AN3224
Application note

Developing an application allowing PR101-USB and MR101-USB FEIG readers to communicate with M24LRXX transponders

Introduction

This application note explains how to develop a Visual Basic or C/C++ application code to drive ISO 15693 FEIG readers from a host computer. FEIG readers are contactless readers which can communicate with transponders based on the STMicroelectronics M24LRXX Dual interface EEPROM.

The readers are delivered within ST demonstration kit DEMOKIT-M24LR-A and development kit DEVKIT-M24LR-A:

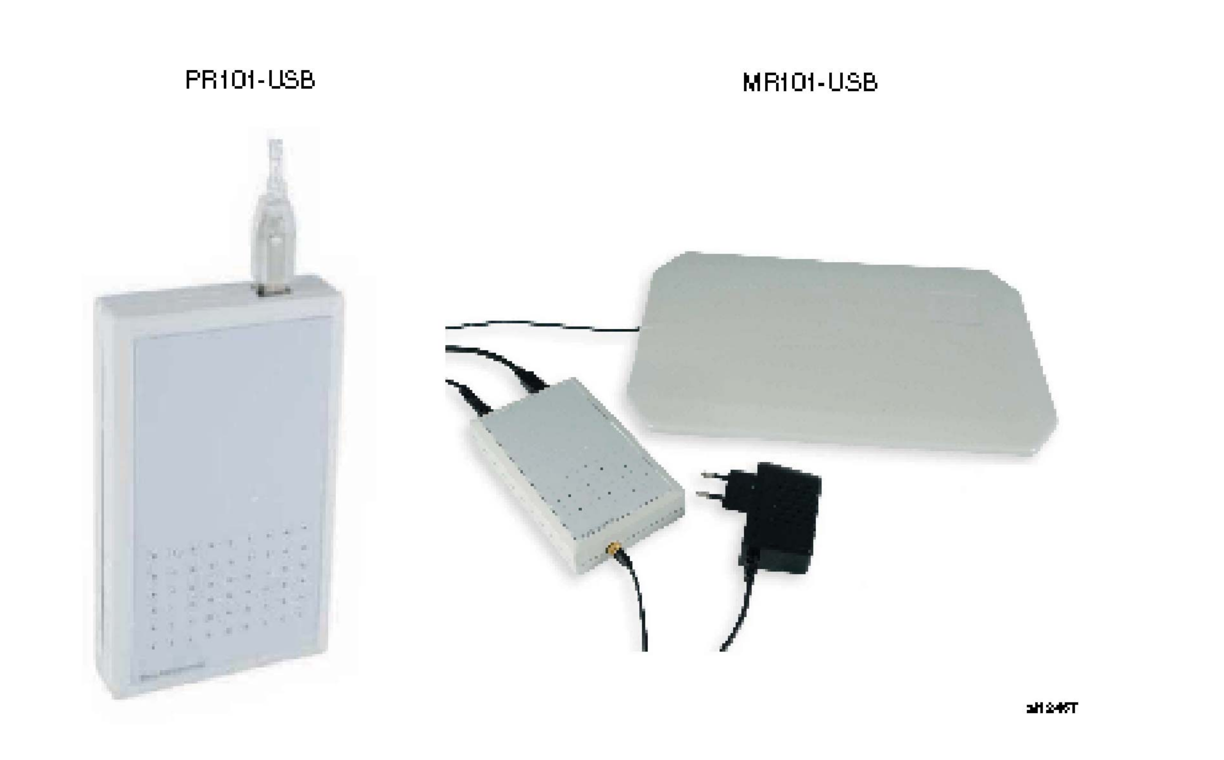
- PR101-USB FEIG reader is delivered within the DEMOKIT-M24LR-A (see *Figure 1*)
- MR101-USB FEIG reader is delivered within the DEVKIT-M24LR-A (see *Figure 1*).

This application note helps software engineers using and including the software delivered within the DEMOKIT-M24LR-A and the DEVKIT-M24LR-A in their own application. Code examples are also provided to illustrate how to send Visual Basic and C/C++ RF commands.

Note: 1 *For details on FEIG readers go to http://www.feig.de.*

2 *This application note complements FEIG development tool documentation and examples.*

Figure 1. PR101-USB and MR101-USB RF reader with integrated RF antenna



Contents

List of tables

List of figures

1 Description

1.1 M24LRXX dual interface EEPROM

The M24LRXX is a dual interface EEPROM which can be accessed either through an I^2C serial bus or a contactless interface using the ISO 15693 RFID protocol.

To easily access the M24LRXX content through its RF interface, ST offers several evaluation kits, among which are the DEMOKIT-M24LR-A and the DEVKIT-M24LR-A.

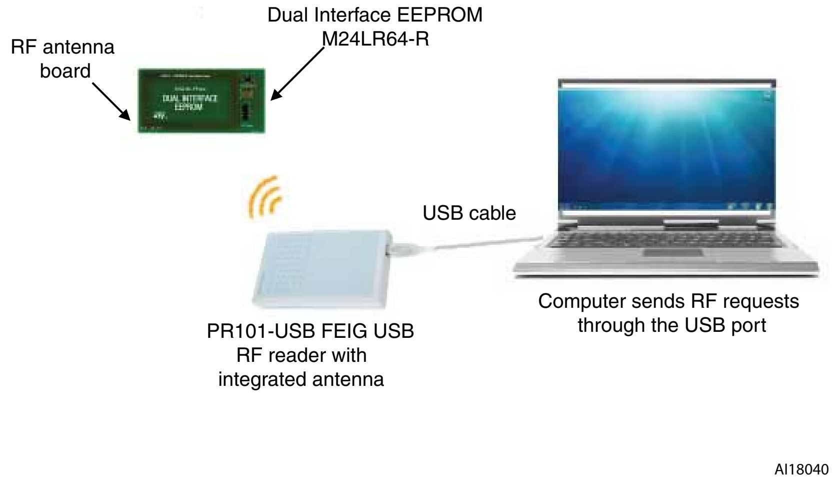
Refer to the product datasheet and to application note AN3163 “Configuring your ISO 15693 reader to support the M24LRXX” for more in-depth information on the M24LRXX and for explanations on the RF and I^2C communication protocols. Both documents are available from http://www.st.com.

1.2 PR101-USB and MR101-USB FEIG contactless readers

1.2.1 PR101-USB FEIG reader

The PR101-USB RF reader is delivered within ST DEMOKIT-M24LR-A. It supports the ISO 15693 protocol with high datarate transfers and one subcarrier to communicate with M24LRXX-based transponders by sending RF ISO 15693 commands. The reader is connected to the host-computer USB port (see *Figure 2*).

Figure 2. DEMOKIT-M24LR-A application schematics



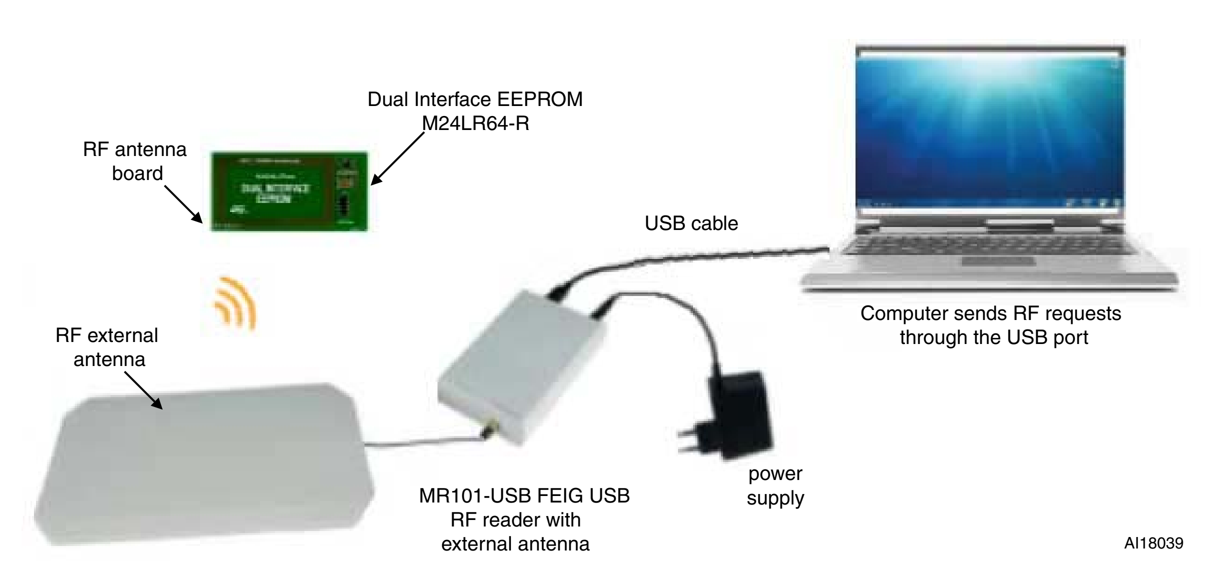
1.2.2 MR101-USB FEIG reader

The MR101-USB is connected to the host-computer USB port. It features an external antenna and is powered from an external power supply to increase the RF read range (see *Figure 3*).

