IDIC Demo Kit 3

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U2270B Base-Station Board 3 / R/W – Demo Software IDS V1.61

Getting Started

- Read this demo board user's manual
- Connect a centronics cable to the U2270B demo board and to the PC
- Connect either a 12-V or a 5-V power supply to the demo board (using the jack connector or pins V_{CC} and GND). For 12-V apply the jumper BR3 has to be closed, jumpers BR4 and BR5 have to be open (default setting). For 5-V apply the jumpers BR3, BR4 and BR5 must be closed. The status "Power on" is indicated by a green LED.
- Start MS-DOS. Do not start the software from the Windows DOS-shell, since Windows is likely to interfere with the measurement procedures.
- Make a new directory → mkdir IDS
- Copy the IDS software from disk to harddisk → A:\copy IDS C:\IDS
- Change to the IDS directory → cd IDS
- Start the program → **id1.exe**
- Select used centronics port → menu "Settings...PC setup"

Using the TK5530 Read-Only Transponder

- Select transponder type → menu "Settings... Transponder type...TK5530"
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details, such as bit rate, modulation coding and header → menu "Settings...Setup"
- For non-specialized applications use the default settings
- Choose "Set" to activate the new settings
- Choose the function key "F4" or "F7" (show transponder code or show graphics) to read the used transponder key

Using the TK5550 Read/Write Transponder

- Select transponder type → menu "Settings... Transponder type...TK5550"
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details, such as bit rate, modulation coding and header → menu "Settings...Setup"
- For non-specialized applications use the default settings
- Choose "Configure" (this function programs the configuration block (block 0) of the TK5550)
- Choose the function key "F8" (TK5550 program setup) to program block 0...7 of the transponder memory
- Choose "Program & Read TK5550"
- For each additional reading use the function key "F4" or "F7" (show transponder code or show graphics) to read the used transponder key

Using the TK5560 Read/Write/Crypto Transponder

- Select transponder type → menu "Settings... Transponder type...TK5560"
- Place a transponder close to the base-station antenna
- Enter the transponder's configuration details, such as bit rate, modulation coding and header → menu "Settings...Setup"
- For non-specialized applications use the default settings
- Choose "Configure" (this function programs the configuration block (block 0) of the TK5560)
- Choose the function key "F8" (TK5560 program setup) to program block 0...4 of the transponder memory
- Choose "Program & Read TK5560"
- For each additional reading choose "F4" or "F7" (show transponder code, or show graphics) to read the used transponder key
- For starting the encryption process, choose → menu "Write transponder...Crypto mode" then choose "Program & Start"

Exit the Program

- Choose in the main window → menu "Settings...Exit"

General Description of the U2270B Base-Station Board

The TEMIC Semiconductors IDIC demo board is capable of demonstrating the features of the TEMIC Semiconductors transponder family. It is used for several base-station application examples. With this board, transponders can be read, data can be written to the transponders, and different operating modes of the transponders can be set.

A complete verification of the encryption algorithm used by the TEMIC Semiconductors crypto transponder TK5560 is also possible. The demo board can be regarded as a base station, using the PC as an intelligent user-interface terminal.

Power Supply

The demo board can be operated from a 9- to 16-V supply rail (standard application) or a 5-V regulator. The supply voltage is connected to the jack connector or between the pins V_{CC} and GND. To switch the demo board to the adequate supply rail, the jumpers BR3, BR4 and BR5 have to be set as shown in the following table.

Supply Voltage	BR3	BR4	BR5
9 to 16 V (default)	Closed	Open	Open
5 V	Closed	Closed	Closed

The status ”Power On” is indicated by the green LED.

Warning:
Before switching on the power supply, make sure that the voltage is set correctly. The demo board is not protected against overvoltage.

Standby Mode

If the demo board is operated with the default 12-V supply, an additional power-saving mode is available. This mode is referred to as standby mode. Setting jumper BR2 between position 1 and 2 makes the standby mode available. In this case, the demo software can switch the board to standby or active mode. When jumper BR2 is set between 2 and 3, this function is disabled.

Standby Mode	BR2	STBY
Available	1–2	high → active mode low → standby mode
Not available	2–3	NC

Please note that standby mode is not available when using the 5-V supply.

Four Stages Frequency Tuning

The demo board has a built-in tuning feature to match the resonant frequency of the LC circuits of the transponder and the base station. Hence follows an increase of reliability and operating distance.

There are three different tuning modes: fixed frequency, manual tuning and auto tuning mode. In fixed frequency mode, the demo kit has one fixed frequency, nominally 125 kHz. 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, semi-low, semi-high and high), assuming the U2270B on-chip oscillator is tuned to 125 kHz (these values are nominal values, the actual values may slightly differ due to component tolerances).

The currently selected frequency stage is indicated on the demo board by the Tune 1/2 LEDs binary encoded.

When jumper BR1 is set between position 1 and 2, the fixed frequency mode is selected (default). To enable the manual and auto mode, set jumper BR1 between positions 2 and 3.

Tuning Mode	BR1
Disabled	1–2
Enabled	2–3

RF Field Status

The status ”RF On” is indicated by the yellow LED on the demo board.

Circuit Diagram

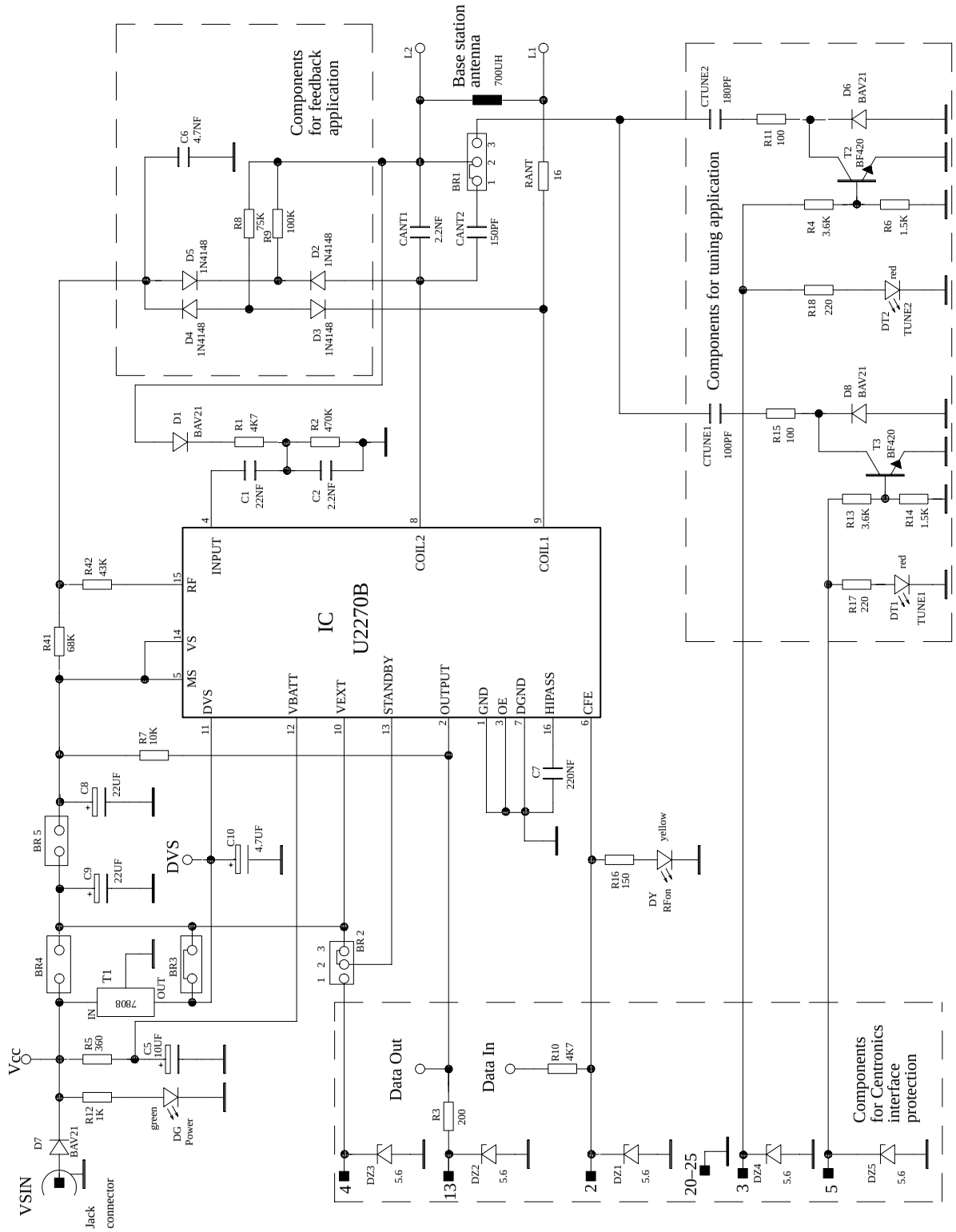

Figure 1. IDIC – Demo kit 3: Circuit diagram with feedback and tuning application

