RFR-02

Installation Guide

ACCU-SORT® SYSTEMS
Lasers • Cameras • RFID • Systems

RFR-02 Reader Installation Guide Revision 1.0

PN 1000062805 1.0 | CMS 06-0119 | 2006.06.28 | RAY

Document Revision Control

This document is under revision control in accordance with Accu-Sort's Quality System. Any addenda or other documents associated with this manual are under separate revision controls. A revision number is changed by 0.1 whenever technical information is changed or added to a document.

Copyright Information

Disclaimer Information

The information contained in this manual is subject to change without notice.

Supplemental information or documentation may be required for certain applications or usage.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Accu-Sort cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Accu-Sort with respect to use of information, circuits, equipment, or software described in this manual.

In no event will ACCU-SORT® SYSTEMS, INC. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

Accu-Sort Systems, Inc. 511 School House Rd. Telford, PA 18969

1-877-ASI-RFID

Table of Contents

Preface

General Precautions

All service should be performed so as not to violate any compliance. Use shielded cable with the unit. Before performing any maintenance, turn off power to the unit and disconnect the power cord. Routinely check cabling, if a cable is damaged, replace it immediately. Check mounting structure for tightness and stability. Ensure the power outlet connected to the unit is properly grounded. Do not apply power to the unit until all components are properly cabled and grounded.

Installation Notes

Only Accu-Sort System, Inc. employees or individuals that have been authorized by Accu-Sort Systems, Inc. should install this device.

Warnings

WARNING: Use of any antenna other then ones supplied with the equipment, or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

WARNING: This device must be installed in a location that is not accessible to the general public. Install the device so that the antenna is at least 25 centimeters from unsuspecting personnel. Failure to install this device as described will result in a failure to comply with FCC rules for RF exposure and is discouraged.

Disclaimer

Operation of any radio transmitting equipment, including this product, may interfere with the functionality of inadequately protected medical devices. Consult a physician or the manufacturer of the medical device if you have any questions. Other electronic equipment may also be subject to interference.

Software Version

This document refers to software version R02STD06 and later versions. This information may not be valid for earlier versions of the RFR-02 software.

Approvals

The RFR-02 Reader and its associated antennas and Power Supply is approved (or is pending) by the appropriate regulatory agencies.

- FCC, Part 15
- UL
- cUL
- CE

NOTE: This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation Manual, may cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

NOTE: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Product Specifications

Physical Features

Enclosure

- Cast Aluminum

Size

- Length: 6.67”
- Width: 4.70”
- Height: 2.10”

Cabling

- App. Specific (does not contribute to length, height or width)

Mounting

- See Mounting Instructions

Visual Diagnostics

- Power LED (red) Indicates unit is powered
- RX LED (green) Indicates data received from Host
- Tag LED (blue) Indicates data received from Tag
- Ant. LED (yellow) Indicates which antenna is Active

Performance Features

Ambient Temp. Range

- 0 – 50 C

Read Rate

- 300 bytes/sec @ 9600
- 600 bytes/sec @ 57600

Serial Interfaces

- RS232 (Setup)
- RS232/422 (Host Comm)

I/O

- 2 Trigger inputs
  - +5 to 24 VDC (opto isolated), or
  - Non-Isolated active low
- 2 Relay Outputs
  - Solid State Form A Relays
  - 30VDC Max @300mA (resistive)

Transmit Power

- Nominal 22.0 dBm +/- 1.5 dB

Operating Frequency

- 13.560 Mhz

Modulation Type

- ASK (Amplitude Shift Keying)

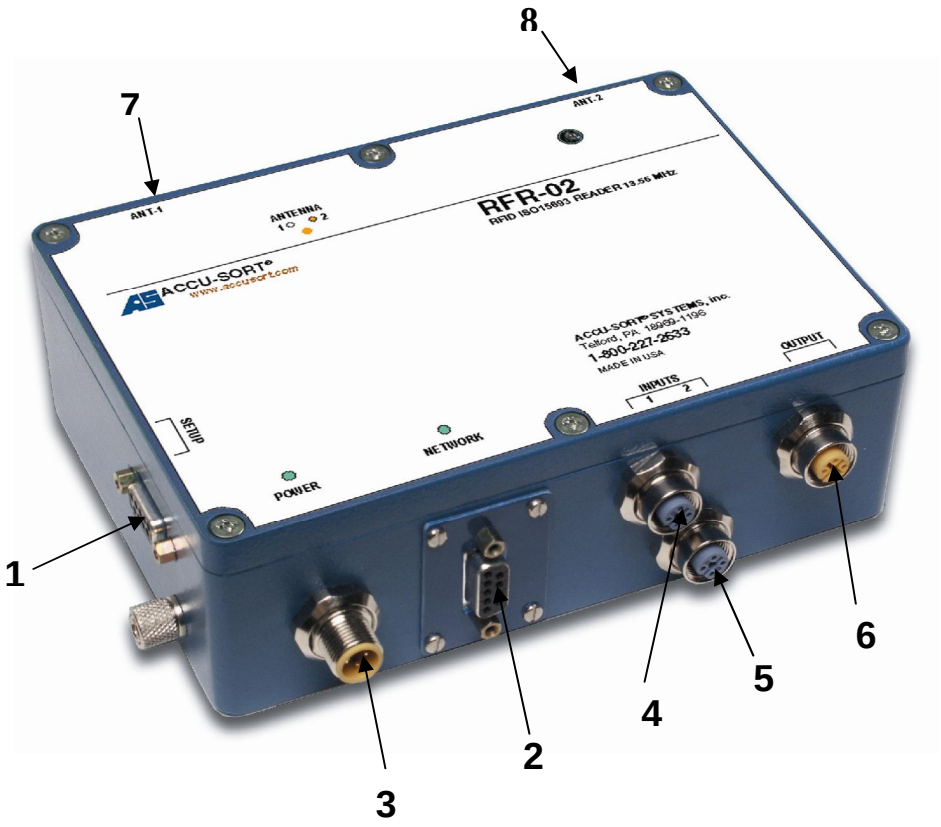
Protocol

- ISO 15693

Antennas

- Dual Antenna option
  - Timed, Trigger, or Command switching

Wiring and Cable Pin Diagrams

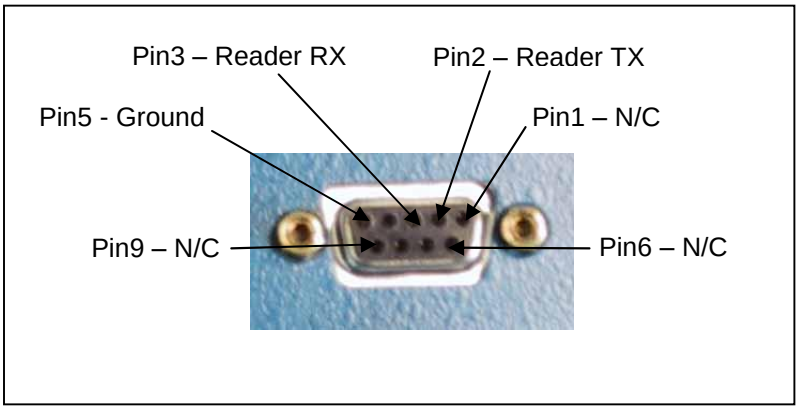


1. See Setup Port
2. See RS232/422 Port
3. See Power Connector
4. See Input1 Connector
5. See Input2 Connector
6. See Output Connector
7. Antenna1 Port
8. Antenna2 Port

1. Setup Port (DB9 FEMALE)

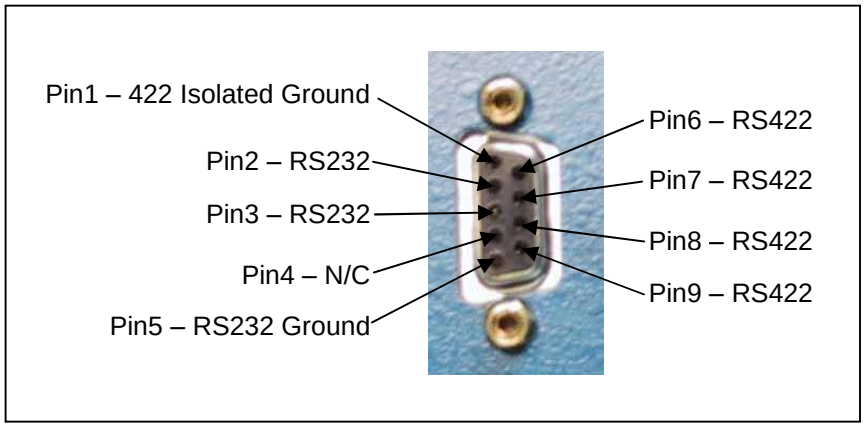
1. NC (not connected)
2. Reader TX (232)
3. Reader RX (232)
4. NC
5. GND (ground)

6-9. NC



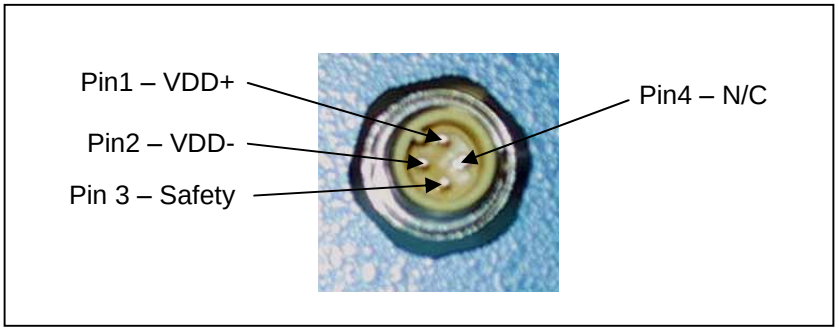
2. RS232/RS422 Communications Port (DB9 FEMALE)

1. 422 Isolated GND
2. Reader TX (232)
3. Reader RX (232)
4. NC
5. 232 GND
6. Reader SD- (422)
7. Reader SD+ (422)
8. Reader RD- (422)
9. Reader RD+ (422)



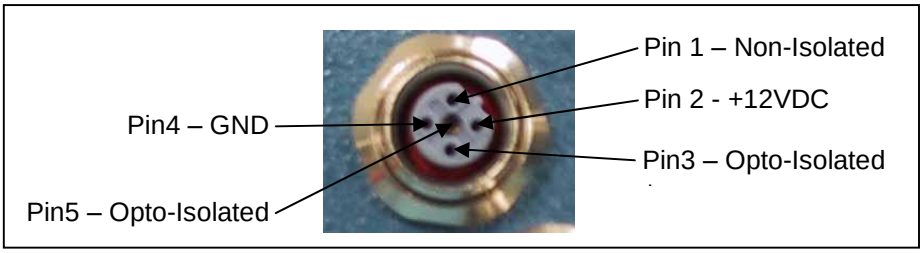
3. Power Connector (Turck 4 Pin Male EuroFast # FSFD4.4-0.5)

1. VDD+
2. VDD-
3. Safety/Chassis Ground
4. NC



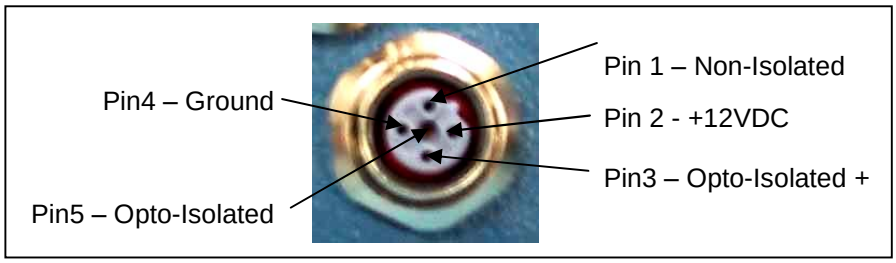
4. Trigger Input 1 (Upper Connector – Turck 5 Pin Female Eurofast #FKFDW4.5-0.5)

1. Non-Isolated (Active Low, Internally pulled to +5VDC)
2. +12VDC
3. Optically Isolated +
4. GND
5. Optically Isolated –



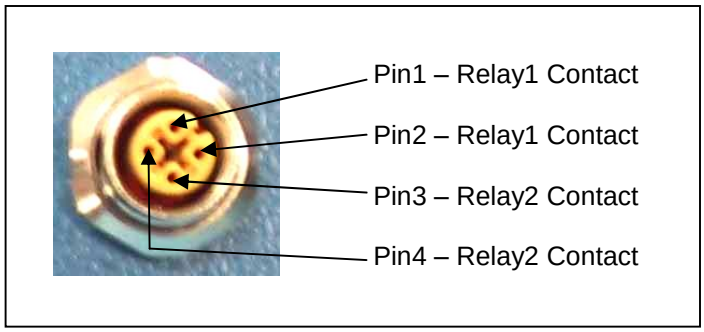
5. Trigger Input 2 (Lower Connector – Turck 5 Pin Female Eurofast #FKFDW4.5-0.5)

1. Non-Isolated (Active Low, Internally pulled to +5VDC)
2. +12VDC
3. Optically Isolated +
4. GND
5. Optically Isolated –



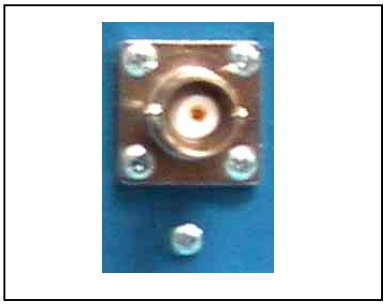
6. Output Connector (Turck 4 Pin Female EuroFast #FKFD4.4-0.5)

1. Relay 1 Contact
2. Relay 1 Contact
3. Relay 2 Contact
4. Relay 2 Contact



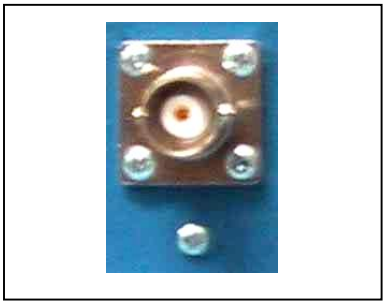
7. Antenna 1 Port (BNC Female)

1. 13.56Mhz Signal



8. Antenna 2 Port (BNC Female)

2. 13.56Mhz Signal



Installation Requirements

Power

There are 2 supply voltage options available for the RFR-02.

