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ICE50

User Guide

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Section 1

Preface

1.1 About this Manual

This manual is using the nomenclature described in this section to show warnings, tips, workarounds etc.

1.1.1 Warnings

This manual contains important warnings to prevent damage to your system and the ICE50. All the warnings are emphasized as shown in the example below.

WARNING!

This is a warning...

Please read all warnings carefully.

1.1.2 Tips

Some sections contain useful tips for using the ICE50. All the tips are emphasized as shown in the example below.

Tip!

This is a tip...

1.1.3 Workaround

Workaround!

This is a workaround...

1.1.4 Checklists

Once comfortable with the configurtion and use of the ICE50, the checklists at the end of these sections can be used for fast setup of a new project.

The checklists are of great help for getting the debugging system on-line without problems. However, novice users should also check that the operating conditions of the target system are compliant to the requirements of ICE50. This is described in the Connecting ICE50 section.

1.1.5 Related Documentation

The following electronic documents from Atmel® are related to the use of the AVR® microcontrollers, and of the debugging tools. All documents can be found on the Atmel Products CD-ROM enclosed in the ICE50 kit. For more information and document updates, please visit our web site: www.atmel.com.

- AVR Studio® user's guide.
- Describes in detail how to use the AVR Studio debugging environment.
- Describes in detail how to use the AVR Assembler.
- Data sheets for the different AVR devices.
- Errata sheets for the different AVR devices.
- Application notes describing different application examples for the AVR microcontrollers.
- Describes in detail how to use the AVR Studio debugging environment.

Note: AVR Studio 4.0 or later is required for ICE50 support. AVR Studio 3.x versions will not work with ICE50!

1.2 ICE50 Firmware History

There has been several releases of the ICE50 firmware.

1.2.1 Version 1.0

- First released version.

1.2.2 Version 1.1

- Errors in trace module fixed.
- Version table readout in main module fixed.

1.2.3 Version 1.2

- All parts with ADC: ADC bit 3 and 4 where interchanged. This is now fixed on all parts with ADC.
- Trace of Program Counter is now correct in single step.
- Brown-out Detection (BOD): Selection of Brown-out Voltage is now enabled for all parts.
- Mega8: Reset Disable Fuse added to ICE50 options.

1.3 ICE50 Known Issues

There are some known issues in the ICE50 that users needs to be aware of.

1.3.1 User Break in Sleep Mode

- User break in sleep mode is not supported. Use an interrupt to wake up the part or a reset to Reset the emulator.

  User break in sleep mode is not supported. Workaround: A Reset will break and reset the emulator.

1.3.2 ADC Latch-up

- The ADC may latch-up if the target is powered before the ICE. Also make sure that no residual voltage is present on the ADC input pins if the ICE is not powered.

1.3.3 User Break

- User break in sleep mode is not supported. Use an interrupt to wake up the part or a reset to reset the emulator.

1.4 Reporting Problems

Problems with AVR Studio can be reported to avr@atmel.com. Problems with beta releases can be reported to avrbeta@atmel.com.

Section 2

Introduction

ATICE50 is an advanced In-Circuit Emulator that covers a wide range of the eight bits AVR microcontrollers from Atmel. This section gives a brief introduction to it's features.

2.1 ICE50 Contents

Figure 2-1.

The ATICE50 contains the following items:

- ICE50 Main Unit/Pod/Two FPC (Flexible Printed Circuit) Cables & Probe
- Personality Adapters for:
  - ATmega8
  - ATmega16
  - ATmega162
  - ATmega32
  - ATmega128
  - ATtiny26

- 9-pin RS-232C Cable
- USB Cable
- Power Supply
- European Power Supply Cable
- US Power Supply Cable
- AVR Technical Library CD-ROM
  - AVR Data Sheets
  - Application Notes
  - AVR Studio 4.00 or Later
- ICE50 Quick Start Guide

2.2 ICE50 Features

The ICE50 In-circuit Emulator is a High-end Emulator from Atmel designed to emulate a wide range of AVR devices. The ICE50 is controlled by AVR Studio 4.0 or later. Present, the following devices are supported:

- ATtiny26
- ATmega8
- ATmega16
- ATmega162
- ATmega32
- ATmega128
- ATmega169
- ATmega8515
- ATmega8535

The ICE50 supports the following features:

- Emulates All Digital and Analog Peripherals
- Target Voltage Range 2.2V - 5.5V
- Full Target Frequency Range for All Supported Devices
- Watches
- Trace Buffer
- Unlimited Number of Break Points
- Symbolic Debugging Support
- Full Visibility of and Access to Register File, SP, PC, and Memories
- Access to all I/O Registers
- I/O Configurable to Run or Halt in Stopped Mode
- Cycle Counter

2.3 System Requirements

The following minimum requirements apply for the ICE50.

