# AT89LP OCD Developer Board 3.0

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# **User Guide**



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# Section 1

# **Getting Started**

Welcome to the Atmel<sup>®</sup> AT89LP OCD Developer Board. The AT89LP OCD Developer board, herein called the "OCD board", was designed to be used with the Atmel AT89LP single-cycle 8051 microcontrollers along with the Atmel AT89LP Developer Studio, an Integrated Development Environment (IDE) which supports our On-Chip Debug (OCD) System. The pairing of the AT89LP OCD Developer Board with the AT89LP Developer Studio allows users to develop and debug code and prototype their designs. To get started using the OCD board immediately, follow the quick start guide in this chapter. Otherwise skip to "Introduction" to learn more about the AT89LP OCD Developer board.

#### 1.1 Get the Software

The first step in using the OCD board is to obtain and install the AT89LP Developer Studio IDE. This software can communicate with the OCD board to program the target device and control its execution via the OCD interface. The latest version of Developer Studio is available at:

<u>http://www.atmel.com/dyn/prod-</u> <u>ucts/tools\_card.asp?tool\_id=4646&category\_id=163&family\_id=604&subfamily\_id=1679</u>

The initial use of the OCD board also requires the use of device programming software to enable the OCD option for the selected target device. If you do not already have this type of software, you can use the Atmel AT89LP ISP Studio. This software is available at:

<u>http://www.atmel.com/dyn/prod-</u> <u>ucts/tools\_card.asp?tool\_id=4843&category\_id=163&family\_id=604&subfamily\_id=1679</u>

### 1.2 Enable On-Chip Debug

AT89LP microcontrollers are normally shipped with the On-Chip Debug (OCD) fuse disabled in order for the OCD interface pins to function as normally intended. The OCD board will not be able to communicate with the target device until this fuse is enabled. If you already have a programming solution that supports your selected target device, use that programmer to enable the OCD fuse. Otherwise you will need to use the AT89LP ISP Studio software in conjunction with the OCD board to program this fuse.

In addition to debugging, the OCD board supports In-System Programming (ISP) of the target through the AT89LP ISP Studio software. Follow these steps to program the OCD fuse of your target device.

#### 1.2.1 Configure Board for ISP

Before running the AT89LP ISP Studio software, the OCD board must be properly configured for ISP programming mode. Refer to Figure 1-1 for the correct jumper settings.

- 1. Mount (connect) jumpers J5, J7 and J10 for ISP operation. Jumpers J6 and J11 must remain open
- 2. Mount (connect) jumper J1 "RST\_RCVRY" in either the RST\_L or RST\_H position depending on whether your target has an active-low or active-high reset
- Mount connect jumper U8 "VCC SELECT" for either 3.3V or 5V operation. Note that this jumper MUST be in the 3.3V position for the AT89LP3240 or AT89LP6440 devices. For other devices either setting is valid
- 4. Mount the target device in the correct socket
- 5. Connect an RS-232 serial cable between your PC and the DB9 connector on the OCD board
- 6. Connect a 9V DC power supply to the A1 "DC\_JAC" connector
- 7. Move the power switch to the ON position



#### *Figure 1-1.* Jumper settings for ISP

#### 1.2.2 Program the Target

Start the AT89LP ISP Studio application and follow these steps.

- 1. Select Target > Select Target from the menu or click the target icon in the toolbar
- 2. In the dialog, highlight your device and click on the Select button
- 3. Click on Configure Port in the Configure Communication box to the left
- 4. Select your COM port and baud rate, for example "COM 1" and "9600" and click Select
- 5. Click **Connect with Current Configuration**. A pop-up message asks you to double check that the power is on. Click **Ok** to proceed
- If connection to the serial port is successful the following message will display in the output window: "Successfully connect to port: COM 1 with baud rate: 9600". Otherwise check all the connections from 1.2.1 "Configure Board for ISP" on page 1-1
- 7. Click **Close** to close the dialog
- 8. Select Target > Connect from the menu or click the connect icon
- 9. If communication with the board is established a pop-up will appear saying that a "Global Board Reset" was issued. Click on **Ok** to proceed
- 10. Select Configure > Configure Target from the menu or click the configure icon
- 11. On the Fuses tab of the Configuration dialog, click the Read Fuses button
- 12. Find the *On-Chip Debug (OCD) Disable* entry. If the value is listed as *Disabled*, click on the value field and select *Enabled* from the selection list
- 13. Find the *Clock Source Select* entry. The OCD board does not provide a clock to the target. If using the board standalone, change the value to *Internal RC Oscillator*. Other choices may be valid if using



a second board with its own clock source. Most development boards include an external clock driver. In this case select *External Clock on XTAL1*.