- 12 Volt (RFR-02 Part # 1000052365)

  Use only Accu-Sort supplied Power Supply part # 1000052837. Failure to use an AccuSort approved Power supply will void the product warranty.

- 10 – 30 Volt (RFR-02 Part # 1000053245)

  Input range 10 – 30 VDC .

NOTE: Safety earth ground must be attached to the reader (Failure to do so will void the warranty), designed for applications where customers are intending to provide their own DC power.

  - Flying leaded Shielded Cable (for use with 10– 30 Volt option only):
    - Accu-Sort Part #:1000052775
    - TURCK Part #: RKS 4.4T-2 (2 meter)

Antennas

Use only Accu-Sort provided RFA-02 Antennas. Connecting any other antenna will disable unit from functioning, and could be in violation of FCC part 15 regulations.

Approved Antenna Choices:

Antenna Model #	Part #	Description
RFA-02	1000052373	5” x 7”
RFA-02-02	0105496001	12” x 16” w/7 Ft cable
RFA-02-02	0105496002	12” x 16” w/10 Ft cable
RFA-02-02	0105496003	12” x 16” w/15 Ft cable
RFA-02-03	0105574001	5” x 16” w/7 Ft cable
RFA-02-03	0105574002	5” x 16” w/10 Ft cable
RFA-02-03	0105574003	5” x 16” w/ 15 Ft cable

Inputs 1 and 2

Two optically isolated inputs or two non-isolated inputs are available. When using isolated inputs user must supply both positive and negative voltage references. When using non isolated inputs user must connect to sink output of trigger device (active low). A current limited (100 ma max) 12VDC connection is provided on each input connector for purposes of providing power to low current consuming devices such as a photo-eyes. Non isolated inputs are internally pulled to +5VDC through a 2.2k ohm resistor. Note avoid sourcing any voltage into the non-isolated inputs as damage may occur to device.

- Pin 1: Non-Isolated Input
- Pin 2: +12 VDC internally current limited
- Pin 3: Optically Isolated + Input
- Pin 4: GND
- Pin 5: Optically Isolted – Input

Mating Field Wireable Connector:

- Accu-Sort Part # 1000052778
- TURCK Part # BSWS-8151

Outputs 1 and 2

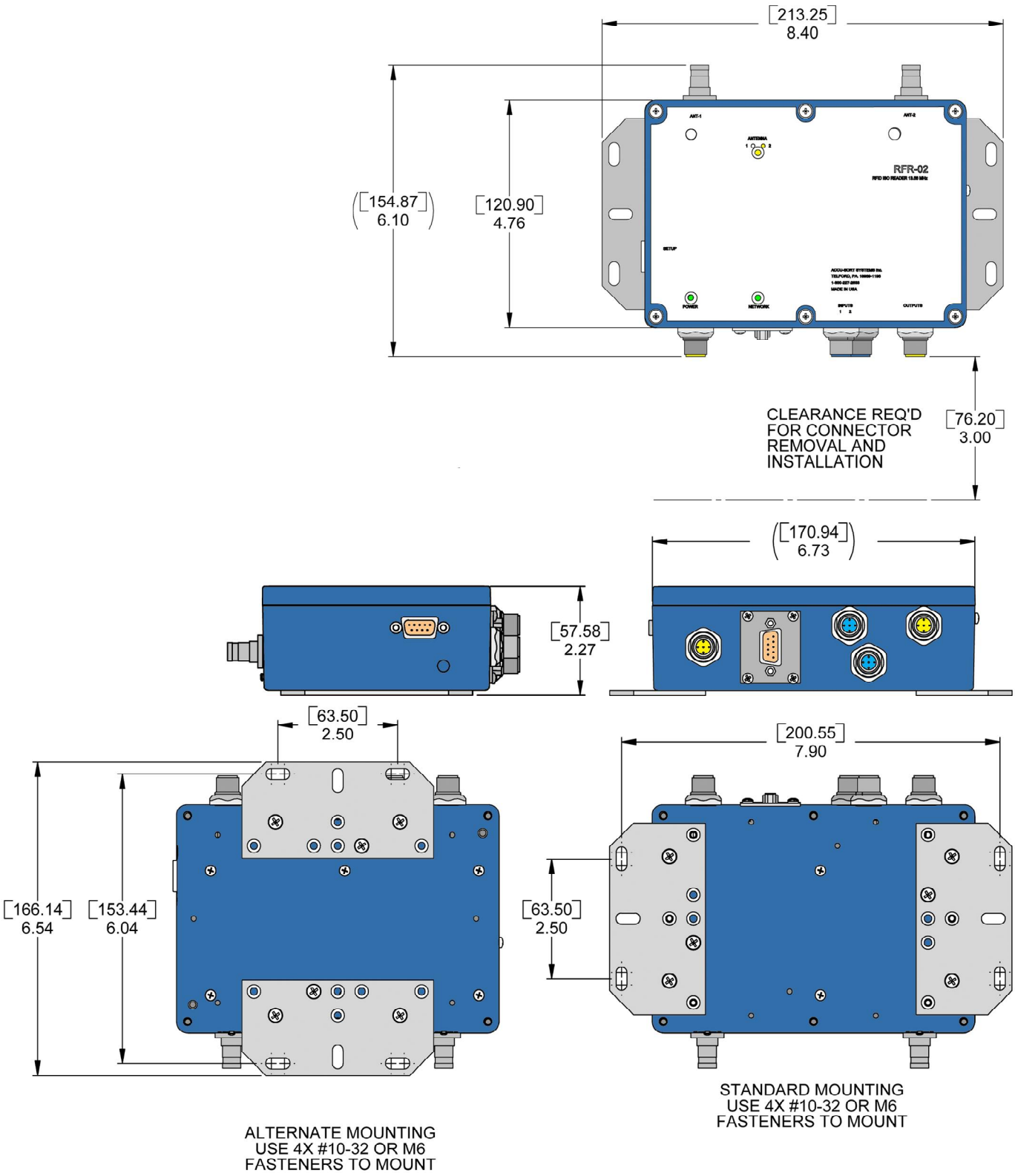
Two Solid-State Form A Relay Outputs.

- Output 1: Pins 1 and 2
- Output 2: Pins 3 and 4

Mating Field Wireable Connector:

- Accu-Sort Part # 1000057444,
- TURCK Part # BS8141-0

Reader Mounting Dimensions



(Extracted from drawing #106103, rev01)

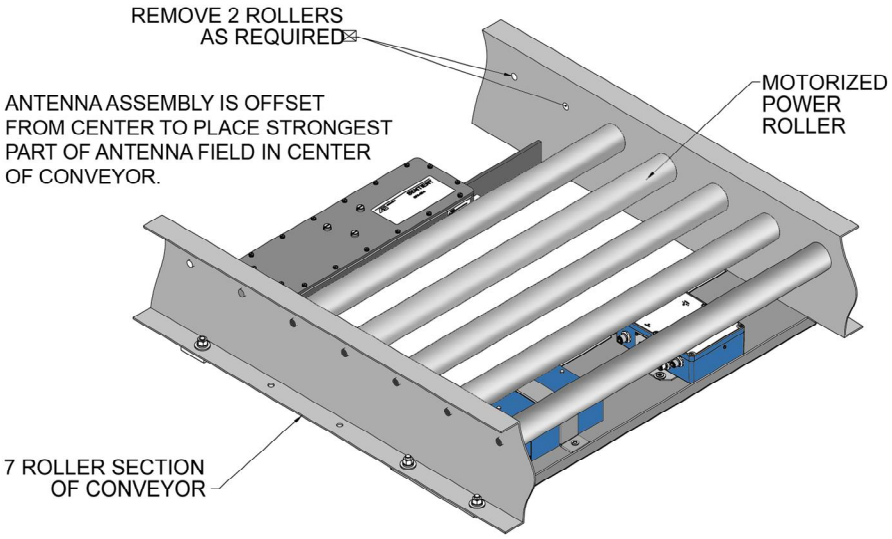
Antenna Mounting

General Guidelines

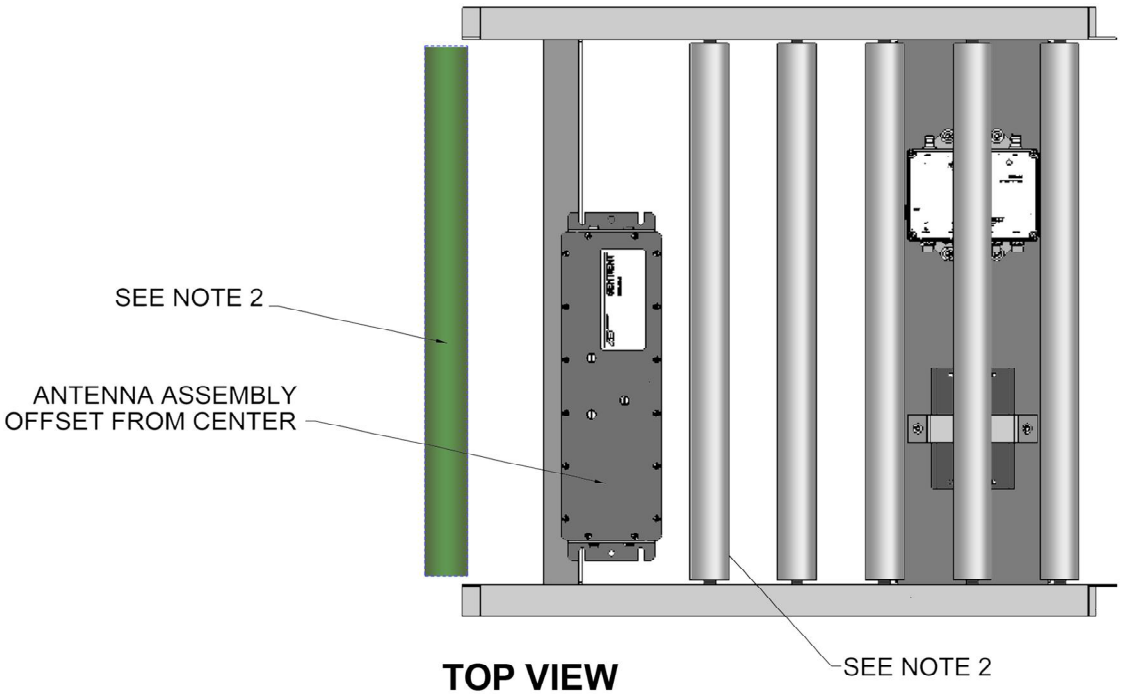
To achieve optimum performance from theRFR-02 Reader, antennae should be mounted as far from metal objects as possible. The RF energy generated by the Reader/Antenna combination to communicate with the RFID tags is called the near field. The near field is the magnetic portion of the RF field and can be influenced by surrounding metallic objects. These metallic objects if located close enough to the antennae and are of the right shape and position can create eddy currents, which diminish and in some instances can totally cancel out the reading ability of the antenna. These metallic objects also will detune the antennae which in turn will cut down on the power transfer between reader and antenna leading to less then optimum performance.

To cover all possible antenna mounting possibilities is beyond the intent of this document, but an example of one way to help reduce the influence of metallic objects on the antenna is shown below. The 5” x 16” antenna is shown in this example being mounted in a roller conveyor.

Antenna Mounting Example



NOTES:
1. CABLES ARE NOT SHOWN FOR CLARITY.
2. NON-METALLIC ROLLERS REQUIRED WHERE INDICATED FOR OPTIMUM PERFORMANCE ON EITHER SIDE OF ANTENNA.
3. MOUNT ANTENNA AS FAR AS POSSIBLE FROM DRIVE ROLLER OR OTHER SOURCES OF EMI.



TOP VIEW

(Extracted and modified from drawing #108804, rev02)

Notes:

Modes of Operation

The RFR-02's modes of operation can be divided into three categories. The reader can be in Setup mode where the user can change parameters, or it can be in Trigger mode where the unit acts only on trigger inputs, or it can be in Serial Command mode where the unit accepts serial data. See following sections for in depth details on each mode.

Setup Mode

All of the user changeable parameters can be configured in setup mode. These settings will be stored in non-volatile memory only if they are saved before power-down. If not saved before power-down, the settings will be lost and the unit will boot-up in its default configuration.

Entering Setup Mode

Setup mode can be entered by either:

1. Powering on the unit, waiting for an ACK (^F, 0x06), then sending ETX (^C, 0x03) within 3 seconds of receiving the ACK. This method only works on the setup port. On power up the RFR-02 always defaults its communication to the setup port for 3 seconds, port configuration is 19200 N81.
2. Typing ‘setup’ in all lower-case characters during normal operation.

In either case, the RFR-02 will send a SYN character (^V, 0x16) and display its firmware version. After the firmware version of the unit is displayed you can view its current configuration by typing a ‘?’ followed by a ‘CR’.

Setup commands are in upper case only and may be followed by 1 or more characters (normally ASCII digits, but can be other characters depending on the command), and are terminated by a CR (^M, 0x0d). Setup commands do not use either transmit or receive headers or trailers (discussed below).

In setup mode, all valid commands will be acknowledged with the following sequence:

ASII	LF STX ACK CR LF CR
HEX	0A 02 06 0D 0A OD

Invalid commands will be acknowledged with the following sequence:

ASII	LF STX NCK CR LF CR
HEX	0A 02 15 0D 0A OD

Setup Mode Parameters

ANTENNAx

Sets the antenna mode of operation to the following configuration options.

The default value for ‘x’ is 0 (single antenna attached to antenna 1 port).

The legal settings for the variable ‘x’ are as follows:

0 Single antenna mode (antenna 1 only)

1 Dual antenna mode, trigger switching

2 Dual antenna mode, timer switching (see ANTTIME command)

3 Dual antenna mode, serial command switching

In all dual antenna modes, each response from the RFR-02 will start with either a ‘1’ or a ‘2’, indicating which antenna was used.

NOTE: There is a 10ms delay in switching between antennas.

ANTTIMExxx

Sets the antenna dwell time for ANTENNA mode 2. The units of ANTTIME are in 10ms time slices, with the default value for ‘xxx’ being 005 (50ms dwell).

The legal values of ‘xxx’ are 001 to 255, and all 3 digits must be sent.

Example: ANTIME100 will cause the unit to switch between the two antennae every 1 second.

BAUDx

Sets the baud rate for serial communications on the Setup and Network ports.

