BALLUFF

# BIS U-6026-034-114-06-ST35 EtherNet/IP
# BIS U-6026-034-124-06-ST35 EtherNet/IP

Technical Description, User's Guide

BISU


english

www.balluff.com

# 1 User Instructions

## 1.1 About this Manual

This manual describes the processor unit for the BIS U-6026 identification systems and startup instructions for immediate operation.

## 1.2 Typographical Conventions

The following conventions are used in this manual.

**Enumerations**

Enumerations are shown as a list with an en-dash.
– Entry 1.
– Entry 2.

**Actions**

Action instructions are indicated by a preceding triangle. The result of an action is indicated by an arrow.
► Action instruction 1.
⇒ Action result.
► Action instruction 2.

**Syntax**

**Numbers:**
– Decimal numbers are shown without additional indicators (e.g. 123),
– Hexadecimal numbers are shown with the additional indicator $_{hex}$ (e.g. $00_{hex}$).

**Parameters:**
Parameters are shown in italics (e.g. *Dynamic).*

**Directory paths:**
References to paths where data is stored or to be saved are shown in small caps (e.g. Project:\Data Types\User-Defined).

**Control characters:**
Control characters for sending are set in angle brackets (e.g. <ACK>).

**ASCII code:**
Characters transmitted in ASCII code are set in apostrophes (e.g. 'L').

## 1.3 Symbols

**Caution!**
This symbol indicates a safety instruction that must be followed without exception.

**Note, tip**
This symbol indicates general notes.

## 1.4 Abbreviations

| | |
|---|---|
| BIS | Balluff Identification System |
| CRC | Cyclic Redundancy Check |
| EDS | Electronic Data Sheet |
| EEPROM | Electrical Erasable and Programmable ROM |
| EIRP | Equivalent Isotropically Radiated Power |
| EMC | Electromagnetic compatibility |
| EPC™ | Electronic Product Code |
| ERP | Effective Radiated Power |
| FCC | Federal Communications Commission |
| IC | Industry Canada |
| IP | Internet Protocol |
| LBT | Listen Before Talk |
| LF CR | Line Feed with Carriage Return |
| MAC | Media Access Control |
| n. c. | not connected |
| PC | Personal Computer |
| PLC | Programmable Logic Controller |
| Tag | Data carrier with antenna |
| TID | Tag identifier |
| UHF | Ultra-high frequency |

# 2 Safety

## 2.1 Intended Use

The BIS U-6026 processor unit is a component of the BIS U identification system. Within the identification system, it is used to connect to a higher-level controller (PLC, PC); it may only be used in the industrial sector.

This description applies to processor units of the following series:

– For operation in the USA, Canada
  BIS U-6026-034-114-06-ST35

– For operation in China
  BIS U-6026-034-124-06-ST35

## 2.2 Meaning of Warning Notes

**Caution!**
The pictogram used with the word "Caution" warns of a situation that could harm someone's health or damage equipment. Failure to observe these warning notes may result in injury or damage to equipment.
► Always observe the described measures for preventing this danger.

## 2.3 General Safety Notes

**Caution!**
This UHF system consists of a processor unit and antennas according to specifications and may only be operated within the specified countries subject to all applicable national legal regulations and standards.
► When using the UHF system in the USA, the directives of the FCC, Part 15 B and 15 C, apply.
► When using the UHF system in Canada, the directives of the IC, RSS-210 apply.

**Installation and startup**
Installation and startup are to be performed by trained technical personnel only.
Any damage resulting from unauthorized manipulation or improper use voids the manufacturer's guarantee and liability claims against the manufacturer. When connecting the processor unit to an external controller, observe proper selection and polarity of the connection as well as the power supply (see "Installation" on page 9).
The processor unit may only be used with approved power supplies (see "Technical Data" on page 11).

**Caution!**

The antennas of the identification system BIS U transmit ultra-high frequency electromagnetic waves.

IEC 62369 stipulates that personnel must not remain within close range of the UHF antenna for long periods (several hours).

**For operation in the USA, Canada:**
When selecting the installation position for the processor unit, make sure that the minimum distance between the UHF antenna and the workplace is 30 cm. The radiated power must not exceed the permissible limit value of 4 watts$_{EIRP}$.

**Note**
See the "Basic UHF manual" for more information on minimum/maximum distances and antenna power.

# 2 Safety

## 2.4 Conformity

**BIS U-6026-034-114-06-ST35**

| | |
|---|---|
| FC IC | The product was developed and manufactured in accordance with the directives applicable in the USA and Canada. Conformity has been verified. |

**BIS U-6026-034-124-06-ST35**

| | |
|---|---|
| **CMIIT-ID 2014DJ1522** | The product was developed and manufactured in accordance with the directives applicable in China. Conformity has been verified. |

All approvals and certifications are no longer valid if:
– Components are used that are not part of the identification system BIS U.
– Components are used that have not been explicitly approved by Balluff.

**Operation and testing**
The operator is responsible for ensuring that local safety regulations are observed. If defects and persistent faults occur in the identification system, take it out of service and secure it to prevent unauthorized use.

# 3 Basic Knowledge

## 3.1 Function Principle of Identification Systems

The identification system BIS U is classified as a non-contacting system with read and write function, which not only allows it to detect information programmed permanently in the data carrier, but also to collect and pass on current information.

Main components of the identification system BIS U include:
– Processor unit
– Antennas
– Data carrier

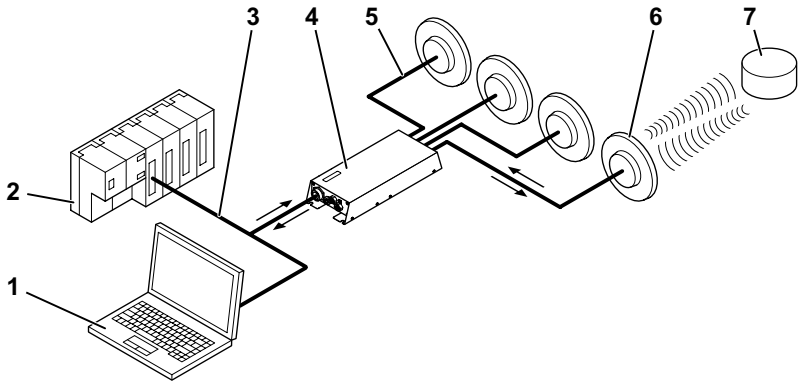



Figure 1: System overview

**1** PC
**2** PLC
**3** Connection to the controlling system
**4** Processor unit
**5** Antenna cable
**6** Antennas (max. 4)
**7** Data carrier

The main areas of application are:
– In the production and control of material flow (e.g. in model-specific processes, workpiece transport in conveying systems, for acquiring safety-related data)
– In tool coding and monitoring
– In organization of tools and equipment
– In warehousing for monitoring material movements
– In transporting and conveyor technology
– in waste disposal for quantity-based fee assessment

**Note**
See the "Basic UHF manual" for more information on UHF identification systems.

## 3.2 Product Description

– UHF RFID
(for working frequencies, see "Operating frequencies and radiated power" on page 12)
– Read/write distance typically up to 6 m depending on ambient conditions and installed system components such as antennas, data carriers, cables, etc.
– Group detection of multiple data carriers, reading, writing of individual data carriers
– Connection option for 4 antennas
– 4 digital outputs and 2 digital inputs for additional functions
– Standard interface: EtherNet/IP
– Service interface: 1 x RS232
– Rugged metal housing
– Control indicators for communication and the status of ports
– Data carrier types according to ISO 18000-6 type C or EPCglobal™ Class 1 Generation 2

# 3 Basic Knowledge

## 3.3 Control Function

The processor unit is the link between data carrier and controlling system. It manages two-way data transfer between data carrier and antenna and provides buffer storage.
The processor unit uses the antenna to write data from the controlling system to the data carrier or reads the data from the data carrier and makes it available to the controlling system.

Controlling systems may be the following:
– A control computer (e.g. industrial PC)
– A PLC

**Double bit string for asynchronous data transmission:**
If a controller does not synchronously send the data range for updating the input/output buffer, data inconsistencies may occur when sending more than two bytes. Consistency of the sent data can then only be ensured by sending the control bits in the first byte and again in the last bytes of the input/output buffer. By comparing the two bit strings, it can be determined whether the data is fully updated and can be accepted.
This method affects neither the PLC cycle time nor the bus access time. Only one byte in the data buffer for the byte of the second bit string is required instead of using it for data.

## 3.4 Data Integrity

In order to ensure data integrity, the data transfer between the data carrier and processor unit can be monitored using a CRC-16 data check.

## 3.5 Bus Connection

The processor unit and the controlling system communicate via the EtherNet/IP protocol.

Ethernet/IP is an industrial networking standard. The IP in Ethernet/IP stands for "Industrial Protocol". Ethernet/IP uses the "Common Industrial Protocol" (CIP) open communication protocol at the application tier (in accordance with ISO/OSI reference model).
Ethernet/IP is supported by the "Open DeviceNet Vendor Association" (ODVA) network organization.

A switch in full-duplex operation has to be used for collision-free data exchange.

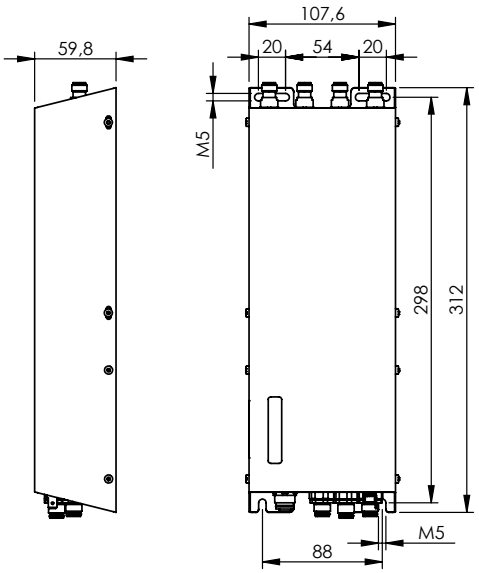
# 4 Installation

## 4.1 Processor Unit Scope of Delivery

Included in the scope of delivery:
- BIS U-6026
- 5x end cap
- Safety notes

**Note**
For corresponding technical documents as well as additional information on available software and accessories, see www.balluff.com.

## 4.2 Processor Unit Installation




BIS U-6026-034-114-06-ST35
BIS U-6026-034-124-06-ST35

Figure 2: Installation

**Caution!**
The antennas for the BIS U identification system transmit ultra-high frequency electromagnetic waves!
► The installation position of the processor unit and antennas must guarantee a safety distance between the antennas and the workplaces of personnel. For safety distances, see Chapter 2 "Safety" beginning on page 5

The read/write distance can typically be as great as 6 m depending on the ambient conditions and installed system components. See the "Basic UHF manual" for more information on minimum/maximum distances.

