APPLICATION NOTE

Atmel

User Guide for Car Access Reference System Kit with 1-way RF

ATAN0002: ATAK51001-V1

Features

- Complete system solution demonstrating Remote Keyless Entry (RKE), Passive Entry/Passive Start (PEPS), and Immobilizer (IMM) functionality.
- Key fob variants include:
 - UHF Fixed-N PLL RKE TX (Atmel ATA5771/3/4)
 - 125KHz 1D IMM transponder (Atmel ATA5580)
 - Integrated UHF Frac-N PLL RKE TX + 125KHz IMM transponder (Atmel ATA5795)
 - Integrated 125KHz 3D PEPS + 1D IMM (Atmel ATA5790) and UHF Frac-N PLL RKE TX (Atmel ATA5749C)
- Car side components include:
 - 6-channel 125KHz PEPS antenna coil driver (Atmel ATA5279N)
 - Integrated 125KHz IMM basestation + Atmel ATtiny87 (Atmel ATA5272)
 - UHF receiver (Atmel ATA5723/4/8)
- Open system software provided includes:
 - RKE Rolling Code using AES
 - Immobilizer stack using AES
 - Scalable and configurable
 - PC GUI for system visualization and viewing data communication
- Body computer emulation using Atmel ATmega2560 on Atmel STK600 development platform.

Overview

This document provides set up and usage instructions for the Car Access Reference (CAR) System using one-way RF communication. It showcases a complete system in which it is possible to evaluate the comprehensive family of Car Access products offered by Atmel[®]. Reference designs are used which are both scalable and configurable, enabling the adaptation of the basic hardware and software building blocks into specialized system requirements that exist today.

1. Getting Started

1.1 Kit Contents

This kit contains the following items:

- Atmel[®] ATAB0001A CAR System Interface Board
- Atmel ATAB5279 6-Channel Coil Driver Board (including 2 coils)
- Atmel ATA5723/24/28-DK Receiver Application Board (including RF antenna)
- Atmel ATA5272-EK1 Basestation Application Board (including coil)
- Atmel ATA5580 Immobilizer Transponder
- Atmel ATA5771/73/74 Transmitter Application Board
- Atmel ATA5795-EK1 Transmitter with 1D LF Application Board
- Atmel ATA5790-EK1 PEPS Transmitter with 3D / 1D LF Application Board
- ISP Interface Adaptor
- USB To Serial Converter
- 120/240AC to 12VDC wall transformer
- (3) 10-wire cables for I/O port connections between STK600 and System Interface Board
- Quick Start Guide
- Notes: 1. An Atmel STK600 is required, but not included in this kit. Please contact www.atmel.com or your local Atmel Sales office for more info on obtaining one.
 - 2. CR2032 lithium coin cell batteries (3) are required for normal operation of each handheld transmitter PCB.

1.2 Connecting the Hardware

Prepare the Atmel STK600 with the Atmel ATmega2560 device board as described in the Atmel STK600 User Guide. Using a 2-wire cable supplied with the Atmel STK600 kit, connect RS232 SPARE pins RXD and TXD to PORTH pins PH0 and PH1 making sure RXD connects to PH0 and TXD connects to PH1. Using the two 10-wire cables supplied with the STK600 kit, connect PORTK to SWITCHES and PORTC to LEDS. Using the three 10-wire ribbon cables supplied with this kit, make connections from the Atmel STK600 to the System Interface Boards; PORTB to PB, PORTD to PD, and PORTE to PE.

Note: Be sure to properly match header alignment to pin 1 on both ends of the cable when making these connections.

Mount the Atmel ATAB5279 6-Channel Coil Driver Board, Atmel ATA5272-EK1 Basestation Application Board, and the Atmel ATAB5723/24/28 Receiver Application Board to the System Interface Board taking care to align the X1 and X2 pin headers on them with the X1 and X2 pin sockets on the System Interface Board. Connect RF antenna to Receiver Application Board. Locate the coils terminated with pigtail wires and connect one to TPA1N and TPA1P and the other to TPA2N and TPA2P on the 6-Channel Coil Driver Board. Attach the round immobilizer coil to the Basestation Application board connector XANT1.

Complete the set-up by connecting supplemental 12VDC power from wall transformer to mating receptacles on Atmel STK600 and System Interface Board.

1.3 Programming the Atmel ATmega2560 on the Atmel STK600

To program the Atmel ATmega2560 on the device card installed in the Atmel STK600, connect a 6-wire cable between the two 6-pins ISP headers on the Atmel STK600. See Figure 1-1 on page 3 and Figure 1-2 on page 3. Ensure that the VTARGET jumper is mounted, and that the voltage is the within the operating range for the target device.

Be sure to set the target voltage for 5.0V when programming the Atmel ATmega2560. Refer to Figure 1-3 on page 4 to Figure 1-7 on page 6 for a screen shot of the properly completed ISP programming menu along with a view of proper fuse settings.



Figure 1-1. Atmel STK600 ISP Headers



Figure 1-2. ISP 6-Wire Ribbon Cable Connection



Please refer to Figure 1-3 on page 4 to Figure 1-7 on page 6 for a series of screen shots depicting the programming steps described below. Using Atmel[®] AVR Studio[®]4, program the Atmel ATmega2560 on the Atmel STK600 by selecting the "Display the 'Connect' Dialog" icon (Figure 1-3 on page 4). Select "STK600" and "USB" followed by clicking on "Connect" button to enable display of the Programming window (Figure 1-4 on page 4). Select the "Main" tab and pick the Atmel ATmega2560 device. Be sure to set ISP frequency to 100kHz. Click the "Read Signature" button to be sure signature matches the selected device. Select the "Fuses" tab and verify proper fuse settings exist (Figure 1-5 on page 5).

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Select the "HW Settings" tab and set the VTarget to 5.0V (Figure 1-6 on page 5). Next select the "Program" tab and browse to locate files titled "ATAK51001-V1_STK600.hex" for the Flash memory image and "ATAK51001-V1_AOIP_BS.eep" (Figure 1-7 on page 6). The files can be found in the distribution files supplied with this kit.

