AT88CK109STK3

Hardware User Guide

8557B—CRYPTO—04/09

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Section 1
Introduction

Congratulations on acquiring the AVR®-based AT88CK109BSTK3 CryptoAuthentication Starter Kit. This kit is designed to give designers a quick start to develop code for the CryptoAuthentication product family. All the necessary hardware is provided in the package. The AT88Microbase has been pre-programmed for your convenience. Please be sure to visit WWW.Atmel.com/Javan for the latest firmware image.

1.1 Overview

This document describes the AT88CK109STK3, which is a development kit for the AT88SA100, AT88SA102, and ATSA8810HS CryptoAuthentication devices. This kit uses a modular approach. The development kit includes the AT88Microbase board and the AT88CK109BK3 CryptoAuthentication daughter board. The AT88Microbase uses a convenient Type-A USB interface allowing users to interface with a personal computer and experiment with CryptoAuthentication. The small USB form factor of the AT88Microbase allows the board to function as a demo as well as a development platform.

The AT88CK109BK3 daughter board has two SOT23-3 sockets for either client-host or multiple client development. Together, these boards allow an easy evaluation of the CryptoAuthentication products using demonstration software. This user guide acts as a general, getting started guide as well as a complete technical reference for advanced users.

1.2 AT88CK109STK3 Starter Kit Features

AT88Microbase provides the following features:

- AT90USB1287 (AVR) 64 QFN device (2.7V < VCC < 5.5V)
  - 128K Bytes of In-System Self-Programmable Flash
  - 4K Bytes EEPROM
  - 8K Bytes Internal SRAM
- AT88SC018 CryptoCompanion IC
- USB software interface for Device Firmware Upgrade (DFU boot loader)[2]
- Power supply LED
  - from the USB interface (USB device bus powered application)
  - from an external power supply
- JTAG Connector:
  - for on-chip ISP
  - for on-chip debugging using JTAG ICE

- Serial interfaces:
  - 1 USB full / low speed device interface
  - USART
- On-board resources:
  - 3 User defined LEDS
  - 10 Pins I/O header (2x5, 0.1” pitch)
    - Supports SPI, TWI, and UART
  - 1 Buzzer
- On-board RESET button
- On-board HWB button to force AVR into DFU mode at reset
- 16 MHz crystal for system clock

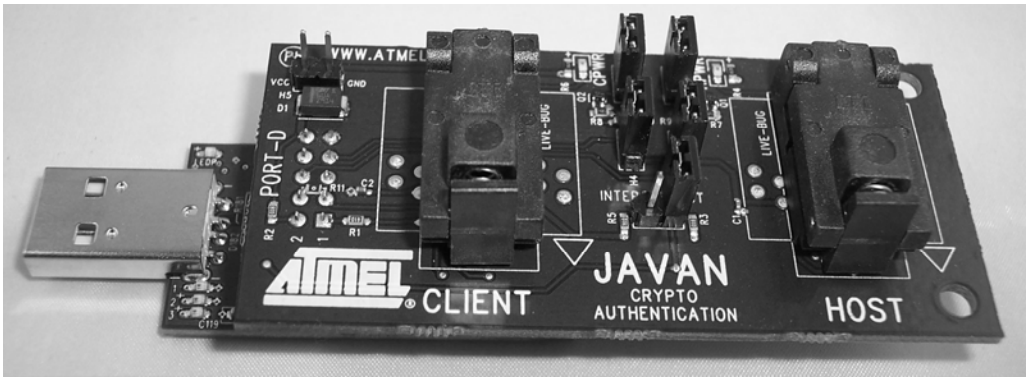
The AT88SC19BK3 provided the following features:

- 2 SOT23-3 CryptoAuthentication Sockets
  - HOST and CLIENT
  - Software PWR control
- AVR Studio® software interface(1)

Notes: 1. AT88Microbase is supported by AVR Studio®, version 4.17 (build 666) or higher. For up-to-date information on this and other AVR tool products, please consult our web site. The newest version of AVR Studio®, AVR tools and this User Guide can be found in the AVR section of the Atmel web site, http://www.atmel.com.

2. ATMEL Flip®, In System Programming Version 3.2.2 or higher shall be used for Device Firmware Upgrade. Please consult Atmel web site to retrieve the latest version of Flip and the DFU bootloader Hex file if needed

Figure 1. AT88CK109STK3 Kit



1.2.1 Device Support

AT88CK109BK3 (daughter board) currently supports the following CryptoAuthentication devices:

- ATSA88100
- ATSA88102
- ATSA8810HS

Locate the latest information about Crypto Authentication at www.atmel.com/Javan .

Section 2
Getting Started

2.1 Unpacking the System

Package content:

- AT88Microbase Controller
- AT88CK109BK3, CryptoAuthentication daughter board
- Atmel CryptoAuthentication product assortment
- 1 USB cable, 6 inches

2.2 System Requirements

The minimum hardware and software requirements are:

- 200 MB free hard disk space (AVR Studio, FLIP and ATMEL's Crypto Evaluation Studio)
- Windows® XP, X86 processor
- Available USB Port

2.3 Software Installation

- Install CryptoAuthentication Demonstration Utility available from WWW.Atmel.com/Javan
- Launch software and follow the online help.

Note: The CryptoAuthentication IC's that are included with your kit have Development Secrets, not Production secrets. See the .xml file that is included with the CryptoAuthentication utility. Please be aware of this during your development.

Section 3
Using the AT88CK109STK3

This chapter describes the features of the AT88Microbase and the AT88CK109BK3 boards.

3.1 Overview

Figure 2. AT88Microbase Components (front side)

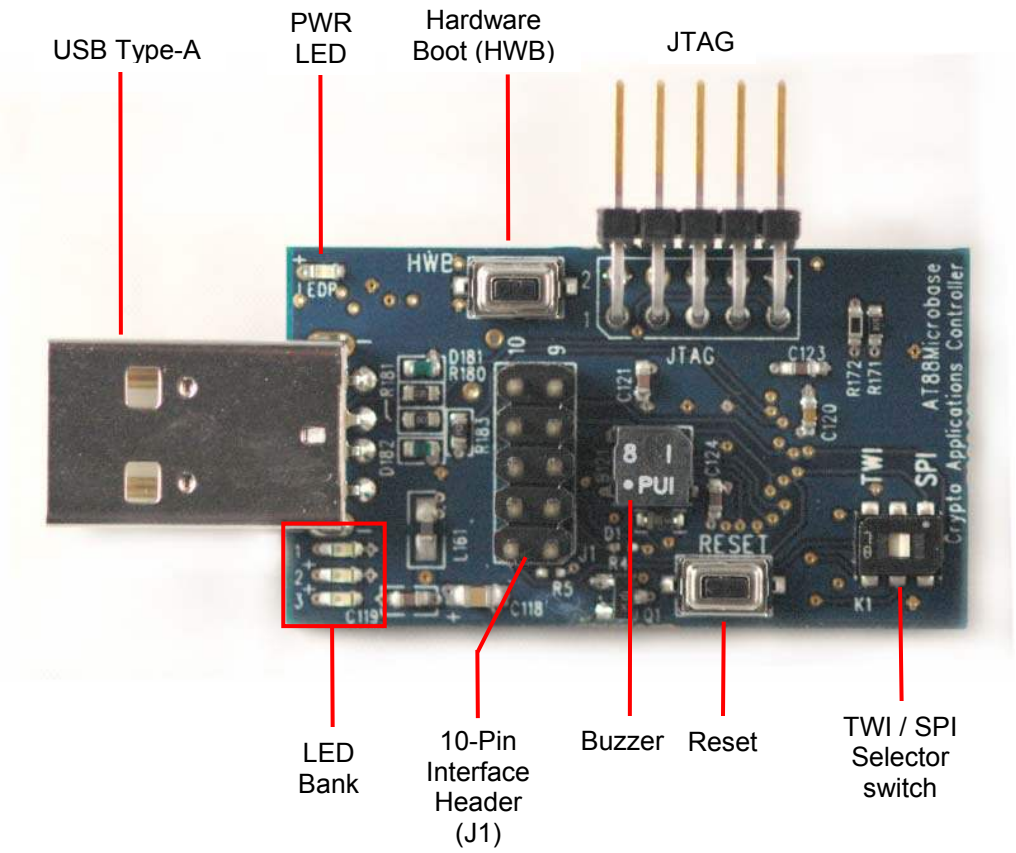
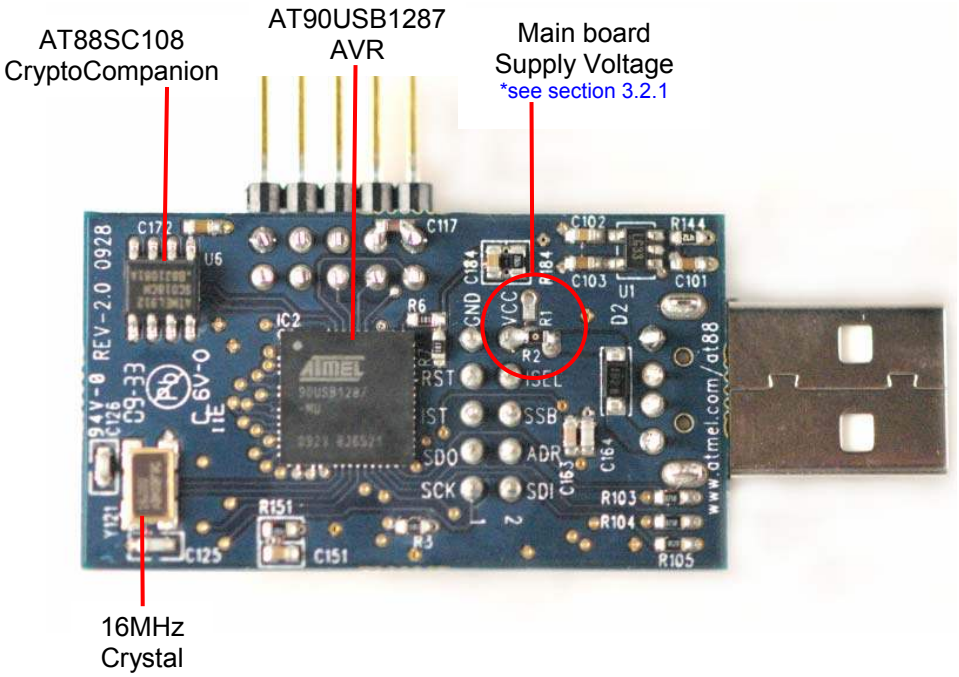


Figure 3. AT88Microbase Components (back side)

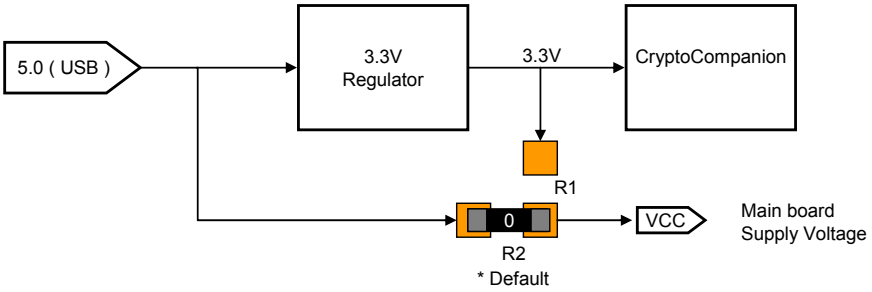


3.2 Power Supply

3.2.1 USB powered

The on-board power supply circuitry allows two possible configurations for the main supply voltage.