2.3.1 Hardware Requirements

For using the ICE50 with AVR Studio, a Pentium 233 MHz (or more) class personal computer with following specifications is recommended:

- 64 MByte RAM, or more
- 20 MByte of free hard disk (HD) space
- CD-ROM or Internet access
- Recommended Screen Resolution 1024x768
- 16650 Compatible Serial Port (COM port)
- AVR Studio v4.0 or later installed
- Acrobat Reader v4.0 or later installed (optional).

2.3.2 Software Requirements

The following operating systems are currently supported by AVR Studio:

- Windows NT® Version 3.51(1)
- Windows NT Version 4.0(1)
- Windows® 95
- Windows 98 (ME)
- Windows 2000
- Windows XP
- AVR Studio is always updated to fit new operating systems and versions. See AVR Studio User's Guide for latest information.

Note: 1. Windows NT 3.51 and Windows NT 4.0 does not support USB communication.

2.3.3 Target Hardware Requirements

- The target must be able to supply 2.2 - 5.5V @150mA. See Table 3-6 for further information.

2.3.4 Operating Conditions

- Operation Temperature: 0°C - 70°C
- Operating Humidity: 10 - 90 % RH (non-condensing)
- Supply Voltage: +9.0V to +12.0V DC

WARNING!

Violating the recommended operating conditions for the ICE50 might cause incorrect operation and damage the emulator.

2.3.5 Host Interface

RS-232C @ 115200 bps, 1 start-, 8 data-, and 1 stop-bit, no parity with hardware handshaking. 9-pin female connector with RTS and CTS connected to support hardware handshaking.

Section 3

General Description

This setion describes the different components of the ATICE50 in detail.

3.1 General Hardware Description

In this section a brief description of emulation is given, and a closer look at the parts that make up the ICE50.

3.1.1 What is an In-Circuit Emulator?

The ICE50 is an In-Circuit Emulator. An emulator is a dedicated piece of hardware designed to “emulate” the behaviour of another piece of hardware. In the case of the ICE50, it is designed to behave as a wide range of AVR devices. Exact emulation is the goal for all emulators and the ICE50 offers the highest possible level of compatibility.

The ICE50 emulator system consists of the following five modules:

- Main Emulator Unit
- POD
- Probe
- Personality adapters
- Test adapter

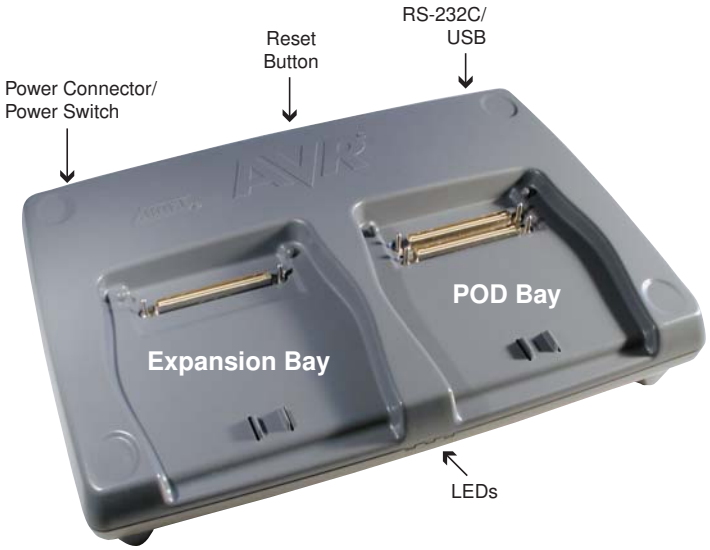
3.2 Main Emulator Unit

The main emulator unit contains the “brain” of the ICE50.