- 14. Click anywhere to remove focus from the fuse value field
- 15. Click on the Write Fuses button
- 16. Click on the Read Fuses button and verify the correct setting
- 17. Click Ok to close the dialog
- 18. Close the application and power off the board

#### 1.3 Configure Board for Debug

Before running the AT89LP Developer Studio software, the OCD board must be properly configured for OCD mode. Refer to Figure 1-2 for the correct jumper settings.

- 1. Mount (connect) jumpers J5, J7 and J10 for OCD operation. Jumpers J6 and J11 must remain open
- 2. Mount (connect) jumper J1 "RST\_RCVRY" in the central ISP\_NON position depending on whether your target has an active-low or active-high reset
- Mount (connect) jumper J3 "DDA\_SELECT" in the XTAL1 position. This is the correct position when using the internal RC oscillator of the target. If another board with an alternate clock source is used, J3 must be placed in the appropriate position. For example place the jumper in the XTAL2 position for an external clock source. See Section 3.5.4 on page 3-5
- Mount connect jumper U8 "VCC SELECT" for either 3.3V or 5V operation. Note that this jumper MUST be in the 3.3V position for the AT89LP3240 or AT89LP6440 devices. For other devices either setting is valid
- 5. Mount the target device in the correct socket
- 6. Connect an RS-232 serial cable between your PC and the DB9 connector on the OCD board
- 7. Connect a 9V DC power supply to the A1 "DC\_JACK" connector
- 8. Move the power switch to the ON position

#### Figure 1-2. Jumper settings for OCD



### 1.4 Pair with Another Development Board

The AT89LP OCD Developer Board is a low-cost board and as such has limited development resources. For best results it needs to be paired with another fully featured development board. Two configurations are possible: either connect the two boards by cable or piggyback the OCD board on a development board through a PDIP socket.



#### Getting Started

#### 1.4.1 Cable Connection

If an application board is designed with a compatible 10-pin ISP/OCD header, the two boards can be connected through a 10-pin ribbon cable. See Section 3.4 on page 3-3 for more information. It is also possible to connect the boards with individual wires on the GND, DCL and DDA lines provided the target board has them available at test points. Note that when driving an external board in this manner, a target device must NOT be mounted in one of the OCD Board sockets.

#### 1.4.2 Daughter Board

For target boards that do not support an Atmel 10-pin header the OCD board can piggyback on the target board as a daughter board as shown in Figure 1-3. For this configuration to work the following requirements must be met.

- The target socket on the AT89LP OCD Developer board must be built with lead extensions on the reverse side so that it can plug directly into another socket
- The target socket on the target board must be for a PDIP or converted to a PDIP with an adapter
- The target board must use the same supply voltage as the OCD board (3.3V or 5V)
- The VCC pin of the target must not connect to the target board (target is powered by the OCD board)
- The target board must not drive the RST/DCL pin of the target device.
- The target board must not drive the DDA pin of the target device (depends on the clock source)

The last three requirements can also be met by removing the lead extensions for the VCC, RST/DCL and DDA pins from the OCD board so that they do not connect to the target board socket. See Section 3.6 on page 3-6.





#### 1.5 Write the Code

The OCD Board requires some application code to run on the target device. You can use AT89LP Developer Studio to generate a project with whatever code your want. Please refer to the AT89LP Developer Studio User Guide and on-line help for more information. For this example we will use the Simple LEDs sample project. Start the AT89LP Developer Studio and follow these steps.

- 1. From the Open Project Dialog click on the ... button
- 2. Browse to the SimpleLeds directory and select SimpleLeds.ncp, then click Open
- 3. Click the Load button to load an existing project



### 1.6 Start the Debugger

Once you have some source code in AT89LP Developer Studio, follow these steps to build, connect and debug your code on the OCD board.

- 1. Select Debug > Build Solution from the menu or click the build icon in the toolbar
- 2. Select Chip > Port Configuration from the menu
- 3. Click on Port Select in the Port Configuration box to the left
- 4. Select your COM port and baud rate, for example "COM 1" and "9600" and click Select
- Click Close to proceed. If connection to the serial port is successful the following message will display in the output window: "Successfully connect to port: COM 1 with baud rate set to 9600".
  Otherwise check all the connections from 1.3 "Configure Board for Debug" on page 1-3
- 6. Select *Device* from the drop-down list on the toolbar between the build and start debug icons
- 7. Select Debug > Start Debug from the menu or click the start debug icon
- 8. If communication with the board is established a pop-up will appear saying that a "Global Board Reset" was issued. Click on **Ok** to proceed
- 9. The disassembly window will appear with a highlight at address zero. Select **Debug** > **Step** from the menu or click on the step icon to step through your code
- 10. Close the application and power off the board



