

		Application Note 427	
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1. Introduction

Welcome to the EM4095 RFID Reader (EMDB409 Reader) user's guide.

To further utilise the EM4095 RFID Reader, the minimum hardware and software requirements are; Windows® NT/XP, 10MB HDD space, 800x600 pixels video resolution

1.1. Setup

Following steps describe the first time initialization of the EMDB409 Reader Application Software when on start up using USB cable.

Setup - Driver Installation

At first, please unpack the EM4095 RFID Reader base station, installation CD, USB cable, transponder samples, and the power supply adapter from the EM4095 RFID Reader box. Following steps describe the first-time initialization of the EMDB409 Reader Application Software when using USB cable (and assuming the drivers have not been installed yet):

- 1. Log-in as administrator
- 2. Launch the Setup.exe executable found in the CD root directory
- 3. Follow the application software installation wizard to install the application software.
- 4. Connect the EMDB409 Reader to the USB port using USB cable
- 5. Connect the power supply adapter to the EMDB409 Reader and power it on
- 6. The operating system detects the reader is connected and initiates the driver installation sequence

Found New Hardware Wizard						
	Welcome to the Found New Hardware Wizard Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission). Read our privacy policy					
	Can Windows connect to Windows Update to search for software? O Yes, this time only O Yes, now and givery time I connect a device O No. not this time Click Next to continue.					
	< <u>B</u> ack. <u>N</u> ext > Cancel					

Select "No, not this time" and click on Next button.

Note: optionally, it can be observed in the Device Manager. To open the device manager, click on Start->Control Panels->System icon, select the Hardware tab, and click on Device Manager button. Following window shall appear, with the reader device indicated by the "Other Devices -> USB Device" item.





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7. The "USB Device" is the USB Serial Converted and operating system will ask for its driver files location;

Found New Hardware Wizard	
	This wizard helps you install software for: USB Serial Converter If your hardware came with an installation CD or floppy disk, insert it now.
	What do you want the wizard to do? C Install the software automatically (Recommended) C Install from a list or specific location (Advanced) Click Next to continue.
	< <u>B</u> ack <u>N</u> ext > Cancel

Select "Install from a list or specific location (Advanced)" item and click on Next button.

8. The operating system displays a dialog to enter the driver location;





Click on Browse button and locate the driver directory on the installation CD (for example; "Your CD/DVD drive letter":\Drivers\CDM20602". Finally click on Next button.

9. Operating system starts the USB Serial Converted driver installation. It may require a confirmation on installation of unsigned driver, as a standard policy.

Hardware	e Installation
1	The software you are installing for this hardware: USB Serial Converter has not passed Windows Logo testing to verify its compatibility with Windows XP. (<u>Tell me why this testing is important.</u>) Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
	Continue Anyway

Click on "Continue Anyway" button.

10. After the USB Serial Converter driver installation, the operating system initiates a second sequence to install the USB Serial Port driver. The operating system will ask for the driver again.





- 11. Hence;
 - a. In newly displayed Wizard dialog, select "Install from a list or specific location (Advanced)" item and click on Next button.
 - b. In newly displayed Driver location dialog, leave the "Your CD/DVD drive letter":\Drivers\CDM20602" in the location edit box and click on Next button
 - c. Confirm the "Continue Anyway" query
- 12. When the operating system finishes the installation, the correctly installed driver (with the reader connected and powered on) shall be indicated in the Device manager as "USB Serial Port";



Application software start

- 1. In the Start->All programs menu, locate the EMDB409 Reader application software and launch it
- 2. Within EMDB409 Reader application software, select a menu Reader Connection -> Connect. The application finds every available virtual COM ports that are provided by FTDI USB drivers.
- 3. Choose the appropriate COM port in the Com Port List Box and click on Connect button to establish the connection.
- 4. The OK field inside the status bar and status window signalize a successful initialization while the reader connection modal window is closed automatically. Otherwise, status bar signalizes an error.

Possible problems caused by EMDB409 Application Software and their suggested solutions:



- 1. No COM port is found the operating system is not properly configured or the insufficient privileges are applied. Please inspect the hardware device list of your PC to check there is a USB<->COM converter device present while the EMDB409 Reader is connected via USB cable and powered on and the drivers have been installed correctly.
- To determine the virtual COM port (system way) please inspect the hardware device list of your PC to check there is a USB<->COM converter device present while the EMDB409 Reader is connected via USB cable and powered on and the drivers have been installed correctly. On some systems, the virtual COM port number may collide with other virtual devices; in such case, please fix the COM port manually to another not-yet used port number.
- 3. To determine the virtual COM port (easy way) run the EMDB409 Reader Application Software and select menu Reader Connection -> Connect. Remember the COM ports listed in the COM Port List Box. Then, connect the EMDB409 Reader via USB cable and power it on. After several seconds, the operating system creates a new virtual COM port, thus, click on Refresh button and check what a new port appears in the COM Port List Box.
- 4. The reader doesn't respond on startup please determine the virtual COM port number and presence as described above.
- 5. Partially installed drivers if the USB Serial Converter driver is installed only, open the device manager;



Then click on "USB Serial Port" with right mouse button, and select "Update driver" item. Continue the installation queries according to the step 11 above.

1.2. User's guide

Follow this user's guide chapters that describe the functionality of EMDB409 Reader application software and show how to communicate with the RFID transponders easily. The same information can be found in the EMDB409 Reader Application help available through pressing the key F1.