3.2.1 Emulator Unit

The main emulator unit is shown in Figure 3-1. The main unit contains the control logic, and general hardware necessary to emulate an AVR device.

Figure 3-1. ICE50 Main Emulator



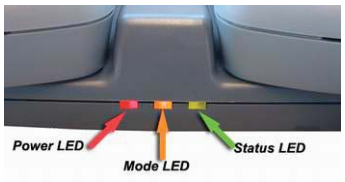
- Status LEDs
- POD Bay
- Expansion Bay
- USB Connector
- RS-232C Connector
- Reset Button
- Power Switch
- Power Connector

3.2.2 Status LEDs

There are three LEDs on the front of the ICE50 cabinet. One red, one red/green duo LED and one green LED. All these LEDs give important status information on the ICE50 and which mode it is operating in. The picture below shows a close-up of the LEDs. When turning on power on the ICE50 the normal LED sequence will be as follows:

1. Red Power LED turns ON.
2. Mode LED turns ON and is first red and next orange.
3. Green status LED turns ON (after approx 15 seconds).
   This indicate that the unit is operating and ready for use.

Figure 3-2. Emulator LEDs



3.2.2.1 Red Power LED

The red LED is the power indicator LED. This will be lit if power on the ICE50 is turned on and the power system is working correctly. If the LED stays off after power on, make sure the power supply meets the requirements of the ICE50. If using another power supply than the one supplied with the ICE50 make sure that the power polarity is correct. See the Power System section for more details on power requirements.

3.2.2.2 Multi Color Mode LED

The Multicolor LED displays information about which mode the ICE50 is working in. During the startup sequence this LED is first red, next orange. Orange indicates that the Emulator is in stopped mode. A green light indicates that the ICE is in run mode. If the LED turns red it indicates an emulator error. If this happens consult the troubleshooting guide.

3.2.2.3 Green Status LED

The green LED will be turned on when the ICE50 is ready for emulation. Once the green LED is on, the ICE50 is ready for emulation. The LED will flash during upgrading of the ICE50. The LED will be turned off during loading of a new part, and lit when the part is finished loading. If the LED does not turn on after a power up sequence please consult the troubleshooting guide for possible solutions.

Figure 3-3. Multi Color Mode

Table 3-1. LED Color Definitions

LED	Meaning	State	Description
Red	Power	Off	Power not connected, or ICE50 Turned off.
		On	Power connected, ICE50 on and voltages OK.
Multi	Mode	Green	Run mode
		Red	Error condition, if permanently lit.
		Orange	Stopped mode
Green	Status	Off	ICE50 is initializing.
		On	ICE50 Ready for emulation.
		Blinking	The LED will flash when doing an upgrade.

3.3 POD Bay

The ICE50 has a very flexible architecture that will ensure a long product life. The different AVR devices are characterised through their number of I/O pins and analog features. Both the I/O pins and the analog features are implemented on the POD board. If new AVR devices are made available to the market that contain I/O or analog features that cannot be emulated by the current POD, Atmel is dedicated to create new POD modules that support the functionality of the new devices.

3.3.1 Removing POD from POD Bay

If for some reason the POD must be removed from the POD Bay, the recommended procedure is as described below. See also Figure 3-4.

1. Lift the POD on the front edge until a click is heard. The POD is now ready to be pulled up from the bay.
2. Lift the POD out of the Bay.

Figure 3-4. Removing POD from POD Bay

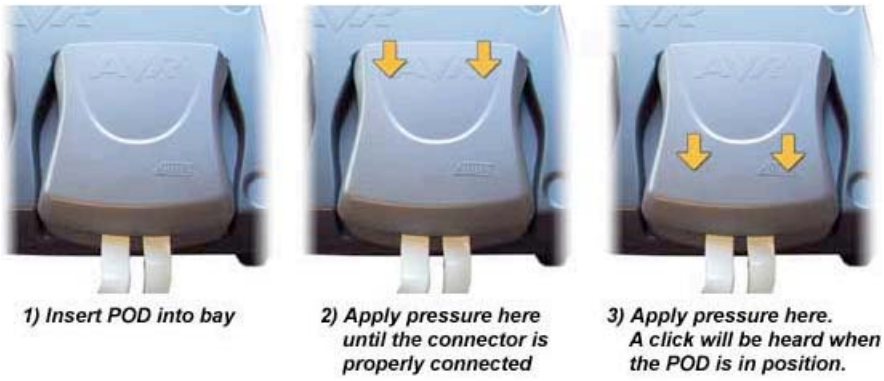
Without the POD connected, the ICE50 will still be able to emulate core functions of the AVR (e.g., timers). This feature can be useful in some debugging sessions. If the POD is inserted and there is no target power applied, the ICE will be held in Reset until target power is turned on. By disabling POR and BOD Reset in ICE50 other options dialog, ICE50 will emulate correctly even if target power is not connected.