► Select a suitable installation position.
► Secure the processor unit using four M5 screws (strength category 8.8, lightly oiled, tightening torque M = 5.2 Nm).

**Note**
Optional mounting plates are available for installing the processor unit (see Accessories on page 54).

# 4 Installation

## 4.3 Interface Information / Wiring Diagrams

**Note**
Make the ground connection either directly or using an RC combination to ground.

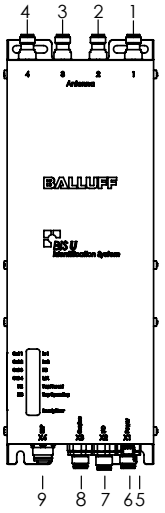
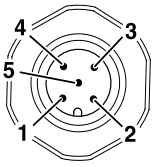



Figure 3: Electric connection of the BIS U-6026

**1** Antenna port 1
**2** Antenna port 2
**3** Antenna port 3
**4** Antenna port 4
**5** Function ground FE
**6** X1 – Power supply
**7** X2 – Control inputs / outputs
**8** X3 – Service interface RS232
**9** X4 – Application interface EtherNet/IP

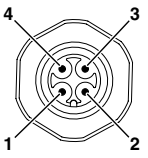
**Note**
Not all antenna ports 1…4 have to be connected.

X1 - Power supply



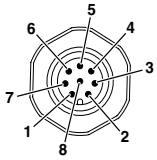

| PIN | Function |
|---|---|
| 1 | $+V_S$ |
| 2 | n. c. |
| 3 | $-V_S$ |
| 4 | n. c. |
| 5 | n. c. |

X3 - Service interface



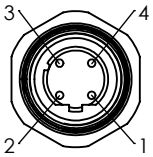

| PIN | Function |
|---|---|
| 1 | n. c. |
| 2 | TxD |
| 3 | GND |
| 4 | RxD |

X2 - Control inputs / outputs




| PIN | Function |
|---|---|
| 1 | Digital output 1 |
| 2 | Digital output 2 |
| 3 | Digital output 3 |
| 4 | Digital output 4 |
| 5 | Digital input 1 |
| 6 | $+V_S$ |
| 7 | $-V_S$ |
| 8 | Digital input 2 |

X4 – EtherNet/IP




| PIN | Function |
|---|---|
| 1 | TD+ |
| 2 | RD+ |
| 3 | TD– |
| 4 | RD– |

## 5 Technical Data

### Dimensions

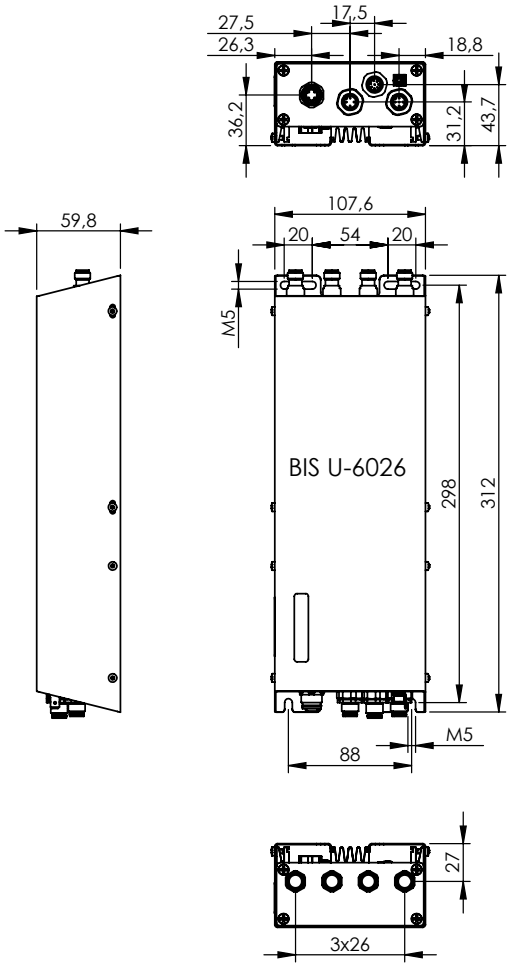



Figure 4: Dimensions of the BIS U-6026-…-ST35 (in mm)

### Mechanical data

| | |
|---|---|
| Housing material | Profile housing and frame made from coated steel |
| X1 - Power supply | M12 integral plug, 4-pin, A-coded |
| X2 – Control inputs / outputs | M12 integral plug, 8-pin |
| X3 – service interface | M12 integral plug, 4-pin, A-coded |
| X4 – EtherNet/IP port | M12 flush socket, 4-pin, D-coded |
| Antenna ports 1…4 | Antenna socket R-TNC |
| Degree of protection as per IEC 60529 | IP 65 (with plugs) |
| Weight | 2050 g |

## 5 Technical Data

### Electrical data

| | |
|---|---|
| Supply voltage $V_S$ | 24 V DC ±20% |
| Residual ripple | ≤ 10% |
| Current consumption at 24 V DC | ≤ 1 A |
| X4 – Application interfaces | Ethernet/IP |
| X3 - Service interface | RS232 |
| Characteristic impedance of the antenna ports | 50 Ω |

### Operating frequencies and radiated power

**BIS U-6026-034-114-…**

| | |
|---|---|
| Operating frequency | 902…928 MHz |
| Maximum permissible radiated power (ERP) | 4 watts$_{EIRP}$ |
| Number of used channels | 52 |
| Channel selection process | Automatic (frequency hopping method) |

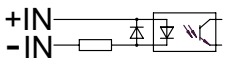
**BIS U-6026-034-124-…**

| | |
|---|---|
| Operating frequency | 920,5…924,5 MHzz |
| Maximum permissible radiated power (ERP) | 2 watts$_{EIRP}$ |
| Number of used channels | 16 |
| Channel selection process | Automatic (frequency hopping method) |

### Control inputs/ outputs

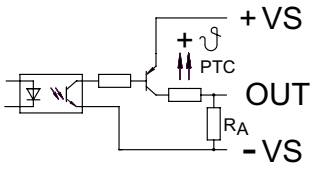
**Digital input (+IN, –IN)**

| | |
|---|---|
| Control inputs | 2, galvanically isolated via optocoupler |
| Control voltage active | 4…40 V |
| Control voltage inactive | 1.5…–40 V |
| Input current at 24 V | 11 mA |




**Control output (01, 02, 03, 04)**

| | |
|---|---|
| Control outputs | 4, galvanically isolated via opto-coupler, PNP, positive switching |
| Supply voltage, output $V_S$ | 19.2…28.8 V DC |
| Output current | ≤ 50 mA |
| Voltage drop at 20 mA | Approx. 2.5 V |
| Output resistance $R_A$ | 10 kΩ to $–V_S$ |




### Operating conditions

| | |
|---|---|
| Ambient temperature | –20 °C…+55 °C |
| Storage temperature | –20 °C…+60 °C |
| Interference radiation<br>– FCC Part 15 B | <br>– Class A |
| Vibration/shock | EN 60068 Part 2-2-6/27/29/32 |

# 5 Technical Data

This UHF system consists of a processor unit and antennas as outlined in the specifications and may only be operated in industrial environments and only in the listed countries issuing operating licenses, subject to all applicable national legal regulations and standards.
(see Chapter 2 "Safety" beginning on page 5).

**Data carrier**

| | |
|---|---|
| ISO 18000-6 | Type C |
| EPCglobal™ | Class 1 Generation 2 |

**Multi-tagging**

| Configured EPC length | Maximum number of data carriers (Sum of all active antennas) |
|---|---|
| 96 Bit | 25 data carriers |
| 496 Bit | 15 data carriers |

**Function indicators**

| | | |
|---|---|---|
| Operating states | Ready<br>Error<br>Tag present<br>Digital input 1<br>Digital input 2<br>Digital output 1<br>Digital output 2<br>Digital output 3<br>Digital output 4 | Green LED<br>Red LED<br>Orange LED<br>Orange LED<br>Orange LED<br>Orange LED<br>Orange LED<br>Orange LED<br>Orange LED |
| EtherNet/IP status | Module status<br>Network Status<br>Data rate<br>Link/activity | Red/green LED<br>Red/green LED<br>Red/green LED<br>Red/green LED |

# 6 Bus Connection

## 6.1 IP Address

The processor unit and the controlling system communicate using Ethernet/IP. Assigning a unique IP address associates the processor unit with a network.

A processor unit can be integrated into a network in different ways (DHCP, ARP). A MAC address provides the basis for integration into a network. This hardware address is unique and identifies network devices such as the processor unit.

**DHCP**

Dynamic Host Configuration Protocol (DHCP) allows for dynamic assignment of an IP address using a server. The hardware can be integrated into the network without requiring any further configuration. Only automatic assignment (MAC address) of the IP address needs to be configured.

**Default-IP**

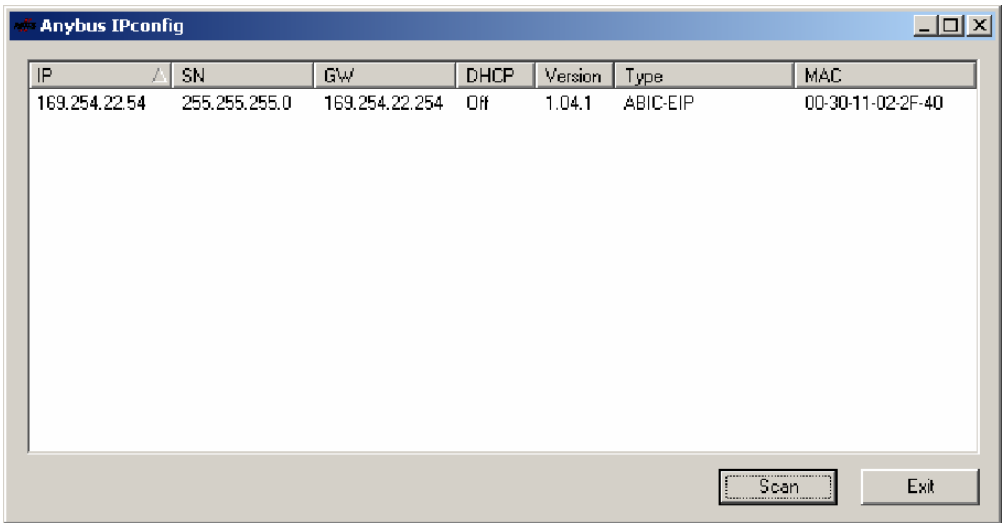
Factory setting for IP address is 192.168.10.2.

## 6.2 AnyBus IPconfig

"AnyBus IPconfig" is a software program that allows the address of the hardware to be assigned for the corresponding subnet before installation. In addition, assignment of the IP address via a DHCP server or BOOTP program can be enabled (DHCP on) or disabled (DHCP off).

