BALLUFF

RFID

BASICS AND INSTALLATION

Adhesive label
Self-adhesive RFID data carrier

Air interface
Air gap between the data carrier and (read/)write head through which the data and energy are transmitted.

Autoclave compatible
Capable of being thermally treated in the pressure area of a gas-tight, closable pressure container. The object is to sterilize materials or cure materials in this pressure container, the so-called autoclave, to vulcanize tires and belts and compress fiber composites. Selected data carriers are suitable for use in autoclaves.

BIS C
Balluff RFID product group which describes low frequency (LF) RFID solutions operating at 70/455 kHz. These products are traditionally used for tool identification (Tool-ID).

BIS L/VL
Balluff RFID product group which describes low frequency (LF) RFID solutions operating at 125 kHz. These are suited for simple identification tasks.

BIS M/VM
Balluff RFID product group which describes high frequency (HF) RFID solutions, operating at 13.56 MHz. It supports ISO standards (e.g. DIN ISO 15693, DIN ISO 14443A) and is suitable for a variety of applications.

BIS U/VU
Balluff RFID product group which describes ultra-high frequency (UHF) system solutions operating at 860 to 960 MHz. Especially suited for applications in which long read distances and multi-tagging are required.

BIS V
Designation for a Balluff RFID processor/controller unit. This version supports read heads/ antennas from the product families BIS VL, BIS C, BIS VM, BIS VU and IO-Link.

Charger, charging cradle
Accessory for the handheld programmer, the handy programmer, and the handheld device.

Checksum
Information written to the data carrier as 2 bytes. 2 bytes per block are lost.
A detailed listing is contained in the manual for the processor unit.

Clear zone (RFID)
Area free of metal around the data carrier, to achieve a prescribed read/write distance.

Code present
Message indicating that the data carrier is within the detection range of the read/write head. The data can now be read and written.

Configuration file (GSD, GSDML, EDS, …)
File (driver file) for incorporating fieldbus components into the controller.
The file contains the fieldbus-specific settings.

Clamp
Mechanical accessory for mounting read/write heads, data couplers and processor units. Includes mounting brackets, mounting plates, and mounting bases.

CRC Check
Cyclic redundancy check. This is a procedure for determining a check value for data in order to detect errors in transmission or saving.

Data bolt
Data carrier which is integrated into a threaded body. The threaded body is available in various thread sizes, screw sizes and materials. Also referred to as databolt.

Data coupler RFID
Data transmitter which uses induction to send data over a short air gap, thereby eliminating a double mechanical interface.

Data carrier
Electronic data storage device as part of an RFID system for data of any kind. Can be read or programmed by computers, peripherals or automation equipment. Also referred to as a tag. For use in industrial applications there are data carriers in various forms (round, rectangular, special form factors), made of various materials and with different antenna technologies.

Data carrier chip
Memory chip in a data carrier which defines the memory capacity and memory structure.

DIN ISO 14443
International series of standards for non-contact chip cards. These are used in identification systems and access control, but also for payment applications such as credit cards, public transportation tickets etc. Operates at a frequency of 13.56 MHz.

DIN ISO 15693
International series of standards for non-contact chip cards, access control and payment applications. Operates at a frequency of 13.56 MHz and is the prevailing standard in automation.

Docking station
Device for connecting portable devices such as an RFID handheld device to a fixed power source. Also called a docking station.

Dynamic read mode
Operating mode of an RFID solution: The processor unit accepts the read/write request from the control system and stores the information regardless of whether there is a data carrier in the active range of the read/write head. As soon as a data carrier enters the active range of the read/write head, the job is executed. This is also known simply as dynamic mode.

Easy loop ID
BIS L system approach with the ability to connect up to 16 read heads to a higher level system through a single processor unit.

Easy Tool-ID
Workaround for machine tools that do not have an integrated tool ID function. Consists of a tool stand with integrated read/write head, a processor unit, a microcontroller and the power supply.

E-Kanban

A system which uses various technologies for controlling the use of components and materials in the manufacturing process. In the electronic version, so-called E-Kanban, RFID data carriers and barcodes replace conventional kanban instruments such as cards. The result is a faster information flow.