2. Starting EMDB409 Application Software

Following steps describe the standard initialization of the EMDB409 Reader Application Software when using USB cable assuming the drivers are already installed:

- 1. Connect the EMDB409 Reader to the USB port using USB cable
- 2. Connect the power supply adapter to the EMDB409 Reader and power it on
- 3. Run EMDB409 Reader Application Software
- 4. Select a menu Reader Connection -> Connect the application finds every available COM port by trying to open it. Every available COM port is inserted into the Com Port List Box.
- 5. Choose the appropriate COM port in the Com Port List Box and click on Connect button to establish the connection
- 6. The OK field inside the status bar and status window signalize a successful initialization while the reader connection modal window is closed automatically. Otherwise, status bar signalizes an error.

3. Graphics User Interface

The EMDB409 Application Software graphics user interface is split into two panels separated by a status bar. The upper panel displays a transponder specific frame (controls, commands, editable fields, etc). No transponder specific frame is displayed after the connection is established (see Figure 1 Graphics User Interface). The bottom panel contains a Message Window.



Figure 2 Start-up graphic user interface

Status Bar

For all the commands the first field of status bar displays a Status (result) of the recent command execution;

- O.K.
- ERROR

Message Window

Message Window displays the commands and their responses actually processed by the application software. Although the message window can be hidden, it displays useful information about the results of the commands.



Operation Selector 4

Until the communication with the EMDB409 Reader is established, following menus are available;

- Reader Connection menu
 - Connect to establish the connection
 - Exit to exit the application software 0
- Tools menu
 - Message Window Visibility to show/hide the message window 0
 - Clear Message window to clear the message window 0
 - Bootloader to upload a new firmware to the EMDB409 Reader 0

As soon as the communication with the EMDB409 Reader is established, the communication menus are enabled. The communication menus comprise:

- Tag Selection menu
 - Animal mode to read transponders programmed with Animal mode data 0
 - Read Only mode to read transponders programmed with Read Only UID 0
 - EM4450 to communicate with EM4450 transponder 0
 - EM4205/EM4305 to communicate with EM4205 or EM4305 transponder 0
 - EM6869 to communicate with EM6869 transponder 0
- Tools menu
 - Field ON RF field on Field OFF RF field off 0
 - 0
 - Field Reset Field off and field on 0

Note: EM4100, EM4102, EM4105, EM4150, EM4350, EM4550, EM4026, and EM4x69 transponders are obsolete products.

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4.1. Animal mode transponder

EMDB409 Reader is capable of reading the UID of Animal mode transponder.

Animal mode Read UID

- 1. Select a Tag Selection ->Animal mode menu
- Place a single Animal mode tag on the EMDB409 Reader
 Click on Single Read button

Territory (
EMDB409 Reade	er Application Softw	are Release 1.0								
Reader Connection	Tag Selection Tools	Help								
Animal mode										
Current Tag Config	uration		Animal Data Map Organization							
Country Code	National ID	Code	000000000111001							
999	000008	31955	0111100011011001							
Data Block	Reserved	Animal Flag	100001000000010							
0	00000	1	0000011110011111							
		-	10000000100000							
Single Read	1		0110110110010111							
			010010000000100							
Start Autodete	set SI	atus:	00000010000001							
		Detected								
Status: O.K.	Reader Firmware Ve	ersion: 0.15, Family: 9	90, Date : 9.10.2009							
Message Window	,									
14:57:58 Received: <	02 04 F0 00 F4 03 >									
14:57:58 OK 14:57:59										
14:57:59 Animal mode	: Read ID									
14:58:00 Received: <	02 14 11 00 00 9C 1E 9	IB 21 40 E0 F9 01 02	B6 E9 12 20 40 80 CA 03 >							
14:58:00 OK	000									
14:58:00 National ID (e = 555 code = 000000831955									
14:58:00 Data Block = 14:58:00 Beserved =	= 0 00000									
14:58:00 Animal Flag	= 1									
J										

Click on Start Autodetect button to run continuous Read of Animal mode UID.

To emulate Animal mode tags by EM4205/EM4305, refer to Animal Application Software on the installation CD (EMDB409 Reader AN Application Software).

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4.2. Read Only mode transponder

EMDB409 Reader is capable of reading UID of transponders programmed with Read Only data structure.

Read Only mode Read UID

- 1. Select a Tag Selection ->Read Only mode menu
- 2. Place a single Read Only mode tag on the EMDB409 Reader
- 3. Click on Single Read button

EMDB409 Reader Application Software Release 1.0								
Reader Connection Tag Selection Tools Help								
Current Tag Configuration	Memory Map							
Costumer Code Data Item	1 1 -	1	1	1 1	1	1	9 header bits	
01 01A6244C	8 version bits or Customer ID	0 0	0 0	0 0	0 1	P0 P1		
Single Read		0	0	0	0	P2		
Statt Autodetect Detected	32 data bits	U 1 0	U 0 1	U 1 1	1 0 0	P3 P4 P5	10 line parity bits	
		0	0 1	1 0	0 0	P6 P7		
		0 1	1 1	0 0	0 0	P8 P9		
	4 column parity bits	PC0	PC1	PC2	PC3	0		
Status: 0 K Reader Firmware Version: 0.15 Family: 90	Date : 9 10 2009							
Message Window	Date . 9.10.2009							
14:52:29 14:52:29 Field Reset 14:52:29 Sent: I/22 04 F0 FF 0B 03 14:52:30 Received: <02 04 F0 00 F4 03 > 14:52:30 C								•
14:52:32 Read Only mode : Read ID 14:52:32 Sent: [J2 03 10 13 03] 14:52:32 Received: <02 09 10 00 80 32 24 65 80 6A 03 > 14:52:33 OK 14:52:33 OK 14:52:33 Uxtomer Code = 01 14:52:33 Unique Serial Number = 01A6244C								Ţ

Click on Start Autodetect button to run continuous Read of Read Only mode UID.

