△ **Leuze electronic**

the sensor people

RFM series - the SMART solution
Stationary RFID read/write systems, transponders

TECHNICAL DESCRIPTION

▲ Leuze electronic

Leuze electronic GmbH + Co. KG
P.O. Box 1111, D- 73277 Owen / Teck
Tel. +49(0) 70 21 / 573-0,
Fax +49(0) 7021 / 573-199
info@leuze.de • www.leuze.com

Sales and Service

Germany	Sales Region North	Sales Region South	Sales Region East
	Phone 07021/573-306	Phone 07021/573-307	Phone 035027/629-106
	Fax 07021/9850950	Fax 07021/9850911	Fax 035027/629-107
	Postal code areas	Postal code areas	Postal code areas
	20000-38999	66000-96999	01000-19999
	40000-65999		39000-39999
	97000-97999		98000-99999

Worldwide

AR (Argentina)
Condelectric S.A.
Tel. Int. + 54 1148 361053
Fax Int. + 54 1148 361053

AT (Austria)
Schmachtl GmbH
Tel. Int. + 43 732 7646-0
Fax Int. + 43 732 7646-785

AU + NZ (Australia + New Zealand)
Balluff-Leuze Pty. Ltd.
Tel. Int. + 61 3 9720 4100
Fax Int. + 61 3 9738 2677

BE (Belgium)
Leuze electronic nv / sa
Tel. Int. + 32 2253 16-00
Fax Int. + 32 2253 15-36

BG (Bulgaria)
ATICS
Tel. Int. + 359 2 847 6244
Fax Int. + 359 2 847 6244

BR (Brasil)
Leuze electronic Ltda.
Tel. Int. + 55 11 5180-6130
Fax Int. + 55 11 5180-6141

CH (Switzerland)
Leuze electronic AG
Tel. Int. + 41 41 784 5656
Fax Int. + 41 41 784 5657

CL (Chile)
Imp. Tec. Vignola S.A.I.C.
Tel. Int. + 56 3235 11-11
Fax Int. + 56 3235 11-28

CN (China)
Leuze electronic Trading
(Shenzhen) Co. Ltd.
Tel. Int. + 86 755 862 64909
Fax Int. + 86 755 862 64901

CO (Colombia)
Componentes Electronicas Ltda.
Tel. Int. + 57 4 3511049
Fax Int. + 57 4 3511019

CZ (Czech Republic)
Schmachtl CZ s.r.o.
Tel. Int. + 420 244 0015-00
Fax Int. + 420 244 9107-00

DK (Denmark)
Leuze electronic Scandinavia ApS
Tel. Int. + 45 48 173200

ES (Spain)
Leuze electronic S.A.
Tel. Int. + 34 93 4097900
Fax Int. + 34 93 49035820

FI (Finland)
SKS-automaatio Oy
Tel. Int. + 358 20 764-61
Fax Int. + 358 20 764-6820

FR (France)
Leuze electronic Sarl.
Tel. Int. + 33 160 0512-20
Fax Int. + 33 160 0503-65

GB (United Kingdom)
Leuze electronic Ltd.
Tel. Int. + 44 14 8040 85-00
Fax Int. + 44 14 8040 38-08

GR (Greece)
UTECO A.B.E.E.
Tel. Int. + 30 211 1206 900
Fax Int. + 30 211 1206 999

HK (Hong Kong)
Sensortech Company
Tel. Int. + 852 26510188
Fax Int. + 852 26510388

HR (Croatia)
Tipteh Zagreb d.o.o.
Tel. Int. + 385 1 381 6574
Fax Int. + 385 1 381 6577

HU (Hungary)
Kvalix Automatika Kft.
Tel. Int. + 36 1 272 2242
Fax Int. + 36 1 272 2244

ID (Indonesia)
P.T. Yabestindo Mitra Utama
Tel. Int. + 62 21 92861859
Fax Int. + 62 21 6451044

IL (Israel)
Galoz electronics Ltd.
Tel. Int. + 972 3 9023456
Fax Int. + 972 3 9021990

IN (India)
M + V Marketing Sales Pvt Ltd.
Tel. Int. + 91 124 4121623
Fax Int. + 91 124 434233

IT (Italy)
Leuze electronic S.r.l.
Tel. Int. + 39 02 26 1106-43
Fax Int. + 39 02 26 1106-40

JP (Japan)
C. Illies & Co., Ltd.
Tel. Int. + 81 3 3443 4143
Fax Int. + 81 3 3443 4118

KE (Kenia)
Profa-Tech Ltd.
Tel. Int. + 254 20 828095/6
Fax Int. + 254 20 828129

KR (South Korea)
Leuze electronic Co., Ltd.
Tel. Int. + 82 31 3828228
Fax Int. + 82 31 3828522

MK (Macedonia)
Tipteh d.o.o. Skopje
Tel. Int. + 389 70 399 474
Fax Int. + 389 23 174 197

MX (Mexico)
Movitren S.A.
Tel. Int. + 52 81 8371 8616
Fax Int. + 52 81 8371 8588

MY (Malaysia)
Ingermark (M) SDN.BHD
Tel. Int. + 60 360 3427-88
Fax Int. + 60 360 3421-88

NG (Nigeria)
SABROW HI-TECH E. & A. LTD.
Tel. Int. + 234 80333 86366
Fax Int. + 234 80333 84463518

NL (Netherlands)
Leuze electronic BV
Tel. Int. + 31 418 65 35-44
Fax Int. + 31 418 65 38-08

NO (Norway)
Elteco A/S
Tel. Int. + 47 35 56 20-70
Fax Int. + 47 35 56 20-99

PL (Poland)
Balluff Sp. z o.o.
Tel. Int. + 48 71 338 49 29
Fax Int. + 48 71 338 49 30

PT (Portugal)
LA2P, Lda.
Tel. Int. + 351 21 4 447070
Fax Int. + 351 21 4 447075

RO (Romania)
O´BOYLE s.r.l
Tel. Int. + 40 2 56201346
Fax Int. + 40 2 56221036

RS (Republic of Serbia)
Tipteh d.o.o. Beograd
Tel. Int. + 381 11 3131 057
Fax Int. + 381 11 3018 326

RU (Russian Federation)
ALL IMPEX 2001
Tel. Int. + 7 495 9213012
Fax Int. + 7 495 6462092

SE (Sweden)
Leuze electronic Scandinavia ApS
Tel. Int. +46 380-490951

SG + PH (Singapore + Philippines)
Balluff Asia Pte Ltd
Tel. Int. + 65 6252 43-84
Fax Int. + 65 6252 90-60

SI (Slovenia)
Tipteh d.o.o.
Tel. Int. + 386 1200 51-50
Fax Int. + 386 1200 51-51

SK (Slowakia)
Schmachtl SK s.r.o.
Tel. Int. + 421 2 58275600
Fax Int. + 421 2 58275601

TH (Thailand)
Industrial Electrical Co. Ltd.
Tel. Int. + 66 2 642 6700
Fax Int. + 66 2 642 4250

TR (Turkey)
Leuze electronic San.ve Tic.Ltd.Sti.
Tel. Int. + 90 216 456 6704
Fax Int. + 90 216 456 3650

TW (Taiwan)
Great Cofue Technology Co., Ltd.
Tel. Int. + 886 2 2983 80-77
Fax Int. + 886 2 2985 33-73

UA (Ukraine)
SV Altera OOO
Tel. Int. + 38 044 4961888
Fax Int. + 38 044 4961818

US + CA (United States + Canada)
Leuze electronic, Inc.
Tel. Int. + 1 248 486-4466
Fax Int. + 1 248 486-6699

ZA (South Africa)
Countapulse Controls (PTY.) Ltd.
Tel. Int. + 27 116 1575-56
Fax Int. + 27 116 1575-13

01/2011

1 General information

1.1 Explanation of symbols

The symbols used in this operating manual are explained below.

Attention!
This symbol precedes text messages which must strictly be observed. Failure to comply with this information results in injuries to personnel or damage to the equipment.

Notice!
This symbol indicates text passages containing important information.

1.2 Declaration of conformity

The devices of the RFM (HF RFID, 13.56 MHz) series, including corresponding TFM transponders and MA… connector units, were developed and manufactured in accordance with the applicable European standards and directives.

Notice!
The Declarations of Conformity for the devices are available for download at www.leuze.com.

The manufacturer of the product, Leuze electronic GmbH + Co. KG in D-73277 Owen, possesses a certified quality assurance system in accordance with ISO 9001.

$C\epsilon$

1.3　　　Definition of terms / abbreviations

For better understanding of the explanations provided in this document, a definition of terms and explanations of the abbreviations follows below:

- **AFI:**
  Application **F**amily **I**dentifier = memory area 1 byte in size that specifies the area of application of the transponder, e.g., medicine, transportation, etc. The definition is specified in ISO/IEC 15693-3.

- **RFID:**
  Radio **F**requency **ID**entification – umbrella term for the contactless identification of objects equipped with transponders by means of radio waves.

- **HF:**
  High **F**requency – radio-frequency band in which data transmission between the read/ write system and transponder occurs. Data transmission occurs acc. to ISO/ IEC 15693 worldwide on frequency 13.56 MHz.

- **UID:**
  Unique **ID**entifier - unique, 64-bit transponder identification code.
  The UID consists of the chip manufacturer number and the chip serial number.

Notice!

Further information can be found in ISO/IEC 15693 and documents published by the chip manufacturer (NXP, Texas Instruments, Infineon, …).

2 Safety notices

2.1 General safety notices

Documentation

All entries in this technical description must be heeded, in particular those in section "Safety notices". Keep this technical description in a safe place. It should be available at all times.

Safety regulations

Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

Repair

Repairs must only be carried out by the manufacturer or an authorized representative.

2.2 Safety standards

The devices of the series RFM - HF RFID Series were developed, manufactured and tested in accordance with the applicable safety standards. They correspond to the state of the art.

2.3 Intended use

Attention!

The protection of personnel and the device is guaranteed only if the device is operated in a manner corresponding to its intended use.

The RFM 12/32/62 SL 200 model read/write systems based on radio frequency identification (RFID) are electronic devices for inductive data transmission from/to compatible code and data carriers, so-called transponders. The systems are used primarily for automatic object detection and material flow control. The MA 2xx connector units simplify the electrical connection of the RFM 12/32/62… read/write systems and facilitate the connection to various interfaces and fieldbus systems.

In particular, unauthorized uses include

- For medicinal purposes

Operation in potentially explosive areas

Available for use in rooms with explosive atmospheres are device variants RFM 32 SL 200 Ex n with certification for use in potentially explosive areas of Zones 2 (gas) and 22 (dust) (see chapter).

⚠️ **Attention!**

Operation of the RFM 32 SL 200 Ex n in potentially explosive areas is recommended only in combination with the TFM 0x 1x10.EX transponders from Leuze electronic, which are approved for use in potentially explosive areas!

Typical areas of application

The read/write systems of types RFM 12/32/62 SL 200 are specially designed for the following areas of application:

- Object recognition in handling and warehousing systems
- Commissioning systems in dispatch centers
- Flexible material flow control in assembly lines and daisy-chained manufacturing cells
- Acquisition of operational data

2.4 Safety notices for the RFM 32 SL 200 Ex n devices

Safety notices for use in potentially explosive areas of Group II, Category 3, Zones 2 ("Gas Ex") and 22 ("Dust Ex")

⚠️ **Attention!**

This product may only be used by qualified personnel and must only be used for the approved purpose. This sensor is not a safety sensor and is not to be used for the protection of persons.

Under unfavorable conditions and if used incorrectly in potentially explosive areas, the health of persons and, if applicable, of animals as well as the safety of property may be endangered.

Safe operation in potentially explosive areas is only possible if the equipment is used properly and for its intended purpose.

This requires that the installation and operating instructions are adhered to and that appropriate measures are taken to ensure that this is effectively and permanently ensured.

ⓘ **Notice!**

In order to achieve safe operation of devices of Group II, Category 3, in potentially explosive areas, installation and protective devices appropriate for the application must ensure that operational events do not damage or overload the equipment.

Installation, commissioning

In order to comply with the requirements acc. to EN 61241-1 and EN 60079-15, the following prerequisites must be met:

- Devices with connector must be equipped with an additional safeguard or a mechanical interlocking guard to avoid unintended separation of the connector. The warning sign "Do not disconnect under voltage" that is supplied with the device must be attached to the device or its mounting bracket so that it is clearly visible.
- Devices with terminal compartment lid must only be commissioned if the terminal compartment lid of the device is properly sealed.
- Connection cables and connectors must be protected from excessive pulling or pushing strain.
- The requirements according to EN 61241-1 regarding dust deposits and temperatures must be observed.

Attention!

- *Due to the physical circumstances, the devices must not be used for the protection of persons or for purposes of emergency shutdown.*
- *The sensors must only be installed and maintained by trained electricians.*
- *The applicable regulations for the installation of electrical equipment in potentially explosive areas must be observed.*
- *Operation of the RFM 32 SL 200 Ex n in potentially explosive areas is recommended only in combination with the TFM 0x 1x10.EX transponders from Leuze electronic, which are approved for use in potentially explosive areas!*

Repairs, maintenance

No changes may be made to the devices designed for potentially explosive areas.

Repairs to the devices may only be performed by persons trained for such work or by the manufacturer. Defective devices must be replaced immediately.

Cyclical maintenance of the devices is not necessary.

Depending on the environmental conditions, it may occasionally be necessary to clean the antenna surface of the devices. This cleaning must only be performed by appropriately trained persons. We recommend using a soft, clean cloth for this purpose. Cleaning agents containing solvents must not be used!