The default value of ‘x’ for is 1, which corresponds to 19200 baud. The legal values are:

0 9600 baud

1 19200 baud

2 28800 baud

3 38400 baud

4 57600 baud

NOTE: All serial communications use 8 data bits, no parity, 1 stop bit, and no flow control (N-8-1).

BLOCKNUMxx

Sets the first block number of a tag's memory contents that the unit will read from when a trigger event occurs. The legal values of 'xx' are 00 to 99, and both digits must be sent. The maximum value depends on the tag's memory capacity, and is normally 63 for ISO15693. The default value for 'xx' is 00.

NOTE: This parameter is only valid when used in conjunction with the following additional parameter settings:
ANTENNA1
TRIGGER1x, when x = 1 ,3, or 5
TRIGGER2x, when x = 1 or 3

BLOCKSxx

Sets the number of additional blocks of a tag's memory contents that the unit will read when a trigger event occurs. The additional blocks to be read will start immediately after the block define by the BLOCKNUMxx setting. The legal values of 'xx' are 00 to 99, and both digits must be sent. The default value for 'xx' is 00.

NOTE: The maximum value depends on the tag's memory capacity, and is normally 63 for ISO15693.

COMMx

Set the unit's active communication port. Note there can only be one active port.

The default value for 'x' is 0 (setup port RS232), and the legal values are:

0 setup port (RS232)

1 network port (RS232)

2 network port (RS422)

3 reserved for future use

DEFAULT

Set all parameters to their default values. See the individual command descriptions for the default values. This command does not have any parameters.

SAVE

Save the current setup parameters to EEPROM.

EXIT

Exit setup mode and return to normal operation. This command does not have any parameters.

NOTE: The current setup values are NOT automatically saved into EEPROM. The current setup values will be used, but the RFR-02 will return to the last saved values at the next power-up. If you wish to keep the current configuration as the power-up mode, you must use the SAVE command before exiting setup.

MATCHxxxxxxxx

Set the filter string for firing the outputs.

The MATCH string is 8 characters, and is used as a "filter" for firing the outputs in OUTPUTx3 or similar (see below) – even with a valid read, the output will not fire unless MBYTES (see below) of the MATCH string match the data read from the tag.

The default value for 'xxxxxxxx' is 00000000 (8 characters of ASCII 0, 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x30), and the string may be any set of 8 bytes (0x00 to 0xFF).

All 8 bytes must be sent when setting the MATCH string.

MBYTESx

Set the number of bytes to compare against the MATCH string.

The MBYTES command allows a variable number of bytes to be used as a filter for firing of OUTPUT1 and OUTPUT2 when set to mode 3 (see below) – even with a valid read the output will not fire unless 'x' number of characters of MBYTES equal the characters of the MATCH string (see above). The comparison of the number of bytes to match starts from the left most character of the MATCH 'xxxxxxxx' parameter.

The default value for 'x' is 0, and the legal values are 0 to 8.

OUTPUT1x

Set the firing mode for OUTPUT1.

OUTPUT 1 will “fire” (connect pins 1 and 2 of the output connector), based on the result of the last read and the current antenna mode.

The default value of OUTPUT1’x’ is 1, fire OUTPUT1 on valid tag read. The legal values are:

0 Do not fire OUTPUT1

1 Fire OUTPUT1 on valid read from a tag

2 Fire OUTPUT1 on invalid read from a tag (no read, misread, collision)

3 Fire OUTPUT1 on valid read and when the first MBYTESx of data from the tag match the first MBYTESx of the MATCH string

In addition to the read condition, OUTPUT1 will fire based on the antenna used in TRIGGER mode.

In serial command mode (tag read is initiated by a serial command), OUTPUT1 will be used (if not 0) regardless of which antenna was used for the read.

In trigger mode (tag read is initiated by a trigger input), OUTPUT1 will be used with any TRIGGER1 setting > 2 and when TRIGGER2 mode is 3 or 4 (see below).

OUTPUT2x

Set the firing mode for OUTPUT2.

OUTPUT 2 will “fire” (connect pins 3 and 4 of the output connector), based on the result of the last read and the current antenna mode.

The default value of OUTPUT2’x’ is 2, fire on invalid read from tag. The legal values are:

0 Do not fire OUTPUT2

1 Fire OUTPUT2 on valid read from a tag

2 Fire OUTPUT2 on invalid read from a tag (no read, misread, collision)

3 Fire OUTPUT2 on valid read and the first MBYTES of data from the tag match the first MBYTES of the MATCH string

In addition to the read condition, OUTPUT2 will fire based on the antenna used in TRIGGER mode.

In serial command mode (tag read is initiated by a serial command), OUTPUT2 will be used (if not 0) regardless of which antenna was used for the read.

In trigger mode (tag read is initiated by a trigger input), OUTPUT2 will be used with any TRIGGER2x and TRIGGER1x when TRIGGER1x mode is greater than 2 (see below).

HOLD1xxx

Set the hold time of the solid state relay connected to OUTPUT1. The units of HOLD1 are 10ms time slices, and the default value for ‘xxx’ is 005 (50ms). The legal values of ‘xxx’ are 005 to 255, and all three digits must be sent.

HOLD2xxx

Set the hold time of the solid state relay connected to OUTPUT2. The units of HOLD2 are 10ms time slices, and the default value for ‘xxx’ is 005 (50ms). The legal values of ‘xxx’ are 005 to 255, and all three digits must be sent.

PROTOCOLx

Sets the Air to Air communications protocol.

The default value of ‘x’ is 2, and corresponds to ISO15693. This parameter should not be changed.

RXHDRx

Set the receive header byte to ‘x’.

The receive header byte, if not NUL (0x00), is expected before any serial command when not in setup mode. This byte is not used by the RFR-02 when in setup mode, it allows for flexibility in communications with the host system.

The default value of ‘x’ is NUL (0x00), and legal values are 0x00 to 0xFF. Note that CR (^M, 0x0D) is also a valid byte, but is also the signal to the RFR-02 for end of command in setup mode. This special case is handled by sending the 2-byte string CR (in upper case) as the header byte. i.e. RXHDRCR<cr>

In addition, some types of communications software programs do not like to send a NUL, and so the RFR-02 software when in setup mode will recognize the special case of sending the 2-byte string 00 (two ASCII zeros) to set the header byte to NUL. i.e. RXHDR00<cr>

RXTRLx

Set the receive trailer byte to ‘x’

The receive trailer byte, if not NUL (0x00), is expected after any serial command when not in setup mode. This byte is not used by the RFR-02 when in setup mode, it allows for flexibility in communications with the host system.

The default value of ‘x’ is NUL (0x00), and legal values are 0x00 to 0xFF. Note that CR (^M, 0x0D) is also a valid byte, but is also the signal to the RFR-02 for end of command. This special case is handled by sending the 2-byte string CR (in upper case) as the trailer byte. i.e. RXTRLCR<cr>

In addition, some types of communication software programs do not like to send a NUL, and so the RFR-02 software when in setup mode will recognize the special case of sending the 2-byte string 00 (two ASCII zeros) to set the trailer byte to NUL. I.e. RXTRL00<cr>

TRIGGER1x

Set action taken when TRIGGER1 becomes active.

The default value is 0 (do nothing, serial trigger), and the legal values are:

0	Do nothing (Serial Command mode)
1	Read BLOCKNUM + BLOCKS additional blocks from antenna 1
2	Inventory tags from antenna 1

3 Read BLOCKNUM + BLOCKS additional blocks from antenna 1 and use both outputs

4 Inventory tags from antenna 1 and use both outputs

5 Read BLOCKNUM + BLOCKS additional blocks from antenna 1 until valid read or TRIGGER2 is asserted, use both outputs

6 Inventory tags from antenna 1 until valid data or TRIGGER2 is asserted, and use both outputs

When TRIGGER1x (or TRIGGER2x) is non-zero, the RFR-02 will not respond to serial commands to read or write tags.

When TRIGGER1 is 5 or 6, TRIGGER2 is used to end the TRIGGER1 action and will not perform any action, despite the value of TRIGGER2.

WARNING: When doing an inventory via TRIGGER1, TRIGWAIT1xxx must be set to at least 013, otherwise the inventory function may time-out before the inventory is complete and the tag could be missed.

TRIGGER2x

Set action taken when TRIGGER2 becomes active.

The default value is 0 (do nothing, serial trigger), and the legal values are:

0 Do nothing (Serial Command mode)

1 Read BLOCKNUM + BLOCKS additional blocks from antenna 2

2 Inventory tags from antenna 2

3 Read BLOCKNUM + BLOCKS additional blocks from antenna 2 and use both outputs

4 Inventory tags from antenna 2 and use both outputs

When TRIGGER2x (or TRIGGER1x) is non-zero, the RFR-02 will not listed to serial commands to read or write to tags.

When TRIGGER1x is 5 or 6, TRIGGER2 is used to end the TRIGGER1 action and will not perform any action, despite the value of TRIGGER2.

WARNING: When doing an inventory via TRIGGER2, TRIGWAIT2 must be set to at least 013 (130ms), otherwise the inventory may time-out before the inventory is complete and the tag could be missed.

TRIGWAIT1xxx

Set the timeout period of TRIGGER1x action.

The units of TRIGWAIT1xxx are a 10ms time slice, and the default value is 005 (50ms).

The legal values of ‘xxx’ are 005 to 255, and all three digits must be sent.

WARNING: When doing an inventory via TRIGGER1, TRIGWAIT1 must be set to at least 013, otherwise the inventory may time-out before the inventory is complete and the tag could be missed.

TRIGWAIT2xxx

Set the timeout period of TRIGGER2 action

The units of TRIGWAIT2 are a 10ms time slice, and the default value is 005 (50ms).

The legal values of ‘xxx’ are 005 to 255, and all three digits must be sent.

WARNING: When doing an inventory via TRIGGER2, TRIGWAIT2 must be set to at least 013, otherwise the inventory may time-out before the inventory is complete and the tag could be missed.

TXHDRx

Set the transmit header byte to ‘x’.

The transmit header byte, if not NUL (0x00), is sent before any serial response when **not in setup mode**. This byte is not used by the RFR-02 when in setup mode, it allows for flexibility in communications with the host system.

The default value of ‘x’ is NUL (0x00), and legal values are 0x00 to 0xFF. Note that CR (^M, 0x0D) is also a valid byte, but is also the signal to the RFR-02 for end of command. This special case is handled by sending the 2-byte string CR (in upper case) as the header byte. i.e. TXHDRCR<cr>

In addition, some communications software programs do not like to send a NUL, and so the RFR-02 software when in setup mode will recognize the special case of sending the 2-byte string 00 (two ASCII zeros) to set the header byte to NUL. I.e. TXHDR00<cr>

TXTRLx

Set the transmit trailer byte to ‘x’

The transmit trailer byte, if not NUL (0x00), is sent after any serial response when not in setup mode. This byte is not used by the RFR-

02 when in setup mode, it allows for flexibility in communications with the host system.

The default value of 'x' is NUL (0x00), and legal values are 0x00 to 0xFF. Note that CR (^M, 0x0D) is also a valid byte, but is also the signal to the RFR-02 for end of command. This special case is handled by sending the 2-byte string CR (in upper case) as the trailer byte. I.e. TXTRLCR<cr>

In addition, some communications software programs do not like to send a NUL, and so the RFR-02 software when in setup mode will recognize the special case of sending the 2-byte string 00 (two ASCII zeros) to set the trailer byte to NUL. I.e. TXTRL00<cr>

?

Display the current setup parameters.

The RFR-02 will reply with it's ACK message, CR LF STX ACK CR LF (^M ^J ^B ^F ^M ^J, 0x0D 0x0A 0x02 0x06 0x0D 0x0A), and then a table of the current values of the user settable parameters. For example, with all values at their defaults:

PROTOCOL:2

ANTENNA:0 ANTTIME:005

COMM:0

BAUD:1

BLOCKNUM:00

BLOCKS:00

TRIGGER1:0 TRIGGER2:0

TRIGWAIT1:005 TRIGWAIT2:005

OUTPUT1:1 OUTPUT2:2

HOLD1:005 HOLD2:005

MATCH:00000000

MBYTES:0

TXHDR:0x00	TXTRL:0x00
RXHDR:0x00	RXTRL:0x00

Output Message Format

Messages from the RFR-02 will include TRHDR and/or TXTRL (if they are not NUL), and will include the antenna (if the RFR-02 is in any dual antenna mode), ISO Flag byte, and requested data. Then general format (with all fields) is:

Response Format with Valid Tag Data Being Read

	TXHDR	Antenna	ISO Flags	Data	TXTRL
Parameter Dependent	Yes	Yes	No	No	Yes
Parameters that will cause data to be included in response from unit.	TXHDRx = anything other than Null (0x00)	ANTENNAx = 1,2, or 3	Always sent see ISO Flag Byte below for definition	Always sent	TXTRLx = anything other than Null (0x00)

Response Format Error Messages

NOTE: Not all commands will send a error message, commands that do not will be so noted.

	TXHDR	Antenna	ISO Flags	Data	TXTRL
Parameter Dependent	Yes	Yes	No	N0	Yes
Parameters that will cause data to be included in response from unit.	TXHDRx = anything other than Null (0x00)	ANTENNAx = 1,2, or 3	Not Sent	See paragraph below for possible error messages	TXTRLx = anything other than Null (0x00)

The error messages from the RFR-02 are:

These messages will be in the format:

<TXHDR><antenna><MESSAGE><TXTRL>

NO TAG	No tag was read or it could be in “Quiet” mode
NO ANT	An Accu-Sort antenna was not detected. Check your antenna connection.
COLL	More than one tag responded.
MISREAD	The data returned from the tag was garbled.

ISO Flag Byte Definition

The ISO Flags (if not 0x00) will indicate an error occurred. Flags will correspond to the specific error (Taken from ISO 15693-3) as listed below.

0x00	No Error
0x01	Command is not supported
0x02	Command is not recognized
0x03	Command option is not supported
0x0F	Error with no information (error code not supported)
0x10	Block is not available (doesn't exist)
0x11	Block is already locked
0x12	Block is locked so its content cannot be changed
0x13	Block was not successfully programmed
0x14	Block was not successfully locked
All others	Reserved for Future Use (RFU)

Trigger Mode

When either TRIGGER1x or TRIGGER2x is not “0”, the RFR-02 will operate in Trigger Mode. In this mode, the only way to get the RFR-02 to communicate with a tag is by the trigger inputs. The RFR-02 can be setup to have either trigger use one or both outputs. Use discretion when assigning outputs because it may be confusing if both triggers are set up to use both outputs.