The reader supports the ISO 15693 protocol with high datarate transfers and one subcarrier.

The MR101-USB RF reader is delivered within the DEVKIT-M24LR-A. It communicates with M24LRXX-based transponders using RF ISO 15693 commands.

Figure 3. DEVKIT-M24LR-A application schematics


Dual Interface EEPROM
M24LR64-R
RF antenna board
USB cable
RF external antenna
Computer sends RF requests through the USB port
MR101-USB FEIG USB RF reader with external antenna
power supply
AI18039

1.3 FEIG development toolchain

The PR101-USB and MR101-USB FEIG readers are driven by the same software. USB driver libraries, software development kits (free Windows SDK and other platform SDKs with charge) and OBID drivers can be downloaded from http://*www.feig.de*. To download FEIG software, go to http://www.feig.de and click **Download**. You can use STMicroelectronics customers' account:

User: stm_customer

Password: 01032010france

Refer to for *Appendix A* the list of FEIG reference document.

2 RF ISO 15693 commands

RF ISO 15693 commands are sent by the host computer to the M24LRXX transponders via the PR101-USB or MR101-USB reader RF interface. Two types of commands are available:

- High-level commands (see *Section 5*)

The host sends an already formatted request sent to the transponders via the reader RF interface. As an example, the High-level Inventory request launches an anticollision sequence to identify all the transponders present in the RF field and sends back the UID information to the host. Refer to *http://www.feig.de* for a description of the full set of high-level commands supported by the readers.

- Transparent commands (see *Section 6*).

  RF Transparent commands are sent by the host to the transponders via the reader RF interface. The Transparent commands transmit single or multiple frames compliant with the ISO 15693 protocol. Refer to the MR101-USB datasheet for a detailed description of the available Dual interface EEPROM command.

  The transponders answers are sent back to the computer.

Examples are included to allow you using, modifying the RF requests sent to the transponders, and decoding RF answers from the transponders. Both Visual Basic and C/C++ examples are provided.

3 Installation requirements

FEIG Windows SDK includes several .dll files which allow to drive all the FEIG USB readers in Visual Basic and C/C++ languages. They support all RF ISO 15693 commands.

The .dll files required to drive FEIG drivers are the following:

- Low level functions to drive USB readers
  - *FEUSB.dll* contains all the functions required for the PC to communicate through a USB interface.
  - *FEUSB.bas*: declaration file for Visual Basic project (VB6)
  - *FEUSB.h*: header file for C/C++ project
  - *FEUSB.lib:* declaration file for C/C++ project
- Medium level functions to driver any readers
  - *FEISC.dll* contains the functions required to perform basic communications through any communication interfaces
  - *FEISC.bas*: declaration file for Visual Basic project (VB6)
  - *FEISC.h*: header file for C/C++ project
  - *FEISC.lib:* declaration file for C/C++ project

Refer to *Section 4.1: Overview of reader detection and connection functions* for a detailed description of FEUSB.dll and FEISC.dll function.

Dll documentation and programming examples are available on the FEIG website *http://www.feig.de.*

3.1 Installing the .dll files

Follow the steps below to install the .dll files on your computer:

1. Copy the .dll files in C:/Windows/System32/:

   If you have installed the *M24LRxx_Application_Software*, then the *dll* files are already present in your Windows system folder.

2. Add the library files and header files to your software project:

   Before using the functions included in the .dll files, reference the .dll files in your software project. .h, .lib and .bas files are available for Visual Basic and C/C++ software development.

   a) Visual Basic project requirements:

      Insert FEUSB.bas and FEISC.bas in your Visual Basic project. These files contain all the High-level or Transparent commands with their declaration and their description. Below is are examples of the command that needs to be declared in your Visual Basic header file.

      USB management command for FEIG reader detection

```
Public Declare Function FEUSB_OpenDevice Lib
"FEUSB.DLL"(ByVal dwDeviceID As Long) As Long
```

High-level command declaration

```
Public Declare Function FEISC_0xB0_ISOCmd Lib "FEISC.DLL"
(ByVal iReaderHnd As Long, ByVal cBusAdr As Byte, ByVal
cReqData As String, ByVal iReqLen As Long, ByVal cRspData As
String, iRspLen As Long, ByVal iDataType As Long) As Long
```

Transparent mode command declaration

```
Public Declare Function FEISC_0xBF_ISOTranspCmd Lib
"FEISC.DLL" (ByVal iReaderHnd As Long, ByVal cBusAdr As Byte,
ByVal iMode As Long, ByVal iRspLength As Long, ByVal cReqData
As String, ByVal iReqLen As Long, ByVal cRspData As String,
iRspLen As Long, ByVal iDataType As Long) As Long ByVal
dwDeviceID As Long) As Long
```

b) C/C++ project requirements

When working in C/C++, insert FEUSB.h, FEUSB.lib, FEISC.h, FEISC.lib in your C/C++ project, and declare them in your source code header file:

```
#include "FEUSB.h"
#include "FEISC.h"
```

Below are examples of command declaration in C/C++.

USB management command for FEIG reader detection

```
int  DLL_EXT_FUNC FEUSB_OpenDevice( long nDeviceID );
```

High-level command declaration

```
int  DLL_EXT_FUNC FEISC_0xB0_ISOCmd(
   int iReaderHnd,
   unsigned char cBusAdr,
   unsigned char* cReqData,
   int iReqLen,
   unsigned char* cRspData,
   int* iRspLen,
   int iDataFormat );
```

Transparent mode command declaration

```
int  DLL_EXT_FUNC FEISC_0xBF_ISOTranspCmd(
int iReaderHnd,
unsigned char cBusAdr,
int iMode,
int iRspLength,
unsigned char* cReqData,
int iReqLen,
unsigned char* cRspData,
int* iRspLen,
int iDataFormat );
```

4 PR101-USB and MR101-USB reader detection

Prior to sending any RF command to a PR101-USB or an MR101-USB RF readers, the host computer must detect the reader. Once detected, a handle is randomly assigned to the reader.

This section presents all the available functions for performing reader detection. Visual Basic and C/C++ source code examples are also provided.

The readers are driven by the FEUSB and FEISC functions delivered in the ***FEUSB.dll*** and ***FEISC.dll*** files (see *Section 3: Installation requirements*).

Refer to Appendix *C.1* for the full list of error codes returned by the FEUSB functions.

4.1 Overview of reader detection and connection functions

FEUSB.dll and ***FEISC.dll*** include several functions allowing to detect or connect to a reader:

- **`FEUSB_ClearScanList`**

  This function re-initializes the USB detection process by clearing the list of scanned readers. Refer to *Section 4.1.1* for a detailed description of the function.
- **`FEUSB_Scan`**

  This function searches for all the USB FEIG readers connected to the USB ports of the host computer. Refer to *Section 4.1.2* for a detailed description of the function.
- **`FEUSB_GetScanListSize`**

  This function retrieves the number of detected readers. Refer to *Section 4.1.3* for a detailed description of the function.
- **`FEUSB_GetScanListPara`**

  This function gives access to all the detected reader information. Refer to *Section 4.1.4* for a detailed description of the function.
- **`FEUSB_OpenDevice`**

  This function opens a communication channel between a USB FEIG reader and the **FEUSB dll**, and assigns a handle to this channel. Refer to *Section 4.1.5* for a detailed description of the function.
- **`FEISC_NewReader`**

  This function opens a communication channel between a USB FEIG reader and the **FEISC dll**. The reader must have been previously detected by the `FEUSB_OpenDevice` function.Refer to *Section 4.1.6* for a detailed description of the function.

4.1.1 FEUSB_ClearScanList

FEUSB_ClearScanList Visual Basic prototype

Table 1 illustrates the FEUSB_`ClearScanList` Visual Basic function.

Table 1. `FEUSB_ClearScanList` Visual Basic function

Function description	
Declaration	`Public Declare Sub FEUSB_ClearScanList Lib "FEUSB.DLL"()`
Prototype	`Call FEUSB_ClearScanList`
Parameters	None
Returned value	None

FEUSB_ClearScanList C/C++ prototype

Table 2 illustrates the FEUSB_`ClearScanList` C/C++ function.

Table 2. `FEUSB_ClearScanList` C/C++ function

Function description	
Declaration	`void DLL_EXT_FUNC FEUSB_ClearScanList();`
Prototype	`FEUSB_ClearScanList();`
Parameters	None
Returned value	None

4.1.2 FEUSB_Scan

FEUSB_Scan Visual Basic prototype

Table 3 illustrates the FEUSB_`Scan` Visual Basic function.