3.3.2 Inserting POD Into POD Bay

Only original ICE50 Pods should be used with ICE50 and care should be taken when placing or removing the POD. During normal use there is no need to remove the POD from the bay. If for some reason the POD is disconnected, the recommended procedure to re-insert the POD is as follows. See also Figure 3-5.

1. Place the POD in the ICE50 POD connector. Make sure that the connector male and female guides align.
2. Use both hands and apply pressure on the upper half of the POD (on top of the connector).
3. After pressing the connector firmly in place, use one hand to apply pressure on the lower half of the POD. You will hear a click when the POD locks into position.

Figure 3-5. Inserting POD Into POD Bay



3.3.3 Expansion Bay

The expansion connector is intended for future use, and not used in the current version of ICE50. The POD placed in this socket is an empty POD enclosure and serves the purpose of protecting the Expansion Connector.

3.3.4 USB Connector

USB communication is supported in AVR Studio 4, Build 181 and higher versions. USB Drivers are found on the AVR Technical Library CD-Rom. The USB port is shown in Figure 3-6

Figure 3-6. USB-, RS-232C-communication, and Reset Button

3.3.5 RS-232C Connector

Present, all communication between the ICE50 and AVR Studio is done through a standard RS-232C interface. This is the communication protocol used by COM ports on PCs. The communication runs at 115200 bit/s, no parity, 8 data bits, 1 stop bit, (N81). For information on how to connect the ICE50 to a PC see the Connecting ICE50 to PC section. See Figure 3-6.

3.3.6 Reset Button

By pressing the reset button on the ICE50, a Warm Reset of the Emulator is preformed. After approximately 15 seconds the configuration is completed, and the green status LED will turn on indicating that the emulator is ready for use. See Figure 3-6.

3.3.7 Power Switch

The Power Switch is the main on/off switch for the ICE50 Emulator. Switching this off will turn off power on the ICE50. The ICE50 will however remain grounded to the power supply. See Figure 3-7.

Figure 3-7. Power Switch and Connector

3.3.8 Power Connector

The Power Connector on the ICE50 system is a standard type with 2.1 mm center tap. Ground should be connected to the center tap. For more information about power requirements and operating conditions see the Power System Description. See Figure 3-7.

3.4 Personality Adapter Description

The personality adapters of the ICE50 provides the physical adaption between the ICE50 and the target device.

3.4.1 Personality Adapter Description

ICE50 is supplied with a range of personality adapters. These adapters map the pinout from the ICE50 POD to each of the microcontrollers it supports. Each adapter includes an identification code that the ICE50 and AVR Studio use for automatic device detection. The ICE50 package contains the following Personality Adapters:

Each adapter corresponds to one pinout type and supports one or more AVR microcontrollers. Table 3-2 shows which devices are supported by the different Personality Adapters.

