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# RFID Application Kit TMEB8704



## 1. Introduction

The RFID application kit TMEB8704 is designed to demonstrate the key features of Atmel's various RFID products. The included software version IDS 5 supports the following products:

- U2270B on the reader side
- TK5530/e5530 on the transponder side
- TK5551/e5551 on the transponder side
- TK5552 on the transponder side
- TK5561/e5561 on the transponder side
- U9280M on the transponder side

## 2. Getting Started

For proper operation of the demonstration system, the following requirements must be met.

### 2.1 Minimum System Requirements

- Pentium® processor-based PC
- 16 MB RAM memory
- Windows® 95 or higher
- CD-ROM drive
- VGA monitor
- RS232 serial interface (COM1 or COM2)
- Mouse

### 2.2 Hardware Requirements and Installation

- Microcontroller board 1.0 with application kit 5
- R/W antenna 100 mm<sup>2</sup>/L = 700 μH/Q = 36
- RS232 serial communication cable
- Power source 12V (AC/DC)/200 mA
- Jack connector cable for power supply

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**TMEB8704**

**RFID**

**Application Kit**

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**Application Note**

Rev. 4781A-RFID-10/05



Before getting started, check the following:

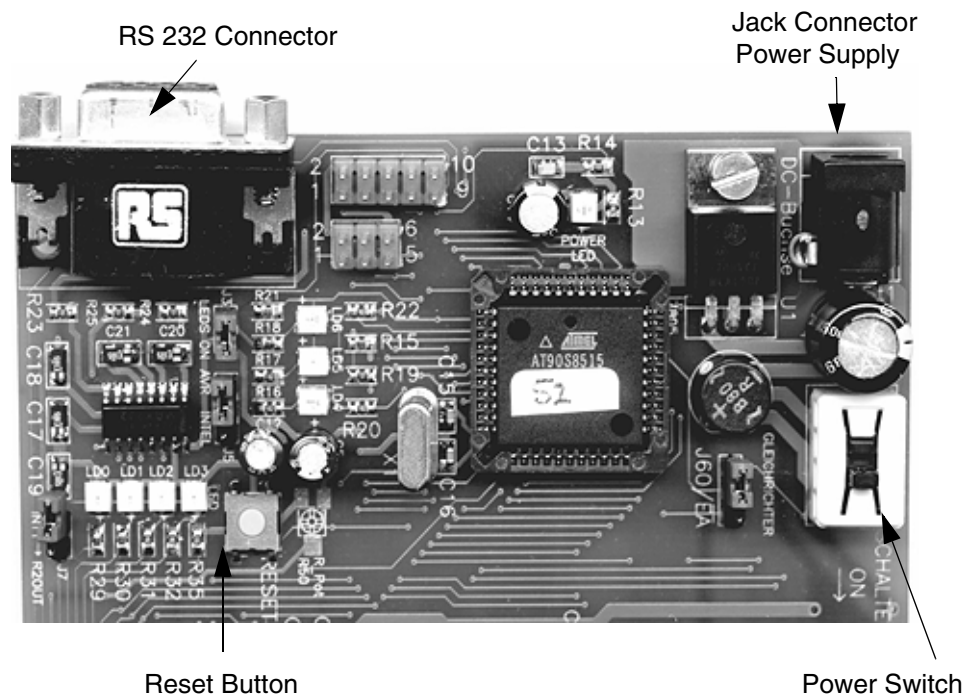
- The antenna must be plugged into the socket of the interface board
- The RS232 connector on the interface board must be connected to either COM1 or COM2 of the PC
- A supply line from the power source to the jack connector must be available

When all 3 conditions are met, set the power switch to *ON*.

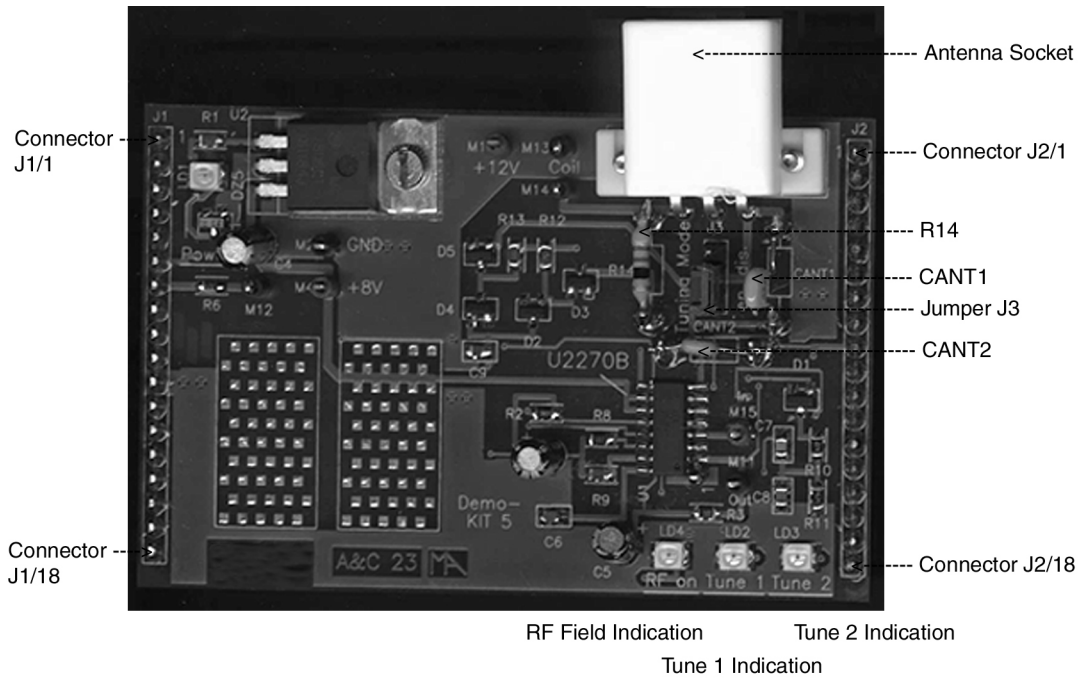
### 2.3 Hardware Settings and Connector Positions

In RFID applications, the main board with the microcontroller is operated in a fixed configuration; no settings are necessary. Check jumper J3 on the antenna interface to verify that it has the default setting (see [Figure 2-1](#) and [Figure 2-2](#) on page 3).

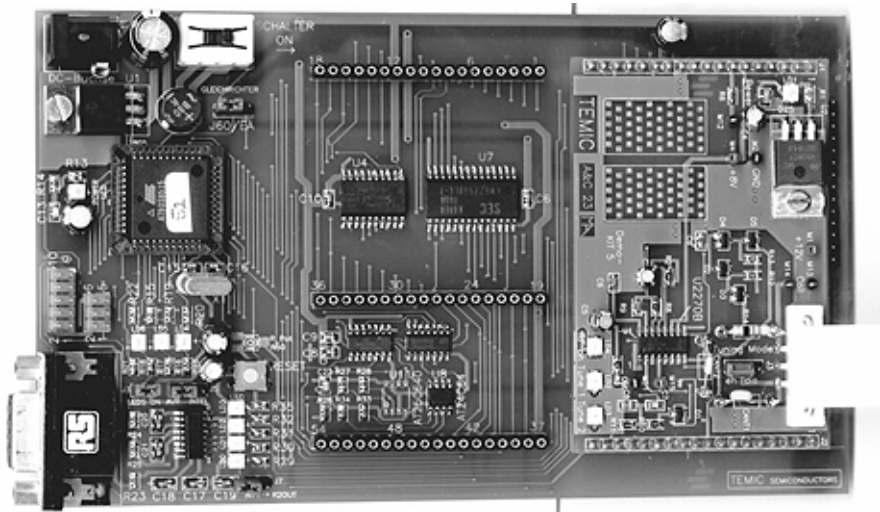
**Figure 2-1.** Main Board



**Figure 2-2.** Antenna Interface Board



**Figure 2-3.** Application Board Topview



## 2.4 Software Installation

The RFID application kit package includes a CD-ROM with the installation program, and has a description of the RFID application kit on the cover.