Figure 1-3. Connection Dialog for Atmel ATmega2560

Select AVR Programmer		
Platform:	Port	
AVR ONE! STK600	N USB	Connect
QT600 AVRISP mkll		Cancel
STK500 JTAGICE mkll		Baud rate:
AVR Dragon		115200
Tip: To auto-connect to the prog button on the toolbar.	ammer used last time, press the 'Programmer'	Baud rate changes are active immediately.
Note that a tool cannot be used a debugging session. In that cas	or programming as long as it is connected in a, select 'Stop Debugging' first.	
Disconnected Mode		

Figure 1-4. Main ISP Programming Window for Atmel ATmega2560

ATmega2560	~	Erase Device	
0x1E 0x98 0x01		Read Signature	
Signature matches selected device			73
Programming Mode and Target Settings			
ISP mode	*	Settings	
		ISP Frequency:	100.0 kHz
		Daisy Chain:	Disabled
		Changes to daisy are only valid from the programming	chain settings n the next time dialog is opened
TK600 Routing/Socket Card Information) 		
AT mega2060 is supported by the followin	g routing/socke RC100M-11 + STK	+ STKE	OF MCU card:
 Routing and socket card : STK600-I Routing and socket card: 		000 ATMECIA2000	
(1) Routing and socket card : STK600-I (2) Routing and socket card: or MCU card: STK600-ATMEGA2	:560		
 Flouting and socket card: STK600- (2) Routing and socket card: or MCU card: STK600-ATMEGA2 Make sure the power is switched off if you 	2560 u are replacing	op cards on the STK	500.





Fuse Value DODEN	riogram ruse	^{IS} LockBits Advanced HW Settings HW Info Auto
DODEN Diswr our de de de donnaktion JTAGEN ✓ SPIEN ✓ BODTSZ Boot Flash size=4096 words start address=\$1F000 BOOTSZ Boot Flash size=4096 words start address=\$1F000 SUT_CKSEL Int. RC Osc.; Start-up time: 6 CK + 65 ms EXTENDED 0xFF HIGH 0x91 LOW 0xE2	e	Value
UTAGEN ✓ SPIEN ✓ WDTON EESAVE BOOTSZ Boot Flash size=4096 words start address=\$1F000 BOOTSZ Boot Flash size=4096 words start address=\$1F000 BOOTSZ Boot Flash size=4096 words start address=\$1F000 CKDIV8	FN	
SPIEN Image: Spien in the spient of the spient	BEN	
WDTON	N	
EESAVE Image: Second Start	TON	
BODTSZ Boot Flash size=4096 words start address=\$1F000 BODTRST	AVE	
BOOTRST	TSZ	Boot Flash size=4096 words start address=\$1F000
CKDIV8	TRST	
CKOUT	IV8	
SUT_CKSEL Int. RC 0sc.; Start-up time: 6 CK + 65 ms EXTENDED 0xFF HIGH 0x91 LOW 0xE2	UT	
EXTENDED 0xFF HIGH 0x91 LOW 0xE2	_CKSEL	Int. RC Osc.; Start-up time: 6 CK + 65 ms
EXTENDED 0xFF HIGH 0x91 LOW 0xE2		
HIGH 0x91 LOW 0xE2	ENDED	0xFF
LOW 0xE2	-	0x91
Auto read	/	0xE2
Smart warnings Verify Read	o read art warnings	ning Program Verify Read

Figure 1-6. Hardware Setting Window for Atmel ATmega2560

тк600) in ISP m	ode wit	h ATmeg	a2560					
Main	Program	Fuses [ockBits	Advanced	HW Settin	igs HW	Info A	uto	
-Voli VT	ages					-	1	5.0 V	
AR	EF 0:						1	0.01 V	
AR	EF 1:							0.01 V	
- Clo	ck Generato	DT	Re	ad 🛛	Write	L.S			
-			Re	ad (Write		1	16.01 MHz 16006912	
Firm	iware Upgra	ade	Upgr	ade					
ietting ietting ietting ietting	VTARGET AREFO 0.0 AREF1 0.0 oscillator pa	. 5.0V 0k)1 V 0K)1 V 0K rameters	к						



Device	
Erase device be	
Flash	
O Use Current Sin	nulator/Emulator FLASH Memory
💿 Input HEX File	600_System\Debug\Exe\ATAK51001-V1_ATA5795.hex
Program	Verify Read
EEPROM	
Use Current Sin	ulator/Emulator EEPROM Memory
Input HEX File	uild\Distribution\Software\ATAK51001-V1_AOIP_BS.eep
Program	Verify Read
ELF Production File Fo	rmat
Input ELF File:	
Save From: FLASH	I ♥ EEPROM ♥ FUSES ♥ LOCKBITS Fuses and lockbits settings must be specified before
L Program	Savesaving to ELF
	1213

The Atmel[®] STK600 ISP capability may be used to program other AVR microcontrollers in this kit. Remove the end of the 6wire ISP cable connected to "ISP Pins Target Device" pin header (see Figure 1-1 on page 3) and use this free end instead to connect to the other PCBs supplied with this kit.

When using Atmel STK600 ISP, it is OK to ignore the warning message that appears indicating that the installed top card in the Atmel STK600 contains the Atmel ATmega2560 and is not compatible with selected device.

1.4 PC Graphical User Interface

To improve the user experience, this kit includes a Graphical User Interface (GUI). It is provided to assist in the visualization of system operation and contains both visual animation and audio feedback of common Car Access System functionality. To bring up this capability, locate the STK600's RS-232 port and connect it to your PC's using supplied USB to Serial Converter. Locate the file named "ATAK51001-V1_PC_Application.exe" in your distribution files and double click on it to enable its operation. The opening screen will appear as shown in Figure 1-8 on page 7.



