RI-ACC-ADR2 Demo Reader
Reference Manual

WARNING

The LF antenna and antenna connections will be under high voltage while the LF interface is active. Touching adjacent electrical connections may lead to electric shock!

General TI High Voltage Evaluation (TI HV EVM) User Safety Guidelines

Always follow TI's set-up and application instructions, including use of all interface components within their recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and those working around you. Contact TI's Product Information Center http://support/ti./com for further information.

Save all warnings and instructions for future reference.

Failure to follow warnings and instructions may result in personal injury, property damage or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. It is intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise and knowledge of electrical safety risks in development and application of high voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments. If you are not suitable qualified, you should immediately stop from further use of the HV EVM.

1. Work Area Safety:

    a. Keep work area clean and orderly.
    b. Qualified observer(s) must be present anytime circuits are energized.
    c. Effective barriers and signage must be present in the area where the TI HV EVM and its interface electronics are energized; indicating operation of accessible high voltages may be present, for the purpose of protecting inadvertent access.
    d. All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding 50Vrms/75VDC must be electrically located within a protected Emergency Power Off EPO protected power strip.
    e. Use stable and non-conductive work surface.
    f. Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

2. Electrical safety:

As a precautionary measure, it is always a good engineering practice to assume that the entire EVM may have fully accessible and active high voltages.

    a. De-energize the TI HV EVM and all its inputs, outputs and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM power has been safely de-energized.
    b. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
    c. Once EVM readiness is complete, energize the EVM as intended.

WARNING: WHILE THE EVM IS ENERGIZED, NEVER TOUCH THE EVM OR ITS ELECTRICAL CIRCUITS AS THEY COULD BE AT HIGH VOLTAGES CAPABLE OF CAUSING ELECTRICAL SHOCK HAZARD.

3. Personal Safety
4.

    a. Wear personal protective equipment e.g. latex gloves or safety glasses with side shields or protect EVM in an adequate lucent plastic box with interlocks from accidental touch.

Limitation for safe use:

EVMs are not to be used as all or part of a production unit.

TI HV EVM Safety Instruction, 19.09.2011

Important Note

The user is required to carefully read and understand the regularities described in chapter 10 prior to usage of this evaluation kit!

WARNING

Do not leave evaluation modules powered up while unattended

1 About this Manual

The AES Demo Software can be used to execute the main features of TI's AES and 80-bit transponders along with a TI Demo Reader, such as the RI-ACC-ADR2. Resonant trimming, transponder communication and passive entry communication can be evaluated – depending on what reader is used. The Demo Software synchronizes settings with the device configuration to achieve valid data communication and response analyzing. Some devices only offer partial functionality (e.g. smaller memory or trimming only). This is not considered in the demo software and needs to be managed by the user.

This manual describes the functionality of the AES Demo Software and serves also as manual for the RI-ACC-ADR2 evaluation module, though other readers can be used with this software. Each description presents a specific function in a general sense. Not all features and functions may be supported on all devices.
The user should consult the device-specific data sheet for these details.

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4 Definitions

Base Station	Communication partner able to communicate by the use LF telegrams with a transponder
Immobilizer Mode	Short range LF communication between base station and transponder running without battery support on transponder side
Downlink	LF communication from Base Station to transponder OR USB communication from PC to Base Station
Charge Phase	LF energy transfer from the Base Station to the transponder; energy is stored in the charge capacitor for the uplink phase
Uplink, Response	LF communication from the transponder to the base station OR USB communication from Base Station to PC
RKE	Remote Keyless Entry: UHF communication from the key fob to the vehicle initiated by a push button press
PEPS	Passive Entry/ Passive Start: The Base Station sends a LF telegram which requests a UHF response from the Key Fob
DST80	Wedge-transponder with TI 80-bit-encryption module
DSTAES	Wedge- or Block-transponder with 128-bit-encryption module
DST	Digital Signature Transponder
RAIDAES	Remote Access Identification Device with AES used in PEPS-applications
CRAIDAES	RAIDAES with additional embedded microcontroller
CRAID	Remote Access Identification Device with DST80 used in PEPS-applications with additional embedded microcontroller

5 Installation

5.1 Hardware Installation of RI-ACC-ADR2-10 Demo Reader

1. Connect the external USB Interface Board to the two designated sockets on the bottom-left side of the Base Station board. Make sure to connect the device in correct orientation (the Texas Instruments logo of the boards should point in the same direction – see picture below).
2. Connect the Loop Antenna to the corresponding connectors in the top-right corner of the Base Station Board, labelled 1 to 6.
3. Connect the USB Interface Board to a PC using the Mini-USB Cable.
4. (Optional) Apply an additional power source to the power-connector of the Base Station (see below) to achieve an increased transmission range and/or drive a bigger antenna.

External Power Supply Requirements

Nom Voltage	Max Current	Efficiency Level
7 - 15 V_{DC}	600 mA	V

External Power Supply Regulatory Compliance Certifications: Recommend selection and use of an external a power supply which meets TI's required minimum electrical ratings in addition to complying with applicable regional product regulatory/safety certification requirements such as (by example) UL, CSA, VDE, CCC, PSE, etc.

5.2 Software Installation

1. Go to the product page of the ADR2 Demo Reader: http://www.ti.com/tool/ri-acc-adr2-10
2. Download the RFID Demo Software ("Tools & Software")
3. Extract the ZIP-file contents into a folder and execute the RFID Demo Software executable – no installation required.
4. To use DST80 functionality, no activation code is required. Just leave the textbox blank and click *OK*. To enable AES related functionality a corresponding activation key is needed – please ask your RFID related TI contact person.
5. After connecting the reader the first time, installation of the COM port driver may be required. This can be done by clicking on the corresponding button on the *COM Port* setting tab page