Getting Started





# Introduction

### 2.1 About AT89LP OCD Developer Board

The Atmel<sup>®</sup> AT89LP OCD Developer Board allows users to develop and debug their code and prototype their designs. The board was designed to be used with the Atmel AT89LP single-cycle 8051 microcontrollers along with the Atmel AT89LP Developer Studio, an Integrated Development Environment (IDE). The AT89LP OCD Developer Board can be used as a simple stand-alone board for quick prototyping with device programming and debugging capabilities. It can also be used as an In-Circuit Debugger (ICD) or In-System Progammer (ISP) for other application boards.

### 2.2 Features

- Stand-alone Board
- In-System Programming (ISP)
- On-Board Voltage Regulator with User-selectable Vcc Supply (3.3V or 5V)
- Supports On-Chip Debug (OCD) through RS-232 (serial) interface
- Microcontroller Sockets
  - 16/28/40 Pin PDIP Sockets
  - PLCC and TQFP to PDIP adapters available
- Off-board connections to program/debug other application boards

#### 2.3 Supported Devices

Table 2-1 lists the devices supported by the AT89LP OCD Developer Board version 3.0.

#### Table 2-1. Supported Devices

AT89LP213	AT89LP828
AT89LP214	AT89LP3240
AT89LP216	AT89LP6440
AT89LP428	

#### 2.4 Supported Software

- AT89LP Developer Studio 1.1.6
- AT89LP ISP Studio 1.0.1
- AT89ISP Software Ver. 3.0

Introduction





# **Hardware Description**

### 3.1 Board Overview

Figure 3.1.1 shows the AT89LP OCD Developer Board.

Figure 3-1. The AT89LP OCD Developer Board.



#### 3.1.1 Block Diagram

Figure 3.2 shows the functional block diagram of the AT89LP OCD Developer Board.

#### Hardware Description

#### Figure 3-2. The Block Diagram of the AT89LP OCD Developer Board



#### 3.2 Power Supply

The AT89LP OCD Developer Board has an on-board voltage regulator to supply power to the board. This regulator requires a 9VDC external power source connected to the 2.1mm male jack outlet. No specific polarization is mandatory as the on-board diode rectifier provides protection against inadvertent polarization insertion. When the power jack is connected the board will be powered on with either 5V or 3.3V depending on Vcc select jumper (U8). The power LED (D1) will illuminate when proper connection of jack outlet and the power switch (S1) is switched to the ON position. The board includes a 100 mA fuse (F1). If power is not being supplied to the board, you may need to replace this fuse.

Figure 3-3. Power supply features D1, S1 and U1



#### 3.3 RS-232

The AT89LP Developer Board comes equipped with a standard RS-232 connector which is then connected to an on-board level shifter (U1). The RS-232 is the connection interface used to send/receive commands from the PC to the OCD board itself. If your PC does not have a serial port, you must purchase a USB-to-RS232 adapter.



### 3.4 OCD/ISP Header

The AT89LP OCD Developer Board can communicate with external target boards through the 10-pin header in the lower right corner. This header provides the signals for both the On-Chip Debug (OCD) and In-System Programming (ISP) interfaces. Figure Note: shows the pinout of the header which is present on the development board. The header can be connected to an equivalent header on a target board through a 10-pin ribbon cable such as the Atmel AT89ISP cable. When using the OCD board with an external target board, all target devices must be removed from sockets U3, U4 and U5 on the OCD board or you can <u>permanently</u> damage the target devices and/or development board. Jumper J2 must be mounted in the EXT position before the board will drive the SCK pin of the header. See Section 3.5.5 on page 3-6.





Note: Please note that the OCD data signal DDA is normally configured based on the selection of the target clock source. Please refer to the target device's datasheet concerning which I/O pins are configured for the OCD interface before connecting the target to the 10-pin header.

### 3.5 Board Settings

The AT89LP OCD Developer Board comes with jumpers that must be set correctly in order to ensure correct operation.

#### 3.5.1 Vcc Select (U8)

The Developer Board supplies either 3.3V or 5V supply voltages to the target device. A jumper connecting pin 1 and 2 of U8 will enable the 3.3V supply. Connecting pin 2 and 3 of U8 will enable 5V supply. If U8 is left open, the result with be the default 5V voltage. Jumper settings are shown in Table 3-1 and Figure 3-5. The jumper MUST be in the 3.3V position for the AT89LP3240 and AT89LP6440 target devices. Other devices can use either settings. If the OCD board is paired with an external target board, that board MUST use the same supply voltage.