Ferrite antenna

Rod shaped inductive antenna for receiving RFID signals. It is built into the data carrier as well as the read/write head and has a polarizing and directional characteristic. When the end of a ferrite bar is pointed at the transmitter, the receiving field strength and thereby the read distance between data carrier and read/write head is reduced. The data carrier and read/write head must therefore be calibrated to each other.

Flush installation

Specification for sensor/read-write head installation to indicate whether the sensor or read/write head may be embedded in metal up to the active surface. This is a function of its design and ensures flawless operation. The switching distance/range is less than for differently constructed sensors/read-write heads of the same size.

Handheld RFID reader/writer
Handheld programmer,
Handy programmer

Device for portable writing and reading data carriers. Available for the various technologies LF (low frequency), HF (high frequency), UHF (ultra-high frequency). Ideal for use in harsh environments. Data is transmitted over optional WLAN, Bluetooth or a wired USB connection.

HF

High frequency of 13.56 MHz. Especially suited for use of RFID technology at close range up to 400 mm. The energy transmission of this high-frequency identification system is by means of a magnetic field using inductive coupling.

High memory

Data carriers with a memory capacity > 8K. The performance specifications from applications in automation also require high speed data transmission. Both can be achieved using selected components.

High-speed data carrier

RFID memory which was developed for applications in which it must provide the data to the controller system time-optimized. In combination with the associated read/write heads two to three times the read speed can be achieved compared with applications compliant with the DIN ISO 15693 standard.

High-temperature data carrier

RFID data carrier for temperature-resistant use in industrial environments at temperatures up to 220 °C (storage temperature).

Hollow taper shank (HSK)

Tool holder used in machine tools. Integration into the tool is extremely simple thanks to the standardized size for installation in hollow shank tapers HSK in accordance with DIN 68871-A and steep tapers SK in accordance with ISO/DIS 12164-1.

LF

Low frequency (70 kHz or 125 KHz). The power in LF identification systems is transmitted via a magnetic field by means of inductive coupling. Appropriate for use in difficult conditions such as metal surroundings.

Metal-free installation

Installation/mounting specification, generally defines an installation situation needed for proper function without the use of metallic materials in order to achieve defined data sheet values.

Mifare
World's most often used contactless chip card technology. Complies with ISO-Standards ISO 7816 and ISO 14443A.

Mounting bracket/base/plate
Mechanical accessory for mounting read/write heads, data couplers and processor units. Examples are clamping holders or mounting brackets.

Mold ID
System solution for automated managing of injection molding tools in the plastics industry.

NFC
Near field communication: An international transmission standard based on RFID for contactless exchange of data using electromagnetic induction and loosely coupled coils over short distances of a few centimeters and a data transfer rate of maximum 424 kBit/s.

Non-flush mounting
Specification for installing sensors or read/write heads which do not have a metal housing surrounding their sensing face. These can be recognized by their "caps". This design ensure flawless sensor function. The switching distance/range and permissible offset are greater than for flush mount sensors or read/write heads of the same size.

Offset
Positioning tolerance between the read/write head and the data carrier

Pistol grip
Accessory for the handheld programmer, the handy programmer, and the handheld device.

Processor unit
Essential component of an RFID system which is used for signal processing and preparation. Usually used or combined with an integrated interface for connecting to the controller/ PC system. It is also referred to as a controller.

Process data buffer
In processor units connecting multiple read/write heads the process data buffer is divided into read/write head-specific areas. Process data is the data which is obtained from a technical process by means of a read/write head. The process data represents the current status.

Reader chip
Memory chip in a data carrier which defines the memory capacity and memory structure.

Read head
The part of an RFID system that supplies the data carrier with power and reads the data stored on it. The read head then passes the data to a processor unit which further processes the data.

Read/write head
Part of an RFID system that supplies the data carrier with power and reads the data stored on it and stores new data. The read head then passes the data to a processor unit which further processes the data.

Read/write time data carrier
Time a data carrier requires for detecting/transmitting data. Comprised of: Data carrier detection + read/write time of the data blocks taken together. The read/write time varies with the data carrier type (FRAM, EEPROM) and the transmission standard.

RFID

Radio frequency identification: Communication technology for non-contact and automatic identification of objects (including merchandise, goods, people, animals using radio waves).