6 RI-ACC-ADR2 Schematics

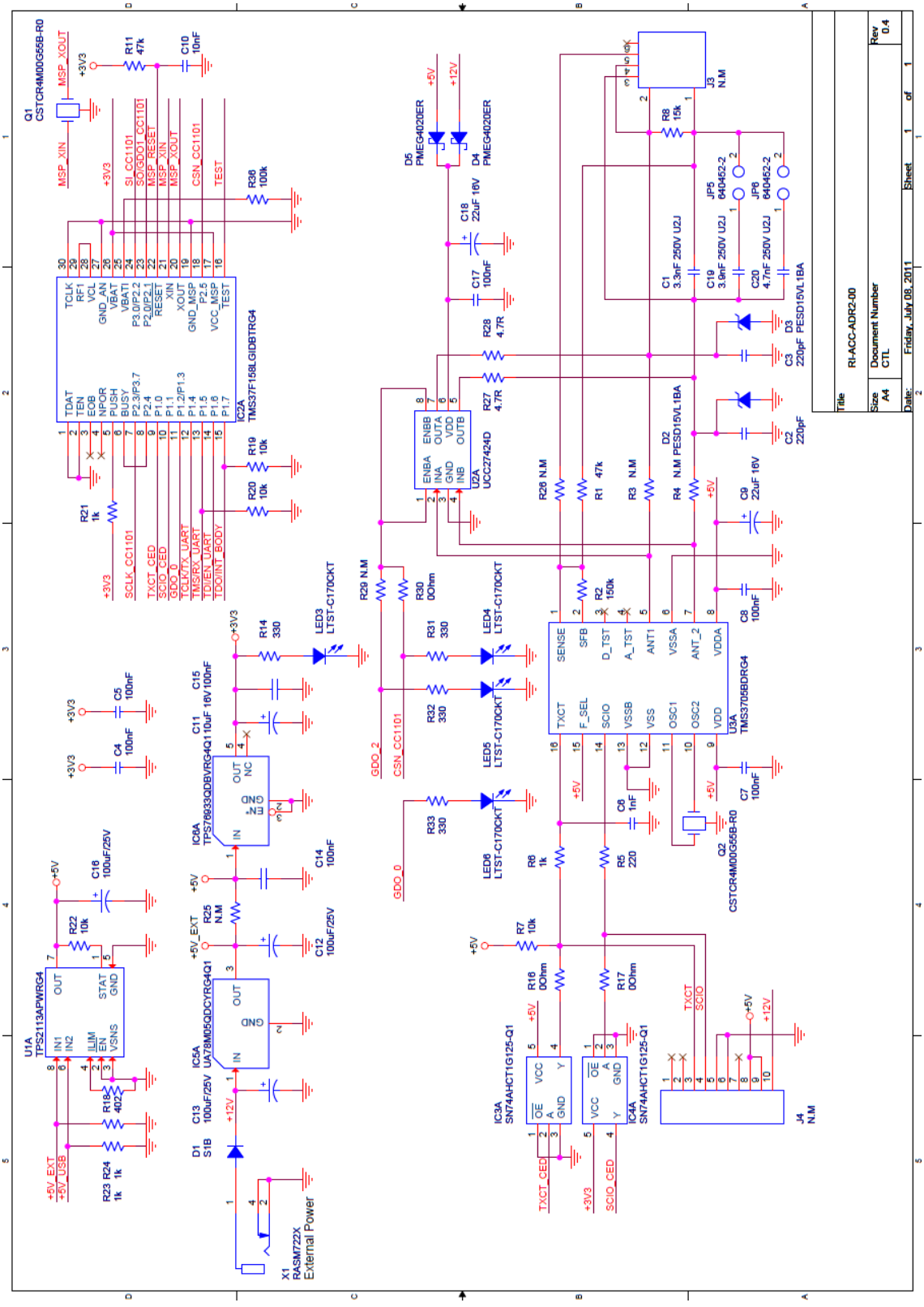


Figure 1: Base Station Schematics

7 COM Ports

7.1 Initial Reader Search

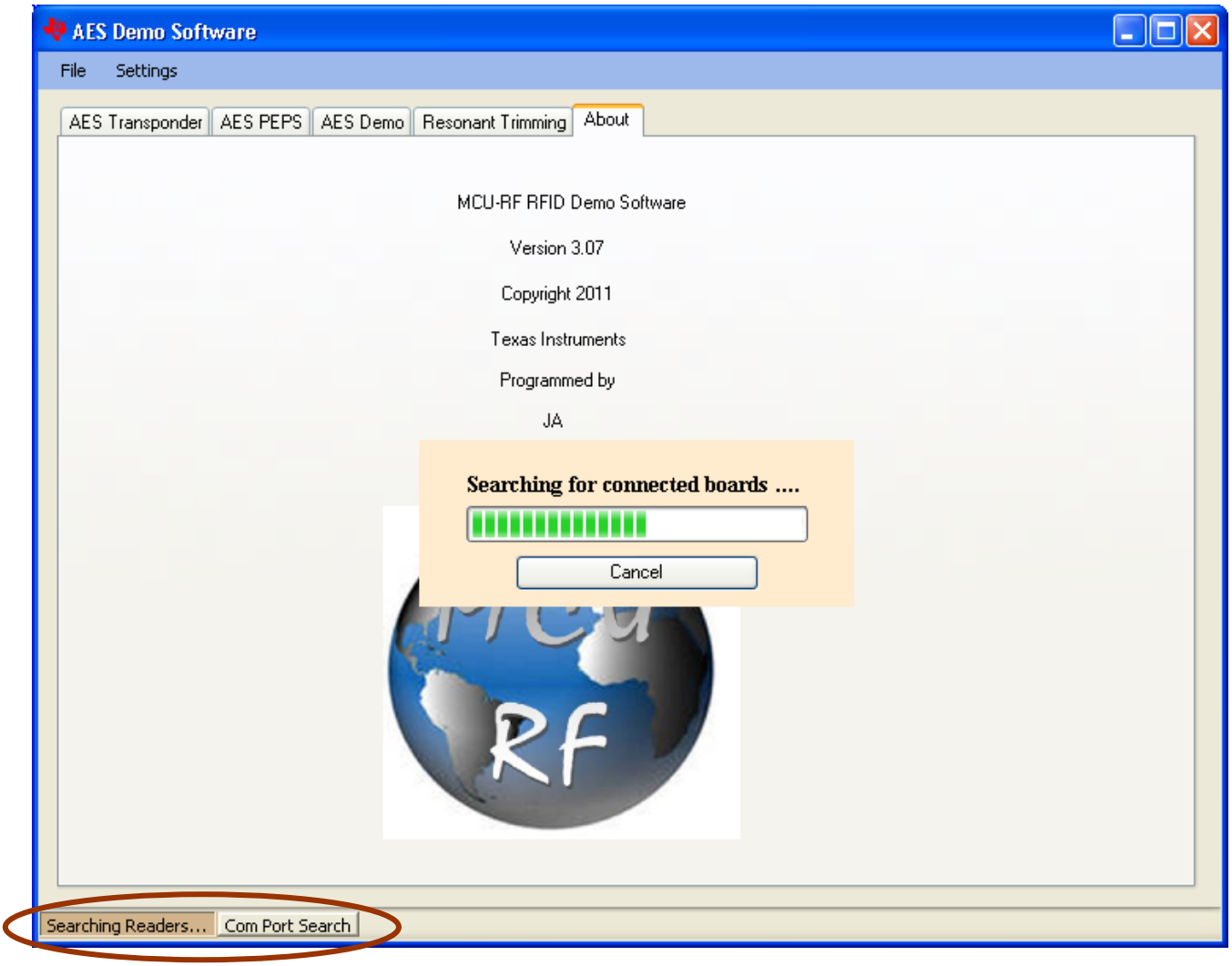


Figure 2: COM Port Search

After start-up of the AES Demo Software an automatic search for attached demo readers and probe test boxes is initiated.
The tool supports the simultaneous use of up to two Demo readers and one Probe Test box.

After completion of the COM port search up to three found devices are displayed in the status line:

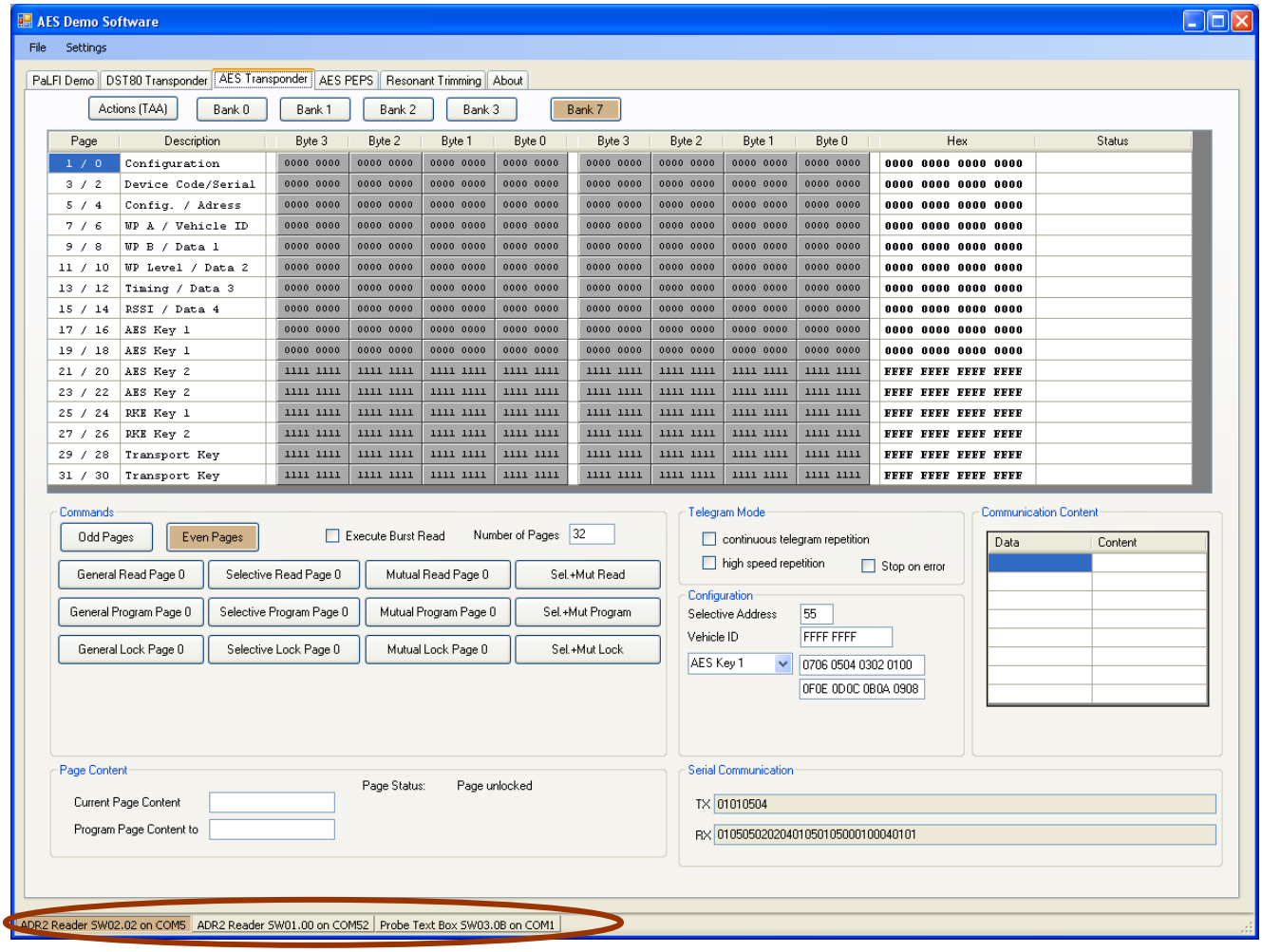


Figure 3: Connected Hardware Tools

The highlighted button indicates the currently used COM port for communication. Each attached device is automatically initialized with the communication parameters valid for the currently used tab.

A click on the desired reader in the status bar will select this reader and timings are transferred to this reader immediately.
The software will only communicate with the selected reader.

7.2 Repeat Automatic Device Search

In some cases it might be desirable to repeat the Automatic Device Search. For example when a device is connected which supports no auto-detection (e.g. Probe Test Box) while the software is already running.

In that case, a click on the *COM Port Search* button in the status bar will induce another COM Port search.

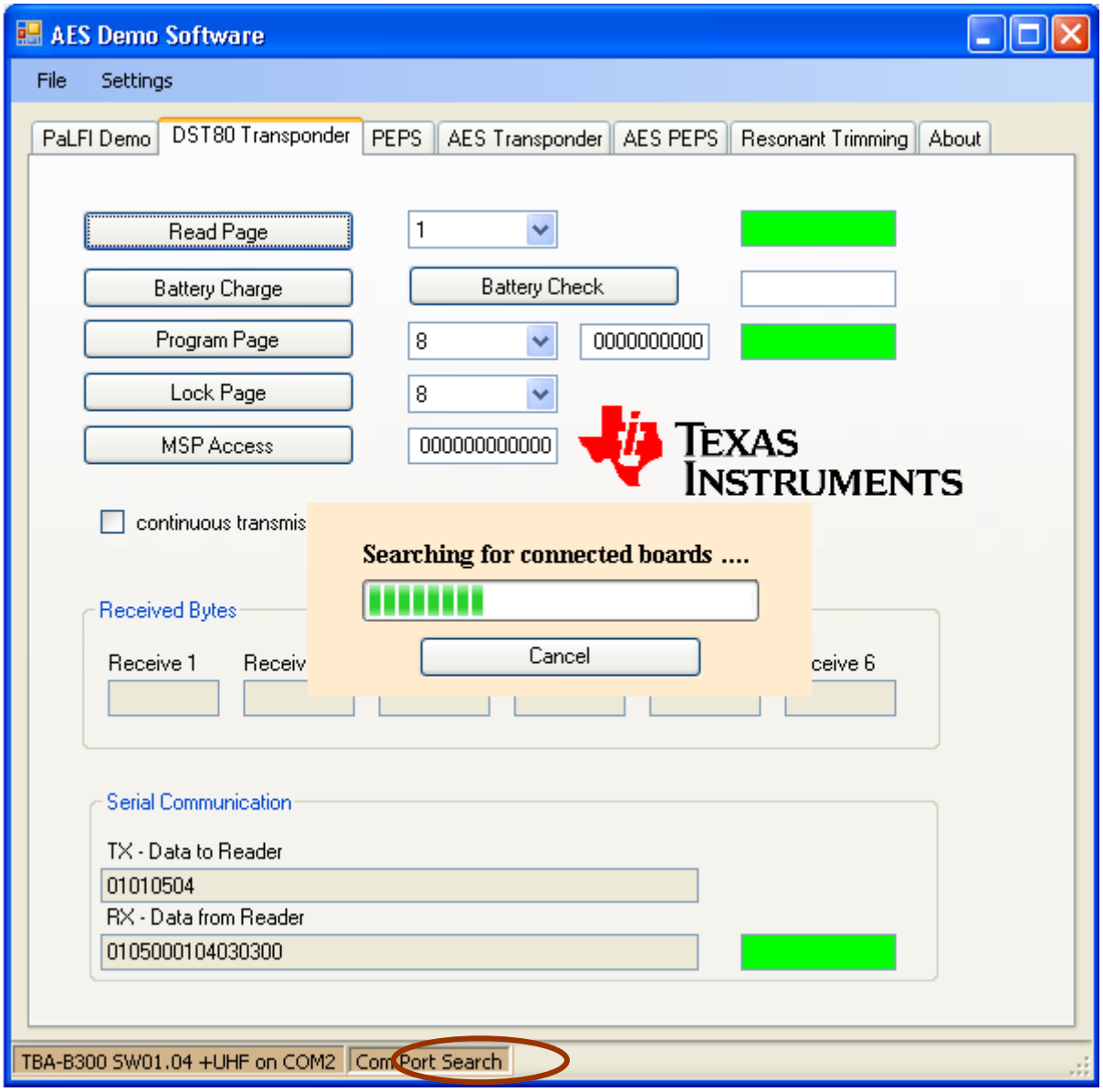


Figure 4: New Automatic Device Search

Note:

If the Automatic COM Port Search is deactivated (see section Manual COM-Port Connection) it will get reactivated by executing an Automatic COM Port Search.

7.3 Manual COM Port Connection

If problems with the Automatic COM Port Search are experienced, or for other reasons a manual selection of the COM Port is desired, the Automatic COM Port Search can be deactivated and the desired COM port can be chosen manually.