Partlist of U2270B Demo-Board Kit 3

Part	Value	Manufactorer
IC	U2270B	TEMIC Semicond.
Diodes		
D1	BAV21	
D2	1N4148	Vishay Telefunken
D3	1N4148	Vishay Telefunken
D4	1N4148	Vishay Telefunken
D5	1N4148	Vishay Telefunken
D6	BAV21	
D7	BAV21	
D8	BAV21	
DZ1	BZX55C5,6V	Vishay Telefunken
DZ2	BZX55C5,6V	Vishay Telefunken
DZ3	BZX55C5,6V	Vishay Telefunken
DZ4	BZX55C5,6V	Vishay Telefunken
DZ5	BZX55C5,6V	Vishay Telefunken
DG	TLUG5400	Vishay Telefunken
DY	TLUY5400	Vishay Telefunken
DT1	TLUR5400	Vishay Telefunken
DT2	TLUR5400	Vishay Telefunken
Transistors		
U1 (T1)	LM7808 (BD139)	
T2	BF420	
T3	BF420	
Resistors		
R1	4.7 k	
R2	470 k	
R3	200	
R4	3.6 k	
R5	360	

Part	Value	Manufactorer
Resistors (continued)		
R6	1.5 k	
R7	10 k	
R8	75 k	
R9	100 k	
R10	4.7 k	
R11	100	
R12	1 k	
R13	3.6 k	
R14	1.5 k	
R15	100	
R16	150	
R17	220	
R18	220	
R41	68 k	
R42	43 k	
RANT	16	
Capacitors		
CANT1	2.2 n	
CANT2	150 p	
CTUNE1	100 p	
CTUNE2	180 p	
C1	22 n	
C2	2.2 n	
C5 Tantal	10 µ /16 V	
C6	4.7 n	
C7	220 n	
C8 Tantal	22 µ /16 V	
C9 Tantal	22 µ /16 V	
C10 Tantal	4.7 µ	

The antenna coil used with IDIC Demo Kit 3 is based on following parameters (measured at f = 125 kHz):

Inductance L = 700 µH
Coil diameter d = 10 cm
Winding number n = 60
Wire diameter d_w = 0.25 mm
Quality factor Q = 35

Description of the IDIC Demo Software (IDS)

Hardware Requirements

- IBM Personal Computer or 100% compatible with Intel 386-25 processor or higher
- Parallel printer interface (centronics)
- VGA-compatible graphics adapter
- Mouse
- MS-DOS 6.0 or higher
- U2270B base-station demo board
- Transponder with f_0 = 125 kHz
  (for example, TK5530, TK5550 or TK5560)
- Connection cable
- Power supply DC: 5 V or 12 V

Software Structure

The software is suitable for all TEMIC transponders. All types of transponders and their particular features and functions can be controlled by one program. Depending on which transponder type is selected, the software automatically selects the features supported by this transponder type. The software is developed for the use of the different transponders and their features, that means the user does not need to care about the technical details.

Main Window

The main window is the starting point of any operation. Status fields at the right side of the bottom line indicate the current status of the system.

The menu items differ in some respect depending on the selected transponder type. Many of the points listed below apply for all types. These are explained first in the following chapter “General Information for All Transponder Types”. The more specialized features, e.g., the encryption algorithm of the TK5560, are explained later, starting with the chapter “Read-Only Transponder TK5530”.

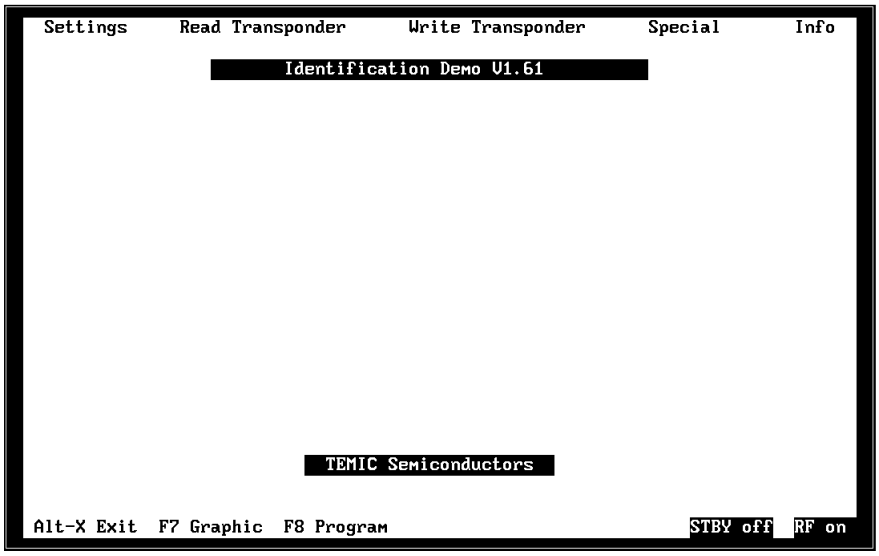

Figure 2. Main window of the IDS V1.61

General Information for All Transponder Types

Settings Menu

PC Setup

Choosing the menu item “PC Setup” in the settings menu opens the PC setup dialog box. This box displays all the centronics ports that are available for use on the PC, for example, LPT 1 and LPT 2. Select the port that is connected to the U2270B base-station board and choose the button “Set”.

Transponder Type

The type of TEMIC transponder that will be used has to be selected from the following list in the menu “Settings...Transponder Type:

TK5530	read-only type
TK5550	read / write type
TK5560	read / write / crypto type

Depending on the selection, the user interface will be adjusted.

The software needs to know which transponder has been selected. Some parameters differ from one transponder type to the other. However, these parameters are set automatically. Also, only menu options that are appropriate for this type of transponder are displayed in black, all others are shaded. For example, all the write options are disabled for the read-only transponder TK5530.

Select the transponder type that will be used and choose the button “OK”. For direct switching to the setup window, choose the button “Setup”.

Read-Timing Setup

Choosing the “Settings...Timing setup...Read” menu item opens the decoding setup dialog box (figure 3). Here, the timing parameters for the decoding can be set. Under normal operating conditions, the default values can be used. The decoding principle, in simple terms, is to record the incoming data stream and process it afterwards. During processing, the received waveform is analyzed. One step of the decoding principle is to determine the time elapsed between two state transitions at the data input. This data is then used to retrieve the information from the signal.

In order to ensure reliable decoding, certain time frames are defined. If the times from the received signal are outside these given time frames, the signal is classified as invalid and an error message is displayed.

The time frames differ, depending on the LC circuit and the bit rates of the transponder. Each bit rate has a default value. This value, however, can be changed by the user if necessary.

The following parameters define the decoding frames for the biphase and manchester decoding method.

TS1,	min. short bit time
TS2,	max. short bit time
TL1,	min. long bit time
TL2,	max. long bit time

Note:
To ensure valid computations, the times have to be in the following order:

$50\ \mu s < TS1 < TS2 < TL1 < TL2 < 1200\ \mu s$.