Another point to mention about Trigger Mode is that if the triggers are operating in trigger switched dual antenna mode (ANTENNA1) that TRIGGER1 will switch to antenna 1 when activated, and TRIGGER2 will switch to antenna 2 when activated.

In Trigger Mode, all serial input is ignored by the RFR-02 and it only accepts input from the triggers. The only exception is that sending ‘setup’ to the unit will put the RFR-02 into Setup Mode. Note you must know the current COMMx setting and BAUDx setting for the unit to accept the setup command.

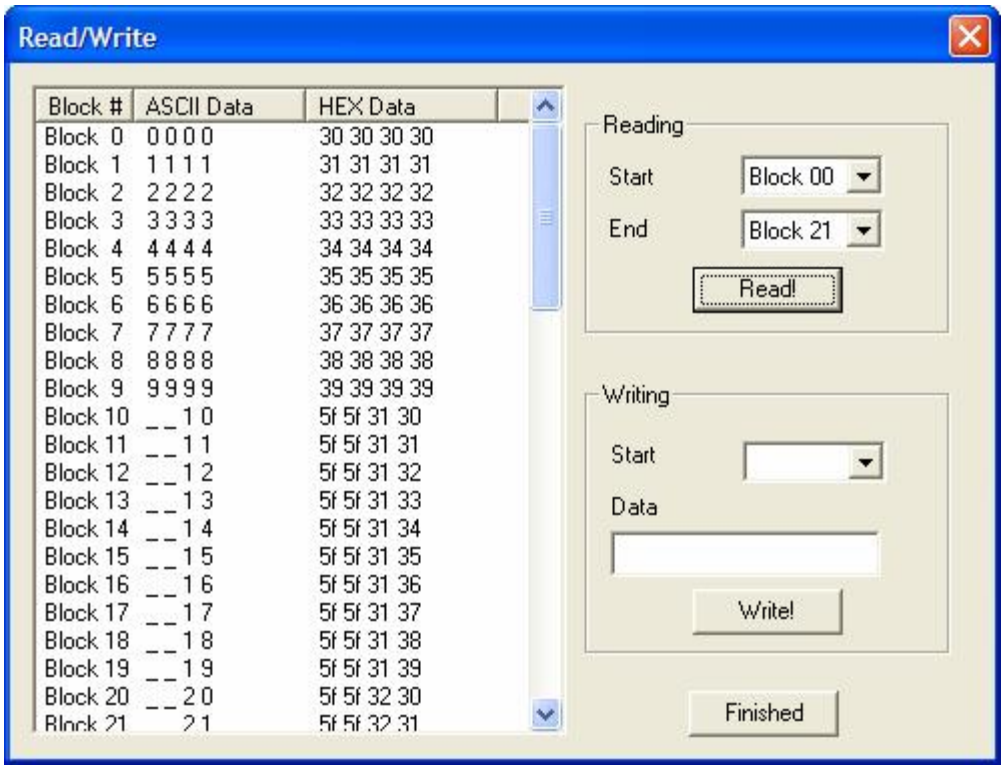
Example: If COMMx = 0 (Setup Port active) and you try and send the setup command on the Network Port the unit will not respond, the same is true concerning the BAUDx setting.

NOTE: A trigger signal must be active for a minimum of 10ms to be accepted.

Trigger Mode Examples

The following examples will be based upon the tag data shown in the screen capture shown below.

The Tag UID is: Hex E0 07 81 26 AD 83 5D 67 (unless otherwise noted)



Read Block 0 of Tag using Trigger Input 1 and Antenna 1 with 50msec timeout with a Transmit Header set to 5B0X (ASCII '[') and a Transmit Trailer set to 5D0X (ASCII ']').

Parameters that have been changed from their default settings are as follows:

ANTENNA1

TRIGGER11

TXHDR0x5B, [

TXTRL0x5D,]

Response With Valid Tag Data Read

NOTE: Commas are shown for clarity purposes and are not part of data.

- NP stands for Non Printable character.
- NA stands for Not Applicable so no character will be sent.

When TRIGGER1 is asserted, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NUL	0,0,0,0	]
Hex	5B	31	00	30,30,30,30	5D

Response with No Tag Data Read

When TRIGGER1 is asserted, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	NO TAG	]
Hex	5B	31	NA	4E,4F,20,54,41,47	5D

Read Blocks 0 Thru 4 of Tag using Trigger Input 1 and Antenna 1 with 50msec timeout

Parameters that have been changed from their default settings are as follows:

ANTENNA1

BLOCKS04

TRIGGER11

TXHDR0x5B, [

TXTRL0x5D,]

Response With Valid Tag Data Read

When TRIGGER1 is asserted, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NUL	0,0,0,0,1,1,1,1,2,2, 2,2,3,3,3,3,4,4,4,4,	]
Hex	5B	31	00	30,30,30,30,31,31,31, 31,32,32,32,32,33,33, 33,33,……..,34	5D

Response With No Tag Data Read

When TRIGGER1 is asserted, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	NO TAG	]
Hex	5B	31	NA	4E,4F,20,54,41,47	5D

Inventory Tag UID Using Trigger Input 1 and Antenna 1 with 200msec timeout

Parameters that have been changed from their default settings are as follows:

ANTENNA1

TRIGGER12

TRIGWAIT1020

TXHDR0x5B, [

TXTRL0x5D,]

Response With Valid Tag UID Read and Trigger 1 asserted for the 1st time

When TRIGGER1 is asserted for the 1st time, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	Not shown due to many Non printable characters	]
Hex	5B	31	NA	67,5D,83,AD,26,81,07,E0 (UID sent reverse order)	5D

Response with Valid Tag UID Read and Trigger 1 asserted for the 2nd time

When TRIGGER1 is asserted for the 2nd time and Tag has not been removed from antenna's field, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	NO TAG	]
Hex	5B	31	NA	4E,4F,20,54,41,47	5D

NOTE: The Tag did not send its UID the second time because the 1st inventory command left the tag in "Quiet mode", if tag is removed from the antenna's field and then placed back in field it will again respond with its UID.

Response With No Tag in antenna Field

When TRIGGER1 is asserted, the output data string will be:

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	NO TAG	]
Hex	5B	31	NA	4E,4F,20,54,41,47	5D

Read Blocks 5 and 6 of Tag Using Trigger1 and Data Match Parameter to Close Output 1

Parameters that have been changed from their default settings are as follows:

ANTENNA1

TRIGGER13

TRIGWAIT1100

OUTPUT13

BLOCKNUM05

BLOCKS01

MATCH55556666

MBYTES8

HOLD1100

TXHDR0x5B, [

TXTRL0x5D,]

Response With Valid Tag Read of Blocks 5 and 6 with matching data.

When TRIGGER1 is asserted, the output data string will be:

And Output 1 will close for 1 second.

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NUL	5,5,5,5,6,6,6,6,	]
Hex	5B	31	00	35,35,35,35,36,36,36,36	5D

Response with Valid Tag Read of Blocks 5 and 6 without matching data (all 0's in blocks 5 and 6).

When TRIGGER1 is asserted, the output data string will be:

And Output 1 will not close.

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NUL	0,0,0,0,0,0,0,0,	]
Hex	5B	31	00	30,30,30,30,30,30,30,30	5D

Response with No Tag Data read

When TRIGGER1 is asserted, the output data string will be:

And Output 1 will not close

Example	TXHDR	Antenna	ISO Flag	Tag Data	TXTRL
ASCII	[	1	NA	NO TAG	]
Hex	5B	31	NA	4E,4F,20,54,41,47	5D

Serial Command Mode

When in Serial Command Mode, the RFR-02 will only accept serial input and will ignore both triggers.

The outputs, if used, are independent of which antenna is used.

Serial commands require RXHDR and/or RXTRL (if they are not NUL), but do not require a CR.

If the RFR-02 is in dual antenna mode but not timer switched mode (ANTENNAx is 3), the antenna must be specified in the 2nd byte of most commands. See below for details on which commands require the antenna to be specified. Note that 1 selects antenna 1, 2 selects antenna 2, and 0 uses the currently selected antenna.

Messages from the RFR-02 will include TRHDR and/or TXTRL (if they are not NUL), and will include the antenna (if the RFR-02 is in any dual antenna mode), as well as the requested data. Then general format (with all fields) is:

<TXHDR><antenna><ISO Flags><data><TXTRL>

Serial Mode Response Format with Valid Tag data being Read

	TXHDR	**Antenna**	**ISO Flags**	**Data**	**TXTRL**
Parameter Dependent	Yes	Yes	No	No	Yes
Parameters that will cause data to be included in response from unit.	TXHDRx = anything other than Null (0x00)	ANTENNAx = 3	See ISO Flag Byte below for definition. Normally 0x00	Always sent	TXTRLx = anything other than Null (0x00)

Serial Mode Response Format with Error Message

	TXHDR	**Antenna**	**ISO Flags**	**Data**	**TXTRL**
Parameter Dependent	Yes	Yes	No	N0	Yes
Parameters that will cause data to be included in response from unit.	TXHDRx = anything other than Null (0x00)	ANTENNAx = 3	Not Sent	See paragraph below for possible error messages	TXTRLx = anything other than Null (0x00)

NOTE: The RFR-02 will write to as many blocks as necessary to fit the intended message. For example writing “1234567890” starting at block 00 will overwrite blocks 0-2.

The error messages from the RFR-02 are:

These messages will be in the format:

<TXHDR><antenna><MESSAGE><TXTRL>

NO TAG	No tag was read or it could be in “Quiet” mode
NO ANT	An Accu-Sort antenna was not detected. Check your antenna connections.
COLL	More than one tag responded.
MISREAD	The data returned from the tag was garbled.

The ISO Flags (if not 0x00) will indicate an error occurred, and the next byte after the Flags will correspond to the specific errors which are shown on page 32.

Serial Mode Command Format

	RXHDR	**Antenna**	**Serial Command**	**RXTRL**
Parameter Dependent	Yes	Yes	No	Yes
Parameters that will cause data to be included in command to unit.	RXHDRx = anything other than Null (0x00)	ANTENNAx = 3	See specifics of each serial command	RXTRLx = anything other than Null (0x00)

Serial Mode Commands

For all examples shown assume that the unit has its setup parameters at their default values, except for the following:

TXHDR0x5B, ASCII = [

TXTRL0x5D, ASCII =]

- **"E" End current continuous reading commands**

  The "E" command is sent to end commands that have put the RFR-02 in a continuous read condition. Commands that require the "E" to end them are "I" (Inventory) and the continuous read commands; R04, R05, R06, R07.

Example	ASCII	HEX
Command	E	45
Response	NA	NA

- **"A" Switch currently selected antenna**

  Only active in dual antenna mode (ANTENNA3), this command will switch the current antenna.

Example	ASCII	HEX
Command	A	41
Response	NA	NA

- **"Ia" Do an inventory of tags.**

  If in dual antenna mode (ANTENNA3), specify which antenna to use, "a"= 1 or 2.

  Report the UIDs of tags in proximity to the antenna. Once the UID of the tag has been read, it will be in "Quiet" mode until the tag leaves the field of the antenna.

  Note that the bytes of the UID are output in reverse order (the same order that the RFR-02 expects the UID in a command).

Example	ASCII	HEX
Command	I	49

Response	[Many NP characters]	5B,67,5D,83,AD,26,81,07,E0,5D

The tag will be in “Quiet” mode until the tag leaves the field of the antenna. **To stop the inventory, type “E” (no RXHDR or RXTRL is necessary).**

- “L” Lock blocks.

  There are two options available:

  - La00bb

  Lock block bb. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Locking a block prevents writing data to the specified block. This is a permanent irreversible change to the tag.

  If the lock is successful, the response will be TXHDR (if any), the antenna (if in dual antenna mode), “YL” (Yes Lock), and TXTRL (if any).

  The example below is locking block 30 of a tag that is in the antenna’s field.

Example	**ASCII**	**HEX**
Command	L0030	4C,30,30,33,30
Response	[YL]	5B,59,4C,5D

An unsuccessful lock can reply with any of the following errors:

NO TAG

NO ANT

COLL

MISREAD

NL<ISO flags>

The first four are normal RFR-02 error messages, the fifth is based on the ISO error flag byte, and probably represents trying to lock a previously locked block.

The example below is locking block 30 without a tag in the antenna’s field.

Example	**ASCII**	**HEX**
Command	L0030	4C,30,30,33,30
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- La02bbuuuuuuuu

Lock block bb of tag with UID uuuuuuuu. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

Note that, since the UID is specified, an ISO15693 tag will respond even if it is in Quiet mode.

Locking a block prevents writing data to the specified block. This is a permanent irreversible change to the tag.

If the lock is successful, the response will be TXHDR (if any), the antenna (if in dual antenna mode), “YL” (Yes Lock), and TXTRL (if any).

The example below is locking block 40 of a Tag with a UID of E0,07,00,00,06 A6,B8,0B

Example	ASCII	HEX
Command	L,0,2,4,0,(Tag UID omitted due to many ASCII NP characters)	4C,30,32,34,30,0B,B8,A6,06,00,00,07,E0
Response	[YL]	5B,59,4C,5D

An unsuccessful lock can reply with any of the following errors:

NO TAG

NO ANT

COLL

MISREAD

NL<ISO flags>

The first four are the normal RFR-02 error messages; the fifth is based on the ISO error Flag Byte, and probably represents trying to lock a previously locked block.

The example below is locking block 40 of a Tag with a UID of E0,07,00,00,06 A6,B8,0B, the tag is not in the antenna’s field

Example	ASCII	HEX
Command	L,0,2,4,0,(Tag UID omitted due to many ASCII NP characters)	4C,30,32,34,30,0B,B8,A6,06,00,00,07,E0
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- **“O” Fire output via serial command.**

  There are two subcommands available.

  - **O01**
    Close output 1 for the time specified by the HOLD1 setup parameter.
  - **O02**
    Close output 2 for the time specified by the HOLD2 setup parameter.

  The example below will close Output 1 for the time specified by setup parameter HOLD1xxx. No response is expected with this command.