Chemical resistance

The read/write systems and the TFM 0x 1x10.EX transponders demonstrate good resistance against many diluted acids and bases.

Exposure to organic solvents is possible only under certain circumstances and only for short periods of time.

Resistance to chemicals should be examined on a case by case basis.

2.5   Working safely

⚠ ***Attention!***
Access to or changes on the devices, except where expressly described in this operating manual, are not authorized.

Safety regulations
Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

Qualified personnel
Mounting, commissioning and maintenance of the device must only be carried out by qualified personnel.
Electrical work must be carried out by a certified electrician.

3   Device description RFM - HF RFID Series

3.1   Information on the RFID read/write systems of the RFM series

The read/write systems of the RFM series are RFID devices suitable for industrial use that operate in the HF band at 13.56 MHz. They are equipped with an integrated decoder for the identification of standard transponders (data carriers) acc. to ISO/IEC 15693, such as NXP I-Code SLI, Texas Instruments Tag-it™ HF-I, Infineon my-d vicinity.

The RFID devices of the RFM series are available with various antenna sizes and operating ranges.

Figure 4.1: RFM device series

In general, the RFID devices of the RFM series are designed for handling and warehousing systems with small to medium operating ranges.

Extensive device configuration possibilities by means of the **RF-Config** software allow the system to be adapted to a number of reading tasks. The optimized reading distance,

combined with a very homogeneous field structure and a compact design, enables optimum use in container and pallet transport systems.

The devices are equipped with an integrated RS 232 interface for direct host connection.

With the help the various possibilities of the **MA...** modular connector units, the devices can be networked and coupled to typical fieldbus systems such as PROFIBUS DP, PROFINET, EtherNet, DeviceNet, etc.

3.2   Characteristics of the RFID read/write systems of the RFM series

3.2.1   General performance characteristics

- Very homogeneous electromagnetic field ensures very reliable detection
- Large opening angle (semi-spherical shape), thus a large reading field width
- Compact construction, optimized for the operating range
- Reliable detection of the transponder while at a standstill and while in motion through activation (trigger)
- Configurable functions following a trigger: read with preset block range, write
- Online commands for customized, fast access to data
- Pre-transmission of write data to the RFM device (Precharge function)
- Support of the transponder-specific functions
- Visualization of the most important operating states by means of bright LEDs
- Switching input for triggering a read process/write process
- Switching output for signaling states
- RS 232 serial interface
- Industrial design in protection class IP 65/IP 67
- Easy-to-use RF-Config configuration software available via free download

### 3.2.2   Special additional characteristics of the RFM 12 SL 200

Performance characteristics RFM 12 SL 200
- Focussed field for detection in difficult (metal) environments
- Especially well suited for use with workpiece holders and fixtures

Typical reading behavior of the RFM 12 SL 200

Transponder TFM 02…
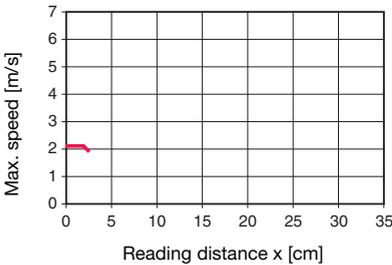
Typ. reading behavior

Max. speed [m/s] — Reading distance x [cm]

Transponder TFM 03/04…

Typ. reading behavior

Max. speed [m/s] — Reading distance x [cm]

Transponder TFM 05/06…

Typ. reading behavior

Max. speed [m/s] — Reading distance x [cm]
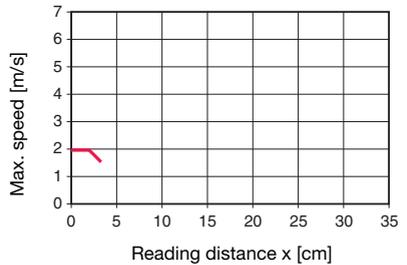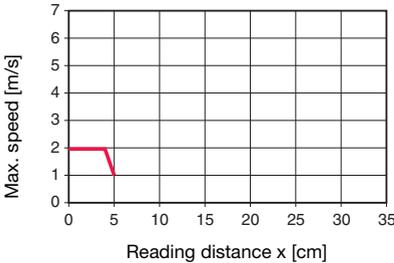
Figure 3.1:   Typical reading behavior - RFM 12 read-write unit

⚠ *Attention!*
The values specified may deviate as a result of temperature influences, installation site, read angle, etc.

3.2.3 Special additional characteristics of the RFM 32 SL 200

Performance characteristics RFM 32 SL 200

- Suitable for universal use thanks to compact construction and good detection range
- Especially well suited for use between rollers in container or pallet applications
- Up to 4 transponders in field simultaneously

Typical reading behavior RFM 32 SL 200
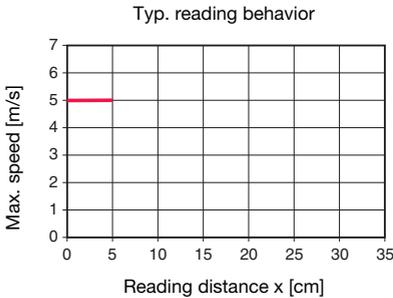
**Transponder TFM 02…**   **Transponder TFM 03/04…**
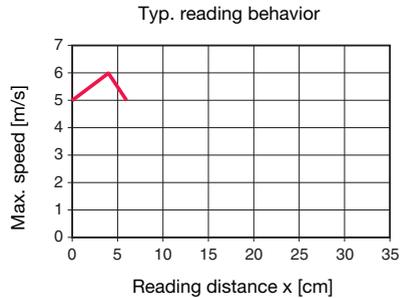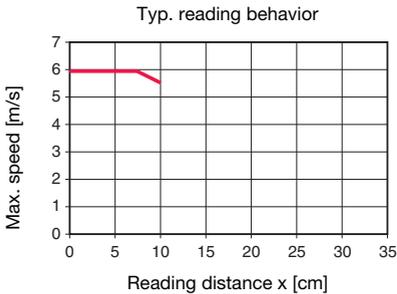
Transponder TFM 05/06…   **Transponder TFM 08…**
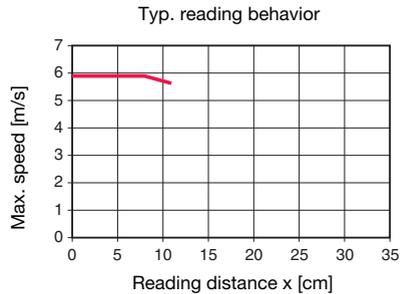
Figure 3.2:   Typical reading behavior - RFM 32 read-write unit

⚠ *Attention!*

The values specified may deviate as a result of temperature influences, installation site, read angle, etc.

3.2.4   Special additional characteristics of the RFM 32 SL 200 Ex n

Performance characteristics of the RFM 32 SL 200 Ex n

- Suitable for universal use thanks to compact construction and good detection range
- Especially well suited for use between rollers in container or pallet applications
- Up to 4 transponders in field simultaneously
- **Certified for use in potentially explosive areas in Zones 2 (gas) and 22 (dust)**

Typical reading behavior of the RFM 32 SL 200 Ex n

Transponder TFM 03… Ex n   **Transponder TFM 05… Ex n**
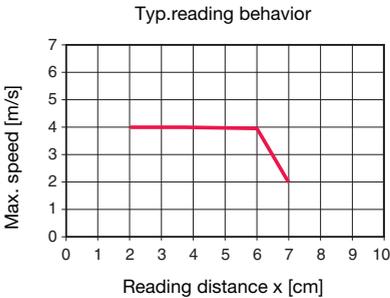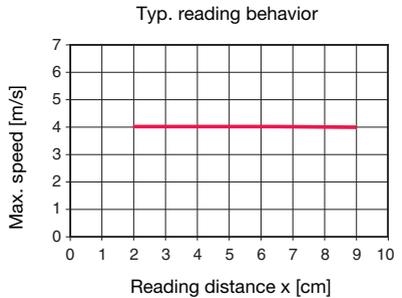
Figure 3.3:   Typical reading behavior - RFM 32 Ex n read-write unit

⚠ **Attention!**
The values specified may deviate as a result of temperature influences, installation site, read angle, etc.

3.2.5   Special additional characteristics of the RFM 62 SL 200

Performance characteristics RFM 62 SL 200

- Large detection range with semiautomatic adjustment function for metal environments
- Especially well suited for use along the side of the transport system for container transport
- Up to 8 transponders in field simultaneously

Typical reading behavior RFM 62 SL 200

Transponder TFM 02…

Typ. reading behavior

Max. speed [m/s] vs Reading distance x [cm]

Transponder TFM 03/04…

Typ. reading behavior

Max. speed [m/s] vs Reading distance x [cm]

Transponder TFM 05/06…

Typ. reading behavior

Max. speed [m/s] vs Reading distance x [cm]

Transponder TFM 08…

Typ. reading behavior

Max. speed [m/s] vs Reading distance x [cm]

Figure 3.4:   Typical reading behavior - RFM 62 read-write unit

⚠ **Attention!**
The values specified may deviate as a result of temperature influences, installation site, read angle, etc.

3.2.6   Device construction
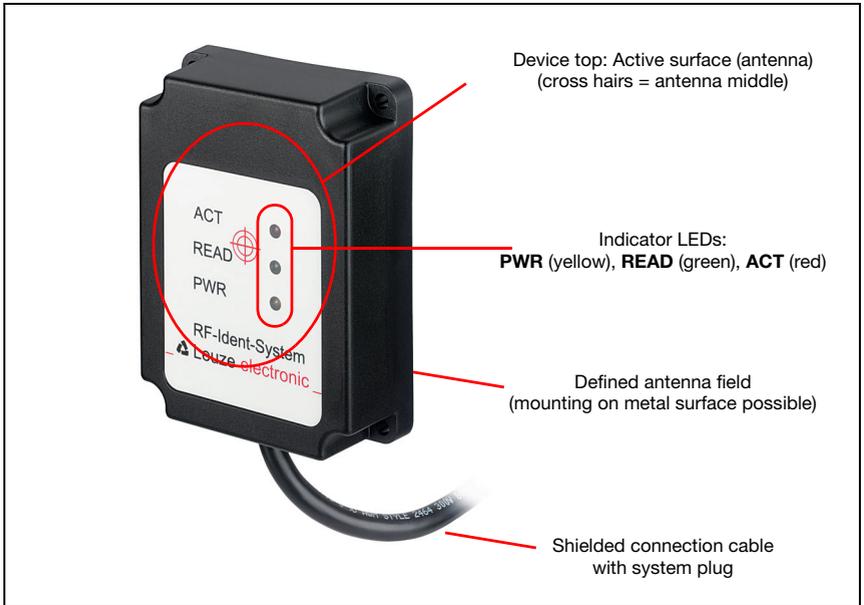
Figure 3.5:   Device construction using the RFM 32 as an example

3.3   Read and write techniques

RFID devices with working frequency of 13.56 MHz (HF) form a spherical, homogeneous electromagnetic field around the antenna. The operating range varies depending on the device type. The transponder that is used (antenna geometry) also has a significant influence. For exact data, please refer to the specifications of the read/write systems (see also "Typical reading behavior" from page 11).

The front of the device (black) or the active side (equipped with LEDs, depends on model) must not be enclosed by metal. A metal surface in the read field will likewise reduce the operating range.

Notice!

The antenna surfaces of transponder and read/write system should be as parallel with one another as possible at the read/write position.