Figure 1-8. PC GUI Opening Screen



To enable communication between the Atmel[®] STK600 and the GUI, locate and click the "COM" command in the tool bar located in the top left corner of the screen. Select the COM port corresponding to the connection made on your PC. When using the included USB converter, check to make sure that the COM port is correct. For true serial ports, this will be the dedicated serial port of the host PC which is typically COM1. Insure that the value populated in the Baud Rate field is set to 38400. Confirmation of successful serial connectivity will be the field in the lower right portion of gray status bar at the bottom of the screen. See Figure 1-9 as an example.



Figure 1-9. Serial Communication Set-up

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To open windows containing function specific message content, select "View" from the blue tool bar at the top of the screen and click on "RF Messaging", "Immobilizer", and "LF Messaging". After the three windows pop up, they can be re-positioned in the screen by clicking on the blue bar and dragging it to a new location as shown in Figure 1-10.





Finally, be sure to enable your PC's sound output so that audio feedback for CARS functionality can be heard! Now, you are ready to explore the CARS functionality.



2. Car Access Reference System Functionality

This section explains each of the sub-systems comprised in a typical Car Access System; Remote Keyless Entry (RKE), Immobilizer (IMM), Passive Entry (PE), and Passive Start (PS).

Using Atmel[®] AVR Studio[®]4, be sure to verify that VTARGET is set to 5V. This may have been modified to 3V if Transmitter boards were reprogrammed. This is necessary for proper communication between the Atmel STK600 and the CAR System Interface Board.

2.1 Remote Keyless Entry (RKE): Learn Mode and Normal Operation

RKE is a feature that allows authorized users to remotely lock or unlock their car. The RF message propagates in all directions with a range of 30m or more. This message contains information that is used to confirm the identity and verify authenticity of the user. Security is provided by the AES cryptology and by the protocol that we have implemented.

Before RKE system functionality can be observed an RF transmitter must be paired to the vehicle. This process involves placing the vehicle's receiver in a mode that allows it to learn the secret key contained in the key fob.

Press SW5 on the Atmel STK600 to enter the RF learn mode. LED5 will turn on indicating the learn mode is active. During this 10 second period, press S1 on the Atmel ATA5771/73/74 Transmitter Application Board. Successful learning is indicated by a blink on LED5 and a momentary appearance of the Learn Mode icon (a graduate's mortarboard) on the PC GUI.

As long as LED5 is on, the learn mode is active and the other transmitters supplied with this kit can be learned too; a) Atmel ATA5795-EK1 Transmitter with 1D LF Application Board using S1 and b) Atmel ATA5790-EK1 PEPS Transmitter with 3D/1D LF Application Board using S3.

To exit the learn mode, either press SW5 on the Atmel STK600 or let the 10 second period time-out. LED5 will turn off indicating normal operation.

Functionality can be observed using the PC GUI and the visual feedback from the Atmel STK600. Consecutive depressions of the transmitter LOCK button (S3 on Atmel ATA577x and Atmel ATA5795-EK1; S1 on Atmel ATA5790-EK1) will sequentially advance the illuminated LED to the left through positions LED0 - LED4. Consecutive depression of the UNLOCK button (S2) will advance the LED to the right.

The PC GUI supplies additional information such as transmitter ID, sequence counter, command, encryption, and status in the RF Message Status window. Watch the icon located in the center of the car and listen for additional feedback on RKE system status.

For additional information on the RF protocol, See Atmel AVR411, located at the following link:

http://www.atmel.com/dyn/resources/prod_documents/doc2600.pdf

This document provides detailed information on the Atmel Rolling Code Algorithm which is implemented in the RF portion of this kit.

2.2 Immobilizer (IMM): Learn Mode and Normal Operation

The immobilizer feature is typically used in vehicles as a means to restrict engine starting to authorized users only. Attempts to start the engine without an authenticated link between key and vehicle will be blocked and result in an immobilized vehicle.

Before immobilizer system functionality can be observed, the LF transponder must be paired with the vehicle. This requires the transfer of two secret keys from the vehicle's control module to the key fob / transponder. These two secret keys are Random Numbers generated on demand and must be sent to the key fob. To accomplish this, place the coil of the device being learned within 2cm of the coil attached to the Atmel ATA5272-EK1 Basestation Application Board and press SW4 on the Atmel STK600. Successful learning is indicated by a blink on LED5 and a momentary appearance of the Learn Mode icon (a graduate's mortar-board) on the PC GUI. For optimum results, align the axis of both coils in parallel. This process can be repeated for all key fobs containing devices with IMM functionality such as Atmel ATA5580 (Figure 2-1 on page 10), Atmel ATA5790 (Figure 2-2 on page 10) or Atmel ATA5795 (Figure 2-3 on page 11).

For devices with an integrated immobilizer, the RKE learn mode requirements are also satisfied during the IMM learning process. One of the two programmed secret keys is shared with RKE and also the Rolling Code Counter is read out from EEPROM during the IMM learn sequence.



Figure 2-1. Atmel ATA5580 Immobilizer Programming



Figure 2-2. Atmel ATA5790 Immobilizer Programming



Note: The immobilizer coil is configured to be part of the integrated 3D LF coil (white square component with L3D designation on PCB). As shown in Figure 2-2, this coil is oriented vertically.



Figure 2-3. Atmel ATA5795 Immobilizer Programming



Immobilizer functionality can be observed using the PC GUI as well as visual feedback from the Atmel[®] STK600. Place the key fob with its immobilizer coil aligned and near to the Atmel ATA5272-EK1 Basestation coil and press SW1 on the Atmel STK600. Successful authentication (vehicle is NOT immobilized) is indicated on the Atmel STK600 by the right to left advancement of an illuminated LED in the range of LED0 to LED4 and the illumination of LED6. It is also shown on the PC GUI with the appearance of an Immobilizer icon. Since the immobilizer is a passive function, it can be demonstrated either with or without the key fob battery in place.