To do so following steps are required:

1. Activate the *Settings* tabs by clicking on *Settings*
2. Select the *COM Port* tab page
3. Uncheck *Automatic Search* checkbox
4. Select the COM Port which the device is connected to
5. To deactivate the *Settings* tabs and return to the last used tab click *Finished*

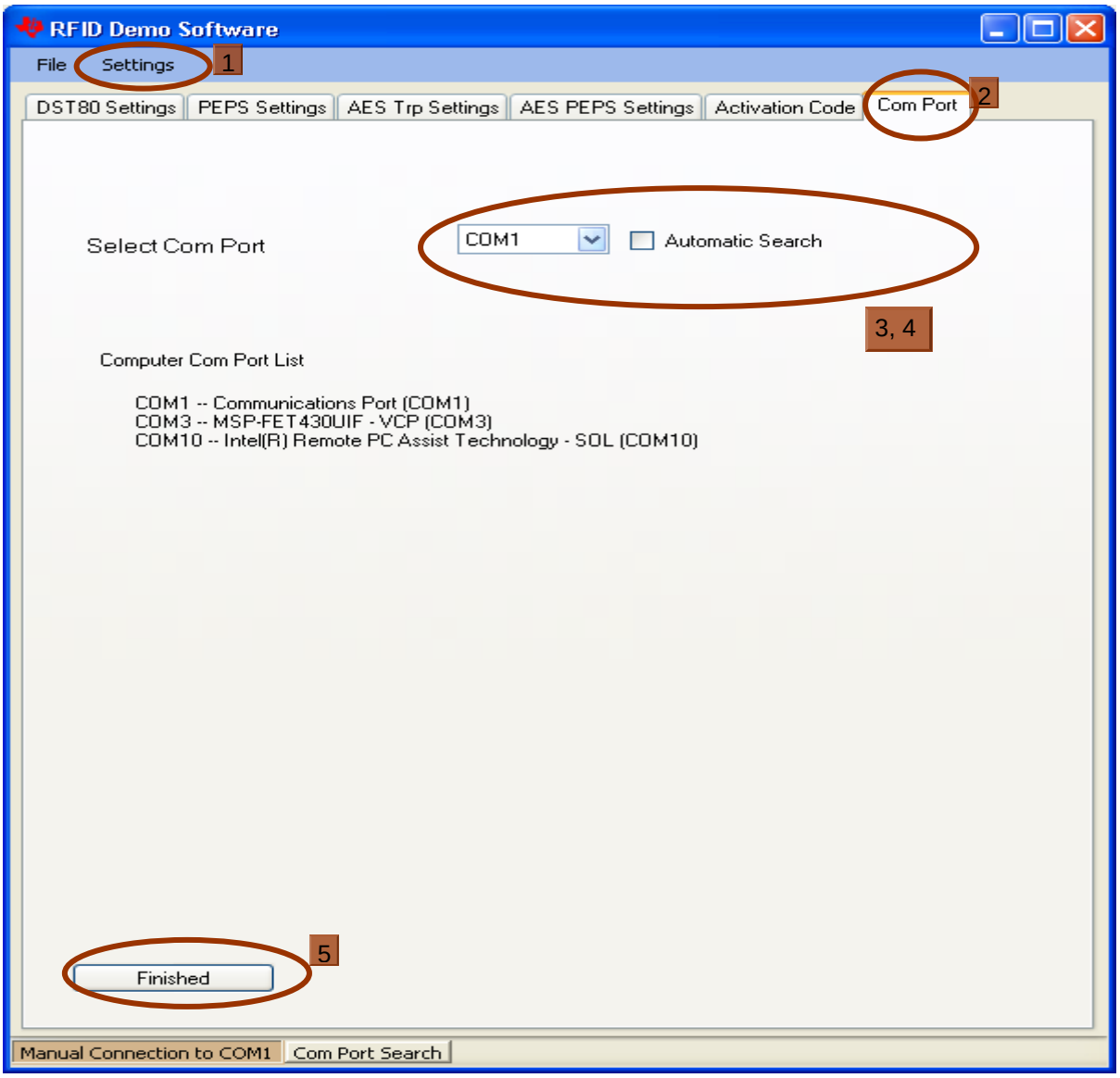


Figure 5: Toggle Manual Selection / Automatic Search of COM Port

8 Software Functionality

8.1 Settings

To configure bit timings, burst durations, COM port connections and more the *Settings* tab page can be used. To access this tab page click on *Settings* as shown below:

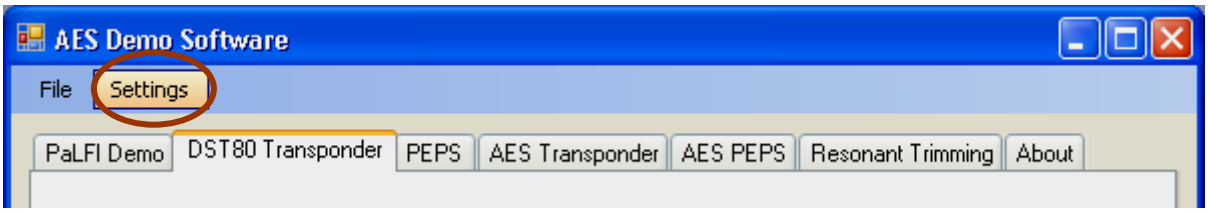


Figure 6: Access Settings Menu

On *Settings* tab pages there are usually two buttons *Transfer Settings* and *Finished*.

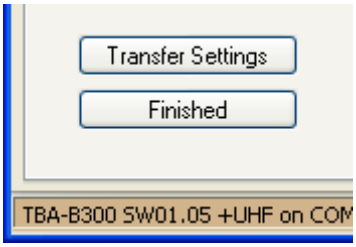


Figure 7: *Transfer Settings* and *Finished*

Transfer Settings transfers the currently displayed settings to the selected reader or the selected COM port but stays on the *Settings* tab page.

Finished transfers the settings exactly like the *Transfer Settings* button but additionally switches to the (non-settings) tab page previously used.

8.2 Resonant Trimming

The AES Demo Software supports Resonant Trimming for DST and AES transponders through the Test Interface.

Requirements:

- Probe Test Box
  OR
- TBA-B300

To execute the resonant trimming procedure, following steps are required:

1. Ensure a Demo Reader is correctly recognized by the software (see bottom left corner)
2. Select tab “Resonant Trimming”
3. Select the device type to be trimmed in the *Device Selection* combo box
4. Click on Automatic Trim All

This executes a PC controlled Automatic Trimming action. This is actually a sequence of *Direct Trimming* and *Get Frequency* actions. For details on the used protocol and telegram examples, please refer to section 9.8.4.

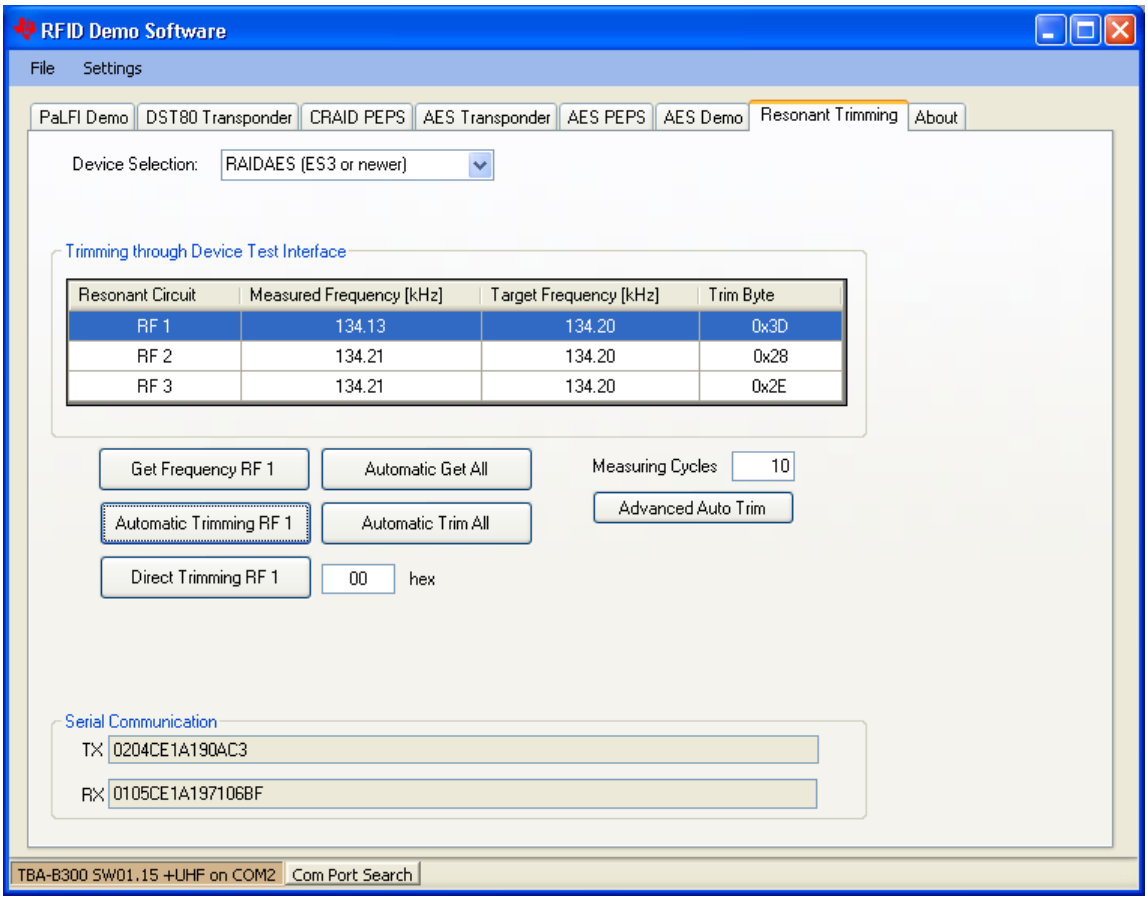


Figure 8: Resonant Frequency Trimming

The Demo Software will show the trimmed frequency in the field “Measured Frequency”. In case the resonant frequency cannot get trimmed to the target frequency a notice will be displayed providing further instructions.

8.2.1 Resonant Trimming (Reader controlled)

It's also possible to perform a reader controlled automatic trimming of all channels.

Requirements:

- TBA-B300

1. Select tab "Resonant Trimming"
2. Select the device to be trimmed in the *Device Selection* combo box
3. Click on Advanced Automatic Trimming button
4. Wait until results are shown in the table above. The orange LED3 on the Base Station indicates trimming activity.

