Installation and Operations

Product Manual

Model HF-3600E IO-Link

13.56 MHz Passive Reader/Writer

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Product Part Numbers & Accessories

Part Number	Description
830-8060-00M124P	Model HF-3600E-IOLINK 13.56 MHz HF RFID Reader w/on Board Standard Ethernet Processor & internal Antenna, 4-pin male M12 connector, both ISO 15693 & ISO 14443 capable

Specifications

Mechanical:	Measurements:	80 x 40 x 84.5mm	3.15” x 1.57” x 3.33”
	Material:	PBT	
	Weight:	4.3 ounces	122 grams
	LED’s:	Solid Green = Power On	Tag Present = Yellow On
Certs/Compliance:	RoHS III	REACH	CE
	FCC Part 15 & ETSI	SIL2	Free of BBP, DEHP, DBP, DIBP
	EN 60068-2-27 Shock	EN 60068-2-32 Drop	EN 60068-2-6 Vibration

RF:	Standard:	ISO 15693 & 14443	Reader & Tag Writer
	Frequency:	13.56 MHz	HF (high frequency)
Operation:	Power/Connector:	8 to 28vdc @ 150mA typical	M12 Male 4-pin
	Baud & Communications	Up to 115.2k baud	IO Link w/Tag Present Option

Environmental:	Storage Temp:	-13°F to +185°F	-25°C to +85°C
	Temp, Operating:	-13°F to +185°F	-25°C to +85°C
	Life:	40 Year Shelf Life	
	Ingress Protection:	IP67	

Read Ranges

Read ranges are dependent upon Tag size and chip. Generally, an ISO 15693 chip will read farther than an ISO 14443 chip by an average of 30%. Here is a sampling, measurements in inches. It should be noted this Model HF-3600E Reader is one of the most advanced and most powerful on the market. Similar read ranges may not be obtained with competing Readers.

Tag Size↓ Tag Chip→	15693	14443	% Less
10mm diameter epoxy	1.25	1	20%
22mm diameter potted	1.75	1.25	29%
30mm diameter ABS	2.25	1.5	33%
35mm diameter ABS	3	2.25	25%
45mm Square Inlay	3.75	2.25	40%
50mm diameter potted	3.25	2.5	23%
ISO Card	4.25	3	29%
86x54mm Inlay	5	3.5	30%

Section 1 – General Information

This manual provides information pertaining to the installation and operation of the Model HF-3600E-RS232 13.56 MHz Reader. This series of Readers are a single piece solution Reader + internal Antenna with integrated processor in enclosure. This Reader is unique in that it can operate with four different types of RFID Tag chips, ISO 15693, ISO 14443A, ISO 14443B, and NXP's original Icode1 (the latter not being an ISO standard). Under these standards there are varying amounts of Tag memory, all of which include a non-alterable ROM UID (unique identification) section that acts as a RO (read only) random identifier, guaranteed unique.

The Reader operates as both a transmitter and receiver, providing a high frequency electromagnetic field at 13.56 MHz to energize and activate an electronic transponder (RFID Tag). Once the Tag is energized it modulates its data back to the Reader which in turn detects and demodulates this data for delivery to the serial port.

Description	Min	Typ	Max	Units
Input Voltage	8	-	28	Volts DC
Input Current	40	50	75	mA
Cabling distance	-	-	?	Feet
Temperature range	0	-	85	Celsius

IO-Link port (M12, A-coded, male)		
	PIN	FUNCTION
	1	24V+
	2*	None
	3	GND
	4	C/Q

Error Rate:	Less than 1 in 10 to the 14th readings		
Power Requirements:	Min = 8vdc Current Min = 50mA	Typical = 24V Current Typ = 50mA	Max = 28vdc Current Max = 75mA
Temperature range:	Operating 0C to 70C	Non-Operating -20C to 125C	