Example	ASCII	HEX
Command	O01	4F,30,31
Response	NA	NA

- “Qauuuuuuuu” Put tag with UID uuuuuuuu into Quiet mode.

  If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

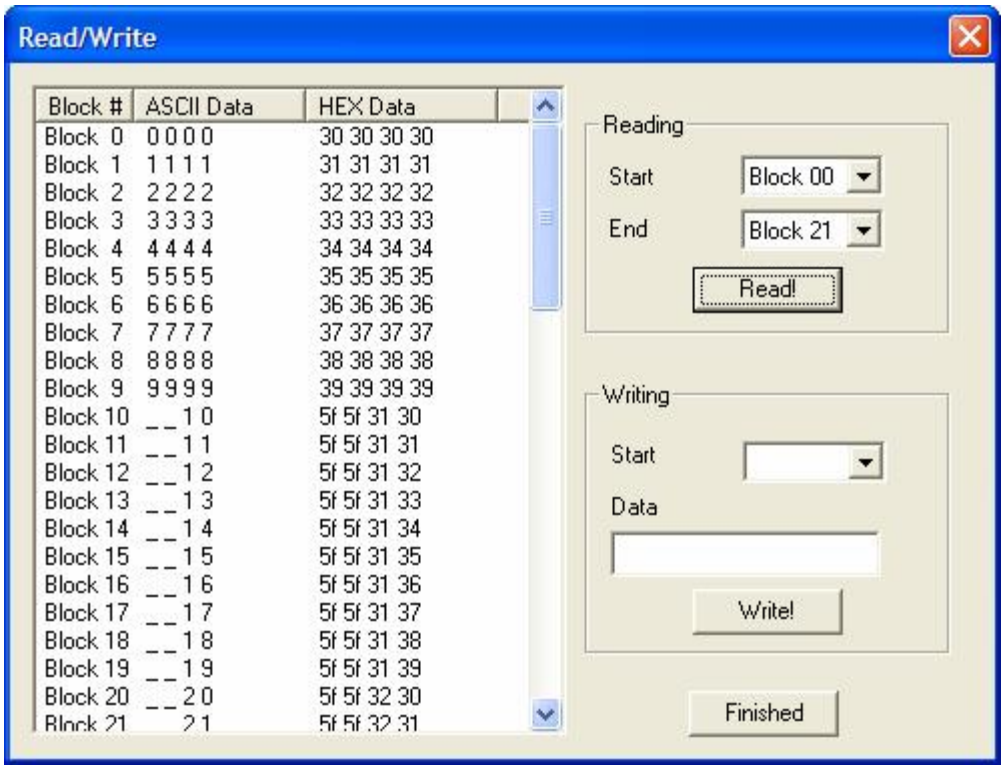
  In Quiet mode, a tag will not respond to requests until it leaves the field of the antenna (Quiet mode does not persist when the tag leaves the antenna’s field).

  The example below is putting the Tag with a UID of E0,07,00,00,06,A6,B8,0B, into Quiet mode. No response is expected with this command.

Example	ASCII	HEX
Command	Q, (Tag UID omitted due to many ASCII NP characters)	51,0B,B8,A6,06,00,00,07,E0
Response	NA	NA

NOTE: For the following examples of Read commands assume that tag data contents are as pictured in below figure, and the setup parameters for the Transmit header and trailer are as follow:

- TXHDR0x5B = ASCII [
- TXTRL0x5D = ASCII]



- **"R" Read Tag**

  Read tag. There are eight available read commands:

  - **Ra00bb**

  Read block "bb" a single time. If in dual antenna mode (ANTENNA3), specify which antenna to use, "a"= 1 or 2.

  The example below will read block 05 of the tag in antenna's field.

Example	ASCII	HEX
Command	R0005	52,30,30,30,35
Response	[,NUL,5,5,5,5,]	5B,00,35,35,35,35,5D

Note the null character ISO error flag of (0x00) is sent first after the transmit header and indicates that no errors occurred, if in dual antenna mode the first character after the transmit header would have been either a "1" or "2" depending on which antenna read the tag after which the ISO error flag would be sent.

Response from above command when no tag is being read is shown below.

Example	ASCII	HEX
Command	R0005	52,30,30,30,35
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- **Ra01bbnn**

  Read block bb and nn additional blocks a single time. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  The example below will start reading at block 00 of the tag and also read 4 additional blocks of data starting from the first block after 00.

Example	ASCII	HEX
Command	R010004	52,30,31,30,30,30,34
Response	[,NUL,0,0,0,0,1,1,1,1,2,2,2,2,3,3,3,3,4,4,4,4,]	5B,00,30,30,30,30,31,31,31,31,32,32……34,5D

Response from above command when no tag is being read is shown below.

Example	ASCII	HEX
Command	R010004	52,30,30,30,35
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- **Ra02bbuuuuuuuu**

  Read block bb from tag with UID uuuuuuuu a single time. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Note that, since the UID is specified, an ISO15693 tag will respond even if it is in Quiet mode.

  The example below will read block 05 from a tag with the UID of E0,07,00,00,06,A6,B8,0B,.

Example	ASCII	HEX
Command	R0205 (Tag UID omitted due to many ASCII NP characters)	52,30,32,30,35,0B,B8,A6,06,00,00,07,E0
Response	[,NUL,5,5,5,5,]	5B,00,35,35,35,35,5D

Response from above command when no tag is being read is shown below.

Example	ASCII	HEX

Command	R0205 (Tag UID omitted due to many ASCII NP characters)	52,30,32,30,35,0B,B8,A6,06,00,00,07,E0
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- **Ra03bbnnuuuuuuuu**

  Read block bb and nn additional blocks from tag with UID uuuuuuuu a single time. If in dual antenna mode (ANTENNA3), specify which antenna to use "a"= 1 or 2.

  Note that, since the UID is specified, the tag will respond even if it is in Quiet mode.

  The example below will start reading at block 00 of the tag with the UID of E0,07,00,00,06,A6,B8,0B, and will also read 4 additional blocks of data starting from the first block after 00.

Example	ASCII	HEX
Command	R030004 (Tag UID omitted due to many ASCII NP characters)	52,30,33,30,30,30,34,0B,B8,A6,06,00,00,07,E0
Response	[,NUL,0,0,0,0,1,1,1,1,2,2,2,2,3,3,3,3,4,4,4,4,]	5B,00,30,30,30,30,31,31,31,31,32,32……34,5D

Response from above command when no tag is being read is shown below.

Example	ASCII	HEX
Command	R030004 (Tag UID omitted due to many ASCII NP characters)	52,30,33,30,30,30,34,0B,B8,A6,06,00,00,07,E0
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

- **Ra04bb**

  Continuous read and transmit of block bb (the same tag will be read repeatedly). If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Block bb is read continually from whatever tag is in the antenna field until the RFR-02 receives an “E” end continuous command (no RXHDR or RXTRL is required). This is most useful for a stream of tags passing a fixed antenna. Note that this command will continually send data if a tag is read, care should be taken by the end user to appropriately manage the host system receive buffers.

  The example below will continually read and transmit block 01 of the tag that is in antenna’s field.

Example	ASCII	HEX
Command	R0401	52,30,34,30,31
Response	[NUL,1,1,1,1,]	5B,00,31,31,31,31,5D

  Response from above command when no tag is being read is shown below.

  Note if no tag is in the antenna field there will be no data sent by the RFR-02, this helps reduce the amount of data that the host system needs to handle.

Example	ASCII	HEX
Command	R0401	52,30,34,30,31
Response	NA	NA

- **Ra05bbnn**

  Continuous read and transmit of block bb and following nn blocks. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Block bb and the subsequent nn blocks are read continually from whatever tag is in the antenna field until the RFR-02 receives an “E” (no RXHDR or RXTRL is required). This is most useful for a stream of tags passing a fixed antenna.

  The example below will start reading at block 00 and will also read 4 additional blocks of data starting from the first block after 00, while continually transmitting data.

Example	ASCII	HEX
Command	R050004	52,30,35,30,30,30,34

Response	[,NUL,0,0,0,0,1,1,1,1,2,2,2,2,3,3,3,3,4,4,4,4,]	5B,00,30,30,30,30,31,31,31,31,32,32……34,5D

Response from above command when no tag is being read is shown below.

Note if no tag is in the antenna field there will be no data sent by the RFR-02, this helps reduce the amount of data that the host system needs to handle.

Example	**ASCII**	**HEX**
Command	R050004	52,30,34,30,31
Response	NA	NA

- **Ra06bb**

  Continuous read of block bb, transmit only once. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Block bb is read continuously from whatever tag is in the field, until the RFR-02 receives an “E” (no RXHDR or RXTRL is required). However, unlike the 04 option, the data is only transmitted once, when it changes (see note below). This is most useful for a stream of tags passing a fixed antenna where the sending of redundant data is not necessary and the tags being read have different data in the block of tag memory that was specified by the read command.

  NOTE: Versions of RFR-02 firmware up to and including R02STD05.hex SII require the contents of two successive tags be different for the specified tag memory block to be read. If the contents are identical the first tag passing over the antenna will read while the second will not. Versions of firmware after R02STD05 do not require successive tags to have different data contents but need the “E” command to be sent between reads of different tags with the same data.

  The example below will continually read but transmit only once block 01 of the tag that is in the antenna’s field.

Example	**ASCII**	**HEX**
Command	R0601	52,30,36,30,31
Response	[NUL,1,1,1,1,]	5B,00,31,31,31,31,5D

Response from above command when no tag is being read is shown below.

Note if no tag is in the antenna field there will be no data sent by the RFR-02, this helps reduce the amount of data that the host system needs to handle.

Example	ASCII	HEX
Command	R0601	52,30,36,30,31
Response	NA	NA

- **Ra07bbnn**

  Continuous read of block bb and next nn blocks, transmit only once. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  Block bb and the next nn blocks are read continuously from whatever tag is in the field, until the RFR-02 receives an “E” (no RXHDR or RXTRL is required). However, unlike the 05 option, the data is only transmitted once, when it changes. This is most useful for a stream of tags passing a fixed antenna where the sending of redundant data is not necessary and the tags being read have different data in the block of tag memory that was specified by the read command.

NOTE: Versions of RFR-02 firmware up to and including R02STD05.hex SII require the contents of two successive tags be different for the specified tag memory block to be read. If the contents are identical the first tag passing over the antenna will read while the second will not. Versions of firmware after R02STD05 do not require successive tags to have different data contents but need the “E” command to be sent between reads of different tags with the same data.

NOTE: There is a limit of 20 characters (a total of 5 blocks) in the data read from the tag for this command.

The example below will start reading at block 00 and will also read 4 additional blocks of data starting from the first block after 00, but will transmit the data only one time.

Example	ASCII	HEX
Command	R070004	52,30,37,30,30,30,34
Response	[,NUL,0,0,0,0,1,1,1,1,2,2,2,2,3,3,3,3,4,4,4,4,]	5B,00,30,30,30,30,31,31,31,31,32,32……34,5D

Response from above command when no tag is being read is shown below.

Note if no tag is in the antenna field there will be no data sent by the RFR-02, this helps reduce the amount of data that the host system needs to handle.

Example	ASCII	HEX
Command	R070004	52,30,37,30,30,30,34
Response	NA	NA

- **"S" Carrier Off (silence).**

  Response shown below from above command.

Example	ASCII	HEX
Command	S	53
Response	NA	NA

This turns off the RF carrier (unit's transmitter turned off). Note that the antenna does not need to be specified, even in dual antenna mode and there is no response back from the unit.

This can be useful after an Inventory command, since turning off the carrier will clear the "Quiet" mode of the tag.

- **"W" Write to tag.**

  There are two available options:

  - **Wa00bbdddd**

  Write data dddd to block bb. If in dual antenna mode (ANTENNA3), specify which antenna to use, "a"= 1 or 2

  Note that the data dddd is 4 binary bytes (each byte can have any value, 0x00 to 0xFF). While the examples in this document use ASCII characters for clarity, this is not a requirement.

  If the write is successful, the response will be TXHDR (if any), the antenna (if in dual antenna mode), "YW" (Yes Write), and TXTRL (if any).

  An unsuccessful write can reply with any of the following errors:

  NO TAG

  NO ANT

  COLL

  MISREAD

  NW<ISO flags>

  The first four are normal RFR-02 error messages, the fifth is based on the ISO Flag Byte, and probably represents trying to write to a locked block.

The example below will successfully write “ABCD” to block 05 of the tag.

Example	ASCII	HEX
Command	W0005ABCD	57,30,30,30,35,41,42,43,44
Response	[YW]	5B,59,57,5D

The example below will try and write “ABCD” to block 05 of the tag, but no tag will be present in the antenna’s field.

Example	ASCII	HEX
Command	W0005ABCD	57,30,30,30,35,41,42,43,44
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

The example below will try and write “ABCD” to block 05 of the tag, but this block will be locked. Note the character “^R” (0x12) is the ISO Flag Byte and in this instance tells you that the block has been locked, so it’s memory contents cannot be changed.

Example	ASCII	HEX
Command	W0005ABCD	57,30,30,30,35,41,42,43,44
Response	[NW,DC2(Non Printable)]	5B,4E,57,12,5D

- **Wa02bbuuuuuuuudddd**

Write data bytes dddd to block bb of tag with UID uuuuuuuu. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2.

Note that the data dddd is 4 binary bytes (each byte can have any value, 0x00 to 0xFF). While the examples in this document use ASCII characters for clarity, this is not a requirement.

Note that, since the UID is specified, the tag will respond even if it is in Quiet mode.

If the write is successful, the response will be TXHDR (if any), the antenna (if in dual antenna mode), “YW” (Yes Write), and TXTRL (if any).

An unsuccessful write can reply with any of the following errors:

NO TAG

NO ANT

COLL

MISREAD

NW<ISO flags>

The first four are normal RFR-02 error messages, the fifth is based on the ISO flagbyte, and probably represents trying to write to a locked block.

The example below will successfully write “ABCD” to block 05 of a tag with a UID of E0,07,00,00,06.A6,B8,0B. Note tag UID sent in reverse.

Example	ASCII	HEX
Command	W0205,(Tag UID omitted due to many ASCII NP characters),ABCD	57,30,32,30,35,0B,B8,A6,06,00,00,07,E0,41,42,43,44
Response	[YW]	5B,59,57,5D

The example below will try and write “ABCD” to block 05 of a tag with a UID of E0,07,00,00,06.A6,B8,0B, but no tag will be present in the antenna’s field. Note tag UID sent in reverse.