Table 3. `FEUSB_Scan` Visual Basic function

Function description	
Declaration	`Public Declare Function FEUSB_Scan Lib "FEUSB.DLL" (ByVal iScanOpt As Long, oSearchOpt As FEUSB_SCANSEARCH) As Long`

Prototype	`Dim SearchOpt As FEUSB_SCANSEARCH`
	`lngScanValue = FEUSB_Scan(FEUSB_SCAN_ALL, SearchOpt)`

Parameters	**iScanOpt**: FEUSB_SCAN_FIRST: performs a search for the first device registered by the PC FEUSB_SCAN_NEXT: performs a search for the next device registered by the PC FESUB_SCAN_NEW : performs a search for a new connected device FEUSB_SCAN_ALL: performs a search for all devices connected to the USB port. FEUSB_SCAN_SEARCh: this parameter can be added to FEUSB_SCAN_ALL to perform a search for a specific device. **oSearchOpt**: This parameter contains the parameters of all the USB devices detected on the PC USB port.
Returned value	0: for FEUSB_SCAN_FIRST or FEUSB_SCAN_ALL if at least one USB device have been detected Index of the detected device if any: for FEUSB_SCAN_NEXT and FEUSB_SCAN_NEW Otherwise FEUSB error code
Example	lngScanValue = FEUSB_Scan (FEUSB_SCAN_ALL, FEUSB_SCAN_SEARCh, oSearchOpt) with oSearchOpt containing the indentifier of a specific device to be searched for.

FEUSB_Scan C/C++ prototype

Table 4 illustrates the FEUSB_`Scan` C/C++ function.

Table 4. **`FEUSB_Scan`** **C/C++ function**

Function description	
Declaration	`Public Declare Function FEUSB_Scan Lib "FEUSB.DLL" (ByVal iScanOpt As Long, SearchOpt As FEUSB_SCANSEARCH) As Long`

Prototype	`FEUSB_SCANSEARCH SearchOpt;`
	`iScanValue = FEUSB_Scan(FEUSB_SCAN_ ALL, &SearchOpt);`

Parameters	**iScanOpt**: FEUSB_SCAN_FIRST: performs a search for the first device registered by the PC FEUSB_SCAN_NEXT: performs a search for the next device registered by the PC FESUB_SCAN_NEW: performs a search for a new connected device FEUSB_SCAN_ALL: performs a search for all devices connected to the USB port. FEUSB_SCAN_SEARCh: this parameter can be added to FEUSB_SCAN_ALL to perform a search for a specific device. **SearchOpt**: This parameter contains the parameters of all the USB devices detected on the PC USB port.
Returned value	0: for FEUSB_SCAN_FIRST or FEUSB_SCAN_ALL if at least one USB device have been detected Index of the detected device if any: for FEUSB_SCAN_NEXT and FEUSB_SCAN_NEW Otherwise FEUSB error code

4.1.3 FEUSB_GetScanListSize

FEUSB_GetScanListSize Visual Basic prototype

Table 5 illustrates the FEUSB_`GetScanListSize` Visual Basic function.

Table 5. **`FEUSB_GetScanListSize`** **Visual Basic function**

Function description	
Declaration	`Public Declare Function FEUSB_GetScanListSize Lib "FEUSB.DLL" () As Long`
Prototype	`lngReaderNumber = FEUSB_GetScanListSize`
Parameters	None
Returned value	Number of readers connected to the computer USB port and detected by the `FEUSB_Scan` function Otherwise FEUSB error code.

FEUSB_GetScanListSize C/C++ prototype

Table 6 illustrates the FEUSB_`GetScanListSize` C/C++ function.

Table 6. **`FEUSB_GetScanListSize`** **C/C++ function**

Function description	
Declaration	`int  DLL_EXT_FUNC FEUSB_GetScanListSize();`
Prototype	`intReaderNumber = FEUSB_GetScanListSize();`
Parameters	None
Returned value	Number of readers connected to the computer USB port and detected by the `FEUSB_Scan` function Otherwise FEUSB error code.

4.1.4 FEUSB_GetScanListPara

FEUSB_GetScanListPara Visual Basic prototype

Table 7 illustrates the FEUSB_`GetScanListPara` Visual Basic function.

Table 7. **`FEUSB_GetScanListPara`** Visual Basic function

Function description	
Declaration	`Public Declare Function FEUSB_GetScanListPara Lib "FEUSB.DLL" (ByVal iIndex As Long, ByVal cPara As String, ByVal cValue As String) As Long`
Prototype	`error = FEUSB_GetScanListPara(iIndex, cPara, cValue)`
Parameters	**iIndex**: Device index number when several USB readers are connected to the computer USB port. **cPara**: Character string containing Device-ID: USB device serial number DeviceHnd: USB channel device handle FamilyName: Name of the device family corresponding to the device connected to the USB channel DeviceName: Name of the device connected to the USB channel Present: USB device if connected (cValue=1) or disconnected (cValue =0) **cValue**: Value returned by the reader depending on cPara.
Returned value	0: no error Otherwise FEUSB error code

FEUSB_GetScanListPara C/C++ prototype

Table 8 illustrates the FEUSB_`GetScanListPara` C/C++ function.

Table 8. **`FEUSB_GetScanListPara`** C/C++ function

Function description	
Declaration	`int  DLL_EXT_FUNC FEUSB_GetScanListPara( int iIndex, char* cParaID, char* cValue );`
Prototype	`error = FEUSB_GetScanListPara(iIndex, cPara, cValue);`
Parameters	**iIndex**: Device index number when several USB readers are connected to the computer USB port. **cPara**: character string containing Device-ID: USB device serial number DeviceHnd: USB channel device handle FamilyName: Name of the device family corresponding to the device connected to the USB channel DeviceName: Name of the device connected to the USB channel Present: USB device if connected (cValue=1) or disconnected (cValue =0) **cValue**: Value returned by the reader depending on cPara.
Returned value	0: no error Otherwise FEUSB error code

4.1.5 FEUSB_OpenDevice

FEUSB_OpenDevice Visual Basic prototype

Table 9 illustrates the FEUSB_`OpenDevice` Visual Basic function.

Table 9. `FEUSB_OpenDevice` Visual Basic function

Function description	
Declaration	`Public Declare Function FEUSB_OpenDevice Lib "FEUSB.DLL" (ByVal dwDeviceID As Long) As Long`
Prototype	`iHandle = FEUSB_OpenDevice(lngDeviceId(i))`
Parameters	**dwDeviceID**: The reader is detected by calling FEUSB_Scan. The FEUSB_GetScanListPara allows retrieving the value of the strDeviceHnd parameter that is converted in Long to obtain dwDeviceID.
Returned value	**iHandle**: USB reader handle for FEUSB functions Otherwise FEUSB Error code

FEUSB_OpenDevice C/C++ prototype

Table 10 illustrates the FEUSB_`OpenDevice` C/C++ function.

Table 10. `FEUSB_OpenDevice` C/C++ function

Function description	
Declaration	`int  DLL_EXT_FUNC FEUSB_OpenDevice( long nDeviceID );`
Prototype	`iDeviceHandle = FEUSB_OpenDevice(dwDeviceSerialNumber);`
Parameters	**dwDeviceID**: The reader is detected by calling FEUSB_Scan. The FEUSB_GetScanListPara allows retrieving the value of the strDeviceHnd parameter that is converted in Long to obtain dwDeviceID.
Returned value	**iHandle**: USB reader handle for FEUSB functions Otherwise FEUSB Error code

4.1.6 FEISC_NewReader

FEISC_NewReader Visual Basic prototype

Table 11 illustrates the FEISC_NewReader Visual Basic function.

Table 11. FEISC_NewReader Visual Basic function

Function description	
Declaration	`Public Declare Function FEISC_NewReader Lib "FEISC.DLL" (ByVal iPortHnd As Long) As Long`
Prototype	`lngAttachedDeviceHandle(1) = FEISC_NewReader(iHandle)`
Parameters	**iHandle**: USB reader handle which has been filled in after the reader detection process for FEUSB functions (FEUSB_OpenDevice)
Returned value	**IngAttachedDeviceHandle(1)**: USB reader handle for FEISC functions Otherwise FEISC error code

FEISC_NewReader C/C++ prototype

Table 12 illustrates the FEISC_NewReader C/C++ function.

Table 12. FEISC_NewReader C/C++ function

Function description	
Declaration	`int DLL_EXT_FUNC FEISC_NewReader( int iPortHnd );`
Prototype	`iFeiscHandle = FEISC_NewReader(iDeviceHandle)`
Parameters	**iHandle**: USB reader handle which has been filled in after the reader detection process for FEUSB functions (FEUSB_OpenDevice)
Returned value	**IngAttachedDeviceHandle(1)**: USB reader handle for FEISC functions Otherwise FEISC error code

4.2 Detection and connection sequence

The sequence required to perform reader detection and connection is the following:

1. Call the **FEUSB_ClearScanList** function to re-initialize the USB detection process.
2. Call the **FEUSB_Scan** function to create the list of USB readers connected to the host ports. The list is stored in the oSearch variable. An error code is sent back if no reader have been detected.
3. Call the **FEUSB_GetScanListSize** function to obtain the number of detected readers.
4. Call the **FEUSB_GetScanListPara** function to retrieve the data related to the detected readers, together with the identifiers (Device-ID) assigned to each detected reader.
5. Call the **FEUSB_OpenDevice** function to open a communication channel between an USB reader, identified by Device-ID, and the **FEUSB dll.** The function sends back the **USB handle** that will be used to manage further FEUSB communication with the reader.
6. Call the **FEISC_NewReader** function to open a communication channel between an USB reader, identified by its **USB handle**, and the **FEISC dll.** The function sends back the **attached device handle (**lngAttachedDeviceHandle variable) that will be used to manage further FEISC communication with the reader.