Areas of application

- Object recognition in handling and warehousing systems
- Commissioning systems in dispatch centers
- Flexible material flow control in assembly lines and daisy-chained manufacturing cells
- Acquisition of operational data
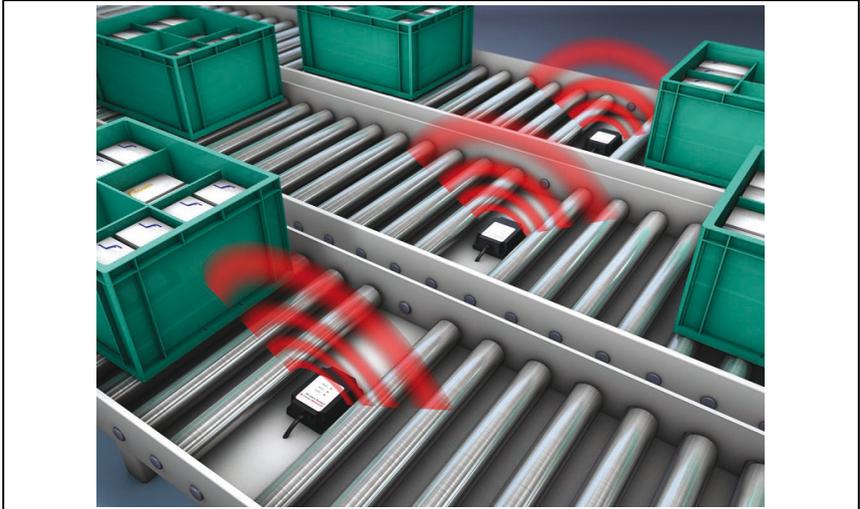
Figure 3.6:   Reading from below (container or pallet)
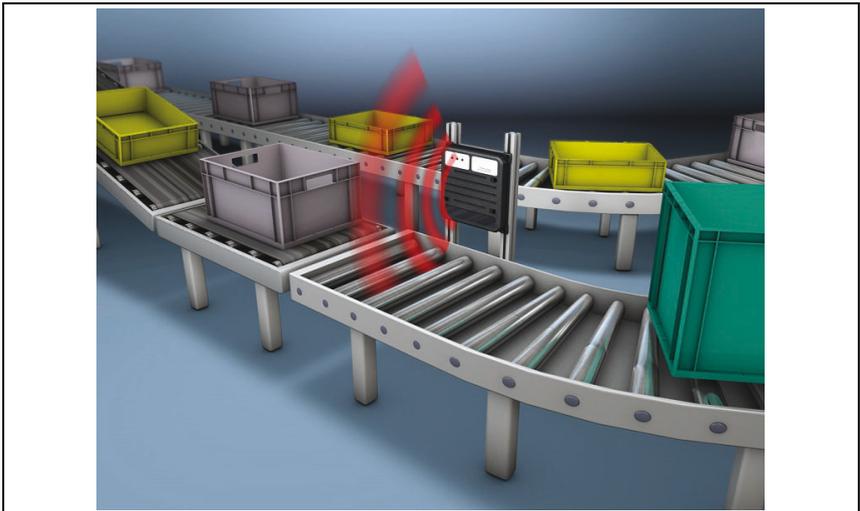
Figure 3.7:   Lateral reading (containers)
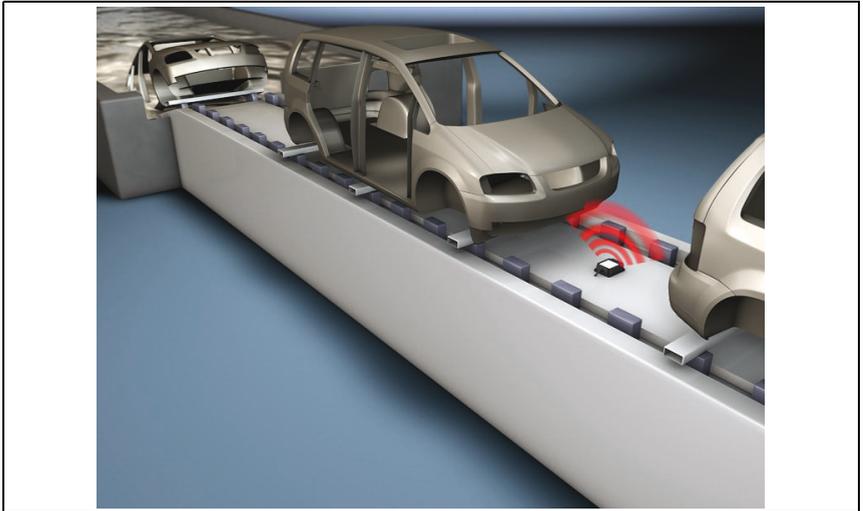
Figure 3.8:　　Reading from below (skid)

The detection field can only be attenuated, and the function thus impaired, by metal surfaces and/or fluids on the transponder or RFM housing.

For this reason, we recommend the use of a nonmetal spacer between transponder and base (e.g., spacer 50 HT which fits the disc transponders with a diameter of 50mm), whereby a spacer height of 10mm is sufficient for a range of approx. 50mm.

For the read/write system, it is recommended that a space in front of and along the sides equal to the "device dimensions + half the operating range" be kept completely free of metal in order optimize performance (reading speed and operating range).

If, due to structural reasons, a metal surface is to enclose most of the device, a slit should be sawed into one side of the surface in order to interrupt the metal short circuit for the detection field.

Acceptable function and operating range can be achieved in this way even in metal.

3.4   Standalone connection

The RFID devices of the RFM family can be operated as standalone single stations. For the electrical connection via the preinstalled cable (length: 1 m), the supply voltage, the interface and the switching input/output are connected via a suitable MA 2 connector unit.
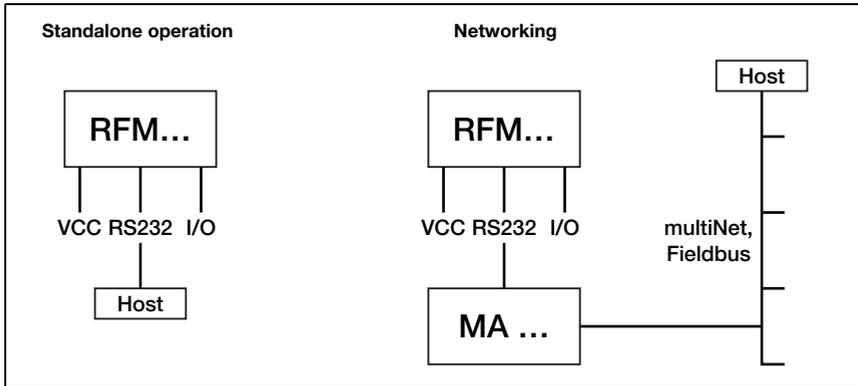
Figure 3.9:   Standalone connection / networking

3.5   Networking - Leuze multiNet plus

Up to 30 RFM read/write systems can be networked via one MA 31 network master. For this purpose, an MA 21 100.2 with unique station address is connected to each RFM read/write system. Networking is via a parallel connection of the individual RS 485 interfaces of the respective MA 21 100.2 units.

Leuze multiNet plus

In Leuze's proprietary **multiNet plus** network, the individual network devices transmit their data upon request through the MA 31 network master in sequence. In addition, each network device (MA 21 100.2) declared as a slave receives a device address which is set with the aid of the rotary switch on the MA 21 100.2.

The master then transmits the data of all network devices to a primary PLC or a computer via its host interface, i.e., it "collects" the data in the network and transmits it via an interface to the host computer. This reduces interface costs (CPs) and time spent programming the software.

Two-wire RS 485

The Leuze **multiNet plus** is optimized for fast transmission of scanner data to a primary host computer. Physically, it consists of a two-wire RS 485 interface that is controlled by a software protocol, the Leuze **multiNet plus** protocol. As a result, wiring of the network is simple and economical, since the network connection is simply looped from one slave to the next.

For the Leuze **multiNet plus**, a shielded, double-strand cable with twisted strands should be used. This makes possible a total network length of up to 1200 m. The M12 connection technology simplifies wiring here.

3.6   Leuze multiScan

The multiScan operation mode is based on the Leuze **multiNet plus** and links individual readings from multiple RFID devices into a single read result. This is used, for example, on a packet conveyor system on which the transponder can be affixed on the right side, on the left side or on top, thereby requiring three read stations. So that the host does not need to process one decoding result and two "No Reads", i.e. three readings for each package, a **multiScan** arrangement is used to ensure that the **multiScan** master passes only one reading from the three read stations to the host. As a result, the read/write system network looks like just one RFID device to the host on the outside!

For this purpose, a **multiScan** master and one or more **multiScan** slaves are connected together via the RS 485 interface. The **multiScan** function on the RS 485 interface is possible for a minimum of 2 and a maximum of 30 devices.

The protocol set on the RS 485 interface is the **multiNet** protocol. As a result, during **multiScan** operation on the RS 485 interface, the **multiNet** master also becomes a **multiScan** master and the **multiNet** slaves become **multiScan** slaves (all **multiNet** slaves are, thus, integrated in **multiScan** operation).

3.7 Fieldbus systems

Various **MA…** modular connector units are available for connecting to a range of different fieldbus systems, such as PROFIBUS DP, ProfiNet, EtherNet, etc.

For simple electrical connection of the RFM to the MA…, the cable with the system plug on the cable end can be plugged in directly to the MA.

Description	Designation	Part no.
RS232 to Leuze Multinet (slave), device connection with system plug, service interface in the MA… for device configuration	MA 21 100.2	50103125
RS232 to RS485 converter, device connection with terminals, service interface in the MA… for device configuration	MA 21 100	50030481
RS232 to RS422 converter, device connection with terminals, service interface in the MA… for device configuration	MA 21 130	50030484
RS232 to RS232 protocol converter with elect. isolation, device connection with terminals, service interface in the MA… for device configuration	MA 21 110	50030482
RS232 gateway to Profibus DP, device connection with system plug, service interface in the MA… for device configuration	MA 204i	50112893
RS232 gateway to Ethernet TCP / IP, device connection with system plug, service interface in the MA… for device configuration	MA 208i	50112892
RS232 gateway to CANopen, device connection with system plug, service interface in the MA… for device configuration	MA 235i	50114154
RS232 gateway to EtherCAT, device connection with system plug, service interface in the MA… for device configuration	MA 238i	50114155
RS232 gateway to PROFINET IO RT, device connection with system plug, service interface in the MA… for device configuration	MA 248i	50112891
RS232 gateway to DeviceNet, device connection with system plug, service interface in the MA… for device configuration	MA 255i	50114156
RS232 gateway to EtherNet/IP, device connection with system plug, service interface in the MA… for device configuration	MA 258i	50114157

4 Specifications

4.1 General specifications of the RFM 12 SL 200 read/write systems

General specifications

Working frequency	13.56 MHz
Reading range [1]	max. 45 mm, 35 mm recommended (transponder Ø 50 mm)
Writing range [1]	max. 40 mm, 30 mm recommended (transponder Ø 50 mm)
Data carrier speed [1]	max. 2.0 m/s
Memory access	write/read - approx. 50 ms/block typical
Data protocols	ISO 15693, e.g., NXP I-Code (1+2), Texas Instruments Tag-It / Tag-It HFI, Infineon my-d vicinity

Electrical data

Operating voltage VCC		12 … 30 VDC
Power consumption		approx. 0.9 W, 35 mA typ. at 24 VDC
Host interface		RS 232
	Baud rate	9600
	Protocol	8 data bits, 1 stop bit, 1 start bit, no parity
Data frame		STX **DATA** CRLF
	Prefix 1	02h = STX
	Postfix 1	0Dh = CR
	Postfix 2	0Ah = LF

Indicators

LED green	Switching output

Mechanical data

Housing	M30 metal bushing with ABS front, black
Weight	210 g
Dimensions	Ø 30 mm, 98 mm long

Environmental data

Ambient temp. (operation/storage)	-25 °C … +65 °C/-40 °C … +70 °C
Relative air humidity	5 … 90 % (non-condensing)
Standards and directives	R&TTE 1999/5/EC, EN 60950-1, EN 300330-2, EN 301489-1/3
Protection class	IP 67 acc. to EN 60529

1) Depends on transponder, reading type and reading distance used

4.2   General specifications of the RFM 32 SL 200 read/write systems (Ex n)

General specifications	**RFM 32 SL 200**	**RFM 32 SL 200 Ex n**
Working frequency	13.56 MHz	
Reading range [1]	max. 110 mm, 85 mm recommended (transponder Ø 50 mm)	
Writing range [1]	max. 95 mm, 70 mm recommended (transponder Ø 50 mm)	
Data carrier speed [1]	max. 6.0 m/s	max. 5.0 m/s
Memory access	write/read - approx. 50 ms/block typical	
Data protocols	ISO 15693, e.g., NXP I-Code (1+2), Texas Instruments Tag-It / Tag-It HFI, Infineon my-d vicinity	

Electrical data

Operating voltage VCC	12 … 30 VDC	
Power consumption	max. 1.2 W, typ. 45 mA at 24 VDC	
Host interface	RS 232	
Baud rate	9600	
Protocol	8 data bits, 1 stop bit, 1 start bit, no parity	
Data frame	STX **DATA** CRLF	
Prefix 1	02h = STX	
Postfix 1	0Dh = CR	
Postfix 2	0Ah = LF	

Indicators

LED green	read process (not online!)	
LED yellow	voltage supply	
LED red	activation (trigger)	

Mechanical data

Housing	ABS, black	ABS, black, molded
Weight	approx. 280 g	approx. 500 g
Dimensions	101.5 x 75.5 x 30 mm	

Environmental data

Ambient temp. (operation/storage)	-25 °C … +65 °C/ -40 °C … +70 °C	-25 °C … +60 °C/ -40 °C … +70 °C
Relative air humidity	5 … 90 % (non-condensing)	
Standards and directives	R&TTE 1999/5/EC, EN 60950-1, EN 300330-2, EN 301489-1/3	R&TTE 1999/5/EC, 94/9/EC EN 50021 EN 60950-1, EN 300330-2, EN 301489-1/3
Protection class	IP 67 acc. to EN 60529	

Explosion protection

Certification (CENELEC)		⟨Ex⟩ II 3G Ex nA IIB T4
		⟨Ex⟩ II 3D Ex tD A22 IP67 T80°C

[1] Depends on transponder, reading type and reading distance used, and the temperature. Above an ambient temperature of 50°C, the operating range decreases by up to 20%.

