB101.

Table 2-1. Mapping of available IO pins on PCB connectors.

ATmega1281 port pin	PCB connection
PORTB5	J103
PORTB6	J104
PORTD5	J108
PORTD6	J107
PORTD7	J105
PORTC2	J106

2.11 Hardware revision pins

The AVR port pins PE7 and PE6 are used to sense the hardware revision of the DB101, or rather what type of display that assumed mounted on the DB101. The resistors R123 and R124 are either left open or closed using 100 ohm resistors. Table 2-2 shows resistor configurations and the assumed displays.

Table 2-2. Hardware ID resistors.

R123	R124	Display type
Not mounted	Not mounted	64128COG
Not mounted	Mounted	64128G
Mounted	Not mounted	64128G_RGB(1)
Mounted	Mounted	Reserved

Notes: 1. Default display mounted on DB101

3 Schematics and Bill of Materials

The schematics for DB101 are found as a separate PDF file distributed with this application note, which can be downloaded from http://www.atmel.com.

3.1 Bill of Materials

Table 3-1. Bill of Materials for DB101 (rev D).

Quantity	MPN/ brief	Manufacturer	Description	Designator
2	6.8p		Ceramic capacitor, SMD 0603, NP0, 50V, ±0,5 pF	C120, C119
6	22p	Kemet®	Ceramic capacitor, SMD 0603, NP0, 50V, ±5 %	C217, C216, C215, C214, C213, C212
7	100n	AVX®	Ceramic capacitor, SMD 0603, X7R, 16V, ±10 %	C303, C203, C130, C113, C112, C111, C110
5	10n	AVX	Ceramic capacitor, SMD 0603, X7R, 50V, ±10 %	C118, C117, C116, C115, C114
11	1u		Ceramic capacitor, SMD 0805, X7R, 16V, ±10 %	C313, C207, C109, C108, C107, C106, C104, C103, C102, C101, C100
3	10u		Ceramic capacitor, SMD 0805, Y5V, 10V, -20/+80 %	C223, C211, C205
3	10 uF	Murata®	10 uF ceramic, 10V, 1206, Y5V	C302, C301, C300
2	1R		Thick film resistor, SMD 0603, 1/10W, 1%	R301, R300
3	10R	KOA®	Thick film resistor, SMD 0603, 1/10W, 1%	R119, R118, R117

Quantity	MPN/ brief	Manufacturer	Description	Designator
4	100R		Thick film resistor, SMD 0603, 1/10W, 1%	R123, R122, R121, R120
1	150R		Thick film resistor, SMD 0603, 1/10W, 1%	R125
6	1k	KOA	Thick film resistor, SMD 0603, 1/10W, 1%	R224, R221, R220, R217, R214, R211
5	4.7k		Thick film resistor, SMD 0603, 1/10W, 1%	R234, R233, R232, R231, R230
22	10k	KOA	Thick film resistor, SMD 0603, 1/10W, 1%	R208, R207, R206, R205, R204, R203, R202, R201, R200, R114, R113, R112, R111, R110, R109, R108, R107, R106, R105, R104, R103, R100
6	39k		Thick film resistor, SMD 0603, 1/10W, 1%	R225, R222, R219, R216, R213, R210
6	47k		Thick film resistor, SMD 0603, 1/10W, 1%	R226, R223, R218, R215, R212, R209
3	130k		Thick film resistor, SMD 0603, 1/10W, 1%	R307, R306, R305
1	220k		Thick film resistor, SMD 0603, 1/10W, 1%	R308
1	270k		Thick film resistor, SMD 0603, 1/10W, 1%	R310
3	390k		Thick film resistor, SMD 0603, 1/10W, 1%	R304, R303, R302
1	1M		Thick film resistor, SMD 0603, 1/10W, 1%	R309
2	BLM21AG121SN1D	Murata	SMD RF inductor 0805 Z=120Ohm (@100MHz), Max R(dc)=0.6Ohm, Max current=200mA	L301, L100
1	ELL6RH3R3M	Panasonic®	3.3uH 1.6A choke coil	L300
1	BAT74	Philips®	SMD Schottky diode, 30V, 200mA	D200
2	VC080514A300DP	AVX	AVX multilayer cermaic transient voltage suppressor	D202, D201
1	BAT54C	Philips	Dual Schottky diode	D100
8	BC847BS	Philips	General purpose SMD small signal BJT Dual transistor, 2xNPN. Body Sot363	Q207, Q206, Q205, Q204, Q203, Q202, Q201, Q200
1	BC847BPN	Philips	General purpose SMD BJT dual NPN-PNP	Q208
3	2N7002	Philips	N-channel MOSFET smal-signal, low-cost, SMD SOT23	Q102, Q101, Q100
1	FSA3157P6X	Fairchild®	SPDT analog switch or 2:1 multiplexer	U204

Quantity	MPN/ brief	Manufacturer	Description	Designator
1	AT45DB161D-SU	ATMEL®	16-megabit 2.7-3.6 volt DataFlash	U100
1	TPS63000DRCRG4	Texas Instruments®	Buck-Boost Converter	U300
1	ATmega1281V-8MU	ATMEL	AVR 8-bit RISC MCU	U101
1	LF XTAL016207	Rakon Ltd®	32.768kHz SMD crystal, 85SMX style	XC101
1	CSTCC7M37G53	Murata	Ceramic Resonator 7,37 MHz	XC100
1	Piezo transducer SMD	Projects Unlimited®	Piezo audio transducer	XC102
1	YMJ-02-O-BK	Cen Link Co. ®	Jumper cap for 2.54mm pinheader	JS300
1	SKRHABE010	ALPS®	ALPS 4-directional switch with center push function	SW100
1	3008TR	Keystone Corp. ®	CR2450 coin-cell battery clip, SMD	SC300
1	1x3 Right angle	Harwin®	1x3 pin header, Right angle, 2.54mm pitch SMD	JP300
1	PIN HEADER 1x4 PIP	Freber®	1x4 pin header, 2.54mm pitch, THM Pin-In-Paste	J200
2	PIN HEADER 1x6 PIP	Freber	1x6 pin header, 2.54mm pitch, THM Pin-In-Paste	J204, J203
1	A0604.3.1010.D		DB101 Display board rev D, 4-layer, size = 50*80mm	PCB2
1	TSM-105-01-T-DH-K-TR	SAMTEC®	2x5 pin header, Right angle, 2.54mm pitch, SMD, Tin	J101
1	TSM-103-01-T-DH-TR	SAMTEC	2x3 pin header, Right angle, 2.54mm pitch SMD, Tin	J100
1	CR2450	Panasonic	CR2450 Lithium coin-cell battery	BT300
1	64128G-RGB	Displaytech®	64 x 128 pixel LCD, with backlight	LCD100

Headquarters

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

International

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

Atmel Europe
Le Krebs
8, Rue Jean-Pierre Timbaud
BP 309
78054 Saint-Quentin-en-
Yvelines Cedex
France
Tel: (33) 1-30-60-70-00
Fax: (33) 1-30-60-71-11

Atmel 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

Product Contact

Web Site
www.atmel.com

Technical Support
avr@atmel.com

Sales Contact
www.atmel.com/contacts

Literature Request
www.atmel.com/literature