Connection	Supply Voltage
1—2 (Left)	3.3V
2—3 (Right)	5V
Open	5V



Figure 3-5. U8 Jumper Settings



### 3.5.2 Mode Select (J5, J6, J7, J10, J11)

These jumpers are located in the bottom center of the board and configure the OCD board in the correct operating mode. To enable both ISP and OCD operation, jumpers J5, J7 and J10 should be mounted and J6 and J11 should be unmounted as shown in Figures 3-6 and 3-7. There is no need to move the jumpers to any other configuration.









### 3.5.3 Reset Recovery (J1)

AT89LP devices have fuses to enable/disable both OCD and ISP. If OCD is enabled or ISP is disabled, the RST pin cannot be used to enter programming mode during a warm reset. In these cases programming mode is activated only if RST is forced active at cold power-up. Jumper J1 "RST\_RCVRY" forces the reset of the target device to either VCC or GND. To ensure correct entry into programming under all configurations, J1 should be set in the RST\_L position for devices with active-low reset and in the RST\_H position for devices with active-high reset. The jumper must be mounted in the central unlabeled



position for OCD, or for devices where progamming does not require forcing of reset. See Figures 3-8 and 3-7.



#### Figure 3-8. Reset J1 Jumper Settings

#### 3.5.4 **DDA Select (J3)**

The Debug Data line (DDA) of the target device changes with the selected clock source. Jumper J3 "DDA SELECT" configures to which pin of the target sockets the DDA signal is connected as shown in Figure 3-9. As a stand-alone board, the OCD Board will only function with the internal oscillator. In this case J2 should be mounted in the XTAL1 position. For external target boards connected through the 10pin header, this jumper has no affect. If the OCD board is piggybacked on to another target board, J3 must be moved to match the clock source of the target. In most cases, development boards use an external clock driver on XTAL1 so the jumper should be mounted in the XTAL2 position. Please refer to the target device's datasheet concerning which I/O pins are configured for the OCD interface.

J3 is located near the lower left corner of the 28DIP socket U4 as shownin Figure 3-10.



#### Figure 3-9. J3 DDA Selection Settings



Figure 3-10. J3 Jumper Location



#### 3.5.5 SCK Select (J2)

Jumper J2 selects if the SCK line of the 10-pin OCD/ISP header is active or not. A jumper connecting pin 1 and 2 of J2 will enable the external SCK for programming an external target. SCK is always connected to on-board targets mounted in sockets U3, U4 or U5. Jumper settings are shown in Table 3-2 and Figures 3-11 and 3-7.

Table 3-2. J2 Jumper Settings

Connection	ISP Target
1—2 (Left)	On-board target or external target
2—3 (Right)	On-board target only
Open	On-board target only

Figure 3-11. J2 Jumper Settings



#### 3.6 Using as a Daughter Board

The AT89LP OCD Developer Board is a low-cost board and as such has limited development resources. For best results it needs to be paired with another fully featured development board. Two configurations are possible: either connect the two boards by cable or piggyback the OCD board on a development board through a PDIP socket. For target boards that do not support an Atmel 10-pin header the OCD board can piggyback on the target board as a daughter board as shown in Figure 3-12.



Figure 3-12. AT89LP OCD Developer Board as Daughter Board



For this configuration to work the following requirements must be met.

The target socket on the AT89LP OCD Developer board must be built with lead extensions on the reverse side as shown in Figure 3-13 so that it can plug directly into another socket. Ideally these should be individually removable for reasons detailed below



Figure 3-13. Lead extensions on a 40DIP socket

- The target socket on the target board must be for a PDIP or converted to a PDIP with an adapter
- The target board must use the same supply voltage as the OCD board (3.3V or 5V)
- The VCC pin of the target device must not connect to the power of the target board (the target is powered by the OCD board)
- The target board must not drive the RST/DCL pin of the target device
- The target board must not drive the DDA pin of the target device (depends on the clock source)

The last three requirements can also be met by removing the lead extensions for the VCC, RST/DCL and DDA pins from the OCD board so that they do not connect to the target board socket. The DDA line of the target device changes with the selected clock source. In most cases, development boards use an external clock driver on XTAL1 so DDA wil be in the XTAL2 position; however, other configurations are possible. See Section 3.5.4 on page 3-5 and also refer to the target device's datasheet concerning which I/O pins are configured for the OCD interface.