4.3   General specifications of the RFM 62 SL 200 read/write systems

General specifications

Working frequency	13.56 MHz
Reading range [1]	max. 400 mm, 260 mm recommended (transponder Ø 50 mm)
Writing range [1]	max. 320 mm, 220 mm recommended (transponder Ø 50 mm)
Data carrier speed [1]	max. 6.0 m/s
Memory access	write/read - approx. 50 ms/block typical
Data protocols	ISO 15693, e.g., NXP I-Code (1+2), Texas Instruments Tag-It / Tag-It HFI, Infineon my-d vicinity

Electrical data

Operating voltage VCC	12 … 30 VDC
Power consumption	approx. 2 W, 90 mA typ. at 24 VDC
Data interface	RS 232
Baud rate	9600
Protocol	8 data bits, 1 stop bit, 1 start bit, no parity
Data frame	STX **DATA** CRLF
Prefix 1	02h = STX
Postfix 1	0Dh = CR
Postfix 2	0Ah = LF

Indicators

LED green	read process (not online!)
LED yellow	voltage supply
LED red	activation (trigger)

Mechanical data

Housing	ABS plastic, black
Weight	approx. 500 g
Dimensions	298 x 298 x 33.5 mm

Environmental data

Ambient temp. (operation/storage)	-25 °C … +65 °C/-40 °C … +70 °C
Relative air humidity	5 … 90 % (non-condensing)
Standards and directives	R&TTE 1999/5/EC, EN 60950-1, EN 300330-2, EN 301489-1/3
Protection class	IP 65 acc. to EN 60529

1) Depends on the transponder used

4.4 General specifications of the TFM transponders… (non-Ex)

General specifications

Working frequency	13.56 MHz
Read distance	see diagrams
Data carrier speed	max. 6.0 m/s (see diagrams from page 11), dependent on reader
Data storage	112 / 256 / 1024 bytes, transponder dependent, see chapter 7.7
Memory access	write/read - approx. 50 ms/block
	min. 100,000 write cycles typical, min. 10 years of data retention
Material	self-adhesive transponder: paper/PET foil with pressure-sensitive adhesive
	disc/high-temperature transponder: Epoxy/Royalplast/PA6/PPS
	keyring/card transponder: PET/PVC
	spacer: Ultramid/PPS
Color	self-adhesive transponder: white
	disc transponder: black
	high-temperature transponder: brown/black
	keyring/card transponder: white
	spacer: black

4.5 Temperature data of the TFM… transponders (non-Ex)

Transponder	Operating temperature 1)						Storage temperature						Storage temperature, for limited time			
	0 °C … +50 °C	-20 °C … +50 °C	-20 °C … +70 °C	-25 °C … +85 °C	-25 °C … +100 °C	-40 °C … +85 °C	-20 °C … +50 °C	-20 °C … +70 °C	-25 °C … +85 °C	-40 °C … +85 °C	-25 °C … +120 °C	-25 °C … +200 °C	up to +140 °C	up to +200 °C	up to +210 °C	up to +250 °C
TFM 02 1125.220				●							●		● 100 h			
TFM 03 1110.210			●								●					
TFM 04 1190.230			●								●					
TFM 05 1110.210			●								●					
TFM 03 1510.210				●						●			● 1000 h			
TFM 05 1510.210				●						●			● 1000 h			
TFM 02 2210.210		●					●									
TFM 05 2210.210		●					●									
TFM 06 2225.220		●					●									
TFM 03 5125.220			●								●					
TFM 03 1910.219			●				●									
TFM 05 1910.219			●				●									
TFM 08 2125.220			●						●							
Spacer 30 HT											●					●
Spacer 50 HT											●					●
Spacer 85 HT											●					
BT TFMx26											●					●

1) ⚠ **Operating temperature**:
temperature range in which the data to/from the transponder are written and read

Other data in the high-temperature range

Transponder	Operation temperature [1]						Storage temperature						Storage temperature, for limited time [2]			
	0°C ... +50°C	-20°C ... +50°C	-20°C ... +70°C	-25°C ... +85°C	-25°C ... +100°C	-40°C ... +85°C	-20°C ... +50°C	-20°C ... +70°C	-25°C ... +85°C	-40°C ... +85°C	-25°C ... +120°C	-25°C ... +200°C	up to +200°C	up to +210°C	up to +220°C	up to +250°C
TFM 05 2610.210 [3] up to 220°C					●					●			● 1000 h or ● 2000 cycles (of 45 min and > 1.5 h cooling (passive)	● 400 h or ● 1000 cycles (of 30 min and > 2 h cooling (passive)	● 100 h or ● 500 cycles (of 15 min and > 2 h cooling (passive)	
TFM 08 1610.210 up to 220°C				●								●	● 4000 h or ● 3000 cycles (of 40 min and > 1.5 h cooling (passive)		● 1000 h or ● 1500 cycles (of 30 min and > 2 h cooling (passive)	

1) ⚠ **Operating temperature**:
   Temperature range in which the data to/from the transponder are written and read.

2) Cycles of +20°C up to the specified value, without quick heating.

3) **Part being discontinued!**

4.6　General specifications of the TFM 0x 1x10.EX **Ex-transponders**

General specifications

Working frequency	13.56 MHz
Data protocol	I-Code SLI
Memory size	1024 bits
User data	896 bits / 112 bytes
Memory structure	32 blocks with 32 bits (4 bytes) each
Memory access	write/read
Read distance	see diagrams
Data carrier speed	max. 4.0 m/s (see Diagrams)
Data storage	see tables
Memory access	write/read - approx. 50 ms/block
	min. 100,000 write cycles typical, min. 10 years of data retention

Mechanical data

Material	PA6 / PU
Color	black
Weight	0.045 kg (TFM05) / 0.01 kg (TFM03)
Dimensions	see dimensioned drawing

Environmental data

Ambient temp. (operation/ storage)[1]	TFM 03 1110.EX:	-25 °C … +60 °C / -25 °C … +85 °C
	TFM 05 1110.EX:	-25 °C … +60 °C / -40 °C … +90 °C
	TFM 05 1510.EX:	-25 °C … +60 °C / -40 °C … +120 °C
Protection class	IP 67	
Standards applied	EN 50014:1997-A1-A2 (general regulations)	
	EN 50020:2002 (intrinsic safety)	
	94/9/EC explosion protection product directive	

Explosion protection

Certification (CENELEC)　　〈Ex〉 II 3G Ex nA IIB T4

　　　　　　　　　　　　　〈Ex〉 II 3D Ex tD A22 IP67 T80°C

1) Observe ATEX approval area

4.7   Dimensioned drawings

Figure 4.1:   Dimensioned drawing of the RFM 12 SL 200 read/write system

Figure 4.2:   Dimensioned drawing of the RFM 32 SL 200 and RFM 32 SL 200 Ex n read/write systems
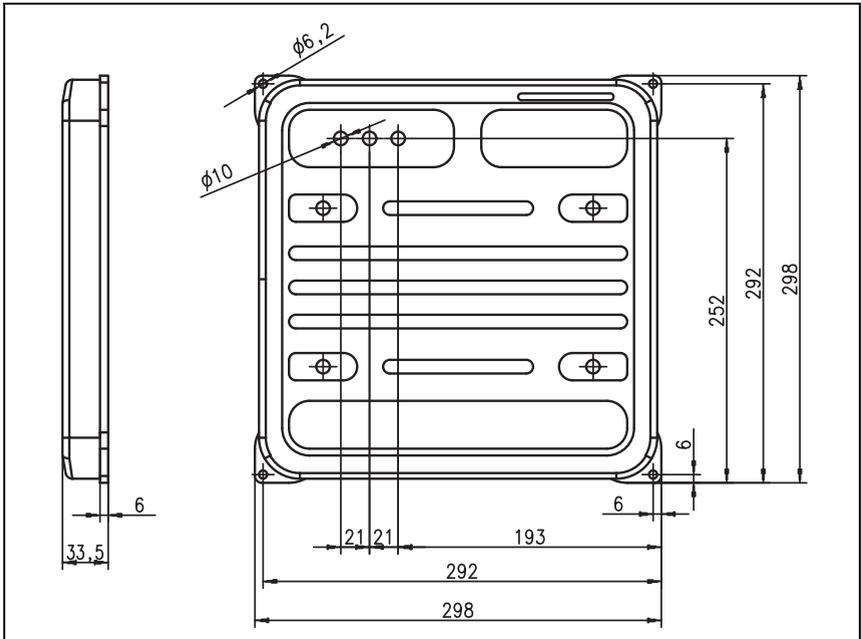
Figure 4.3: Dimensioned drawing of the RFM 62 SL 200 read/write system
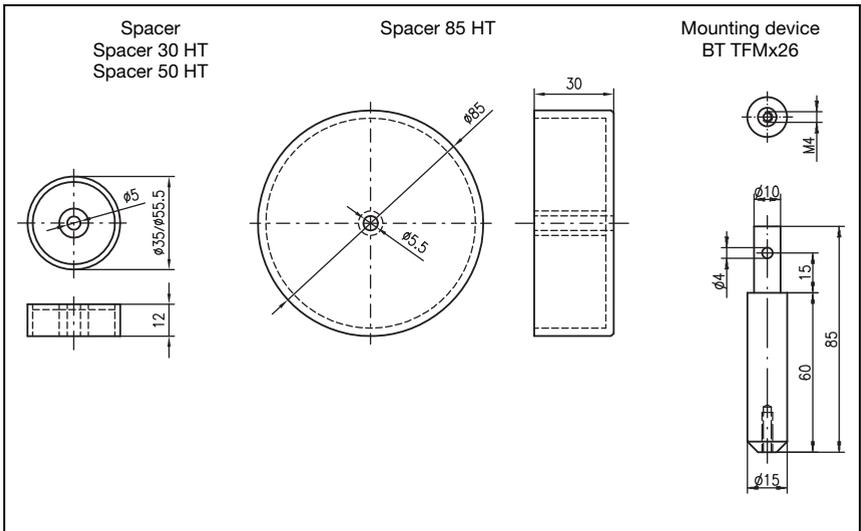
Figure 4.4: Dimensioned drawing of spacer/mounting devices for transponders

TFM 02 1125.220

TFM 02 2210.210
TFM 08 2125.220

TFM 03 1910.219
TFM 05 1910.219

TFM 05 2610.210

TFM 03 1110.210
TFM 03 1510.210

TFM 04 1190.230
TFM 05 1110.210

TFM 05 2210.210
TFM 06 2225.220

TFM 05 1510.210

TFM 03 5125.220

TFM 08 1610.210
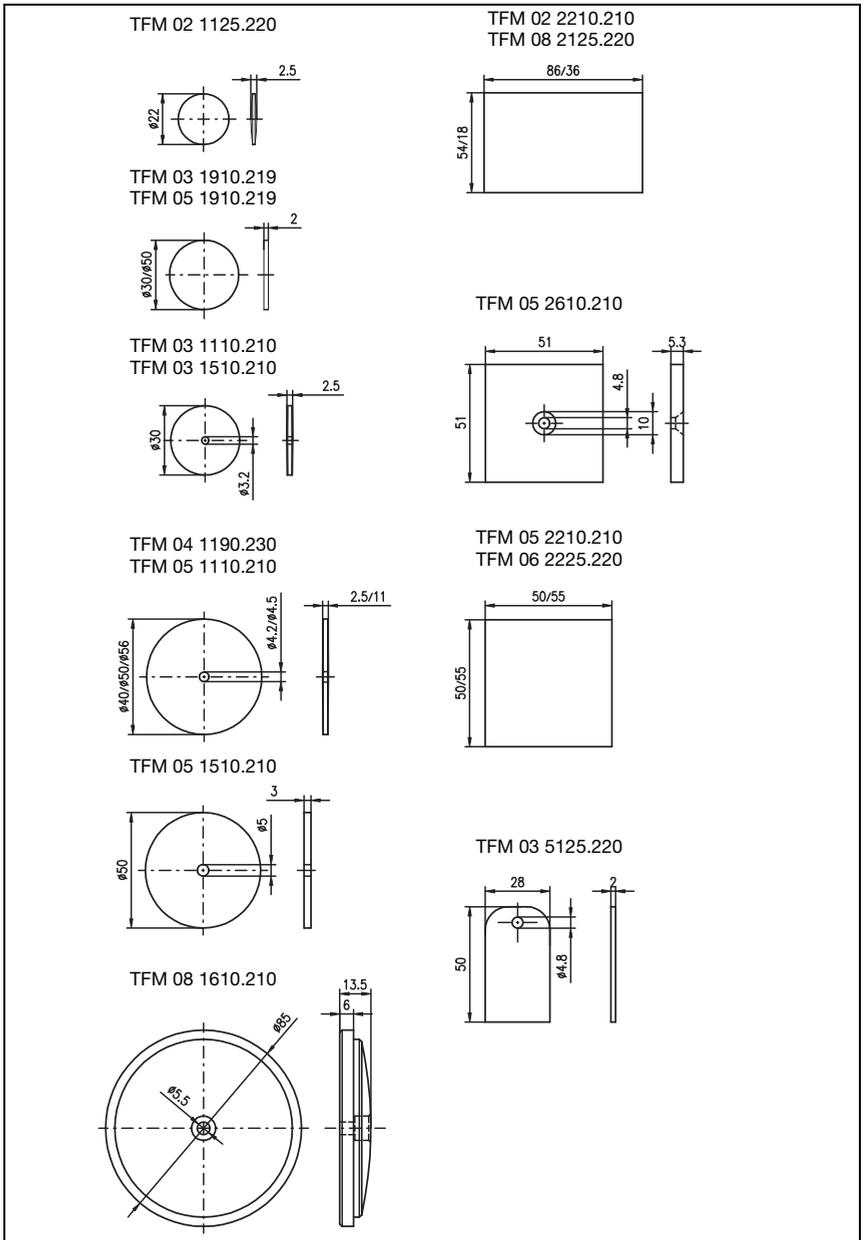
Figure 4.5:   Dimensioned drawing of the TFM… (non-Ex) transponders

TFM 03 1110.EX

TFM 05 1110.EX
TFM 05 1510.EX
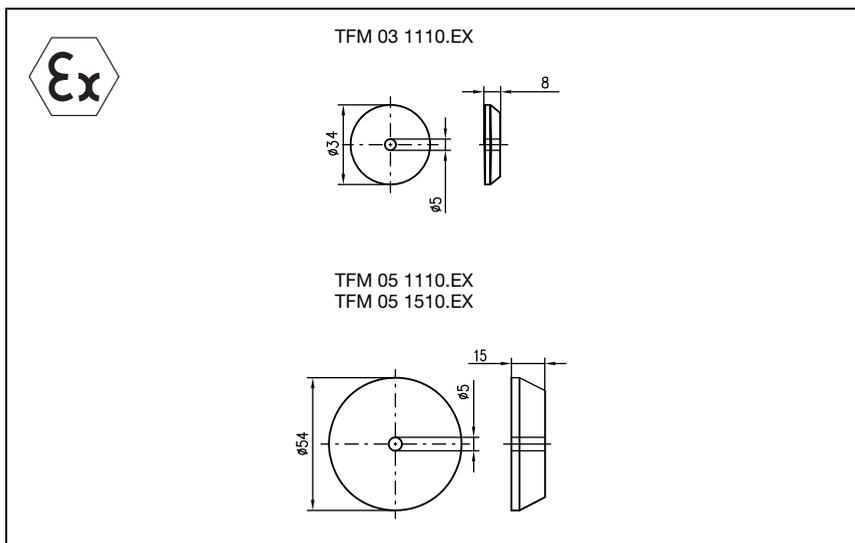
Figure 4.6:   Dimensioned drawing of the TFM 0x 1x10.EX Ex transponder

5 Installation and mounting

5.1 Unpacking

↳ *Check the packaging for any damage. If damage is found, notify the post office or shipping agent as well as the supplier.*

↳ *Check the delivery contents using your order and the delivery papers:*

- Delivered quantity
- Device type and model as indicated on the nameplate
- Brief manual

The name plates provide information about the given device type. For specific information, please refer to the package insert or chapter 9.1.