Mounted Resistor	Main Board Supply Voltage	Comments
R1	3.3V	
R2	5.0V (USB)	Default Setting



The CryptoCompanion supply voltage is always 3.3V, regardless of R1and R2 configuration.

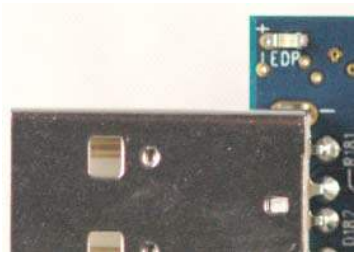
Note 1: For the AT88SA100, AT88SA102, and the AT88SA10HS devices, 5.0V is required to burn the fuses.

Note 2: The AT88Microbase is shipped with a 16MHz crystal, which allows the AT90USB1287 on-chip USART to obtain the 230.4K baud rate (-3.5% error) required to communicate with a CryptoAuthentication device. The 16MHz crystal requires that $4.5 \leq VCC \leq 5.5$. To operate the AT88Microbase below 4.5V, the 16MHz crystal must be replaced with an 8MHz crystal. The ABM3B-8.000MHZ-B2-T 8MHz crystal is a drop-in replacement.

3.2.2 Power LED, "LEDP"

The blue LED (LEDP) is always lit when power is applied to the AT88Microbase regardless of the voltage supply.

Figure 4. Power on LED "LEDP"



3.3 RESET

Although the AT90USB1287 has its on-chip RESET circuitry, (c.f. AT90USB1287 Datasheet, section "System Control and Reset"), the AT88Microbase provides two additional means to reset the AT90USB1287.

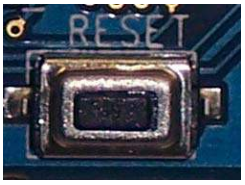
3.3.1 Power-on Reset

The on-board RC network acts as power-on RESET.

3.3.2 RESET Push Button

By pressing the RESET push button on the AT88Microbase, a warm RESET of the AT90USB1287 AVR is performed.

Figure 5. RESET Push Button (AVR RESET) Implementation



3.4 AT90USB1287 AVR Microcontroller

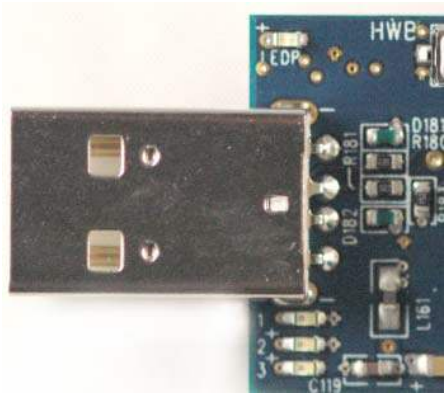
To use the USB interface of the AT90USB1287, the clock source should always be a crystal or an external clock oscillator (the internal 8MHz RC oscillator cannot be used to operate the USB interface). Only the following crystal frequencies allow proper USB operations: 2MHz, 4MHz, 6MHz, 8MHz, 12MHz, and 16MHz. The AT88Microbase comes with a default 16MHz crystal oscillator, which is required to obtain the 230.4K USART baud rate needed for CryptoAuthentication communication.

3.5 Serial Links

3.5.1 USB

The AT88Microbase is supplied with a standard USB Type-A receptacle. The AT88Microbase only operates as an “USB device”.

Figure 6. USB Type-A Receptacle



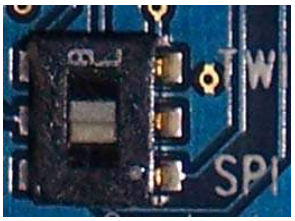
3.5.2 USART

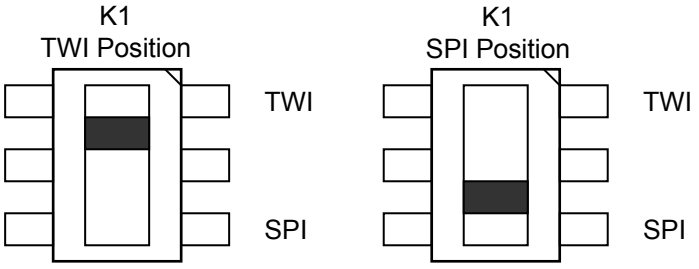
The AT90USB1287 AVR comes with an on-chip USART peripheral (USART1). Only the asynchronous mode is supported. See section 3.6.3 for pinout details.

3.5.3 SPI / TWI Selector Switch

The SPI – TWI selector switch (K1) allows either the SPI pins (MOSI and SCLK) or the TWI pins (SDA and SCL) to be routed to the 10 pin Interface header, J1. See section 3.6.3 for pinout details.

Figure 7. TWI – SPI Selector Switch



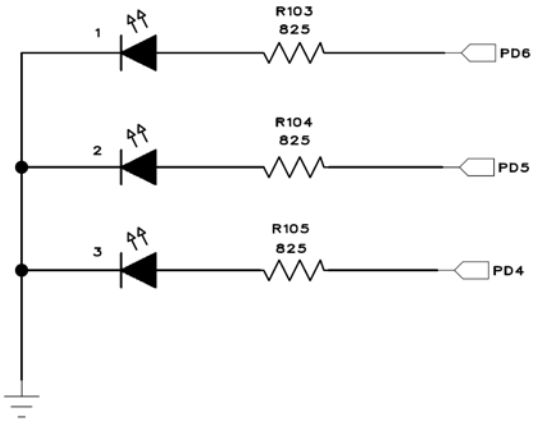


3.6 On-board Resources

3.6.1 Description of LED Bank

The AT88Microbase includes 3 general purpose red LEDs, which are connected to PD6, PD5 and PD4. To light an LED, the corresponding port pin must be driven high. To turn off an LED, the corresponding port pin must be driven low.

Figure 8. LEDs Implementation Schematic

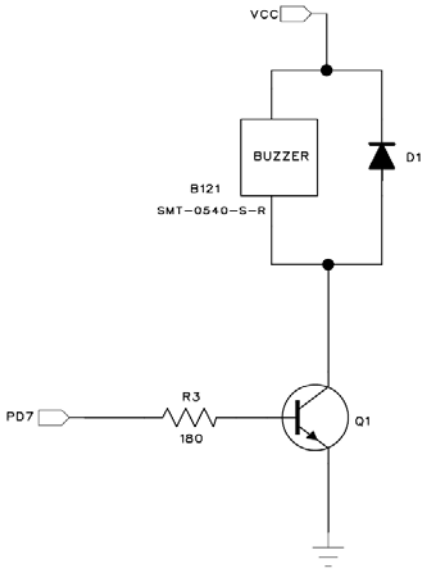


Note: AVR can source or sink enough current to drive an LED directly.

3.6.2 Buzzer

The small onboard buzzer adds audio capability to the AT88Microbase board. The buzzer requires that PD7 be driven with a square wave at 4.0 ± 0.5 KHz to achieve a maximum decibel of 78dB.

Figure 9. Buzzer Implementation Schematic



Brief Spec:

Input Signal: Square Wave

Resonant frequency: 4.0 ± 0.5 KHz

Sound Pressure Level: 78dB

3.6.3 Description of the Interface Header

The 10-Pin header (J1) of the AT88Microbase provides interfacing for daughter boards.