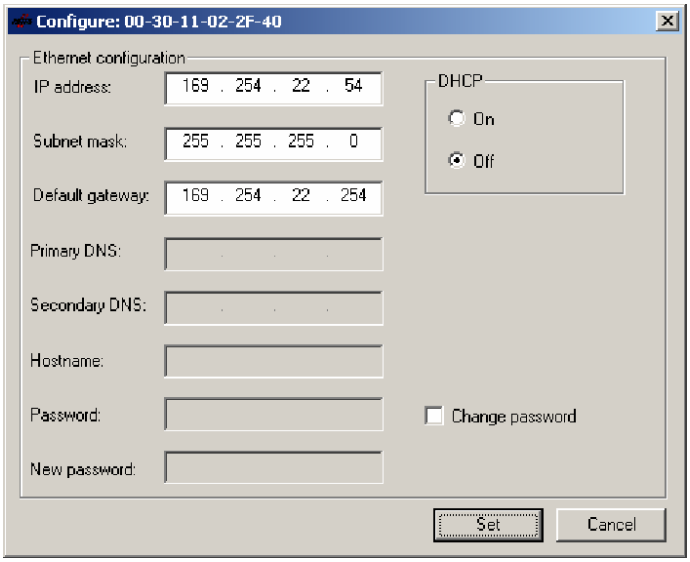
The "Anybus IPconfig" application is included on the BIS CD provided.

► Start "Anybus IPconfig".
⇒ The subnet is scanned for a connected BIS U-6026. The result of the scan is shown in the "Anybus IPconfig" window.




► Select the device from the scan list and double click it.
⇒ The "Configure" window opens.

# 6 Bus Connection




- ► Assign the IP address, subnet mask and gateway address.
- ► Switch DHCP on/off.
- ► Confirm the settings with Set.

## 6.3 Configuration via Web Browser

If the IP address of the device is known and valid in the local network, the device can be contacted by a web browser, for example "http://169.254.22.54/".

The current settings are displayed; the IP address, subnet mask, gateway and DHCP can be set (password-protected).

For diagnostic purposes, the current contents of the data buffer can also be displayed.

# 7 Setting the Processor Unit Parameters

The setting of the processor unit parameters is divided into two parts. One part is the configuration of the BUS parameters. The other is the configuration of the application parameters.
The BUS parameters are configured directly via EtherNet/IP and describe the behavior of the EtherNet/IP interface; see Chapter "BUS parameters" on page 16
The application parameters are configured via the service interface (RS232) and specify the behavior of the processor unit with respect to the application, see Chapter "Application parameters" on page 18

## 7.1 BUS Parameters

**Basic knowledge**

**Schematic structure of the total buffer (process data)**

| |
|---|
| Buffer 1 (for antenna 1 or antenna 3) |
| Buffer 2 (for antenna 2 or antenna 4) |

**Dynamic mode**

If the dynamic mode function (Dynamic) is enabled, the processor unit accepts the read/write job from the controlling system and saves it, regardless of whether a data carrier is in the active range of the antenna. If a data carrier enters the active range of the antenna, the stored job is run.

**Antenna number**

If this parameter is activated, the antenna number of the currently selected antenna is displayed in the bit string.

**Configuration**

The parameters can be configured in two different ways. Configuration with a user program or the EDS file.

**Basic information**

The parameters for operating the processor unit are stored in the BIS Config Object (class $64_{hex}$). Explicit messages are used to access the parameters.

**Configuration with a user program**
A common user program used for EtherNet/IP device configuration is the Windows software TSLogix5000 for the Logix5000 controller by Rockwell Automation.

**EDS file**
The EDS file contains all the device parameters for the processor unit. The file can be found on the BIS CD.

## 7 Setting the Processor Unit Parameters

**Parameters**

*ShowAntenna*

| | |
|---|---|
| class: | $64_{hex}$ |
| instance: | $01_{hex}$ |
| attribute: | $01_{hex}$ |

Factory settings: Enable (=1)

The AN bit in the input buffer shows the selected antenna (1 or 3 for buffer 1 or 2, or 4 for buffer 2).

Other settings: Disable (=0)

The AN bit in the input buffer is always 0.

*Dynamic1*

| | |
|---|---|
| class: | $64_{hex}$ |
| instance: | $01_{hex}$ |
| attribute: | $02_{hex}$ |

Factory settings: Disable (=0)

Antennas 1 and 3 are in static mode. Read/write commands from the controller are carried out only if there is a data carrier in the range of the respective antenna.

Other settings: Enable (=1)

Antennas 1 and 3 are in dynamic mode.

*Dynamic2*

| | |
|---|---|
| class: | $64_{hex}$ |
| instance: | $01_{hex}$ |
| attribute: | $03_{hex}$ |

Factory settings: Disable (=0)

Antennas 2 and 4 are in static mode. Read/write commands from the controller are carried out only if there is a data carrier in the range of the respective antenna.

Other settings: Enable (=1)

Antennas 2 and 4 are in dynamic mode.

**Setting the Parameters**

The parameters can be edited with a variety of programs, such as the EtherNet/IP Tool (EIPTool) from Molex.

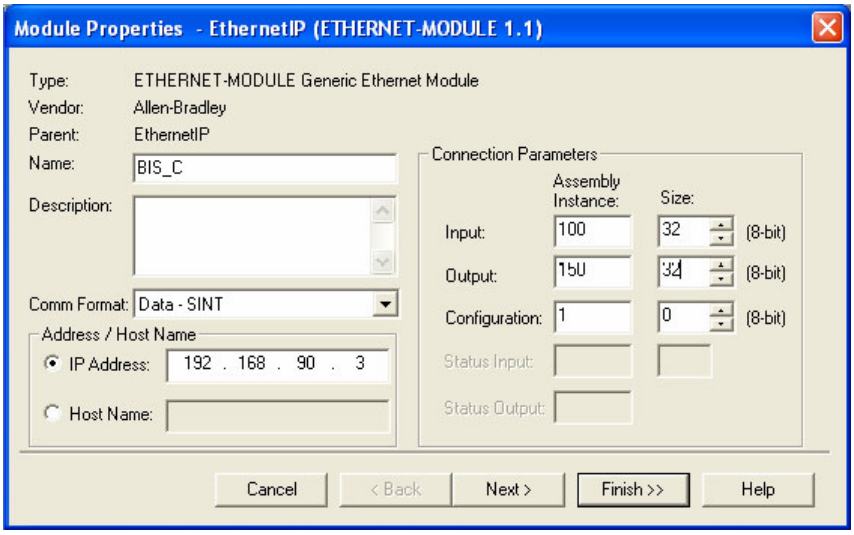
# 7 Setting the Processor Unit Parameters

**Connection parameters**

► Set the connection parameters as follows:

| | | Instance | Size |
|---|---|---|---|
| Connection parameters | Input: | 100 | 32 bytes |
| | Output: | 150 | 32 bytes |
| | Configuration: | 1 | 0 |

**Note**
"Configuration" is not supported. Therefore the values are set to 1 and 0.




## 7.2 Application Parameters

**Factory Settings**

The device is preset ex works. The factory settings are highlighted for the respective parameters.

Some parameters are fixed and cannot be modified:

*Multiplexing*:
The multiplexing sequence and the dwell time in front of each antenna are fixed.
– The sequence in which the antennas are activated is always 1-2-3-4-1-2-….

**Configuration software**

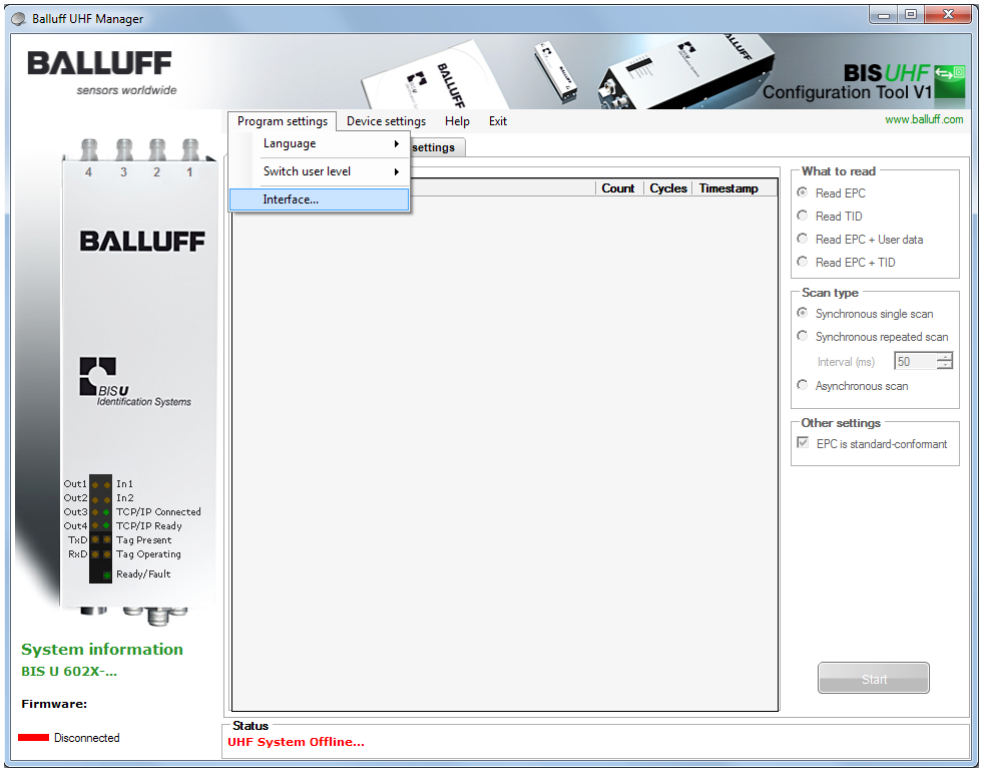
The parameters are configured using the "BIS UHF Manager" software.
One requirement is that the processor is connected to the controlling system via the service interface (RS232). The configuration can be overwritten at any time.
The parameters can be saved in an XML file so that they can be retrieved whenever needed.

**Note**
Detailed information on "BIS UHF Manager" can be found in the software's online help system.

► Start "BIS UHF Manager".
► Click "Device Settings" and "Parameters…" in the menu bar.
⇒ The "Settings" window appears.

# 7 Setting the Processor Unit Parameters

**Note**
Only the parameters described in the following can be modified. The area for configuring advanced device parameters is password-protected and can only be accessed by a Balluff service technician.