↳ *Save the original packaging for later storage or shipping.*

If you have any questions concerning your shipment, please contact your supplier or your local Leuze electronic sales office.

↳ *Observe the applicable local regulations when disposing of the packaging materials.*

5.2 Mounting the RFM read/write systems

The HF RFID read/write systems are mounted in various ways:

- **RFM 12 SL 200**:
  Mounting in Ø 30mm bore hole by means of M30 thread and fastening nuts (BT D30M.5 mounting bracket as optional accessory) or by means of MC 030K mounting clamp (optional accessory)

Fastening the RFM 12 with optional fastening accessory
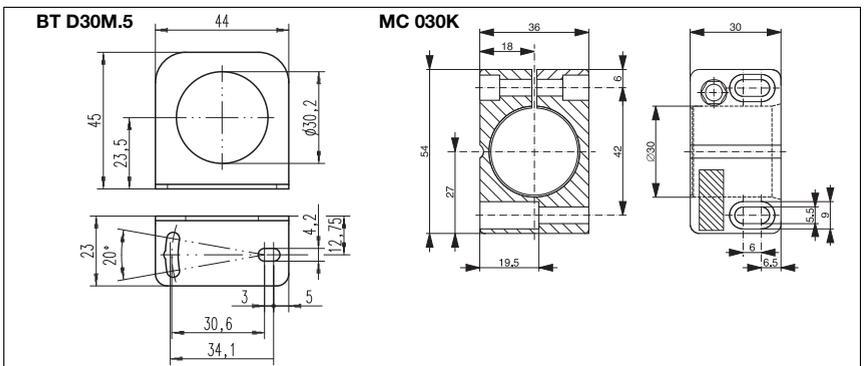
Figure 5.1:   Fastening the RFM 12 with optional fastening accessory

- **RFM 32 SL 200 and RFM 32 SL 200 Ex n**:
  by means of four fastening holes in the device with four screws.

RFM 32 fastening via four fastening holes
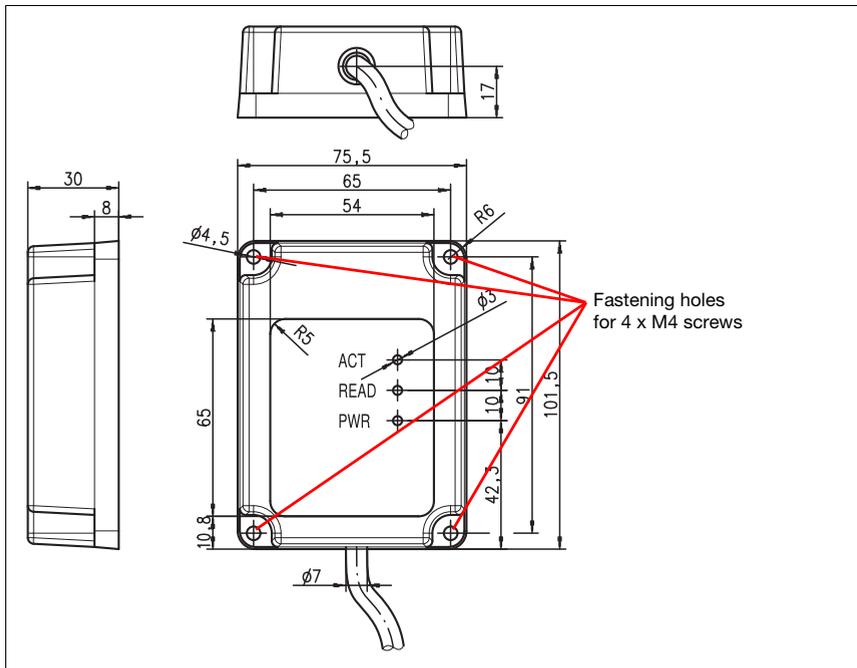
Figure 5.2:   RFU 32 fastening holes

- **RFM 62 SL 200**:
  via four fastening holes in the device with 4 M4 screws

RFM 62 fastening via four fastening holes

Figure 5.3:   RFU 62 fastening holes

5.3   Mounting of the transponders

Self-adhesive transponder

When affixing, the surface must be dry, grease-free and clean in order to ensure secure bonding. In the vicinity of the chip, the self-adhesive transponders must not be mounted around corners or edges as damages could result. Recommended distance to metal/metal foils: > 5 mm. Intended for use in mechanically protected environments.

Disc transponder

Screw connection of the disc transponders only with sufficient play. Excessive tightening of the fastening screw may result in damage to the transponder. Recommended distance to metal/metal foils: > 5 mm. Also suitable for areas with slight mechanical loading.

High temperature transponder

High material expansions are possible due to high temperature differences that may occur by using these transponders. The fastening of these transponders must, thus, absolutely be loose.

5.4 Device arrangement

5.4.1 Selecting a mounting location

In order to select the right mounting location, several factors must be considered:

- Size, alignment (parallel to the read/write system) and position tolerance of the transponder with respect to the object to be detected.
- The minimum and maximum reading distances determined from the read field of the devices (see read field curves from page 11) are also transponder dependent.
- The reading location should be as free of metal as possible or at a defined distance to metal.
- The transponder temperature at the reading location must be within the operating temperature range.
- The distance between two adjacent devices should be twice as large as the maximum operating range in order to avoid interference.
- The distance between the RFM / MA and the host system with respect to the permissible cable length of the interface.

The best read results are achieved if

- the transponder is moved over the middle of the antenna (device middle) with an angular deviation less than ± 10 … 15° to parallelity
- at the reading location, the temperature of the transponder is less than 60°C and the transponder is not wet
- the reading distance is in the middle part of the read field
- the transponders pass by the device individually

5.4.2 Arrangement on the transport system

Notice!

Writing/reading can occur at a standstill and while the transponder is in motion.
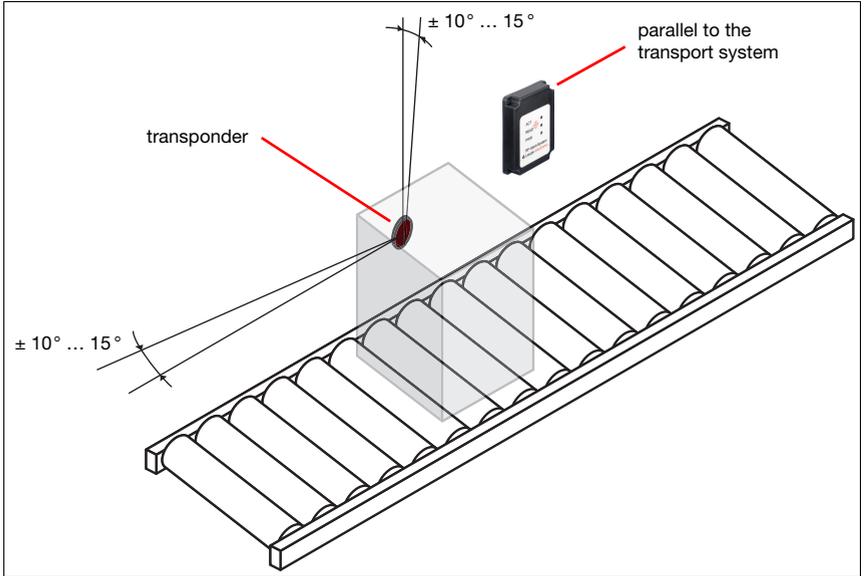
Figure 5.4:   Arrangement of the read/write systems on the transport system

5.5 Cleaning

↳ *Clean the housing of the RFM - HF RFID Series with a soft cloth after mounting. Remove all packaging remains, e.g., carton fibers or Styrofoam balls.*

Attention!

Do not use aggressive cleaning agents such as thinner or acetone for cleaning the device.

6　Electrical connection

All RFID devices of the RFM - HF RFID Series are equipped with a 1m (non Ex-devices) or 10m (RFM 32 SL 200 Ex n) long, ready-made connection cable.

The JST system plug on the cable end can be directly plugged into the corresponding MA … connector unit. A screwed cable gland for mounting in the housing of the MA … connector unit is also premounted.

Configuration via the RS232 interface is particularly simple via the service interface of the used MA… connector unit.
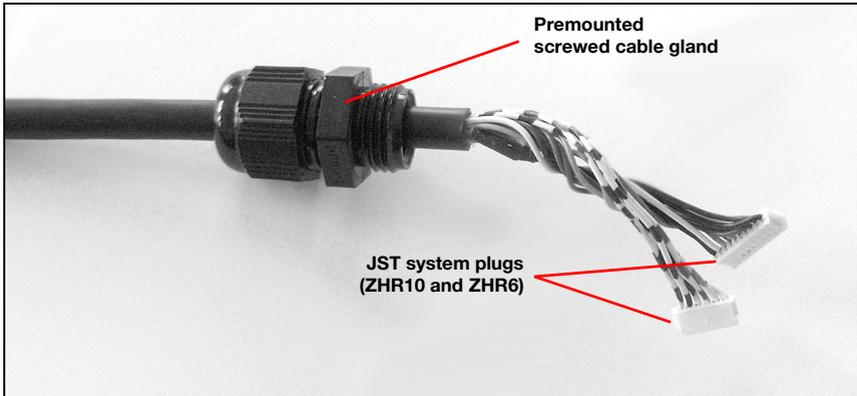
Figure 6.1:　　Electrical connection with ready-made connection cable

6.1　Safety notices for the electrical connection

⚠ *Attention!*
Before connecting the device, be sure that the supply voltage agrees with the value printed on the name plate.
Connection of the devices and cleaning must only be carried out by a qualified electrician. Ensure that the functional earth (FE) is connected correctly. Unimpaired operation is only guaranteed when the functional earth is connected properly.
If faults cannot be corrected, the device should be removed from operation and protected against possible use.

⚠ *Attention!*
For UL applications, use is permitted exclusively in Class 2 circuits according to NEC (National Electric Code).

The RFM… read/write systems and MA… connector units are designed in accordance with safety class III for supply by PELV (Protective Extra Low Voltage).

Notice!

Protection class IP 65 / IP 67 is achieved only if the screwed cable glands are mounted and screwed into place / the terminal compartment is screwed into place!

6.2   Pin assignment

	PIN	Colour	Signal
Connector ZHR10	1	br/BN	RS 232 GND
	2	rt/RD	reserved
	3	or/OG	reserved
	4	ge/YE	RS 232 RxD
	5	gn/GN	RS 232 TxD
	6	bl/BU	reserved
	7	vi/VI	Trigger IN
	8	gr/GY	VCC
	9	ws/WH	GND
	10	Schirm/SHIELD	FE
Connector ZHR6	1	ws-br/WH-BN	reserved
	2	ws-rt/WH-RD	reserved
	3	ws-or/WH-OG	reserved
	4	ws-ge/WH-YE	reserved
	5	ws-gn/WH-GN	reserved
	6	ws-sw/WH-BK	SW OUT

Figure 6.2:   Connections of the RFM… read/write systems

6.3   Cable lengths and shield

↳ *Observe the following maximum cable lengths and shield types:*

Connection	Interface	Max. cable length	Shield
RFM – host/ connector unit/ fieldbus gateway	RS 232	10 m	mandatory

Table 6.1:   Cable lengths and shield

6.4   Network/fieldbus connection via MA… connector units

Various modular MA… connector units are available for connecting the read/write system to a network or fieldbus. A separate MA… connector unit is required for each station. Each telegram is represented in the standard Leuze data frame. ASCII characters are transmitted.

Network/fieldbus	Connector unit MA…
RS485 network	**MA 21 100**
RS422 network	**MA 21 130**
Leuze multiNet	**MA 21 100.2**
PROFIBUS	**MA 204i**
EtherNet TCP/IP	**MA 208i**
CANopen	**MA 235i**
EtherCAT	**MA 238i**
PROFINET	**MA 248i**
DeviceNet	**MA 255i**
EtherNet/IP	**MA 258i**

Each connector unit makes available a separate RS 232 service interface that enables configuration of the RFM read/write system with the **RF-Config** software via a null modem cable from a PC/notebook.

7   Commissioning and configuration

With the Leuze **RF-Config** software program, a Windows-based graphical user interface is available for configuring the RFID devices of the RFM series. Operating systems: Windows 2000, Windows XP, Windows Vista, Windows 7.