Figure 10. 10-Pin Interface Header

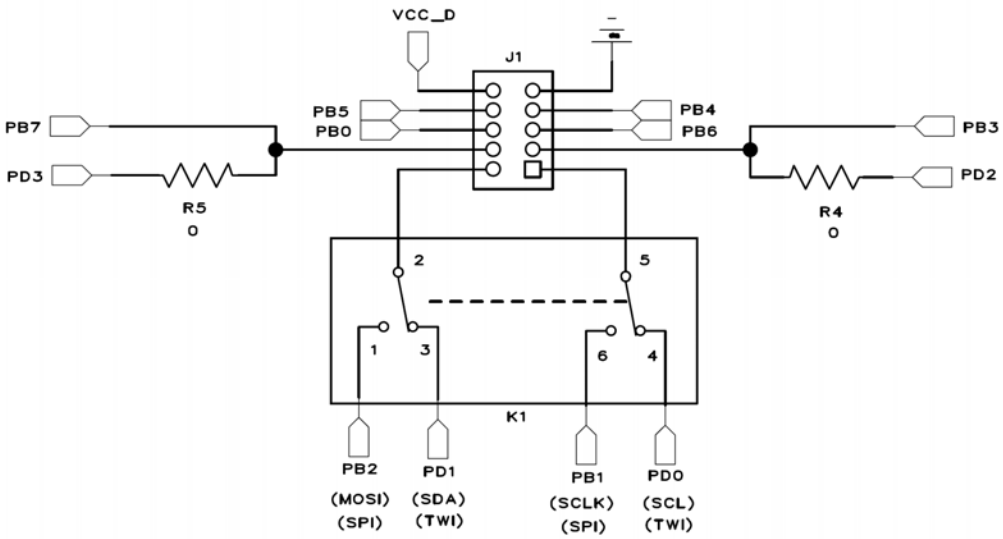
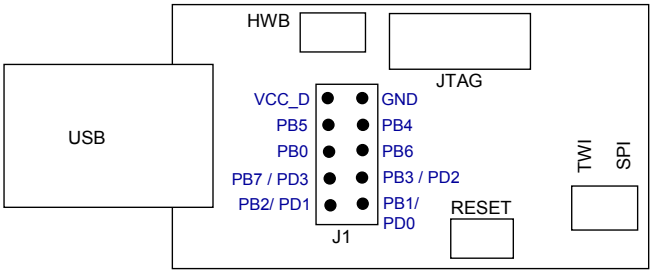


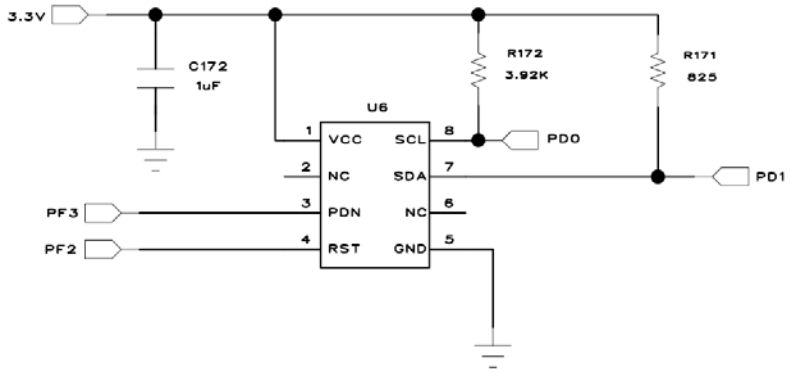
Figure 11. 10-Pin Interface header (J1) Orientation



3.6.4 CryptoCompanion Chip

The AT88Microbase has one CryptoCompanion device (AT88SC108), which is located on the back side of board. The AT88SC018 is designed as the mate to Atmel's CryptoRF® (CRF) and CryptoMemory® (CM) chips. The SCL and SDA pins are connected to PD0 and PD1, respectively. The RST and PDN pins are connected to PF2 and PF3, respectively.

Figure 12. System CryptoCompanion Schematic



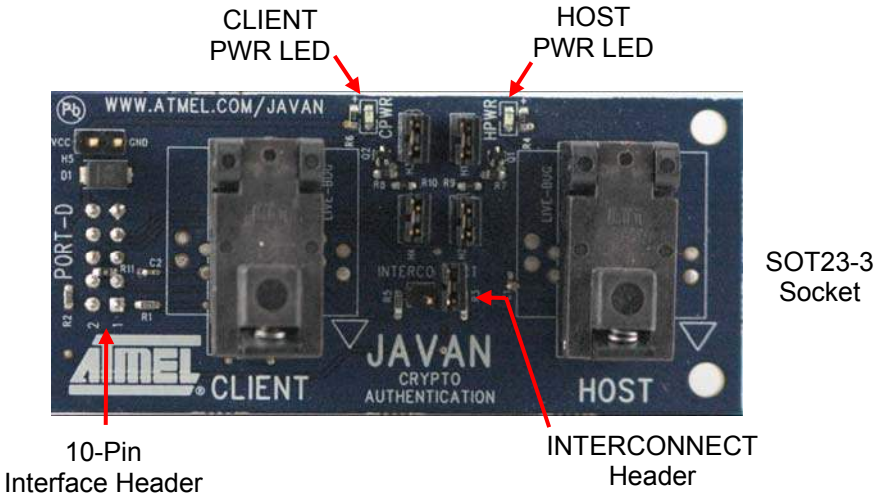
Datasheet can be found on the Atmel web site, http://www.atmel.com/products/securemem.

Note: The CryptoCompanion chip cannot be used with the CryptoAuthentication family of devices.

The following sections 3.7 – 3.11 describe the AT88CK109BK3 CryptoAuthentication daughter board.

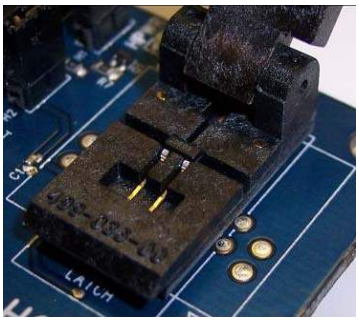
3.7 AT88CK109BK3 CryptoAuthentication Daughter Board

Figure 13. AT88CK109BK3 Components (top side)



AT88CK109BK3 has two SOT23-3 sockets that support the AT88SA100, AT88SA102, and the AT88SA10HS 3-leads devices.

Figure 14. Chip-in-Socket Placement (Live bug)



3.8 AT88CK109BK3 HOST and CLIENT Sockets Compatibility

AT88CK109BK3 is supplied with two SOT23-3 sockets titled HOST and CLIENT. Since both sockets have identical pinout's, the AT88Microbase can physically accept a host or a client device in either socket. Therefore, the AT88CK109BK3 can be configured for either a host-client or client-client development.

Note: When using the demonstration software, the host (AT88SA10HS) and client (AT88SA100 or AT88SA102) devices must be in their respective sockets according to the “HOST” and “CLIENT” texts on the board.

3.9 HOST and CLIENT Power Configuration

The AT88CK109BK3 provides the user with the capability to independently power cycle each socket with software or place the sockets in a constant power-on state, assuming power is applied to the board.

Figure 15. HOST and CLIENT Power Headers

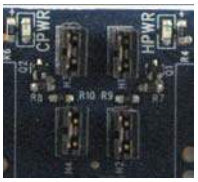


Figure 16. Schematic Implementation for Software Power Control, HOST-side

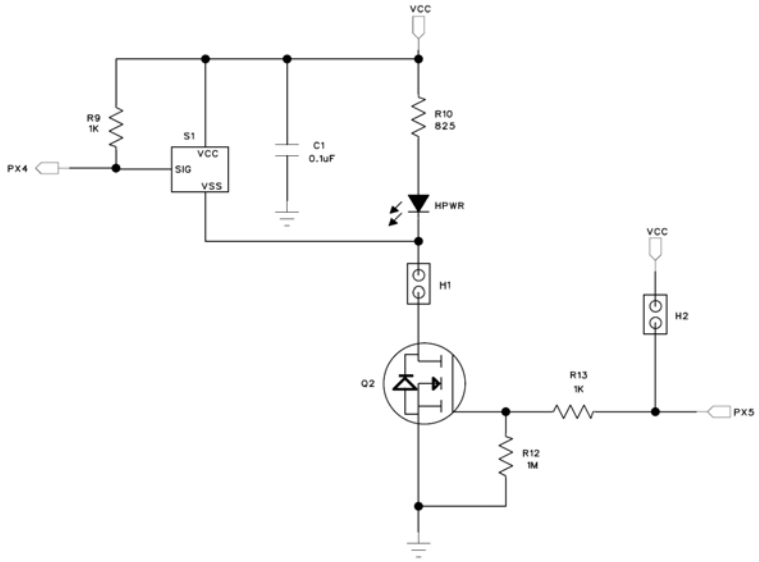
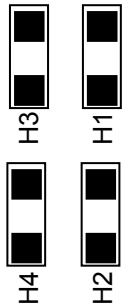


Table 1. HOST and CLIENT sockets Power Configuration

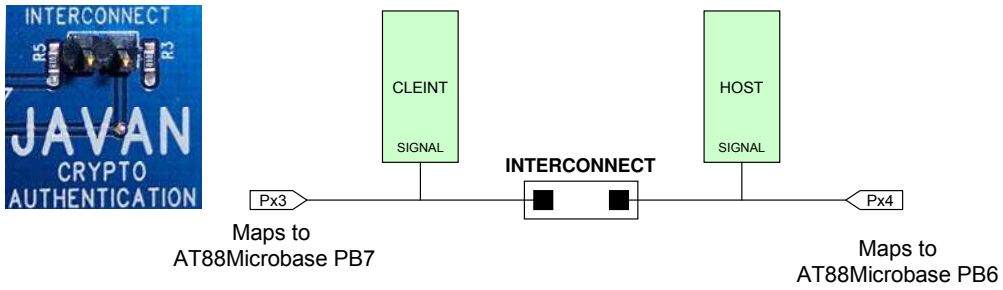
Jumpers Position	Comments	View
Hardware Power Configuration **H1, H2, H3 and H4 Mounted**	With all 4 jumpers mounted, the HOST and CLIENT sockets are placed into a constant power–on state. *Default setting	

HOST **Software Power Configuration** **H1 Mounted** **H2 Not - mounted**	This configuration allows the user to power cycle the HOST socket via software. See Table 2 and 3 for pinout details	
CLIENT **Software Power Configuration** **H3 Mounted** **H4 Not - mounted**	This configuration allows the user to power cycle the CLIENT socket via software. See Table 2 and 3 for pinout details	

3.10 Device Interconnect Header

The “INTERCONNECT” header provides a single-wire bus between the signal pins of the HOST and CLIENT devices. The header can also serve as test points.