To emulate Read Only tags by EM4x69, refer to Read Only Application Software on the installation CD (EMDB409 Reader RO Application Software).



4.3. EM4450 transponder

Following notes describe typical usage of the EMDB409 Application Software graphics user interface for family of EM4x50 transponders.

<u>Setup</u>

- 1. Select a Tag Selection -> EM4450 menu (see Figure 4 EM4450 Communication Frame)
- 2. Place a single EM4450 tag on the EMDB409 Reader

EMDB409 Reader	Application Software	Release 1.	0			_ 🗆 ×
Reader Connection T	ag Selection Tools <u>H</u> e	sip.				
Transponder EM4450						
Memory Map				Commands		
Block number	Contents	Mode	Value 🔺	Pand Black	Vidite Bleek	
1	Protection word	(BW)		Neau block	WINE BIOCK	
2	Control word	(BW)				
3	User word 0	(BW)		Selective Read	Set Control Word	
4	User word 1	(BW)				
5	User word 2	(BW)		Read in Control Word	New Password	
6	User word 3	(BW)				
7	User word 4	(BW)				
8	User word 5	(BW)				
9	User word 6	(BW)				
10	User word 7	(BW)				
11	User word 8	(BW)		Login	Reset Tag	
12	User word 9	(BW)				
13	User word 10	(BW)		Login Status:		
14	User word 11	(BW)		Not logged in		
15	User word 12	(BW)	-	Notioggeuin		
,						
Status: O.K.	Reader Firmware Versio	on: 0.15, Fam	ily: 90, Date : 9.10.20	09		
Message Window	,					
15:39:02						
15:39:02 Field Beset						
15:39:02 Sent: 02 04 Fi	0 FF 0B 03					
15:39:03 Received: <02	2 04 F0 00 F4 03 >					
15:39:03 OK						
						~

Figure 3 EM4450 communication frame

Read Block

- 1. Click into the Memory Map table to select a block to be read
- 2. Click on Read Block button

Write Block

- 1. Click into the Memory Map table to select a block to be written
- 2. Click on Write Block button
- 3. Enter the new block value (see Figure 5 Enter new value)
- 4. Click on Ok button





Figure 4 Enter new value

Note: The Write Block command can be used only for Read/Write (RW) Blocks

<u>Login</u>

Login command is used to access protected memory areas. The login status is displayed in the Login Status window.

- 1. Click on Login button
- 2. Enter the current password value (see Figure 6 Enter password)
- 3. Click on Ok button

Enter password:	-D×
Enter current pas	sword value:
00000000	
MSByte	LSByte
Ok	Cancel

Figure 5 Enter password

Selective Read

Selective Read command is used to read blocks that are defined between First Block Read value and Last Block Read value.

- 1. Click on Selective Read button
- 2. Enter the First and Last Block values (see Figure 7 Enter Blocks values)
- 3. Click on Ok button

Note: Possible values are: 1<= First Block value <= Last Block value <= 33



🌇 Set Firs	st and La 💶 🗙
01	First Block Read
10	Last Block Read
Ok	Cancel

Figure 6 Enter block addresses

Set Control Word

Set Control Word command is used to set the Control Word which stored in the Block 2. When you click on Set Control Word button, the reader reads actual content of the Control Word first.

Sets new value of the Control Word

- 1. Click on Set Control Word button
- 2. Change the setting of the Control Word (see Figure 8 Set Control Word)
- 3. Click on Set button



Figure 7 Set control word

Read In Control Word

Read in Control Word command reads values of the First Block Read and Last Block Read in the Control Word and then it reads these blocks.



New Password

New Password command is used to change current password value.

- 1. Click on New Password command
- Enter Current password value (see Figure 9 Passwords values)
 Enter New password value
- 4. Click on Ok button

Set password values:	미지
Current password value =	
00000000	
New password value =	
0000000	
,	
Ok	

Figure 8 Password selection window

Reset Tag

Reset Tag command returns the tag from any mode to the Standard Read Mode in which the tag sends data continuously, word by word from the memory section defined by the First Block Read and Last Block Read in the Control Word.



4.4. EM4205 / EM4305 Transponder

Following notes describe typical usage of the EMDB409 Application Software graphics user interface for EM4205 or EM4305 transponders.