Additional details of the authentication process and protocol can be obtained in the document titled "Open Immobilizer Protocol Stack". A registered copied can be obtained by following the link:

http://www.atmel.com/forms/registration_immobilizer_stack.asp?category_id=154&family_id=692&subfamily_id=1949&fn=d I_doc9195.pdf

2.3 Passive Entry (PE): Learn Mode and Normal Operation

Passive Entry (PE) is a vehicle access feature that eliminates the need to manually press the LOCK/UNLOCK buttons on the key fob. Instead, the vehicle generates a magnetic field around certain regions of it's periphery that is used to wake up the key fob from a low power state which then sends a response over RF back to the vehicle. The learn process for this feature is the same as for RKE or IMM.

To observe PE unlock functionality on the PC GUI, position the antennas connected to the Atmel ATAB5279 6-Channel Coil Driver Board at rights angles to each other and place the Atmel ATA5790-EK1 PEPS Transmitter with 3D/1D LF Application Board about 1m away (user standing beside vehicle). The key fob orientation doesn't matter because its three antennas are orthogonally mounted in order to enable magnetic field detection regardless of its position in space. Press SW7 on the Atmel STK600 to initiate the magnetic field generation associated with the driver side door trigger event. This typically occurs when the door handle is touched. LED7 turns on to indicate that the lock command originated from a passive trigger (not RKE) and sequentially advances the illuminated LED to the left through positions LED0 - LED4 on the STK600. The PC GUI animates the magnetic field generation in blue, the keyfob's detection, RF transmission, and the successful vehicle's authorization as a green key fob icon. This is shown in Figure 2-4 on page 12.





Ten making rep		
If Wakeup Antenna Status Arterna Charel T Arterna Curret Zôtni Arterna D ABCD1234		
		7
	· 🕒 🖓	
		1
F		A
L	rt fff Message Status	
	FIF Message Status PE RF Message Schi 0000001 PE PEssage RF Message Counter 220440072 120 Xsin R55 RF Message NAC 80155209 150 Z-said R51.72	

The PE Lock function shows two different use case possibilities. The first demonstrates what would happen if the key fob is forgotten inside the vehicle when the lock button on the door handle is pressed. To observe this, place the Atmel[®] ATA5790-EK1 PEPS Transmitter with 3D/1D LF Application Board about 0.5m away (fob inside vehicle) and press SW6 on the Atmel STK600 to trigger the magnetic field generation associated PE lock function. This typically occurs after the vehicle is switched off and the driver's door ajar switch cycles state indicating the driver is exiting the vehicle. The system will "search" the inside of the vehicle, and upon receiving a valid message indicating that the key fob is present and left in the vehicle, LED7 turns on to indicate a passive trigger (not RKE) and sequentially advances the illuminated LED to the right through positions LED4 - LED0 on the Atmel STK600. The PC GUI will show a key fob in red inside the vehicle as a warning and the doors will unlock as shown by the icon and sound. This show that keys left in the vehicle by accident can not be locked in unintentionally.

Note: It is possible to intentionally lock a PEPS key in the vehicle by pressing the LOCK button on a second key fob.

The second case show what happens if the key fob is removed from the vehicle. Position the Atmel ATA5790-EK1 PEPS Transmitter with 3D/1D LF Application Board >3m away (to simulate user has walked away from vehicle) and press SW6 on the Atmel STK600 to trigger the magnetic field generation. Because the key fob is out of range, an RF message will not be sent. The vehicle will wait for a time-out period and then lock the vehicle.



Both cases are shown in Figure 2-5.

Figure 2-5. Passive Keyless Entry - LOCK



Note: In a true PEPS implementation, the system uses the received signal strength (RSSI) of the LF field at the key fob to determine if the key is inside or outside the vehicle. Because of this, an RF message may be sent if the key fob is outside the vehicle but still in LF wake-up range. Currently this ability is not shown with this kit due to the difficulty to keep physical locations constant with a demo kit that will be set up differently each time. We model this functionality by the reception (or lack thereof) of an RF message.



2.4 Passive Start (PS): Learn Mode and Normal Operation

Passive Start is a feature that enables the user to start the engine by pressing a pushbutton mounted in the interior of the vehicle, typically on the dashboard. This eliminates the need for a mechanical key. The pushbutton triggers the generation of a magnetic field in the interior of the vehicle which is measured by the key fob. If the key fob detects magnetic field strength corresponding to a location within the vehicle and the vehicle can authenticate the key fob to the vehicle, the engine is allowed to start.

This feature can be observed with the Atmel[®] ATA5790-EK1 PEPS Transmitter with 3D / 1D LF Application Board. Using the same set up described in Section 2.3 "Passive Entry (PE): Learn Mode and Normal Operation" on page 11, locate the key fob within 1m of the Atmel ATAB5279 6-Channel Coil Driver Board's antenna coils and press SW0. LED7 will illuminate and an LED will sequence from left to right in the field contained by LED4 to LED0 indicating successful engine start. The PC GUI will animate this process as shown in Figure 2-6.

Figure 2-6. Passive Start

LF Wakeup Antenna Statu. Arterna Charrel 2 Arterna Cuareet Store StoreABC	
TH Menage	es Status
HF Message 5/ BF Message 5/ BF Message 5/	PS Status AN 07000007 PYE message Covers 4/20440070 175 X-avis A55
RF Message A RF Message A RF Message A RF Message A RF Message A RF Message A	20 STatus X 5/A 01000001 PF.E. message Covers 42/20440070 125 X-avis PSS Command FKE Ire 1917 Y-avis 21210 MCC SICCODEB 01 Z-avis Feruit Authenticated



The system also includes a contingency in case the battery within the Atmel[®] ATA5790-EK1 PEPS Transmitter is discharged. To observe this, remove its battery and place the immobilizer coil aligned and near to the Atmel ATA5272-EK1 Basestation coil (shown in Figure 2-5 on page 13). Pressing SW0 will trigger the passive start function as before. However, because the system did not receive an RF response due to the removed battery it will time-out and try the Immobilizer function next. This time LED6 will illuminate indicating the back up immobilizer was the source of authentication to start the engine. This is also animated on the PC GUI as shown in Figure 2-7.