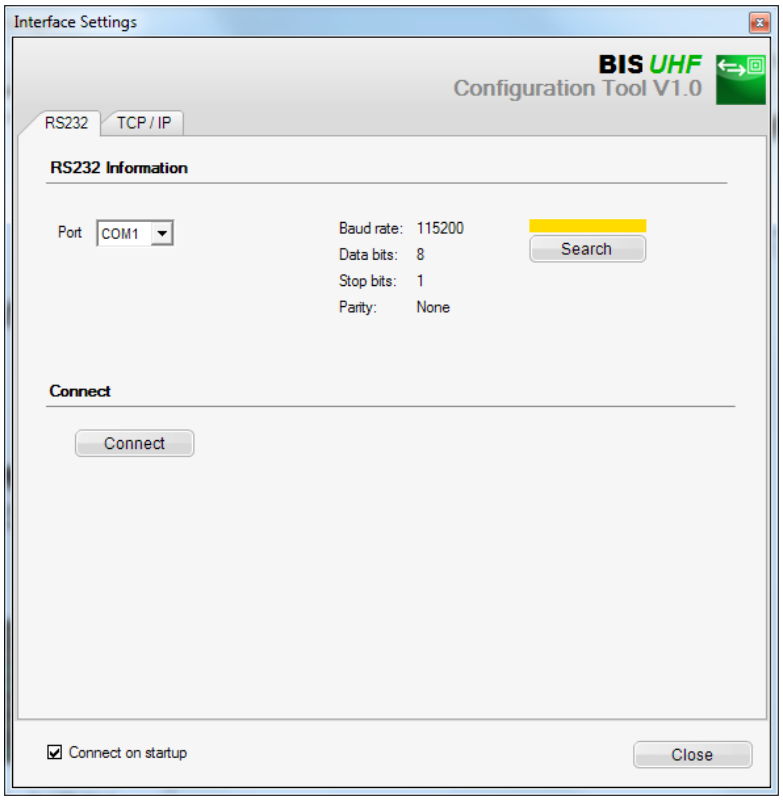

► Start "BIS UHF Manager".
⇒ If "Connect on startup" was selected in the "Interface Settings" window (default setting), the device automatically attempts to establish the last identified connection.

If the device is able to establish the last known connection, "BIS connected…" appears in the status bar.

If the device is not able to establish a connection, "BIS not connected…" appears in the status bar.
The device must then be connected manually:
► Click "Program Settings" and "Interface" in the menu bar.
⇒ The "Interface Settings" window opens.

# 7 Setting the Processor Unit Parameters

**Interface settings**
**Service interface (RS232)**




When the program starts, the device automatically connects if "Connect on startup" was selected in the "Interface Settings" window (factory setting).

When the "Interface Settings" window is opened, the last known connection is displayed and the bar above the "Search" button turns yellow.

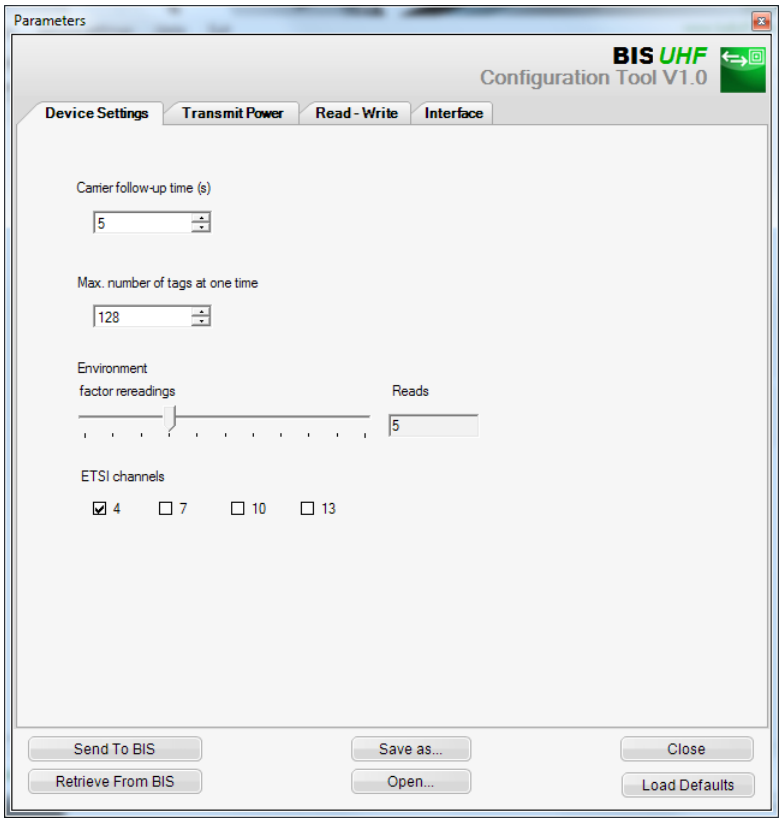
► Click the "Search" button.
⇒ The program searches for connections.

If the program finds a connection, the connection settings are displayed and the bar above the "Search" button turns green.
► Click the "Connect" button.
⇒ The device is connected.

If the program does not find a connection, the bar above the "Search" button turns red.

# 7 Setting the Processor Unit Parameters

## Device Settings




*Carrier follow-up time*
Follow-up time in seconds of the switched-on antennas after the command is sent. The read or write command should be executed within this time after detection.

Factory setting: *5 seconds*

*Max. number of tags at the same time*
Maximum number of expected data carriers in the field.

Factory setting: *128*

*Environment*
Factor rereadings (only for asynchronous detection or dynamic mode)

Number of rereadings after which a data carrier is reported as present (tag coming) or number of failed rereadings after which a data carrier is reported as not present (tag going) (only in dynamic mode).

Factory setting: *5*

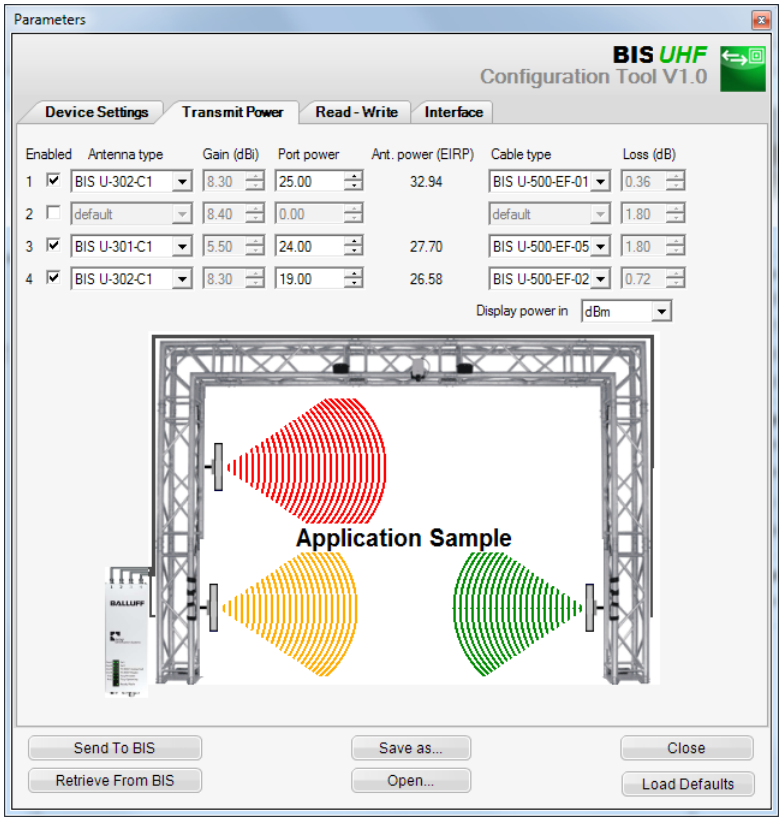
*ETSI channels*
The channel setting determines the channel assignment. If multiple channels are activated, the device automatically selects them by means of the frequency hopping method.

Factory setting: *channel 4 switched on, channels 7…13 switched off*

**Note**
The ETSI channels selection is only available when using the devices within the European Community.

# 7 Setting the Processor Unit Parameters

## Transmitting Power




**Note**

The *Gain* and *Loss* parameters are defined in the *Antenna type* and *Cable type* fields. These values are used to determine the maximum permissible radiated power.

The maximum permissible radiated power and factory settings differ depending on the set country profile. For information on the valid regulations of the different countries, see Chapter 2 "Safety".

In the countries of the European Union, the radiated power is specified in the form of ERP (max. 2 $watts_{ERP}$).

In the USA and Canada, the radiated power is specified in the form of an EIRP power (max. 4 $watts_{EIRP}$).

See the "Basic UHF manual" for more information on radiated powers.

## 7 Setting the Processor Unit Parameters

*Enabled:*
Enables/disables antennas 1…4.

Factory setting: *antenna 1 enabled, antennas 2…4 disabled.*

*Antenna type*
Selection of the used antenna.

Factory setting: *BIS U-302-C1 or BIS U-302-C0*

*Port power*
For selecting the power on the device (port power).

Factory setting: *22.5 dBm (176 mW) or 20.5 dBm (112 mW)*

*Antenna power*
Power at the antenna (EIRP or ERP).

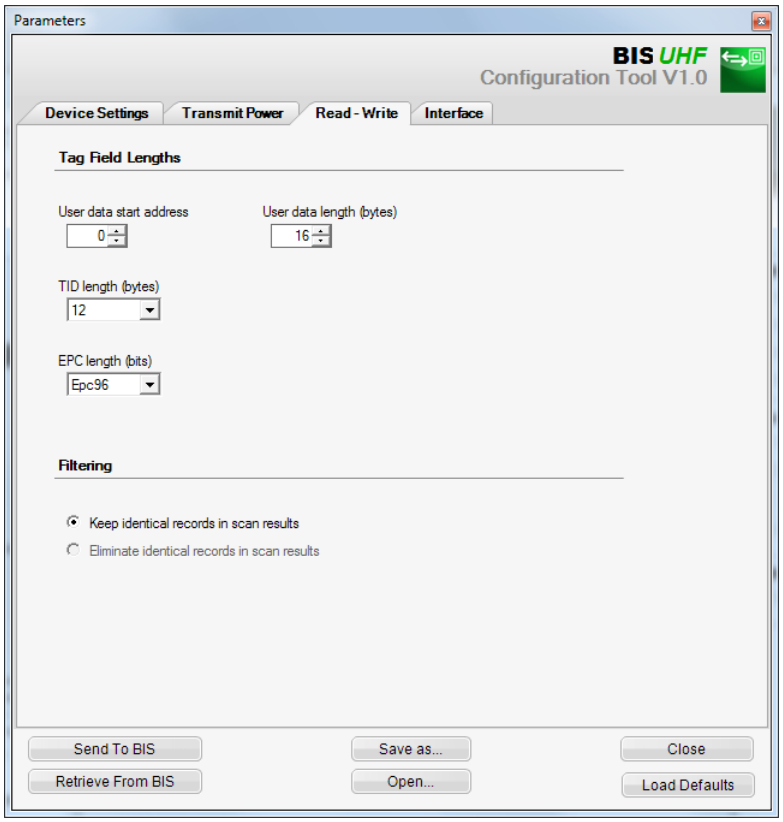
Factory setting: *27 dBm (500 mW)*

*Cable type*
Selection of the cable used.