8.3 Passive Entry, Passive Start with a CRAID (TMS37128)

For a unidirectional PEPS communication, which means the Base Station will send a LF Wake Pattern without expecting a response, following requirements apply:

Requirements (unidirectional PEPS):
- ADR2 demo reader **OR** TBA-B300
- CRAID demo key fob

For a complete (bidirectional) PEPS communication, which means the Base Station will send a LF Wake Pattern and can receive the UHF response of the responding key fob, following requirements apply:

Requirements (bidirectional PEPS):
- TBA-B300 with connected UHF- Module
- CRAID demo key fob

To perform a PEPS command some preparation is required if the CRAID EEPROM is not yet configured:
1. Connect the CRAID and the Base Station via the Test Interface
2. Activate the *CRAID PEPS* tab
3. Check the Configure CRAID EEPROM checkbox
4. Choose a configuration or just load the default values (by clicking on *Get AFE Defaults*)
5. Transmit settings by clicking on *Set AFE Configuration*. On success, the background of the button will become green. The *Configure CRAID EEPROM* checkbox may be unchecked again to view the RSSI measurement diagram.
6. Disconnect the device from Test Interface

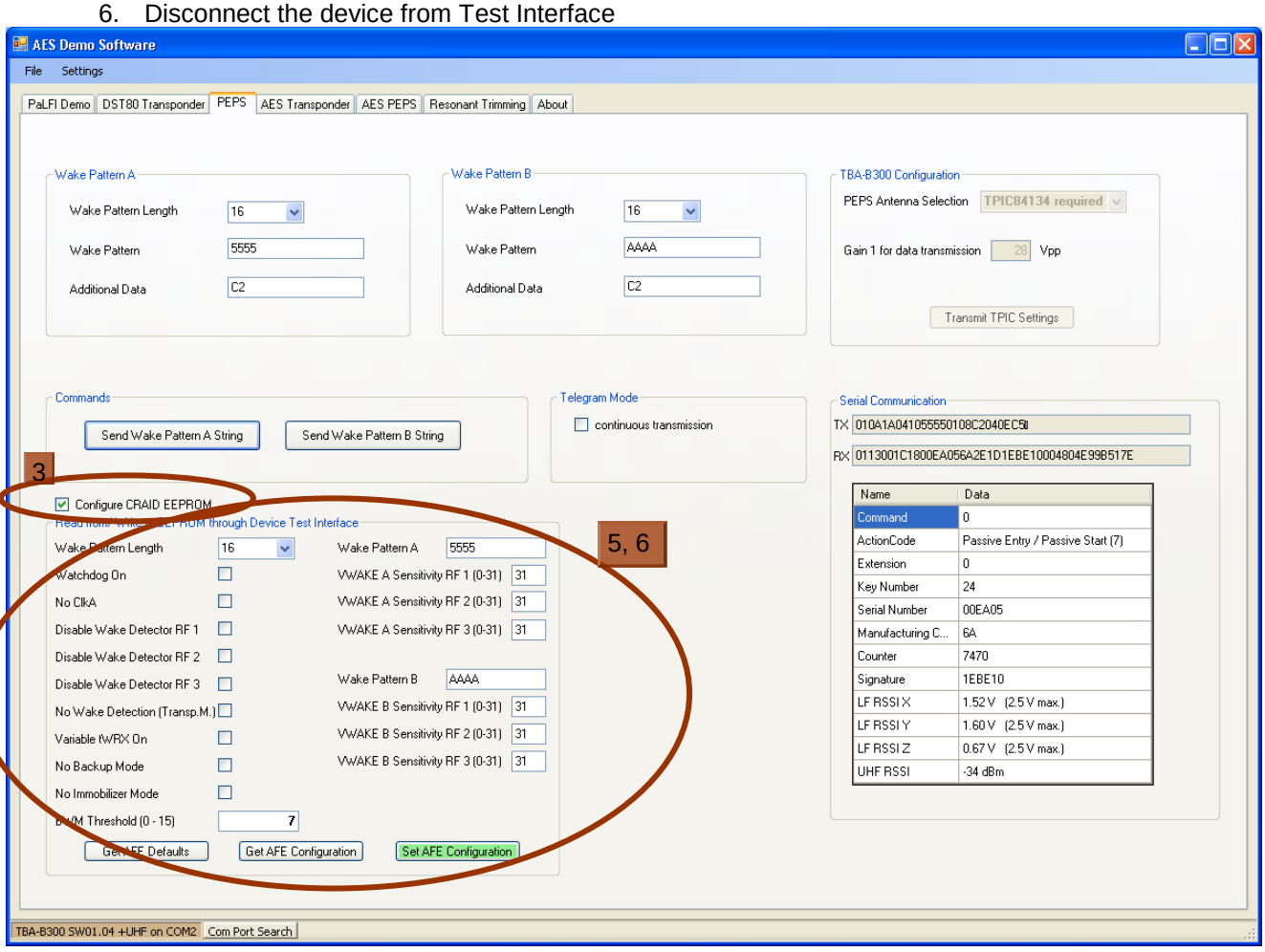
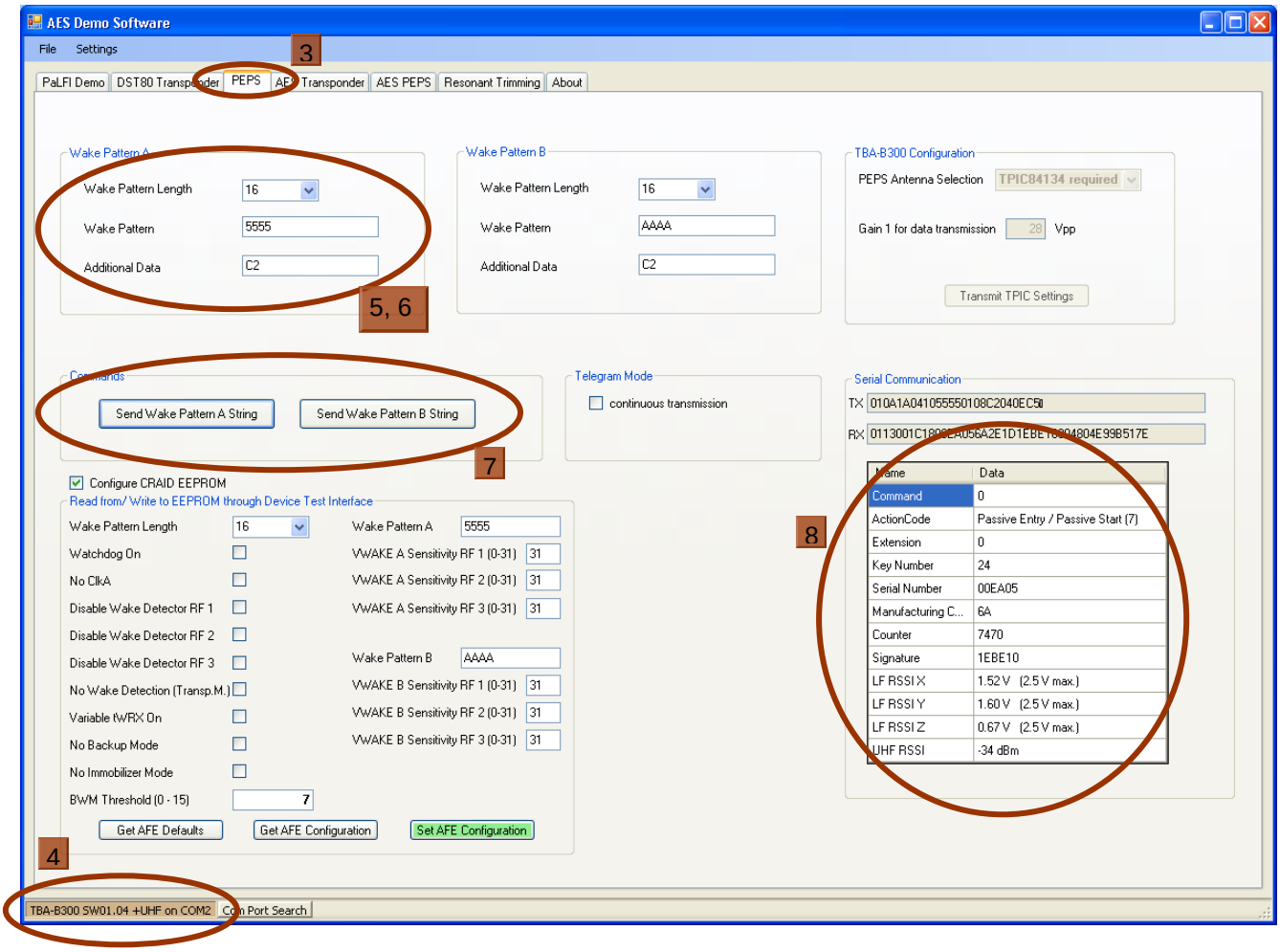


Figure 9: Configure CRAID EEPROM

With the configured EEPROM of the CRAID device it is now possible to execute the PEPS command.

1. Power up the CRAID (e.g. insert 3V Coin Cell)
2. Place the CRAID demo board somewhere in range of the stick antennas LF field but not too close to the UHF Module of the Base Station to prevent oversaturation.
3. Select the PEPS tab in the software.
4. Ensure the correct reader is selected – preferably with UHF Module to receive a response
5. Adjust *Wake Pattern Length* and *Wake Pattern* according to the configuration on the CRAID EEPROM (by configuring the EEPROM the correct values were already entered in the corresponding boxes)
6. Eventually add an Additional Data string. Sending “C2” will cause the demo key fob to measure the LF RSSI.
7. To execute the action click on *Send Wake Pattern String*
8. If a UHF response is obtained the content will be displayed
9. *Optional:* If a diagram of the RSSI result of the last 20 received responses is desired, uncheck the *Configure CRAID EEPROM* checkbox.



If problems with the LF RSSI measurement occur though “C2” is sent as *Additional Data*, consider configuration of *RSSI Burst Time* in the *PEPS Settings* tab page (*Settings* menu). During this power burst at the end of the LF transmission the RSSI value is measured.

8.4 Immobilizer Read Page (DST80)

To read a page of a DST80 transponder or related devices, like the RAID / CRAID, follow those instructions:

1. If not done yet, power up the board, connect it to the PC, start the software and place the Transponder / LF- Antenna in the LF field of the readers Immobilizer Loop Antenna.
2. Activate the *DST80 Transponder* tab
3. Choose the page which should be read
4. Click on *Read Page*
5. After a successful read *CRC correct* should be displayed along with green highlighting
6. The data read out from the page will be displayed in the *Received Bytes* section