<u>Setup</u>

- 1. Select a Tag Selection -> EM4305 menu (see following figure)
- 2. Place a single EM4305 or EM4205 tag on the EMDB409 Reader

- 1 22	EMDB409 Reader Application Software Release 0.13								
<u>R</u> e	ader Connection	Tag Selection Tools H	elp						
ΞSu	pported tags : EM	4205,EM4305							
Г	Memory Map				Commands	Tag data			
	Block number	Contents	Mode	Value		Tag Features FD>	KB Initialise FDXB		
	0	Device type / User free	(BW)		Configuration	⊢Tag Features in Ta	g Memory		
	1	UID / User free	(RW)						
	3	User free	[RW]		Read Blook	Customer Code	Unique Identification Number		
	4 F	Configuration word	IBW1						
	<u> </u>	User mee	(BW)		Lutrite Blook	-	-		
	7	User free	(D)(A)						
	<u>,</u> 8	User free	(BW)			Resonant Capaci	itor Chip Type		
	9	User free	(BW)			· · ·			
	10	User free	(BW)		Protection	_			
	11	User free	(BW)						
	12	User free	(BW)		Login				
	13	User free	(BW)			Re	ead Tag Features		
	14	Protection word 1	(BP)		New Password				
	15	Protection word 2	(BP)						
					Disable	Login status:			
						Not logged in			
Stal	us: O.K.	Reader Version: 0.11,	Family: 9	0, Date : 15.6.2007					
Me	ssage Window								
08:	37:56 Reader con	nected.							
08:	38:01								
08:	38:01 Field Reset 38:01 Sept: 102.04	EU EE UB U3I							
08:	38:02 Received: <	02 04 F0 00 F4 03 >							
08:	38:02 OK								
08:	38:02								
08:	38:02 Reader Set 20:02 South 102:07	New Configuration							
08	38:02 Sent (02.07 38:02 Beceived: <	N2 N4 FC N0 F8 N3 >							
08:	38:03 OK								
08:	38:03 Current Rea	der configuration: Bi/32, L'	WR=8						
							-		

Figure 9 EM4205/EM4305 communication frame

Before using any command it is necessary to ensure that the reader and EM4305 or EM4205 transponder have the same configuration. To configure both the reader and transponder, please use the Configuration command. After entering the EM4305 frame, the reader is configured to Biphase RF/32 downlink communication automatically, i.e. the default EM4205 / EM4305 downlink communication configuration.

Configuration

Configuration command is used for configuration EM4305, EM4205 and EM4095 RFID Reader.

Configuration of Code, Data Rate and LWR for EM4305, EM4205 and EM4095 RFID Reader

- 1. Click on Configuration button in main window for EM4305 or EM4205 transponder
- Choose Configuration mode, Code/Data Rate and Last Word Read (LWR). For example; both EM4305 and Reader configuration, Bi/32, and LWR=8.
- 3. Click on Set button



EM4305 Configuration	EM4305 Configuration								
Configuration mode EM4305 and Reader s Only EM4305 configural Only Reader configural EM4305 configuration OMn/64 OMn/64	ame configuration ation tion Reader configuration O Mn/64								
 Bi/64 Bi/32 	© Mn/32 © Bi/64 © Bi/32								
EM4305 Delayed ON No delay (00) BP/4 BP/8 No delay (11)	Actual Reader Config. Biphase RF/32 LWR = 8								
EM4305 Special Bits Double pulse PSK4 Read Login Write Login	 Disable RTF Pigeon mode 								
LWR 5 6 7 8 9 10	· · · · · · 11 12 13 14 15								
Set	Cancel								

Figure 10 EM4205/EM4305 configuration window

If the configuration command proceeds successfully the Configuration window closes automatically. Otherwise, the configuration needs to be repeated or cancelled until successful.

Further guide assumes the reader and the tag configuration matches.

Read Block

- 1. Click into the Memory Map table to select a block to be read.
- 2. Click on Read Block button
- 3. Click on Ok button

Write Block

- 1. Click into the Memory Map table to select a block to be written.
- 2. Click on Write Block button
- 3. Enter the new block value.
- 4. Click on Ok button

Note: The Write Block command can be used only for Read/Write (RW) Block

<u>Login</u>

Sending Login command is necessary before sending any password protected command. The status of Login command is visible in Login Status window under the Login button.

- 1. Click on Login button
- 2. Enter actual password value
- 3. Click on Ok Button



🐨 Enter password:	
Enter current pass	word value:
00000000	
MSByte	LSByte
Ok	Cancel

Figure 11 Enter the password value

New Password

New Password command is used to change the actual password value. Before changing the password values the transponder has to be in Logged state (see Login Status).

- 1. If the Login Status is in Not logged state, use Login command to log-in
- 2. Enter new password value
- 3. Click on Ok button

Protection

Protection command protects Blocks in the transponder memory from being written. After clicking on Protection button the reader sends a command to read current value of the Protection Word. The already protected Blocks are ticked and they have gray color.

Warning: The bits in Protection word that are stored in the Protection words (Block 14 and 15) are one time programmable (OTP) which means that once they have been set they can not be reset any more.

- 1. Click on Protection button
- 2. Tick the blocks which you would like protect
- 3. Click on Set button in Set Protection Bits window
- 4. Click on Yes button in Warning window



Figure 12 EM4205/EM4305 Protection selection window





<u>Disable</u>

Disable command is accepted in the case the Disable bit in Tag Special Bits is set to 1 (see Configuration -> EM4305 Special bits selection). When this command is detected EM4305 or EM4205 tag stops all operations until power-up. In case the Disable command is not accepted (Disable bit is set to 0) EM4305 or EM4205 tag returns in Default Read mode.

Within the EM4305 frame, the FDXB and Initialise FDXB indices provide the controls to read and configure the EM4205 or EM4305 tag into the Animal mode (FDXB).