Insert the CD-ROM into the CD-ROM drive and execute *setup.exe*. The program (including all libraries needed) will be installed automatically.

Note: It is necessary to have write permission for the system.

## 3. Description of the Application Board System

### 3.1 System Overview

The RFID application board consists of a standard microcontroller board 1.0 (equipped with the Atmel microcontroller AT90S8515), combined with a piggybacked board serving as antenna interface.

The microcontroller AT90S8515 carries out the following functions:

- Handling the bi-directional data communication between the application board and the host PC
- Executing the read and write commands to be sent to the antenna interface
- Decoding the specific read data delivered by the antenna interface

The application software is downloaded into the 8 KByte Flash memory of the microcontroller. The current program version is indicated on the label attached to the main board.

### 3.2 Power Supply

For proper operation of the application board, an external power supply in the range of DC 10V to 15V/200 mA is required. A bridge rectifier placed at the connector input is used for polarity independence.

### 3.3 Antenna Interface

The antenna interface (see [Figure 2-2 on page 3](#)) is connected via the header connector located on the main board. The LED *Power* indicates the actual supply voltage. To adapt a specific antenna coil to the resonant frequency and the Q-factor, the components CANT1/CANT2 and R14 (see [Figure 2-2 on page 3](#)) can be changed. The matching of the interface depends on the added coil. The parameters and the corresponding components for the adjustment are given as follows:

Resonant frequency:  $f_{res} = 125$  kHz by CANT1/CANT2 at Jumper 3 to position *Disable*  
Q-factor:  $Q = 20$  by R14

#### 3.3.1 Frequency Tuning Mode Selection

The application system has a built-in tuning feature to match the resonant frequency of the LC antenna circuit automatically to the frequency of a specific transponder. The board is equipped with two stages of high-voltage transistor switches to tune the resonator by switched capacitors. This increases the reliability and operating distance.

The frequency tuning can be selected using jumper J3 (see [Figure 2-2 on page 3](#)).

**Table 3-1.** Tuning Mode Selection

Tuning Mode	Jumper J3 Position
Disabled	1 – 2
Enabled	2 – 3

When tuning mode is disabled, the RFID application kit operates with a fixed frequency, adjusted nominally to 125 kHz. To control the tuning, the tuning mode has to be enabled by the RFID application program. The binary combination of two tuning stages enables the selection of one out of four frequency states. The frequency range is extended typically from 122 kHz to 128 kHz in steps of 2 kHz (specified in the program menu by *Low Frequency*, *Semi Low Frequency*, *Semi High Frequency* and *High Frequency*).

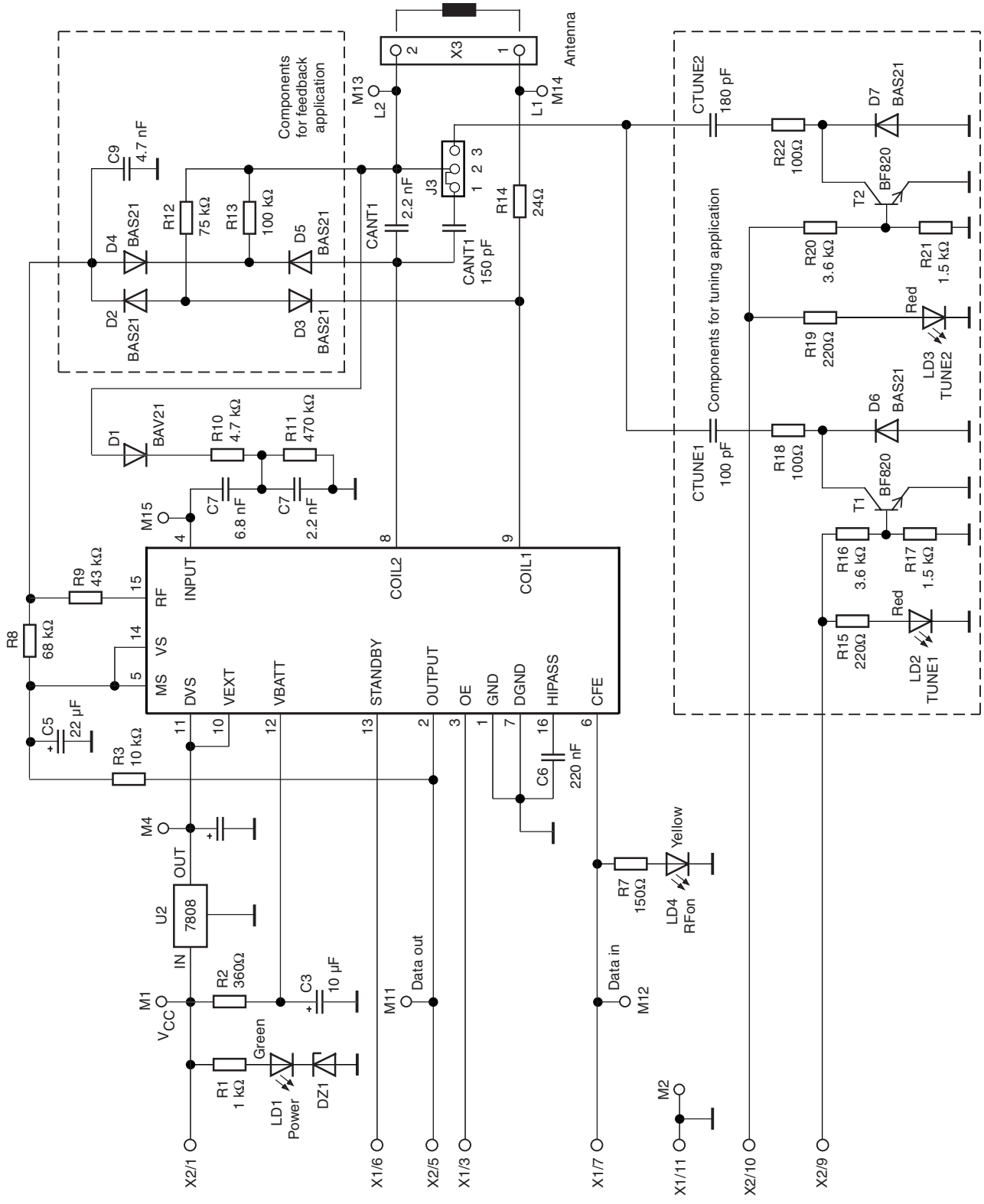
The currently selected frequency stage is indicated in binary mode on the application board by the red LEDs *Tune 1* and *Tune 2* (see [Figure 2-2 on page 3](#)).

### 3.3.2 RF Field Control

The status of the RF field controlled by the microcontroller is indicated by the yellow LED *RF On*.

### 3.3.3 Circuit Diagram of the Antenna Interface

Figure 3-1. Circuit Diagram of the Antenna Interface



## 3.3.4 Parts List of the Antenna Interface

U1	=	U2270B	SO16
U2	=	LM7808	TO220
Diodes:			
D1	=	BAS21	SOT23
D2	=	BAS21	SOT23
D3	=	BAS21	SOT23
D4	=	BAS21	SOT23
D5	=	BAS21	SOT23
D6	=	BAS21	SOT23
D7	=	BAS21	SOT23
DZ1	=	BZX84C	5.6V, SOT23
LEDs:			
LD1	=	TLMC3100 (green)	PLCC2
LD2	=	TLMT3100 (red)	PLCC2
LD3	=	TLMT3100 (red)	PLCC2
LD4	=	TLMA3100 (yellow)	PLCC2
Transistors:			
T1	=	BF820	SOT23
T2	=	BF820	SOT23
Resistors:			
R1	=	3.6 k $\Omega$	0805
R2	=	360 $\Omega$	0805
R3	=	10 k $\Omega$	0805
R7	=	1 k $\Omega$	0805
R8	=	68 k $\Omega$	0805
R9	=	43 k $\Omega$	0805
R10	=	4.7 k $\Omega$	0805
R11	=	470 k $\Omega$	0805
R12	=	75 k $\Omega$	0805
R13	=	100 k $\Omega$	0805
R14	=	24 $\Omega$	0805
R15	=	1 k $\Omega$	0805
R16	=	3.6 k $\Omega$	0805
R17	=	1.5 k $\Omega$	0805
R18	=	100 $\Omega$	0805
R19	=	1 k $\Omega$	0805
R20	=	3.6 k $\Omega$	0805
R21	=	1.5 k $\Omega$	0805
R22	=	100 $\Omega$	0805