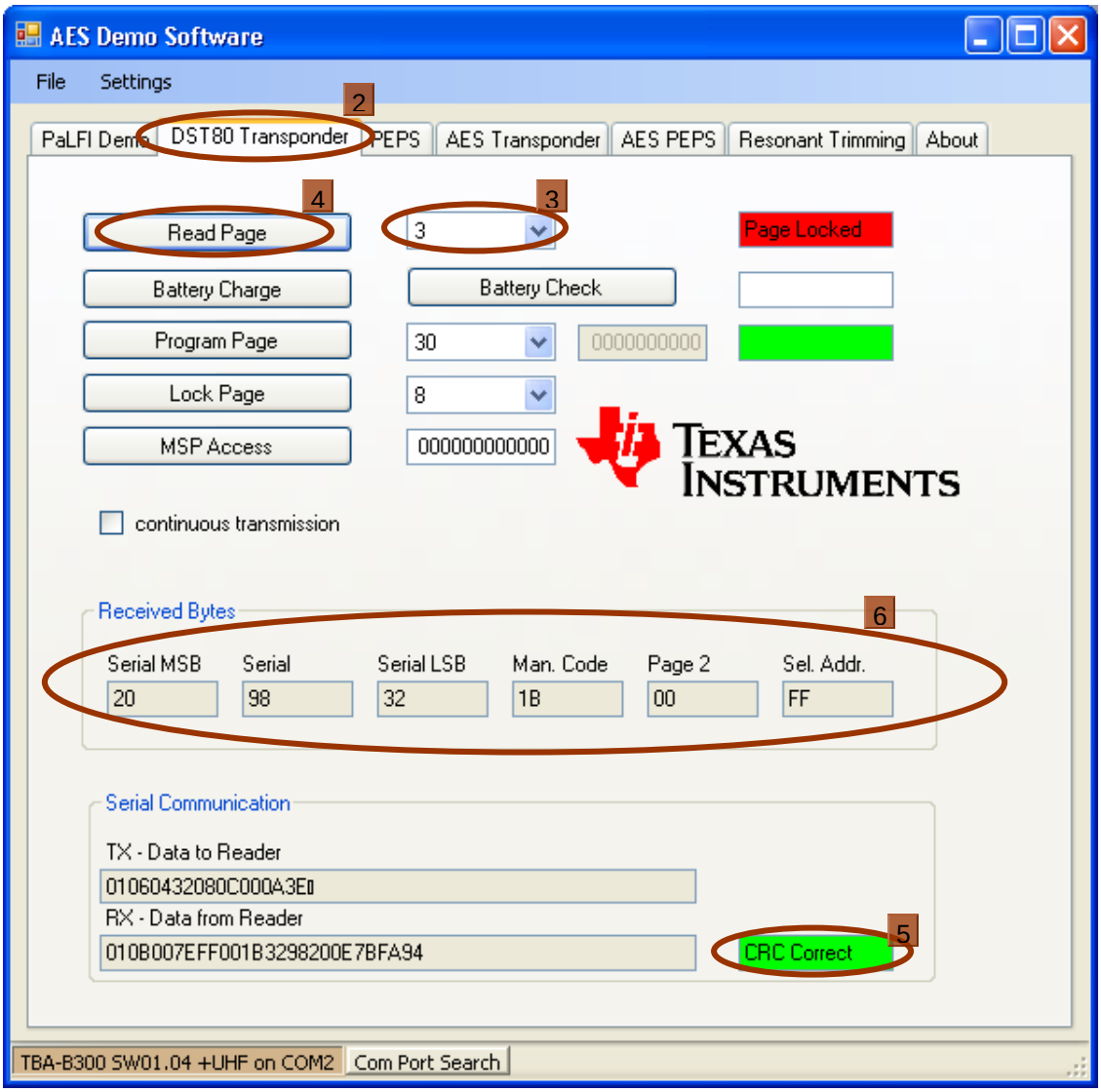


Figure 10: Transponder: Read Page (DST80)

8.4.1 DST80 Transponder Immobilizer Timing Settings

When in doubt, use default timing settings and pulse width modulation bit coding (PWM).

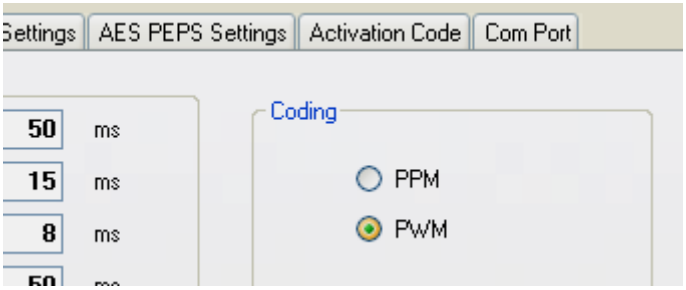


Figure 11: Coding Configuration (DST80)

8.4.2 Example: Read Page 3 Telegram (DST80)

By clicking on *Read Page 3* the software sends via *Serial Communication* following telegram based on the protocol described in 9.4:
" 0106043208 0C 000A AC". This data is assembled as follows:

Serial Communication Protocol

Start	Length	Cmd	PB1	No. TX bits	TX bits	PB2	No. RX bytes	BCC
01	06	04	32	08	0C	00	0A	AC

Byte	Abbreviation	Content	Example Value	Explanation
1	Start	Start Mark	01	
2	Length	Length	06	6 Byte transmission are following, excluding BCC
3	Cmd	Command	04	Cf. section 9.7
4	PB1	Data – Power Burst 1	32	50 ms Power Burst
5	No. TX bits	Data – Number of Transmit Bits	08	8 Bit to transmit to transponder
6	TX bits	Data – Transmit Bits	0C	see following table
7	PB2	Data – Power Burst 2	00	No second Power Burst
8	No. RX bytes	Data – Number of Receive Bytes	0A	10 Byte response expected from transponder
9	BCC	Block Check Character	AC	Cf. section 9.4

LF Transmit Bits	hex	0C		
1. Page 2. Command	hex	0C	0000 1100	
		Page	0000 11	Page 3
		Command	00	Read

8.4.3 Example: Read Page 8 Response (DST80)

As response following telegram is received based on the protocol described in 9.5: “010B007E00123456789020 EE2407”

Serial Communication Protocol

Start	Length	Cmd	TX bits	BCC
01	0B	007E	00123456789020 EE24	07

Byte	Abbreviation	Content	Example Value	Explanation
1	Start	Start Mark	01	
2	Length	Length	0B	11 Byte are following, excluding BCC
3,4	Cmd	Command	007E	Transponder response
5 to 13	TX bits	LF transponder response	001234567890 20 EE24	See following table
14	BCC	Block Check Character	07	Cf. section 9.4

LF Uplink Data	hex	00123456789020 EE24		
3. Page 2	hex	00		
4. Page 8 content	hex	1234567890 (Byte 0, Byte 1, Byte 2, Byte 3)		
5. Read Address 6. Read Address Extension	hex	20	0010 0000	
		Page	0010 00	Page 8
		Page locked	0	General access
		Programming	0	No Programming
7. CRC check sum	hex	EE24		

8.5 Immobilizer Program Page (DST80)

To program a page of a DST80 transponder or a RAID / CRAID device, follow these instructions:

1. If not done yet, power up the board, connect it to the PC, start the software and place the transponders LF- Antenna in the LF field of the readers Immobilizer Loop Antenna.
2. Activate the *DST80 Transponder* tab
3. *Hint:* Read the page which shall be programmed first. This will help to find out if the page is maybe locked for write access. The lock-status will be displayed after a successful *Read page* command
4. Choose the page which shall be programmed
5. Enter the data which shall be programmed Programming configuration pages may differ from programming pages containing user defined data. Examples: Page 3 can't be programmed; Page 2 has partial write access; Page 30 has a configuration mask
6. Click on Program Page
7. The transponder answers with a *Read Page* command of the programmed page.

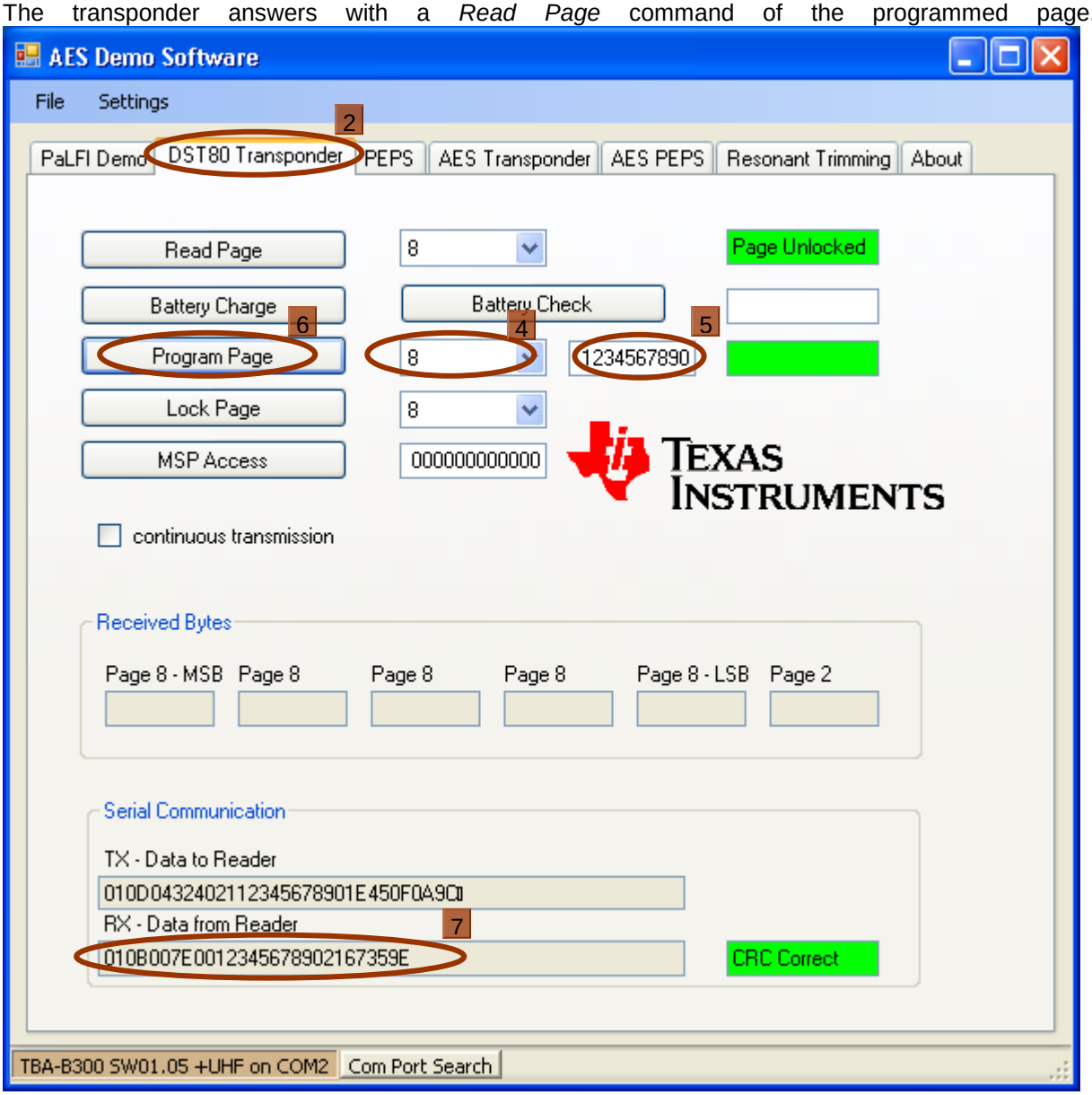


Figure 12: Example: Program Page 8 (DST80)

8.5.1 Example: Program Page 8 Telegram (DST80)

By clicking on *Program Page (*Page *8* selected) the software sends via *Serial Communication* following telegram based on the protocol described in 9.4: ” 010D043240211234567890 1E450F0A9C”. This data is assembled as follows:

Serial Communication Protocol

Start	Length	Cmd	PB1	No. TX bits	TX bits	PB2	No. RX bytes	BCC
01	0D	04	32	40	21 1234567890 1E45	0F	0A	9C

Byte	Abbreviation	Content	Example Value	Explanation
1	Start	Start Mark	01	
2	Length	Length	0D	6 Byte transmission are following, excluding BCC
3	Cmd	Command	04	Cf. section 9.7
4	PB1	Data – Power Burst 1	32	50 ms Power Burst
5	No. TX bits	Data – Number of Transmit Bits	40	8 Byte to transmit to transponder
6 - 13	TX bits	Data – Transmit Bits	21 12345 67890 1E45	see following table
14	PB2	Data – Power Burst 2	0F	No second Power Burst
15	No. RX bytes	Data – Number of Receive Bytes	0A	10 Byte response expected from transponder
16	BCC	Block Check Character	9C	Cf. section 9.4

LF Transmit Bits	hex	211234567890 1E45		
8. Page 9. Command	hex	21	0010 0001	
		Page	0010 00	Page 8
		Command	01	Program
10. Page Content	hex	1234567890		
11. CRC check sum	hex	1E45		

Response will be similar to a *Read Page* response (cf. 8.4.3)

8.6 Immobilizer Lock Page (DST80)

To lock a page of a DST80 transponder, follow these instructions:

1. Activate the *DST80 Transponder* tab
2. Choose the page to lock
3. Click on *Lock Page*
4. The transponder answers with a *Read Page* answer of the locked page viewable in the *RX – Data from Reader* textbox (5a). Additionally the new *Page Lock Status* which is *Paged Locked* after a successful lock command is executed will be displayed in the top right corner (5b).