Example	ASCII	HEX
Command	W0205,(Tag UID omitted due to many ASCII NP characters),ABCD	57,30,32,30,35,0B,B8,A6,06,00,00,07,E0,41,42,43,44
Response	[NO TAG]	5B,4E,4F,20,54,41,47,5D

The example below will try and write “ABCD” to block 05 of a tag with a UID of E0,07,00,00,06.A6,B8,0B, but this block will be locked. Note tag UID sent in reverse.

Example	ASCII	HEX
Command	W0205,(Tag UID omitted due to many ASCII NP characters),ABCD	57,30,32,30,35,0B,B8,A6,06,00,00,07,E0,41,42,43,44
Response	[NW,DC2(Non Printable)]	5B,4E,57,12,5D

Serial Mode Read Rate Diagnostic Commands

- **Ra96bbnn**

  Read rate test. If in dual antenna mode (ANTENNA1 or ANTENNA3), specify which antenna to use, “a”= 1 or 2.

  This read rate test reads block bb and the next nn blocks 100 times, and counts the number of successful and unsuccessful reads.

  The example below will start reading at block 00 and will also read 9 additional blocks of data starting from the first block after 00.Each block will be read 100 times. The number of successful and unsuccessful reads if any will be displayed.

Example	**ASCII**	HEX
Command	R960009	52,39,36,30,30,30,39
Response	[VALID,SP,READS:SP, 100/100,SP(100.0%)SP ,SP CR,LF]	5B,56,41,4C,49,44,2052,45,41,44,53,3A,20, 31,30,30,2F,31,30,30,20,28,31,30,30,2E,30, 25,29,20,20,OD,OA,5D

Response from above command with no tag being read is shown below.

Example	**ASCII**	**HEX**
Command	R960009	52,39,36,30,30,30,39
Response	[VALID,SP,READS:SP, 0/100,SP,(0.0%)SP,SP 100,SP,NOTAGS,SP,S P,CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20 ,30,2F,31,30,30,20,28,30,2E,30,25,29,20,20 ,31,30,30,20,4E,4F,54,41,47,53,20,20,OD,O A,5D

Note SP is shown in the ASCII response to show where spaces are inserted within the response message; also note the CR and LF before the TXTRL.

If there are read errors, they will be reported along with the valid read information. For example, in single antenna mode

R960009

Might return

[VALID READS: 85/100 (85.0%) 4 NOTAGS 5 MISREADS 6 COLLISIONS]

Note that Ra960000 does the same test as Ra99 with extended result reporting.

- Ra97bb

  Read rate test. If in dual antenna mode (ANTENNA3), specify which antenna to use, specify which antenna to use, “a”= 1 or 2. This read rate test reads blocks 0 to bb 100 times each, and counts the number of successful and unsuccessful reads.

  The example below will read block 00 thru 09 100 times per each block with a tag in the antenna’s field. The number of successful and unsuccessful reads of the entire 1000 reads will be displayed.

Example	ASCII	HEX
Command	R9709	52,39,37,30,39
Response	[VALID,SP,READS:SP,1000/1000,SP(100.0%)SP,SP CR,LF]	5B,56,41,4C,49,44,2052,45,41,44,53,3A,20,31,30,30,30,2F,31,30,30,30,,20,28,31,30,30,2E,30,25,29,20,20,OD,OA,5D

Response from above command with no tag being read is shown below.

Example	ASCII	HEX
Command	R9709	52,39,37,30,39
Response	[VALID,SP,READS:SP,0/1000,SP,(0.0%)SP,SP1000,SP,NOTAGS,SP,SP,CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20,30,2F,31,30,30,30,20,28,30,2E,30,25,29,20,20,31,30,30,30,20,4E,4F,54,41,47,53,20,20,OD,OA,5D

Note the CR/LF before the TXTRL.

If there are read errors, they will be reported along with the valid read information.

Note that Ra9700 does the same testing as Ra99 with extended result reporting.

- Ra98bb

  Read rate test. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2. This read rate test reads block bb 100 times and counts the number of successful and unsuccessful reads.

  The example below will read block 09 100 times with a tag in the antenna’s field. The number of successful and unsuccessful reads will be displayed.

Example	ASCII	HEX
Command	R9809	52,39,38,30,39
Response	[VALID,SP,READS:SP,100/100,SP(100.0%)SP,SP CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20,31,30,30,2F,31,30,30,20,28,31,30,30,2E,30,25,29,20,20,OD,OA,5D

Response from above command with no tag being read is shown below.

Example	ASCII	HEX
Command	R9809	52,39,38,30,39
Response	[VALID,SP,READS:SP, 0/1000,SP,(0.0%)SP,S P 100,SP,NOTAGS,SP,S P,CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20 ,30,2F,31,30 30,20,28,30,2E,30,25,29,20,20,31,30,30,20, 4E,4F,54,41, 47,53,20,20,OD,OA,5D

Note the CR/LF before the TXTRL.

R9809

Might also return

[VALID READS: 88/100 (88.0%) 3 NOTAGS 4 MISREADS 5 COLLISIONS]

Note that Ra9800 does the same testing as Ra99 with extended result reporting.

- **Ra99**

  Read rate test. If in dual antenna mode (ANTENNA3), specify which antenna to use, “a”= 1 or 2. This read rate test reads block 0 100 times and counts the number of successful reads.

  The example below will read block 00 100 times with a tag in the antenna’s field. The number of successful reads will be displayed.

Example	ASCII	HEX
Command	R99	52,39,39
Response	[VALID,SP,READS:SP, 100/100,CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20 ,31,30,30,2F,31,30,OD,OA,5D

Response from above command with no tag being read is shown below.

Example	ASCII	HEX
Command	R99	52,39,39
Response	[VALID,SP,READS:SP, 0/100,CR,LF]	5B,56,41,4C,49,44,20,52,45,41,44,53,3A,20 ,30,2F,31,30,30,OD,OA,5D

Note the CR/LF but before the TXTRL.

If there are read errors, they are not reported.

Quick Reference Command Chart

Command	Antenna	Option	Block #	Additional Block	UID	Data
R	a	00	bb			
	a	01	bb	nn		
	a	02	bb		uuuuuuuu	
	a	03	bb	nn	uuuuuuuu	
	a	04	bb			
	a	05	bb	nn		
	a	06	bb			
	a	07	bb	nn (max 20 bytes)		
	a	96	bb	nn		
	a	97	bb			
	a	98	bb			
	a	99				
E						
L	a	00	bb			
	a	02	bb		uuuuuuuu	
W	a	00	bb			dddd
	a	02	bb		uuuuuuuu	dddd
Q	a				uuuuuuuu	
I	a					
O		01				
		02				
S						
A						

Using the RFR-02 Setup Program

Make sure the RFR-02 reader is mounted properly.

Attach a DB9 RS232 cable between the setup port of the RFR-02 reader and your PC's COMM port.

- Cable Wiring:
  - Pin 2 to 2
  - Pin 3 to 3
  - Pin 5 to 5

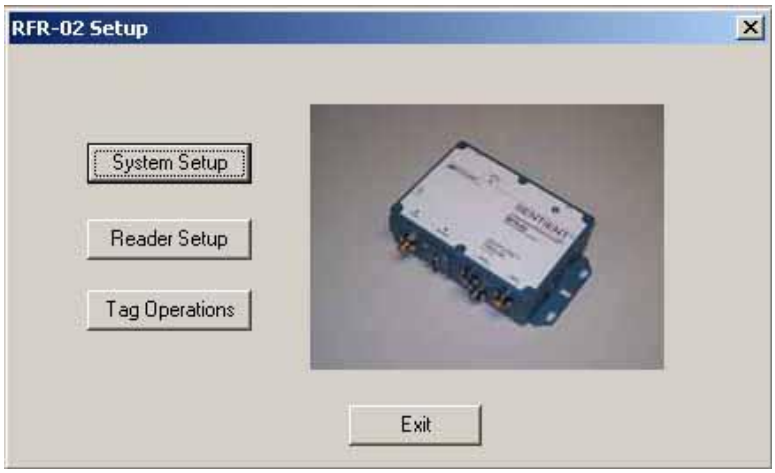
Power up the RFR-02 and the PC.

Using the Software

When the PC has booted, double click the RFR-02 Setup icon on the desktop.

NOTE: Be sure the RFR-02 has been powered on for at least 10 seconds before clicking on the Reader Setup or Tag Operations button!

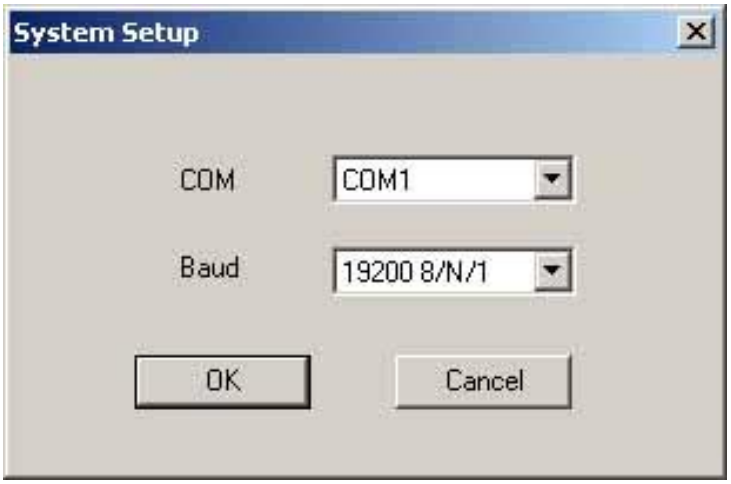
The window shown below will appear on the screen.



System Setup

Use the System Setup window to select a COM port to communicate with the RFR-02 Reader, as well as the baud rate to be used.

To get to the RFR-02 System Setup window, click **System Setup** on the RFR-02 Setup window.



The software defaults to COM1 and a baud rate of 19200 8/N/1. When the RFR-02 Reader is put into default mode, it will communicate at 19200 8/N/1.

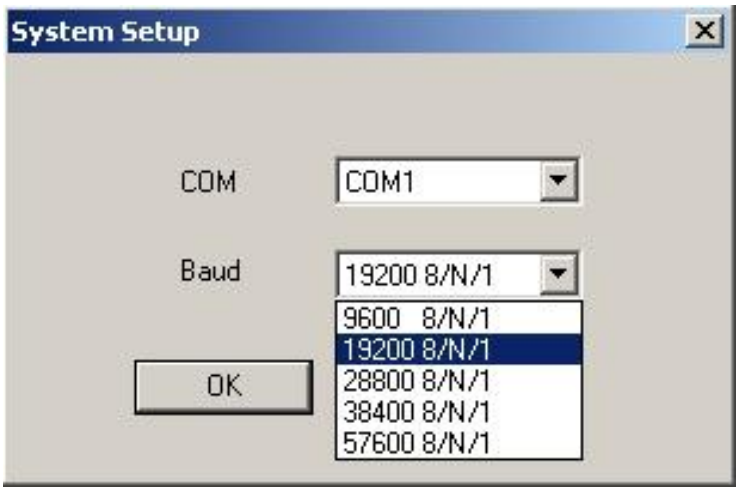
To change the COM port used:

1. Click on the **COM** dropdown list and choose a new port.

2. Click **OK**.

To change the baud rate:

1. Click on the **Baud** dropdown list and choose a new baud rate from those available.

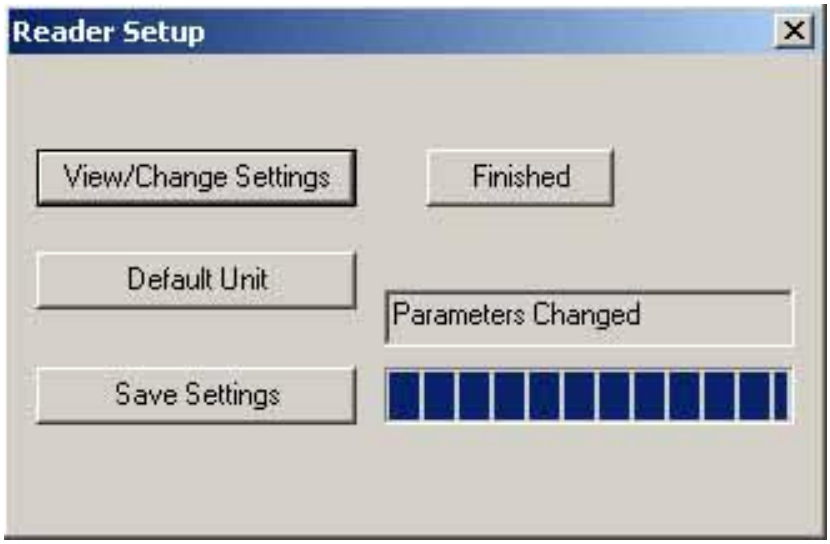


2. Click **OK**.

Reader Setup

Use the Reader Setup window to view or change setting and reset RFR-02 Reader defaults.

To get to the RFR-02 Reader Setup window, click **Reader Setup** on the RFR-02 Setup window.



NOTE: If any errors occur while opening this window, click **Finished** and make sure that the System Setup is correct.

To change the setup of the RFR-02 Reader:

Click **View/Change Settings**. A tabbed window will open that allows you to change all the parameters of the reader. The firmware version is displayed in the title bar. See *Setup Mode Parameters* in this manual for further details on the individual settings.