Drawing

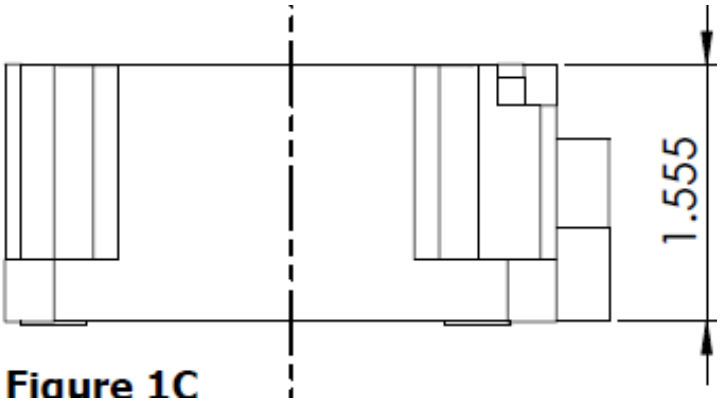


Figure 1C

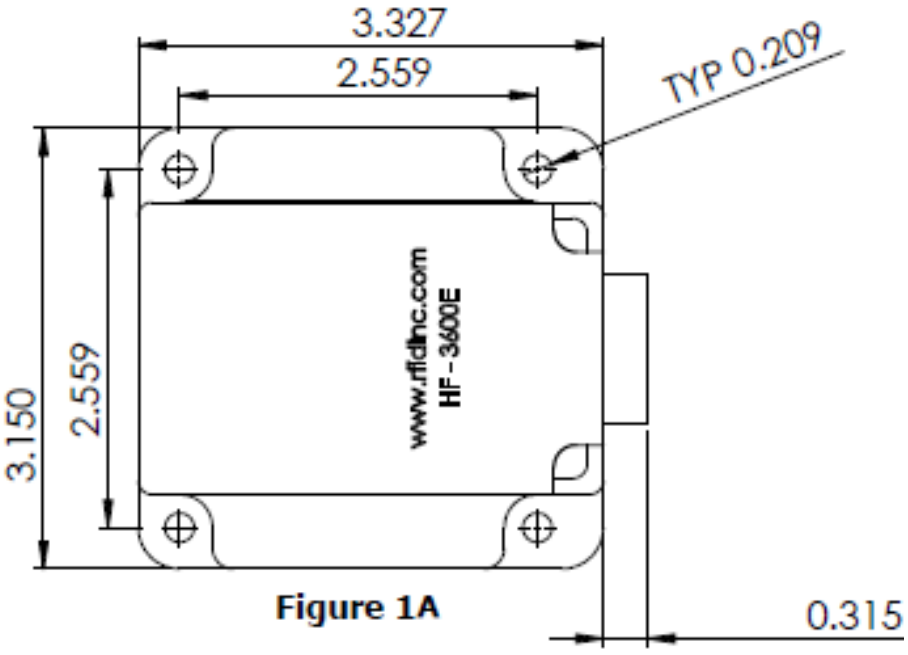


Figure 1A

Section 2 – User and Installation Guide

Tag Memory

Generally, HF RFID passive Tag chips, containing an EEPROM with encoded data, have no finite life for read only operations and a finite life of 100k writes. There exists a plethora of HF Tag chips available on the market, thus Tag memory is not discussed in detail herein. RFID, Inc. can provide a specific memory organization map dependent upon the chip and size of memory you intend to use.

ISO15693

The Tag UID is 64 bits long (8 bytes), represented by 16 hexadecimal characters. Example E0078077CDCD153E.

Most ISO15693 transponders are divided in blocks of 4 bytes (32 bits) represented by 8 hexadecimal characters. Example 00000578.

In some very rare cases an ISO15693 transponder will be divided in blocks of 64 bits. The reader automatically recognizes these types of Tags and adjusts its data size accordingly. If you are not familiar with the block size of the Tag in use, it is recommended to read a block from it to discover the block size.