You can download the RF-Config software program from the Leuze website at **–> Download –> identify –> Stationary RFID read/write systems**.

7.1   Antenna tuning at the installation site

RFM 12 and RFM 32

The RFM 12 and RFM 32 devices are tuned so that the full operating range is ensured when mounted in the standard manner or in a mounting holder with no metal in the area around the active surface. The RFM32 can also be mounted directly on metal, though this results in an approx. 10% reduction of the max. operating range.

RFM 62

With the RFM 62, a check and, if necessary, antenna tuning must always be performed after mounting. To do this, first connect the device to the voltage supply, open the housing cover and use the "**environment**" slide switch to set whether the distance of the RFM 62 to metal surfaces is greater or less than 20 mm.
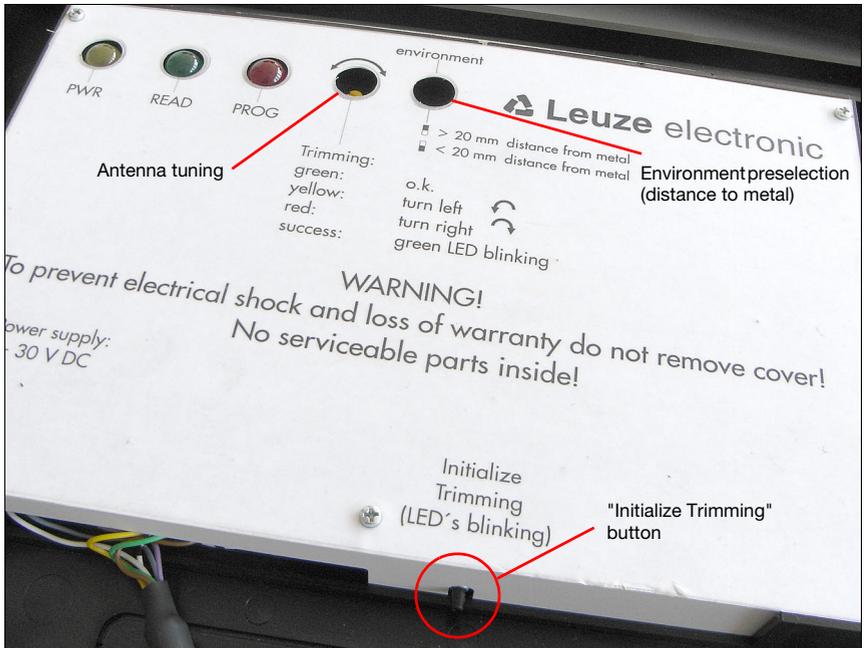
Figure 7.1:   RFM 62 antenna tuning

Then push the "**Initialize Trimming**" button located on the lower edge of the electronics cover once. One of the LEDs (yellow, green, red) begins to flash, indicating antenna tuning:

Yellow LED flashes:　　　　turn antenna tuning to **left** until the green LED illuminates.

Red LED flashes:　　　　　turn antenna tuning to **right** until the green LED illuminates.

Green LED illuminates:　no antenna tuning necessary.

Now push the "**Initialize Trimming**" button again. The device exits tuning mode and is again ready for operation. By means of this tuning process, the device is optimally adjusted to the environment of the installation location and the maximum operating range for data transmission to/from the transponder is enabled.

7.2　　　Configuration via the service interface of the MA…

Device configuration using the service interface of the MA… connector unit (9-pin, Sub-D connector) simplifies the configuration.

To configure, the PC with installed RF-Config software (administrator permissions not required) is simply connected to the 9-pin, Sub-D plug connection of the MA… service interface using a null modem cable (cross-wired cable with Sub-D connectors).

Configuration can also be performed by means of appropriate ASCII commands via the serial process interface (host interface). The devices also use the process interface as a service interface. It may be necessary to adjust the baud rate for downstream devices or for service access!

7.3　　　Commands and messages of the devices

The factory settings of the serial interface correspond to those of the other Leuze electronic RFID devices.

The interface parameters are:
9600 baud, 1 start bit, 8 data bits , no parity, 1 stop bit.

Standard telegram structure:

STX	Command	CR LF
0x02	HEX character	0x0D 0x0A

Notice!

The baud rate cannot be set for the RFM devices.

The following commands (in the standard telegram structure specified above) can be used to address the device via the interface.

○
ⵏ **Notice!**

The data from/to the read/write system is always displayed and entered in ASCII-hex coding and read out or written in complete blocks. Usable as data are the characters from the ASCII character set. A delay of approx. 150ms should be maintained between the reception of data and the transmission of data. 1 block =

Beginning with firmware version 080513, the commands of all devices are detected both in lower-case as well as in upper-case letters.

The factory setting enables immediate function after connection of the supply voltage.

Factory settings (read with trigger, 1 transponder in the field):

The following settings are activated by factory settings:

- **Single shot:** This function reads the data / serial number of a transponder once while it is in the field. The information that has been read is output via the interface.
- **Data:** The read activation (trigger) outputs the serial number of the transponder.
- **Trigger:** The device reads after a trigger signal has been supplied, or after a software trigger (command '**+**').
- **Switching output:** If the read is successful, the device supplies a 300ms high pulse at the output.
- **Anti-collision off:** This function permits the simultaneous handling of several transponders within the field. In case of active trigger, only a single transponder is expected, hence anti-collision=off.
- **Precharge:** A write command can be sent before the transponder enters the field.
- **Transponder type:** Transponder type I-code (tag type 01) and I-code SLI (tag type 04) are activated.

Transponder types

In many of the following command descriptions and acknowledgements, the transponder type (tag type) is also transmitted. Listed in the following table are the supported transponder types with their number.

Tag type	Transponder type	Features			Block size
		Number of characters	Start block (when writing)	Number of blocks	
01	ICODE	44	05	11	4 byte
02	ST_M LR512	60	00	16	4 byte
03	TAG-IT	32	00	08	4 byte
04	ICODE SLI	112	00	28	4 byte
05	INFINEON my-d (2P)	256	03	29	8 byte
	INFINEON my-d (10P)	1024	03	128	8 byte
06	EM4135	288	13	36	8 byte
07	TAG-IT HFI	256	00	32	8 byte

Table 7.1:   Transponder types - Tag type

Short commands without data

The following commands can be used to carry out direct actions:

- **Command '+'** activates a read process.
  (0x2B)　　　Command syntax: **<STX>+<CR><LF>**
  　　　　　　　Answer:　　　　　**<STX>F@0TagtypeSNR<CR><LF>**
  　　　　　　　F = Telegram flag.
  　　　　　　　　F = 0: only 1 telegram is output,
  　　　　　　　　F = 1: multiple telegrams are output
  　　　　　　　　(for more than 256 bytes of data).
  　　　　　　　@0 is the designator for following serial number.
  　　　　　　　Tagtype is the transponder type, see table 7.1.
  　　　　　　　SNR is the serial number of the transponder.

- **Command '-'** Terminates the read process without an answer.
  (0x2D)　　　If no transponder was read, a NO READ (0x18) is output.

- **Command 'V'** Returns the firmware version of the RFM.
  (0x56)　　　Command syntax: **<STX>V<CR><LF>**
  　　　　　　　Answer:　　　　　**<STX>y1y0m1m0d1d0t3t2t1t0Name<CR><LF>**
  　　　　　　　Where **y** = Year(2); **m** = Month(2); **d** = Day(2); **t** = Tag number(4)
  　　　　　　　and **Name** = Device type, e.g., RFM 32

- **Command 'R'** Executes a restart and resets the device to factory settings.
  (0x52)　　　Command syntax**<STX>R<CR><LF>**
  　　　　　　　Answer:　　　　　**<STX>Q2<CR><LF>** and then **<STX>S<CR><LF>**
  　　　　　　　Where **Q2** = Action carried out and **S** = Ready for operation

- **Command 'H'** Stops all actions and executes a software restart.
  (0x48)　　　Command syntax　**<STX>H<CR><LF>**
  　　　　　　　Answer　　　　　　**<STX>Q2<CR><LF>**
  　　　　　　　Where **Q2** = Action carried out

- **Command 'I'** Returns the serial numbers of **all** transponders in the field of the RFM.
  (0x49)　　　Function for transponder detection independent of the set transponder
  　　　　　　　type.
  　　　　　　　Command syntax　**<STX>I<CR><LF>**
  　　　　　　　Answer　　　　　　**<STX>F@0TagtypeSNR<CR><LF>** or
  　　　　　　　F = Telegram flag.
  　　　　　　　　F = 0: only 1 telegram is output,
  　　　　　　　　F = 1: Multiple telegrams are output
  　　　　　　　　(for more than 256 bytes of data).
  　　　　　　　@0 is the designator for following serial number.
  　　　　　　　Tagtype is the transponder type, see table 7.1.
  　　　　　　　SNR is the serial number of the transponder.

Further commands

> ⚠ **Attention!**
>
> For commands '**N** ', '**M**' and '**W**' (without Precharge), it is absolutely necessary that a **read process first be performed by means of trigger** and that the transponder remains in the field.

- **Command 'N'** Read block.
  (0x4E)   Command syntax **<STX>NB#TagtypeNOBSNR<CR><LF>** where
  B# = Block number from which reading begins, e.g., '05'.
  Tagtype is the transponder type, see table 7.1.
  NOB = Number of blocks to be read (1 … 9)
  SNR = Serial number of the transponder to be read. Is necessary if multiple transponders are in the field.
  Answer: **<STX>FB#TagtypeData<CR><LF>**
  F = Telegram flag.
     F = 0: only 1 telegram is output,
     F = 1: multiple telegrams are output
     (for more than 256 bytes of data).
  B# = Block number from which reading began, e.g., '05'.
  Tagtype is the transponder type, see table 7.1.
  Data = Data contents of the blocks specified in the command

> ○ *Notice!*
>
> *If multitransponder mode (anticollision) is active, serial-number transmission must be activated and the SNR of the desired transponder must be specified in the command (all characters after 0@0'tag type', e.g., from the answer to command 'I').*
> *An average answer time of 50 ms can be assumed per datablock.*

- **Command 'M'** Read transponder.
  (0x4D)   With this command, the entire transponder is read out from the first **datablock to the last.**
  Command syntax **<STX>MTagtype<CR><LF>** where
  Tagtype is the transponder type, see table 7.1.
  Answer: **<STX>FTagtypeData<CR><LF>** where
  F = Telegram flag.
     F = 0: only 1 telegram is output,
     F = 1: Multiple telegrams are output
     (for more than 256 bytes of data).
  Tagtype is the transponder type, see table 7.1.
  Data is all data beginning with block 00

> ○ *Notice!*
>
> *Command 'M' functions only with one transponder simultaneously in the field.*
> *This command is not supported by the EM4135 chip!*

- **Command 'W'** Write block.

  (0x57) Command syntax **<STX>WB#TagtypeNOBSNRData<CR><LF>**
  where

  B# = Block number from which writing begins, e.g., '05'.

  Tagtype is the transponder type, see table 7.1.

  NOB = Number of blocks to write (1 … 9)

  SNR = Serial number of the transponder to be written. Is necessary if multiple transponders are in the field.

  Data = Data to be written (hexadecimal) for 1 block

  Answer: **<STX>yy<CR><LF>** where

  yy = **Q4**: Command understood (if precharge activated!)

  yy = **Q5**: Write operation successful (after trigger)

  yy = **Q0**: Write operation failed (see chapter 7.5)

Notice!

When writing, one or more complete blocks must always be transmitted, i.e., 8 characters (hex) for 4 bytes/block or 16 characters (hex) for 8 bytes/block.

- **Command 'F'** Antenna (electromagnetic field) ON/OFF.

  (0x46) Command syntax **<STX>Fx<CR><LF>** where

  x = 0x01: Field ON

  x = 0x02: Field OFF

  x = 0x03: RESET field

  Answer: **<STX>Q2<CR><LF>** (see chapter 7.5)

Notice!

The device field is generally off; only following activation is it switched on.

The magnetic field is automatically activated following a new trigger.

- **Command 'A'** Set output.

  (0x41) This command permanently sets the output; it is not acknowledged!

  Command syntax **<STX>A0xx<CR><LF>** where

  xx = 0xFF: Output activated

  xx = 0x00: Output not activated

  Answer: none

Attention!

This command can only be executed if the switching output is not automatically activated via the configuration!

Data output / answer telegram of the devices

In the following you will find several examples for the output of data in the answer telegram of the devices.

Data output after trigger (set via configuration: operating mode)

The devices can be used to read various pieces of data following a trigger:

- **Serial number** (factory setting)
  Answer telegram, e.g.:
  0@00101000000011AAAF6
  Multiple pieces of information are contained in this answer (starting at the front):
  - **0** = Telegram flag, only 1 telegram is output
  - **@0** is the designator for following serial number.
  - **01** is the transponder type, see table 7.1.
  - **01000000011AAAF6** is the unique serial number of the transponder.

- **Block data**
  With this setting, 1 … 9 blocks can be read (depending on transponder).
  Answer telegram (read 1 block beginning with block 05), e.g.:
  005014672616E
  Multiple pieces of information are contained in this answer as well (starting at the front):
  - **0** = Telegram flag, only 1 telegram is output
  - **05** = Start block number
  - **01** is the transponder type, see table 7.1.
  - **4672616E** is the data in hexadecimal form (for 4 bytes/block)

- **Multiple Read**
  With command '**M**' or setting **Multiple Read**, all information is read from the transponder.
  Answer telegram, e.g.:
  00001011AAAF601000000FFFFFFF0000000033331323346 72616E6B2057756573746572FFF…
  Multiple pieces of information are contained in this answer as well (starting at the front):
  - **0** = Telegram flag, only 1 telegram is output
  - **00** = Start block number
  - **01** is the transponder type, see table 7.1.
  - **011AAAF601000000FFFFFFF0000000033…** is the data in hexadecimal form.