RFID data carriers

Electronic data storage medium as part of an RFID system. It can be read and, in specific configurations, also written. Also called a transponder.

Rod antenna

Rod shaped inductive antenna for receiving RFID signals (ferrite antenna). It is built into the data carrier as well as the read/write head and has a polarizing and directional characteristic. When the end of a ferrite bar is pointed at the transmitter, the receiving field strength and thereby the read distance between data carrier and read/write head is reduced. The data carrier and read/write head must therefore be calibrated to each other

Round antenna

Device for receiving RFID signals. In contrast to the bar/ferrite antenna it has no polarizing or directional effect. The electrostatic lobe is distributed evenly around the antenna. The round antenna is used both in data carriers and in the read/write head. Therefore these need to be tuned to each other.

Service interface

Connection point for various devices. For service purposes it sends device-specific setting data and is not suitable or standardized as a process interface.

Simultaneous operation

Multiple read/write heads are read by a processor unit (controller) simultaneously.

Slow tag detection

Data carrier detection whereby the antenna on the read/write head is switched on for detection only every 200 ms.

Static read mode

Mode of operation of an RFID system. The data carrier remains in place in front of the read/write head. This enables a greater read/write distance than in dynamic mode.

Subnet 16

Special solution approach for systematic wiring and for operating multiple read/write heads with a gateway component.

Tag

Electronic data storage device used as part of an RFID system for data of any kind. Can be read or programmed by computers, peripherals or automation equipment. For use in industrial applications there are data carriers in various forms (round, rectangular, special form factors), made of various materials and with different antenna technologies. Also referred to as a data carrier.

Taper (SK)

Standardized form of a tool holder for clamping various tools in the main spindle of a machine tool. The taper is standardized in DIN ISO 7388 Part 1. The main field of application is in milling machines.

Tool ID

Identification of tools and tool data for automated detection, traceability of tool data in the area of machine tools. Data carriers and read/write heads are generally installed in metallic surroundings. The requirements for read distance and installation conditions are generally high.

UHF

Ultra high frequency (865 to 960 MHz). The power transmission in UHF identification systems takes place by means of electromagnetic waves as in the classic radio systems. Appropriate for use over larger distances (several meters).

UID

Unique identifier for RFID data carriers. Each number is assigned only once.

Workpiece identification

Identification of workpieces, semi- and finished products or workpiece carriers. The requirements vary depending on the materials used. Compared with tool identification the requirements for read distance are generally low to moderate. "Dynamic reading" operating mode is often used.

RFID SYSTEMS HF (13.56 MHZ) BIS M
RFID SYSTEMS LF (70/455 KHZ) BIS C
RFID SYSTEMS LF (125 KHZ) BIS L

Mounting

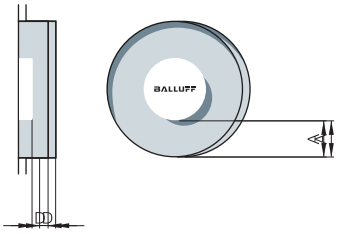
Flush in steel
The sensing surface can be mounted on the surface of steel so that it is even with adjacent areas.

Non-flush on steel
The sensing surface must not be in contact or surrounded by steel.

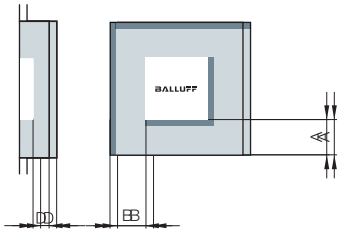
Non-metal
The entire clear zone must remain free of any type of metal.

Mounting in steel

To reach the specified read/write distance, the data carrier in the metallic environment must be mounted within a certain metal-free clear zone.