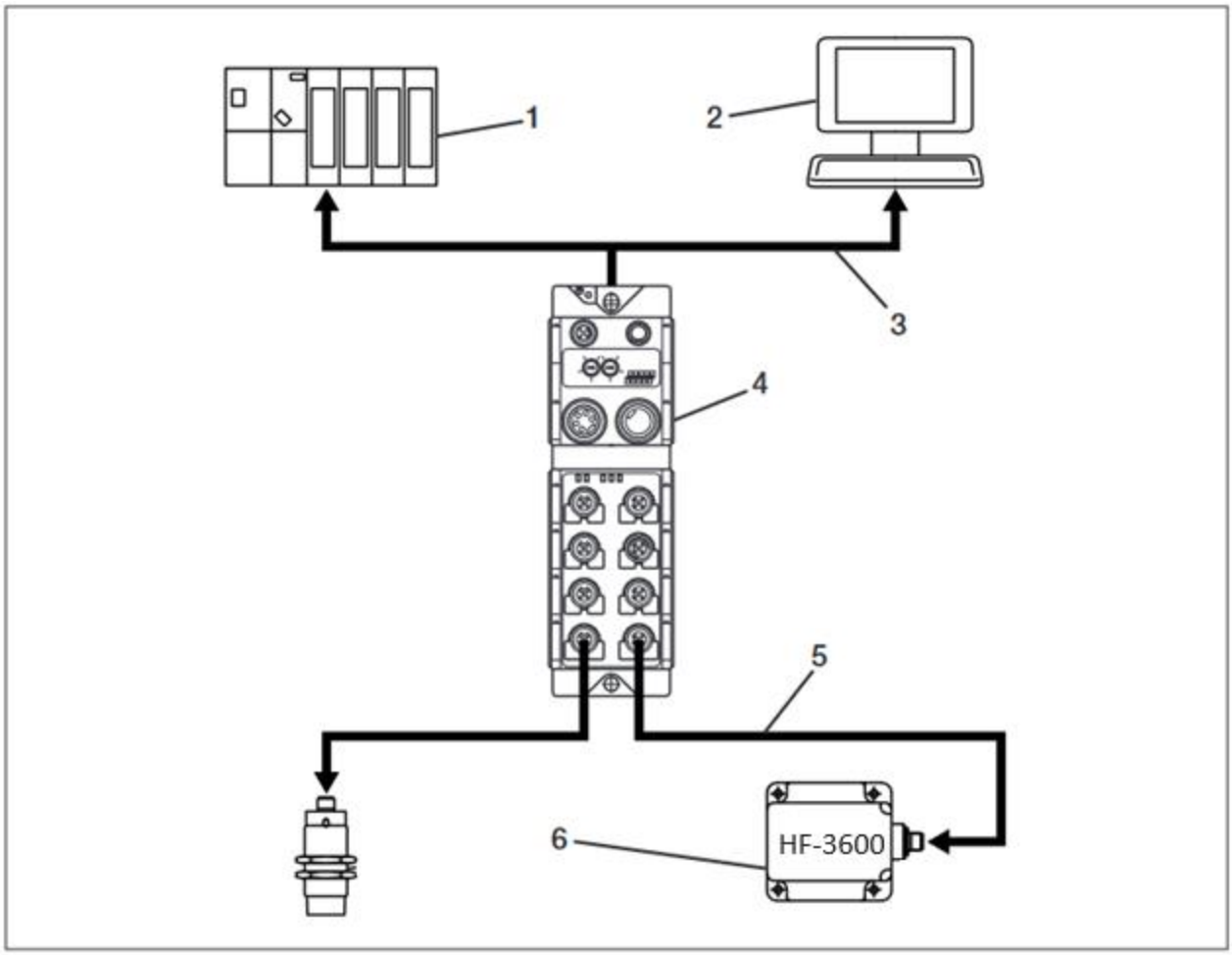


Figure 1: Topology of the HF-3600 IO-Link Reader.