Capacitors:

CANT1	=	2.2 nF (5%)	
CANT2	=	150 pF	
CTUNE1	=	100 pF	0805
CTUNE2	=	180 pF	0805
C3	=	10 $\mu$ F/16V	
C4	=	22 $\mu$ F/16V	
C5	=	22 $\mu$ F/16V	
C6	=	220 nF	0805
C7	=	22 nF	0805
C8	=	2.2 nF	0805
C9	=	4.7 nF	0805

Miscellaneous:

- SUB-D 9-pole socket
- 3-pole connector for coil
- Gold-pin block for jumper (1 x 3 pole)
- 2 gold-pin block 1 x 18 pole (used for header connector to the main board)

The antenna coil included in the IDIC application kit measures the following parameters related to 125 kHz:

Inductance	L = 700 $\mu$ H
Coil diameter	d = 100 mm
Winding number	n = 60
Wire diameter	d <sub>w</sub> = 0.25 mm



## 4. Identification Application Software IDS 5

### 4.1 Getting Started

- Read this RFID Application Kit user's manual.
- Install the IDS 5 software.
- Connect an RS232 serial cable between the RFID application kit and the PC.
- Connect a 12V (AC or DC) power supply to the RFID application kit (using the jack connector). The status *Power on* is indicated by a green LED near the microcontroller.
- Start the program *RFID Application Software*.
- Select the COM port to be used in the *Setup* menu.

#### 4.1.1 Using the TK5530 Read-only Transponder

- Select the transponder type  
*Setup -> Transponder -> TK5530*
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details such as bit rate, coding, ID-code length, signature and header. (For non-specialized applications, use the default settings.)
- Click *Read* to show the transponder code

#### 4.1.2 Using the TK5551 Read/Write Transponder

- Select the transponder type  
*Setup -> Transponder -> TK5551*
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details such as bit rate, coding, ID-code length and signature. (For non-specialized applications, use the default settings.)
- Click on *Configure Transponder* (this function programs the configuration block, Block 0, of the TK5551)
- Choose the *Write* tab to program Blocks 1 to 7 of the transponder memory
- Select *Program Transponder*
- To read out the transponder, click the *Read* button in the *Read* tab to show the transponder code

#### 4.1.3 Using the TK5552 Read/Write Transponder

- Select the transponder type  
*Setup -> Transponder -> TK5552*
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details such as bit rate, coding, ID-code length and signature. (For non-specialized applications, use the default settings.)
- Click on *Configure Transponder* (this function programs the configuration block, Block 0, of the TK5552)
- Choose the *Write* tab to program Blocks 1 to 31 of the transponder memory
- Select *Program Transponder*
- To read out the transponder, click the *Read* button in the *Read* tab to show the transponder code

#### 4.1.4 Using the TK5561 Read/Write/Crypto Transponder

- Select the transponder type  
*Setup -> Transponder -> TK5561*
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details such as bit rate, coding, ID-code length and signature. (For non-specialized applications, use the default settings.)
- Click on *Configure Transponder* (this function programs the configuration blocks, Block 0 and Block 9, of the TK5561)
- Choose the *Write* tab to program Blocks 1 to 4 of the transponder memory
- Select *Program Transponder*
- To read out the transponder, click on the *Read* button in the *Read* tab to show transponder code
- To start the encryption process, choose the *Authentication* tab to program Blocks 5 to 8 of the transponder memory
- Select *Program Transponder*
- Choose *Start Authentication* for encryption process

#### 4.1.5 Using the U9280M Read/Write/Crypto

- Select transponder type  
*Setup -> Transponder -> U9280M*
- Place the transponder sample close to the base-station antenna (consider axial alignment)
- The configuration is fixed; it can only be changed by programming through the interface
- Choose the *Write* tab to program Blocks 1 to 4 of the transponder memory
- Click *Program Transponder*
- Click the *Read* button in the *Read* tab to show the transponder code
- To start the encryption process, choose the *Authentication* tab to program Blocks 5 to 8 of the transponder memory
- Click *Program Transponder*
- Click *Start Authentication* for encryption process

#### 4.1.6 Exit the Program

- Choose *Exit* from the main menu to quit the program

## 5. Description of the RFID Application Kit Software IDS 5

Figure 5-1. RFID Application Kit 5 Software



### 5.1 Software Structure

The included software supports the following Atmel transponder types:

- TK5530 Read-only
- TK5551 Read/Write
- TK5552 Read/Write (1 kbit)
- TK5561 Read/Write/Crypto
- U9280M Read/Write/Crypto

All transponder types and their particular features and functions can be controlled by one program; the software automatically selects the features supported depending on the transponder type used. The software is developed for the use of different transponders and their features. This means the user does not need to worry about the technical details.

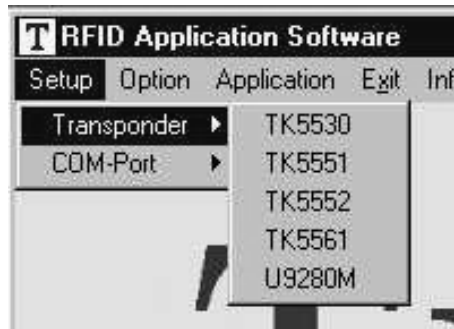
### 5.2 Start Window

The menu bar of the application software contains five menus. These are: *Setup*, *Option*, *Application*, *Exit*, *Info*.

#### 5.2.1 Setup

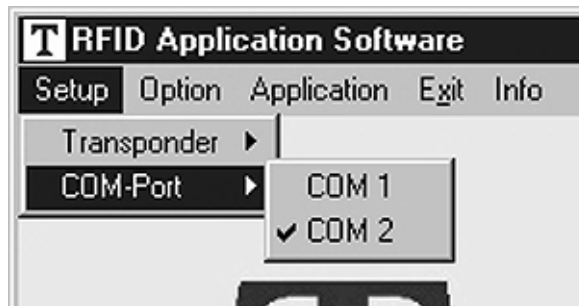
When the submenu *Transponder* in the *Setup* menu is selected, the different types of Atmel's transponders can be seen (see [Figure 5-2 on page 12](#)). Depending on the transponder chosen, the user interface will be adjusted.

**Figure 5-2.** *Transponder Menu*



In the submenu *COM-Port*, select the appropriate RS232 serial port to communicate with the RFID application kit (see [Figure 5-3](#)). (To verify that there is communication between the PC and the application board, press function key *F12* and all LEDs will flash; if the LEDs don't flash, change *COM-Port*.)

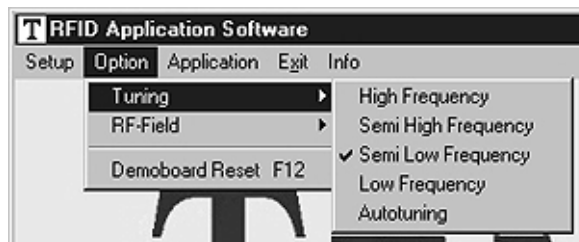
**Figure 5-3.** *COM-Port Menu*



## 5.2.2 Option

The submenu *Tuning* enables two different tuning modes: manual tuning (*High to Low Frequency*) and *Autotuning* (see [Figure 5-4](#)).