Round data carriers



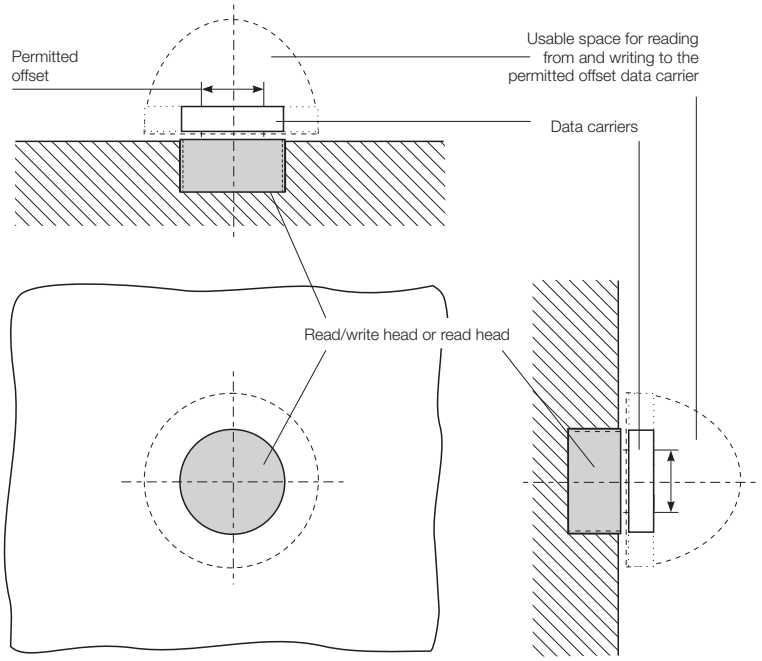
Block-style data carriers

For further information see data sheets of read/write heads on www.balluff.com

Spatial arrangement of read/write head or read head and data carrier

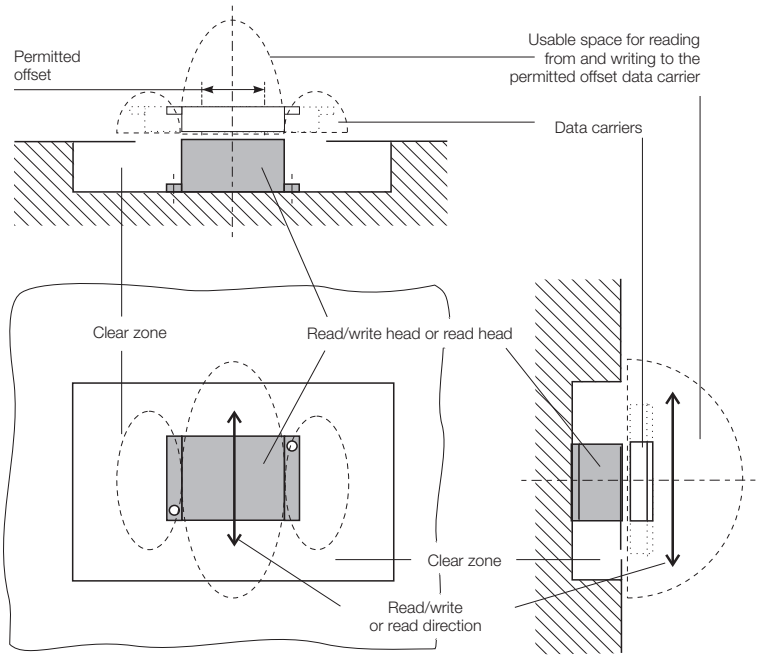
The key to reliable data exchange between the read/write head or read head and the data carrier is maintaining sufficient dwell time of the data carrier within a specified spatial distance from the read/write head or read head.

For a static read/write or read operation, the data carrier comes to a complete stop in front of the read/write or read head; This enables a larger distance between the two.



Spatial arrangement of read/write heads or read head and data carrier for non-directional read/write heads or read heads and non-flush mounting (round antenna).

For dynamic operation the data carrier is read or programmed on the fly as it moves past the read/write head or read head. The shorter distance is necessary in order to achieve as large a read/write path or read path as possible. Each read/write head or read head has certain data carriers which can be used with it (the pairing is based on physical size and antenna field configuration).



Spatial arrangement of read/write heads or read head and data carrier for directional read/write heads or read heads and non-flush mounting (rod antenna).