Figure 2-7. Backup Passive Start using Immobilizer



3. Source Code Modification

FLASH and EEPROM programming is required for all boards that contain an AVR microcontroller and can be accomplished using In System Programming (ISP). The affected PCB assemblies are noted below:

- Atmel[®] ATA5771/73/74 Transmitter Application Board
- Atmel ATA5795-EK1 Transmitter with 1D LF Application Board
- Atmel ATA5790-EK1 PEPS Transmitter with 3D / 1D LF Application Board
- Atmel ATA5272-EK1 Basestation Application Board

The ISP frequency (SCK) must be less than 1/4 of the target clock. The ISP frequency is set by the Atmel STK600 programming dialog in AVR Studio[®].

3.1 Adding New Device Support to AVR Studio4

Support for the new devices showcased in this Evaluation Kit must be added to AVR Studio. All files referenced below are included with this kit.

Note: [Studio install path] is typically C:\Program Files\Atmel\

[IAR install path] is typically C:\Program Files\IAR Systems\Embedded Workbench 5.4

For AVRStudio4 support file, the following files must be properly located as noted below:

- ata5790.xml" and "ata5795.xml" files go into [Studio install path]\AVR Tools\Partdescriptionfiles
- ata5790def.inc" and "ata5795def.inc" files go in [Studio install path]\AVR Tools\AVRAssembler\Appnotes
- ata5790def.inc" and "ata5795def.inc" files go in [Studio install path]\AVR Tools\AVRAssembler2\Appnotes

For General support, the following files must be properly located and edited as noted below:

- Atmel ATA5790.h file goes in your project root folder
- Edit the [Studio install path]\AVR Tools\Compilers\.supportedparts.txt file by adding two new lines; one for ATA5790
 and one for ATA5795

For IAR Compiler support, the following files must be properly located as noted below:

- ioata5790.h" and "ioata5795.h" file goes in [IAR install path]\avr\inc
- Inkata5790.xcl" and "Inkata5795.xcl" files goes in your project root folder

3.2 Programming the Atmel ATA5272-EK1 Basestation

Prepare the Atmel ATA5272-EK1 Basestation Application Board (including coil) for programming by removing the PA4/OUT jumper. The AVR[®] microcontroller contained within the Atmel ATA5272 is an Atmel ATtiny87. Please refer to Figure 3-1 on page 17 to Figure 3-5 on page 19 for a series of screen shots depicting the programming steps described below. Using AVR Studio4[®], program the Atmel ATtiny87 on the Atmel STK600 using the same sequence of steps described in the previous section. Select the "Display the 'Connect' Dialog" icon and specify "STK600" and "USB" followed by clicking on "Connect" button to enable display of the Programming window. Select the "Main" tab and pick the AT tiny87 device. Be sure to set ISP frequency to 100kHz. Verify proper fuse settings and insure target voltage is set to 5.0. Return to "Main" tab and verify proper set up by clicking the "Read Signature" to be sure signature matches the selected device. Next select the "Program" tab and browse to locate files titled "ATAK51001-V1_ATA5272.a90" to program into the Flash and "ATAK51001-V1_AOIP_BS.eep" to program into the EEPROM. The files can be found in the distribution files supplied with this kit.

After programming, be sure to restore the PA4/OUT jumper to its original location for normal operation.



Figure 3-1. Connection Dialog Window for Atmel ATA5272-EK1 Basestation Application Board

		T OIC	
AVR ONE!	~	USB	Connect
STK600			<u></u>
AVBISP mkll			Cancel
STK500			Davidantes
JTAGICE mkll			Baud rate:
AVR Dragon			115200
AVRISP	~		Baud rate changes ar
			active immediately.
l ip: I o auto-connect to t	he program	mer used last time, press the 'Programmer'	
Julion on the toolbal.			
Note that a tool cannot b	e used for p	programming as long as it is connected in	
a debugging session. In t	hat case, se	elect 'Stop Debugging' first.	

Figure 3-2. Main ISP Programming Window for Atmel ATA5272-EK1 Basestation Application Board

evice and Sign	nature Bytes			
ATtiny167		~	Erase Device	
Signature not re	ad		Read Signature	•
Programming Mo	ide and Target Settings		Settings	h
ior mode			ISP Frequency:	 100.0 kHz
			Daisy Chain: Changes to daisy are only valid from the programming	Uisabled chain settings the next time dialog is opened
STK600 Routing)/Socket Card Informati	ion	d (
Routing card: Socket card:	STK600-RC020T STK600-SDIC	-23	a compination(s) or i	MCO caro.
or MCU card:	<not available=""></not>			
	ower is switched off if u	vou are replacing to	p cards on the STK	600.



Figure 3-3.	Fuse Setting Window f	or Atmel ATA5272-EK1	1 Basestation Application Board
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ain Program F	uses LockBits Advanced HW Settings HW Info Auto
Fuse	Value
SELFPRGEN	
RSTDISBL	
DWEN	
SPIEN	V
WDTON	
EESAVE	✓
BODLEVEL	Brown-out detection disabled
CKDIV8	
CKOUT	
SUT_CKSEL	Int. RC Osc. 8 MHz; Start-up time PWRDWN/RESET: 6 CK/14 CK + 64 ms
EXTENDED	0xFF
EXTENDED HIGH	0xFF 0xD7 0xE2
extended High Low	0xFF 0xD7 0xE2
EXTENDED HIGH LOW Auto read Smart warnings Verify after prog	0xFF 0xD7 0xE2 amming Program Verify Read

Figure 3-4. Hardware Settings Window for Atmel ATA5272-EK1 Basestation Application Board