   The `detect_FEIG_USB_reader`() function returns TRUE if a FEIG USB reader is detected and FALSE otherwise.
7. When data transmissions and receptions have completed, call the `FEUSB_CloseDevice` function to close USB communication.

Hereafter are source code examples of reader detection and connection examples in Visual Basic and C/C++.

4.3 Visual Basic source code example

```
‘--- global variable to manage FEUSB handle
Public glngFEUSBhandle as long
‘--- global variable to manage FEISC handle
Public lngAttachedDeviceHandle() as long
'--- Detect FEIG USB readers (detected=true, non-detected=false) ---
Private Function detect_USB_FEIG_reader() As Boolean
  Dim Back As Long
  Dim i As Long
  Dim Cnt As Integer
  Dim Char As String
  Dim CharCnt As Integer
  Dim oSearch As FEUSB_SCANSEARCH
  Dim lngReaderNumber As Long
  Dim error As Long
  Dim DeviceHnd As Long

  Dim lngDeviceId(0 To 15) As Long
  Dim strFamilyName(0 To 15) As String
  Dim strDeviceName(0 To 15) As String
  Dim lngPresent(0 To 15) As Long
  Dim strDeviceHnd(0 To 15) As String * 8
  Dim strPresent(0 To 15) As String * 25
  Dim strDeviceID(0 To 15) As String * 8

  Dim dwHandle As Long
  Dim iHandle As Long

'init display
‘txtDetectResult.Text = ""
oSearch.iMask = 0

  '--- Clear Scan List (dll function)
  FEUSB_ClearScanList ' should be called before every scan process
  '--- scan and open in one process (dll function)
  DeviceHnd = FEUSB_Scan(FEUSB_SCAN_ALL, oSearch)

  If (DeviceHnd = FEUSB_ERR_NO_DEVICE_FOUND) Then
    '--- txtScannedReaders.Text = "NO READER DETECTED"
  Else
    '---Number of USB device connected
    lngReaderNumber = FEUSB_GetScanListSize
    For i = 1 To lngReaderNumber
      '--- Get System parameters of all detected USB devices
      error = FEUSB_GetScanListPara(0, "DeviceHnd", strDeviceHnd(i))
      error = FEUSB_GetScanListPara(0, "FamilyName",
strFamilyName(i))
      error = FEUSB_GetScanListPara(0, "DeviceName",
strDeviceName(i))
      error = FEUSB_GetScanListPara(0, "Present", strPresent(i))
      error = FEUSB_GetScanListPara(0, "Device-ID", strDeviceID(i))
      '--- decode lngDeviceHnd(i) value
      CharCnt = 0
      lngDeviceHnd(i) = 0
      For Cnt = 1 To 8
        Char = UCase(Mid(strDeviceHnd(i), 9 - Cnt, 1))
        If ((Char >= "0") And (Char <= "9")) Then
          lngDeviceHnd(i) = lngDeviceHnd(i) + (Asc(Char) - 48) * _
                           (16 ^ CharCnt)
          CharCnt = CharCnt + 1
        End If
        If ((Char >= "A") And (Char <= "F")) Then
          lngDeviceHnd(i) = lngDeviceHnd(i) + (Asc(Char) - 55) * _
                           (16 ^ CharCnt)
          CharCnt = CharCnt + 1
        End If
      Next Cnt
      '--- decode strFamilyName(i) value
      strFamilyName(i) = ""
      For Cnt = 1 To 25
        Char = UCase(Mid(strFamilyName(i), Cnt, 1))
        If (((Char >= "0") And (Char <= "9")) Or _
           ((Char >= "A") And (Char <= "Z")) Or _
```

```
     (Char = "-") Or (Char = ".") Or (Char = " ")) Then
        strFamilyName(i) = strFamilyName(i) & Char
  End If
Next Cnt
'--- decode strDeviceName(i) value
strDeviceName(i) = ""
For Cnt = 1 To 25
  Char = UCase(Mid(strDeviceName(i), Cnt, 1))
  If (((Char >= "0") And (Char <= "9")) Or ((Char >= "A") _
     And (Char <= "Z")) Or (Char = "-") Or (Char = ".") Or _
     (Char = " ")) Then
        strDeviceName(i) = strDeviceName(i) & Char
  End If
Next Cnt
'-- decode strDeviceID value
CharCnt = 0
lngDeviceId(i) = 0
For Cnt = 1 To 8
  Char = UCase(Mid(strDeviceID(i), 9 - Cnt, 1))
  If ((Char >= "0") And (Char <= "9")) Then
     lngDeviceId(i) = lngDeviceId(i) + (Asc(Char) - 48) * _
                     (16 ^ CharCnt)
     CharCnt = CharCnt + 1
  End If
  If ((Char >= "A") And (Char <= "F")) Then
    lngDeviceId(i) = lngDeviceId(i) + (Asc(Char) - 55) * _
                     (16 ^ CharCnt)
    CharCnt = CharCnt + 1
  End If
Next Cnt
'-- decode strPresent value
CharCnt = 0
lngPresent(i) = 0
For Cnt = 1 To 8
  Char = UCase(Mid(strPresent(i), 9 - Cnt, 1))
  If ((Char >= "0") And (Char <= "9")) Then
    lngPresent(i) = lngPresent(i) + (Asc(Char) - 48) * _
                   (16 ^ CharCnt)
    CharCnt = CharCnt + 1
  End If
  If ((Char >= "A") And (Char <= "F")) Then
    lngPresent(i) = lngPresent(i) + (Asc(Char) - 55) * _
                   (16 ^ CharCnt)
    CharCnt = CharCnt + 1
  End If
Next Cnt

'--- summary of Detected Device parameters for One USB device
'- txtDeviceHandle.Text = "DeviceHnd : " & lngDeviceHnd(i)
'- txtFamilyName.Text = "FamilyName : " & strFamilyName(i)
'- txtDeviceName.Text = "DeviceName : " & strDeviceName(i)
'- txtPresent.Text = "Present : " & CLng("&h" & lngPresent(i))
```

```
   '- txtDeviceID.Text = "Device-ID : " & lngDeviceId(i)
  Next i
 End If
'--- analysis if FEIG USB readers are connected and how much
 If (lngReaderNumber = 0) Then
   '--- NO FEIG USB device detected
   ‘txtDetectResult.Text = "No FEIG USB Reader detected"
   detect_USB_FEIG_reader = False
 ElseIf (lngReaderNumber > 1) Then
   '--- TOO MUCH DETECTED FEIG USB READERs
   ‘txtDetectResult.Text = "Too much FEIG USB Reader detected"
   detect_USB_FEIG_reader = False
 ElseIf (lngReaderNumber = 1) Then
  '--- only One FEIG USB device detected OK
  glngFEUSBhandle = FEUSB_OpenDevice(lngDeviceId(1))
  If (glngFEUSBhandle < 0) Then
   error = FEUSB_CloseDevice(glngFEUSBhandle)
   detect_USB_FEIG_reader = False
  Else
   lngAttachedDeviceHandle(0) = FEISC_NewReader(glngFEUSBhandle)
   detect_USB_FEIG_reader = True
  End If
 End If
End Function
```

4.4 C/C++ source code example

```
/* global variables */
int iDeviceHandle;
int iFeiscHandle;
int main ()
{
 char  sDeviceHandle[32];
 char  sDeviceName[32];
 char  sDeviceSerialNumber[32];
 char  sDeviceFamilyName[32];
 char  sDevicePresence[2];
 DWORD dwDeviceSerialNumber = 0;

 FEUSB_ClearScanList();/* check USB device connected */

 while (FEUSB_Scan(FEUSB_SCAN_FIRST,NULL) < 0)
 {
  /* time out to be added toexit while loop If no reader connected
*/
  /*return 0;
 }
/* GetScanListPara : Get Detected FEIG USB device parameters */
 FEUSB_GetScanListPara( 0, "DeviceName", sDeviceName ) ;
 FEUSB_GetScanListPara( 0, "Device-ID", sDeviceSerialNumber ) ;
 FEUSB_GetScanListPara( 0, "DeviceHnd", sDeviceHandle ) ;
```

```
  FEUSB_GetScanListPara( 0, "FamilyName", sDeviceFamilyName ) ;
  FEUSB_GetScanListPara( 0, "Present", sDevicePresence ) ;

/* convert receive data in hexa format */
sscanf((const char*)sDeviceSerialNumber, "%lx",
&dwDeviceSerialNumber);

  /* Open Communciation with one FEIG USB device */
  /* and get USB hanle for FEUSB functions */
  iDeviceHandle = FEUSB_OpenDevice(dwDeviceSerialNumber);

  if (iDeviceHandle < 0)
  {
    /* Error : USB connection problem */
    /* Close USB connection */
    iErr = FEUSB_CloseDevice(iDeviceHandle);
    return 0;
  }
/* Link FEIG USB device with FEISC functions */
  /* and get USB hanle */
  iFeiscHandle = FEISC_NewReader( iDeviceHandle );

  if (iFeiscHandle < 0)
  {
    /* Error : USB connection problem */
    /* Close USB connection */
    iErr = FEISC_DeleteReader( iFeiscHandle );
    return 0;
  }
  Else
  {
    /* USB connection OK */
    /* iDeviceHandle is handle for FEUSB functions */
    /* iFeiscHandle is handle for FEISC functions */
    return 1;
  }

}
```

5 RF ISO 15693 High-level commands

The `FEISC_0xB0_ISOCmd` function is part of the FEISC.dll. It allows sending predefined RF ISO 15693 commands to RF transponders via the FEIG readers, and retrieving the transponder answers. The reader is identified by its attached device handle contained in the lngAttachedDeviceHandle(1) variable which must have been previously filled in with the correct FEIG USB reader handle by calling the `FEISC_NewReader` function (see *Section 4.2: Detection and connection sequence*).