Hardware Description





# Section 4

# **Board Description**

### 4.1 Board Layout

The PCB layout layers for the AT89LP OCD Developer version 3.0 are provided here for reference. Electronic Gerber files and OrCAD schematics can be found at:

http://www.atmel.com/dyn/resources/prod\_documents/LP\_Studio\_Board.zip















## 4.2 Board Schematic



Figure 4-4. AT89LP OCD Developer Board Schematic



## 4.3 Bill of Materials

|--|

Comment	Footprint	Designators	Notes
.1uF	0603	C8	Non-Polarized
.1uF	0603	C9	Non-Polarized
.1uF	0603	C10	Non-Polarized
.1uF	0603	C11	Non-Polarized
.1uF	CAP_5MM	C12	Non-Polarized
.1uF	CAP_5MM	C13	Non-Polarized
.1uF	CAP_5MM	C14	Non-Polarized
.1uF	CAP_5MM	C15	Non-Polarized
.1uF	CAP_5MM	C16	Non-Polarized
10uF	1206(2)	C2	Polarized
100nF	1206(2)	C4	Non-Polarized
100nF	1206(2)	C5	Non-Polarized
100uF	1206(2)	C1	Polarized
100uF	1206(2)	C3	Polarized
5pF	1206(2)	C6	Non-Polarized
2.4K	1206(2)	R3	5%
3.3K	1206(2)	R7	5%
3.3K	1206(2)	R2	5%
.330K	1206(2)	R8	5%
.330K	1206(2)	R6	5%
.330K	1206(2)	R11	5%
.330K	1206(2)	R10	5%
.330K	1206(2)	R9	5%
4M	1206(2)	R4	5%
.500K	1206(2)	R14	5%
.500K	10PIN_RESNET	R12	5%
.500K	10PIN_RESNET	R13	5%
5K	1206(2)	R17	5%
5K	1206(2)	R18	5%
LED	1206(2)	D1	Power LED
LED	1206(2)	D2	
LED	1206(2)	D3	
LED	1206(2)	D4	
DC_JACK	DC_JACK	A1	2.1mm
LM317T	TO-220	A4	
SM6T18CA	SM6T18CA	A2	
MAX3232	SO-16	U1	
DF10S	DF10S	A3	SOIC
DB9	DB-9RA/F	Y1	Female / RA
11.0592Mhz	XTAL	Y2	



Comment	Footprint	Designators	Notes
SW SPST	SPDT	S1	
RST_RCVRY	3x2 Header	J1	
SCK_SLCT	3PIN Header	J2	
DDA_SELECT	4x2 Header	J3	
VCC Select	3PIN Header	U8	
10ISP_OSCD	AT89ISP_OCD	U6	
AT89LP216	DIP 16	U3	
AT89LP6440	DIP 40	U5	
AT89LP828	DIP 28	U4	
AT89LP828_TQFP	AT89LP828 TQFP	U2	LINK

Table 4-1. Bill of Materials for AT89LP OCD Developer Board 3.0



**Board Description** 





# Troubleshooting

#### 5.1 The board has no power (LED D1 is not lit)

Double check that a DC supply is connected to the board and the power switch is turned on. If a 9VDC power supply is connected to the power jack and switch S1 is in the ON position, but LED D1 does not light up, then the protection fuse F1 may have blown. You can perform a continuity check across the fuse with an ohm meter. You may need to replace the fuse with a new 100mA axial fuse.

#### 5.2 Software cannot connect to the board

Follow these steps to troubleshoot problems with serial communication between the PC and board.

- 1. Make sure the board is powered and switch S1 is in the ON position. LED D1 should light when power is present on the board
- 2. Double check the RS-232 cable between the PC and board
- 3. Occasionally Microsoft Windows<sup>®</sup> will not release the serial port when an application terminates erroneously. Try to log out and log back in before restarting the software.
- 4. If you are using a USB-to-RS232 converter, but have not verified its operation previously, you may need to update the driver. Some USB-to-RS232 drivers have been found to be incompatible with Microsoft Windows<sup>®</sup> 7 in particular.

### 5.3 ISP Programmer cannot verify signature or always shows target as blank

Follow these steps to troubleshoot ISP communication with the target.

- 1. The mode jumpers must be mounted in the correct configuration as shown in Section 3.5.2 on page 3-4 before ISP will function correctly
- 2. In some target configurations prgramming is only possible by forcing the reset active at power-up. See Section 3.5.3 on page 3-4 on using jumper J1 to force the reset

Troubleshooting





# Section 6

# **Revision History**

## 6.1 Revision History

Revision No.	History
Revision A – February 2011	Initial Release

**Revision History** 





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