**Figure 5-4.** *Tuning Menu*



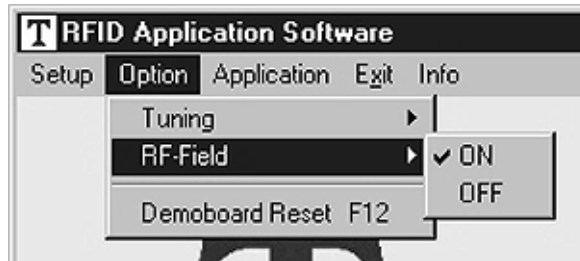
In manual tuning mode, the user can select one of four frequency stages from 122 kHz to 128 kHz in steps of 2 kHz (*Low Frequency*, *Semi Low Frequency*, *Semi High Frequency* and *High Frequency*). This requires that the on-chip oscillator of the U2270B is tuned to 125 kHz (these values are nominal values, the actual values may differ slightly due to component tolerances). In autotuning mode, the software switches between the four frequencies until the transponder can be read out. The currently selected frequency stage is indicated, binary encoded, on the application board by the Tune 1/Tune 2 LEDs (see [Table 5-1 on page 13](#)).

**Table 5-1.** Binary Tuning LED Code

Tune 2	Tune 1	Frequency
0	0	High
0	1	Semi-high
1	0	Semi-low (default)
1	1	Low

Use the submenu item *RF-Field* to switch the RF field on the RFID application kit *ON* or *OFF* (see [Figure 5-5](#)). The status is indicated by the yellow *RF On* LED on the application board. *RF On* is the default value.

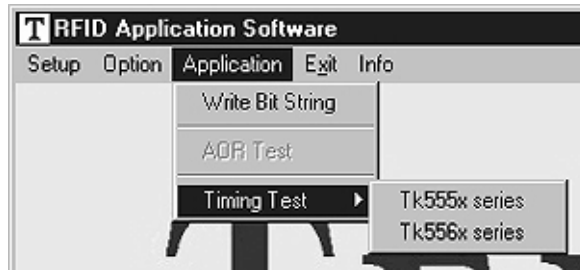
**Figure 5-5.** *RF-Field* Menu



The submenu item *Demoboard Reset* resets the application board and all changes in the *Option* menu to default values. The reset can also be selected by pressing key *F12*.

## 5.2.3 Application

**Figure 5-6.** *Application* Menu



The submenu *Application* is for advanced users and enables them to find the optimal adjustment of the *Write Timing*, as well as providing the possibility to write bit strings to the transponder.

## 5.2.4 Exit

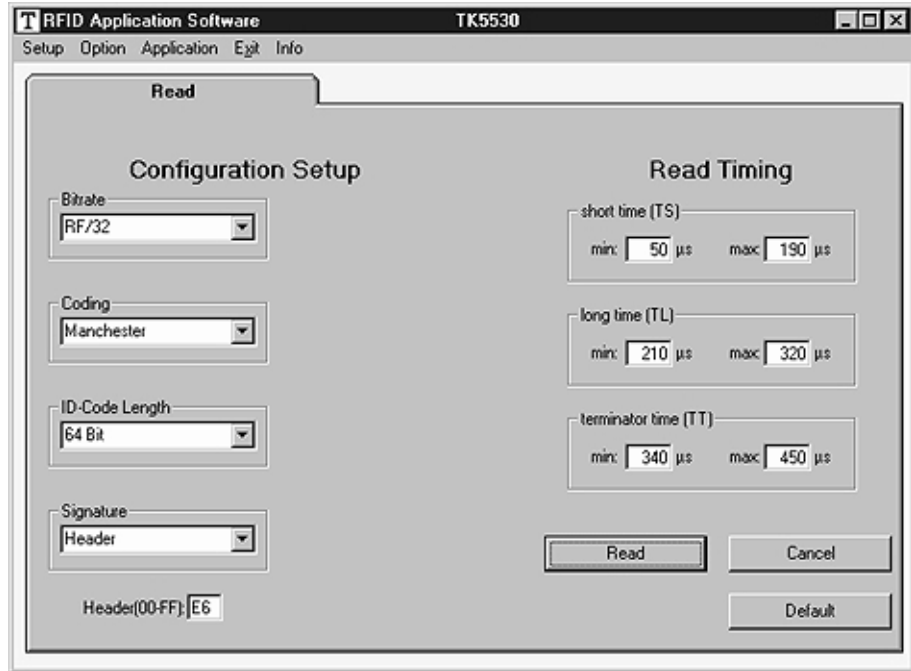
To exit the program, choose *Exit*.

## 5.2.5 Info

The submenu *About* in the main menu *Info* shows the program version and creation date.

### 5.3 TK5530 Read-only Transponder

Figure 5-7. TK5530 *Read* Tab



When the transponder TK5530 is selected, the TK5530 *Read* tab is shown. This window enables the user to set the following parameters in the *Configuration Setup* (on the left side):

- Bit rate: Rf/32, Rf/40 and Rf/64
- Coding: Manchester and Bi-phase
- ID-code length: 32, 64, 96 and 128 bit
- Signature: Header

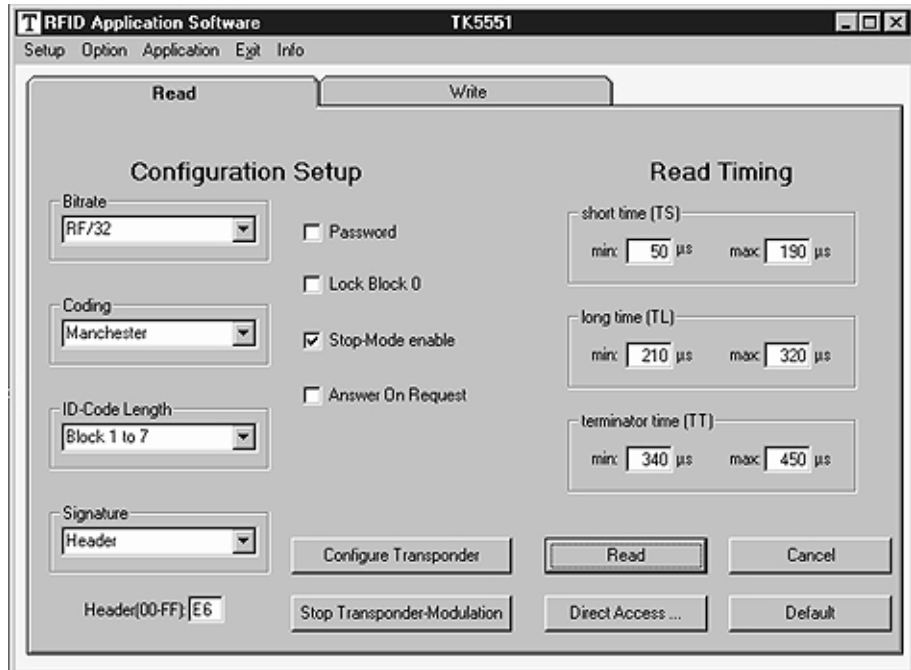
Note: For details, please refer to the e5530 datasheet.

Using *Read Timing* on the right side, the timing parameters for the decoding can be set. Under normal operating conditions, the default values can be used.

To read out the transponder, click *Read*. A message box shows the decoded transponder code in hexadecimal characters or an error report. The decoding principle, in simple terms, consists of sending the chosen *Configuration* and *Read Timing* to the microcontroller on the RFID application kit. In a real-time analysis, the incoming data stream is decoded to binary values and sent to the PC. Clicking on the button *Default* restores the default setting. Click the *Cancel* button to leave the TK5530 user interface.