FDXB continuous read

- 1. Select the FDXB index
- 2. Check the Auto Read checkbox

Reader Connection Supported tags : E Memory Map	M4205,EM4305	ыр	Commands	r Tag data
Biock number 0 1 3 4 5 6 7 8 9 10 11 12 13 14 15	Contents Device type / User free User free Configuration word User free User free Protection word 1 Protection word 2	Mode Value (RW) (RW) (RW) (RW)	Configuration Read Block Write Block Protection Login New Password Disable	Tag Data Tag Features FDXB Current Tag Configuration Country Code 999 0000000000512 Data Block Reserved Animal Flag 0 00000 1 Auto Read V Login status: Not logged in
Status: Processing	Reader Version: 0.11,	Family: 90, Date : 15	.6.2007	
Lessage Window 19:47:50 Sent: [02 19:47:50 Received 19:47:50 OK 19:47:50 EM4x05 : 19:47:50 EM4x05 : 19:47:51 EM4x05 : 19:47:51 Sent: [02 19:47:51 Sent: [02 19:47:51 EM4x05 : 19:47:51 EM4x05 : 19:47:51 EM4x05 : 19:47:51 Received	w 03 11 12 03 c <02 14 11 00 00 04 28 10 2	0 40 E0 F9 01 02 06 0 40 E0 F9 01 02 06 0 40 E0 F9 01 02 06	8A 19 20 40 80 36 03 > 	

Figure 13 Reading EM4205/EM4305 configured in FDXB mode

When the Auto Read checkbox is checked, the application software detects the presence of the FDXB configured tags in the RF field, the FDXB data is displayed in appropriate panels. The same continuous detection is available in Tag Selection -> EM4005 / EM4105 frame.

Initialise FDXB (Write)

- 1. Switch to the Initialise FDXB index
- 2. Enter the desired FDXB data contents
- 3. Click on Write button within the Initialise FDXB index



ported tags : E emory Man	M4205,EM4305				Tag data
lock number	Contents	Mode	Value	1	Tag Features EDXB Initialise EDXB
	Device type / User free	e (RW)	11000	Configuration	-Band Avida FERDON Manage
	UID / User free	(BW)			Read / Write EEPRUM Memory
	User free	(BW)			Country Code : 999
	Configuration word	(BW)		Read Block	
	User free	(BW)	10280C00		National ID code : 00000000513
	User free	(BW)	F9E04020	Write Block	Data Block : 0
	User free	(BW)	9FFE0201		
	User free	(BW)	80402011		Reserved : 00000
	User free	(BW)			Animal Flag : 1
)	User free	(BW)		Protection	Open Log
	User free	(BW)			Operations
2	User free	(BW)		Login	
}	User free	(BW)			Read Write Lock Initialize
1	Protection word 1	(BP)		New Password	
5	Protection word 2	(BP)			
				Disable	Login status:
s: O.K.	Reader Version: 0.1	1, Family: 9	0, Date : 15.6.2007		
age Window	ı				
:10 Sent: 02 0 :10 Received:)8 91 07 01 02 FE 9F FC (<02 04 91 00 95 03 >	03			
:10 OK					
:10 Value : 0x	9FFE0201 is written to Blo	ock 7			
ा U Writing <8 ा ।	0402011> line 8				
11 EM4v05 · 1	Write Word				
:11 Sent: 102 0	8 91 08 11 20 40 80 60 0	31			
11 Received:	<02 04 91 00 95 03 >				

Figure 14 Initialising EM4205/EM4305 in FDXB mode

Analogously, Read (to verify the FDXB data), Lock (to lock blocks 4-8), and Initialise (to write the FDXB configuration word along the FDXB data) functions can be invoked by clicking on appropriate buttons.

Note: The FDXB index / Auto Read feature uses the default read FDXB data capture, i.e. no command is sent to the tag, just the FDXB downlink response is captured freely. On the other hand, Initialise FDXB index commands emit the EM4205/EM4305 commands, i.e. uplink command is also sent by the reader.



4.5. EM6869 transponder (LF interface)

Following notes describe typical usage of the EMDB409 Application Software graphics user interface for EM6869 transponders.

<u>Setup</u>

- 1. Select a Tag Selection -> EM6869 menu (see following figure)
- 2. Place a single EM6869 tag on the EMDB409 Reader

E E	MDB409 Rea	der Application Softw	are Release 1.0			
Read	der Connection	Tag Selection Tools	<u>H</u> elp			
EMI	6869 Transpon	der				
⊢M	emory Map			Page selector:	Commands	
Б	lock number	Contents	Value 🔺	0	Bead Block	
	(0x000)	Device ID		1		
1	(0x001)	CK protection (OTP)		2	Write Block	
2	(0x002)	Protection register		4		
3	(0x003)	ИМ		5	Bead Page Bange	
4	(0x004)	ИМ		6		
5	(0x005)	ИМ		7	Write Page Bange	
6	(0x006)	им		8		
<u>IIIZ</u>	(0x007)	ИМ		10		
	10x0081	Password[15:0]		11		
1 13	10x0091	Password[31:16]		12		
비분	1 (0. 00P)	ID[15:0]				
비분	1 10X00B1	10(31:16)		14		
H	2 (0.000)			16		
비법	310x0001	им		17	AES & Protection	
H	5 (0v00E)	ПМ		18		
Πİ	6 (0x010)	ПМ		19	LF Wake-up	
	7 (0, 014)			20		
Statu	s: 0.K.	Reader Firmware Ve	ersion: 0.15, Family: 90), Date : 9.10.2009		
Mess	age Window					
10:59	3:02 Sent: 02 0	3 FD FE 03				
10:59	3:02 Received:	<02 08 FD 00 0F 49 13 5	iA FA 03 >			_
10:59	3:02 Version: 0.	.15				
10.50	3:02 namily: 30 3:02 Diata - 9.11	0.2009				
10:59	3:02 OK	0.2003				
10:59	02 Reader co	nnected.				
10:59	9:05					
10:59	3:05 Field Rese 2:05 Comb 192.0					
10:53	100 sent juzit 106 Beceived:	<02 04 F0 05 03 <02 04 F0 00 F4 03 \				
10:59	3:06 OK					

Figure 15 EM6869 communication frame

Tag position

EM6869 is typically equipped with very small SMD antenna (usually on ferrite core). In order to communicate with such transponder successfully the transponder antenna must be placed on the EMDB409 reader antenna logo directly, the antenna axis shall be perpendicular to the plastic box surface.