Main Program Fuses LockBits Advanced HW Settings HW Info Auto Voltages VTarget: 50 V AREF 0: 0.01 V AREF 1: 0.01 V Clock Generator 16.01 MHz 16.01 MHz 16006912	560 📃 🗖 🔀	600 in ISP mode with A	STK60 0
Voltages 5.0 V VTarget: 0.01 V AREF 0: 0.01 V AREF 1: 0.01 V Clock Generator 16.01 MHz 16006912	vanced HW Settings HW Info Auto	ain Program Fuses Lock	Main
Clock Generator	5.0 V 0.01 V 0.01 V	Voltages VTarget:	Volt VTa ARI AR
Read Write	16.01 MHz [16006912]	Clock Generator	Cloc
Firmware Upgrade		Firmware Upgrade	Firm
Getting VTARGET 5.0V 0K Getting AFEF0 0.01 V 0K Getting AFEF1 0.01 V 0K	A	tting VTARGET 5.0V 0K tting AREF0 0.01 V 0K tting AREF1 0.01 V. 0K	Getting Getting





in Program Fuses	LockBits Advanced HW Settings HW Info Auto
Device	
Erase Device	
🔽 Erase device bel	fore flash programming Verify device after programming
Flash	
O Use Current Sim	ulator/Emulator FLASH Memory
💿 Input HEX File	1_ATA5272\Debug\Exe\ATAK51001-V1_ATA5272.hex
Program	Verify Read
EEPBOM	
O Use Current Sim	ulator/Emulator EEPROM Memory
💿 Input HEX File	uild\Distribution\Softwark 47 #39001-V1_ADIP_BS.eep
Program	
riogram	
ELF Production File For	mat
Input ELF File:	
Save From: 📝 FLASH	EEPROM VEFUSES VELOCKBITS Fuses and lockbits settings
Program	must be specified before Save Saving to ELF
•	

3.3 Programming the Atmel ATA5771/73/74 Transmitter

Prepare to program the Atmel[®] ATtiny44 contained within the Atmel ATA577x IC by connecting the ISP 6-wire cable from the Atmel STK600 to the 6-pin header on ISP Interface Adaptor. Insert the Atmel ATA5771/73/74 Transmitter Application Board into the edge card connector on the ISP Interface Adaptor.

Be sure to remove the battery in the Atmel ATA5771/73/74 Transmitter Application Board and set the target voltage for 3.0V prior to programming the Atmel ATtiny44.

Please refer to Figure 3-6 on page 20 to Figure 3-10 on page 22 for a series of screen shots depicting the programming steps that follow. Using AVR Studio4[®], program the Atmel ATtiny44 using the Atmel STK600 in the same sequence of steps described in the previous section. Select the "Display the 'Connect' Dialog" icon. Select "STK600" and "USB" followed by clicking on "Connect" button to enable display of the Programming window. Select the "Main" tab and pick the Atmel AT tiny44 device. Be sure to set ISP frequency to 100kHz. Verify proper fuse settings and insure target voltage is set to 5.0. Return to "Main" tab and verify proper set up by clicking the "Read Signature" to be sure signature matches the selected device. Next select the "Program" tab and browse to locate files titled "ATAK51001-V1_ATA577x.a90" to program into the Flash and "ATAK51001-V1_AOIP_ATA577x_ID1.eep" to program into the EEPROM. The files can be found in the distribution files supplied with this kit.

Figure 3-6. Connection Dialog Window for Atmel ATA5771/73/74 Transmitter Application Board

AVR ONE!	^	USB	Connect
QT600 AVBISP mkll			Cancel
STK500			Baud rate:
AVR Dragon			115200
AVRISP		4	Baud rate changes a
Fip: To auto-connect to button on the toolbar.	o the programme	r used last time, press I	he 'Programmer'
Note that a tool cannol a debugging session. It	t be used for proj n that case, sele	gramming as long as it ct 'Stop Debugging' firs	is connected in it

Figure 3-7. Main ISP Programming Window for Atmel ATA5771/73/74 Transmitter Application Board

ATtinu44	~	Frase Device
Signature not rea	d	Read Signature
Programming Mod	le and Target Settings	
ISP mode		Settings.
		ISP Frequency: 100.0 kHz
		Daisy Chain: Disabled
		Changes to daisy chain settings are only valid from the next time the programming dialog is opened
TK600 Routing/ Ttiny44 is suppo	Socket Card Information	et card combination(s) or MCU card:
Routing card: Socket card: or	STK600-RC014T-12 STK600-DIP	
MCU card:	<not available=""></not>	
Aake sure the po	wer is switched off if you are replac	cing top cards on the STK600.



Figure 3-8.	Fuse Setting Window for	Atmel ATA5771/73/74 Transr	mitter Application Board
-------------	-------------------------	----------------------------	--------------------------

in Program	Fuses LockBits Advanced HW Settings HW Info Auto
Fuse	Value
SELFPRGEN	
RSTDISBL	
DWEN	
SPIEN	M
WDTON	
EESAVE	
BODLEVEL	Brown-out detection disabled
CKDIV8	
CKOUT	
SUT_CKSEL	Int. RC Osc. 8 MHz; Start-up time PWRDWN/RESET: 6 CK/14 CK + 64 m.
EXTENDED	0xFF
HIGH	0xD7
LOW	0xE2
] Auto read] Smart warning:] Verify after pro	; gramming Program Verify Read
ing mode and de	evice parameters 0K!

Figure 3-9. Hardware Settings Window for Atmel ATA5771/73/74 Transmitter Application Board

in Program Fuses	LockBits Advanced HW Settin	98 HW Info Auto
Voltages VTarget:	0	V <u>3.0</u> V
AREF 0:		0.01 V
AREF 1:		. 0.01 V
	Read Write	
Clock Generator	Bead	16.01 MHz 16006912
Firmware Upgrade	Upgrade	
tina VTARGET 5.0V	ок	



Figure 3-10. Program Window for Atmel ATA5771/73/74 Transmitter Application Board

K600 in ISP mode w Main Program Fuses	rith ATtiny44	- 0 2
Erase Device	fore flash programming	ng
Flash	deter/E-endeter ELACH Menory	
 O use Current sim Input HEX File 	V1_ATA577x\Debug\Exe\ATAK51001-V1_ATA577x.a90	
Program	Verify Read	
EEPROM	ulater /Emulater EEDDOM Marrow	
 O use current sim Input HEX File 	tion\Software\ATAK51001-V1_A0IP_ATA577x_ID1.eep	
Program	Verify Read	
ELF Production File For Input ELF File: Save From: V FLASH	mat □ ■ EEPROM ■ FUSES ■ LOCKBITS Fuses and lockbits se must be specified before must be specified before) ttings pre
etting VTARGET 5.0V 01	Savesaving to ELF	
tting AREF1 0.01 V 01 tting oscillator parameter	K s. OK	~

After programming is completed and board is disconnected from ISP cable, be sure to insert battery to restore normal operation.