1 PLC	2 PC
3 Fieldbus	4 IO-Link master
5 Connection to the host system	6 HF-3600 read/write device, IO-Link device.

Data carrier detection is indicated by an LED on the device. At the same time, the CP bit is set in the input buffer.

Advantages of IO-Link:

– Uniform, simple wiring of different devices

– The host system can be used to change the device parameters

– Remote querying of diagnostic information is possible

– Centralized data retention of the device parameters is possible

The manufacturer-specific standard IO-Link sends not only the actual process signal, but also all relevant parameter and diagnostic data on the process level over a single standard cable.

Communication is based on a standard UART protocol with 24V pulse modulation; no separate power supply is required.

The HF-3600 IO-Link uses three-conductor technology (physics 2) and operates with a transfer rate of 38400 (COM2). The data quantity of the process data is 10 bytes in each direction.

LED

LED	STATUS	FUNCTION
LED 1	GREEN	POWER
LED 2	YELLOW	Tag in range
LED 1	Green Flashing	IO Link connected

IO-Link integrates conventional and intelligent actuators and sensors into automation systems.

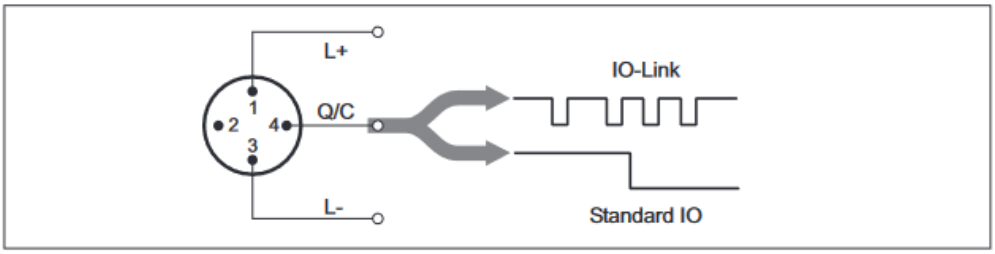
Mixed use of traditional and intelligent devices is possible with no additional expense.

IO-Link is intended as a communications standard below the traditional fieldbus level. Fieldbus neutral IO-Link transmission uses existing communications systems (fieldbuses or Ethernet based systems).

The actuators and sensors are connected in point-to-point connection using conventional unshielded cables.

IO-Link devices can send application-specific parameters and data (e.g. diagnostics data) using a serial communication procedure. Flexible telegrams are possible for sending larger quantities of data. Communication is based on a standard UART protocol with 24V pulse modulation. Only one data line is used for communication. This carries both the controller telegram as well as the device telegram. This means that conventional 3-conductor physics is possible.

IO-Link supports both communication mode as well as standard IO mode (SIO). Standard IO provides a switching signal on the communication line, as is used by normal binary switching sensors. This mode is only possible with devices using 3-conductor connection technology. SIO mode is not supported by BIS M-IO-Link devices.



Three conductor physics of the IO Link.

Communication Mode

In communication mode, the HF-3600 IO-Link device operates with frame type 2. In this transmission type, up to 32 bytes of process data are sent in both directions per frame and 2 bytes of demand data is sent per frame. Process data is the application-specific data; demand data may contain parameters, service, or diagnostic data.

The IO-Link protocol provides a process data container 32 bytes in size. Addressing occurs in the command byte, which is sent by the IO-Link master. When process data is sent, addressing is directly to the subindices 00hex ... 1Fhex.
The HF-3600 processes 10 bytes of input and 10 bytes of output data (input buffer/output buffer). The process data is mapped to the first 10 bytes of the process data container (subindices 00hex...09hex).

IO Link protocol Sub Address
00hex
…
1Fhex

HF -3600 IO Link device sub address
00hex
…
09hex

Via the Service-PDU, information stored on the device can be read in addition to the application specific parameters.