Among the ISO 15693 commands that can be used by FEIG readers to communicate with M24LRXX transponders are:

- Inventory: command code is ‘0x01 00’
- RESET TO READY: command code is ‘0x26 00’

Refer to the M24LRXX datasheet and to user manuals available from *http://www.feig.de* for the full list of RF ISO 15693 requests supported by the FEIG readers and ST M24LRXX Dual interface EEPROM.

Refer to *Section 5.1* for a general description of the `FEISC_0xB0_ISOCmd` function, and to *Section 5.2* and *Section 5.3* for details on the High-level Inventory and READY TO READY functions.

Refer to Appendix *C.2* for the full list of error codes returned by the FEISC functions.

5.1 FEISC_0xB0_ISOCmd general description

Table 13 and *Table 14* give the description of the FEISC_0xB0_ISOCmd function in Visual Basic and C/C++.

Table 13. FEISC_0xB0_ISOCmd Visual Basic prototype

Function description	
Prototype	`IngStatus = FEISC_0xB0_ISOCmd(lngAttachedDeviceHandle(1), &hFF,strReqData,lngReqDataLen,strRespData, lngRespDataLen,N)`
Parameters	**lngAttachedDeviceHandle(1)**: USB reader handle which has been filled in after the reader detection process (`FEISC_NewReader` function). **&hFF**: Communication address. **strReqData**: High-level command to be sent to the reader. **lngReqDataLen**: High-level command length. **strRespData**: Transponder answer (if any). This variable is filled after the USB request is issued. Before sending any USB request, **strRespData** must be formatted as follows: Dim strRespData As String * 512 **lngRespDataLen**: size of the RF answer (length of **strRespData**). **N**: Format of all the parameters passed to the function 0: ASCII. Example: ‘2356’ corresponds to the string ‘#V’ composed of 2 ASCII codes. 1: Characters. Example: ‘2356’ corresponds to 4 characters (2, 3, 5, 6) 2: Hexadecimal. Example: ‘2356’ corresponds to 2 bytes (&h23 and &h56)
Returned value	**lngStatus**: error code 0: USB request transmission successful 1: USB request transmission failed

Table 14. FEISC_0xB0_ISOCmd C/C++ prototype

Function description	
Prototype	`result = FEISC_0xB0_ISOCmd(iFeiscHandle, 0xFF, sReqData, iReqLen, sRspData,&iRspLen, N);`
Parameters	**IFeiscHandle**: USB reader handle which has been filled in after the reader detection process (`FEISC_NewReader` function). **0xFF**: Communication address. **sReqData**: High-level command to be sent to the reader. **iReqLen**: High-level command length. **sRspData**: Transponder answer (if any). This variable is filled after the USB request is issued. Before sending any USB request, **strRespData** must be formatted as follows: char sRspData[64]={0} **&iRspLen**: size of the RF answer (length of **sRspData**). **N**: Format of all the parameters passed to the function 0: ASCII. Example: ‘2356’ corresponds to the string ‘#V’ composed of 2 ASCII codes. 1: Characters. Example: ‘2356’ corresponds to 4 characters (2, 3, 5, 6) 2: Hexadecimal. Example: ‘2356’ corresponds to 2 bytes (0x23 and 0x56)
Returned value	**result**: error code 0: USB request transmission successful 1: USB request transmission failed

5.2 RF ISO 15693 High-level Inventory command

To issue an RF ISO 15693 High-level Inventory command, send the `FEISC_0xB0_ISOCmd` function with the strReqData set to ‘0100’ (Inventory request).

At the end of an inventory request, all the transponders are put in Quiet mode (ISO 15693 “STAY QUIET”). To be able to communicate with the detected transponder. A “RESET TO READY” RF request must be issued.

Below are code examples in Visual Basic and C/C++.

5.2.1 Example of High-level Inventory command Visual Basic source code

```
Private Function Cmd_Inventory_FEIG() As Boolean
Dim strReqData As String
Dim lngReqDataLen As Long
Dim lngRspLength As Long
Dim strRespData As String * 512
Dim lngRespDataLen As Long
Dim lngStatus As Long
Dim i As Long
Dim lngTranspNumber  As Long
Dim strtransponder As String
'init display
‘txtInventoryRF_answer.Text = ""
‘For i = 0 To 2
‘    txtTransponderUID(i).Text = ""
‘    txtTransponderDSFID(i).Text = ""
‘Next i

  ' Inventory request Host mode : 0x0100
  strReqData = "0100"
 lngReqDataLen = Len(strReqData)
' FEIG USB INVENTORY request in Host mode
  lngStatus = FEISC_0xB0_ISOCmd(lngAttachedDeviceHandle(0), &HFF, _
              strReqData, lngReqDataLen, strRespData, _
              lngRespDataLen, 1)

  ' RF INVENTORY REQUEST RESULT
  ' if(lngStatus = 0) then PASS else FAIL
  ' if (lngRespDataLen = 0) then No transponder answer
  ' else strRespData contains the transponder(s) answer(s)

    If (lngRespDataLen = 0) Then

        Cmd_Inventory_FEIG = False
        ‘txtInventoryRF_answer.Text = "No Tag answer detected"
    Else
        lngTranspNumber = CLng("&h" & Mid(strRespData, 1, 2))
        If (lngRespDataLen > 1 And lngTranspNumber > 3) Then
            Cmd_Inventory_FEIG = False
            ‘Too much Tags detected :
```

```
        Else
            Cmd_Inventory_FEIG = True
            `lngTranspNumber & " Tags Detected"
For i = 0 To lngTranspNumber - 1
               strtransponder = Mid(strRespData, 3 + (20 * (i)), 20)
            Next i
        End If
  End If

  ' after INVENTORY request, all transponders are in QUIET mode
  ' RESET TO READY request is sent to Wake Up transponders
  Call cmd_ResetToReadyRF_FEIG
End Function
```

5.2.2 Example of High-level Inventory command C/C++ source code

```
int Cmd_Inventory_FEIG (void)
{

  int entry3;
  int i;
  UCHAR sReqData[64]={0};
  UCHAR sRspData[64]={0};
  int   iReqLen,iRspLen;
  int   iResult, iResult2;
  int   iRspLength=56;

  /* Inventory request HOST MODE command : B0 + 0100 */
  sReqData[0] = (UCHAR)0x01;
  sReqData[1] = (UCHAR)0x00;
  iReqLen = 2;  /* (number of bytes :param=2 in request) */

  printf("\n\n\n\n");
  printf("\n>>> INVENTORY request in ISO mode : ");
  printf("\n    --> request : ");
  for (i=0; i<iReqLen; i++) printf("%.2x",sReqData[i]);

  /* FEIG USB INVENTORY request in HOST MODE command */
  iResult = FEISC_0xB0_ISOCmd(iFeiscHandle,0xFF,
                  sReqData, iReqLen,/* request */
                  &sRspData[0], &iRspLen,/* answer */
                  2);/* length format 2 : Number of Bytes */

  printf("\n    --> answer  : ");
  if (iRspLen == 0)
  printf("No tag answer received");
  else
  for (i=0; i<iRspLen; i++) printf("%c",sRspData[i]);

  printf("\n\n\n\n");
  printf("\npress any key to continue");
  printf("\n");
  scanf("%x", &entry3);

  /* RF INVENTORY REQUEST RESULT */
  /* if(iResult == 0) PASS else FAIL */
  /* if (iRspLen == 0) No transponder answer */
  /* else sRspData contains the transponder(s) answer(s) */
  if (iResult != 0)
  {
    /* No Tag detected in the Antenna Field */
  }
  else
  {
    /* 1 or more transponders are in Antenna Field */
  }


  /* after INVENTORY request, all transponders are in QUIET mode */
  /* RESET TO READY request is sent to Wake Up transponders */
  /* RESET TO READY  [0xB0] request */
  sReqData[0] = (UCHAR)0x26;
  sReqData[1] = (UCHAR)0x00;
  iReqLen = 2;  /* (number of bytes :param=2 in request) */

  iResult2 = FEISC_0xB0_ISOCmd(iFeiscHandle,0xFF,
            sReqData, iReqLen, /* request */
            &sRspData[0], &iRspLen,/* answer */
            2);/* length format 2 */

  if (iResult2 != 0)
  {
    /* Reset to ready request problem */
  }
  else
  {
    /* Reset to ready request OK */
  }

  return iResult;
}
```

5.3 RF ISO 15693 High-level RESET TO READY command

To issue an RF ISO 15693 High-level RESET TO READY command, send the `FEISC_0xB0_ISOCmd` function with the strReqData set to ‘0026’ (RESET TO READY request).