Read Block

Select the page number in Page selector and select the block number line in the Memory map. Click on Read Block button to obtain the block contents.

Read Page Range

A range of consequent blocks can be selected and read by single reader command Read Page Range. When single block is selected in the Memory map, the reader will read complete page (see example below).





ELIDD (00 D -			1.0		
EMDB409 RE	ader Application Sort	ware Release	1.0		
Reader Connectio	in <u>rag</u> selection r <u>o</u> ois	, Teib			
EM6869 Transpo	nder			P 1 1 P 1	
Memory Map	-			Page selector: Lommands	
Block number	Contents	Value	_ <u> </u>	Read Block	
0 (0x000)	Device ID	6869			
1 (0x001)	CK protection (OTP)	0000		2 Write Block	
2 (0x002)	Protection register	FFFF		4	
3 (0x003)	UM	0000		5 Bead Page Bange	
4 (0x004)	UM	0000		6	
<u>5 (0x005)</u>	UM	0000		7 Write Page Bange	
6 (0x006)	UM	0000		8 witter age ridinge	
7 (0x007)	UM	0000		10	
8 (0x008)	Password[15:0]	NACK		11	
9 (0x009)	Password[31:16]	NACK		12	
10 (0x00A)	ID[15:0]	0000		13 - 1	
11 (0x00B)	ID[31:16]	0000		14	
12 (0x00C)	UM	0000		15	
13 (0x00D)	UM	0000		16 17 AES & Protection	
14 (0x00E)	UM	0000			
15 (0x00F)	UM	0000		19	
16 (0x010)	UM	0000		20 The second se	
147/0 0141	lo c c	0000			
tatus: O.K.	Reader Firmware	Version: 0.15,	Family: 9	Date : 9.10.2009	
lessage Windo	w				
1:01:19 Value in 1:01:19 Value in	Block 20 (0x014) is : NAC Block 21 (0x015) is : NAC Block 22 (0x016) is : NAC Block 22 (0x016) is : NAC Block 23 (0x018) is : NAC Block 25 (0x018) is : NAC Block 25 (0x018) is : NAC Block 28 (0x01C) is : NAC Block 28 (0x01C) is : NAC Block 29 (0x01D) is : NAC Block 20 (0x01D) is : NAC Block 20 (0x01D) is : NAC Block 20 (0x01D) is : NAC	к к к к к к к к к к к к к к к к к к к			

Figure 16 Whole page read example

EMDB409 firmware uses Read Word (0-1023) command to read each block separately. The tag may reject the reading of each block by NACK response.

Write Page Range

Similarly, EMDB409 firmware can write up to 16 blocks by single reader command; select the page in Page selector and consequent range of words in the Memory map and click on Write Page Range button (see 3 blocks example below).

🌇 Enter new value:	<u>_ ×</u>
New value =	
0123456789AB	
MSByte	LSByte
Ok	Cancel

Figure 17 Write 3 words example





			1.0			
EMDB409 Re	ader Application Sol	tware Relea	se 1.0			
Reader Connectio	n Lag Selection Too	ols <u>H</u> elp				
EM6869 Transpo	onder					
Memory Map				Page selector:	Lommands	
Block number	Contents	Value			Read Block	
0 (0x060)	LR/LW			2		
<u>1 (0x061)</u>	UM1		_	3	Write Block	
2 10x0621	UM1	0123		4		
3 10x0631	UM1	4567		5	Read Page Range	
4 10x0641	UMI	8348		5		
				8	Write Page Range	
7 (0,067)				9		
8 (0v068)	LIM2			10		
9 (0v069)	LIM2			11		
10 (0x06A)	LIM2			12		
11 (0x06B)	UM2			14		
12 (0x06C)	UM3			15		
13 (0x06D)	UM3			16	AEC & Destantion	
14 (0x06E)	UM3			1/	AES & Protection	
15 (0x06F)	UM3			19	L Davisla un	
16 (0x070)	UM4		_	20 -	LF Wake-up	
117 (0.071)	luur					
<u> </u>						
Status: O.K.	Reader Firmware	e Version: 0.15	, Family: 9	0, Date : 9.10.2009		
Message Windo	w					
11:01:19 Value in	Block 29 (0x01D) is : NA	ACK				A
11:01:19 Value in	Block 30 (0x01E) is : NA	ACK				
11:01:19 Value in 11:00:00	Block 31 (0x01F) is : NA	4CK				
11:03:02 EM6869	· Write Page					
11:03:02 Sent: 02	OC A4 62 00 04 23 01 1	67 45 AB 89 E(C 03			
11:03:02 Receive	d: <02 08 A4 00 FF FF F	F FF AC 03 >				
11:03:02 OK						
11:03:02 nack = r 11:03:02 Value in	rrrrrr Block 98 (AvA62) is · Av(0123				
11:03:02 Value in	Block 99 (0x063) is : 0x4	4567				
11:03:02 Value in	Block 100 (0x064) is : 0:	x89AB				
						-

Figure 18 Write 3 words example result

<u>AES and Protection</u> The application software provides partial control of EM6869 transponder AES configuration including the key and random number setup, click on AES & Protection button.