	SPDU		Object name	Length	Information
	Index	Subindex			
Identification data	0_{hex}	8 9	Vendor ID	2 bytes	0x094E
		10 11 12	Device ID	3 bytes	0x000001
	10_{hex}	0	Vendor name	7 bytes	RFIDINC
	11_{hex}	0	Vendor text	15 bytes	RFIDINC
	12_{hex}	0	Product name	23 bytes	Device designation
	13_{hex}	0	Product ID	7 bytes	HF-3600E-IOLINK
	14_{hex}	0	Product text	27 bytes	IO-Link RFID read-write head
	16_{hex}	0	Hardware revision	5 bytes	Hardware version
	17_{hex}	0	Firmware revision	5 bytes	Firmware version

The device-specific parameters of the identification system can be configured via the SPDU. The parameter data of the HF-3600 IO-Link device is described in further detail in the following.

	Access SPDU		Description	Data width	Value range	Factory setting
	Index	Subindex				
Parameter data	40_{hex}	1_{hex}	CRC yes/no	1 byte	0 = without CRC	0
	40_{hex}	2_{hex}	Dynamic mode - yes/ no	1 byte	0 = no 1 = yes	0
	40_{hex}	3_{hex}	Action if tag present	1 byte	0 = no action 1 = serial number and tag type 7 = automatically read 8 bytes of data beginning at a set start address after subindex 4 and 5	1
	40_{hex}	4_{hex}	Low byte of start address for autoread	2 bytes	Observe data-carrier specifications.	0
	40_{hex}	5_{hex}	High byte of start address for autoread			
	40_{hex}	6_{hex}	Used data-carrier type	1 byte	1 = 14443A 4 = 15693 5 = ST25TB04K 7 = ALL PROTOCOLS	0

Dynamic Mode

If dynamic mode is activated, a job can be sent even if no data carrier is located in the read/write range of the read/write head, which would result in errors without dynamic mode. The job is then stored and is executed as soon as a data carrier is detected.

The following figure applies for this parameter:

Index 40_{hex}, subindex 2_{hex} - 1 byte	
00_{hex}	Dynamic mode not activated (default setting)
01_{hex}	Dynamic mode activated

Action if tag present

The "Action on tag present" parameter specifies how the read/write device is to react if a new data carrier is detected in the field. The default setting is to send the UID (serial number). In addition, it is possible to set that nothing or a selected range of 8 bytes is to be sent immediately as read data.

The following values are permissible:

Index 40_{hex}, subindex 3_{hex} - 1 byte	
00_{hex}	No action
01_{hex}	Send UID immediately (default setting)
07_{hex}	Immediately send 8 bytes of data beginning at a set address (parameter "Autoread start address")

Start address for autoread

This parameter is only valid if "Autoread" was selected as the action on tag present. The start address can be set via subindices 4hex (low byte) and 5hex (high byte). The value range is dependent on the specification of the data carrier; take this into account. An incorrect setting prevents autoread from functioning; no data is output.

Data carrier type

This parameter offers the possibility of specifying certain data carrier protocols that are to be detected. All Protocols, all ISO15693 or ISO14443A models can be selected. The data carriers are detected more quickly if only those that are used are configured.

The following values are permissible:

Index 40-hex, subindex 6-hex - 1 byte	
01-hex	ISO14443A
04-hex	ISO15693
05-hex	ST25TB04K
07-hex	ALL PROTOCOLS

Saving the Parameter Data

The set parameters are stored in the EEPROM memory of the HF-3600 IO-Link device. On restart, the most recently used parameters are used.

If the IO-Link parameter server is activated on the IO-Link master, configuration occurs automatically when the device is exchanged.

NOTE: Should it be necessary to exchange a HF3600 IO-Link device in the system, make certain that the correct parameter settings are programmed in the new device.

For information on commissioning, please read the instructions for your IO-Link master. HF-3600 IO-Link devices use a process data buffer of 10 bytes each.