To return the RFR-02 to its factory default settings:

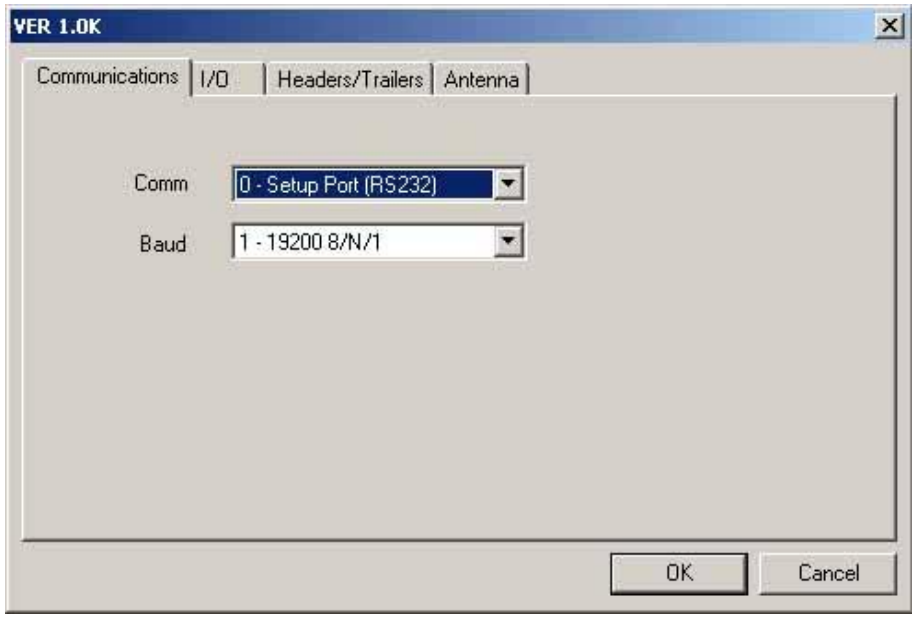
Click **Default Unit**.

To save the parameters inside the RFR-02 so that they will be used even after the unit has been reset:

Click **Save Settings**.

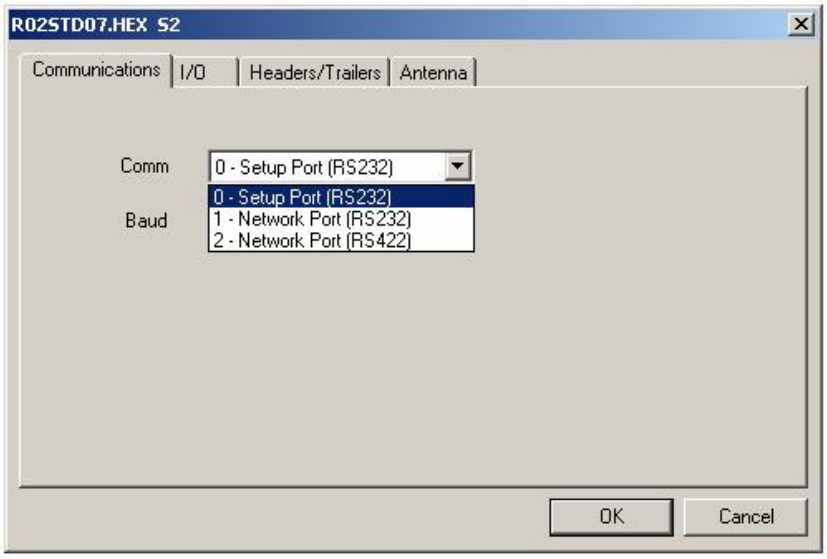
Communications Tab

The **Communications Tab** on the View/Change Settings (the firmware is displayed in the header) window allows the user to change the baud rate and communications port/protocol used by the reader.



To change the Com port used:

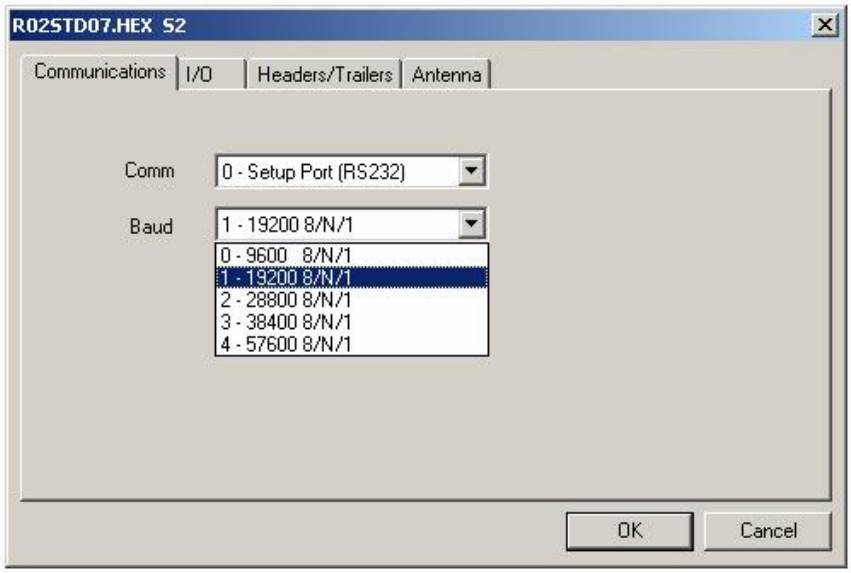
1. Click on the **Comm** dropdown list to choose a new port and protocol combination.



2. Click **OK**.

To change the Baud rate used:

1. Click on the **Baud** dropdown list and choose a new baud rate.

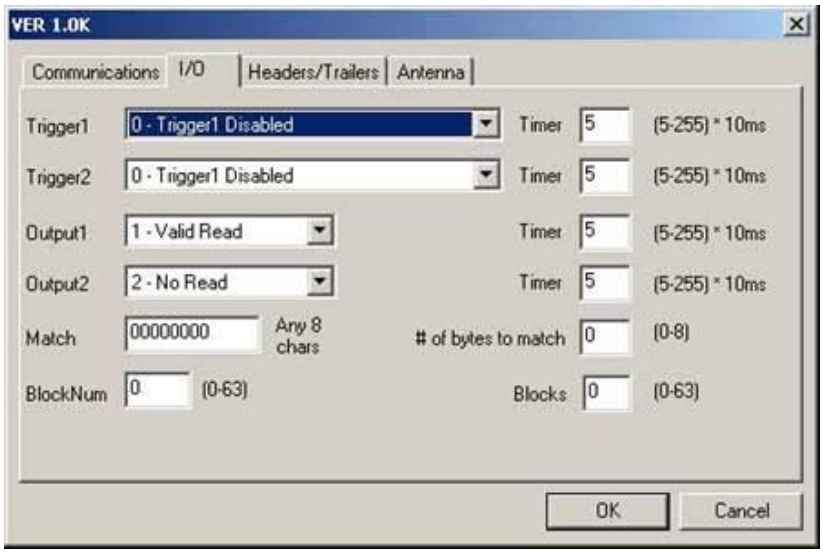


2. Click **OK**.

I/O Tab

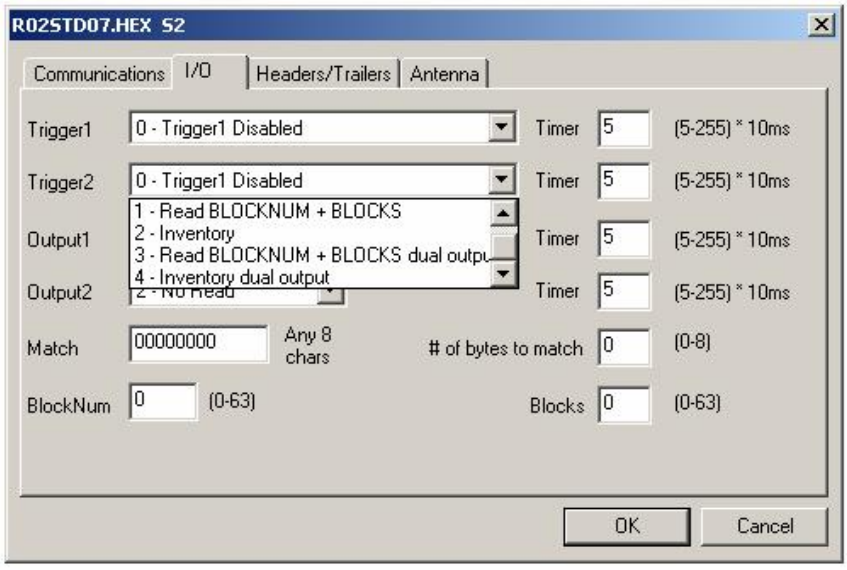
The **I/O Tab** on the View/Change Settings window allows the user to configure the **Triggers, Outputs,** and their respective timers. From this menu the user can also configure the **Match** string, **# of bytes to match, BlockNum** and **Blocks**.

NOTE: Be aware that the unit will not operate properly if BlockNum + Blocks is greater than 63!



To change trigger settings:

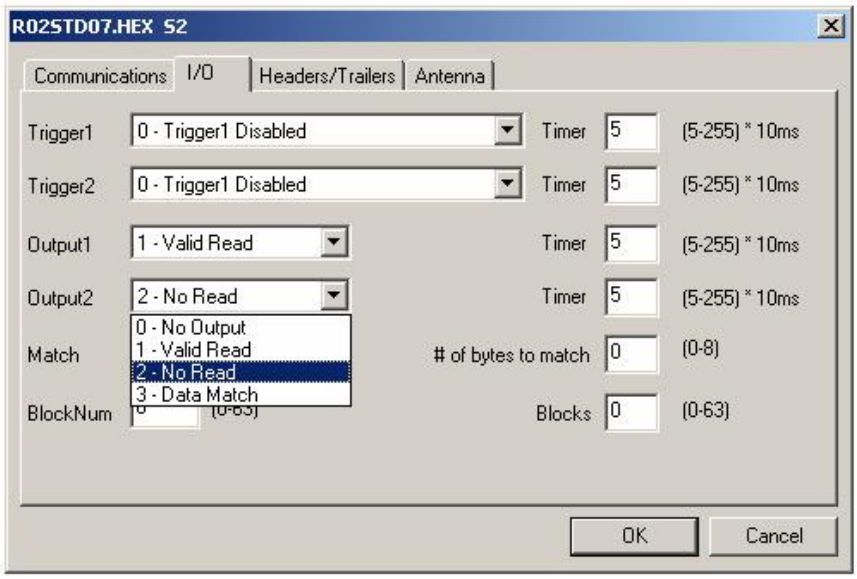
1. Click on the **Trigger1** or **Trigger2** dropdown list and choose a new setting. See *Setup Mode Parameters* in this manual for further details on the individual settings.



2. Click **OK**.

To change output settings:

1. Click on the **Output1** or **Output2** dropdown list and choose a new setting. See *Setup Mode Parameters* in this manual for further details on the individual settings.

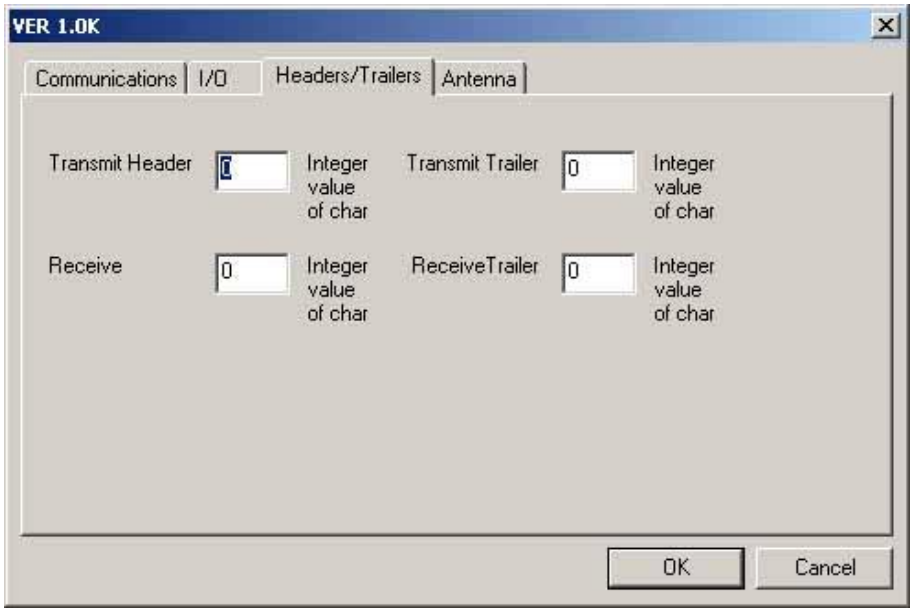


2. Click **OK**.

Change the **Match, BlockNum, # of bytes to match, Blocks,** and **Timer** field settings as needed. See *Setup Mode Parameters* in this manual for further details on the individual settings.

Headers/Trailers Tab

Use the Headers/Trailers Tab to configure transmit and receive headers and trailers used by the RFR-02. They are one character each maximum and must be entered as the decimal equivalent of the character. Consult an ASCII chart for the proper value *(See appendix A)*.

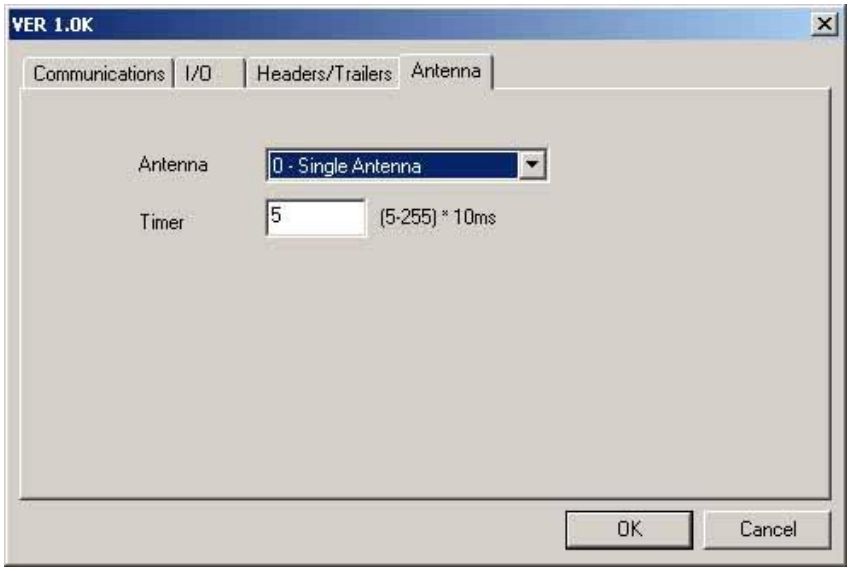


To change the Transmit Header, Transmit Trailer, Receive (Header), and Receive Trailer settings:

1. Input each field value as needed.
2. Click **OK**.

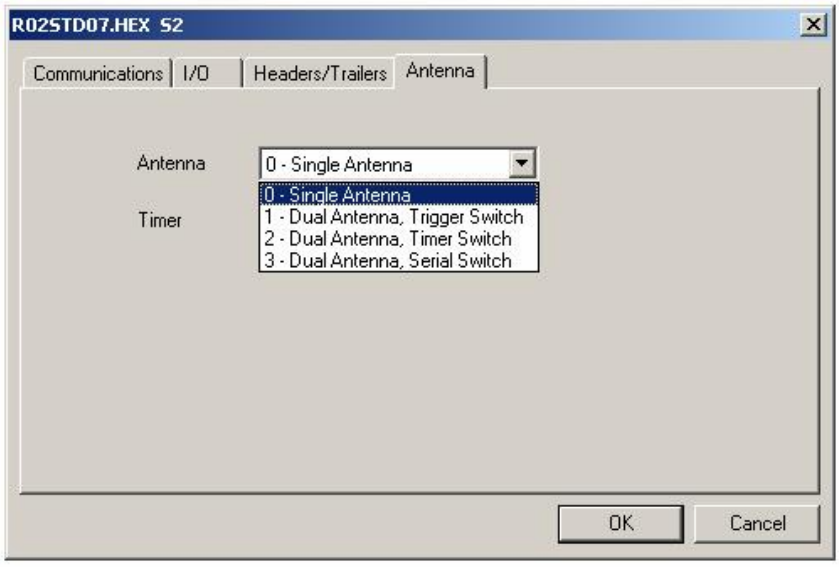
Antenna Tab

Use this tab to set the RFR-02 to operate in single or dual antenna mode, and the how it will switch between active antennas.