## 5.4 TK5551 Read/Write Transponder

Figure 5-8. TK5551 Read Tab



When the transponder TK5551 is selected, the *Read* tab of the TK5551 user interface is shown. This window enables setting the following parameters in the *Configuration Setup* (on the left side):

- Bit rate: Rf/8, Rf/16, Rf/32, Rf/40, Rf/50, Rf/64, Rf/100 and Rf/128
- Coding: Manchester, Bi-phase, direct, PSK, FSK, (see e5551 datasheet)
- ID-code length: Block 0, Block 1, Block 1 to 2, Block 1 to 3, Block 1 to 7
- Signature: Header, sequence terminator, block terminator, and block and sequence terminator
- Password: Activates password mode
- Lock Block 0: Setting this bit locks the configuration block of the transponder. That means bit rate, coding, etc. are fixed and cannot be changed anymore. Please use this feature with care
- Stop-mode enable: obey stop command
- Answer-On-Request: Activates anticollision mode (ticking shows an additional button for AOR wake-up)

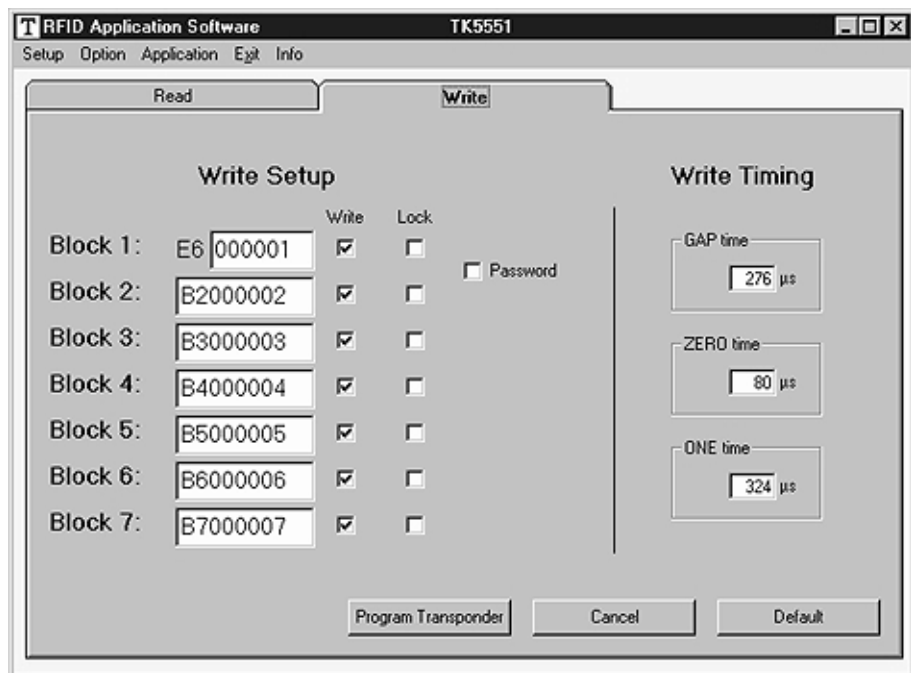
Note: The U2270B is not able to read all displayed bit rates and coding types. If invalid settings are selected, a warning message will be displayed. For details, please refer to the e5551 datasheet.

To change the *Configuration Setup*, click the *Configure Transponder* button to program the configuration block of the transponder. (The transponder should be placed close to the RFID application kit antenna.)

*Read Timing* on the right side enables the setting of the timing parameters for decoding. Under normal operating conditions, the default values can be used.

To read out the transponder, click *Read*. The decoding principle, in simple terms, is to send the chosen *Configuration* and *Read Timing* to the microcontroller on the RFID application kit. In a real-time analysis, the incoming data stream is decoded to binary values and then sent to the PC. Clicking the button *Default* restores the default setting. Clicking the *Stop Transponder-Modulation* button sends the stop command to the transponder. (This disables modulation until the transponder receives a POR or AOR wake-up command.) To leave the TK5551 user interface, click *Cancel*. Click *Direct Access...*, to do blockwise reading. Make sure that the right *Header* for the chosen block is typed into the header text field. If *Sequence Terminator* is activated, only Block 0 and the Maxblock are readable (for example, Block 1 to 5 is configured, then Block 5 is also readable with *Direct Access...*).

**Figure 5-9.** TK5551 *Write* Tab



When the *Write* tab is selected, the *Write Setup* and *Write Timing* are shown. The first byte in Block 1, the header byte, is adjusted in the header text field of the *Read* tab. The password box is the same as in the configuration setup. When the *Password* box is selected, Block 7 changes to password.

Use *Write Timing* on the right side to set the timing parameters for writing. Under normal operating conditions, the default values can be used.

The programming of the transponder is performed by clicking *Program Transponder*. The data for each block is entered using hexadecimal code (characters 0 to 9 and A to F). The blocks to be programmed are selected by selecting the corresponding check box in the *Write* column. To protect the data from being overwritten, the *lock bit* feature can be used. Once set, the information cannot be overwritten. (Please use this feature with care.) *Default* restores the default setting. To leave the TK5551 user interface, click *Cancel*.



## 5.4.1 Answer-On-Request (AOR)

This feature is used to address an individual transponder when several transponders are in the field. A transponder with activated AOR feature remains silent (no modulation) when an RF field is applied. When the AOR wake-up sequence has been transmitted, the transponder starts transmitting in ID mode and remains active until a POR occurs or a stop command is sent. A transponder that has been activated by an AOR sequence operates like a transponder in standard read mode. The AOR feature is only useful in combination with the password mode. Without a password, all transponders start modulation after each AOR wake-up sequence.

### Warning:

Once the transponder has been configured to AOR mode, the user needs to know the correct AOR wake-up sequence (password/Block 7) to read out the transponder's code. To change the transponder's configuration (for example, to deactivate AOR mode), the password is also required. During system design, use this feature with care.

To configure AOR mode, follow the steps below:

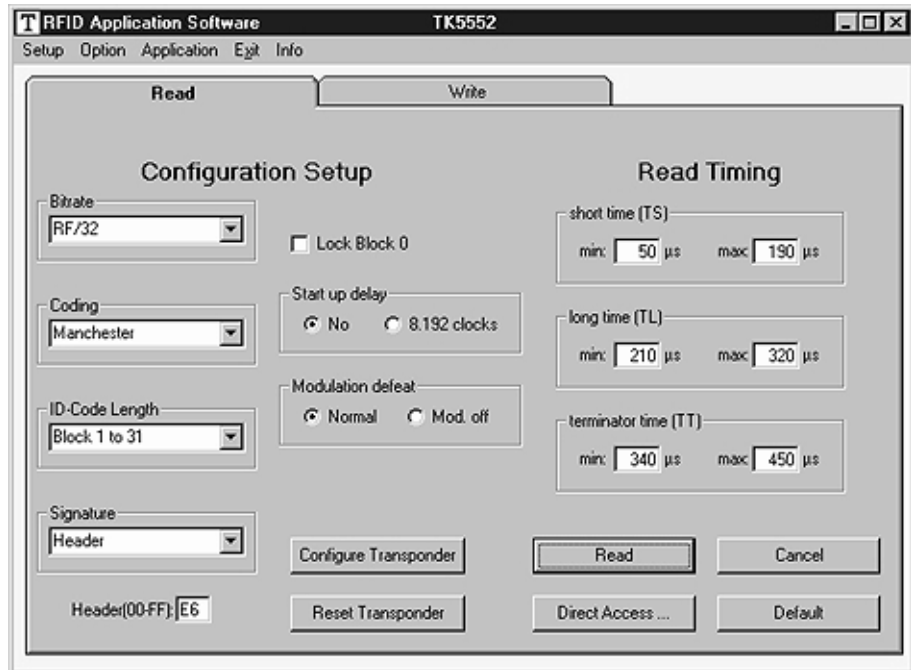
1. Activate *Password* and *Answer-On-Request* in the *Configuration Setup* of the *Read* tab
2. Type in a unique password (hexadecimal code) into the *Password* text field
3. Change to the *Write* tab, select the *Password* check box in the *Write Setup* column and click on the *Program Transponder* button
4. Then click on *Configure Transponder* in the *Read* tab
5. The transponder is now in AOR and password mode

This way, each transponder can be set to AOR mode. When all transponders are configured, put them into the RF field. To read out the transponders, follow the steps below.