Factory setting: *BIS U-500-EF-05*

# 7 Setting the Processor Unit Parameters

**Reading/writing**




**Tag Field Lengths area**

*User data start address*
Start address of the USER data for automatic reading during data carrier searches and if USER data is used as an address during reading or writing.

Factory setting: *0 bytes*

*User data length*
Length of the USER data for automatic reading during data carrier searches and if USER data is used as an address during reading or writing. The value range is 1 to 16.

Factory setting: *16 bytes*

*TID length*
Length of the TID data with value range from 2 to 12.

Factory setting: *12 bytes*

**Note**
If data carriers have a length other than the TID set here, it is possible that they cannot be read from or written to.

## 7 Setting the Processor Unit Parameters

*EPC length*
Length of the EPC format on the data carriers. This parameter determines the maximum length of the EPC data to be processed and the output format for the command "Read multiple data carriers (EPC)".

Factory setting: *96 bits*

**Note**
If the actual EPC length of the data carriers is not equivalent to 96 bits, set the value to 496 bits. Otherwise the read and write commands cannot be run without errors.

# 8 Device Function

## 8.1 Function Principle of the BIS U-6026

Two buffers are needed to exchange data and commands between the processor unit and the controlling system. The buffer contents are exchanged using cyclical polling. The buffer content depends on the cycle in which it is written (e.g. control commands at the beginning of a job). When writing to the buffer, the transmitted data from the preceding cycle is overwritten. Unwritten bytes are not deleted and retain their data content.

### Total buffer

The buffer size of the input and output buffer is 32 bytes.
This total buffer is divided into 2 halves, each with 16 bytes, for the two antenna pairs 1/3 or 2/4:

– The first 16 bytes contain the process data for antenna 1 or 3 (depending on the status of the HD bit).
– The second 16 bytes contain the process data for antenna 2 or 4 (depending on the status of the HD bit).

Fourteen bytes per antenna are available for data exchange, since the first and last byte of the respective data buffer are used for the controller and status messages.

### Output buffer

The control commands for the identification system and the data to be written to the data carrier are sent via the output buffer.

| Bit No. / Subaddress | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| $00_{hex}$ = 1st bit string | | TI | KA | HD | | GR | | AV |
| $01_{hex}$ | Command designator or data | | | | | | | |
| $02_{hex}$ | Start address (Low Byte) or data or number of bytes | | | | | | | |
| $03_{hex}$ | Start address (Middle Byte) or data | | | | | | | |
| $04_{hex}$ | Start address (High Byte) or data | | | | | | | |
| $05_{hex}$ | Number of bytes (Low Byte) or data | | | | | | | |
| $06_{hex}$ | Number of bytes (Middle Byte) or data | | | | | | | |
| $07_{hex}$ | Number of bytes (High Byte) or data | | | | | | | |
| … | Data | | | | | | | |
| Last byte = 2nd bit string | | TI | KA | HD | | GR | | AV |

# 8 Device Function

**Output buffer (cont.)**

**Configuration and explanation (output buffer)**

| Subaddress | Bit name | Meaning | Function description |
|---|---|---|---|
| $00_{hex}$ = bit string | TI | Toggle bit in | Controller is ready to receive additional data (read job). |
| | KA | Antenna deactivation | Activates or deactivates the antenna selected with HD.<br>0: activated<br>1: deactivated |
| | HD | Antenna selection | Selection of the antennas for buffer 1 and buffer 2.<br>Buffer 1: 0: antenna 1, 1: antenna 3<br>Buffer 2: 0: antenna 2, 1: antenna 4 |
| | GR | Basic state | The processor unit goes into basic state for the respective antenna. Any pending job is canceled. |
| | AV | Job | A job is pending for the respective antenna. |

## 8 Device Function

**Input buffer**

The input buffer is used to send the data read by the identification system, the designations and the status codes to the controlling system.

| Bit No. / Subaddress | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| $00_{hex}$ = 1st bit string | BB | HF | TO | AN | AF | AE | AA | TP |
| $01_{hex}$ | Status code or Data | | | | | | | |
| $02_{hex}$ | Data | | | | | | | |
| … | Data | | | | | | | |
| Last byte = 2nd bit string | BB | HF | TO | AN | AF | AE | AA | TP |

**Configuration and explanation (input buffer)**

| Subaddress | Bit name | Meaning | Function description |
|---|---|---|---|
| $00_{hex}$ = bit string | BB | Ready | Processor unit is ready for operation. |
| | HF | Antenna error | Cable breakage at antenna or no antenna connected. |
| | TO | Toggle bit out | **Read operation:** additional data is made available by the processor unit.<br>**Write operation:** processor unit can accept additional data. |
| | AN | Antenna | Selected antenna.<br>Buffer 1: 0: antenna 1, 1: antenna 3<br>Buffer 2: 0: antenna 2, 1: antenna 4 |
| | AF | Job error | Error in processing the job or job canceled. |
| | AE | Job end | Confirmation – Job finished without error. |
| | AA | Job start | Confirmation – Job was recognized and started. |
| | TP | Tag present | Data carrier is in the range of the antenna (only in connection with read, write and list commands). |

# 8 Device Function

**Input buffer (cont.)**

### Structure of the input buffer

The process data buffer is identical for all commands.

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Status code or data | – If AF bit 1: provides information on the status of a query<br>– If AF bit 0: data is written as with the individual commands |
| … | Data | – If AF bit 1: unused<br>– If AF bit 0: data |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

**Information**

- The status code is only sent if the AF bit is set in the bit string.
- Because the read EPC can have varying lengths (number of bytes), a length field is sent. The maximum processed EPC length (12 bytes or 62 bytes) is configured.
- The TID is always sent in a 12-byte frame. The actual length within this frame is configured (see Chapter "BUS Parameters", on page 16 and Chapter "Application Parameters", on page 18).

### Status codes

**Information**
Status codes are only valid in combination with the AF bit!

| Subaddress | Function description |
|---|---|
| $01_{hex}$ | Job cannot be executed because there is no active data carrier in the active range of the antenna. |
| $02_{hex}$ | Not possible to read the data carrier. |
| $03_{hex}$ | Data carrier was removed from the range of the antenna during reading. |
| $04_{hex}$ | Cannot write to the data carrier. |
| $05_{hex}$ | Data carrier was removed from the range of the antenna during writing. |
| $07_{hex}$ | No or invalid command designator with set AV bit or the number of bytes is $00_{hex}$. |
| $09_{hex}$ | Cable breakage at antenna or no antenna connected. |
| $0E_{hex}$ | There is more than 1 data carrier or more than 1 selected data carrier in the active range of the antenna and the executed command is valid only for individual data carriers. |
| $0F_{hex}$ | First and second bit string not equal. The second bit string must be used. |
| $43_{hex}$ | Error when reading or writing parameters of the internal memory. |
| $44_{hex}$ | Arbitrary device behavior. |
| $46_{hex}$ | Command outside the address range of the data carrier. |
| $4E_{hex}$ | No antenna activated. |

# 8 Device Function

**Communication**

Communication between the controlling system and processor unit is defined by a sequence protocol. Communication between the controlling system and processor unit is implemented using control bit in the output and input buffer.

**Basic sequence**

1. The controller sends a command designator to the processor unit in the output buffer with the AV bit set. The AV bit tells the processor unit that a job is beginning and the transmitted data is valid.
2. The processor unit accepts the job and confirms the job by setting the AA bit in the input buffer.
3. If additional data needs to be exchanged for the job, readiness for additional data exchange is indicated by inverting the TI and TO toggle bits.
4. The processor unit has correctly executed the job and sets the AE bit in the input buffer.
5. The controller has accepted all data. The AV bit in the output buffer is reset.
6. The processor unit resets all control bits set in the input buffer during the job (AA bit, AE bit). The processor unit is ready for the next job.

**Structure of the output buffer for various commands**

**Command designator $00_{hex}$: No command present**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $00_{hex}$: No command present. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

**Command designator $81_{hex}$ or $01_{hex}$: Read individual data carrier (USER data)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $81_{hex}$: read data carrier (USER data). |
| $02_{hex}$ | Start address 1 (Low Byte) | Start address (Low Byte) from which reading is to start. |
| $03_{hex}$ | Start address 2 (Middle Byte) | Start address (Middle Byte) from which reading is to start. |
| $04_{hex}$ | Start address 3 (High Byte) | Start address (High Byte) from which reading is to start. |
| $05_{hex}$ | Number of bytes 1 (Low Byte) | The number of bytes (Low Byte) that are to be read starting from the start address. |
| $06_{hex}$ | Number of bytes 2 (Middle Byte) | The number of bytes (Middle Byte) that are to be read starting from the start address. |
| $07_{hex}$ | Number of bytes 3 (High Byte) | The number of bytes (High Byte) that are to be read starting from the start address. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Transmission of data that was read from the data carrier. |
| … | Data | Transmission of data that was read from the data carrier.<br><br>… is continued, if necessary, in further buffer transmissions until the total number of bytes is reached. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

**Command designator $42_{hex}$ or $03_{hex}$: Read individual data carrier (EPC)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $03_{hex}$: Read data carrier (EPC). |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Number of bytes of the EPC read |
| … | Data | Transmission of EPC data that was read from the data carrier.<br>… is continued, if necessary, in further buffer transmissions until the total number of bytes is reached. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $44_{hex}$ or $05_{hex}$: Read individual data carrier (TID)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $05_{hex}$: read data carrier (TID). |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Transmission of TID data that was read from the data carrier. |
| … | Data | Transmission of TID data that was read from the data carrier.<br>… is continued, if necessary, in further buffer transmissions until the total number of bytes is reached. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $82_{hex}$ or $02_{hex}$: Write to individual data carrier (USER data)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $82_{hex}$: Write to data carrier (USER data). |
| $02_{hex}$ | Start address 1 (Low Byte) | Start address (Low Byte) from which writing is to start. |
| $03_{hex}$ | Start address 2 (Middle Byte) | Start address (Middle Byte) from which writing is to start. |
| $04_{hex}$ | Start address 3 (High Byte) | Start address (High Byte) from which writing is to start. |
| $05_{hex}$ | Number of bytes 1 (Low Byte) | The number of bytes that are to be written starting from the start address (Low Byte). |
| $06_{hex}$ | Number of bytes 2 (Middle Byte) | The number of bytes that are to be written starting from the start address Middle Byte). |
| $07_{hex}$ | Number of bytes 3 (High Byte) | The number of bytes that are to be written starting from the start address (High Byte). |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

Data is accepted from the processor unit only after the command has been accepted by the processor unit and acknowledged.

| | | |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Transmission of the data that is to be written to the data carrier. |
| … | Data | Transmission of the data that is to be written to the data carrier. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $43_{hex}$ or $04_{hex}$: Write to individual data carrier (EPC)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $04_{hex}$: Write to data carrier (EPC). |
| $02_{hex}$ | No. of bytes | Number of bytes (1…62) to be written beginning with the start address $00_{hex}$. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

Data is accepted from the processor unit only after the command has been accepted by the processor unit and acknowledged.