3.4 Programming the Atmel ATA5790-EK1 PEPS Transmitter

Program the Atmel[®] ATA5790 by connecting the ISP 6-wire cable from the Atmel STK600 to the 6-pin ISP header located on the Atmel ATA5790-EK1 PEPS Transmitter board. Begin programming by selecting Tools/AVR Programming to bring up the ISP menus. Select the "Display the 'Connect' Dialog" icon. Select "STK600" and "USB" followed by clicking on "Connect" button to enable display of the Programming window. Select the "Main" tab and pick the Atmel ATA5795 device. Be sure to set ISP frequency to less than 100kHz! Verify proper fuse settings and insure target voltage is set to 3.0. Return to "Main" tab and verify proper set up by clicking the "Read Signature" to be sure signature matches the selected device. Next select the "Program" tab and browse to locate files titled "ATAK51001-V1_ATA5790-5749.a90" and "ATAK51001-V1_AOIP_KF1.eep" as shown in Figure 3-11 on page 23 to Figure 3-15 on page 25. The files can be found in the distribution files supplied with the CARS kit.

Be sure to remove the battery in the Atmel ATA5790-EK1 PEPS Transmitter and set the target voltage for 3.0V prior to programming the Atmel ATA5790.



Figure 3-11. Connection Dialog Window for Atmel ATA5790-EK1 PEPS Transmitter Application Board

Platform:	Port:	
AVR ONE! STK600 QT600 AVRISP mkll STK500 JTAGICE mkll AVR Dragon		Connect Cancel Baud rate: 115200
AVRISP Fip: To auto-connect to auton on the toolbar. Note that a tool cannot a debugging session. In Disconnected Mode.	the programmer used las be used for programming that case, select 'Stop D	as long as it is connected in ebugging' first.

Figure 3-12. Main ISP Programming Window for Atmel ATA5790-EK1 PEPS Transmitter Application Board

Program Fi	uses LockBits Advanced HV ture Bytes	Erase Device
Programming Mod	e and Target Settings	
ISP mode	×	Settings ISP Frequency: 100.0 kHz Daisy Chain: Disabled Changes to daisy chain settings are only valid from the next time the programming dialog is opened
STK600 Routing/ ATA5790 is support Routing card: Socket card: or MCU card:	Socket Card Information orted by the following routing/sock/ STK500-RC064M-9 STK500-TQFP64 <not available=""></not>	et card combination(s) or MCU card:
Make sure the po ecting on 'USB' 600 with serial pur	wer is switched off if you are replac	ing top cards on the STK600.



Main	Program	Fuses	LockBits	Advanced	HW Settings	HW Info	Auto	
Fu	ise	V	'alue					
CK	DIV8	V	-					
DV	VEN							
SP	IEN	N	2					
W	DTON							
EE	SAVE							
Re	served	~	1					
32	DEN							
EX	TCLKEN							
A	uto read							
♥ Au ♥ Sr ♥ Ve	uto read nart warning erify after pro	is Ingrammir	ng		Program	Verify		Read

Figure 3-13. Fuse Setting Window for Atmel ATA5790-EK1 PEPS Transmitter Application Board

Figure 3-14. Hardware Settings Window for Atmel ATA5790-EK1 PEPS Transmitter Application Board

/oltages		
VTarget:		3.0 V
AREF 0:		0.01 V
AREF 1:		V
	Read Write	
Clock Generator		16.01 MHz
	0	16006912
	Read Write	
Firmware Upgrade -	Upgrade	



Figure 3-15. Program Window for Atmel ATA5790-EK1 PEPS Transmitter Application Board

Device Erase Device	LockBits Advanced HW Settings HW Info Auto
🔽 Erase device be	ofore flash programming Verify device after programming
Flash	
O Use Current Sim	ulator/Emulator FLASH Memory
Input HEX File	_5749\Debug\Exe\ATAK51001-V1_ATA5790-5749.a90
Program	Verifu Bead
riogian	
EEPROM	
🔘 Use Current Sim	nulator/Emulator EEPROM Memory
💿 Input HEX File	ild\Distribution\Software\ATAK51001-V1_ADIP_KF1.eep
Program	Venity Head
ELF Production File Fo	rmat
June at ELE Eiler	
Save From: V FLASH	EEPROM VIFUSES VILOCKBITS Fuses and lockbits settings
Program	Save saving to ELF

After programming is completed and board is disconnected from ISP cable, be sure to insert battery to restore normal operation.

3.5 Program the ATA5795-EK1 Transmitter

Program the Atmel[®] ATA5795 by connecting the ISP 6-wire cable from the Atmel STK600 to the 6-pin ISP header on the Atmel ATA5795-EK1 Transmitter Board.

Be sure to remove the battery in key fob and set the target voltage for 3.0V prior to programming the Atmel ATA5795.

Please refer to Figure 3-16 on page 26 to Figure 3-20 on page 28 for a series of screen shots depicting the programming steps that follow. Using AVR Studio4[®], program the Atmel ATA5795 using the Atmel STK600 in the same sequence of steps described in the previous section. Select the "Display the 'Connect' Dialog" icon. Select "STK600" and "USB" followed by clicking on "Connect" button to enable display of the Programming window. Select the "Main" tab and pick the Atmel ATA5795 device. Be sure to set ISP frequency to less than 100kHz! Verify proper fuse settings and insure target voltage is set to 3.0. Return to "Main" tab and verify proper set up by clicking the "Read Signature" to be sure signature matches the selected device. Next select the "Program" tab and browse to locate files titled "ATAK51001-V1_ATA5795.a90" to program into the Flash and "ATAK51001-V1_AOIP_KF2.eep" to program into the EEPROM. The files can be found in the distribution files supplied with this kit.