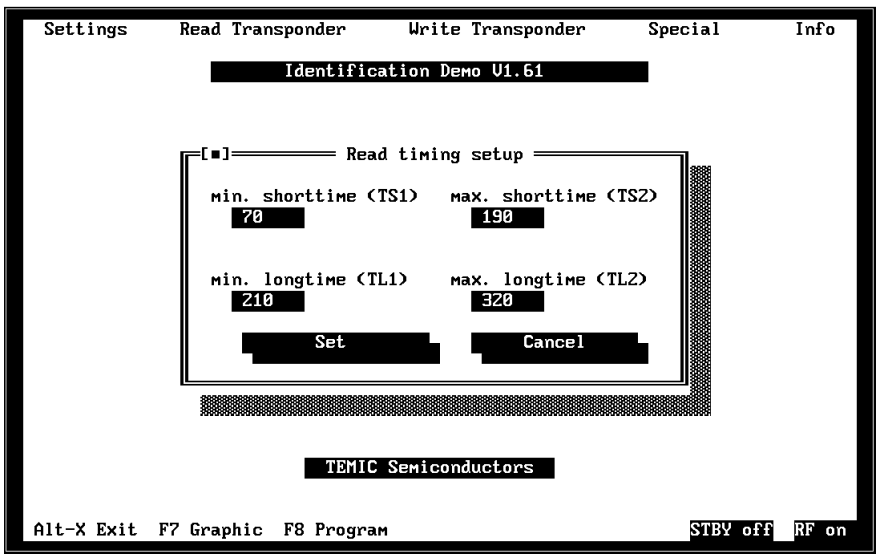

Figure 3. Read-timing setup

Write-Timing Setup

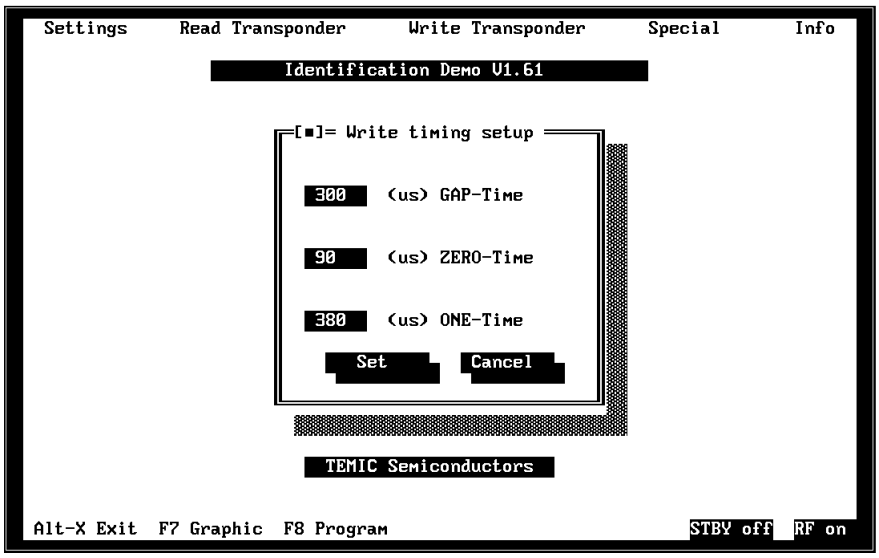

Figure 4. Write-timing setup

In the dialog box “Settings...Timing setup...Write”, the parameters for the write mode can be adjusted (figure 4).

The TEMIC write method is used. The RF field is interrupted by gaps. The time between the gaps is used to encode the information. The length of the gap and for transmitting a one or a zero can be adjusted.

- **GAP** time: Time of field interruption
- **ONE** time:
  Duration of switch-on mode: logic 1
  The time the field is switched on
  (between two gaps) to be recognized as
  a valid ‘1’.
- **ZERO** time:
  Duration of switch-on mode: logic 0
  The time the field is switched on
  (between two gaps) to be regognized as a valid ‘0‘.

For detailed information about this write method, please refer to the e5550 or e5560 data sheets.

Note:
The times listed above are dependent on the LC circuit. In order to receive and decode a signal reliably, those times have to be adjusted correctly. The default values are suitable for a wide range of applications. However, under certain circumstances such as different LC combinations, adjustment is necessary.

Colors

To change the color outfit of the main window, choose this menu item.

Exit

To exit the program, choose this menu item.

Read Transponder

The bit stream coming from the base-station board to the PC’s centronics interface is recorded and decoded by the demo software. The code of the transponder can be displayed as a string of hexadecimal characters (“show transponder code”) or alternatively as waveform (“show graphics”).

To read out the transponder, first set the configuration. If the reading fails, check in the show graphics window. Make sure the bit rate, the modulation type and, if used, the header was set correctly.

Show Transponder Code (F4)

A measurement is started, if the function key “F4” is chosen or the menu item “Read transponder...Show transponder code” is selected. A message box shows the decoded transponder code (figure 5) or an error report.

The transponder code is displayed as a string of hexadecimal characters. If no code is detected, or the program fails to receive a valid data format, an error message is displayed.

The program also checks the data stream for multiple headers, if the header mode is used. If some are found, a special error report is shown.

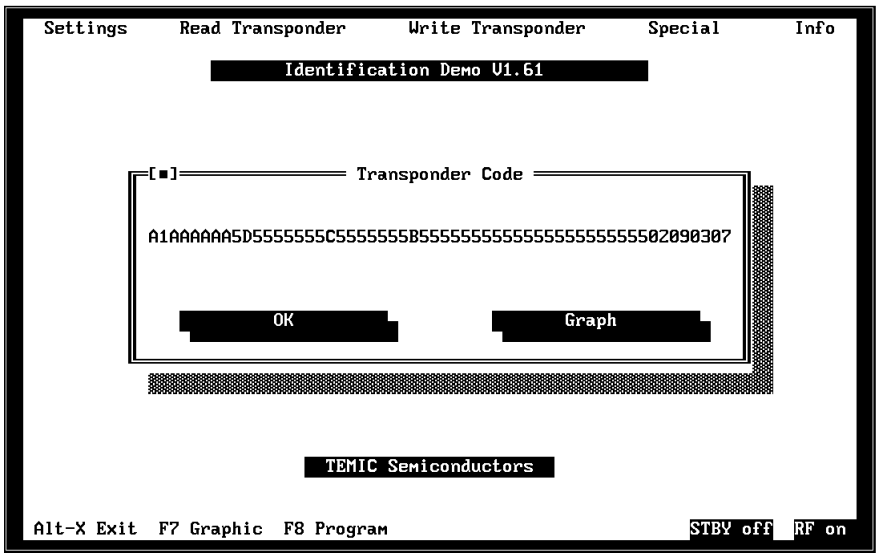

Figure 5. Transponder-code output box

Show Graphics (F7)

The “show graphics” display can be used to gain more information on the received data stream. This is especially useful when the “show transponder code” operation has failed. By using the “show graphics” display, it is possible to determine many common faults on the transponder, the hardware setup or the software setup of the equipment used. This menu is started directly, if the function key “F7” is chosen.

A typical “show graphics” screen is shown in figure 6.

Elements of the “Show Graphics” Windows

The Oscilloscope Window

The incoming bit stream is displayed as waveform using the upper part of the PC screen as an oscilloscope. If a transponder has been decoded correctly and the header mode is in use, the header will be printed white and the rest of the code will be printed in red color. If terminator mode is used, the code is printed in red color and no header is displayed.

Note:

The data format of the TK5560 is changed to the data format TK5530 and TK5550. For the TK5560, each block is transmitted with the LSB first. Also, the hexadecimal characters are sent and received with LSB first. For example, the bit stream for hexadecimal A would be 0101 for TK5560 and 1010 for TK5530/TK5550. This can be confusing, but is due to the internal register structure of the devices. For more information, please refer to the e55xx data sheets.