1. Type the password for a specific transponder into the *Password* text field
2. Click on the *AOR wake-up* button to activate the specific transponder
3. Read out the transponder by clicking *Read*
4. To stop the read function, click *Stop Transponder-Modulation*
5. Repeat steps 1 to 4 for the next transponder, using the appropriate password

## 5.5 TK5552 Read/Write Transponder

Figure 5-10. TK5552 *Read* Tab



When the transponder TK5552 is selected, the *Read* tab of the TK5552 user interface is shown. This page enables setting the following parameters in the *Configuration Setup* (on the left side):

- Bit rate: Rf/16 and Rf/32
- Coding: Manchester and PSK
- ID-code length: Block 0, Block 1, Block 1 to 2, Block 1 to 3, ..., Block 1 to 31
- Signature: Header
- Lock Block 0:  
Setting this bit locks the configuration block of the transponder. This means bit rate, coding, etc. are fixed and cannot be changed anymore. Please use this feature with care
- Start-up delay: No (only POR) or POR and additional 8192 clocks of the RF-field
- Modulation defeat:  
When *Mod. off* is activated, no data will be transmitted. It will appear as if no transponder is in the RF field

Note: The U2270B is not able to read all bit rates and coding types displayed. If invalid settings have been selected, a warning message will be displayed. For details, please refer to the e5552 datasheet in the TK5552 appendix.

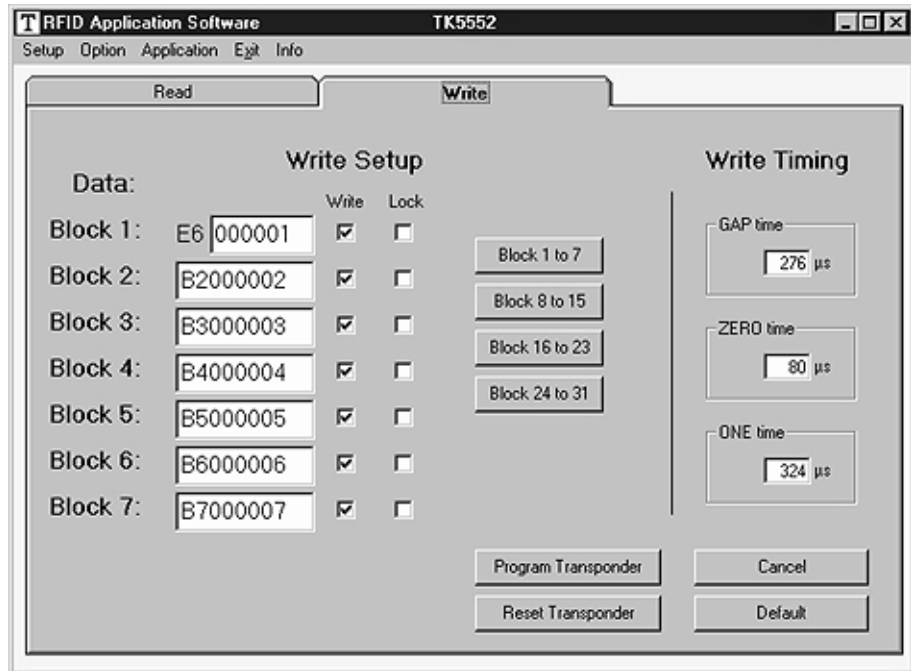
To change the *Configuration Setup*, click the *Configure Transponder* button to program the configuration block of the transponder. (The transponder should be placed close to the application board antenna.)

Click *Read Timing* on the right side to set the timing parameters for decoding. Under normal operating conditions, the default values can be used.

To read out the transponder, use the *Read* button. The decoding principle, in simple terms, is to send the chosen *Configuration* and *Read Timing* to the microcontroller on the RFID application

kit. In a real-time analysis, the incoming data stream is decoded to binary values and then sent to the PC. Choosing the button *Default* restores the default setting. Clicking the *Reset Transponder* button sends the reset command to the transponder. (There is no change in the configuration or data blocks of the transponder.) To leave the TK5552 user interface, click the *Cancel* button. Clicking the *Direct Access...* button makes blockwise reading possible. Make sure that the right *Header* for the chosen block is typed into the header text field.

Figure 5-11. TK5552 Write Tab



When changing to the *Write* tab, the *Write Setup* and *Write Timing* are shown. With the buttons *Block 1 to 7*, *Block 8 to 15*, *Block 16 to 23* and *Block 24 to 31*, all 31 data blocks can be shown by packages, each with 7 blocks. The first byte in Block 1, the header byte, is adjusted in the header text field of the *Read* tab.

Use *Write Timing* to set the timing parameters for writing. Under normal operating conditions, the default values can be used.

The programming of the transponder is performed by clicking *Program Transponder*. The data for each block is entered using hexadecimal code (characters 0 to 9 and A to F). The blocks to be programmed are selected by selecting the box in the *Write* column. To protect the data from being overwritten, the *Lock* bit feature can be used. Once set, the information cannot be overwritten anymore. (Please use this feature with care.) Selecting the button *Default* restores the default setting. Clicking the *Reset Transponder* button sends the reset command to the transponder. (There is no change in the configuration or data blocks of the transponder.) To leave the TK5552 user interface, click on the *Cancel* button.

## 5.6 TK5561 Read/Write/Crypto Transponder

When the transponder TK5561 is selected, the *Read* tab of the TK5561 user interface is shown. This sheet enables to set the following parameters in the *Configuration Setup* (on the left side):

- Bit rate: Rf/32 and Rf/64

- Coding: Manchester and Bi-phase
- ID-code length: 64 bit or 128 bit
- Signature: Header, Terminator 1 and Terminator 2
- Password: Activates password mode
- Enable Stop-mode: Obey stop command
- Lock Block 0:
- Setting this bit locks the configuration block of the transponder. This means bit rate, coding, etc. are fixed and cannot be changed anymore. Please use this feature with care.
- AUT64 rounds: Number of AUT64-times
- Auto adapt: Automatic (ON) or user-programmed adapt bit setting (OFF)

Note: The U2270B is not able to read all bit rates and coding types displayed. If a transponder is configured in an invalid mode, a warning message will be displayed. For details, please refer to the e5561 datasheet.

To change the *Configuration Setup*, click the *Configure Transponder* button to program the configuration block of the transponder. (The transponder should be placed close to the application board antenna.)

Use *Read Timing* on the right side to set the timing parameters for decoding. Under normal operating conditions, the default values can be used.

To read out the transponder, click the *Read* button. The decoding principle, in simple terms, is to send the chosen *Configuration* and *Read Timing* to the microcontroller on the RFID application kit. Using real-time analysis, the incoming data stream is decoded to binary values and then sent to the PC. Clicking on the button *Default* restores the default setting. The *Stop Transponder-Modulation* button sends the stop command to the transponder. (This halts modulation until POR.) To leave the TK5561 user interface, click on the *Cancel* button. Clicking the *Direct Access...* button makes blockwise reading possible.