EM6869 A	ES Authenti	cation Comman	ds		<u>- 0 ×</u>
Parameters RN1 size C 32 bits C 64 bits C 96 bits C 128 bits	F C C	size 32 bits 64 bits 128 bits	G size C 32 bits C 64 bits C 128 bits	RI C C C C	N2 size 32 bits 64 bits 96 bits 128 bits
SK1 = RN1 exp =	0000000000 digh SX1(127:124 0000000000 digh SX1(63:60) 0000000000 digh XN1exp[95: 00000000 digh XN1exp[31:	0000000 4] digit SK1(67:64) 0000000 digit SK1(3:0) 0000000 92] RW1exp[3:32] 28] RW1exp[3:0]	SK3 = 0 di 0 di 0 di 0 di 0 di MASK = 0 MASK = 0 M	00000000000000000000000000000000000000	0000 digit 3X3[67:64] 0000 digit 3X3[3:0] MY2ext[3:0]
Crypto configu Write CryptC Unlock K Write Ke Write Ri	ration F Config. eys ys	Protection Unlock UM Unlock LB0 LB1 Write Password Protect	Authentica Single Mutual	ation e Auth. al Auth. ISO Auth.	Cancel

Figure 19 AES & Protection window



The EM6869 AES Authentication Commands window contains the selection of random number RN1 and RN2 size, function F and G size, secure key SK1 and SK3 contents, random number RN1 and RN2 expansion, and the Mask. All these values selected are used by the Crypto configuration, Protection, and Authentication commands invoked by clicking on corresponding buttons; the application software assumes that the tag is configured with matching values.

If the select configuration does not match the settings of the tag, the Crypto configuration, Protection, and Authentication commands usually fail.

Optionally, the values in this window can be used to be written into the tag's appropriate blocks.

Write Crypto Configuration

As the first step, the EM6869 tag Crypt Configuration shall be initialized. Please refer to EM6869 datasheet on Crypt Configuration word settings and its meaning in relation to EM6869 AES Authentication commands. Set the desired RN1 and RN2 size, function F and G size and click on "Write CryptConfig" button.

Note: the crypto configuration change is possible as long as tag's Protection register LBP bit is not set (i.e. LBP = '1').

Tag Key change

To change the SK1 and SK3 key contents in the tag, fill the current correct SK1[31:0] password part in its edit box. Click on Unlock Keys command to enable the key change. After the Unlock Keys command is executed successfully, fill the new SK1 and SK3 key contents into the edit boxes and click on Write Keys button.

Note: it is recommended to save the new key value in some notepad.

Note: the tag's key change is possible as long as tag's Protection register LB1 bit is not set (i.e. LB1 = '1').

Tag RN exp/Mask change

EM6869 Authentication commands use AES 128b cipher which usually involves one or two 128bit random numbers in the calculation. In order to decrease the number of words exchanged between the tag and the reader during the authentication, EM6869 allows the RN1 and RN2 size exchanged being reduced to 32, 64 or 96 bits. When the exchanged RN1 or RN2 size is shorter than 128b, both tag and reader need to extend them internally with arbitrary value into 128b for AES calculation. Such arbitrary value is called RN1 expansion and RN2 expansion, the actual values are stored in the tag memory; RN1 exp, RN2 exp register.

Another arbitrary value, the Mask, is required for Single and Mutual Authentication commands to when function F is set to 128b.

Fill new RN1 exp, RN2 exp, and Mask value into the corresponding edit boxes and click on Write RNs button. **Note**: RN exp/Mask change is possible as long as tag's Protection register LBP bit is not set (i.e. LBP = '1').

AES authentication

With above Crypto Configuration, Key, and RN exp/Mask settings updated, all three EM6869 authentication commands can be performed.

EMDB409 Rea	der Application Softw	are Release	1.0			- 🗆 🗵
Reader Connection	<u>Tag Selection</u> Tools	<u>H</u> elp				
EM6869 Transpon	der					(
Memory Map				Page selector:	Commands	
Block number	Contents	Value		0	Bead Block	
15 (0x06F)	UM3	T diate			Hodd block	
16 (0x070)	UM4			2	Write Block	
17 (0x071)	UM4			<u>3</u>		
18 (0x072)	UM4			5	Bead Page Bange	
19 (0x073)	UM4			6 -		
20 (0x074)	UM5			7	Write Page Bange	
21 (0x075)	UM5			8	witten agentalige	
22 (0x076)	UM5			10		
23 (0x077)	UM5		-	11		
24 (0x078)	UM6		-	12		
2510x0791	UM6		-	13 -		
2610x07A1	UM6		-	14		
27 IUxU7BI	UM6			16		
2810x07C1	UM7			17	AES & Protection	
2910x07D1	UM7 UM7			18		
21 (0v07E)	10/07			19	LF Wake-up	
	10///7		-	20 -		
Status: O.K	Reader Eirmware Ve	ersion: 0.15 E	amily: 9	0 Date : 9 10 2009		
	reader i miniare ve			0, 5000 - 7.10.2007		
Message Window	,					
13:17:25 Mask=000	10					
13:17:25 KEY=0000		00000000				
13:17:25 Input strea	m=4903LA6792A69EDB	6513345AUUU	ED21			
13:17:25 E vor MAS	K=Δ2160675899E495E6	UNB201B6CEB	5000			
13:17:25 G=6B335F	4FC46105663715653125	5B481F3				
13:17:25						
13:17:25 EM6869 :	Single AES Authentication					
13:17:25 Sent JU2 2	24 A 5 3F 45 D 3 LA 67 52 202 14 A 5 00 CD 22 5E 4	A6 3E DB 65 I	3 34 Q 27 15 I	3 UL UZ ED ZI AZ 16 U6 75 25 21 25 D/ 01 E2 AA 02 \	183 3F 43 SE 60 DB 20 1B 6C FB AA CS 9C 03	
13:17:26 OK	102 14 AD 00 00 DD DD 01 4		51 131	55125040115AA057		
13:17:26 Single Aut	hentication passed.					
						•