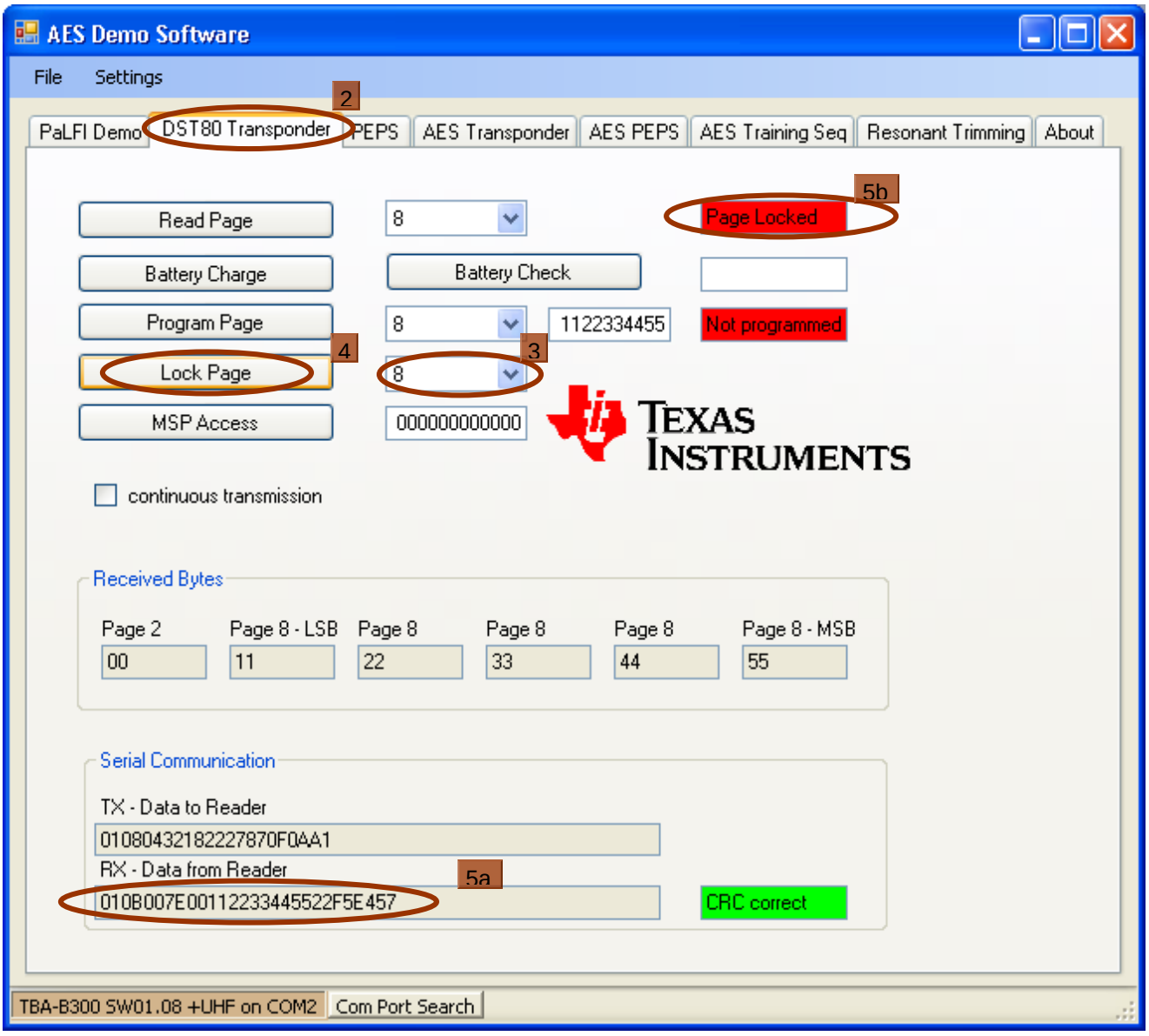


Figure 13: Example: Lock Page 8 (DST80)

8.6.1 Example: Lock Page 8 Telegram (DST80)

By clicking on *Lock Page* the software sends via *Serial Communication* following telegram based on the protocol described in 9.4:
" 0108043218222787 0F0AA1". This data is assembled as follows:

Serial Communication Protocol

Start	Length	Cmd	PB1	No. TX bits	TX bits	PB2	No. RX bytes	BCC
01	08	04	32	18	222787	0F	0A	A1

Byte	Abbreviation	Content	Example Value	Explanation
1	Start	Start Mark	01	
2	Length	Length	08	6 Byte transmission are following, excluding BCC
3	Cmd	Command	04	Cf. section 9.7
4	PB1	Data – Power Burst 1	32	50 ms Power Burst
5	No. TX bits	Data – Number of Transmit Bits	18	3 Byte to transmit to transponder
6, 7, 8	TX bits	Data – Transmit Bits	222787	see following table
9	PB2	Data – Power Burst 2	0F	No second Power Burst
10	No. RX bytes	Data – Number of Receive Bytes	0A	10 Byte response expected from transponder
11	BCC	Block Check Character	A1	Cf. section 9.4

LF Transmit Bits	hex	222787		
12. Page 13. Command	hex	22	0010 0010	
		Page	0010 00	Page 8
		Command	10	Lock
14. CRC check sum	hex	2787		

Response will be similar to a *Read Page* response (cf. 8.4.3)

8.7 Using the TPIC84134 Antenna Extension Board

Requirements:

- TBA-B300 Base Station
- TPIC84134 Antenna Extension Board

To use the antenna extension board following steps are required:

1. Ensure the TPIC84134 is detected correctly by the reader and that both are detected by the Demo Software. This is indicated by the "+TPIC" addition after the reader name in the status bar.

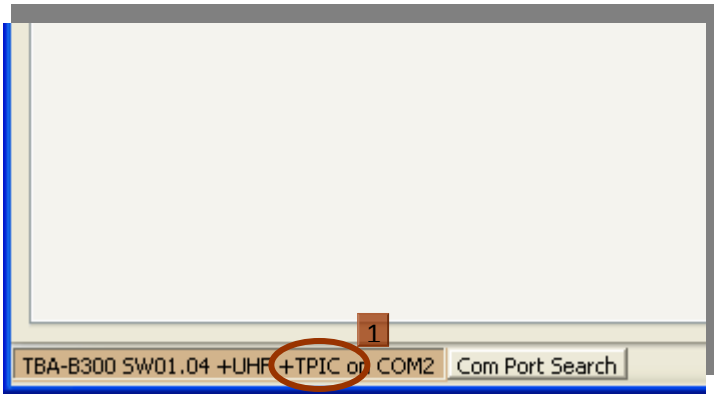


Figure 14: TPIC connection

2. Activate the *PEPS* or *AES PEPS* tab dependant on which device should be used for PEPS communication (for details of PEPS communication refer to **8.3** for DST80 devices or to Error! Reference source not found. for AES devices)
3. Choose the output on which the antenna is connected which should be used. **J1, J2 and J3** are the three standard TBA-B300 antenna outputs. Usually connected to J1 is the Immobilizer Antenna, to J2 the Stick Antenna while J3 remains unused. The **TPIC outputs** in the dropdown box are numbered accordingly to the output numbering on the board. By picking a single TPIC Output *Half Bridge Mode* will be activated, which is normal operation. If two TPIC outputs are selected *Full Bridge Mode* is activated. This means the outputs are sending the LF- transmission with a 180 degree phase shift on the second output. Wired correctly to an antenna this means twice the peak-to-peak voltage.
By picking **Default Antenna** the Base Station is configured for behaviour as though the TPIC would not have been connected. This means J2 is used for PEPS and J1 is used for Immobilizer.
4. Choose the desired peak-to-peak voltage (Vpp) on a single output

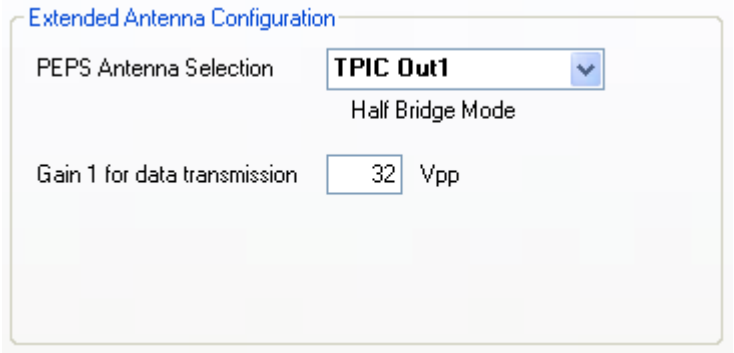


Figure 15: Antenna Extension Configuration

5. Execute a PEPS command as described in corresponding sections.

9 Serial Communication Protocol Description

9.1 RS232 / USB settings

The RI-ACC-ADR2-00 reader is designed for engineering purposes.
The data communication is performed via USB port but shows up as serial COM port on the PC side. The transmission parameters are 8 data bits, 1 stop bit, no parity and a speed of 9600 baud.
No hardware or software handshake is used. The protocol data consists only of the following ASCII characters '0','1', …,'9', 'A',…,'F'.

The data communication between the PC and the reader is performed within a frame structure.

9.2 Setup Protocol

To setup or request parameter, the following *Setup* protocol has to be sent from the PC to the reader. This sets up the reader configuration.

Start	Length	Cmd	Param1		Param N	BCC

Block	Abbreviation	Content
1	Start	Start Mark
2	Length	Length (following number of bytes without BCC)
3	Cmd	Command
4 .. N	Para	Parameter
N+1	BCC	Block Check Character

Command ASCII	Description	N	Parameter	Parameter format
'01'	Read PWM timings	8	ToffH, TonH, ToffL, TonL	2 byte for each in us
'03'	Write PWM timings	8	ToffH, TonH, ToffL, TonL	2 byte for each in us
'05'	Read Version Information	4	SW_major, SW_minor, HW_major, HW_minor	1 byte for each
'07'	Set Mode Control bytes	2	MCW1, MCW2	1 byte for each
'11'	Read PPM timings	8	Toff, TonH, TonSC, TonL	2 byte for each in us
'13'	Write PPM timings	8	Toff, TonH, TonSC, TonL	2 byte for each in us
'17'	Write BLC timings part I	12	T_{SOF_ON}, T_{SOF_OFF}, T_{LOW_ON}, T_{LOW_OFF}, T_{HIGH_ON}, T_{HIGH_OFF}	2 byte for each in us
'1B'	Write BLC timings part II	10	T_{EOF_ON}, T_{EOF_OFF}, T_{WAKE_ON}, T_{WAKE_OFF}, PEPS_Pattern, Immo_Pattern	2 byte for each in us
'19'	Read BLC timings part I	12	T_{SOF_ON}, T_{SOF_OFF}, T_{LOW_ON}, T_{LOW_OFF}, T_{HIGH_ON}, T_{HIGH_OFF}	2 byte for each in us
'1D'	Read BLC timings part II	10	T_{EOF_ON}, T_{EOF_OFF}, T_{WAKE_ON}, T_{WAKE_OFF}, PEPS_Pattern, Immo_Pattern	2 byte for each in us
'31'	Read Power Burst timings	14	Charge, Programtime 64bit, Programtime 128bit, Encryption time, Mutual Authentication Time, MCU Access Time (Supported only by TBA-B300 for AES Pairing Demo Mode).	2 byte for each, charge: 4 byte in ms
'33'	Write Power Burst timings	14		

9.3 Setup Response Protocol

Setup information from the Reader to the PC is transmitted using following *Setup Response* protocol.