Process Data

Data exchange occurs via the process data, which, depending on the control system that is used, is mapped in the input and output buffer or in a memory field. The HF-3600 uses 10 bytes of input data and 10 bytes of output data.
The assignments are described in the following. Sub address 00hex corresponds to the respective start address in the corresponding data field.

Output/input buffer

The HF-3600 provides two fields for sending commands and data between the HF-3600 read/write device and the host system:
– Output buffer
– Input buffer
These fields are embedded in process data transmission via the IO-Link master. As already described, 10 bytes of process data are sent in each direction.
The mapping of this process data is described in the following:

Output buffer:

Bit No. / Subaddress	7	6	5	4	3	2	1	0
00_{hex} - 1st bit string		TI	KA			GR		AV
01_{hex}	Command designator or data							
02_{hex}	Start address (low byte) or data							
03_{hex}	Start address (high byte) or data							
04_{hex}	Number of bytes (low byte) or data							
05_{hex}	Number of bytes (high byte) or data							
06_{hex}	Data							
07_{hex}	Data							
08_{hex}	Data							
Last byte - 2nd bit string		TI	KA			GR		AV

Explanations on the output buffer using 10 bytes as an example:

Subaddress	Bit name	Meaning	Function description
00_{hex}	1st bit string		
	TI	Toggle bit	A state change during a job indicates that the controller is ready to receive additional data made available by the read/write device.
	KA	Head on/off	1 = Head off (read/write head switched off)
			0 = Head on (read/write head in operation)
	GR	Basic state	1 = Software reset - causes the BIS to switch to the ground state
			0 = Normal operation
	AV	Job	1 = New job pending
			0 = No new job or job no longer pending

01_{hex}		Command designator	00_{hex} = No command
			01_{hex} = Read data carrier
			02_{hex} = Write data carrier
			32_{hex} = Write a constant value on the data carrier

Subaddress	Bit name	Meaning	Function description
		or data	Data that is to be written on the data carrier
02_{hex}		Start address Low byte	Low byte of the start address on the data carrier for the current job
		or data	Data that is to be written on the data carrier
03_{hex}		Start address High byte	High byte of the start address on the data carrier for the current job
		or data	Data that is to be written on the data carrier
04_{hex}		No. of bytes Low byte	Low byte of the data length for the current job
		or data	Data that is to be written on the data carrier
05_{hex}		No. of bytes High byte	High byte of the data length for the current job
		or data	Data that is to be written on the data carrier
06_{hex}		Data	Data that is to be written on the data carrier
07_{hex}		Data	Data that is to be written on the data carrier
08_{hex}		Data	Data that is to be written on the data carrier
09_{hex}	2nd bit string		
	TI, KA, GR, AV		If 1st and 2nd bit strings agree, valid commands or data are present.

Note

When specifying the starting address and the number of bytes, observe the specifications for the data carrier used and the maximum job size!

Input buffer:

Bit No. / Subaddress	7	6	5	4	3	2	1	0
00_{hex} - 1st bit string	BB	HF	TO		AF	AE	AA	CP
01_{hex}	Error code or data or high-byte version							
02_{hex}	Data or low-byte version							
03_{hex}	Data							
04_{hex}	Data							
05_{hex}	Data							
06_{hex}	Data							
07_{hex}	Data							
08_{hex}	Data							
Last byte - 2nd bit string	BB	HF	TO		AF	AE	AA	CP

Explanations on the input buffer using 10 bytes as an example:

Subaddress	Bit name	Meaning	Function description
00_{hex}	1st bit string		
	BB	Power	1 = Device is ready
			0 = Device is in ground state
	HF	Head Failure	1 = Head is turned off
			0 = Head is turned on
	TO	Toggle bit	A state change during a job indicates that the read/write device is ready to transfer other data
	AF	Job error	1 = Job incorrectly processed
			0 = Job processed without errors
	AE	Job end	1 = Job processed without errors
			0 = No job or job running
	AA	Job accepted	1 = The job was detected and accepted. Is being processed.
			0 = No job active
	CP	Codetag Present	Data carrier is in the read range of the read/write head
			No data carrier in read range