User Memory Protection

Unlock UM button can be used to temporarily disable the protection of words locked in User Pages (lock bits located in the word 0 of each User Page). Correct SK3 key value is required.

Protection

Protection register contents can be set by means of Protection button. The current tag Protection word is read, and selected lock bits can be set and written back to the tag.

Please refer to EM6869 datasheet on Configuration register settings. The Configuration register access is controlled by LB0 protection bit which can be reset by means of Unlock LB0 LB1 button using the tag Password registers. (The tag Password contents can be also changed using Write Password button.)



4.6. Bootloader

Following notes describe a process of uploading a new firmware into the EMDB409 Reader. It is possible to upload the firmware without performing an establishment of the connection.

<u>Setup</u>

- 1. Connect the USB cable and power supply adapter to the EMDB409 Reader
- 2. Select a Tools -> Bootloader

EMDB409 Reade	r Application Software		
Reader Lonnection I	ag Selection I ools Help		
BUUU LUAUEI SUPPOIL			
File name:			
		Browse	
	Upload firmware		
	Upload progress:		
	09/		
	U%		
Status: O.K.	Reader Version: 0.3, Family: 90, Date : 22.9.2005		
Message Window	,		
15:36:24			A
15:36:24 Skipping boot	oader (if any)		_
15:36:24 (06) 15:36:25			
15:36:25 Reader Version	n		
15:36:25 Sent: 02 03 Fl 15:36:25 Beceived: <02	D FE U3 2 08 ED 00 03 36 08 54 91 03 >		
15:36:25 Version: 0.3			
15:36:25 Family: 90 15:36:25 Data - 22 9 20	05		
15:36:25 OK	05		
15:36:25 Reader conne	cted.		_
I			7

Figure 21 Bootloader communication frame

Click on Browse button to enter a complete path of the new firmware hex file. If the firmware hex file is imported to the PC memory successfully, Upload firmware button is enabled.

Upload firmware

- 1. Click on Upload firmware button
- 2. If the EMDB409 Reader connection is not yet established, the EMDB409 application software asks for the COM port select the appropriate port the EMDB409 is connected to

Upload firmware process lasts about 1 minute. If the firmware is uploaded successfully, the connection is established automatically (see Figure 19 Firmware is uploaded successfully). In the second item of the status bar, current firmware version, family, and date of creation is displayed.



AN427

2002	
EMDB409 Reader Application Software	
<u>Reader Connection</u> <u>Tag Selection</u> T <u>o</u> ols <u>H</u> elp	
Bootl Loader Support	
Cie name:	
Citiku Desumentelar sin hau	
JC. My Documents main.nex	Browse
Upload firmware	
Upload progress:	
100%	
Status: O.K. Reader Version: 0.3, Family: 90, Date : 22.9.2005	
Message Window	
08:28:27 251	A
108:28:28 Firmware has been updated. 108:28:28 252 pages (each 256 bytes long) upload successful	
08:28:28	
108:28:28 Reader Version 108:28:28 Sent: 102.03 ED FE 031	
08:28:29 Received: <02 08 FD 00 03 36 0B 5A 91 03 >	
108:28:29 Version: 0.3 109:28:29 Familu: 90	
08:28:29 Date : 22.9.2005	
108:28:29 OK 108:28:29 Beader connected	
	•
7	

Figure 22 Firmware is uploaded successfully



5. Error handling

There are three kinds of errors:

- Reader Communication errors (e.g.; USB cable has been disconnected accidentaly and the EMDB409 reader does not answer at all) – check the USB cable and power supply adapter are connected correctly, then the connection has to reestablished unconditionally (Reader Connection -> Connect menu)
- Tag Communication errors insufficient RF energy (e.g.; tag response has CRC error) try to change the position of the tag or mutual position among the tags in respect to the reader antenna
- Tag Communication errors protocol issue (e.g.; no response from the tag) try to determine whether the tag is the type it is considered to be or whether the tag is in some altered mode it is not exepected to respond

6. Other software

Beside the EMDB409 Reader Application Software, which is located on the installation CD and described in this user's guide, the dedicated application software exists. It is EMDB409 Reader AN Application Software and EMDB409 Reader RO Application Software. EMDB409 Reader ANM Application Software can be used to emulate Animal mode tags and EMDB409 Reader RO Application Software can be used to emulate Read Only tags by EM4205 / EM4305 transponders.

Please, check the EM Microelectronic web pages to download the latest release of the software.