Figure 17. Interconnect Header



3.11 Mapping AT88CK109BK3 to AT88Microbase, STK500 and STK600

The AT88CK109BK3 maps to the 10-pin header of the AT88Microbase as follow:

Table 2. Mapping the AT88CK109BK3 to the AT88Microbase

AT88Microbase Header (J1)	AT88CK109BK3	Comments
PB0	Software Power Control	HOST Socket

PB1	NC	Not Connected
PB2	NC	
PB3	Tied to PB7 with R11	USART (Receive)[1]
PB4	Software Power Control	CLIENT Socket
PB5	NC	
PB6	HOST Signal Pin	Bit-banging
PB7	CLIENT Signal Pin	Bit-banging / USART (Transmit)[1]
GND	GND	GND
VCC	VCC	VCC

Table 3. Mapping AT88CK109BK3 to the STK500 and STK600

STK500 / STK600	AT88CK109BK3	Comments
Px0	NC	-
Px1	NC	-
Px2	Tied to Px3 with R11[1]	USART (Receive)[1]
Px3	CLIENT Signal Pin	Bit-banging / USART (Transmit)[1]
Px4	HOST Signal Pin	Bit-banging
Px5	Software Power Control	HOST Socket
Px6	Software Power Control	CLIENT Socket
Px7	NC	-
GND	GND	GND
VTG	VCC	VCC

Figure 18. AT88CK109BK3 Mounted to the STK500

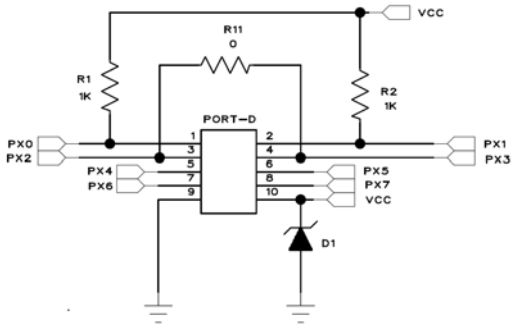
[1] See section 3.12

Note 3: “x” in Table 3 denotes any port on the STK500 and STK600

3.12 Interfacing a USART with CryptoAuthentication

A microcontroller's USART requires a minimum of two signals (RXD and TXD) to communicate. The AT88SA100, AT88SA102, and AT88SA10HS devices have a 1-wire communication interface. The make the USART compatible with a 1-wire CryptoAuthentication device, the USART's pins (TX and Rx) are tied together.

Figure 19. USART TXD and RXD pins configured for 1-wire Interfacing



On the AT88CK109BK3, Px2 and Px3 are tied together with a zero ohm resistor (R11). When mounted to the AT88Microbase, pins Px2 and Px3 align with pins (PB3/PD2) and (PB7/PD3). The USART pins, PD2 (RXD) and PD3 (TXD), are effectively tied together with R11allowing the USART to be compatible with the CryptoAuthentication 1-wire interface.

3.13 In-System Programming

3.13.1 Programming with USB bootloader: DFU (Device Firmware Upgrade)

AT90USB1287 AVR comes with a default factory pre-programmed USB bootloader located in the on-chip boot section of the AT90USB1287. This is the easiest and fastest way to reprogram the device directly over the USB interface. The "Flip" PC side application, available for free on Atmel website, offers a flexible and user friendly interface for reprogramming the application over the USB bus.

The "HWB" push button is used to place the AVR into DFU mode after reset (Refer to AT90USB1287 datasheet section "boot loader support").

The following steps enable the DFU mode:

1. Press and hold "HWB" button
2. Press the "RESET" button
3. Release the "RESETT" button.
4. Release the "HWB" button.

For more information about the USB bootloader and FLIP software, please refer to the 'USB bootloader datasheet' document and 'FLIP User Manual'.

Note: HWBE fuse must be enabled to support DFU.

3.13.2 Programming with AVR JTAG ICE

The AT90USB1287 can be programmed using specific the JTAG link. This sub-section will explain how to connect and use the AVR JTAG ICE.

Note: When the JTAGEN fuse is disabled, the four TAP pins are normal port pins, and the TAP controller is in reset. When the JTAGEN fuse is enabled, the input TAP signals are internally pulled high. This enables the JTAG for Boundary-scan and programming. The AT90USB1287 device is shipped with this fuse programmed.

Figure 20. Connecting AVR JTAGICE mkII to the AT88Microbase

The Flash, EEPROM and all Fuse and Lock Bit options ISP-programmable, can be programmed individually or with the sequential automatic programming option.

Note: See AVR Studio® on-line Help for information.

3.14 Debugging

3.14.1 Debugging with AVR JTAG ICE mkII

Every AT88CK109STK3 can be used for debugging with JTAG ICE MK II.

Connect the JTAG ICE mkII as shown in Figure 20, for debugging help; please refer to AVR Studio® Help information.

When using JTAG ICE MK II for debugging, and as AT90USB1287 parts are factory configured with the higher security level set, a chip erase operation will be performed on the part before debugging. Thus the on-chip flash bootloader will be erased. It can be restored after the debug session using the bootloader hex file available from ATMEL website.

3.15 Test Points

There are 4 test points implemented, these test points are referenced in the full schematics section.

- VCC, AT88CK109BK3
- GND AT88CK109BK3
- HOST signal pin AT88CK109BK3 INTERCONNECT Header
- CLIENT signal pin AT88CK109BK3 INTERCONNECT Header

Section 4
Troubleshooting Guide

Table 4. Troubleshooting Guide

Problem	Reason	Solution
The blue Power LED is not on.	USB Port of AT88Microbase is not connected to PC.	Connect AT88Microbase USB port to PC's USB port.
The AVR device cannot be programmed.	The JTAG header is not connected to JTAG programmer.	Connect the JTAG header to the JTAG programmer.
	The memory lock bits are programmed.	Erase the memory before programmed.
	Reset disable fuse is set.	Check reset disable fuse.
	Programming too fast with ISP SPI	Check oscillator settings and make sure it is not set higher than SPI clock
	USB Port of AT88Microbase is not connected to PC (programmed through USB).	Connect AT88Microbase USB port to PC's USB port.
	AT88Microbase is not in DFU mode.	— Press and hold the “HWB” push button. — Press the “RESET” push button. — Release the “RESET” push button. — Release the “HWB” push button.
	The communication medium in FLIP hasn't been selected	From the FLIP menu, select “Settings > Communication > USB”.
AVR Studio does not detect JTAG or ISP programmer.	JTAG or ISP programmer is not connected or power is off.	Connect JTAG programmer to JTAG header or ISP programmer to ISP header and check power connections.
FLIP program not working.	AT88Microbase is not in DFU mode.	JTAG to load the bootloader and set (check) the HWBE fuse. Correct fuse settings: Reading fuses address 0 to 2.. 0xDE, 0x99, 0xF3

Section 5
Technical Specifications

- System Unit
  - — AT88Microbase
    - o Physical Dimensions — L=58 x W=25 x H=12 mm
    - o Weight — 9.0g
  - — AT88CK109BK3
    - o Physical Dimensions — L=74 x W=35 x H=23 mm
    - o Weight — 17.5g
  - — Assembled Module
    - o Physical Dimensions — L=100 x W=35 x H=26 mm
    - o Weight — 26.5g
- Operating Conditions
  - — USB — 4.4V - 5V.25 (100mA)
    *See Section 3.2 — 3.3V
  - — Supply Current — 50mA
- Connections
  - — USB Connector — Type-A receptacle
  - — USB Communications — Full speed 2.0

Section 6
Technical Support

For technical support, please contact securerf@atmel.com. When emailing or contacting tech support, please do not include any proprietary information you may have input into the device. When requesting technical support, please include the following information:

- Which target AVR device is used (complete part number)
- Target voltage and speed
- Clock source and fuse setting of the AVR
- Programming method (ISP, JTAG or specific Boot-Loader)
- Hardware revisions of the AVR tools, found on the PCB
- Version number of AVR Studio. This can be found in the AVR Studio help menu.
- PC operating system and version/build
- PC processor type and speed
- A detailed description of the problem

Section 7
Complete Schematic

On the next pages, the following documents of the AT88CK109STK3 are shown:

- AT88Microbase, revision 2.0
  - Complete Schematic
  - Assembly Drawing
  - Bill of Material
  - Default configuration summary
- AT88CK109BK3, revision 1.0
  - Complete Schematic
  - Assembly Drawing
  - Bill of Material
  - Default configuration summary