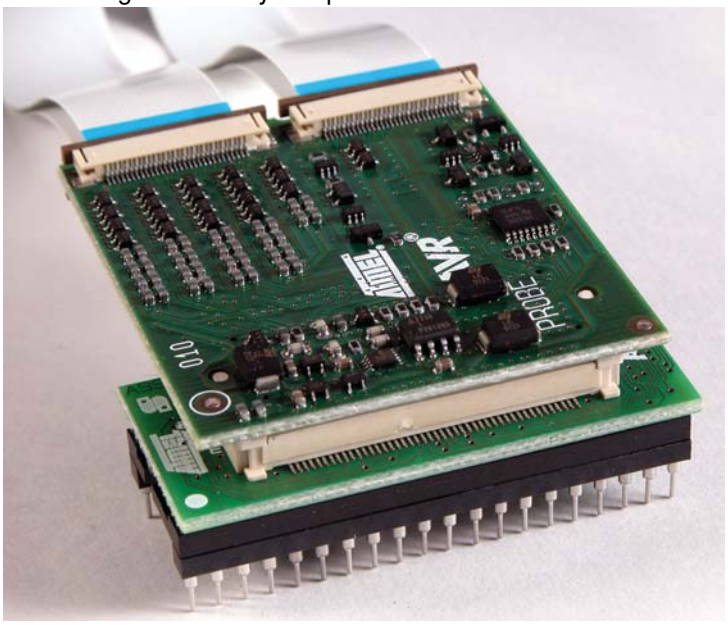
Table 3-2. Personality Adapters

Device	Use Personality Adapter Named	Seral Number
ATmega16	m32	A9902.3.1310.A
ATmega128	m128	W10635SDF
ATmega32	m32	A9902.3.1310.B
ATtiny28/29	t28/t29	A9902.3.1350.B
ATtiny26	t26	A9902.3.1370.A
ATmega162	m162	A9902.3.1300.B
ATmega8	m8	A9902.3.1390.C
ATmega169	m169	W10634SDF

3.4.1.1 Connecting the Personality Adapter to the Probe

When connecting the Personality Adapter and the Probe, make sure that the Probe is connected with the correct orientation. The connectors will only fit when the boards have the correct orientation. On the Personality Adapters a circle indicates pin 1. Make sure that the circle on the Probe matches the circle on the Personality Adapter as shown in Figure 3-8.

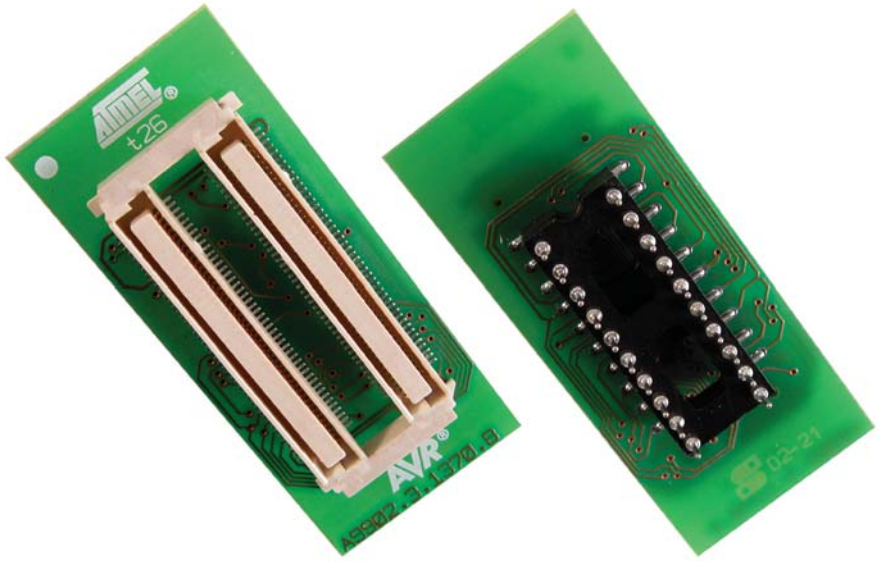
Figure 3-8. Connecting Personality Adapter to Probe



3.4.2 t26 Personality Adapter

The t26 Personality adapter is a PDIP adapter for t26 devices. The footprint is a standard 20-lead 0.300" wide, PDIP package. If the target uses another package type, an additional adapter has to be purchased from a third party vendor. When connecting the Personality Adapter to the Probe, make sure to align the circles on the Probe and Personality Adapter as shown above.

Figure 3-9. t26 Personality Adapter[1]