RFID SYSTEMS HF (13.56 MHZ) BIS M

Read times BIS M-1xx-0x and BIS M-1xx-20

EEPROM – data carrier with 16 byte blocks		FRAM – data carrier with 16 byte blocks	
Bytes	Read time	Bytes	Read time
0 to 15	20 ms	0 to 15	30 ms
For each additional started 16 bytes add additional	10 ms	For each additional started 16 bytes add additional	15 ms

Read times for BIS M-1xx-1x and BIS VM-3xx-401-S4

FRAM – data carrier with 64 byte blocks	
Bytes	Read time
0 to 63	14 ms
For each additional started 64 bytes add additional	6 ms

Write times BIS M-1xx-0x and BIS M-1xx-20

EEPROM – data carrier with 16 byte blocks		FRAM – data carrier with 16 byte blocks	
Bytes	Read time	Bytes	Read time
0 to 15	40 ms	0 to 15	60 ms
For each additional started 16 bytes add additional	30 ms	For each additional started 16 bytes add additional	40 ms

Write times for BIS M-1xx-1x and BIS VM-3xx-401-S4

FRAM – data carrier with 64 byte blocks	
Bytes	Read time
0 to 63	30 ms
For each additional started 64 bytes add additional	15 ms

Write/read cycles

Data carriers	Memory type	Write cycles	Read cycles	Data retention time
112 bytes	EEPROM	100000	Unlimited	10 years
160 bytes	EEPROM	100000	Unlimited	10 years
736 bytes	EEPROM	100000	Unlimited	10 years
752 bytes	EEPROM	100000	Unlimited	10 years
992 bytes	EEPROM	100000	Unlimited	10 years
2,000 bytes	FRAM	Unlimited	Unlimited	10 years
8,192 bytes	FRAM	Unlimited	Unlimited	10 years
32,768 bytes	FRAM	Unlimited	Unlimited	10 years
65,536 bytes	FRAM	Unlimited	Unlimited	10 years
131,072 bytes	FRAM	Unlimited	Unlimited	10 years

Minimum distance between two data carriers

	BIS M-122-01/L, BIS M-122-02/L	BIS M-110-02/L	BIS M-101-01/A, BIS M-111-02/A	BIS M-102-01/L, BIS M-112-02/L	BIS M-105-01/A, BIS M-105-02/A	BIS M-108-02/A	BIS M-120-01/L	BIS M-151-02/A, BIS M-150-02/A
BIS M-300		>100	>100	>150	>100	>100		
BIS M-301		>200	>200	>200	>100	>200	>250	
BIS M-302, BIS VM-307	>100	>100	>100	>100	>100	>100		
BIS M-304	>100	>100	>100	>100	>100	>100		
BIS M-400-007-001-00-S115		>100	>100	>150	>100	>100		
BIS M-401-007-001-00-S115		>200	>200	>200	>100	>200	>250	
BIS M-400-007-002-00-S115	>100	>100	>100	>100	>100	>100		
BIS M-351, BIS VM-351								>250
BIS M-451-007-001-00-S115								>250

Dimensions in mm

Minimum distance between two read/write heads

BIS M-300	200
BIS M-301	600
BIS M-351/BIS VM-351	600
BIS M-302/BIS VM-307	100
BIS M-304	100
BIS M-400-007-001-00-S115	200
BIS M-401-007-001-00-S115	600
BIS M-451-007-001-00-S115	600
BIS M-400-007-002-00-S115	100
BIS M-410-007-002-00-S115	200
BIS M-411-007-002-00-S115	300
BIS VM-305-001-S4	100
BIS VM-341-401-S4	600
BIS VM-343-401-S4	50
BIS VM-344-401-S4	200
BIS VM-345-401-S4	200
BIS VM-346-401-S4	50
BIS VM-348-401-S4	50
BIS VM-352-001-S4	100
BIS VM-355-401-S4	200

Dimensions in mm

RFID SYSTEMS LF (70/455 KHZ) BIS C

Installation in aluminum

With clear zone, static operation

When installing components in aluminum, provide clear zones for trouble-free operation. In static operation, the depth of the clear zone in aluminum of at least 10 mm must be observed, Figure 1. Clear zone dimension A corresponds to the diameter of the larger communication partner (data carrier or read/write head) plus the maximum possible offset (see information for read/write head), Figure 2. In combination with the read/write heads BIS C-318, 327, 328, 350, 351 and 355, dimension B and C is calculated over the length and width of the larger communication partner (data carrier or read/write head) plus the maximum possible offset (see information for read/write head), Figure 3.