Note:

The signal in the oscilloscope window is the same signal that can be seen on the demo board on Pin “DATA OUT”. A HIGH signal on the oscilloscope window corresponds to a damped signal from the transponder. A LOW signal on the oscilloscope window corresponds to a non-damped signal from the transponder. Please refer to the e55xx data sheets for details on damping and non-damping.

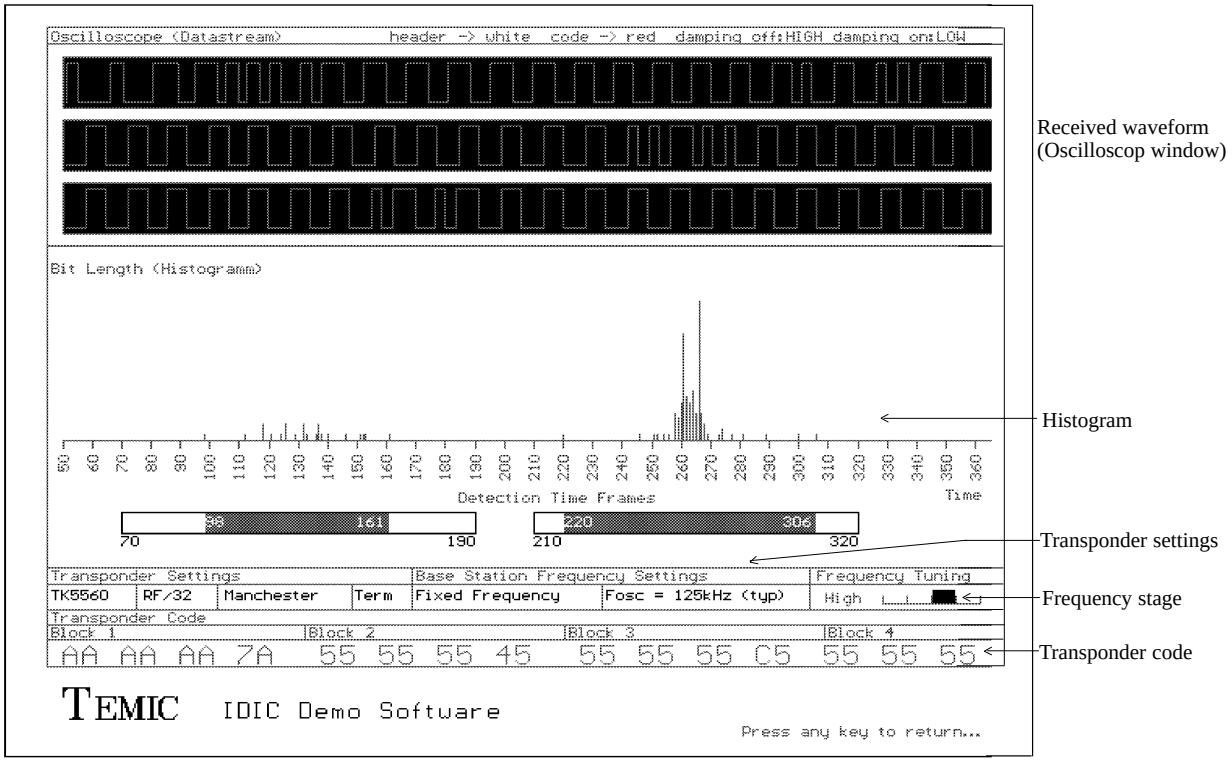

Figure 6. A typical “show graphics” window

The Histogram

The measured time frames are counted and their distribution is displayed in the histogram. The length of the time frame is measured in microseconds and displayed on the x-axis. Every occurrence of a particular time frame is counted and the number of occurrences determines the length of the red line.

The two boxes below show the permitted values and the actually measured values. The permitted values are limited by the minimum and maximum times at either side of the boxes. The maximum spread of the actually measured values is displayed as gray area.

The limits for the time frames vary, depending on the bit rate chosen. If the measured values are outside the given limits, the signal cannot be decoded reliably any more and an error message is displayed. A common error is to read data from a transponder using a different bit rate. If such a problem occurs, the settings of the transponder, as well as the base-station board should be checked.

The precision of the measured times is dependent on the PC used. The tolerance of the measured times is about $\pm 10\,\mu s$. The bit stream is then decoded with the Manchester or Biphase method (see data sheet e55xx).

The Transponder Settings

Here, the settings of the demo board are displayed. The transponder type, the bit rate used, the modulation coding used and, if applicable, the header. Please note that these settings are not necessarily identical to the settings of the transponder. They should be the same, but the user has to be aware of the fact that the way the transponder is set up is not checked by the software of the demo board.

The Transponder Code

At the bottom of the screen, a text field shows the code of the transponder.

Direct Access

The direct access mode is available for TK5550 and TK 5560 transponders. It is used to read out one block of the transponder’s memory. It is possible to read out data from blocks that are usually not transmitted, especially if the transmitted bit stream is limited by the MaxBlock setting (see e5550 data sheet). By using direct access, the data contents of these blocks can also be read out.

For the e5550 the software does not support terminators as synchronization method for direct access. To use the direct access feature with the e5550 use a header in each block which is identical to the transponder’s header.

A later IDS update version will support a block terminator to simplify the direct access mode.

The direct access command is transferred to the transponder by entering the menu item ”Read transponder...Direct Access”. The transponder responds with transmitting the selected block in a loop. Leaving the menu will set the transponder into normal mode.

Write Transponder

To transfer data to the R/W transponders TK5550 and TK5560, the “DATA IN” Pin of the U2270B demo board is triggered by the demo software through the centronics interface.

By switching the RF field on and off in a certain pattern, the data is transmitted serially to the transponder. For details on the TEMIC write method, please refer to the e5550 or e5560 data sheet. The information is encoded in the time between field gaps. A long time between two gaps is a ‘1’, a short time is a ‘0’. The times are set up in the dialog box “Write timing setup” which is described in the chapter “Settings Menu”.

Read-Only Transponder TK5530

Setup for the TK5530

If the transponder type TK5530 is selected in the dialog box “Transponder type”, choosing the menu item “Settings...Setup” shows the TK5530 setup dialog box (figure 8).

This box enables to set the following parameters:

- **Bit rate**: RF./ 32, RF/ 40 and RF/ 64
- **Header:** sample header E6 or
  custom header 00 ... FF
- **Modulation coding:**
  Manchester Modulation: rising edge → 1; falling edge → 0
  Biphase Modulation: long bit time → 0; two short bit times → 1
- **ID code length:** 64 or 128 bit

If any other header than the standard TEMIC sample header is desired, the custom header button has to be selected and the desired header has to be typed in the text field.

The text field accepts two hexadecimal characters, each representing four bits.

After the selection of the correct configuration, press the “Set” button.