Below is an example of code in Visual Basic and C/C++.

5.3.1 RESET TO READY command Visual Basic source code example

```
Private Function cmd_ResetToReadyRF_FEIG() As Boolean

Dim strReqData As String
Dim lngReqDataLen As Long
Dim lngRspLength As Long
Dim strRespData As String * 512
Dim lngRespDataLen As Long
Dim lngStatus As Long

' Reset to Ready request Host mode : 0x2600
  strReqData = "2600"

  lngReqDataLen = Len(strReqData)

  ' FEIG USB INVENTORY request in Host Mode
  lngStatus = FEISC_0xB0_ISOCmd(lngAttachedDeviceHandle(0), &HFF, _
                   strReqData, lngReqDataLen, _
                                strRespData, lngRespDataLen, _
                                1)
         ' RF INVENTORY REQUEST RESULT
  ' if(lngStatus = 0) then PASS else FAIL
  ' if (lngRespDataLen = 0) then No transponder answer
  ' else strRespData contains the transponder(s) answer(s)

  If (lngRespDataLen = 0) Then
    cmd_ResetToReadyRF_FEIG = False
  Else
    cmd_ResetToReadyRF_FEIG = True
  End If
   End Function
```

6 RF ISO 15693 Transparent commands

The `FEISC_0xBF_ISOTranspCmd` function is part of the FEISC.dll. It allows sending any RF ISO 15693 request to RF transponders via the FEIG readers.

The reader is identified by its attached device handle contained in the lngAttachedDeviceHandle(1) variable which must have been previously filled in with the correct FEIG USB reader handle by calling the `FEISC_NewReader` function (see *Section 4.2: Detection and connection sequence*).

Several parameters must be passed to the `FEISC_0xBF_ISOTranspCmd` function to indicate to the reader the type of RF request, and the type of transponder answer expected.

Refer to *Section 6.1* for a general description of the `FEISC_0xB0_ISOCmd` function. All the requests described in the M24LRXX datasheet can be issued by using this method. *Section 6.2* and *Section 6.3* illustrate two examples of requests, the Read single block and Write single block request, which allow to read and write a single block of Dual interface memory.

For more informations about how to use Transparent commands, please refers to FEIG documentation available from *http://www.feig.de.*

6.1 FEISC_0xBF_ISOTranspCmd general description

Table 15 and *Table 16* give the description of the FEISC_0xBF_ISOTranspCmd function in Visual Basic and C/C++.

Table 15. FEISC_0xBF_ISOTranspCmd Visual Basic prototype

Function description	
Prototype	`IngStatus = FEISC_0xBF_ISOTranspCmd(lngAttachedDeviceHandle(1),&hFF, M, lngRspLength, strReqData, lngReqDataLen,strRespData,lngRespDataLen,N)`
Parameters	**lngAttachedDeviceHandle(1)**: USB reader handle which has been filled in after the reader detection process (`FEISC_NewReader` function). **&hFF**: Communication address. **M:** Mode. The method used by the Transparent command to detect the transponder answer depends on the mode. 1: answer detected after reception of a Read request 2: answer detected after reception of a Write request with Option_flag = 0. 3: answer detected after reception of a Write request with Option_flag = 1. 4: answer detected after reception of an Inventory request **lngRspLength:** Expected RF answer size (bit number) **strReqData**: RF request frame to be sent to the reader **lngReqDataLen**: RF request frame length (strReqData) **strRespData**: Transponder answer (if any). This variable is filled after the USB request is issued. Before sending any USB request, **strRespData** must be formatted as follows: Dim strRespData As String * 512 **lngRespDataLen**: strRespData length (0 if no answer) **N**: Format of all the parameters passed to the function 0: ASCII. Example: ‘2356’ corresponds to the string ‘#V’ composed of 2 ASCII codes. 1: Characters. Example: ‘2356’ corresponds to 4 characters (2, 3, 5, 6) 2: Hexadecimal. Example: ‘2356’ corresponds to 2 bytes (&h23 and &h56)
Returned value	**lngStatus**: error code 0: USB request transmission successful 1: USB request transmission failed

Table 16. FEISC_0xBF_ISOTranspCmd C/C++ prototype

Function description	
Prototype	`iResult = FEISC_0xBF_ISOTranspCmd(iFeiscHandle, 0xFF, M, iRspLength, &sReqData[0], iReqLen, &sRspData[0],&iRspLen, N);`
Parameters	**IFeiscHandle**: USB reader handle which has been filled in after the reader detection process (`FEISC_NewReader` function). **0xFF**: Communication address. **M:** Mode. The method used by the Transparent command to detect the transponder answer depends on the mode. 1: answer detected after reception of a Read request 2: answer detected after reception of a Write request with Option_flag = 0. 3: answer detected after reception of a Write request with Option_flag = 1. 4: answer detected after reception of an Inventory request **&iRspLength**: Expected RF answer size (bit number) **&sReqData**: RF request frame to be sent to the reader. **iReqLen**: RF request frame length (sReqData) **&sRspData**: Transponder answer (if any). This variable is filled after the USB request is issued. Before sending any USB request, **sRspData** must be formatted as follows: char sRspData[64]={0} **&isRspLen**: sRspData length (0 if no answer) **N**: Format of all the parameters passed to the function 0: ASCII. Example: ‘2356’ corresponds to the string ‘#V’ composed of 2 ASCII codes. 1: Characters. Example: ‘2356’ corresponds to 4 characters (2, 3, 5, 6) 2: Hexadecimal. Example: ‘2356’ corresponds to 2 bytes (0x23 and 0x56)
Returned value	**iResult**: error code 0: USB request transmission successful 1: USB request transmission failed

6.2 Issuing a Read single block request with a transparent command

Table 17 and *Table 18* give an example of parameters to be passed to the FEISC_0xBF_ISOTranspCmd function to issue a Transparent Read single block command. *Section 6.2.1* and *Section 6.2.2* describe code examples in Visual Basic and C/C++.

Table 17. Example of Read single block command in Visual Basic

FEISC_0xBF_ISOTranspCmd parameters	
Parameters	**lngAttachedDeviceHandle(0)**: USB Handle **&hFF**: Communication address **M:** 1: Read mode **lngRspLength**: 0x38 **strReqData**: 021F: Reader parameter 0A: RF protocol flag request 20: RF ISO 15693 Read single block command FA01: address &h01FA **lngReqDataLen**: 12 **strRespData**: answer from Transponder (if any) **lngRespDataLen**: size of strRespData **N:**1 (data expressed in characters)
Returned value	Error code
Example	`FEISC_0xBF_ISOTranspCmd(lngAttachedDeviceHandle(0),&hFF, 1, &h38, ‘021F0A20FA01’, lngReqDataLen, strRespData, lngRespDataLen, 1)`

Table 18. Example of Read single block command in C/C++

FEISC_0xBF_ISOTranspCmd parameters	
Parameters	**lFeiscHandle**: USB Handle **0xFF**: Communication address **M:** 1: Read mode **iRspLength**: 0x38 **sRqData**: 021F: Reader parameter 0A: RF protocol flag request 20: RF ISO 15693 Read single block command FA01: address 0x01FA **iReqLen**: 6 **sRspData**: answer from Transponder (if any) **lRspLen**: size of sRspData **N**: 2 (data expressed in hexadecimal bytes)
Returned value	Error code
Example	`iResult = FEISC_0xBF_ISOTranspCmd(iFeiscHandle, 0xFF, 1, iRspLength,'021F0A20FA01', iReqLen, &sRspData[0],&iRspLen, 2);`