Note: 1. SNR: A9902.3.1370.A

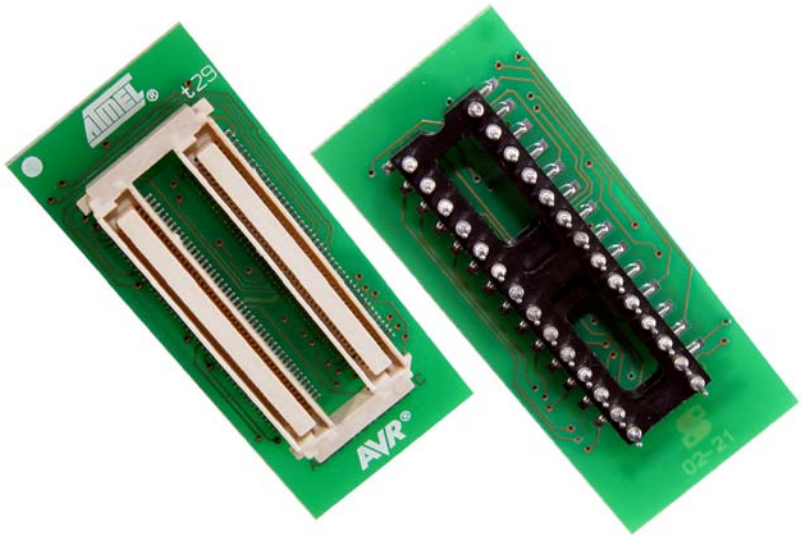
3.4.2.1 Supported Devices

- ATtiny26

3.4.3 t28 and t29 Personality Adapter

The t28 Personality adapter is a PDIP adapter for t28 devices. The footprint is a standard 28-lead 0.300" wide, PDIP package. If the target uses another package type, an additional adapter has to be purchased from a third party vendor. When connecting the Personality Adapter to the Probe, make sure to align the circles on the Probe and Personality Adapter as shown above.

Figure 3-10. t28 and t29 Personality Adapter(1)



Note: 1. SNR: A9902.3.1350.B

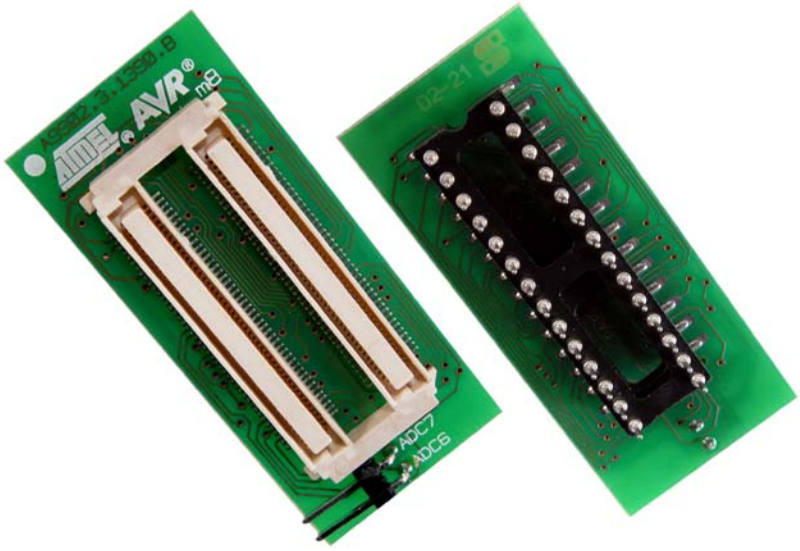
3.4.3.1 Supported Devices

- ATtiny28

3.4.4 m8 Personality Adapter

The m8 Personality adapter is a PDIP adapter for m8 devices. The footprint is a standard 28-lead 0.300" wide, PDIP package. If the target uses another package type, an additional adapter has to be purchased from a third party vendor. When connecting the Personality Adapter to the Probe, make sure to align the circles on the Probe and Personality Adapter as shown above.

Figure 3-11. m8 Personality Adapter(1)