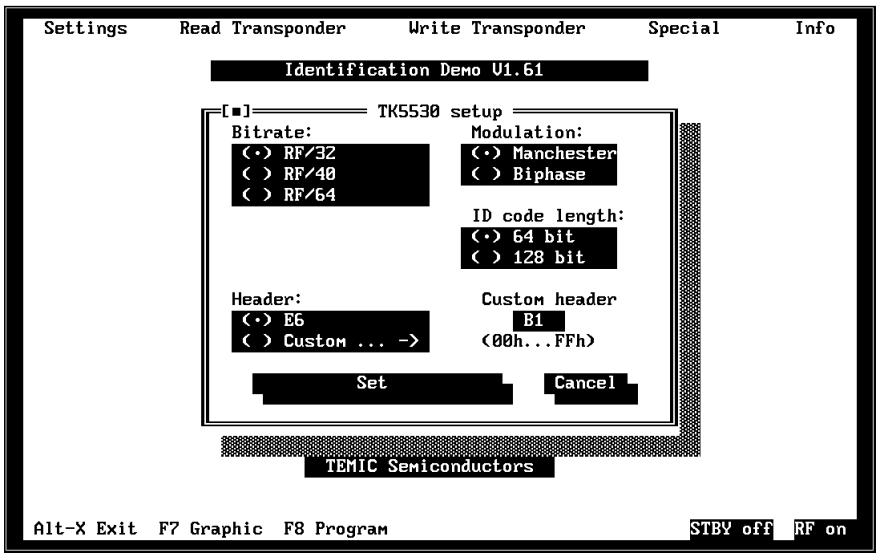

Figure 7. Setup for the TK5530

Read / Write Transponder TK5550

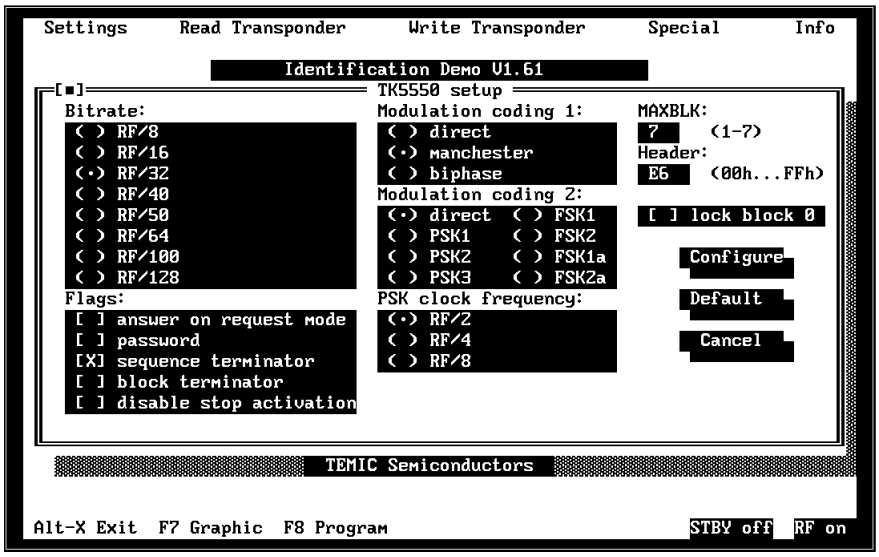

Figure 8. Setup for the TK5550

Setup for the TK5550

If the transponder type TK5550 is selected in the dialog box “Transponder type”, choosing the menu item “Settings...Setup” shows the TK5550 setup dialog box (figure 8).

When leaving the menu using the “Configure” button, the configuration block of the transponder is programmed. The transponder should be placed close to the base-station antenna. Choosing the button “Default” enables a default adjustment, but the configuration is not programmed to the transponder.

This box enables the following parameters to be set:

- **Bit rate**: Select the required bit rate
- **Flags:**
  Many of the features of the TK5550 are selected by the setting of a particular bit in the configuration block. For details on these features, please refer to the e5550 data sheet.
- **Header:** custom header 00 ... FF (default:E6)
- **Modulation coding:**
  The two modulation coding stages can be programmed independently. Please note that not all settings make sense. As a simple guideline, at least one of the modulators should be in direct mode. For more information on how to configure the modulation stages, please refer to the e5550 data sheet.
- **PSK clock frequency:**
  This setting is only of interest if PSK is used (Mod 1: direct, Mod 2: PSK1, 2, 3). For details, please refer to the e5550 data sheet.
- **Lock bit of block 0:**
  Setting this bit locks the configuration block of the transponder. This means, the modulation type, bit rate etc. are fixed and can not be changed ever again. Please use this feature with care!

Note: The U2270B is not able to read all the bit rates and modulation types displayed. If a transponder is about to be configured in such a mode, a warning is displayed.

Writing to the TK5550

If the transponder type TK5550 is selected in the dialog box “Transponder type”, choosing the menu item “Write Transponder...Program memory” shows the TK5550 program setup dialog box (figure 9).

All memory blocks of the TK5550 can be programmed. The blocks to be programmed are selected by ticking the box in the **write** column.

The data is entered using hexadecimal code (characters 0...9 and A...F). To replace the default data contents, delete the data using backspace and type in the new data.

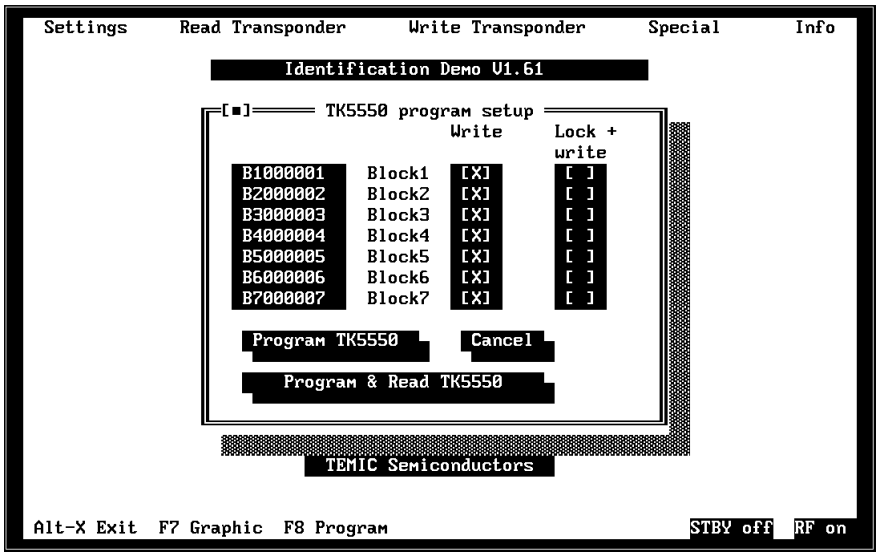

Figure 9. Program TK5550

The programming of the transponder is performed by the button “Program TK5550”. A programming with automatic read-out after programming is carried out by pressing the button “Program & Read TK5550”. This is a useful option to verify if programming was successful.

Remark: Programming requires higher field strength than reading. If programming fails, place the transponder closer to the base-station coil and try again.

To protect the data from being overwritten, the lock bit feature can be used. Once set, the information can not be overwritten anymore.

Note: Activating the lock bit is not reversible!

Password Function of the TK5550

The Password function allows to protect memory from unauthorized or accidental programming.

When active, a write sequence is only accepted as valid, if the password is recognized correctly by the IC. The transponder regards the content of block 7 as password. If no password is transmitted or the transmitted password does not match with the content of block 7, the IC will not enter programming mode. It will then remain in ID mode.

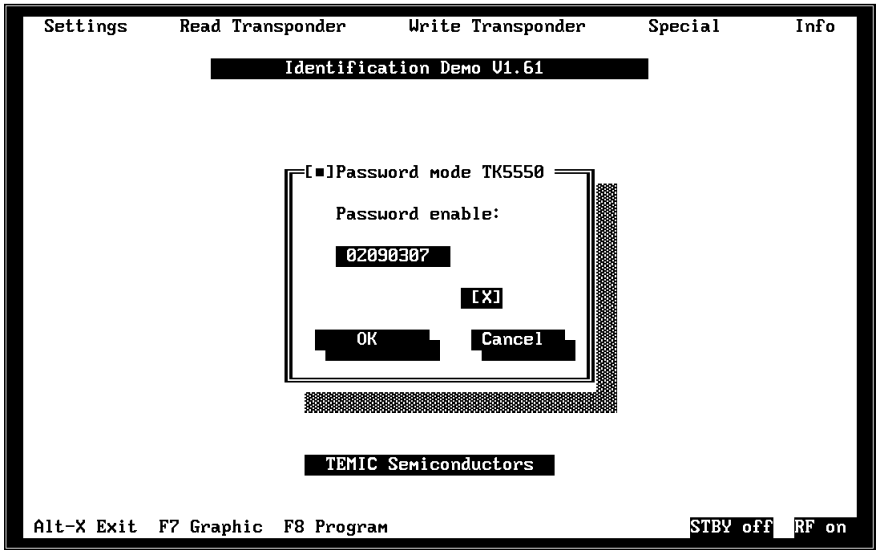

Figure 10. Password function of the TK55550

A usual write sequence consists of the write opcode, the lockbit, 32 data bits and 3 address bits. If the password is activated, the IC expects the following sequence: opcode, 32 bits password, lockbit, 32 bits data, 3 bits address.