Figure 5-12. TK5561 Read Tab

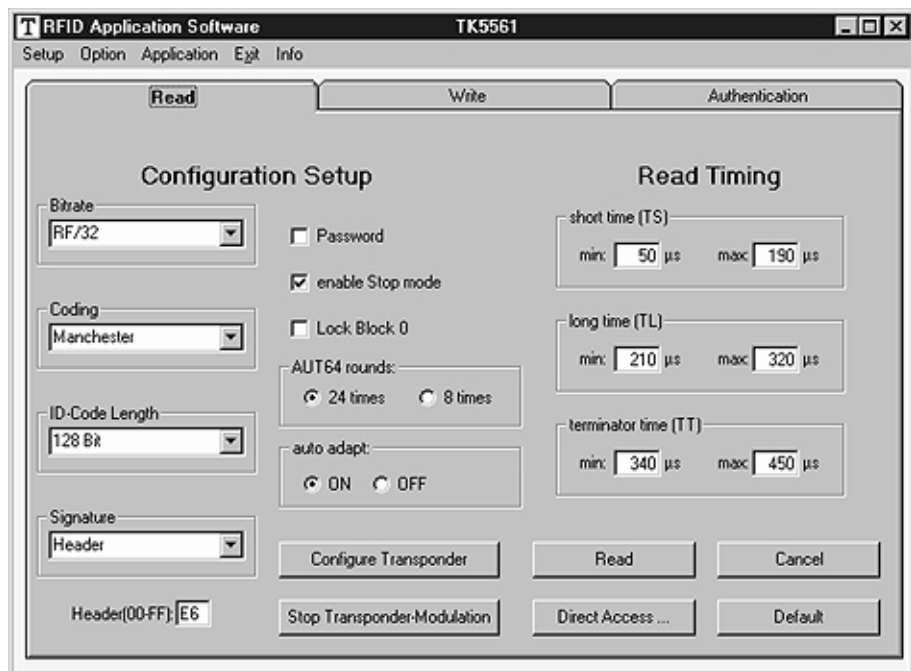
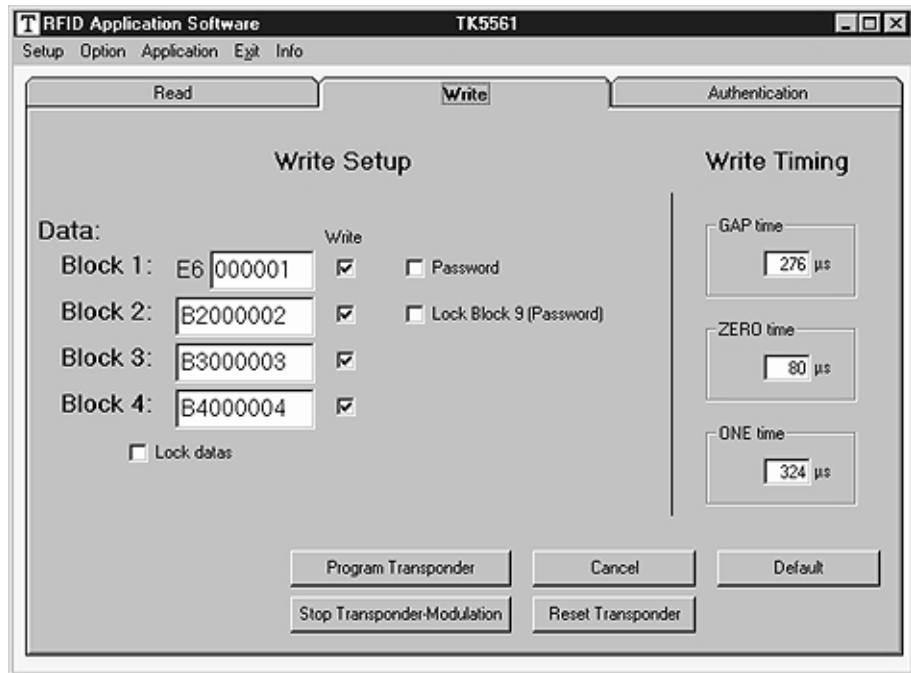


Figure 5-13. TK5561 Write Tab

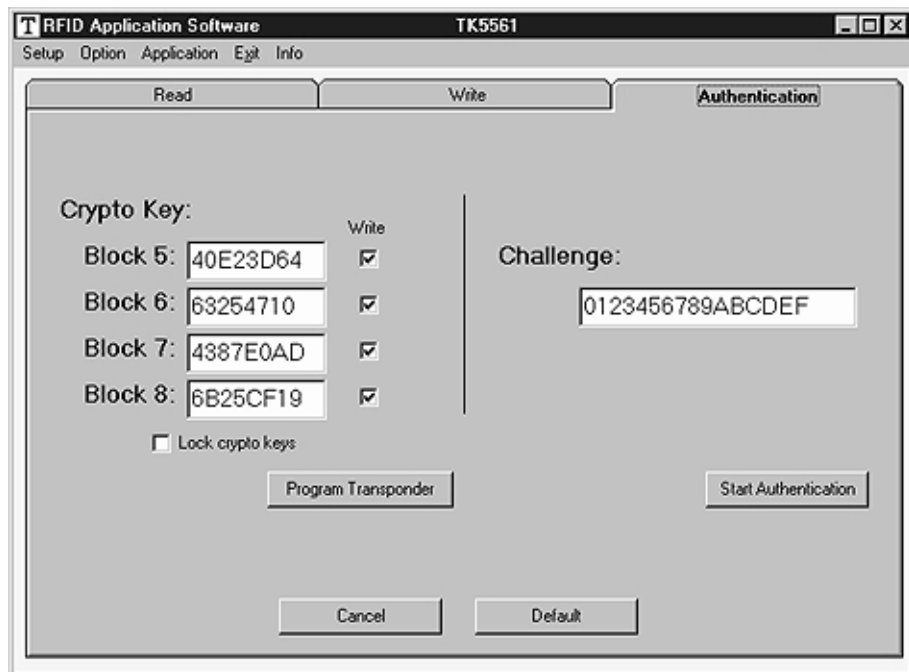


When changing to the *Write* tab, the *Write Setup* and *Write Timing* are shown. The first byte in Block 1, the header byte, is adjusted in the header text field of the *Read* tab. The *Password* box is the same as in the configuration setup. The *Lock Block 9* box locks the password. The data blocks (Blocks 1 to 4) can be locked with the *Lock data* box. Please use this feature with care.

Use *Write Timing* on the right side to set the timing parameters for writing. Under normal operating conditions, the default values can be used.

Click *Program Transponder* to program the transponder. The blocks to be programmed are selected by selecting the box in the *Write* column. Clicking the button *Default* restores the default setting. With the *Stop Transponder-Modulation* button, the stop command is sent to the transponder. (This halts modulation until POR.) With the *Reset Transponder* button, the reset command is sent to the transponder. (There is no change in the configuration or data blocks of the transponder.) To leave the TK5561 user interface, click on the *Cancel* button.

**Figure 5-14.** TK5561 *Authentication* Tab



When changing to the *Authentication* tab, the *Crypto Key* and *Challenge* are shown. The password box is the same as in the *Configuration Setup*. The *Crypto Key* (Blocks 5 to 8) can be locked with the *Lock crypto keys* box. Please use this feature with care.

The programming of the transponder is performed by clicking *Program Transponder*. The data for each block is entered using hexadecimal code (characters 0 to 9 and A to F). The blocks to be programmed are selected by selecting the box in the *Write* column. With the *Start Authentication* button, the challenge is sent to the transponder and the authentication procedure is started. Clicking the button *Default* restores the default setting. To leave the TK5561 user interface, click on the *Cancel* button.

## 5.6.1 Authentication

The RFID application kit can be used to demonstrate the encryption feature of the TK5561 read/write/crypto transponder. The PC software provides a user interface that enables the configuration of the transponder. Furthermore, the RFID application kit acts as a base station so a real challenge/response authentication procedure can be carried out. The AUT64 encryption algorithm used in the transponder is fully emulated by the microcontroller of the RFID application kit. The algorithm is carried out by hardware in the transponder and by the microcontroller. Both results are displayed on the PC and authentication is verified. The user can change the input parameters and key data of the encryption algorithm.

## 5.7 U9280M Microcontroller with Transponder Interface

The transponder board is equipped with a standard U9280M-036 ROM mask version.

The U9280M-036 emulates the basic functions of the RFID transponder TK5561 combined with keyless entry functionality.

When the transponder U9280M is selected, the *Read* tab is displayed. This sheet shows the parameters of the *Fixed Configuration* (on the left side):

- Bit rate: Rf/32
- Coding: Manchester
- ID-code length: 128 bit
- Signature: Terminator 1
- AUT64 rounds: 24 times

This configuration cannot be changed by a base station set up command. Parameters can be changed by executing a special interface programming.

Use *Read Timing* on the right side to set the timing parameters for decoding. Under normal operating conditions, the default values can be used.