Note: 1. SNR: A9902.3.1390.C

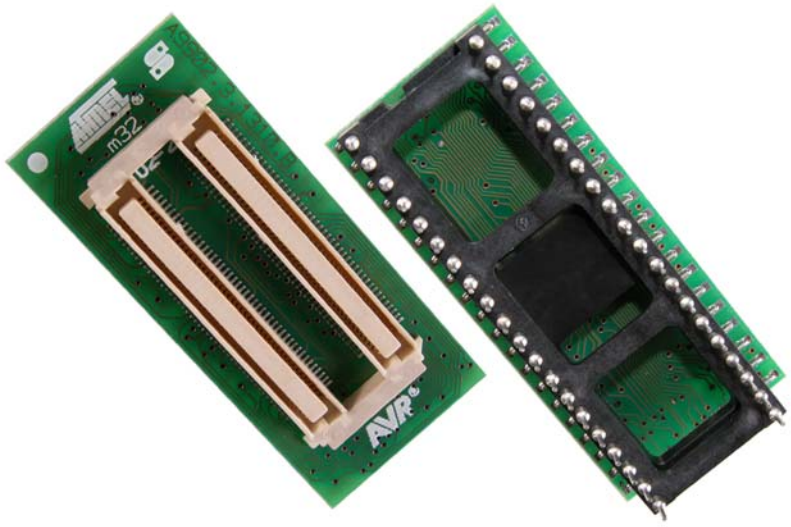
3.4.4.1 Supported Devices

- ATmega8

3.4.5 m32 Personality Adapter

The m32 Personality adapter is a PDIP adapter for m32/m16 devices. The footprint is a standard 40-lead 0.600" wide, PDIP package. If the target uses another package type, an additional adapter has to be purchased from a third party vendor. When connecting the Personality Adapter to the Probe, make sure to align the circles on the Probe and Personality Adapter as shown above.

Figure 3-12. m32 Personality Adapter[1]



Note: 1. SNR: A9902.3.1310.B

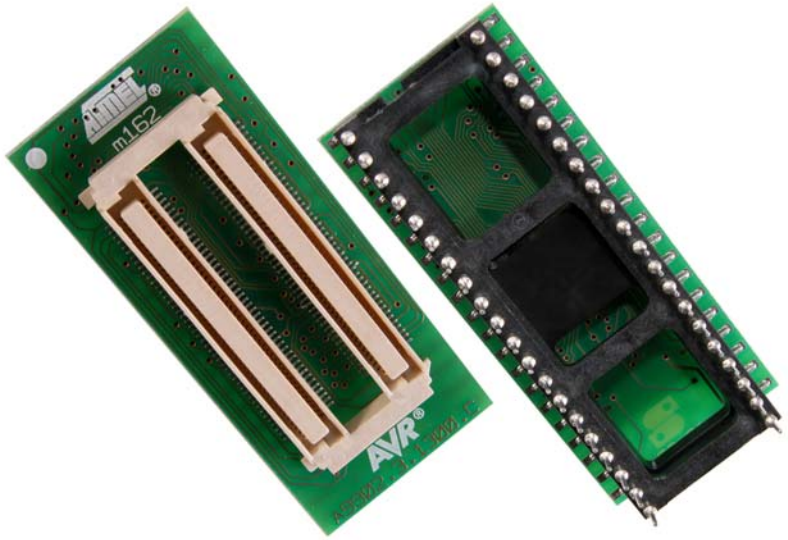
3.4.5.1 Supported Devices

- ATmega32/ATmega16

3.4.6 m162 Personality Adapter

The m162 Personality adapter is a PDIP adapter for m162 devices. The footprint is a standard 40-lead 0.600" wide, PDIP package. If the target uses another package type, an additional adapter has to be purchased from a third party vendor. When connecting the Personality Adapter to the Probe, make sure to align the circles on the Probe and Personality Adapter as shown above.

Figure 3-13. m162 Personality Adapter[1]