If the IC is in password mode, anything but the correct sequence with the correct password will be treated like an error, and the IC immediately falls into ID-mode.

To enable the transponder for password mode choose ”Settings...Setup” and select ”password”. Place the transponder near the reader coil of the base–station and choose ”configure”. The transponder is now in password mode (If the password function is not used disable ”password” and configure the transponder. Block 7 then can be used to store customer data).

To activate the password mode select ”Write Transponder...Password mode” and select the ”Password enable”. Enter the valid password of the transponder (block 7) in hexadecimal notation. The transponder now can be programmed.

The password mode will be used in any write sequence, if the password enable box is ticked. If the box is not ticked, a normal write sequence is carried out.

Warning: To change the transponder’s configuration, e.g., deactivate password mode, the password is also required. During system design use this feature with care!

Answer-On-Request (AOR) Function of the TK5550

This feature is used to address individual transponder when several transponder are in the field. A transponder with activated AOR feature remains silent when a RF field is applied. It waits for an AOR wake-up sequence.

Once the sequence was transmitted the transponder wakes up and starts transmitting in ID mode and remains active until a power-on reset occurs or a stop mode sequence is received. A transponder that has been activated by an AOR sequence behaves exactly like a transponder in standard read mode.

An AOR sequence consists of the standard write opcode followed by 32 password bits. The AOR sequence is then compared with the content of block 7 (just like the password). Only if the sequence data and the data in block 7 are identical the AOR is recognized and this transponder is woken up and starts ID mode. All other transponder remain silent. This allows to address individual transponder by allocating different password data to each of them.

The AOR feature is only useful in combination with the password mode (for configuration of password mode see Password Function). To enable the transponder for AOR mode choose ”Settings...Setup” and select ”answer-on-request mode”. Place the transponder near to the reader coil of the base-station and choose ”configure”. The transponder is now in AOR mode (If the AOR function is not used disable ”answer-on-request mode”).

To activate the AOR mode select ”Write Transponder...Answer on request mode” and select ”AOR enable”. Enter the AOR enable code of the transponder in hexadecimal notation and select ”OK”.

A single transponder can now be addressed in a field among several transponders.

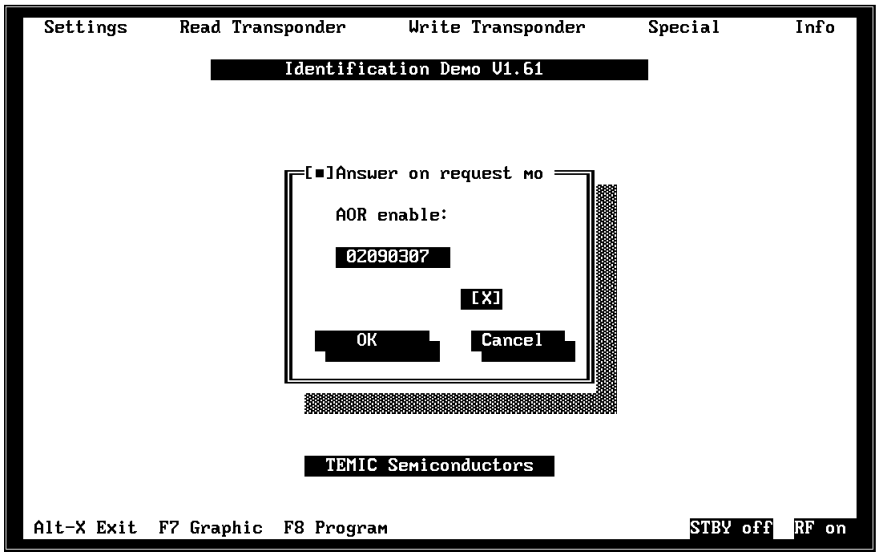

Figure 11. Answer-on-request function of the TK5550

To repeat an AOR the transponder has to be reset or taken out of the field. A new AOR call is then executed by selecting ”OK” in the ”Write Transponder....Answer-on-request mode” Box.

Warning: If the transponder has once been configured to AOR mode, the correct AOR wake-up sequence (password / block 7) has to be known to read out the transponder’s code. To change the transponder’s configuration, e.g., deactivate AOR mode the password is also required. During system design use this feature with care!

Read / Write / Crypto Transponder TK5560

Overview of the TK5560 Operating Modes

In order to understand the operation of the demo kit, and especially the emulation of the encryption algorithm, it is useful to describe the most important modes of the TK5560 briefly. The TK5560 can be operated in several internal modes, each providing a special function. The relevant modes for demonstration are:

- **ID Mode:**
  This is the default mode after start up. The transponder transmits an ID code. This ID code is used by the base station to recognize the transponder and select the appropriate key for the following authentication procedure. If, for any reason, a write procedure has failed, the transponder terminates this procedure and returns to ID mode.

- **Direct Access Mode:**
  In this mode, the contents of one of the transponder’s memory blocks is read out. This is possible for all blocks. Direct access mode can also be used to verify write operations.

- **Programming Mode and Crypto Mode:**
  In programming mode, data is written to the memory of the TK5560. This applies to the memory location of the ID code, blocks 1–4, as well as the crypto key, blocks 5–8.

For more information about other possible modes, please refer to the e5560 data sheet.

Setup for the TK5560

If the transponder type TK5560 is selected in the dialog box “Transponder type”, choosing the menu item “Settings...Setup” shows the TK5560 setup dialog box (figure 12). When leaving the menu using the “Configure” button, the configuration block is programmed. The transponder should be placed close to the base-station antenna. Choosing the button “Default” achieves a default adjustment, but the configuration is not programmed.

This box enables to set the following parameters:

- **Bit rate**:
  The correct setting for the bit rate is important for the time frames in which the detected time is classified as valid.

- **Modulation coding:**
  Select the Manchester or Biphase coding. If the wrong modulation type is selected, the received data will not be interpreted correctly. This results, in most cases, in an error message. In a few rare cases, the received data stream can be decoded in both modulation types and yield a valid result in each case.

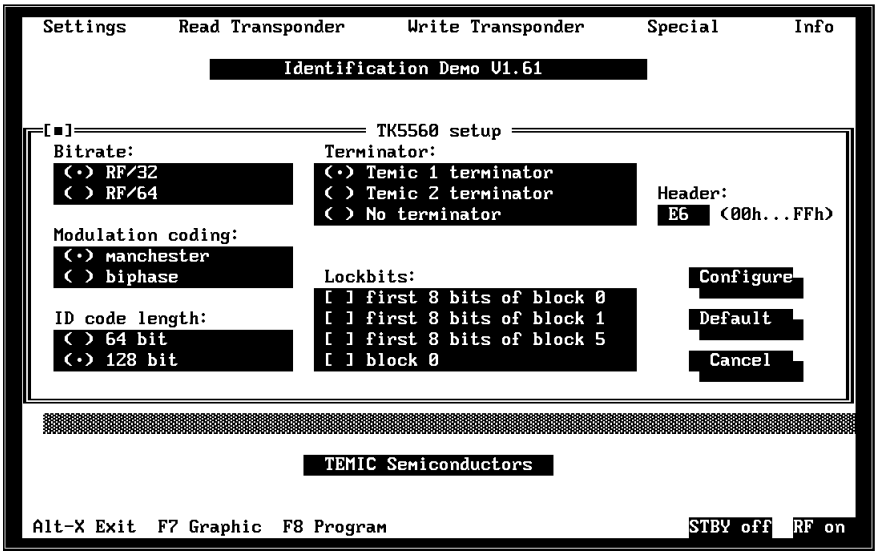

Figure 12. Setup for the TK5560

- **ID Code length:**
  The ID code can be 64 bits or 128 bits long. If 64 bits are selected, memory block 1 and 4 are transmitted. When 128 bits are selected, all blocks from 1–4 are transmitted.
- **Terminator:**
  The transponder can be configured to use different terminators, or none at all, when it is in ID mode. The terminators are sequence terminators. They are inserted every 64 or 128 bits, depending on the ID code length. This setting refers to the ID mode only ! It has no effect on the challenge/ response part. The terminator used there is the TEMIC 1 terminator, and can not be altered by the user.
- **Lock bits:**
  Setting the lock bits of a special memory part. After locking the memory bits, they cannot be programmed anymore. Please use this feature with care!
- **Adapt mode:** No function
- **Header:** custom header 00 ... FF (default:E6)

ID Mode

In ID mode, the transponder transmits an identification data stream (also referred to as ID code) to the base station. The ID code consists of the content of memory blocks 1 to 4. Depending on the configuration of the transponder, the length of the ID code data stream is 64 or 128 bits. The blocks read out are displayed as hexadecimal characters. If the ID mode is set to 64 bits, only block 1 and block 4 are transmitted. The ID code is sent in a loop as long as the RF field is applied and no field gap causes the transponder to change to another mode. Two different bit rates and modulations are possible.