Data output following an online command (via terminal software)

The devices can be used to read various pieces of data by means of an online command:

- **Block data**

  With command '**N**', 1 … 9 blocks can be read (depending on transponder).

  Answer telegram (read 1 block beginning with block 05), e.g.:

  005014672616E

  Multiple pieces of information are contained in this answer (starting at the front):

  0 = Telegram flag, only 1 telegram is output

  05 = Start block number

  01 is the transponder type, see table 7.1.

  4672616E is the data in hexadecimal form (for 4 bytes/block)

- **Reading transponder**

  With command '**M**', all information is read out of the transponder.

  Answer telegram, e.g.:

  004616361626F75FFFF…

  Multiple pieces of information are contained in this answer as well (starting at the front):

  0 = Telegram flag, only 1 telegram is output

  04 is the transponder type, see table 7.1.

  616361626F75FFFF… is the data in hexadecimal form.

7.4   Configuring the RFID reader using the RF-Config software

The devices can be configured with the RF-Config software from Leuze electronic transparently and easily with a mouse click. All parameters and functions can be set via the user interface using menus.

Should direct access be necessary via a PLC or without the software tool, a standard terminal program can likewise be used with the information and commands described here. In this case, always observe the described command syntax.

The RFM 12, RFM 32 and RFM 62 RFID devices include a register with 16 addresses (0x00 to 0x0F) for recording the configuration data

- **Command 'G'** Read configuration.
  (0x47)   Command syntax **<STX>Gxxxx<CR><LF>** where
                    xxxx = 0xFF 0x00: Completely read out configuration
                    Answer: **<STX>00yyyyyyyy<CR><LF>**

- **Command 'C'** Write configuration data.
  (0x43)   Command syntax **<STX>Cyyzz<CR><LF>** where
                    yy = Register address
                    zz = Configuration data
                    Answer: **<STX>Q1<CR><LF>** (see chapter 7.5)

○ *Notice!*
The data is always hexadecimal encoded. The number of pieces of data must be specified here appropriately for the byte length (2 characters/byte); otherwise, an error message occurs (E02, see table 7.3). If the device is addressed via a fieldbus system, each character of the command must be considered as a separate ASCII character and transmitted as such.

The complete description of the instruction set and configuration is included with the configuration software or can be downloaded separately from www.leuze.com.

To simplify the setting of parameters, corresponding menus are provided in the "RF-Config" configuration tool.

○ *Notice!*
You can find the program on the Internet at www.leuze.com –> Download –> identify –> Stationary RFID read/write systems.

After downloading the file to your computer, simply start the installation routine to set up the program. No special permissions are necessary for this purpose (e.g., administrator permissions). After installing, double-click the desktop icon to start the program.

You can use RF-Config to configure and parameterize all RFID devices from the Leuze electronic product line. The various device types with their parameter sets are available for selection via a device list.

After starting the program, first select the connected device from the left side of the user interface in the device bar.

Its factory configuration (parameter set) is displayed on the right side of the user interface in three tabs.

Notice!

In the **Help** menu, you will find the documentation for the selected device type:
- Technical description
- Instruction set and configuration structure
- Commissioning tips
- Data sheet for the standard HF transponders available from Leuze

Transponder tab

In this tab, you can select from the available transponder types. The various types have different memory sizes and memory areas; please take note. The basic setting is release for ICODE 1 and ICODE SLI transponders.
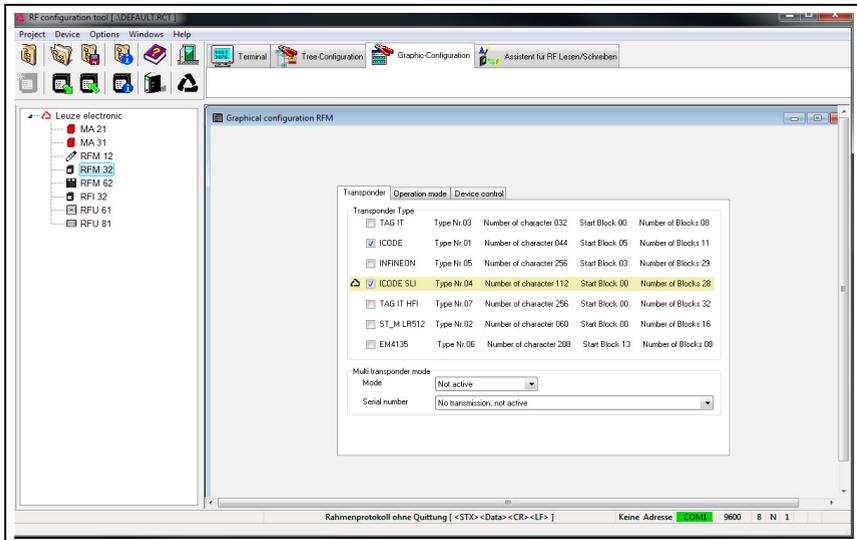
Figure 7.2:   RF-Config – Transponder tab

In addition, the operating mode for multiple transponders in the field simultaneously can be activated and serial number transmission in the telegram can be added.

○
⫫ *Notice!*
- *The RFM 12 can only process 1 transponder in the field at a time.*
- *The RFM 32 can process up to 4 transponders simultaneously in the field (commands '**N**' and '**W**').*
- *The RFM 62 can process up to 8 transponders simultaneously in the field (commands '**N**' and '**W**').*

⚠ *Attention!*
Any settings that are made do not take effect until transferred to the device!

Operation mode tab

The operation mode setting is important for automatic operation of the device. Here, you set the function after activation/trigger (operation mode) and memory access (block number).
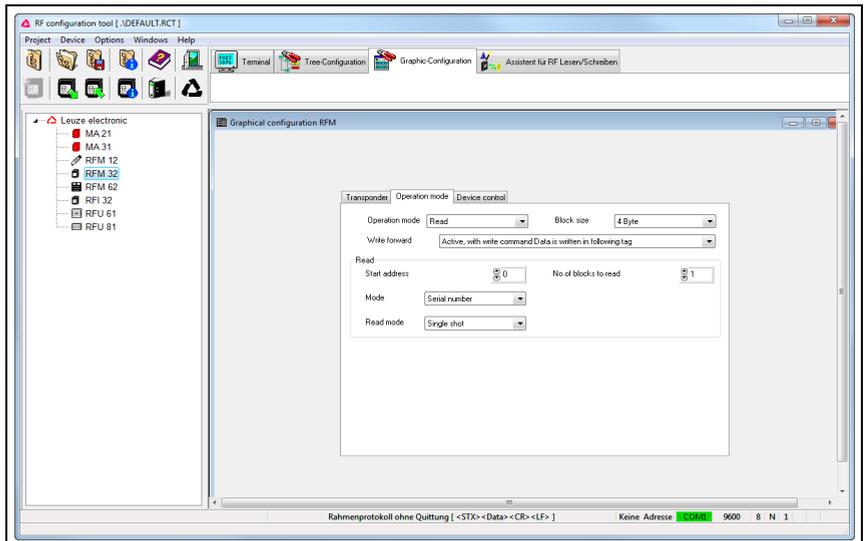
Figure 7.3:   RF-Config – Operation mode tab

Start block, number of blocks and block size are transponder dependent (see table 7.1). If selected but not present, an error message is output.

For the "Write" online command, the **Precharge** function can also be set. In this case, the write data are transferred to the read/write system before the transponder to be written is located in the field. When the transponder does enter the field, it is automatically written with the precharged data.

Device control tab

Grouped together on this tab are the options for controlling the device.
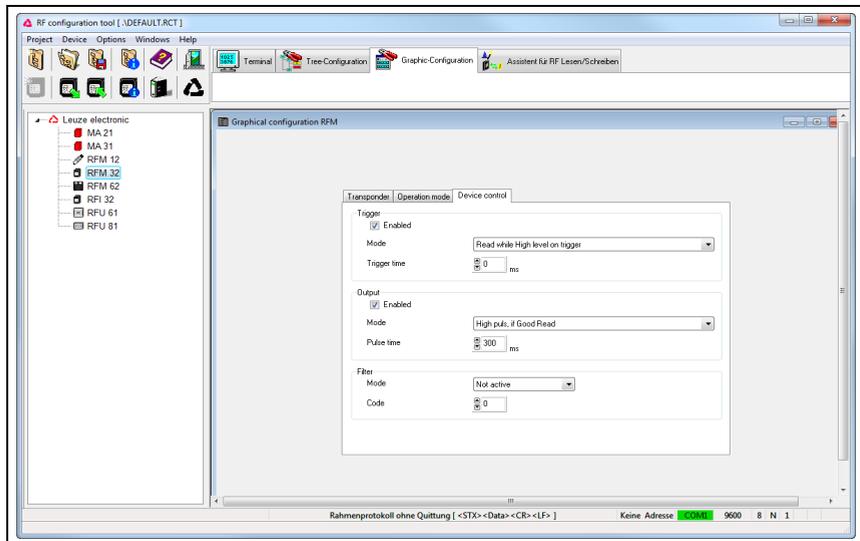
Figure 7.4:   RF-Config – Device control tab

The configuration options range from activation or type of activation to the function of the switching output to the setting of the code filter.

Attention!

Some parameters and functions are dependent on others, others are mutually exclusive.

Listed below are some of the most important configuration constellations for which such dependencies exist:

- If the **Precharge** function = "Active" (address 01, bit 6), **Trigger** must also = "Active" (address 01, bit 4).
- If **Permanent reading** is set as read type/read mode (address 01, bit 5), **Trigger** must = "Not active" (address 01, bit 4) and **Precharge** must = "Not active" (address 01, bit 6).

If these dependencies are not observed either in whole or in part, the "**E10**" error message is returned by the device without any changes having been made to the device configuration.

Notice!

During the propagation time of the output signal (if activated), no transponders can be read.

7.5 Acknowledgments and error codes

To receive acknowledgment to specific commands and to recognize transmission errors, several acknowledgment and error codes are defined.

Acknowledgments

Code	Meaning
Q0	Command could not be carried out
Q1	Configuration change carried out
Q2	Action carried out
Q4	Write command understood (only for the **Precharge** function)
Q5	Data successfully written (including control reading)

Table 7.2:   Possible command acknowledgments

Error codes

An error occurs if a command or transmitted command parameters are transmitted incompletely or with faulty characters.

Code	Meaning
E01	Invalid command
E02	Invalid parameter
E04	Framing error (transmission)
E08	CRC checksum error
E10	Contradictory settings activated (e.g., permanent reading and trigger)

Table 7.3:   Possible error codes

○
⊔ *Notice!*

*If error code "**E08**" occurs, a CRC check was most likely accidentally activated. To reset, please send commands "**R**" and "**0xD2**" via the interface.*

7.6   LED indicators

LED	State	Meaning
PWR	⦿ Off	Device OFF - No supply voltage
READ **ACT**	Green continuous light **and** red continuous light for approx. 3s	Device OK, initialization phase - Self test running
PWR	🟡 Yellow, continuous light	Device ready
ACT	🔴 Red, continuous light	Device (antenna) activated - Reading gate open/precharged for writing - Transponder is expected
READ	Green, flashing	Transponder has been detected - Data output via interface

Table 7.4:   LED indicators and their meaning

7.7   Transponder memory organization

⚠ ***Attention!***
Not all available and readable transponders have the same number of blocks and the same block size! Operations on non-available memory areas are acknowledged with Q0!

Tag type	Transponder type		Features			Block size
	Type designation (current Leuze transponder)	Part no.	Number of characters	Start block (when writing)	Number of blocks	
01	**ICODE**		44	05	11	4 byte
02	**ST_M LR512**		60	00	16	4 byte
03	**TAG-IT**		32	00	08	4 byte
04	**ICODE SLI**		112	00	28	4 byte
	TFM 03 1110.210	50102917				
	TFM 05 1110.210	50102916				
	TFM 03 1510.210	50106412				
	TFM 05 1510.210	50106413				
	TFM 02 2210.210	50107790				
	TFM 05 2210.210	50109232				
	TFM 05 2610.210 [1]	50109317				
	TFM 08 1610.210	50114962				
	TFM 03 1910.219	50114960				
	TFM 05 1910.219	50114961				
	TFM 03 1110.EX	50108071				
	TFM 05 1110.EX	50108070				
	TFM 05 1510.EX	50110026				
05	**INFINEON my-d**		1024	00	128	8 byte
	TFM 04 1190.230	50108290				
06	**EM4135**		288	13	36	8 byte
07	**TAG-IT HFI**		256	00	32	8 byte
	TFM 02 1125.220	50102915				
	TFM 06 2225.220	50102913				
	TFM 03 5125.220	50102956				
	TFM 08 2125.220	50109233				

1)   Part being discontinued.

Table 7.5:   Transponder types / memory organization of the TFM HF transponders

8 Diagnostics and troubleshooting

8.1 General causes of errors

Error	Possible cause of error	Remedial measures
Status LED **PWR** off	• No supply voltage connected to the device. • Hardware error.	• Check supply voltage. • Send device to customer service.
Status LED **ACT** red continuous light **and** status LED **READ** green continuous light **for more than approx. 3s**	• Error during initialization.	• Switch the supply voltage off and on again. • Send device to customer service.
Status LED **ACT** red continuous light	• Device deactivated or device activated, but no transponder detected.	• Check wiring of trigger.
After activation and with transponder in read field: Status LED **READ** not flashing green	• Device activated, but no transponder detected.	• Check enable of the transponder type in the configuration.