Figure 1. AT88Microbase Schematic, 1 of 4

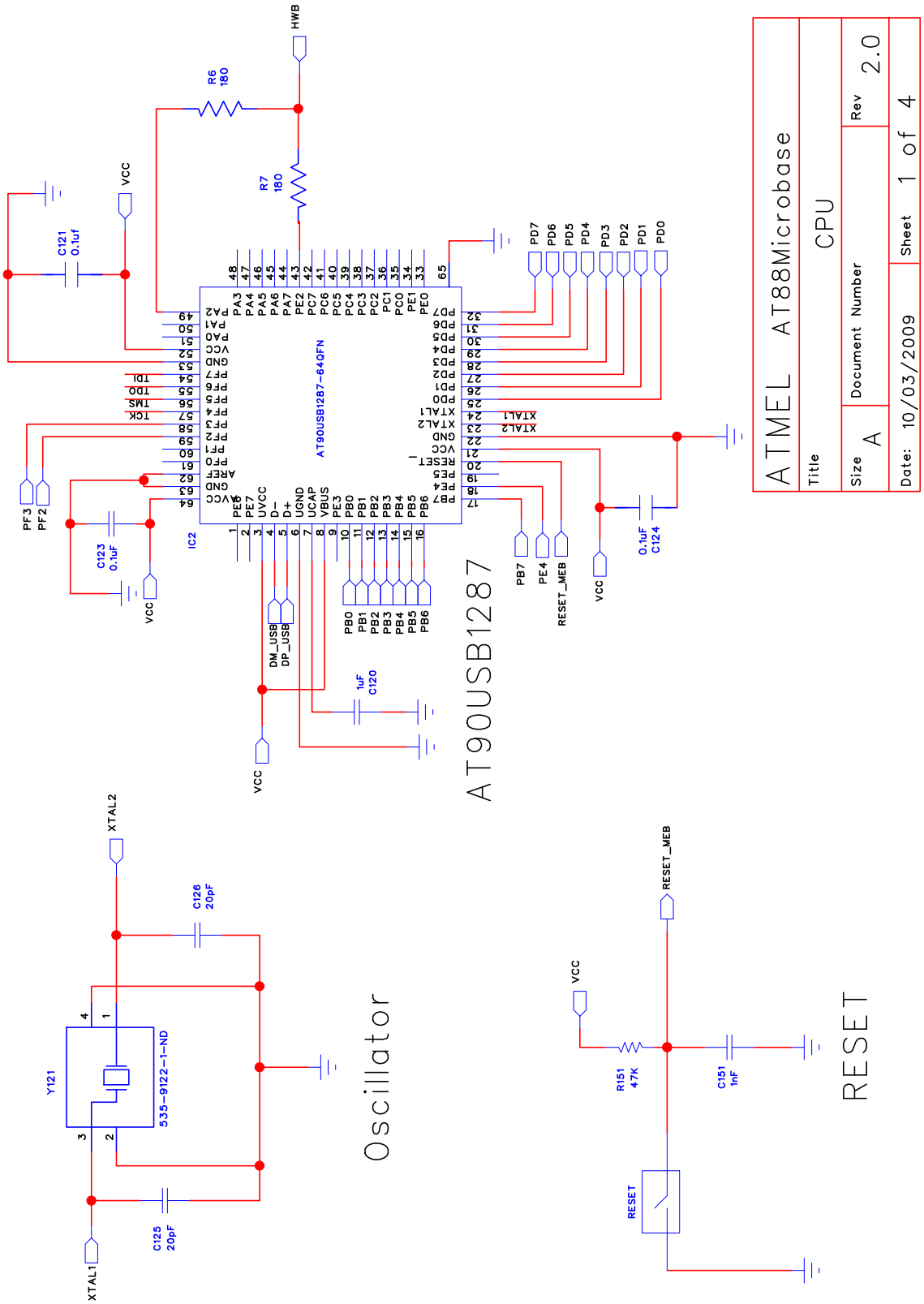


Figure 2. AT88Microbase Schematic, 2 of 4

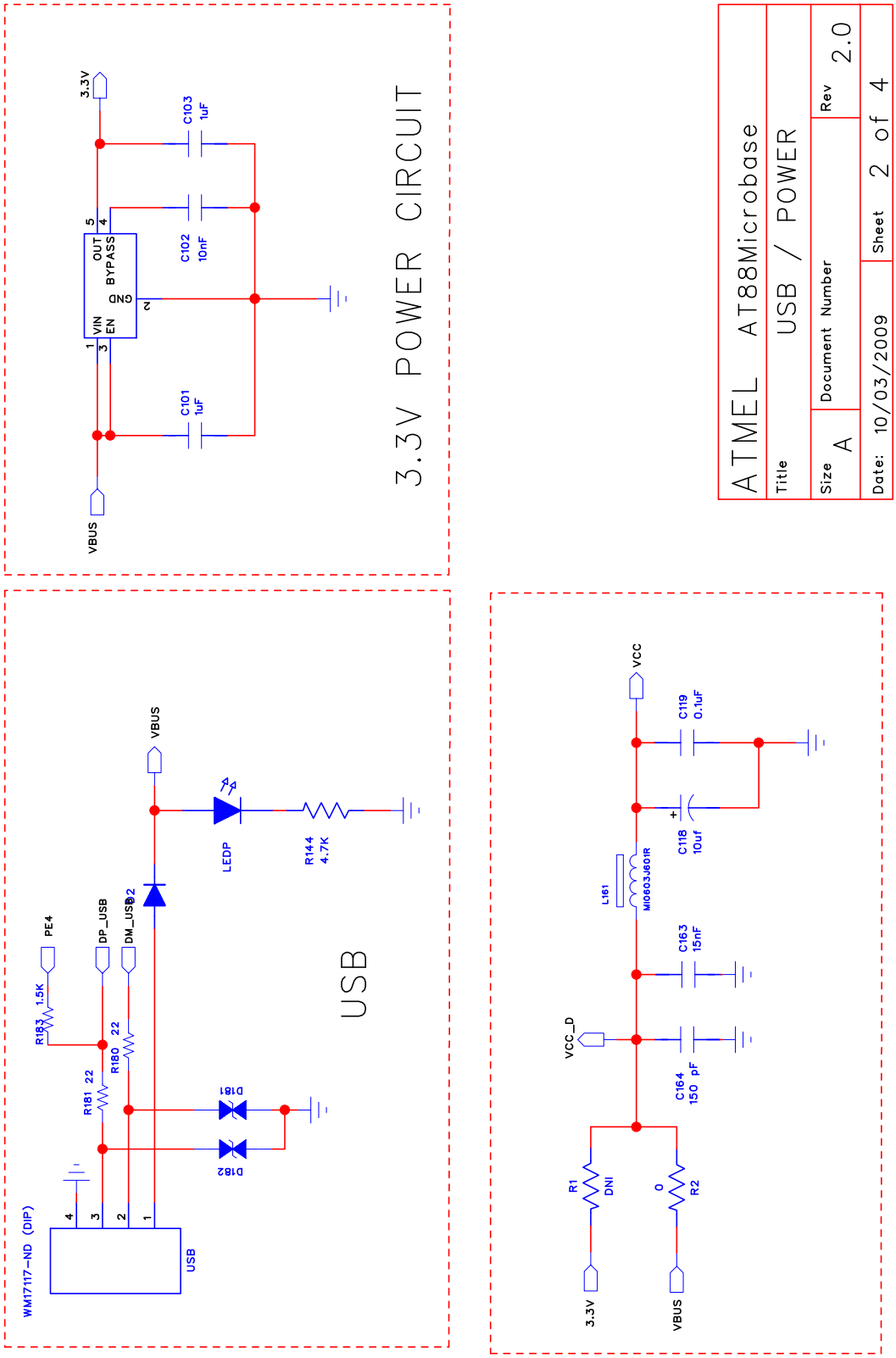
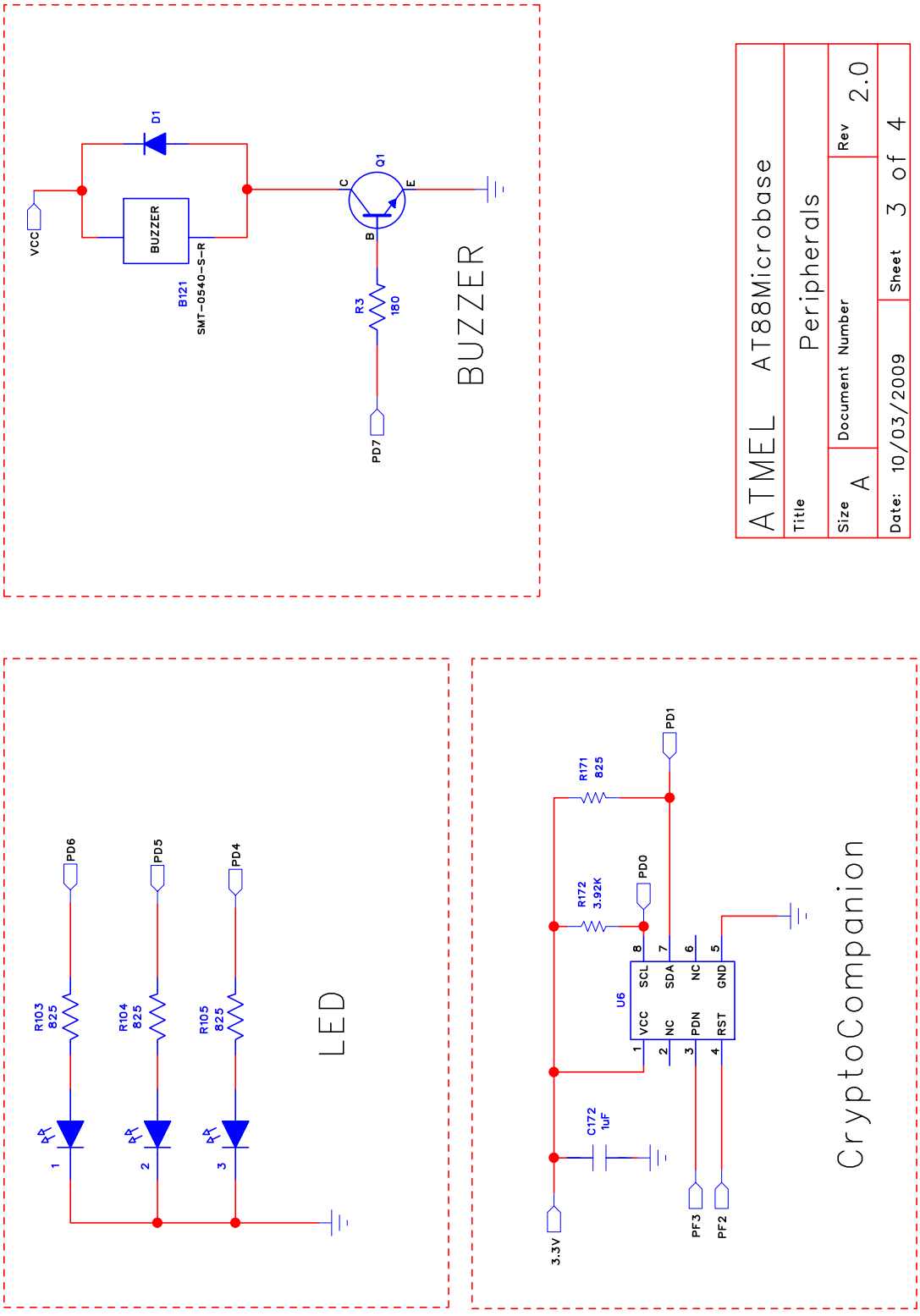
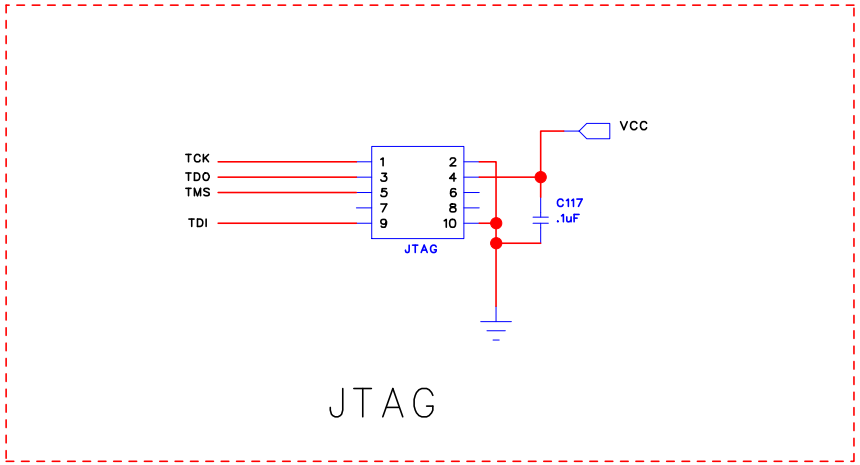
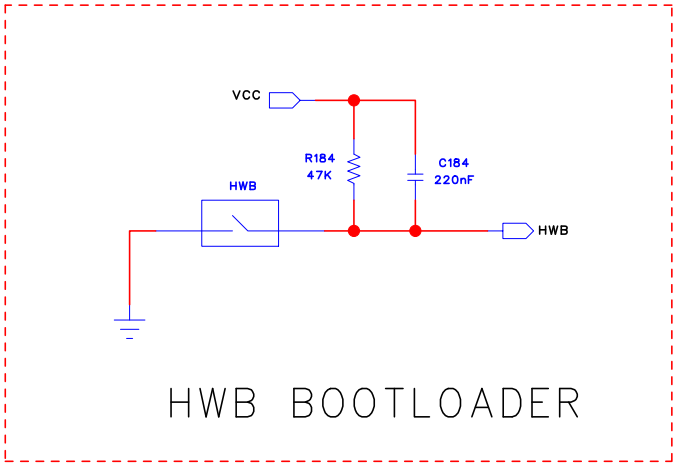
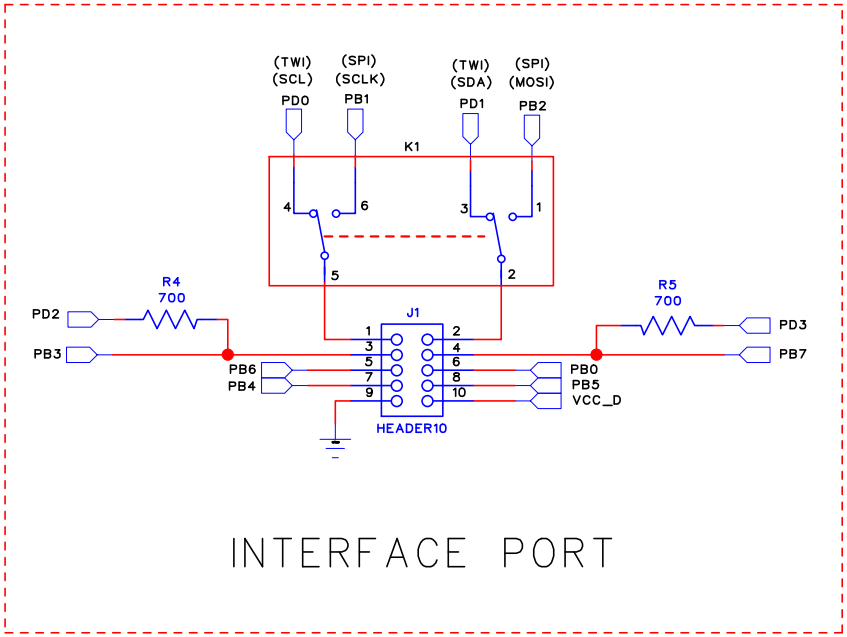