Note: 1. SNR: A9902.3.1300.B

3.4.6.1 Supported Devices

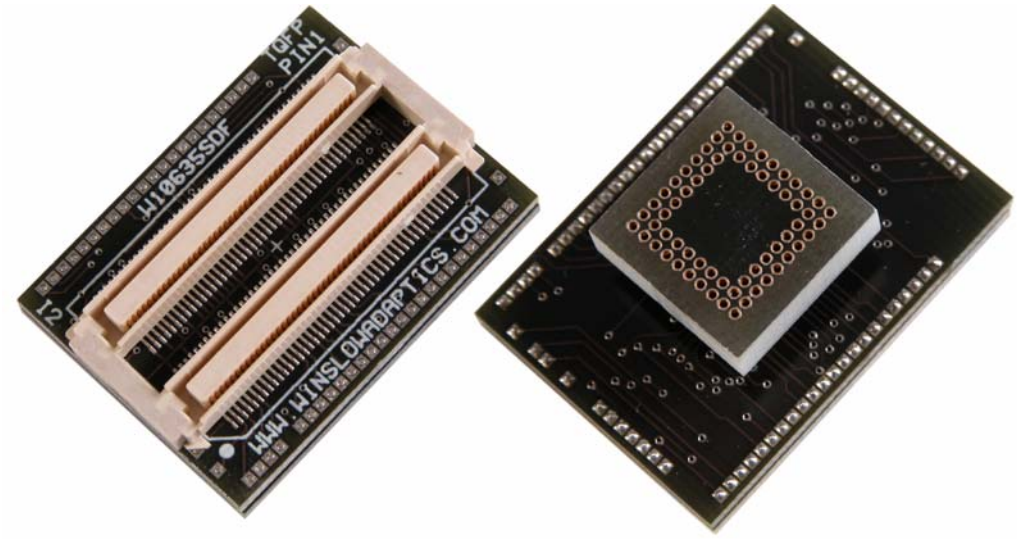
- ATmega162

3.4.7 m128 Personality Adapter

The m128 Personality Adapter is a TQFP64 adapter, and it consists of two modules. The bottom module has the TQFP footprint, and should be soldered on the target application. Make sure to solder it with the correct orientation. Pin 1 is indicated with a printed “1” as shown here. Once the bottom module is soldered into the application, connect the top module. Make sure that pin 1 on the top module matches the pin 1 on the bottom module.

Once the Personality Adapter is securely mounted, place the Probe on the Personality adapter. The circle marked on the Probe should align with pin 1 on the m128 adapter.

Figure 3-14. m128 Personality Adapter(1)



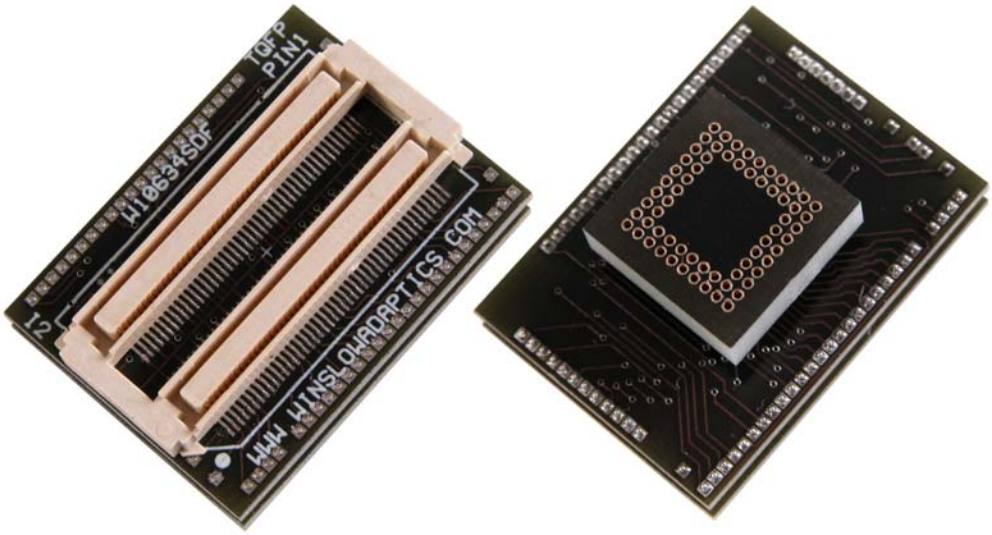
Note: 1. SNR: W10635SDF

3.4.7.1 Supported Devices

- ATmega128

3.4.8 m169 Personality Adapter

Figure 3-15. m169 Personality AdapterFigure 1



Note: 1. SNR: W10634SDF

3.4.8.1 Supported Devices

- ATmega169

3.5 POD Description

The ICE50 POD implements all digital I/O and analog functionality of the current AVR family of devices. If new AVR devices are made available to the market that contain I/O or analog features that cannot be emulated by the current POD, Atmel is dedicated to create new POD modules that support the functionality of the new devices.

3.5.1 POD Description

The ICE50 POD is shown in Figure 3-16. It connects to the main unit through two docking connectors. When connecting or disconnecting the POD do not use excessive force as this might damage the POD.

Figure 3-16. ICE50 POD

The POD contains all analog and digital logic necessary to emulate the target AVR device. The circuitry is designed to give as close as possible electrical characteristics as the real device. The POD emulates the following functions:

- Digital I/O
- Analog Comparator
- A/D Converter

The ICE50 is a jumperless design. All configuration of the POD is done through AVR Studio. No manual configuration of jumpers is necessary.