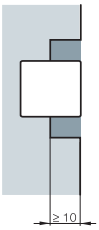


Fig. 1

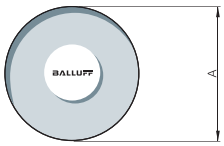


Fig. 2

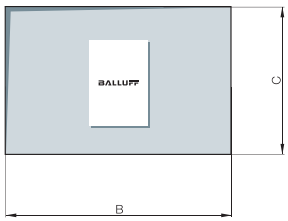


Fig. 3

With clear zone, dynamic operation

In dynamic operation, the depth of the clear zone in aluminum also has to be at least 10 mm, Figure 1. Clear zone dimension A corresponds to twice the diameter of the larger communication partner and the equivalent of the diameter of the smaller communication partner. Clear zone dimension C corresponds to the diameter of the larger communication partner plus the corresponding maximum offset (see information for read/write head), Figure 4. In combination with the read/write heads BIS C-318, 327, 328, 350, 351 and 355, dimension B is calculated from twice the read/write distance (see information about read/write heads) plus the width of the data carrier. Clear zone dimension C corresponds to the read/write head length plus the corresponding maximum offset (see specification for read/write head), Figure 5.

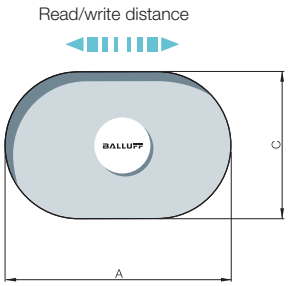


Fig. 4

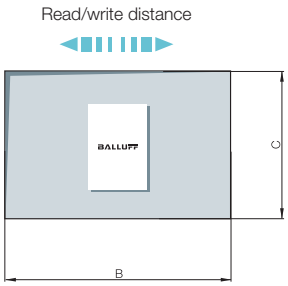


Fig. 5

Read/write cycles

Data carriers	Memory type	Coding	Write cycles up to 30 °C	Write cycles up to 70 °C	Read cycles	Memory organization
511 bytes	EEPROM	-04	1000000	500000	Unlimited	32-byte blocks
1023 bytes	EEPROM	-05	1000000	500000	Unlimited	32-byte blocks
2047 bytes	EEPROM	-11	1000000	500000	Unlimited	64-byte blocks
8 kbytes	FRAM	-32	Unlimited	Unlimited	Unlimited	64-byte blocks

Read times in static mode

For double read and compare:

Data carrier with 32 bytes per block		Data carrier with 64 bytes per block	
Bytes	Read time	Bytes	Read time
From 0 to 31	110 ms	From 0 to 63	220 ms
For each additional started 32 bytes add additional	120 ms	For each additional started 64 bytes add additional	230 ms
From 0 to 255	= 950 ms	From 0 to 2047	= 7350 ms

Write times in static mode

Includes checking and comparing:

Data carrier with 32 bytes per block		Data carrier with 64 bytes per block	
Bytes	Write time [ms]	Bytes	Write time [ms]
From 0 up to 31	110 + n × 10	From 0 up to 63	220 + n × 10
≥ 32	y × 120 + n × 10		y × 230 + n × 10
From 0 up to 255	= max. 3510	From 0 up to 2047	= max. 27830

n = Number of contiguous bytes to write
y = Number of blocks to process

Read times in dynamic operation

Read times within the 1st block for double read and compare:

Data carrier with 32 bytes per block		Data carrier with 64 bytes per block	
Bytes	Read time	Bytes	Read time
From 0 up to 3	14 ms	From 0 up to 3	14 ms
For all additional bytes	3.5 ms	For all additional bytes	3.5 ms
From 0 up to 31	112 ms	From 0 up to 64	224 ms

The times indicated apply after the data carrier has been detected. If the tag has not been recognized, an additional 30 ms must be added to allow for creating the energy field necessary to recognize the data carrier.

Memory organization

Memory size up to 1023 bytes = 32 bytes per block
Memory size 2047 bytes and larger = 64 bytes per block

Maximum speed

To calculate the permitted speed in which the data carrier and head move relative to each other, the static distance values are used. The permissible speed is:

$$V_{max.perm.} = \frac{\text{Path}}{\text{Time}} = \frac{2 \times |\text{offset value}|}{\text{Processing time}}$$

The offset value is dependent on the read/write distance actually used in the system.