Subaddress	Bit name	Meaning	Function description
01_{hex}		Error code	Error number is entered if the job was incorrectly processed or canceled. Only valid with AF bit!
			00_{hex} = No error
			01_{hex} = No data carrier in read/write range
			02_{hex} = Error during reading
			03_{hex} = Data carrier was removed from the read range of the head during reading
			04_{hex} = Error during writing
			05_{hex} = Data carrier was removed from the write range of the read/write head during writing.
			07_{hex} = AV-bit is set but command designator is invalid or missing. Or: number of bytes is 00_{hex}.
			$0E_{hex}$ = *The CRC on the data carrier does not agree with the calculated CRC for the read data.*
			$0F_{hex}$ = 1st and 2nd bit string of the output buffer do not agree.
			20_{hex} = Addressing of the job lies outside of the memory range of the data carrier
			21_{hex} = Calls up a function that is not possible with the current data carrier.
		or data	Data which was read from the data carrier
		or SW version	High byte of the software version
02_{hex}		Data	Data which was read from the data carrier
		or SW version	Low byte of the software version
03_{hex}		Data	Data which was read from the data carrier
⋮		⋮	⋮
08_{hex}		Data	Data which was read from the data carrier
09_{hex}	2nd bit string		
	BB, HF, TO, AF, AE, AA, CP		Valid data is present if the 1st and 2nd bit strings match

Note
The 1st and 2nd headers must be compared by the user (host system) in order to query the validity of the sent data.

When communication is initiated by the IO-Link master, transmission of the current process data begins.

As long as no data carrier was detected after start-up of the device, the firmware version of the device is displayed in the first two user bytes (see chapter 9.4 "Protocol examples" on page 53).
If a data carrier is detected, the configured "Reaction to Tag Present" is executed. If, for example, display serial number is set here, the serial number of the currently detected data carrier is displayed in index 01hex...08hex.

The bit strings of the output buffer can be used to control the device. For example, a device restart can be triggered by setting the GR bit or a new job can be passed by setting the AV bit. Furthermore, the write data can be passed to the device here.

The state of the device is displayed in the input buffer. Here, for example, the AF bit indicates an error in the current job and the HF bit indicates that the head is currently switched off. In addition, the input buffer is used to pass read data and status codes. If no data carrier is present, the most recent data is displayed in the input buffer. The deleted CP bit indicates that no data carrier is in the field.

By means of this method, all functions of the read/write device can be used. This includes
– reading,
– writing,
– dynamic reading,
– dynamic writing,
– writing a constant value,
– initializing CRC16 on the data carrier.

> **Note:**
> Note that a job is restricted to its maximum scope. This is determined by the Tag (data carrier) used.
> If the volume of data to be processed exceeds the maximum job quantity, multiple individual jobs must be started.

Functions can only be executed if a data carrier is in the read/write range. If a command is to be sent that is not to be executed until the next tag is encountered, the device must be configured for dynamic mode.

FCC Statement

WARNING

FCC Info for FCC Part 15 Devices

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

This product meets the applicable FCC Part 15 rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To limit RF exposure, please ensure 8 inches (20 cm) of separation from the device at all times.

WARRANTY

RFID, Inc. products are warranted against defects in materials and workmanship for one (1) year from date of shipment. RFID, Inc. shall, at its option, either repair or replace products that prove to be defective and are returned with freight prepaid to RFID, Inc.'s plant within the warranty period. The foregoing warranty shall not apply to defects resulting from abuse, misuse, accident, alteration, neglect or unauthorized repair or installation. RFID, Inc. shall have the right of final determination as to the existence and cause of the defect.

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