Figure 3-16. Connection Dialog Window for Atmel ATA5795-EK1 Transmitter Application Board

Platform:	Port	
AVR ONE!	USB	Connect
STK600		
AL/DICD MUI		Cancel
STK500		
JTAGICE mkll		Baud rate:
AVR Dragon		115200
AVRISP	~	Baud rate changes ar
	100 C	active immediately.
Tip: To auto-connect to) the programmer used last ti	me, press the 'Programmer'
outton on the toolbar.		
Note that a tool cannot	be used for programming as	long as it is connected in
a debugging session. In	h that case, select 'Stop Deb	ugging' first.

Figure 3-17. Main ISP Programming Window for Atmel ATA5795-EK1 Transmitter Application Board

evice and Signa	ture Bytes	
ATA5795	*	Erase Device
Signature not rea	d	Read Signature
rogramming Moc	e and Target Settings	
ISP mode	~	Settings.
		ISP Frequency: 100.0 kHz
		Daisy Chain: Disabled
		Changes to daisy chain settings are only valid from the next time the programming dialog is opened
TK600 Routing/ TA5795 is supp	Socket Card Information	t card combination(s) or MCU card:
Routing card: Socket card: or	STK600-RC064M-9 STK600-TQFP64	
MCU card:	<not available=""></not>	
lake sure the po	wer is switched off if you are replaci	ng top cards on the STK600.



STK600 in ISP mode	e with ATA5795
Main Program Fus	es LockBits Advanced HW Settings HW Info Auto
Fuse	Value
CKDIV8	
DWEN	
SPIEN	
WDTON	
EESAVE	✓
Reserved	
320EN	
EXTCLKEN	
Auto read	
Smart warnings	
Verify after program	rming Program Verify Read
Setting mode and device Entering programming m Reading fuses address (Leaving programming m	e parameters 0K! ode 0KI 0 to 0 0xE2 0K! ode 0K!

Figure 3-18. Fuse Setting Window for Atmel ATA5795-EK1 Transmitter Application Board

Figure 3-19. Hardware Settings Window for Atmel ATA5795-EK1 Transmitter Application Board

Target:		3.0 V
i algoci i		,
REF 0:		0.01 V
AREF 1:		0.01 V
	Read Write	
lock Generator		10.01 MIL
		16006912
1	Read Write	
irmware Upgrade	Upgrade	



Figure 3-20. Program Window for Atmel ATA5795-EK1 Transmitter Application Board

STK600 in ISP mode with ATA5795
Main Program Fuses LockBits Advanced HW Settings HW Info Auto
Device
Erase device before flash programming Verify device after programming
Flash
Input HEX File I_ATA5795\Debug\Exe\ATAK51001-V1_ATA5795.a90 III
Program Verify Read
EEPROM
Use Current Simulator/Emulator EEPROM Memory
Input HEX File Id\Distribution\Software\ATAK51001-V1_AOIP_KF2.eep
Program Verify Read
ELF Production File Format
Input ELF File:
Save From: V FLASH V EEPROM V FUSES V LOCKBITS Fuses and lockbits settings
Program Save saving to ELF
Setting mode and device parameters. DKI
Entering programming mode OKI Beading fuses address 0 to 0 OKI
Leaving programming mode OK!

After programming is completed and board is disconnected from ISP cable, be sure to insert battery to restore normal operation.



4. Troubleshooting

Table 4-1. Troubleshooting Guide

Problem	Cause	Solution
Get warning message saying can't program using ISP	The AVR device is in DebugWire mode.	Consult User Guide for either AVR Dragon or JTAGEICE mkII for directions on how to clear DebugWire mode. Requires opening a project and running a debug session.
	ISP clock frequency is set too high.	Using AVR Studio4 [®] , set ISP to 100kHz or less. See Figure 1-4 on page 4.
PKE function does not work	VTARGET on Atmel STK600 is not set to 5V	Using AVR Studio4, set VTARGET to 5V. See Figure 1-6 on page 5.
	LF Driver antenna connection is not sufficient	Recheck the connection of the LF antennas. This may not be a solid connection.
	Key fob is not waking up	Check to see if the LED blinks on the key fob. Remove the battery and replace to reset the software.
	RF reception is corrupted	Check for other sources of RF noise or transmissions.
LED5 on Atmel STK600 periodically blinks "ON" rapidly 3 times	Atmel ATmega2560 on Atmel STK600 can establish communication with Atmel ATA5724 receiver	Check to insure receiver board in properly mounted and 12V power is applied CAR System Interface Board.
	VTARGET on STK600 is not set to 5V	Using AVR Studio4, set VTARGET to 5V. See Figure 1-6 on page 5.
RKE or PKE function does not work	CR2032 lithium battery not inserted in socket (Atmel ATA5790, Atmel ATA5795 and Atmel ATA5774 handheld PCBs)	
	RF reception is corrupted	Check for other sources of RF noise or transmissions.
Immobilizer does not function	Key Fob transponder orientation is incorrect	Because of the properties of a magnetic field the antennas must be aligned correctly. See Figure 2-1 on page 10 to Figure 2-3 on page 11.
	Basestation coil is placed on or near metal surfaces	Metal will detune the antenna resonant circuit. This can be fixed by moving the antenna or retuning.
	Key Fob transponder is too far away	The immobilizer draws all power to operate from the LF field. This means that the range of operation is quite small. Typically < 20cm
	PA4/OUT jumper removed	This provides the demodulated data from the LF reader to the microcontroller for processing. It is required to remove this when reprogramming the microcontroller but must be replaced.
Can't read device signature in ISP mode	12V supply not connected to Atmel STK600. Some power is supplied through USB connection, but not for ISP programming.	In addition to connecting USB between Atmel STK600 and host PC, connect 12V wall transformer output to mating plugs on Atmel STK600 and CAR System Interface Board.

5. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History
9253B-RKE-07/15	Put document in the latest template



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