The purpose of the ID code is to enable the base station to identify the transponder in order to select the corresponding crypto key for this particular transponder.

Synchronization can be carried out by using terminators or headers. Both are used by the base station for synchronization. Terminators are easy to detect because they are a violation of the modulation pattern.

The TK5560 is capable of using two different terminators. They are referred to as Terminator 1 and Terminator 2. For details on these terminators, please consult the e5560 data sheet.

The options of selecting the terminators are valid for ID mode only. In all other modes, including response mode, Terminator 1 is always used.

For ID mode, the following is valid: If no terminator is selected, the base station needs some other means for synchronization. For this purpose, the header is used. The header – 8 bits long – is a normal piece of code. Unlike the terminators, the header is not a violation of the modulation scheme. The user has to assure that there is only one header in the data stream, otherwise, the base station could lock-on at various points of the data stream, resulting in different read outs.

It is recommended to use terminators rather than headers. First of all, terminators are easier to detect which makes the data transfer more reliable. An additional advantage is that the user underlies no restrictions with regard to the data itself. When using headers, a piece of data may resemble the terminator. This can be avoided by the use of terminators.

Programming ID Blocks

If the transponder type TK5560 is selected in the dialog box “Transponder type”, choosing the menu item “Write Transponder...Program memory” shows the TK5560 program setup dialog box (figure 13).

All memory blocks of the TK5560 can be programmed. The blocks to be programmed are selected by ticking the box in the **write** column.

The data is entered using hexadecimal code (Characters 0...9 and A...F). To replace the default data contents, delete the data using backspace and type in the new data.

Programming of the transponder is performed by the button “Program TK5560”. Programming with automatic read out after programming is carried out by button “Program & Read TK5560”. This is a useful option to verify if programming was successful.

Remark: Programming requires higher field strength than reading. If programming fails, place the transponder closer to the base-station coil and try again.

Programming Crypto Blocks

Blocks 5–8 contain the relevant data for the authentication procedure. In order to demonstrate the encryption, some actions have to be carried out beforehand.

The demo software emulates the AUT64 encryption algorithm. To obtain an identical response, all the data used as input has to be the same. This is known as the crypto key which is the contents of the memory blocks 5–8 and also the challenge (random number).

Assuming the same data is used, both responses should be identical. To ensure that the same data input is used for the algorithm, the key information has to be identical, both in the demonstration program and in the memory of the transponder.

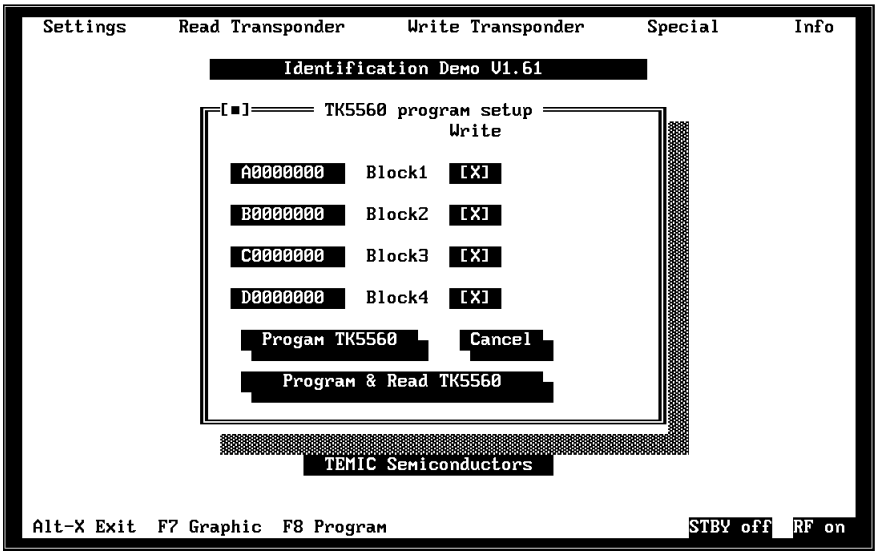

Figure 13. Program ID-blocks TK5560

This can be achieved in two ways:

1. Type in the data content of blocks 5–8 in the dialog box crypto mode (figure 13) and then write the data into the transponder (Program & Start). This dialog box is reached through the menu “Write Transponder...Crypto mode”. Now, the old contents of the transponder have been overwritten by the data that has been typed in the demo software by the user.

2. Read out the data content of the transponder’s memory blocks with direct access mode and type in this data at the data window of the crypto mode and press “Start”. The data will not been programmed in the blocks, but the crypto process is initialized.

Once the memory contents are the same, i.e., the transponder and the demonstration program use the same key, the authentication may proceed.

Lock Crypto Key

During the design of an application it is useful to read out and/or change the crypto keys. For custom use the crypto keys can be locked, which means that the crypto key can not be changed and read out anymore. To lock the crypto keys choose ”Write Tansponder...crypto mode” and enable the ”Lock crypto keys”. Press ”Start”, the crypto key of the TK5560 is now locked.

Warning: As the Lock Crypto Key function is not reversible use this feature with care.

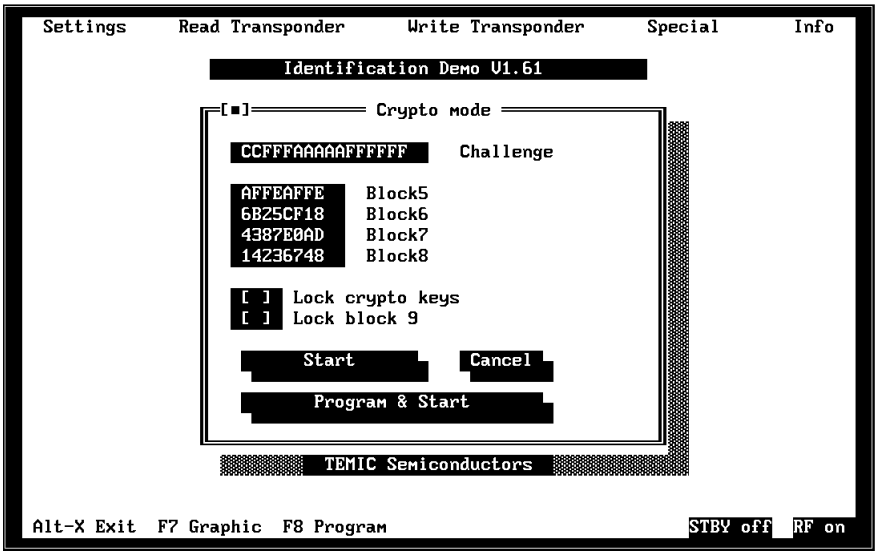

Figure 14. Crypto-mode input box

Password Function of the TK5560

The TK5560 is capable of using a password. To lock the password choose ”Write Transponder...Crypto mode” and enable ”Lock block 9”. The content of block 9 is regarded as password.