Start	Length	Cmd	Param 1		Param N	BCC

Block	Abbreviation	Content
1	Start	Start Mark
2	Length	Length (following number of bytes without BCC)
3	Cmd	Command
4 .. N	Param	Setup Parameter
N+1	BCC	Block Check Character

9.3.1 Setup Protocol Examples

9.3.1.1 “Get Version Information”

Request:

Block	ASCII	Hex	Content	Description
1	‘01’	30,31	Start Mark	Start of Protocol Frame
2	‘01’	30,31	Length	1 byte follow excluding BCC
3	‘05’	30,35	Command	Read Version Information
4	‘04’	30,34	Block Check Character	BCC over previous blocks excluding Start Mark

Response:

Block	ASCII	Hex	Content	Description
1	‘01’	30,31	Start Mark	Start of Protocol Frame
2	‘05’	30,35	Length	5 bytes follow excluding BCC
3	‘00’	30,30	Command	Normal mode: 00hex
4	‘02’	30,32	Data	Software Version major
5	‘03’	30,33	Data	Software Version minor
6	‘04’	30,34	Data	Hardware Version major
7	‘02’	30,32	Data	Hardware Version minor
8	‘02’	30,32	Block Check Character	BCC over previous blocks excluding Start Mark

9.4 Common Immobilizer Downlink Protocol

To initiate an action, following *Request* protocol has to be sent from the PC to the reader.

Start	Length	Cmd	PB1	No. TX bits	TX bits	PB2	No. RX bytes	BCC

Block	Abbreviation	Content
1	Start	Start Mark
2	Length	Length
3	Cmd	Command
4	PB1	Data - Power Burst 1
5	No. TX bits	Data - Number of Transmit Bits
4 .. N	TX bits	Data - Transmit Bits
N+1	PB2	Data - Power Burst 2
N+2	No. RX bytes	Data - Number of Receive Bytes
N+3	BCC	Block Check Character

Start Mark
The *Start Mark* identifies the beginning of the Request protocol. It is represented by the ASCII characters '01'.

Length
The *Length* indicates the number of the following Command and Data bytes (Power Burst 1, Number of Transmit Bits, Transmit Bits, Power Burst 2 and Number of Receive Bytes).

Command
The *Command* defines the mode in which the controller operates.
For definition of the command bytes see section 9.7.

Data – Power Burst 1
The *Data – Power Burst 1* parameter specifies the duration of the transponder charge burst in milliseconds.

Data – Number TX Bits
The *Data – Number TX Bits* parameter specifies the amount of bits to be transferred to the transponder.

Data – Transmit Bits
The *Data – Transmit Bits* contains the information to be transferred to the transponder.

Data – Power Burst 2
The *Data – Power Burst 2* parameter specifies the duration of the transponder program or encrypt burst in milliseconds.

Data – Number RX Bytes
The *Data - Number RX Bytes* parameter specifies the expected amount of bytes responded by a transponder.

Block Check Character
See section 9.6 for details.

9.5 Common Immobilizer Response Protocol

Data information from the Reader to the PC is transmitted using following *Response* protocol.

Start	Length	Cmd	RX bytes	BCC

Block	Abbreviation	Content
1	Start	Start Mark
2	Length	Length
3	Cmd	Command
4 .. N	RX bytes	Data - Receive Bytes
N+1	BCC	Block Check Character

Start Mark
The *Start Mark* identifies the beginning of the Response protocol. It is represented by the ASCII characters '01'.

Length
The *Length* indicates the number of the following Command and Data blocks.

Command
The *Command* defines the mode in which the controller operates.
For definition of the command bytes see section 9.7.

Data – Receive Bytes
The *Data –Receive Bytes* consists of the data information transferred by a transponder beginning with the transponder Start Byte.

BCC
See section 9.6 for details.

9.6 Block Check Character

The data integrity of the serial communication protocols is secured by the provided Block Check Character (BCC). The *BCC* is the one-block value of the Longitudinal Redundancy Check calculation (Xor'ed blocks) of the preceding blocks. The BCC is calculated over all bytes of the incoming and outgoing data excluding the start byte. The BCC is always the last byte of the outgoing or incoming data. The user can calculate the BCC over the received data and compare it with the received BCC for error detection.

The sample code below shows a calculation routine for the Block Check Character which is calculated by the use of a Longitudinal Redundancy Check (LRC). It returns the BCC as a byte value.

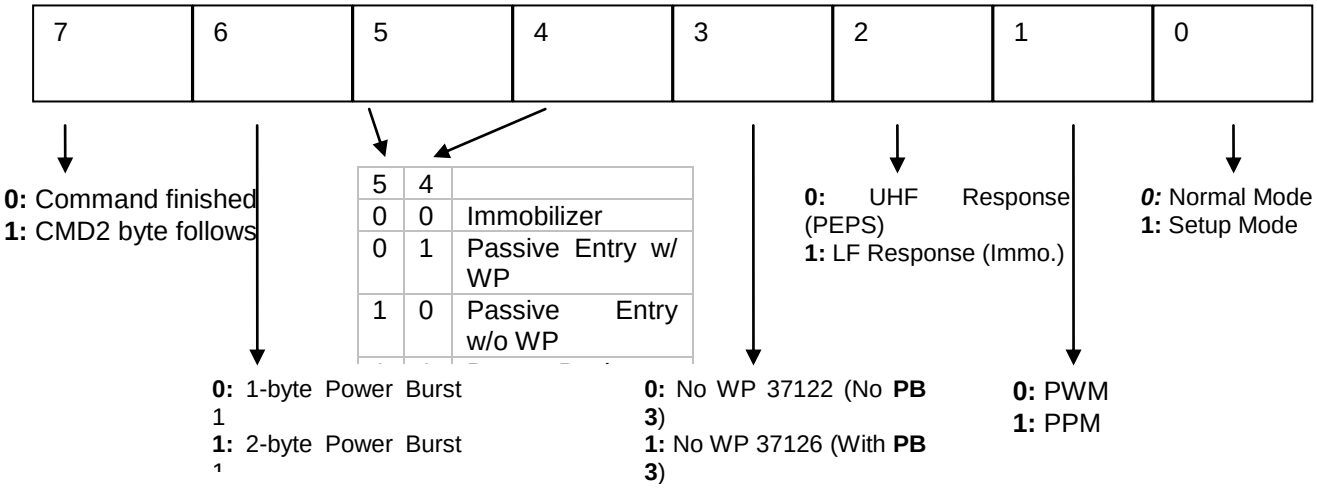
```
public byte LRC_calc(byte[] bytes, int length)
{
int lrc;

lrc = bytes[0];
for (int i = 1; i < length; i++)
{
        lrc = lrc ^ bytes[i];
}
return (byte)(lrc);
}
```

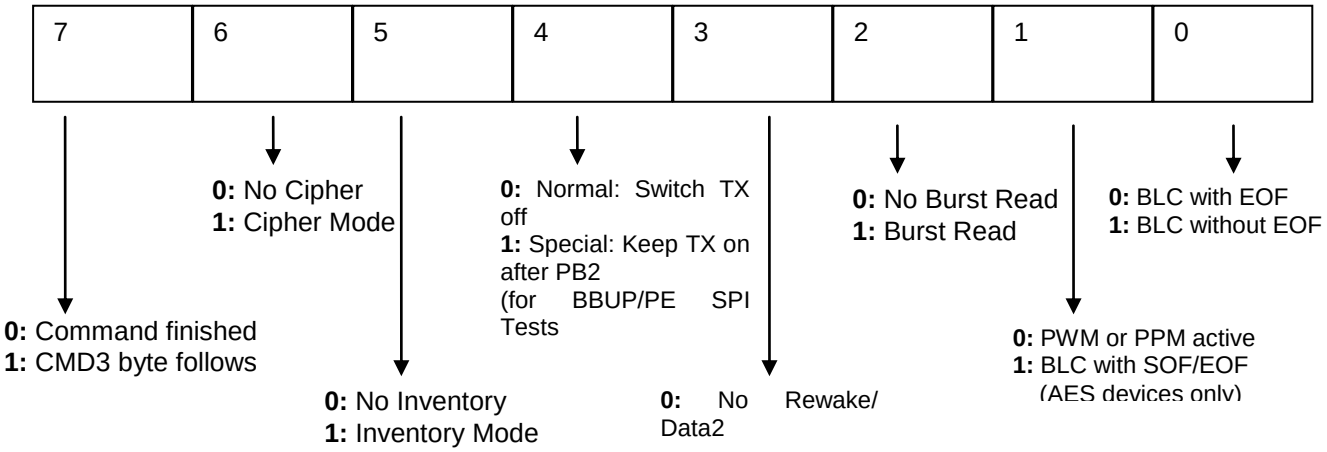
9.7 Command Byte Definition

Every Serial Communication Protocol uses command bytes, which are defined as follows:

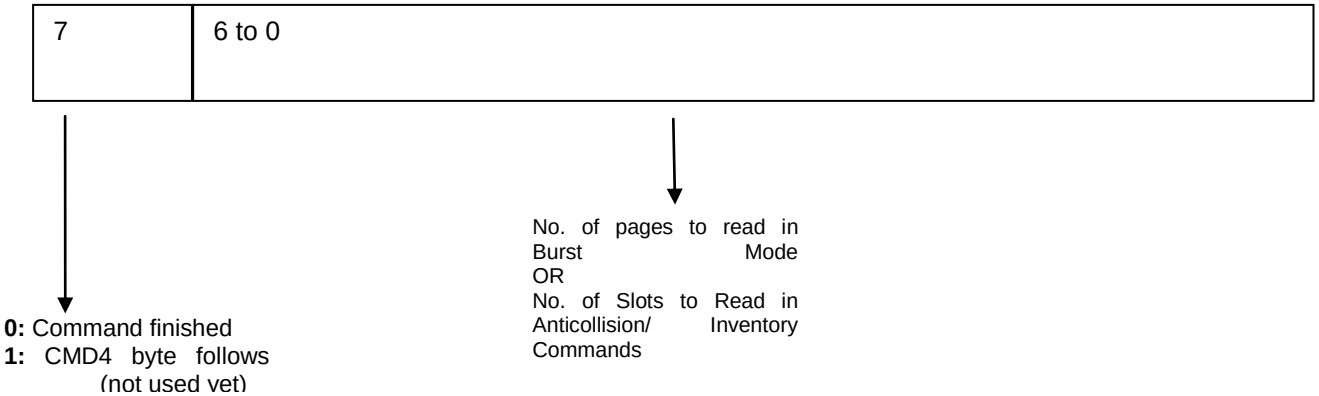
1st Byte CMD



2nd Byte CMD2



3rd Byte CMD3



9.8 Specific Protocols

9.8.1 CRAID PEPS Downlink Protocol

Start	Len	Cmd	Wake_Dur	Wake_Len	Wake_Pat	
	DD_Burst	TX_Data	Data	Final_Burst	RX_Bytes	BCC