To read out the transponder, use the *Read* button. The decoding principle, in simple terms, is to send the *Fixed Configuration* and *Read Timing* to the microcontroller on the RFID application kit. In a real-time analysis, the incoming data stream is decoded to binary values and then sent to the PC. Clicking on the button *Default* restores the default setting. Clicking the *Stop Transponder-Modulation* button sends the stop command to the transponder (this halts modulation until POR). To leave the U9280M user interface, click on the *Cancel* button.

Figure 5-15. U9280M Read Tab

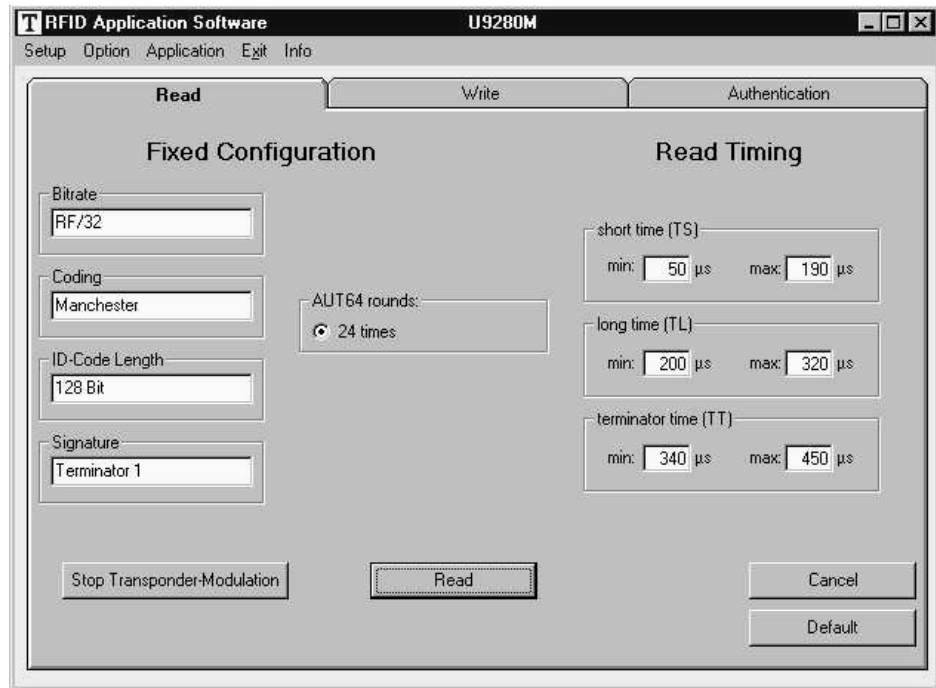
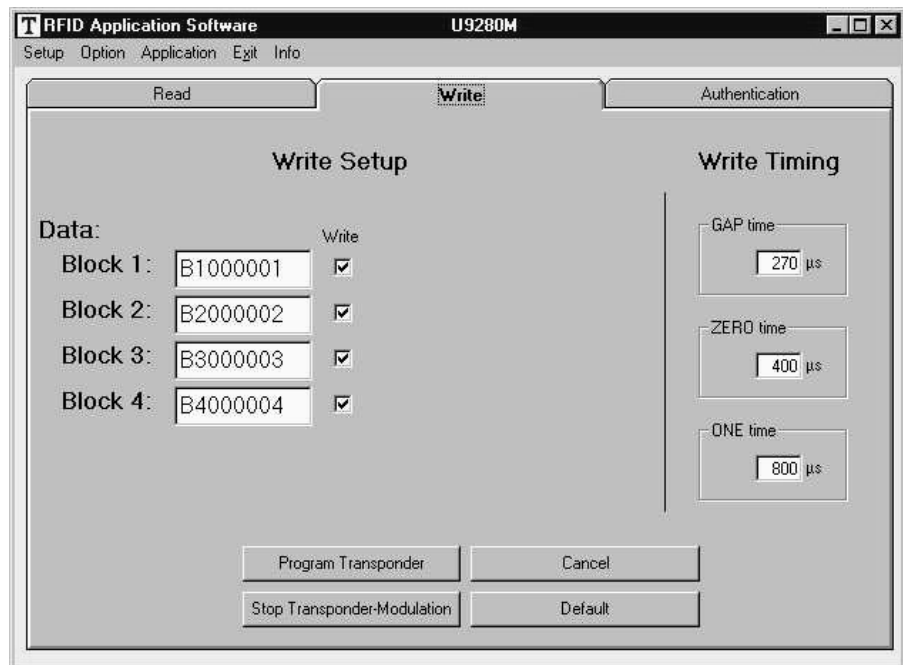


Figure 5-16. U9280M Write Tab





When changing to the *Write* tab, the *Write Setup* and *Write Timing* are shown.

Use *Write Timing* on the right side to set the timing parameters for writing. Under normal operating conditions, the default values can be used.

The programming of the transponder is performed by the *Program Transponder* button.

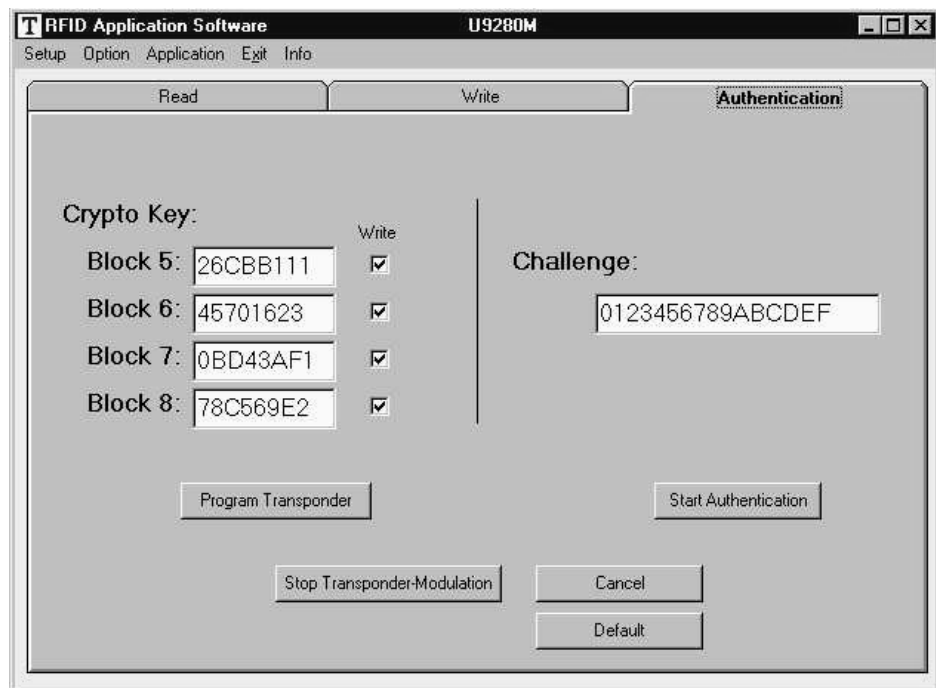
The blocks to be programmed are selected by selecting the box in the *Write* column.

Clicking the button *Default* restores the default setting.

With the *Stop Transponder-Modulation* button, the stop command is sent to the transponder (this halts modulation until POR).

To leave the U9280M user interface, click on the *Cancel* button.

**Figure 5-17.** U9280M *Authentication* Tab



## 5.7.1 Authentication

The RFID application kit can be used to demonstrate the encryption feature of the U9280M read/write/crypto transponder. The PC-based software provides a user interface that enables the configuration of the transponder. Furthermore, because the RFID application kit acts as a base station, a real challenge/response authentication procedure can be carried out. The AUT64 encryption algorithm used in the U9280M is implemented as a part of the mask programming. The algorithm is started by the button *Start Authentication*. The checksum result and encryption response of the AUT64 are displayed in separate messages for the transponder and base station. If both responses are equal, the AUT64 result displays *OKAY*; if unequal, the AUT64 result displays *Error AUT64*.

The user can change the input parameters and key data of the encryption algorithm.

Note: Remark: Data value in block 6 is restricted: The 3 LSB of each nibble must be different.

Figure 5-18. Message Box AUT64 Result





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