6.2.1 Transparent Read single block command Visual Basic source code example

```
Private Function RFReadsingleBlock() As Boolean
Dim strReqData As String
Dim lngReqDataLen As Long
Dim lngRspLength As Long
Dim strRespData As String * 512 ' has to be formatted
Dim lngRespDataLen As Long
Dim lngStatus As Long
'init display
`txtReadRF_answer.Text = ""
`txtReadData.Text = ""
 lngRspLength = &H38 'response length (Feig USB Reader)

   ' RF READ SINGLE BLOCK request
   ' FEIG reader parameters 0X021F
   ' Flag  0x0A
   ' RF Read command 0X20
   ' Address 0x01FA : send FA01
 strReqData = "021F0A20FA01"
 lngReqDataLen = Len(strReqData)
' SEND COMMAND IN transparent mode
  lngStatus = _
    FEISC_0xBF_ISOTranspCmd(lngAttachedDeviceHandle(0), &HFF, _
               &H1, lngRspLength, _
        strReqData, lngReqDataLen, _
               strRespData, lngRespDataLen, _
```

```
       1)
' RF READ REQUEST RESULT
  ' if(lngStatus = 0) then PASS else FAIL
  ' if (lngRespDataLen = 0) then No transponder answer
  ' else strRespData contains the transponder answer

  If (lngRespDataLen = 0) Then
    RFReadsingleBlock = False
    `txtReadRF_answer.Text = "No detected Tag answer"
  Else
    If (Mid(strRespData, 1, 2) = "00") Then
        RFReadsingleBlock = True
       `txtReadRF_answer.Text = strRespData & " = read single block
OK"
        `txtReadData.Text = Mid(strRespData, 3, 8)
    Else
        RFReadsingleBlock = False
        `txtReadRF_answer.Text = strRespData & " = Error code"
    End If
  End If
End Function
```

6.2.2 Transparent Read single block command C/C++ source code example

```
int RFReadsingleBlock (void)
{
  int entry3;
  int i;
  int iRspLength=56;
  int iReqLen,iRspLen,iResult;
  unsigned char  sReqData[32]={0};
  unsigned char  sRspData[32]={0};
 /* RF READ SINGLE BLOCK request format */
  /* FEIG reader parameters : 021F*/
  /* Flag : 0A   */
  /* RF Read single block command : 20*/
  /* Address :01FA  (note : send FA01 = LSB BYTE first)*/
  /* request = 021F + 0A20FA01*/
 sReqData[0] = (UCHAR)0x02;
  sReqData[1] = (UCHAR)0x1F;
  sReqData[2] = (UCHAR)0x0A;
  sReqData[3] = (UCHAR)0x20;
  sReqData[4] = 0xFA
  sReqData[5] = 0x01
  iReqLen = 6; /* (number of characters :param=2 in request) */
 printf("\n\n\n\n");
 printf("\n>>> RF Read at adress %.2x%.2x : ",Address_parameter[0],
Address_parameter[1]);
  printf("\n    --> request : {021F} ");
  for (i=2; i<iReqLen; i++) printf("%.2X",sReqData[i]);
/* FEIG USB request in transparent mode */
```

```
  iResult = FEISC_0xBF_ISOTranspCmd (iFeiscHandle, 0xFF,
            1,      /* MODE 1 : read answer */
            iRspLength, sReqData,/* request */
            iReqLen,/* USB request length */
            &sRspData[0], &iRspLen,/* answer */
            2 );   /* length format 2 : Number of Bytes */
 printf("\n    --> answer  : ");
  if (iRspLen == 0)
  printf("No tag answer received");
  else
  for (i=0; i<iRspLen; i++) printf("%c",sRspData[i]);
  printf("\n\n\n\n");
  printf("\npress any key to continue");
  printf("\n");
  scanf("%x", &entry3);
 /* RF REQUEST RESULT */
  /* if(iResult == 0) PASS else FAIL */
  /* if (iRspLen == 0) No transponder answer */
  /* else sRspData contains the transponder answer */
return iResult;
}
```

6.3 Issuing a Write single block request with a transparent command

Table 19 and *Table 20* gives an example of parameters to be passed to the FEISC_0xBF_ISOTranspCmd function to issue a Transparent Write single block command. *Section 6.3.1* and *Section 6.3.2* describe code examples in Visual Basic and C/C++.

Table 19. Example of Write single block command in Visual Basic

FEISC_0xBF_ISOTranspCmd parameters	
Parameters	**lngAttachedDeviceHandle(0)**: USB Handle **&hFF**: Communication address= 0xFF **M:** 2: Write mode **lngRspLength**: &h18 **strReqData**: 021F: Reader parameter 0A: RF protocol flag request 21: RF ISO 15693 Write single block command FA01: address 0x01FA 01020304: data to be written **lngReqDataLen**: 20 **strRespData**: answer from Transponder (if any) **lngRespDataLen**: size of strRespData **N:**1 (data expressed in characters)
Returned value	Error code
Example	`FEISC_0xBF_ISOTranspCmd(lngAttachedDeviceHandle(0),&hFF ,2, 1, &h18, '021F0A21FA01`01020304', `lngReqDataLen, strRespData, lngRespDataLen, 1)`

Table 20. Example of Write single block command in C/C++

FEISC_0xBF_ISOTranspCmd parameters	
Parameters	**IFeiscHandle**: USB Handle **0xFF**: Communication address **M: 2** (Write mode) **IRspLength**: 0x18 **strReqData**: 021F: Reader parameter 0A: RF protocol flag request 21: RF ISO 15693 Write single block command FA01: address 0x01FA 01020304: data to be written **IReqLen**: 10 **&sRspData**: answer from Transponder (if any) **&IRspLen**: size of sRspData **N:** 2 (data expressed in hexadecimal bytes)
Returned value	Error code
Example	`iResult = FEISC_0xBF_ISOTranspCmd(iFeiscHandle, 0xFF, 2, iRspLength,’021F0A20FA01’, iReqLen, &sRspData[0],&iRspLen, 2);`

6.3.1 Transparent Write single block command Visual Basic source code example

```
Private Function WriteSingleBlockRF() As Boolean
Dim strReqData As String
Dim lngReqDataLen As Long
Dim lngRspLength As Long
Dim strRespData As String * 512 ' has to be formatted
Dim lngRespDataLen As Long
Dim lngStatus As Long
'init display
`txtWriteRF_answer.Text = ""
lngRspLength = &H18 'FEIG response length

  ' RF WRITE SINGLE BLOCK request
  ' FEIG reader parameters 0X021F
  ' Flag  0x0A
  ' RF Write Single Block command 0X21
  ' Address 0x01FA :  send FA01
  ' Data  0x01020304
 strReqData = "021F0A21FA0101020304"
 lngReqDataLen = Len(strReqData)
 lngStatus = _
    FEISC_0xBF_ISOTranspCmd(lngAttachedDeviceHandle(0), &HFF, _
&H2, lngRspLength, _
        strReqData, lngReqDataLen, _
         strRespData, lngRespDataLen, _
1)
```

```
  ' RF WRITE REQUEST RESULT
  ' if(lngStatus = 0) then PASS else FAIL
  ' if (lngRespDataLen = 0) then No transponder answer
  ' else strRespData contains the transponder answer
If (lngRespDataLen = 0) Then
    WriteSingleBlockRF = False
    `txtWriteRF_answer.Text = "No detected Tag answer"
  Else
    If (Mid(strRespData, 1, 2) = "00") Then
        WriteSingleBlockRF = True
        `txtWriteRF_answer.Text = strRespData & " = write single
block OK"
    Else
        WriteSingleBlockRF = False
        `txtWriteRF_answer.Text = strRespData & " = Error code"
    End If
  End If
End Function
```

6.3.2 Transparent Write single block command C/C++ source code example

```
int WriteSingleBlockRF (void)
{
  int entry3;
  int i;
  int iRspLength=0x18;
  int iReqLen,iRspLen,iResult;
  unsigned char  sReqData[32]={0};
  unsigned char  sRspData[32]={0};
 /* RF WRITE SINGLE BLOCK request format*/
  /* FEIG reader parameters : 021F*/
  /* Flag : 0A     */
  /* RF Write command : 21*/
  /* address : 01FA  (note: send FA01 = LSB BYTE first) */
  /* Data : 01020304*/
  /* request = 021F + 0A21FA0101020304*/
 sReqData[0] = (UCHAR)0x02;
  sReqData[1] = (UCHAR)0x1F;
  sReqData[2] = (UCHAR)0x0A;
  sReqData[3] = (UCHAR)0x21;
  sReqData[4] = Address_parameter[1];/* ex: 0x01FA -> FA 01 to be
sent */
  sReqData[5] = Address_parameter[0];
  sReqData[6] = Data_parameter[0];
  sReqData[7] = Data_parameter[1];
  sReqData[8] = Data_parameter[2];
  sReqData[9] = Data_parameter[3];
  iReqLen = 10; /* (number of characters :param=2 in request) */
 printf("\n\n\n\n");
```

```
  printf("\n>>> RF Write at adress %.2x%.2x data %.2x%.2x%.2x%.2x :
",Address_parameter[0],
Address_parameter[1],Data_parameter[0],Data_parameter[1],Data_param
eter[2], Data_parameter[3]);
  printf("\n    --> request : {021F} ");
  for (i=2; i<iReqLen; i++) printf("%.2X",sReqData[i]);
 iResult = FEISC_0xBF_ISOTranspCmd (iFeiscHandle, 0xFF,/* USB
parameters */
                  2,/* MODE 2 : write like answer */
                  iRspLength, sReqData,/* request */
                  iReqLen,/* USB request length */
                  &sRspData[0],&iRspLen,/* answer */
                  2 );/* length format 2 : Number of Bytes */

  printf("\n    --> answer  : ");
  if (iRspLen == 0)
   printf("No tag answer received");
  else
   for (i=0; i<iRspLen; i++) printf("%c",sRspData[i]);
  printf("\n\n\n\n");
  printf("\npress any key to continue");
  printf("\n");
  scanf("%x", &entry3);

  /* RF REQUEST RESULT */
  /* if(iResult == 0) PASS else FAIL */
  /* if (iRspLen == 0) No transponder answer */
  /* else sRspData contains the transponder answer */

  return iResult;
}
```

Appendix A FEIG reference documents

- Installation manual: M30100-3de-ID-B.pdf
- FEUSB manual: H00501-7e-ID-B.pdf
- FEISC manual: H9391-27e-ID-B.pdf
- Standard readers manual: H60700-2e-ID-B.pdf
- Standard readers manual: H60301-1e-ID-B.pdf

Appendix B Useful source code zip files

The AN3224.zip package contains two simple projects to test the RF ISO 15693 High-level and Transparent commands. These projects can be used to understand how to develop an application to communicate with the FEIG RF USB readers:

- AN3224_VB_sourcecode folder contains the Visual Basic project
- AN3224_C_sourcecode folder contains the C/C++ project,

The AN3224.zip package can be downloaded from http://www.st.com/dualeeprom.