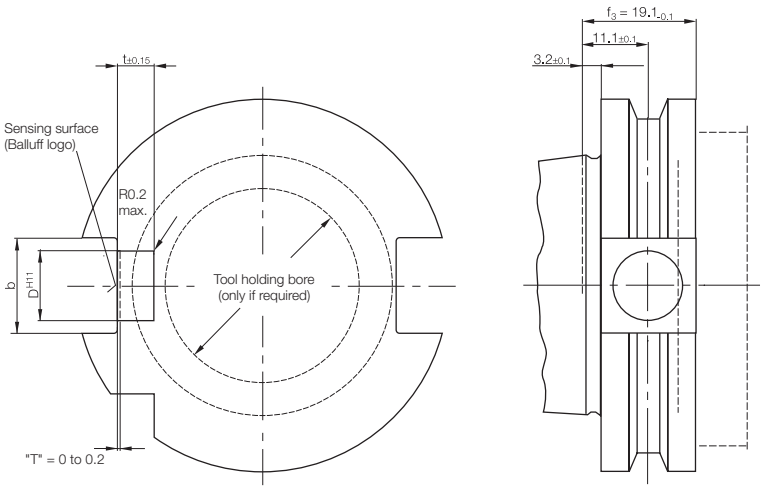
$$\text{Processing time} = \text{Data carrier response time} + \text{Read/write time of first block to be read} + n^1 \times \text{Read/write time for additional started blocks}$$

n^1 = number of started blocks

Installation in taper SK

Data Carriers	BIS C-122			BIS C-103			BIS C-105		
Taper DIN 69871-A	D^{H11}	t ±0.15	rpm_{max}	DH11	t ±0.15	rpm_{max}	D^{H11}	t± 0.15	rpm_{max}
No. 30	10	4.65	90000	12	8.15	68000	12	6.15	68000
No. 40	10	4.65	75000	12	8.15	54000	12	6.15	54000
No. 45	10	4.65	66000	12	8.15	43000	12	6.15	43000
No. 50	10	4.65	59000	12	8.15	33000	12	6.15	33000

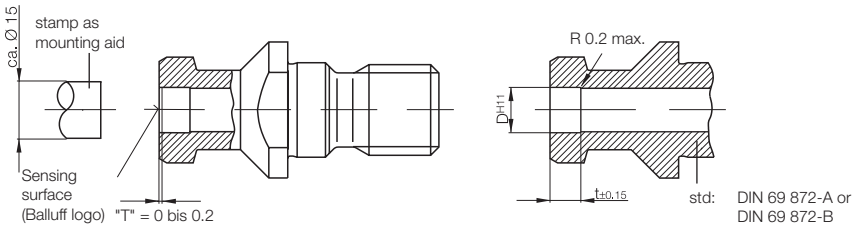
Dimensions in mm



Installation in retention knob

Data Carriers	BIS C-122		BIS C-103		BIS C-105	
Taper DIN 69871-A	D^{H11}	t ±0.15	D^{H11}	t ±0.15	D^{H11}	t ±0.15
No. 30						
No. 40	10	4.65				
No. 45	10	4.65	12	8.15	12	6.15
No. 50	10	4.65	12	8.15	12	6.15

Dimensions in mm



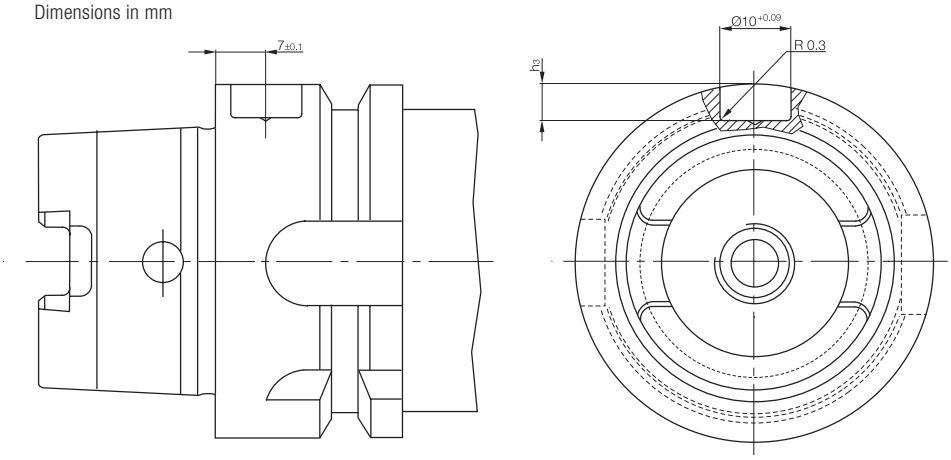
Installation:

1. Degrease gluing surfaces.
2. Apply a bead of glue approximately 3 mm wide around the perimeter of the data carrier housing (recommended glue e.g. LOCTITE Hysol 1C or UHU-Plus endfest 300), observe manufacturer's processing instructions
3. Press in data carrier housing manually, observe dimension "T"
4. Remove excess glue
5. Allow to cure

Installation in hollow shank taper HSK

Data Carriers	BIS C-122	
HSK Form A ISO/DIN 12164-1	$h_{3\ +0,20}$	$rpm_{\ max}$
32	5.4	96000
49	5.2	80000
50	5.1	75000
63	5	65000
80	4.9	57000
100	4.9	48000

Dimensions in mm



Mechanical strength

Data carriers and read/write heads BIS C-1xx, BIS C-3xx	
Shock load	100 g/6 ms per EN 60068-2-27 and 100 g/2 ms per EN 60068-2-29
Vibration	20 g, 10...2000 Hz per EN 60068-2-6

Values apply to data carriers BIS C-1xx and read/write heads BIS C-3xx except for the non-potted read/write heads BIS C-350, BIS C-351, BIS C-352 and BIS C-355.

Processor units and non-potted read/write heads BIS C-6xxx, BIS C-350, BIS C-351, BIS C-352, BIS C-355	
Shock load	15 g/11 ms per EN 60068-2-27 and 15 g/6 ms per EN 60068-2-29
Vibration	5 g, 10...150 Hz per EN 60068-2-6

RFID SYSTEMS LF (125 KHZ) BIS L

easy loop® communication module

easy loop® provides compact read heads and a communication module for simple connection to the controller at minimal cost for extending BIS L systems. Prefabricated cable and connectors for fast, proper connections. No need to configure addresses.

Install the BIS L simply by connecting up to eight read heads on each of two lines with the easy loop® interface. One cable is all you need for the simple installation of BIS L, a separate power supply is not necessary. All processor units function independently to allow dynamic operation: Data is transferred reliably when the data carrier passes by.

Read times BIS L-1xx

Serial number detection typically 110 ms*

Data carrier with 4 byte blocks	
Bytes	**Read time**
From 0 to 3	180 ms
For each additional started 4 bytes add additional	90 ms

Read times BIS L-1xx

Serial number detection = reading data carriers = typically 100 ms*

Write times BIS L-1xx

Data carrier with 4 byte blocks	
Bytes	**Write time**
From 0 to 3	305 ms
For each additional started 4 bytes add additional	215 ms

*Only applies to the parameter type and output of the serial number.

All information is provided as general values. Deviations are possible depending on the application and combination of read/write head and data carrier.

Minimum distance between two data carriers

	BIS L-100-01/L	BIS L-101-01/L	BIS L-102-01/L	BIS L-103-05/L	BIS L-200-03/L	BIS L-100-05/L-R0	BIS L-201-03/L	BIS L-101-05/L-R0	BIS L-202-03/L	BIS L-102-05/L-R0	BIS L-203-03/L	BIS L-103-05/L-R0	BIS L-150-05/A
BIS VL-300-001-S4	250	300	400	250	250	250	300	300	400	400	250	250	
BIS VL-301-001-S4	300	400	500	350	350	350	400	400	500	500	350	350	
BIS VL-302-001-S4	300	400	500	350	350	350	400	400	500	500	350	350	
BIS VL-304-001-S4	150	200	200	180	180	180	200	200	250	250	180	180	
BIS VL-306-001-S4	80			50							50		
BIS VL-350-001-S4													50

Dimensions in mm

Minimum distance between two read/write heads

BIS VL-300-001-S4	400
BIS VL-301-001-S4	800
BIS VL-302-001-S4	200
BIS VL-304-001-S4	200
BIS VL-306-001-S4	100
BIS VL-350-001-S4	100

Dimensions in mm

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