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Transmission of the data that is to be written to the data carrier. |
| … | Data | Transmission of the data that is to be written to the data carrier. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

**Command designator $B2_{hex}$ or $32_{hex}$: Write constant value to individual data carrier (USER data)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $B2_{hex}$: Write to data carrier (USER data). |
| $02_{hex}$ | Start address 1 (Low Byte) | Start address (Low Byte) from which writing is to start. |
| $03_{hex}$ | Start address 2 (Middle Byte) | Start address (Middle Byte) from which writing is to start. |
| $04_{hex}$ | Start address 3 (High Byte) | Start address (High Byte) from which writing is to start. |
| $05_{hex}$ | Number of bytes 1 (Low Byte) | The number of bytes that are to be written starting from the start address (Low Byte). |
| $06_{hex}$ | Number of bytes 2 (Middle Byte) | The number of bytes that are to be written starting from the start address Middle Byte). |
| $07_{hex}$ | Number of bytes 3 (High Byte) | The number of bytes that are to be written starting from the start address (High Byte). |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

Data is accepted from the processor unit only after the command has been accepted by the processor unit and acknowledged.

| | | |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | Value that is to be written to the data carrier. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $45_{hex}$: Set antenna power**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $45_{hex}$: Set antenna power |
| $02_{hex}$ | Antenna power | Antenna power for the current antenna (head) in increments of 0.25 dBm<br><br>Permitted value range (decimal):<br>**BIS U-6026-034-114-…:**<br>77 (+19.25 dBm EIRP) … 144 (+36.00 dBm EIRP)<br><br>The set power is not permanently saved and is reset to the saved default value when the reader is booted.<br><br>The socket power on the device is calculated and set based on the configured antenna/cable parameters. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

**Command designator $46_{hex}$: Read out antenna power**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $46_{hex}$: Read out antenna power |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Antenna power | Antenna power for the current antenna (head) in increments of 0.25 dBm or 0 for antenna that is switched off |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $47_{hex}$: Read multiple data carriers (EPC)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $47_{hex}$: Read multiple data carriers (EPC) |
| $02_{hex}$ | Type | 0 = EPC (other values currently not supported) |
| $03_{hex}$ | Max Number of Data Carriers | Maximum number of data carriers to be output 1…255, (0 = no limitation)<br>If the number is greater than the values listed under "Technical Data - Multi-tagging", then the lower value applies. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Number of data carriers read | 1…255 |
| $02_{hex}$ | Number of bytes per EPC | 12 or 64<br>This corresponds to the length of the longest transmitted EPC configured in the device. EPCs shorter than this length are output right-justified and filled with zeros on the left.<br>In the following, the (number of data carriers read) × (number of bytes per EPC) are transmitted.<br>For 64 bytes per EPC, the actual EPC length in ASCII is specified in the 1st and 2nd byte of the EPC. |
| $03_{hex}$ | Data of 1st EPC | Actual EPC data |
| … | Data of 1st EPC | Actual EPC data |
| … | Data of 1st EPC | Actual EPC data |
| … | Data of 2nd EPC | Actual EPC data |
| … | Data of 2nd EPC | Actual EPC data |
| … | Data | … is continued, if necessary, in further buffer transmissions until the total number of bytes is reached. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

This command always responds immediately—even for configured dynamic mode—with the currently identified number of tags.

If no tag is identified, this command generates an error message (status code 01).

# 8 Device Function

**Command description (continued)**

**Command designator $55_{hex}$: Read number of tags**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $55_{hex}$: Read number of tags |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Number of data carriers read | 0…255 |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

This command always responds immediately—even for configured dynamic mode—with the currently identified number of tags.

If no tag is identified, this command returns the number "0" and no error message.

# 8 Device Function

**Command description (continued)**

**Command designator $40_{hex}$: Select (data carrier selection for multi-tagging)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $40_{hex}$: Select tag (selection of the data carrier to be used for further processing steps such as reading or writing) |
| $02_{hex}$ | Type | 0 = EPC (other values currently not supported) |
| $03_{hex}$ | No. of bytes | Number of bytes of the data carrier identifier (EPC) that is transmitted in following cycles. |
| $04_{hex}$ | Reserved | Reserved for expansions; please set to 0. |
| $05_{hex}$ | Reserved | Reserved for expansions; please set to 0. |
| $06_{hex}$ | Reserved | Reserved for expansions; please set to 0. |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

Data of the data carrier identifier is accepted from the processor unit only after the command has been accepted by the processor unit and acknowledged.

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Data | 1st byte of the data carrier identifier (EPC or TID) |
| … | Data | Other bytes of the data carrier identifier (EPC or TID) … is continued, if necessary, in further buffer transmissions until the total number of bytes is reached. |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

After the Select command, read/write commands (command designators $01_{hex}$, $02_{hex}$, $03_{hex}$, $04_{hex}$, $05_{hex}$, $32_{hex}$, $42_{hex}$, $43_{hex}$, $44_{hex}$, $81_{hex}$, $82_{hex}$, $B2_{hex}$) for the corresponding antenna are run only on the designated data carrier, if it is available.

If the selected data carrier is not in the field of the antenna at the moment, the Select command is processed without errors anyway, but following read/write commands return an error with status code $01_{hex}$ (no data carrier).

If the selected data carrier identifier is present on more than one tag, the following commands are run as follows:
- Read commands are run on **one** data carrier, which is randomly selected from the suitable data carriers.
- Write commands are run on **all** suitable data carriers.

# 8 Device Function

**Command description (continued)**

**Information**

– The data carrier identifier is usually taken from a preceding command $47_{hex}$: *Read multiple data carriers (EPC)*. Omit the leading fill bytes in the data carrier list for this. The entire entry is usually used for the 12-byte EPC format; for the 64-byte format (as ASCII digits in byte address 0 and 1 of the respective entry), read the actual length and then read out the identifier starting from the byte address (64-length).
Example: Length specification = "24" means that the EPC is in byte address 40…63.

– If multiple data carriers are to be processed in sequence, what usually results is the following command sequence:

  Command $47_{hex}$: Read multiple data carriers (EPC)

  Command $40_{hex}$: Select (1st identifier)
  … Process 1st data carrier

  Command $40_{hex}$: Select (2nd identifier)
  … Process 2nd data carrier

  Command $40_{hex}$: Select (3rd identifier)
  … Process 3rd data carrier

  etc.

  Command $41_{hex}$: Unselect

  The controller can choose the sequence of data carriers at random, omit data carriers or select the same one repeatedly.

– With the BIS U-602_ devices the selection is made only using the EPC, thereby also enabling operation of multiple antennas at one read position. Then a data carrier with a suitable data carrier identifier is also read if it is located in front of an antenna **other** than the one to which the Select command refers. If you need to ensure that only data carriers in front of the current antenna are read after a Select command, the EPC identifiers of the data carrier must be unique **and** the presence of the data carrier in front of the desired antenna must first be checked using command $47_{hex}$: *Read multiple data carriers (EPC)*.

– A data carrier selection for an antenna remains valid until one of the following events occurs:
  – A new selection is defined.
  – An Unselect command undoes the selection.
  – The GR bit (basic state) for the corresponding antenna is set.
  – The device is restarted.

## 8 Device Function

**Command description (continued)**

**Command designator $41_{hex}$: Unselect (undo the data carrier selection)**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $41_{hex}$: Unselect (undo the fixed data carrier selection) |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

The Unselect command undoes a data carrier selection for an antenna. If no selection was made, the status remains unchanged.

Subsequent read/write commands then refer to any individual data carrier in the field of the antenna. If multiple data carriers are in the field of the antenna, the following read/write commands are ended with an error and status code $0E_{hex}$ (multiple data carriers).

**Command designator $61_{hex}$: Set IO outputs**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $61_{hex}$: Set IO outputs |
| $02_{hex}$ | Outputs to be set (bit mask) | $01_{hex} = 00000001_b$ = Set output 1<br>$02_{hex} = 00000010_b$ = Set output 2<br>$04_{hex} = 00000100_b$ = Set output 3<br>$08_{hex} = 00001000_b$ = Set output 4<br>Combination is possible, for example<br>$0D_{hex} = 00001101_b$ = Set outputs 1, 2 and 4; other outputs remain unaffected. |
| $03_{hex}$ | Value to be set | $00_{hex}$ = Set outputs to 0<br>$01_{hex}$ = Set outputs to 1<br>$02_{hex}$ = Invert outputs<br>$03_{hex}$ = Flash outputs (0.5 s) |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

## 8 Device Function

**Command description (continued)**

**Command designator $62_{hex}$: Read in IO inputs**

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Command designator | $62_{hex}$: Read in IO inputs |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

If execution is successful, the response is passed to the input buffer in the following format:

| Subaddress | Meaning | Function description |
|---|---|---|
| $00_{hex}$ | 1st bit string | |
| $01_{hex}$ | Status values (bit mask) | $00_{hex} = 00000000_b$ = In 1 Low, In 2 Low<br>$01_{hex} = 00000001_b$ = In 1 High, In 2 Low<br>$02_{hex} = 00000010_b$ = In 1 Low, In 2 High<br>$03_{hex} = 00000011_b$ = In 1 High, In 2 High |
| … | None | No meaning |
| Last byte | 2nd bit string | If first and second bit strings agree, there is valid data present. |

# 8 Device Function

## 8.2 Function Indicators

The operating states of the identification system and the EtherNet/IP connection are indicated via LEDs.

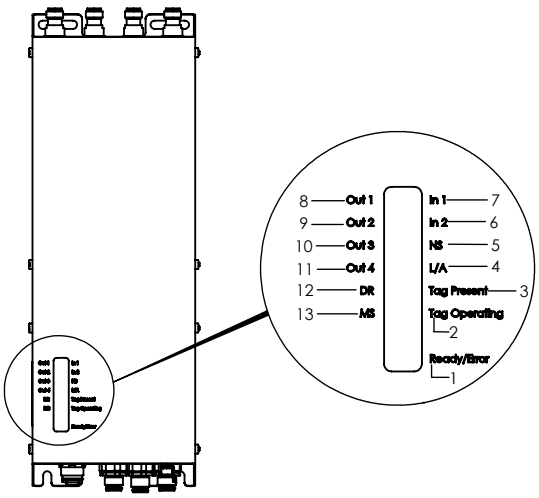



Figure 5: Function indicators

**1** Ready / Error
**2** Tag operating
**3** Tag present
**4** Link/Activity (L/A)
**5** Network status (NS)
**6** Digital input 2 (In 2)
**7** Digital input 1 (In 1)
**8** Digital output 1 (Out 1)
**9** Digital output 2 (Out 2)
**10** Digital output 3 (Out 3)
**11** Digital output 4 (Out 4)
**12** Data rate (DR)
**13** Module status (MS)

**Start-up phase**

The "Ready/Error" LED flashes green during the start-up phase.
When setup is finished and the system is ready for operation, the "Ready/Error" LED lights up green.