Note: The password function has not yet been implemented to the IDS V1.61 A later update version will support the password feature of the TK5560. Block 9 can be read out by direct access if it has not been locked.

Warning: As the Lock Block 9 function is not reversible use this feature with care.

Authentication

To start the authentication procedure, the menu “Write Transpondercode...Crypto mode” has to be activated.

The demo kit can be used to demonstrate the encryption feature of the TK5560 read/write/crypto transponder. The PC-based software provides a user interface that enables the configuration of the transponder. Furthermore, the demo kit acts as a base station and a real challenge/ response authentication procedure can be carried out. The AUT64 encryption algorithm used in the transponder is fully emulated by the software of the demo kit. The algorithm is carried out by hardware in the transponder and by software in the PC. Both results are displayed and authentication is verified or not. The user can change the input parameters and key data of the encryption algorithm and observe the results.

Set Challenge

The challenge is typed in by the user. It is then stored in an ASCII file called challeng.dat. If the program is restarted, the previously used challenge is loaded and displayed in the crypto-mode window. To change the challenge, simply delete the characters and type in the new challenge.

The menu item crypto mode starts the actual authentication procedure. The software reads the ASCII files key.dat and challeng.dat to obtain the initial values of the input for the algorithm. With “Start” or “Program & Start”, the challenge is sent to the transponder. The computation of the valid result is carried out in parallel in the PC and the hardware of the 5560 transponder. During the computation of the response, the transponder sends out the checksum of the challenge. This checksum is also computed by the demo software. Once computation of the response is finished, the transponder transmits the response in a loop, separated by a terminator. The demo kit synchronizes for this terminator and reads the response. Finally, the response and the checksum calculated by the software are compared with the actually received data. If the result for the checksum and for the response is identical, authentication was successful. In this case, the following window (figure 14) is the output.

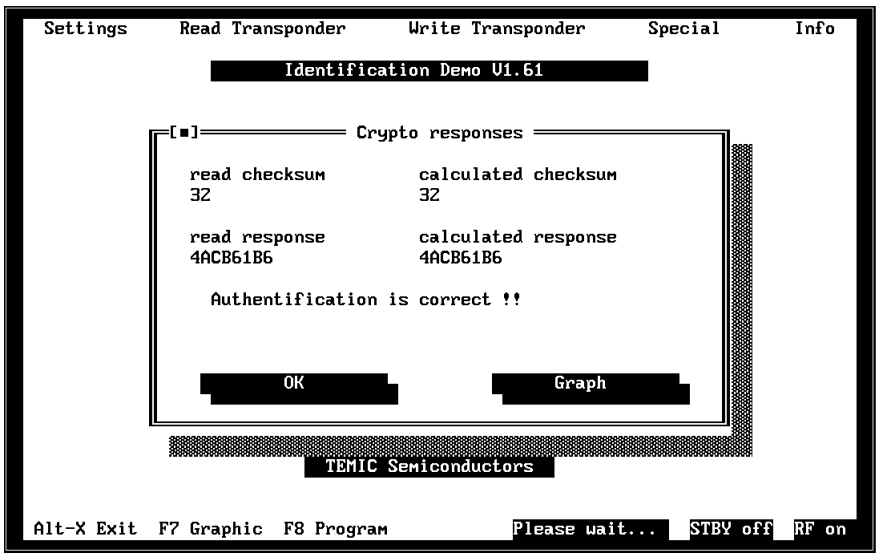

Figure 15. Crypto-mode output box

Errors

The response and the checksum received from the transponder are compared with the response and the checksum calculated by the demo kit software. If one comparison fails, the whole authentication fails. The most common errors are:

- **Transponder interrupts programming or challenge/response procedure** and returns to ID mode. In ID mode, the ID code is sent out in a loop. If the TEMIC terminator is set, the demo kit takes a part of the ID mode as a response. Obviously, this will not be the same as the calculated response and authentication fails. To overcome this error, retry the procedure. If the error continues to occur, check the settings of the transponder (bit rate, modulation type).

- **Different data used** as input for encryption algorithm. If the algorithm was started with the button start, the data in the transponder's memory is not overwritten with the data of the data input window. For the algorithm, the PC uses the data inside the data input window, the transponder uses the data of its memory blocks 5–8. If this data is not the same, authentication fails.

- To make sure the data is the same, use **Program & Start**. Now, the contents of the data input window are written into the memory blocks of the transponder before the algorithm is started. This ensures that the data is identical.

- **Transponder is too far away**. The farther away the transponder is from the field-generating base-station coil, the more likely are data errors in the data stream. The TK5560 has many features to detect errors in the data stream and therefore avoid programming with the wrong data. If such an error is detected, the transponder stops programming and enters ID mode.

- The histogram window in the "show graphics" window provides a good indication about the quality of the received signal. If a good signal is to be achieved, the distribution is narrow, the detected times are close together. If the histogram is spread out wide, the signal is difficult to decode via the base station. If the detected times are outside the limits, decoding is not possible. This is indicated by coloring the usually gray area below the histogram red.

Special Commands

Send Stop

The command “Write Transponder...Send stop” transmits the stop command to the TK5550 and the TK5560. After that the transponder terminates the modulation procedure. A following read command (Read Transponder ...) shows that the transponder does not modulate anymore.

Reset Transponder

The command “Special...Reset transponder” switches off the magnetic field for two seconds. Due to the field interrupt, a power-on reset occurs to the transponder chip. This is necessary in order to return from stop mode to read mode.

RF Field on

Switches on the RF field of the base-station antenna. Control Pin “DATA IN” high.

The status “RF on” on the right side of the bottom line is displayed.

Note: The status ”RF On” is additionally indicated by the yellow LED on the demo board.

RF Field off

Switches off the RF field of the base-station antenna. Control Pin “DATA IN” low.

The status “RF off” on the right side of the bottom line is displayed.

Standby on

Switches the base-station IC U2270B to standby mode (sleep). Control Pin “STANDBY” high.

The status “STBY on” on the right side of the bottom line is displayed.

Standby off

Switches the base-station IC U2270B to operation mode. Control Pin “STANDBY” low.

The status “STBY off” on the right side of the bottom line is displayed.

Tuning

This feature controls the four stage frequency tuning application which is implemented on the base station demo board. The available settings are shown in figure 16. For detailed information see General Description of the U2270B Base–Station Board.

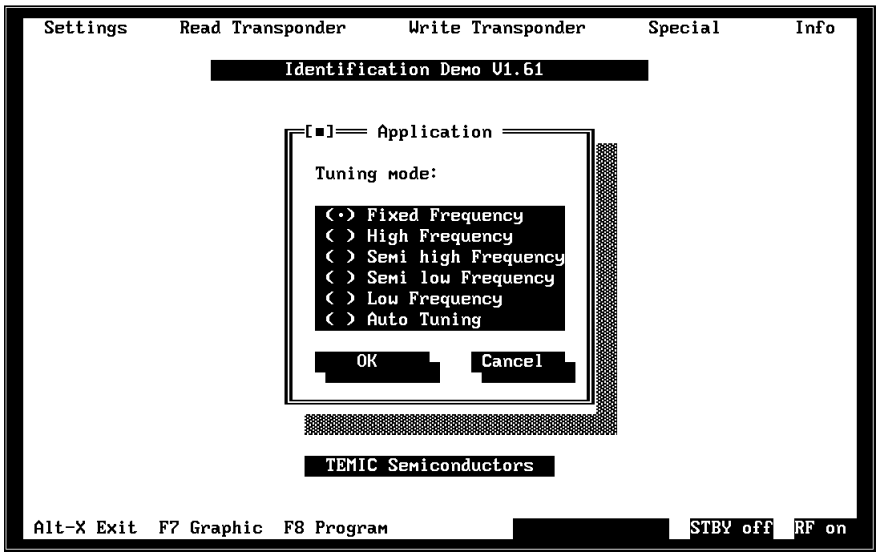

Figure 16. Frequency tuning application