Figure 3. AT88Microbase Schematic, 3 of 4









ATMEL AT88Microbase		
Title PROGRAMMING / INTERFACE		
Size A	Document Number	Rev 2.0
Date: 10/03/2009	Sheet 4 of 4	

Figure 4. AT88Microbase Schematic, 4 of 4

Figure 5. AT88Microbase Assembly Drawing, 1 of 2 (Top side)

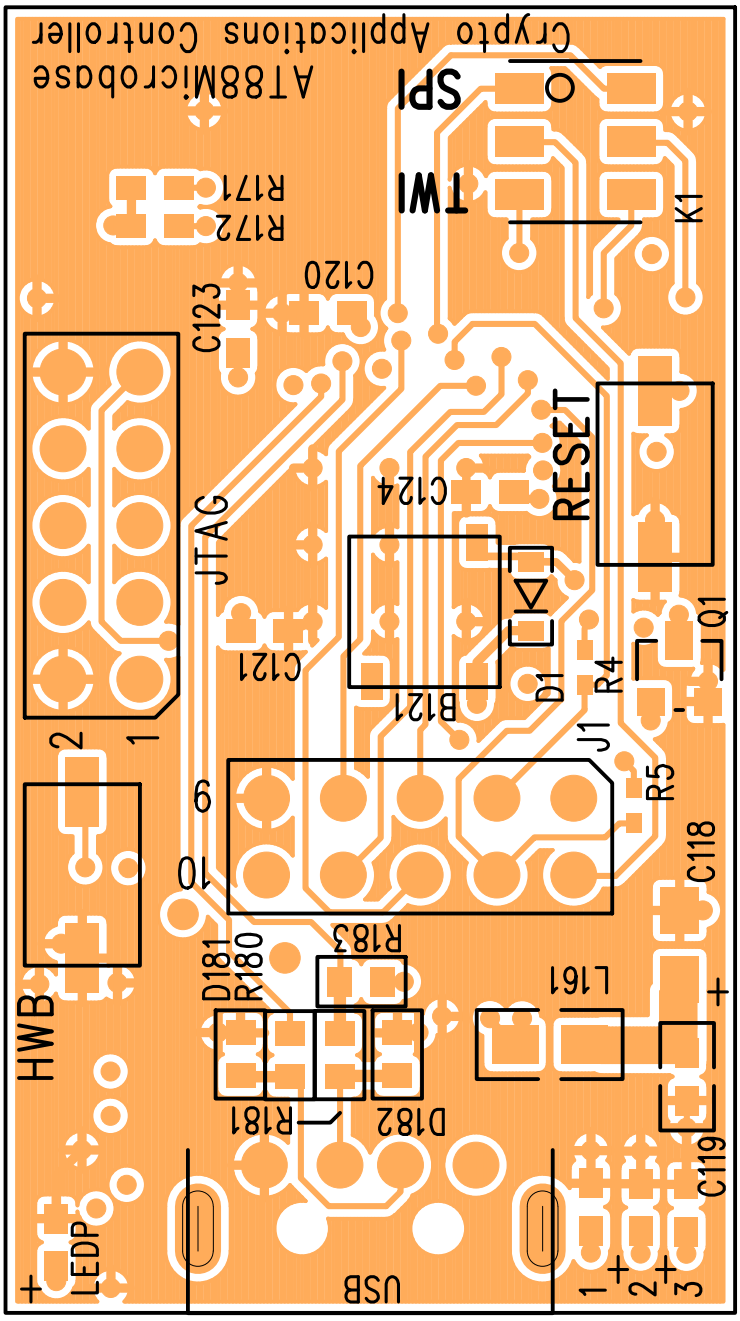
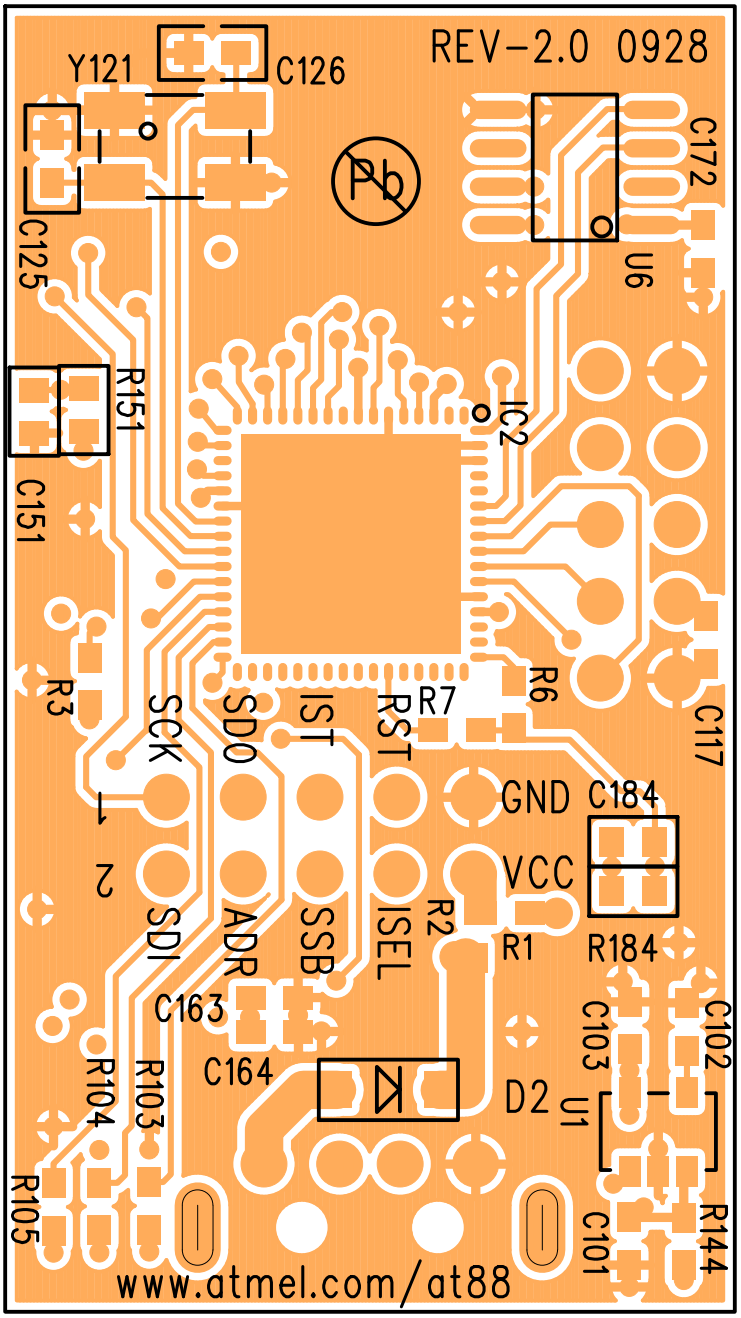