The MS, NS, DR and L/A LEDs flash alternating between green and red during the switch-on operation before they reach their respective display status.

# 8 Device Function

## Diagnostics

### Identification system

| Status LED | Meaning |
|---|---|
| Ready / Error | |
| Off | Device is not ready for operation |
| Illuminated green | Device is ready for operation |
| Flashing green | Startup phase of the device (Setup) |
| Flashing red | Error (e.g. device error or broken cable) |
| Red lit | Internal error (contact Service if this occurs repeatedly) |

| Tag operating | |
|---|---|
| Off | No command |
| Illuminated orange | Command to data carrier (e.g. detection, read or write) |

| Tag present | |
|---|---|
| Off | No command |
| Flashing orange | No data carrier detected in the active range of the antenna |
| Illuminated orange | Data carrier detected in the active range of the antenna |

### Digital inputs/outputs

| In 1…In 2 | |
|---|---|
| Off | Digital input is not set or not connected |
| Illuminated orange | Digital input is connected and set |

| Out 1…Out 2 | |
|---|---|
| Off | Digital output is not set |
| Illuminated orange | Digital output is set |

## 8 Device Function

### Ethernet and EtherNet/IP connection

| Status LED | Meaning |
|---|---|
| Data rate (DR) | |
| Off | Transmission rate 10 Mbit |
| Green | Transmission rate 100 Mbit |
| Red | – |

| Module status (MS) | |
|---|---|
| Off | No power supply for the module |
| Green | Device is ready for operation |
| Flashes green | Missing or incorrect configuration of the module |
| Red | Fatal error |
| Flashes red | Rectifiable error |

| Network status (NS) | |
|---|---|
| Off | No voltage or no IP address |
| Green | Device has at least one EtherNet/IP connection |
| Flashes green | Device has no EtherNet/IP connection |
| Red | One IP address exists in duplicate |
| Flashes red | One or more EtherNet/IP connections have a time-out |

| Link/Activity (L/A) | |
|---|---|
| Off | No voltage |
| Green | The device is connected over Ethernet |
| Flashes green | RX/TX activity |
| Red | – |

# 8 Device Function

## 8.3 Examples

**1st example** **Read 33 bytes of USER data starting at data carrier address 10**

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $01_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit |
| $02_{hex}$ | Start address $0A_{hex}$ | $01…0E_{hex}$ | Enter first 14 bytes |
| $03_{hex}$ | Start address $00_{hex}$ | $00_{hex}/0F_{hex}$ | *Set AE bit* |
| $04_{hex}$ | Start address $00_{hex}$ | | |
| $05_{hex}$ | No. of bytes $21_{hex}$ | | |
| $06_{hex}$ | No. of bytes $00_{hex}$ | | |
| $07_{hex}$ | No. of bytes $00_{hex}$ | | |
| $00_{hex}/0F_{hex}$ | Set AV bit | | |
| 3. Process input buffer: | | 4. Process input buffer: | |
| $01…0E_{hex}$ | Copy first 14 bytes | $01…0E_{hex}$ | Enter second 14 bytes |
| Process output buffer: | | $00_{hex}/0F_{hex}$ | Invert TO bit |
| $00_{hex}/0F_{hex}$ | Invert TI bit | | |
| 5. Process input buffer: | | 6. Process input buffer: | |
| $01…0E_{hex}$ | Copy second 14 bytes | $01…05_{hex}$ | Enter last 5 bytes |
| Process output buffer: | | $00_{hex}/0F_{hex}$ | Invert TO bit |
| $00_{hex}/0F_{hex}$ | Invert TI bit | | |
| 7. Process input buffer: | | 8. Process input buffer: | |
| $01…05_{hex}$ | Copy last 5 bytes | $00_{hex}/0F_{hex}$ | Reset AA and AE bits |
| Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | | |

## 8 Device Function

**2nd example** **Read the EPC of the data carrier**

**For configuration with EPC length of 12 bytes!**

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $03_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit |
| $00_{hex}/0F_{hex}$ | Set AV bit | $01_{hex}$ | Length of the received EPC |
| | | $02…0D_{hex}$ | Enter EPC |
| | | $00_{hex}/0F_{hex}$ | *Set AE bit* |
| 3. Process input buffer: | | 4. Process input buffer: | |
| $02…0D_{hex}$ | Copy EPC | $00_{hex}/0F_{hex}$ | Reset AA and AE bits |
| Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | | |

## 8 Device Function

**3rd example** **Read the TID of the data carrier**

If the TID length configured in the UHF manager is shorter than 12 bytes, leading zeros are used to pad the TID to 12 bytes.

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $05_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit |
| $00_{hex}/0F_{hex}$ | Set AV bit | $01…0C_{hex}$ | Enter TID |
| | | $00_{hex}/0F_{hex}$ | *Set AE bit* |
| 3. Process input buffer: | | 4. Process input buffer: | |
| $01…0C_{hex}$ | Copy TID | $01…0F_{hex}$ | Reset AA and AE bits |
| Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | | |

## 8 Device Function

**4th example** **Read 30 bytes of USER data starting at data carrier address 10 with read error**

**Information**
If an error occurs, the AF bit is set instead of the AE bit, together with a corresponding error number. Setting the AF bit cancels the job and declares it as finished.

| Command from controller | BIS U-6026 reaction |
|---|---|

1. Process output buffer (note sequence):

| | |
|---|---|
| $01_{hex}$ | Command designator $01_{hex}$ |
| $02_{hex}$ | Start address $0A_{hex}$ |
| $03_{hex}$ | Start address $00_{hex}$ |
| $04_{hex}$ | Start address $00_{hex}$ |
| $05_{hex}$ | No. of bytes $1E_{hex}$ |
| $06_{hex}$ | No. of bytes $00_{hex}$ |
| $07_{hex}$ | No. of bytes $00_{hex}$ |
| $00_{hex}/0F_{hex}$ | Set AV bit |

2. Process input buffer (note sequence):
**If an error occurs immediately!**

| | |
|---|---|
| $00_{hex}/0F_{hex}$ | Set AA bit |
| $01_{hex}$ | Enter error number |
| $00_{hex}/0F_{hex}$ | *Set AF bit* |

3. Process input buffer:

| | |
|---|---|
| $01_{hex}$ | Copy error number |

Process output buffer:

| | |
|---|---|
| $00_{hex}/0F_{hex}$ | Invert AV bit |

4. Process input buffer:

| | |
|---|---|
| $00_{hex}/0F_{hex}$ | Reset AA and AF bits |

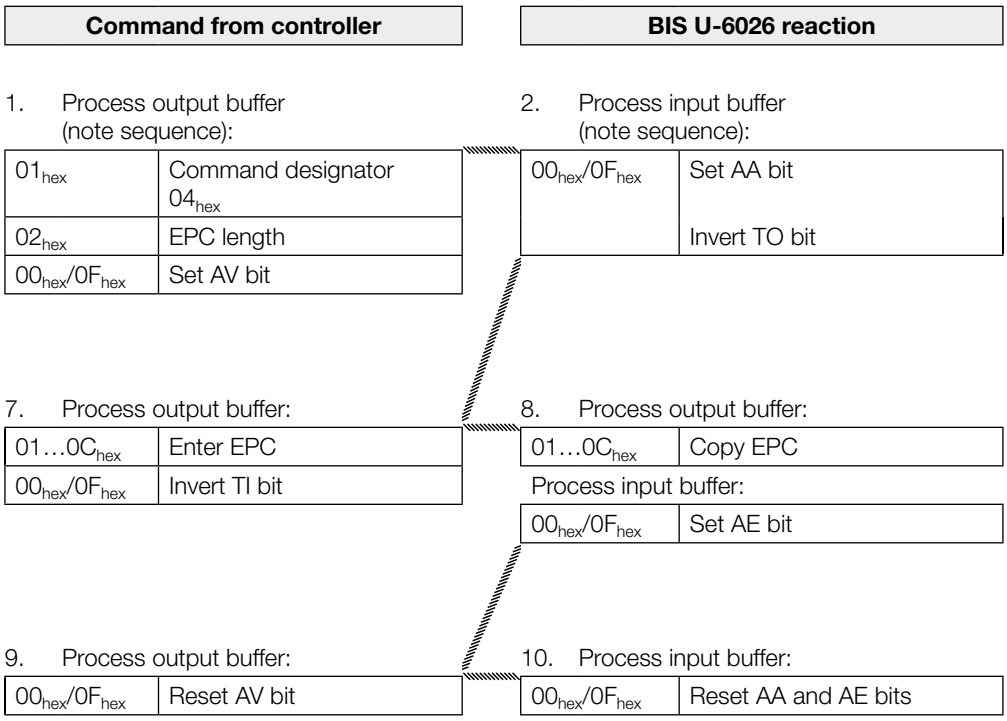
## 8 Device Function

**5th example** **Write 32 bytes of USER data starting at data carrier address 20**

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $02_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit<br>Invert TO bit |
| $02_{hex}$ | Start address $14_{hex}$ | | |
| $03_{hex}$ | Start address $00_{hex}$ | | |
| $04_{hex}$ | Start address $00_{hex}$ | | |
| $05_{hex}$ | No. of bytes $20_{hex}$ | | |
| $06_{hex}$ | No. of bytes $00_{hex}$ | | |
| $07_{hex}$ | No. of bytes $00_{hex}$ | | |
| $00_{hex}/0F_{hex}$ | Set AV bit | | |
| 3. Process output buffer: | | 4. Process output buffer: | |
| $01…0E_{hex}$ | Enter first 14 bytes | $01…0E_{hex}$ | Copy first 14 bytes |
| $00_{hex}/0F_{hex}$ | Invert TI bit | Process input buffer: | |
| | | $00_{hex}/0F_{hex}$ | Invert TO bit |
| 5. Process output buffer: | | 6. Process output buffer: | |
| $01…0E_{hex}$ | Enter second 14 bytes | $01…0E_{hex}$ | Copy second 14 bytes |
| $00_{hex}/0F_{hex}$ | Invert TI bit | Process input buffer: | |
| | | $00_{hex}/0F_{hex}$ | Invert TO bit |
| 7. Process output buffer: | | 8. Process output buffer: | |
| $01…04_{hex}$ | Enter last 4 bytes | $01…04_{hex}$ | Copy last 4 bytes |
| $00_{hex}/0F_{hex}$ | Invert TI bit | Process input buffer: | |
| | | $00_{hex}/0F_{hex}$ | Set AE bit |
| 9. Process output buffer: | | 10. Process input buffer: | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | $00_{hex}/0F_{hex}$ | Reset AA and AE bits |

## 8 Device Function

**6th example** **Write 12 bytes of EPC on the data carrier**



## 8 Device Function

**7th example** **Establish basic state of antenna 1**

The antennas of the BIS U identification system can be set to the basic state independent of one another.

| Controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Go to basic state. Process input buffer: | |
| $00_{hex}/0F_{hex}$ | Set GR bit | $00_{hex}/0F_{hex}$ | Reset BB bit |
| 3. Process output buffer: | | 4. Process input buffer: | |
| $00_{hex}/0F_{hex}$ | Reset GR bit | $00_{hex}/0F_{hex}$ | Set BB bit |

**8th example** **Switch off antennas**

In normal operation, all antennas are switched on. By setting the KA bit, the antenna selected by the HD bit can be switched off (antenna 1 or 3 for buffer 1, antenna 2 or 4 for buffer 2).

| Controller | |
|---|---|
| 1. Process output buffer: | |
| $00_{hex}/0F_{hex}$ | Set KA bit |

The antennas are switched back on by resetting the KA bit.