Abbreviation	Content	Example	Explanation
Start	Start	01	Start of Telegram
Len	Length	0A	Following Bytes in Telegram (in Byte excluding BCC)
Cmd	Command	1A	Cf. section 9.7
Wake_Dur	Wake Burst Duration	04	4 ms Wake Burst
Wake_Len	Wake Pattern Length	10	Bit Count of WP. (Hex! Here 16 Bits)
Wake_Pat	Wake Pattern	5555	
DD_Burst	Data Delay Burst	01	1 ms Burst between Wake Pattern and Data
TX_Data	Amount of Data (TX)	08	8 Bits of Data following
Data	Transmitted Data	C2	Data to transmit If C2 is transmitted as Data, the CRAID will measure the 3D-LF RSSI and include it in its response
Final_Burst	Add Power Burst	04	4 ms Burst after Data to measure the LF RSSI
RX_Bytes	Number Rx Bytes	00	No LF response expected
BCC	Block Check Char	C1	BCC over Message

9.8.2 CRAID PEPS Response / RKE Protocol

Start	Len	PID	Status	Key #	Serial #	ManuC	
	Counter	Signature	LF RSSI	UHF RSSI	BCC		

Abbreviation	Content	Example	Explanation
Start	Start	01	Start of Telegram
Len	Length	10	Following Bytes in Telegram (in Byte excluding BCC)
PID	Protocol Identifier	00	RKE Protocol ID: 00h
Status	Status Byte	11	Bit7: Extension Bit Bit6- Bit2: Action Code Bit1- Bit0: Reader Command
Key #	Key Number	11	
Serial #	Serial Number	69E517	
ManuC	Manufacturer Code	94	

Counter	16 Bit Counter	1162	
Signature	24 Bit Signature	9D482B	
LF RSSI	3D- LF RSSI Data	6F4937	Byte2: X-Axis LF- RSSI in range from 00h to FFh Byte1: Y-Axis LF- RSSI in range from 00h to FFh Byte0: Z-Axis LF- RSSI in range from 00h to FFh
UHF RSSI	UHF RSSI Data	69	RSSI value of UHF transmission
BCC	Block Check Char	1A	BCC over Message

9.8.3 DST80 Immobilizer Downlink Protocol

Start	Len	Cmd	Wake_Dur	TX_Data	Page	

	Burst	RX_Bytes	BCC

Abbreviation	Content	Example	Explanation
Start	Start	01	Start of Telegram
Len	Length	06	Following Bytes in Telegram (in Byte excluding BCC)
Cmd	Command	04	Cf. section 9.7
Wake_Dur	Wake Burst Duration	A0	160 ms Wake Burst
TX_Data	Amount of Data (TX)	08	8 Bits of Data following
Page	Page Select	0C	Page index to read from Transponder Page 1: 04 Page 2: 08 Page 3: 0C etc.
Burst	Data Delay Burst	00	No Burst before transmitting data
RX_Bytes	Number Rx Bytes	0A	Amount of Bytes demanded as response
BCC	Block Check Char	AC	BCC over Message

9.8.4 Resonant Trimming Protocols

The used protocol depends on the chosen device. There are following device types available:

1. *RAIDAES (ES3 and newer)*
   An AES device of the ES3 chip generation or newer (e.g. CRAIDAES)
2. *RAIDAES (ES2 and older)*
   An AES device of the ES2 chip generation or older.
3. *Others*
   Any other (non-AES) device (e.g. CRAID).

9.8.4.1 Get Frequency Protocol (non-AES)

Start	Len	Device	Channel	Password	Plucks & LQ	

	Cycles	BCC

Abbreviation	Content	Example	Explanation
Start	Probe Test Start	02	The startbyte is dependant on the Reader which is used: *Probe Test Box:* Startbyte: 01 *TBA-B300:* Startbyte: 02
Len	Length	05	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	7E	
Channel	Channel ID	18	0x18: Measure RF1 0x28: Measure RF2 0x38: Measure RF3
Password	Password	5A	Password to unlock Probe Test Mode
Plucks & LQ	Number of Plucks and L & Q Info	A1	Bit7-Bit4: Num Plucks\ Bit3-Bit0: L & Q Info
Cycles	Number of Cycles	0A	Number of measure clock cycles per pluck
BCC	Block Check Character	92	BCC over Message

9.8.4.2 Get Frequency Response Protocol (non-AES)

Start	Len	Device	Channel	Freq LSB	Freq MSB	BCC

Abbreviation	Content	Example	Explanation
Start	Start mark	01	
Len	Length	04	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	7E	
Channel	Channel ID	18	0x18: Channel RF1 0x28: Channel RF2 0x38: Channel RF3

Freq LSB	LSB of frequency value	70	In this example: Measured value: 0670h = 1648d Frequency= 10^7 / (measured value * 45.2112) = 134.21 kHz
Freq MSB	MSB of frequency value	06	
BCC	Block Check Character	92	BCC over Message

9.8.4.3 Direct Trimming Protocol (non-AES)

Start	Len	Device	Channel	Password	Trim Byte	BCC

Abbreviation	Content	Example	Explanation
Start	Probe Test Start	02	The startbyte is dependant on the Reader which is used: *Probe Test Box:* Startbyte: 01 *TBA-B300:* Startbyte: 02
Len	Length	04	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	7E	
Channel	Channel ID	14	0x14: Trim Byte RF1 0x24: Trim Byte RF2 0x34: Trim Byte RF3
Password	Password	5A	Password to unlock Probe Test Mode
Trim Byte	Trimming value which will be programmed to the Capacitive Trimming Array	3C	Value between 00h and 7Fh which determines the capacitance of the resonant capacitor
BCC	Block Check Character	08	BCC over Message

9.8.4.4 Direct Trimming Response Protocol (non-AES)

Start	Len	Device	Channel	BCC

Abbreviation	Content	Example	Explanation
Start	Start mark	01	Start of Telegram
Len	Length	02	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	7E	
Channel	Channel ID	14	0x14: Trim Byte RF1 0x24: Trim Byte RF2 0x34: Trim Byte RF3
BCC	Block Check Character	68	BCC over Message

9.8.4.5 Get Frequency Protocol (AES)

Start	Len	Device	Mode	Channel	Plucks & Cycles	BCC

Abbreviation	Content	Example	Explanation
Start	Probe Test Start	02	Start of Telegram
Len	Length	04	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	CE	
Mode	Mode Byte	1A	Mode: Measure Frequency
Channel	Channel ID	11	**ES3 or newer:** 0x19: Measure RF1 0x1A: Measure RF2 0x1B: Measure RF3 **ES2 or older:** 0x11: Measure RF1 0x12: Measure RF2 0x13: Measure RF3
Plucks & Cycles	Number of Plucks and Cycles	0A	Bit7-Bit4: Plucks Bit3-Bit0: Cycles
BCC	Block Check Char	92	BCC over Message

9.8.4.6 Get Frequency Response Protocol (AES)

Start	Len	Device	Mode	Channel	Freq LSB	Freq MSB	BCC

Abbreviation	Content	Example	Explanation
Start	Start mark	01	
Len	Length	05	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	CE	
Mode	Mode Byte	1A	Mode: Measure Frequency

Channel	Channel ID	18	0x18: Channel RF1 0x28: Channel RF2 0x38: Channel RF3
Freq LSB	LSB of frequency value	70	In this example: Measured value: 0670h = 1648d Frequency= 10^7 / (measured value * 45.2112) = 134.21 kHz
Freq MSB	MSB of frequency value	06	
BCC	Block Check Character	92	BCC over Message

9.8.4.7 Direct Trimming Protocol (AES)

Start	Len	Device	Mode	Channel	Trim Byte	BCC

Abbreviation	Content	Example	Explanation
Start	Probe Test Start	02	The startbyte is dependant on the Reader which is used: *Probe Test Box:* Startbyte: 01 *TBA-B300:* Startbyte: 02
Len	Length	04	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	CE	
Mode	Mode Byte	0D	Mode: Program Trim Byte
Channel	Channel ID	01	0x01: Program RF1 0x02: Program RF2 0x04: Program RF3
Trim Byte	Trim Byte	3F	Value between 00h and 7Fh which determines the capacitance of the resonant capacitor
BCC	Block Check Char	C3	BCC over Message

9.8.4.8 Direct Trimming Response Protocol (AES)

Start	Len	Device	Mode	Channel	BCC

Abbreviation	Content	Example	Explanation
Start	Start mark	01	
Len	Length	03	Following Bytes in Telegram (in Byte excluding BCC)
Device	Device ID	CE	
Mode	Mode Byte	0D	Mode: Program Trim Byte
Channel	Channel ID	01	0x01: Program RF1 0x02: Program RF2 0x04: Program RF3
BCC		C3	BCC over Message

9.9 UHF Passive Entry/ Passive Start / Remote Keyless Entry Protocol

9.9.1 Communication Link Settings

- Carrier frequency: 868.34 MHz
- FSK deviation: 20.6 kHz
- Modulation: GFSK
- Data rate: 38.4kBaud
- Receiver bandwidth: 101.6 kHz
- Transmitter output power: -5 dBm
- Manchester coding: disabled
- Data whitening: disabled
- Automatic Frequency compensation: enabled
- Forward Error Correction: disabled

9.9.2 Communication Protocol

- Total length: 24 bytes

- Preamble length: 4 bytes
- Sync word: 2 bytes (D391hex)
- Data length: 16 bytes
- Protocol Identifier 8 bit

- Key number 8 bit
- Serial number 24 bit
- Manufacturer Code 8 bit
- Counter Value 16 bit
- Signature 24 bit
- Dummy Byte 8 bit

- Dummy Bits 2 bit
- LF RSSI RF3 10 bit; Is set to zero in RKE-Mode
- LF RSSI RF2 10 bit; Is set to zero in RKE-Mode
- LF RSSI RF1 10 bit; Is set to zero in RKE-Mode
- UHF RSSI, LQI, CRC: 2 bytes

10 EVM Important Notice

10.1 EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

Mailing Address: Texas Instruments Post Office Box 655303 Dallas, Texas 75265

10.2 REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules

For EVMs not subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this is strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

10.3 Important Notice for Users of this Product in Japan

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan!

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

Use this product in a shielded room or any other test facility as defined in the notification \#173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.
Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjukku-ku, Tokyo, Japan

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（1）電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。

（2）実験局の免許を取得後ご使用いただく。

（3）技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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10.4 EVALUATION BOARD/KIT/MODULE (EVM)WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, **this EVM is not a finished electrical equipment and not intended for consumer use**. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. **It should not be used as all or part of a finished end product.**

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in

accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

11 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Rev.	Version	SCN	Description of Change	Date	By
0	0	-	New Issue	08/01/2011	J. Austen
1	0	-	Prepared for certification	6/26/2013	M. Albrecht

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