Figure 6. AT88Microbase Assembly Drawing, 2 of 2 (Bottom side)



AT88Microbase BOM

Qty	Reference	Value	Description	Case	Manufacturer PN
			CAPACITOR		
2	C125-126	20pF	Ceramic	0603	GRM1885C1H200JA01D
1	C164	150pF	Ceramic	0603	C1608C0G1H151J
1	C151	1nF	Ceramic	0603	C0603X7R500-102KNE
1	C102	10nF	Ceramic	0603	C0603X7R500-103JNE
1	C163	15nF	Ceramic	0603	ECJ1VB1H153K
1	C184	220nF	Ceramic	0603	GRM188R71A224KA01D
5	C117 C119	0.1uF	Ceramic	0603	C0603Y5V250-104ZNE
	C121		Ceramic	0603	
	C123-124		Ceramic	0603	
4	C101 C103	1uF	Ceramic	0603	C0603Y5V250-105ZNE
	C120 C172		Ceramic	0603	
1	C118	10uF	Ceramic	0805	C0805X5R6R3-106KNE
			RESISTOR		
1	R1	0	1/16 W	0603	CR0603-16W-000T
2	R180-181	22	1/16 W	0603	CR0603-16W-220JT
3	R3 R6-R7	180	1/16 W	0603	CR0603-16W-181JT
4	R103-105, R171	825	1/16 W	0603	CRCW0603825RFKEA
1	R183	1.5K	1/16 W	0603	CR0603-16W-152JT
1	R144	4.7K	1/16 W	0603	CR0603-16W-472JT
1	R172	3.92K	1/16 W	0603	ERJ3EKF3921V
2	R151 R184	47K	1/16 W	0603	CRCW060347K0FKEA
1	R2	DNI	1/16 W	0603	
2	R4, R5	0	1/16 W	0402	CR0402-16W-000T
			IC		
1	IC2	-	ATMEL AVR	64 PIN QFN	AT90USB1287-64QFN
1	Y121	16MHz	Crystal	SMD	ABM3B-16.000MHZ-B2-T
1	U1	3.3V	Regulator	SOT-23-5	MIC5219-3.3YM5 TR
1	U6	-	ATMEL CryptoCompanion	8ld SOIC	ATSC018-SU-CM
			DIODE		
1	LEDP	BLUE	LED	0603	MB1111C-TR
3	LED1-3	RED	LED	0603	BR1111C-TR
2	D181-182	-	ESD Suppressor	0603	PGB1010603MR
1	D1	DIODE	Schotkky	SOD-323	NSR1020MW2T1G
1	D2	DIODE	Schotkky	SOD-123	MBR0520L
			MISC		
1	USB	WM17117-ND	TYPE A	USB RT ANG.	48037-0001
1	L161	-	Ferrit Bead	0603	MI0603J601R-10
1	Q1	NPN	Transistor	SOT23-3	MMBTA42LT1G
1	H2	0.1" Pitch	JTAG	2x5 Male Header RA	TSW-105-16-L-D-RA
1	J1	0.1" Pitch	PORT-D Interface	2x5 Male Header	PBC05DAAN
1	B121	-	Buzzer	SMD	SMT-0540-S-R
2	B151	-	Push Button	SMD	PTS635SL25SMTR LFS
1	K1	-	DPDT switch	SMD	CAS-220TA