Appendix C List of error codes

C.1 FEUSB error codes

The error codes which are returned by the FEUSB ISO 15693 and I^2C commands are the following:

C.1.1 Common errors

```
#define FEUSB_ERR_EMPTY_DEVICELIST            -1100
#define FEUSB_ERR_EMPTY_SCANLIST              -1101
#define FEUSB_ERR_POINTER_IS_NULL             -1102
#define FEUSB_ERR_NO_MORE_MEM                 -1103
#define FEUSB_ERR_SET_CONFIGURATION           -1104
#define FEUSB_ERR_KERNEL                      -1105
#define FEUSB_ERR_UNSUPPORTED_OPTION          -1106
#define FEUSB_ERR_UNSUPPORTED_METHOD          -1107
```

C.1.2 Scanning errors

```
#define FEUSB_ERR_NO_FEIG_DEVICE              -1110
#define FEUSB_ERR_NO_FEIG_DEVICE              -1110
#define FEUSB_ERR_SEARCH_MISMATCH             -1111
#define FEUSB_ERR_NO_DEVICE_FOUND             -1112
#define FEUSB_ERR_DEVICE_IS_SCANNED           -1113
#define FEUSB_ERR_SCANLIST_OVERFLOW           -1114
```

C.1.3 Handle errors

```
#define FEUSB_ERR_UNKNOWN_HND                 -1120
#define FEUSB_ERR_HND_IS_NULL                 -1121
#define FEUSB_ERR_HND_IS_NEGATIVE             -1122
#define FEUSB_ERR_NO_HND_FOUND                -1123
```

C.1.4 Communication errors

```
#define FEUSB_ERR_TIMEOUT                     -1130
#defineFEUSB_ERR_TIMEOUT                      -1130
#define FEUSB_ERR_NO_SENDDATA                 -1131
#define FEUSB_ERR_UNKNOWN_INTERFACE           -1132
#define FEUSB_ERR_UNKNOWN_DIRECTION           -1133
#define FEUSB_ERR_RECBUF_TOO_SMALL            -1134
#define FEUSB_ERR_SENDDATA_LEN                -1135
#define FEUSB_ERR_UNKNOWN_DESCRIPTOR_TYPE     -1136
#define FEUSB_ERR_DEVICE_NOT_PRESENT          -1137
```

C.1.5 Open/close device errors

```
#define FEUSB_ERR_DEVICE_NOT_SCANNED          -1140
#define FEUSB_ERR_DEVHND_NOT_IN_SCANLIST      -1141
#define FEUSB_ERR_DRIVERLIST                  -1142
```

C.1.6 Parameter errors

```
#define FEUSB_ERR_UNKNOWN_PARAMETER            -1150
#define FEUSB_ERR_PARAMETER_OUT_OF_RANGE       -1151
#define FEUSB_ERR_ODD_PARAMETERSTRING          -1152
#define FEUSB_ERR_INDEX_OUT_OF_RANGE           -1153
#define FEUSB_ERR_UNKNOWN_SCANOPTION           -1154
#define FEUSB_ERR_UNKNOWN_ERRORCODE            -1155
```

C.1.7 Identification errors

```
#define FEUSB_ERR_DEV_DESC_LENGTH              -1160
#define FEUSB_ERR_CFG_DESC_LENGTH              -1161
#define FEUSB_ERR_INTF_DESC_LENGTH             -1162
#define FEUSB_ERR_ENDP_DESC_LENGTH             -1163
#define FEUSB_ERR_HID_DESC_LENGTH              -1164
#define FEUSB_ERR_STRG_DESC_LENGTH             -1165
#define FEUSB_ERR_READ_DEV_DESCRIPTOR          -1166
#define FEUSB_ERR_READ_CFG_DESCRIPTOR          -1167
#define FEUSB_ERR_READ_STRG_DESCRIPTOR         -1168
#define FEUSB_ERR_MAX_INTERFACES               -1170
#define FEUSB_ERR_MAX_ENDPOINTS                -1171
#define FEUSB_ERR_MAX_STRINGS                  -1172
```

C.2 FEISC error codes

C.2.1 Common errors

```
#define FEISC_ERR_NEWREADER_FAILURE            -4000
#define FEISC_ERR_EMPTY_LIST                   -4001
#define FEISC_ERR_POINTER_IS_NULL              -4002
#define FEISC_ERR_NO_MORE_MEM                  -4003
#define FEISC_ERR_UNKNOWN_COMM_PORT            -4004
#define FEISC_ERR_UNSUPPORTED_FUNCTION         -4005
#define FEISC_ERR_NO_USB_SUPPORT               -4006
#define FEISC_ERR_OLD_FECOM                    -4007
```

C.2.2 Query errors

```
#define FEISC_ERR_NO_VALUE                     -4010
```

C.2.3 Handle errors

```
#define FEISC_ERR_UNKNOWN_HND                  -4020
#define FEISC_ERR_HND_IS_NULL                  -4021
#define FEISC_ERR_HND_IS_NEGATIVE              -4022
#define FEISC_ERR_NO_HND_FOUND                 -4023
#define FEISC_ERR_PORTHND_IS_NEGATIVE          -4024
#define FEISC_ERR_HND_UNVALID                  -4025
```

C.2.4 Communication errors

```
#define FEISC_ERR_PROTLEN                     -4030
#define FEISC_ERR_CHECKSUM                    -4031
#define FEISC_ERR_BUSY_TIMEOUT                -4032
#define FEISC_ERR_UNKNOWN_STATUS              -4033
#define FEISC_ERR_NO_RECPROTOCOL              -4034
#define FEISC_ERR_CMD_BYTE                    -4035
#define FEISC_ERR_TRANSCEIVE                  -4036
#define FEISC_ERR_REC_BUS_ADR                 -4037
```

C.2.5 Parameter errors

```
#define FEISC_ERR_UNKNOWN_PARAMETER           -4050
#define FEISC_ERR_PARAMETER_OUT_OF_RANGE      -4051
#define FEISC_ERR_ODD_PARAMETERSTRING         -4052
#define FEISC_ERR_UNKNOWN_ERRORCODE           -4053
#define FEISC_ERR_UNSUPPORTED_OPTION          -4054
#define FEISC_ERR_UNKNOWN_EPC_TYPE            -4055
```

C.2.6 Plug-in errors

```
#define FEISC_ERR_NO_PLUGIN                   -4060
#define FEISC_ERR_PLUGIN_PRESENT              -4061
#define FEISC_ERR_UNKNOWN_PLUGIN_ID           -4062
#define FEISC_ERR_PI_BUILD_DATA               -4063
#define FEISC_ERR_PI_BUILD_FRAME              -4064
#define FEISC_ERR_PI_SPLIT_FRAME              -4065
#define FEISC_ERR_PI_SPLIT_DATA               -4066
```

C.2.7 Communication data flow errors

```
#define FEISC_ERR_BUFFER_OVERFLOW             -4070
```

C.2.8 Task errors

```
#define FEISC_ERR_TASK_STILL_RUNNING          -4080
#define FEISC_ERR_TASK_NOT_STARTED            -4081
#define FEISC_ERR_TASK_TIMEOUT                -4082
#define FEISC_ERR_TASK_SOCKET_INIT            -4083
#define FEISC_ERR_TASK_BUSY                   -4084
#define FEISC_ERR_THREAD_CANCEL_ERROR         -4085
```

Revision history

Table 21. Document revision history

Date	Revision	Changes
15-Oct-2010	1	Initial release.
19-Sep-2011	2	Replaced part number “M24LR64-R” with “M24LRXX” throughout the document. Updated value of lngRspLength in *Table 19: Example of Write single block command in Visual Basic* and *Table 20: Example of Write single block command in C/C++*.

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