8.2 Interface error

Error	Possible cause of error	Remedial measures
No communication via RS232 / RS 422 / RS485	• Wiring not correct.	• Check wiring.
Sporadic error on the RS232 interface	• Influences from electromagnetic interference (EMC).	• Check shield (shield overlap up to the clamping point!). • Avoid electromagnetic interference from high-voltage power lines running parallel.

Notice!

*Please use **chapter 8 as a master copy** should servicing be required.*
Cross the items in the "Measures" column which you have already examined, fill out the following address field and fax the pages together with your service contract to the fax number listed below.

Customer data (please complete)

Device type:	
Software version:	
Company:	
Customer number / order number:	
Contact partner / department:	
Phone (direct):	
Fax:	
Street / No:	
ZIP code/City:	
Country:	

Leuze Service fax number:

+49 7021 573 - 199

9　Type overview and accessories

9.1　Model overview of the RFM series

Type designation	Description	Part no.
RFM 12 SL 200	Stationary read/write system, for small operating ranges up to 40 mm	50040497
RFM 32 SL 200	Stationary read/write system, for medium operating ranges up to 110 mm	50040498
RFM 62 SL 200	Stationary read/write system, for large operating ranges up to 400 mm	50040499
RFM 32 SL 200 Ex n	Stationary read/write system, for medium operating ranges up to 110 mm, for use in potentially explosive areas of Zones 2/22	50103087

Table 9.1:　　　　Model overview of the RFM series

9.2　Mounting accessories

Type designation	Description	Part no.
BT D30M.5	Mounting bracket for RFM 12	50113510
MC 030K	Mounting clamp for RFM 12	50111503

Table 9.2:　　　　Mounting accessories

9.3　Model overview of connector units / networking

Type designation	Description	Part no.
MA 21 100.2	Leuze multiNet plus connector unit (slave)	50103125
MA 21 100	Connector unit/interface converter RS 232 – RS 485 (electrically insulated)	50030481
MA 21 130	Connector unit/interface converter RS 232 – RS 422 (electrically insulated)	50030484
MA 21 110	Connector unit/interface converter RS 232 – RS 232 (electrically insulated)	50030482
MA 204i	PROFIBUS DP gateway	50112893
MA 208i	EtherNet TCP/IP gateway	50112892
MA 235i	CANopen gateway	50114154
MA 238i	EtherCAT gateway	50114155
MA 248i	PROFINET-IO RT gateway	50112891
MA 255i	DeviceNet gateway	50114156
MA 258i	EtherNet/IP gateway	50114157

Table 9.3:　　　　Model overview of connector units / networking

9.4 Model overview of the TFM… HF transponders

Type	Part no.	Protection class	Dimensions[1]	Weight
Disc transponder				
TFM 02 1125.220	50102915	IP 68	Ø 22x3.0 mm	2 g
TFM 03 1110.210	50102917	IP 67	Ø 30x2.5 mm	5 g
TFM 04 1190.230	50108290	IP 67	Ø 40x2.5 mm	4 g
TFM 05 1110.210	50102916	IP 67	Ø 50x2.5 mm	10 g
TFM 03 1510.210	50106412	IP 68	Ø 30x2.5 mm	3 g
TFM 05 1510.210	50106413	IP 68	Ø 50x2.5 mm	4 g
Self-adhesive transponder				
TFM 02 2210.210	50107790	IP 54	18x36x0.3 mm	2 g
TFM 05 2210.210	50109232	IP 54	50x50x0.3 mm	2 g
TFM 06 2225.220	50102913	IP 54	55x55x0.3 mm	~ 2 g
High temperature transponder				
TFM 05 2610.210	50109317 [2]	IP 68	51x51x7 mm	50 g
TFM 08 1610.210	50114962	IP 68	Ø 85x15 mm	50 g
Keyring transponder				
TFM 03 5125.220	50102956	IP 65	50x28x2.5 mm	~ 4 g
Card transponder				
TFM 03 1910.219	50114960	IP 65	Ø 30x2 mm	~ 3 g
TFM 05 1910.219	50114961	IP 65	Ø 50x2 mm	~ 4 g
TFM 08 2125.220	50109233	IP 68	86x54x1 mm	~ 5 g
Spacer				
Spacer 30 HT	50107102	–	Ø 36x10 mm	3 g
Spacer 50 HT	50107103	–	Ø 56x10 mm	4 g
Spacer 85 HT	50106411	–	Ø 85x30 mm	20 g
BT TFMx26	50110631	–	Ø 15x60 mm	50 g

1) Due to tolerances and product updates, dimensions/weights may change. Tolerances of disc transponders: average ±0.5mm.

2) **Part being discontinued!**

Table 9.4: Model overview of the TFM… HF transponders

9.5 Model overview of the TFM… Ex n Ex-HF transponders

Type	Part no.	Protection class	Dimensions[1]	Weight
Disc transponder				
TFM 03 1110.EX	50108071	IP 67	Ø 34x8 mm	10 g
TFM 05 1110.EX	50108070	IP 67	Ø 54x15 mm	45 g
TFM 05 1510.EX	50110026	IP 67	Ø 54x15 mm	45 g

1) Due to tolerances and product updates, dimensions/weights may change. Tolerances of disc transponders: average ±0.5mm.

Table 9.5: Model overview of the TFM… Ex n Ex-HF transponders

10 Maintenance

10.1 General maintenance information

The RFID devices of the RFM series require no maintenance by the operator.

If a film forms, the devices can be cleaned with a cloth; function is influenced only by metal dust or liquid present on the device.

Attention!

Do not use solvents or cleaning agents containing acetone.
Use of improper cleaning agents can damage the housing.

10.2 Repairs and servicing

Repairs to the device must only be carried out by the manufacturer.

⮫ *Contact your Leuze distributor or service organization should repairs be required. The addresses can be found on the inside of the cover and on the back.*

Notice!

When sending devices to Leuze electronic for repair, please provide an accurate description of the error.

10.3 Disassembling, packing, disposing

Repacking

For later reuse, the device is to be packed so that it is protected.

Notice!

Electrical scrap is a special waste product! Observe the locally applicable regulations regarding disposal of the product.

11 Appendix

11.1 ASCII table

ASCII	Dec.	Hex.	Oct.	Designation	Meaning
NUL	0	00	0	NULL	Null
SOH	1	01	1	START OF HEADING	Start of heading
STX	2	02	2	START OF TEXT	Start of text characters
ETX	3	03	3	END OF TEXT	Last character of text
EOT	4	04	4	END OF TRANSMISSION	End of transmission
ENQ	5	05	5	ENQUIRY	Request for data transmission
ACK	6	06	6	ACKNOWLEDGE	Positive acknowledgment
BEL	7	07	7	BELL	Bell signal
BS	8	08	10	BACKSPACE	Backspace
HT	9	09	11	HORIZONTAL TABULATOR	Horizontal tabulator
LF	10	0A	12	LINE FEED	Line feed
VT	11	0B	13	VERTICAL TABULATOR	Vertical tabulator
FF	12	0C	14	FORM FEED	Form feed
CR	13	0D	15	CARRIAGE RETURN	Carriage return
SO	14	0E	16	SHIFT OUT	Shift out
SI	15	0F	17	SHIFT IN	Shift in
DLE	16	10	20	DATA LINK ESCAPE	Data link escape
DC1	17	11	21	DEVICE CONTROL 1 (X-ON)	Device control character 1
DC2	18	12	22	DEVICE CONTROL 2 (TAPE)	Device control character 2
DC3	19	13	23	DEVICE CONTROL 3 (X-OFF)	Device control character 3
DC4	20	14	24	DEVICE CONTROL 4	Device control character 4
NAK	21	15	25	NEGATIVE ACKNOWLEDGE	Negative acknowledge
SYN	22	16	26	SYNCRONOUS IDLE	Synchronization
ETB	23	17	27	END OF TRANSMISSION BLOCK	End of data transmission block
CAN	24	18	30	CANCEL	Invalid
EM	25	19	31	END OF MEDIUM	End of medium
SUB	26	1A	32	SUBSTITUTE	Substitution
ESC	27	1B	33	ESCAPE	Escape
FS	28	1C	34	FILE SEPARATOR	File separator
GS	29	1D	35	GROUP SEPARATOR	Group separator
RS	30	1E	36	RECORD SEPARATOR	Record separator
US	31	1F	37	UNIT SEPARATOR	Unit separator
SP	32	20	40	SPACE	Space
!	33	21	41	EXCLAMATION POINT	Exclamation point
"	34	22	42	QUOTATION MARK	Quotation mark
#	35	23	43	NUMBER SIGN	Number sign
$	36	24	44	DOLLAR SIGN	Dollar sign
%	37	25	45	PERCENT SIGN	Percent sign
&	38	26	46	AMPERSAND	Ampersand
'	39	27	47	APOSTROPHE	Apostrophe
(	40	28	50	OPENING PARENTHESIS	Opening parenthesis

Table 11.1: ASCII table

Leuze electronic

ASCII	Dec.	Hex.	Oct.	Designation	Meaning
)	41	29	51	CLOSING PARENTHESIS	Closing parenthesis
*	42	2A	52	ASTERISK	Asterisk
+	43	2B	53	PLUS	Plus sign
,	44	2C	54	COMMA	Comma
-	45	2D	55	HYPHEN (MINUS)	Hyphen (minus)
.	46	2E	56	PERIOD (DECIMAL)	Period (decimal)
/	47	2F	57	SLANT	Slant
0	48	30	60	0	Number
1	49	31	61	1	Number
2	50	32	62	2	Number
3	51	33	63	3	Number
4	52	34	64	4	Number
5	53	35	65	5	Number
6	54	36	66	6	Number
7	55	37	67	7	Number
8	56	38	70	8	Number
9	57	39	71	9	Number
:	58	3A	72	COLON	Colon
;	59	3B	73	SEMICOLON	Semicolon
<	60	3C	74	LESS THAN	Less than
=	61	3D	75	EQUALS	Equals
>	62	3E	76	GREATER THAN	Greater than
?	63	3F	77	QUESTION MARK	Question mark
@	64	40	100	COMMERCIAL AT	Commercial AT
A	65	41	101	A	Uppercase letter
B	66	42	102	B	Uppercase letter
C	67	43	103	C	Uppercase letter
D	68	44	104	D	Uppercase letter
E	69	45	105	E	Uppercase letter
F	70	46	106	F	Uppercase letter
G	71	47	107	G	Uppercase letter
H	72	48	110	H	Uppercase letter
I	73	49	111	I	Uppercase letter
J	74	4A	112	J	Uppercase letter
K	75	4B	113	K	Uppercase letter
L	76	4C	114	L	Uppercase letter
M	77	4D	115	M	Uppercase letter
N	78	4E	116	N	Uppercase letter
O	79	4F	117	O	Uppercase letter
P	80	50	120	P	Uppercase letter
Q	81	51	121	Q	Uppercase letter
R	82	52	122	R	Uppercase letter
S	83	53	123	S	Uppercase letter
T	84	54	124	T	Uppercase letter
U	85	55	125	U	Uppercase letter

Table 11.1:   ASCII table

ASCII	Dec.	Hex.	Oct.	Designation	Meaning
V	86	56	126	V	Uppercase letter
W	87	57	127	W	Uppercase letter
X	88	58	130	X	Uppercase letter
Y	89	59	131	Y	Uppercase letter
Z	90	5A	132	Z	Uppercase letter
[	91	5B	133	OPENING BRACKET	Opening bracket
\	92	5C	134	REVERSE SLANT	Reverse slant
]	93	5D	135	CLOSING BRACKET	Closing bracket
^	94	5E	136	CIRCUMFLEX	Circumflex
_	95	5F	137	UNDERSCORE	Underscore
'	96	60	140	GRAVE ACCENT	Grave accent
a	97	61	141	a	Lowercase letter
b	98	62	142	b	Lowercase letter
c	99	63	143	c	Lowercase letter
d	100	64	144	d	Lowercase letter
e	101	65	145	e	Lowercase letter
f	102	66	146	f	Lowercase letter
g	103	67	147	g	Lowercase letter
h	104	68	150	h	Lowercase letter
i	105	69	151	i	Lowercase letter
j	106	6A	152	j	Lowercase letter
k	107	6B	153	k	Lowercase letter
l	108	6C	154	l	Lowercase letter
m	109	6D	155	m	Lowercase letter
n	110	6E	156	n	Lowercase letter
o	111	6F	157	o	Lowercase letter
p	112	70	160	p	Lowercase letter
q	113	71	161	q	Lowercase letter
r	114	72	162	r	Lowercase letter
s	115	73	163	s	Lowercase letter
t	116	74	164	t	Lowercase letter
u	117	75	165	u	Lowercase letter
v	118	76	166	v	Lowercase letter
w	119	77	167	w	Lowercase letter
x	120	78	170	x	Lowercase letter
y	121	79	171	y	Lowercase letter
z	122	7A	172	z	Lowercase letter
{	123	7B	173	OPENING BRACE	Opening brace
l	124	7C	174	VERTICAL LINE	Vertical line
}	125	7D	175	CLOSING BRACE	Closing brace
~	126	7E	176	TILDE	Tilde
DEL	127	7F	177	DELETE (RUBOUT)	Delete

Table 11.1:   ASCII table