## 8 Device Function

**9th example** **Read the EPCs of multiple data carriers in front of the antenna**

With a maximum number of 5, EPC size of 12 bytes configured, 3 data carriers identified

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $47_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit |
| $02_{hex}$ | Type EPC $00_{hex}$ | $01_{hex}$ | Number of data carriers $03_{hex}$ |
| $03_{hex}$ | Max. number $05_{hex}$ | $02_{hex}$ | Number of bytes per EPC $0C_{hex}$ |
| $00_{hex}/0F_{hex}$ | Set AV bit | $03_{hex}…0E_{hex}$ | First EPC 12 bytes |
| | | $00_{hex}/0F_{hex}$ | Set AE bit |
| 3a. Process input buffer: | | 4. Process input buffer: | |
| $01_{hex}$ | Note number of data carriers | $01…0C_{hex}$ | Enter second EPC 12 bytes |
| $02_{hex}$ | Save number of bytes | $0D_{hex}$ /$0E_{hex}$ | Enter third EPC 2 bytes |
| $03_{hex}$ /$0E_{hex}$ | Copy first EPC 12 bytes | $00_{hex}/0F_{hex}$ | Invert TO bit |
| 3b. Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Invert TI bit | | |
| 5a. Process input buffer: | | 6. Process input buffer: | |
| $01_{hex}…0C_{hex}$ | Copy second EPC 12 bytes | $01_{hex}…0A_{hex}$ | Enter third EPC 10 bytes |
| $0D_{hex}$ /$0E_{hex}$ | Copy third EPC 2 bytes | $00_{hex}/0F_{hex}$ | Invert TO bit |
| 5b. Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Invert TI bit | | |
| 7a. Process input buffer: | | 8. Process input buffer: | |
| $01_{hex}$ /$0A_{hex}$ | Copy third EPC 10 bytes | $00_{hex}/0F_{hex}$ | Reset AA and AE bits |
| 7b. Process output buffer: | | | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | | |

## 8 Device Function

**10th example** **Select a data carrier for further processing**

For configuration with EPC size of 12 bytes

| Command from controller | | BIS U-6026 reaction | |
|---|---|---|---|
| 1. Process output buffer (note sequence): | | 2. Process input buffer (note sequence): | |
| $01_{hex}$ | Command designator $40_{hex}$ | $00_{hex}/0F_{hex}$ | Set AA bit<br>Invert TO bit |
| $02_{hex}$ | Type EPC $00_{hex}$ | | |
| $03_{hex}$ | Length of the EPC $0C_{hex}$ | | |
| $04_{hex}$ | Reserved $00_{hex}$ | | |
| $05_{hex}$ | Reserved $00_{hex}$ | | |
| $06_{hex}$ | Reserved $00_{hex}$ | | |
| $00_{hex}/0F_{hex}$ | Set AV bit | | |
| 3. Process output buffer: | | 4a. Process output buffer: | |
| $01_{hex}…0C_{hex}$ | Enter 12 bytes EPC | $01_{hex}…0C_{hex}$ | Save EPC |
| $00_{hex}/0F_{hex}$ | Invert TI bit | 4b. Process input buffer: | |
| | | $00_{hex}/0F_{hex}$ | Set AE bit |
| 5. Process output buffer: | | 6. Process input buffer: | |
| $00_{hex}/0F_{hex}$ | Reset AV bit | $00_{hex}/0F_{hex}$ | Reset AA and AE bits |

## Appendix

### Type code

**BIS U– 6026 –034–114–06–ST35**

Balluff Identification System
Series U read/write system
Hardware type
6020 = Serial interface RS232 (metal housing)
6026 = EtherNet/IP (metal housing)
6027 = Ethernet TCP/IP (metal housing)
6028 = PROFINET (metal housing)

Software type
034 = Balluff protocol EtherNet/IP
048 = Balluff protocol PROFINET
053 = Balluff protocol RS232 UHF for Europe
054 = Balluff protocol Ethernet TCP/IP UHF for Europe
059 = Balluff protocol RS232 UHF for USA/Canada/Mexico/Brazil/China/Japan etc.
060 = Balluff protocol Ethernet TCP/IP UHF for USA/Canada/Mexico/Brazil/China/Japan etc.

Antenna socket version
10_ = Country setting 865…868 MHz Europe
11_ = Country setting 902…928 MHz USA/Canada/Mexico/Argentina
12_ = Country setting 920.5…924.5 MHz China
13_ = Country setting 915…928 MHz Brazil
15_ = Country setting 916.8…920.4 MHz Japan
17_ = Country setting 920…926 MHz Australia
__4 = 4 antenna sockets

Interface
00 = RS232
06 = Ethernet

Customer connection
ST22 = for PROFINET device with AIDA recommendation
ST26 = for serial device
ST27 = for TCP/IP device
ST28 = for PROFINET device
ST35 = for EtherNet/IP device

### Accessories (optional, not included in scope of delivery)

| Type | Ordering code |
|---|---|
| Mounting plates | BIS Z-HW-004 |

**Note**
You can find more accessories for the BIS U-6026-… in the Balluff BIS catalog and at www.balluff.com.

## Appendix

### ASCII table

| Decimal | Hex | Control code | ASCII | Decimal | Hex | ASCII | Decimal | Hex | ASCII |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 00 | Ctrl @ | NUL | 43 | 2B | + | 86 | 56 | V |
| 1 | 01 | Ctrl A | SOH | 44 | 2C | , | 87 | 57 | W |
| 2 | 02 | Ctrl B | STX | 45 | 2D | - | 88 | 58 | X |
| 3 | 03 | Ctrl C | ETX | 46 | 2E | . | 89 | 59 | Y |
| 4 | 04 | Ctrl D | EOT | 47 | 2F | / | 90 | 5A | Z |
| 5 | 05 | Ctrl E | ENQ | 48 | 30 | 0 | 91 | 5B | [ |
| 6 | 06 | Ctrl F | ACK | 49 | 31 | 1 | 92 | 5C | \ |
| 7 | 07 | Ctrl G | BEL | 50 | 32 | 2 | 93 | 5D | [ |
| 8 | 08 | Ctrl H | BS | 51 | 33 | 3 | 94 | 5E | ^ |
| 9 | 09 | Ctrl I | HT | 52 | 34 | 4 | 95 | 5F | _ |
| 10 | 0A | Ctrl J | LF | 53 | 35 | 5 | 96 | 60 | ` |
| 11 | 0B | Ctrl K | VT | 54 | 36 | 6 | 97 | 61 | a |
| 12 | 0C | Ctrl L | FF | 55 | 37 | 7 | 98 | 62 | b |
| 13 | 0D | Ctrl M | CR | 56 | 38 | 8 | 99 | 63 | c |
| 14 | 0E | Ctrl N | SO | 57 | 39 | 9 | 100 | 64 | d |
| 15 | 0F | Ctrl O | SI | 58 | 3A | : | 101 | 65 | e |
| 16 | 10 | Ctrl P | DLE | 59 | 3B | ; | 102 | 66 | f |
| 17 | 11 | Ctrl Q | DC1 | 60 | 3C | < | 103 | 67 | g |
| 18 | 12 | Ctrl R | DC2 | 61 | 3D | = | 104 | 68 | h |
| 19 | 13 | Ctrl S | DC3 | 62 | 3E | > | 105 | 69 | i |
| 20 | 14 | Ctrl T | DC4 | 63 | 3F | ? | 106 | 6A | j |
| 21 | 15 | Ctrl U | NAK | 64 | 40 | @ | 107 | 6B | k |
| 22 | 16 | Ctrl V | SYN | 65 | 41 | A | 108 | 6C | l |
| 23 | 17 | Ctrl W | ETB | 66 | 42 | B | 109 | 6D | m |
| 24 | 18 | Ctrl X | CAN | 67 | 43 | C | 110 | 6E | n |
| 25 | 19 | Ctrl Y | EM | 68 | 44 | D | 111 | 6F | o |
| 26 | 1A | Ctrl Z | SUB | 69 | 45 | E | 112 | 70 | p |
| 27 | 1B | Ctrl [ | ESC | 70 | 46 | F | 113 | 71 | q |
| 28 | 1C | Ctrl \ | FS | 71 | 47 | G | 114 | 72 | r |
| 29 | 1D | Ctrl ] | GS | 72 | 48 | H | 115 | 73 | s |
| 30 | 1E | Ctrl ^ | RS | 73 | 49 | I | 116 | 74 | t |
| 31 | 1F | Ctrl _ | US | 74 | 4A | J | 117 | 75 | u |
| 32 | 20 | | SP | 75 | 4B | K | 118 | 76 | v |
| 33 | 21 | | ! | 76 | 4C | L | 119 | 77 | w |
| 34 | 22 | | " | 77 | 4D | M | 120 | 78 | x |
| 35 | 23 | | # | 78 | 4E | N | 121 | 79 | y |
| 36 | 24 | | $ | 79 | 4F | O | 122 | 7A | z |
| 37 | 25 | | % | 80 | 50 | P | 123 | 7B | { |
| 38 | 26 | | & | 81 | 51 | Q | 124 | 7C | \| |
| 39 | 27 | | ' | 82 | 52 | R | 125 | 7D | } |
| 40 | 28 | | ( | 83 | 53 | S | 126 | 7E | ~ |
| 41 | 29 | | ) | 84 | 54 | T | 127 | 7F | DEL |
| 42 | 2A | | * | 85 | 55 | U | | | |

## Index

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