Figure 7. AT88CK109BK3 Schematic, 1 of 3

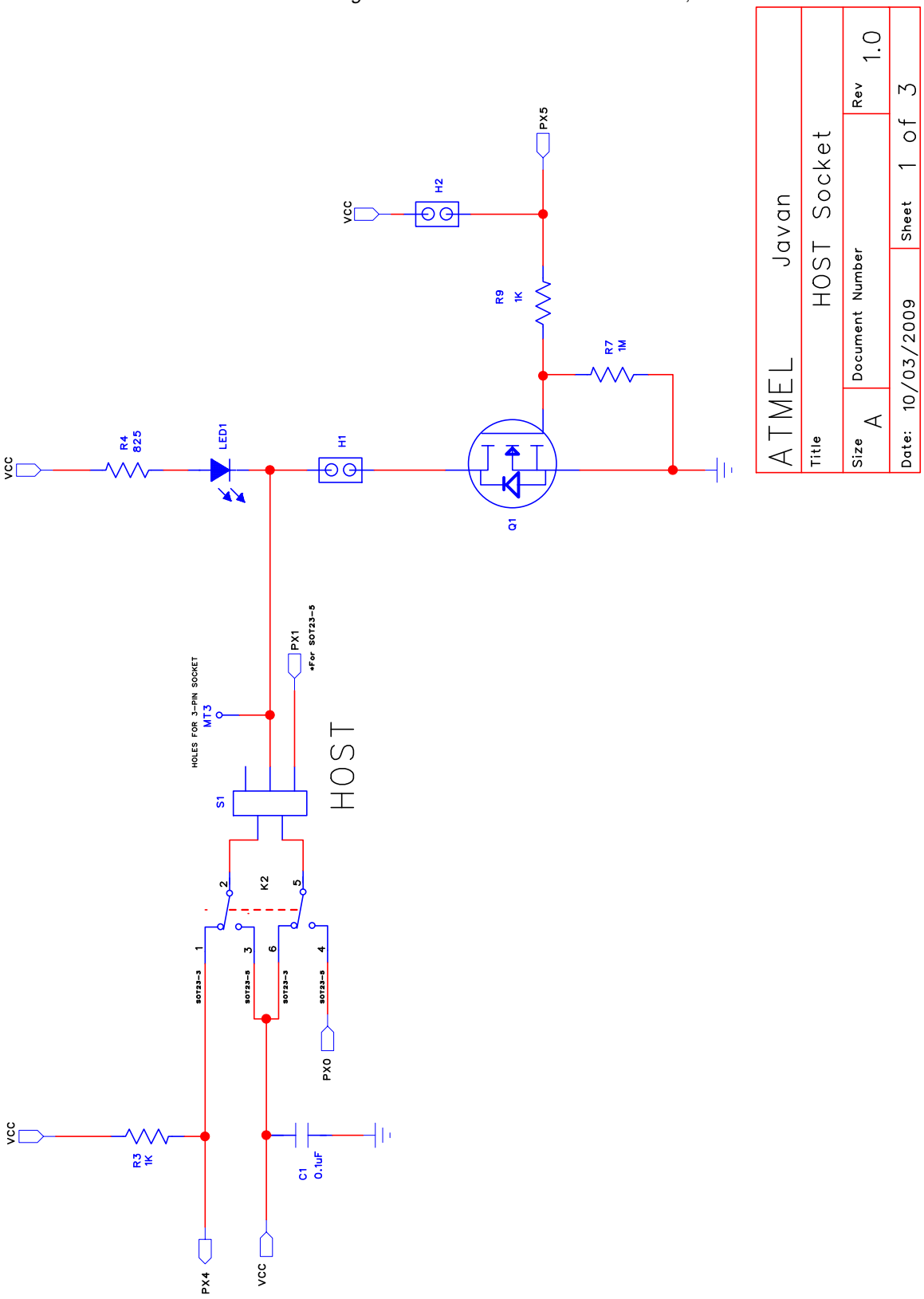


Figure 8. AT88CK109BK3 Schematic, 2 of 3

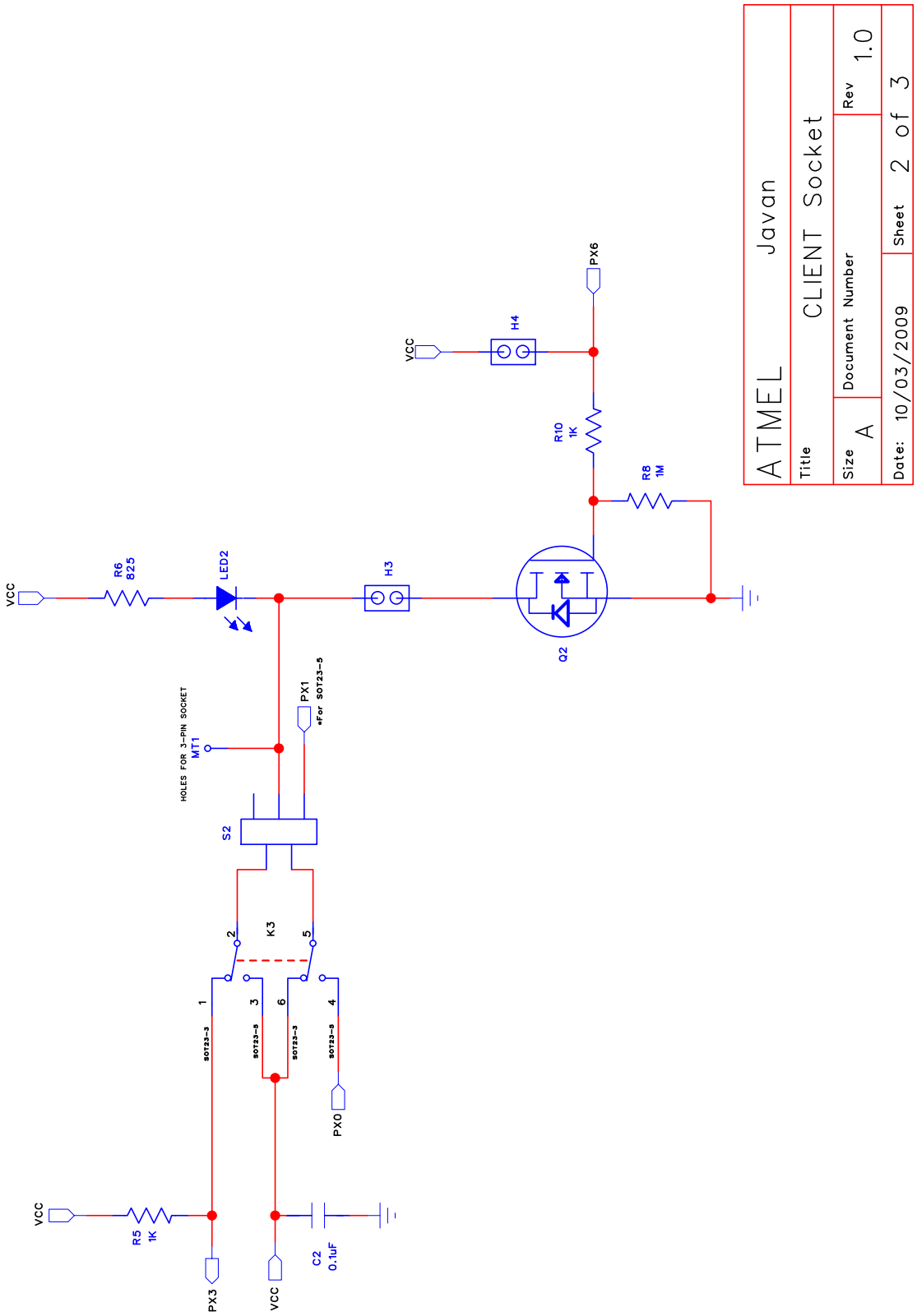
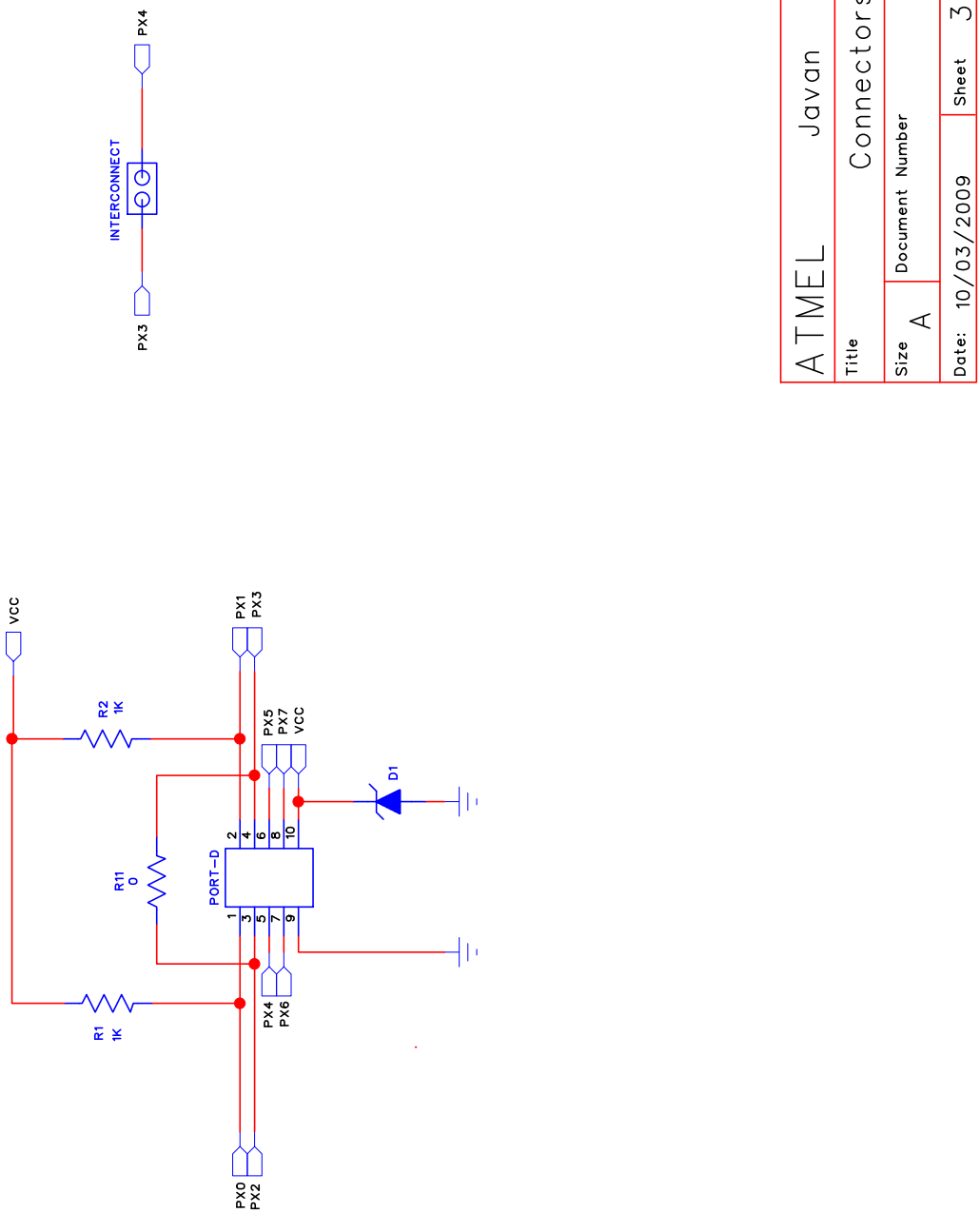


Figure 9. AT88CK109BK3 Schematic, 3 of 3



AT88CK109BK3 Assembly Drawing, 1 of 2 (Top side)

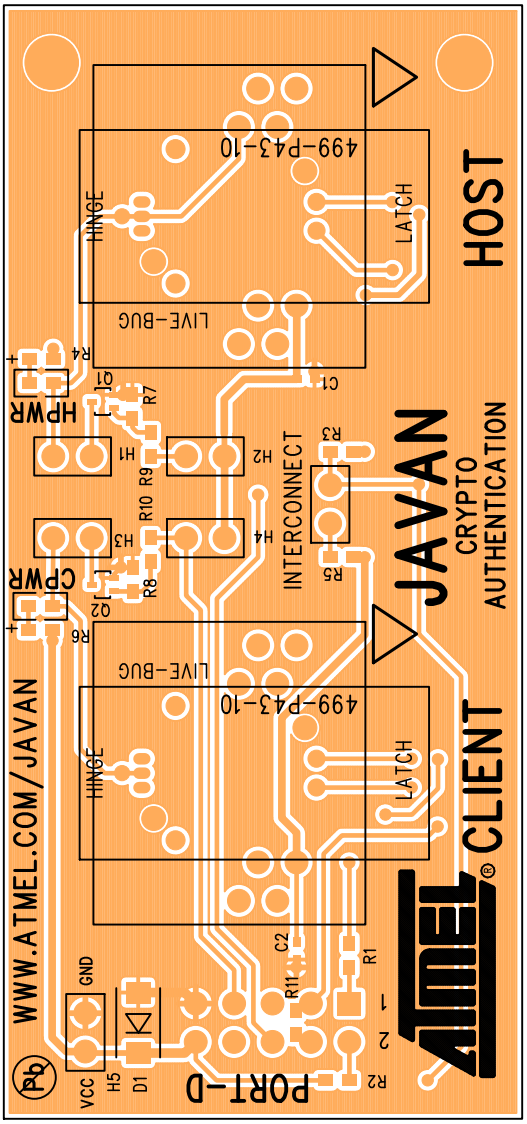
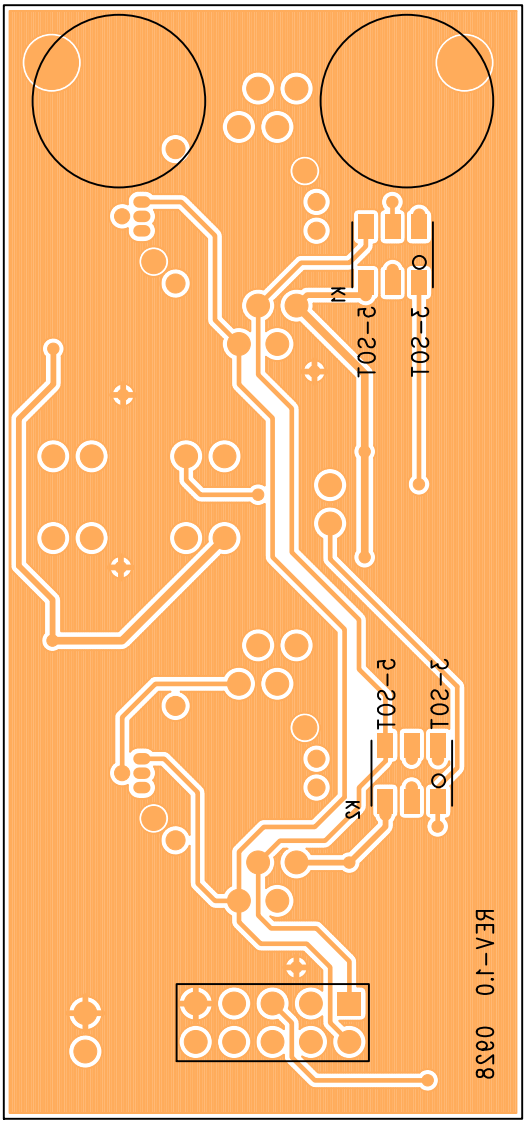


Figure 10. AT88CK109BK3 Assembly Drawing, 2 of 2 (Bottom side)



AT88CK109BK3 BOM

Qty	Reference	Value	Description	Case	Manufacturer PN
			CAPACITOR		
2	C1-2	0.1uF		402	C0402X7R160-104KNE
			RESISTOR		
1	R11	0	1/16W	0603	CR0603-16W-000T
2	R9-10	180	1/16W	0603	CR0603-16W-181JT
4	R1-3, R5	1K	1/16W	0603	CR0603-16W-1001FT
2	R7-8	1M	1/16W	0603	CR0603-16W-105JT
2	R4 R6	825	1/16W	0603	CRCW0603825RFKEA
			DIODE		
2	LED1-2	RED	LED	0603	BR1111C-TR
2	Q1-2	N-CHANNEL	MOSFET	SC-75	NTA4001NT1G
1	D1	Diode	Unidirectional TVS	DO-214AC, SMA	SMA6J5.0A-TR
			MISC		
2	S1-2	CryptoAuthentication	Socket	SOT23-3	499-P36-20
6	H1-5, Interconnect	2PIN HEADER	VERT	2POS .100 TIN	PBC02DAAN
1	PORT-D	10 Pin 2x5	VERT	.100 10POS Fem	SSW-105-01-G-D
2	K1-2	Switch	DPDT	Surface Mount	CAS-220TA

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