To adjust the antenna mode setting:

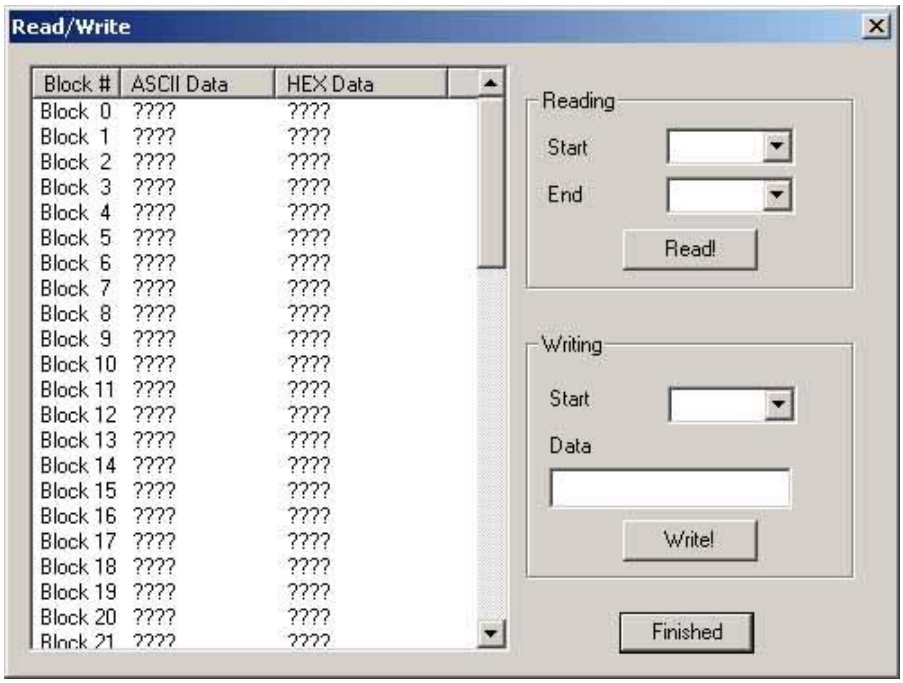
1. Click on the **Antenna** dropdown list and select the desired mode.



2. Enter a timer value as needed in the **Timer** field.
3. Click **OK.**

Tag Operation

This section of the program provides an interface to the tag data. The user can read from and write to a tag.



To read from the tag:

1. Select the block you wish to begin reading from the **Start** dropdown list located in the Reading group.
2. Select the last block you wish to read from the **End** dropdown list.
3. Click **Read** to read the data from the tag. If successful, the data will appear in the table on the left side of the window.

To write data to the tag:

1. Select the beginning block you want to write to from the **Start** dropdown list located in the Writing group.
2. Type the data you wish to write to the tag in the Data text field.
3. Click **Write** to send the data to the tag. If the write was successful, you should see the written data in the table on the left side of the window.

NOTE: The RFR-02 will write to as many blocks as necessary to fit the intended message. For example writing “1234567890” starting at block 00 will overwrite blocks 0-2.

Upgrading the RFR-02 Firmware

Before attempting to download new firmware to the RFR-02, it is a good idea to make a note of the current setup parameters. The parameters will return to default settings when the new code is installed.

To update the firmware follow these steps:

1. Attach a DB9 RS232 cable between the setup port of the reader and your PC's COMM port.

   Cable Wiring: Pin 2 to 2

   Pin 3 to 3

   Pin 5 to 5

2. Open the RFR-02 Setup program shown below.

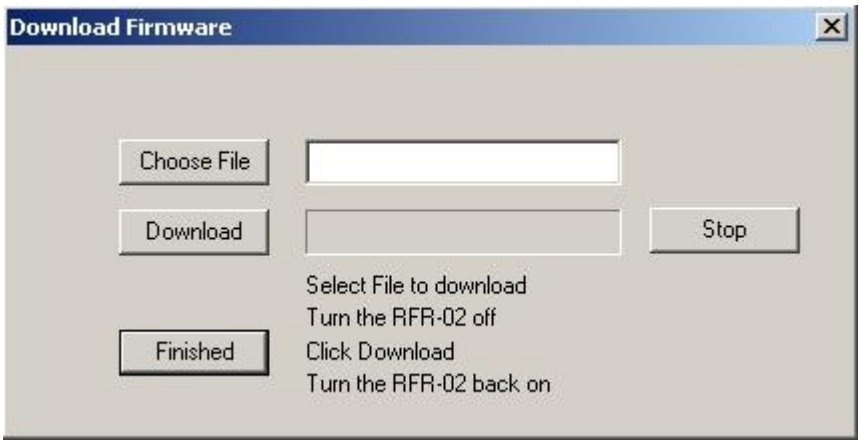
3. Click **System Setup** and confirm the following settings.

   - COMM: Set to Comm Port of your PC.
   - BAUD: 19200 N/8/1

   Click OK when complete.

4. Click **Update Firmware**.

5. From the resulting window, click **Choose File** and then browse for file you wish to download. An example of an update file name would be R02STDxx.hex.



6. Make sure the power to the RFR-02 is turned off.
7. Click **Download** and then immediately apply power to the RFR-02 unit, the status bar next to the Download button should start to increment. If it doesn't, click **Stop** and go back to step 6. Approximate download time is 2 minutes.
8. Click **OK** when Firmware Download Complete message appears.
9. Click **Finished** when you are done downloading units.

Timing for reading data from Tag

The following list of times is based upon an unaddressed read with no headers or trailers used. The times shown are total reader through put times and are based upon when the reader receives the first character of a command from a host to when the reader sends the last character of the requested data. All recorded times are with a stationary tag centered on the antenna.

COMM BAUD RATE →		**19200**	**38400**	**57600**
Command	**# of Blocks (bytes)**	**Time (ms)**	**Time (ms)**	**Time (ms)**
R0000	1 (4)	10	7	7
R010009	10 (40)	42	30	27
R010019	20 (80)	76	61	58
R010029	30 (120)	118	103	100
R010039	40 (160)	171	155	152
R010049	50 (200)	234	220	216
R010063	64 (256)	342	326	323

Timing for writing data to Tag

The following list of times is based upon an unaddressed read with no headers or trailers used. The times shown are total reader through put times and are based upon when the reader receives the first character of a command from a host to when the reader sends the last character of the YW response which indicates that data has been correctly written to the tag. All recorded times are with a stationary tag centered on the antenna. Please note that at the present time the ISO 15693 tag only supports the single block write command. For the timing needed to write multiple blocks of data multiply the time listed below by the number of blocks to write, remember to factor in any latency associated with the Host controller. The example below shows the command to write the ASCII data FFFF to block 01 of the tag.

COMM BAUD RATE →		**19200**	**38400**	**57600**
Command	# of Blocks (bytes)	Time (ms)	Time (ms)	Time (ms)
W0001FFFF	1 (4)	26	23	21

Troubleshooting

Reader not responding to serial commands:

1. Verify the power indicator is lit, if not apply power to the unit.
2. Verify the serial communications indicator flashes when a byte is sent
3. Check communications cabling.
4. Make sure unit is configured to work on the port and baud rate that you are using.
5. Verify you are using the correct headers and trailers and both Trigger settings are (0).

NOTE: See Setup mode of operation for further details on configuring unit.

Unable to read a Tag present in the field (Tag Comm indicator does not light):

1. Check antenna cabling.
2. Ensure the antenna is not near any metal surfaces or sources of EMI.
3. Check antenna indicator ensuring that it matches port connected to antenna.
4. Make sure protocol is correct for the tag type being used.
5. If using a terminal emulation program ensure that printable characters are programmed into tag.
6. Ensure that antenna is tuned properly using Complex Impedance Analyzer, Accu-Sort part #1000052875.
7. Ensure that tag is not being detuned by article that it is attached to. Items such as metal and conductive plastics that contain carbon will detune tag and reduce its performance. Items that are carried within article that tag is attached to may also lead to detuning of tag.

Reader does not respond to a trigger

1. Verify Trigger cabling is correct.
2. If using Non-Isolated inputs, be aware the trigger is active low and should be connected to an open collector type drive circuit. If using isolated inputs you must provide both positive and negative voltage connections.
3. Verify that the Trigger you are using is set up properly.
4. Verify Trigger signal is asserted for more than 10ms to overcome internal debounce.

Glossary

ACK - A control character sent to acknowledge that a transmission block has been received.

active/passive device - In 20mA current loop communications, a device capable of providing the current for the loop (active) and a device that draws the current from the equipment it is connected to (passive).

Active tag- An RFID tag that has a transmitter to send back information, rather than reflecting back a signal from the reader, as a passive tag does. Active tags generally use a battery to transmit a signal to a reader. However, some tags can gather energy from other sources.

address - A unique designation for the location of data or the identity of a smart device; allows each device on a single communications line to respond to its own message.

alphanumeric - The character set which contains letters, digits and other characters such as punctuation marks.

Amplitude- The maximum absolute value of a periodic curve measured along its vertical axis (the height of a wave, in layman's terms).

Amplitude modulation-. Changing the amplitude of a radio wave. A higher wave is interpreted as a 1 and a normal wave is interpreted as a zero. By changing the wave, the RFID tag can communicate a string of binary digits to the reader.

ANSI (American National Standards Institute) - The principle standards development group in the U.S. A non-profit, non-governmental group supported by over 1000 trade organizations, professional societies, and companies. Member body to the ISO (International Standards Organization).

Antenna- An RFID tag antenna is the conductive element that enables the tag to send and receive data. Passive, low- (135 kHz) and high-frequency (13.56 MHz) tags usually have a coiled antenna that couples with the coiled antenna of the reader to form a magnetic field. UHF tag antennas can be a variety of shapes. Readers also have antennas which are used to emit radio waves. The RF energy from the reader antenna is "harvested" by the antenna and used to power up the microchip, which then changes the electrical load on the antenna to reflect back its own signals.

Antenna gain- In technical terms, the gain is the ratio of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength at the same distance. Antenna gain is usually expressed in decibels and the higher the gain the more powerful the energy output. Antennas with higher gain will be able to read tags from farther away.

ASCII (American Standard Code for Information Interchange) - Pronounced ask-ee. A seven bit plus parity code established by ANSI to achieve compatibility between data services.

asynchronous transmission - Transmission in which the time intervals between transmitted characters may be of unequal length. Transmission is controlled by start and stop bits at the beginning and end of each character.

baud rate - A unit used to measure communications speed or data transfer rate; represents the number of discrete conditions or events per second.

BCC (Block Check Character) - Used to check transmission accuracy, a character transmitted by the sender after each message block and compared with a block check character computed by the receiver.

bed width - The width of the conveyor bed measured in inches.

BEL - A control character that is used when there is a need to call for attention; it may control alarm or attention devices.

belt width - The width of the conveyor belt measured in inches.

bit (binary digit) - The contraction of binary digit, the smallest unit of information in the binary system; a one or zero condition.

bottom read - When the antenna or scanner is mounted under the conveyor to read codes on the bottom of the boxes or on the front or back of the boxes. If used there is not enough clearance for a standard front or back read.

BPS (Bits per Second) - Unit of data transmission rate. See baud rate.

bridge - An interface between links in a communication network that routes messages from one link to another when a station on one link addresses a message to a station on another link.

buffer - A temporary storage device used to compensate for a difference in data rate and data flow between two devices (typically M).

bus - An internal pathway along which electronic signals travel between the components of an electronic device.

button - A graphic user interface component that allows users to select a given software function. Instead of physically pressing a button, the user simply clicks on the desired button to access a menu, tab screen, or function.

byte - A binary element string functioning as a unit, usually shorter than a computer "word." Eight-bit bytes are most common. Also called a "character."

capture count - The number of consecutive identical valid decodes that result in a valid read.

cart - A signal, typically provided by a photoeye or proximity switch, that informs the scan head of the presence of an object within its reading zone. Also called trigger.

communications protocol - The rules governing exchange of information between devices connected together on the same communications line.

configuration - The arrangement and interconnection of hardware components within a system, and the hardware (switch and jumper) and software selections that determine the operating characteristics of the system.

configuration file - The set of attributes which belongs to and defines the operation of a single physical device.

conveyor speed - The speed that the conveyor is moving measured in feet per minute. Conveyor speed directly impacts the time that the code is in front of the scanner; therefore, it affects the number of reads that are possible.

CR (Carriage Return) - An ASCII or EBCDIC control character that moves the cursor or print mechanism to the left margin.

CTS (Clear to Send) - The modem interface signal that indicates to the DTE device to begin transmission.

current loop - Method of interconnecting terminals and transmitting signals, whereby a mark (binary 1) is represented by current on the line and a space (binary 0) is represented by the absence of current.

decoder - As part of an reading system, the electronic package which receives the signals from the reader, performs the algorithm to interpret the signals into meaningful data and provides the interface to other devices.

decoder logic - The electronic package that receives signals from the reader, interprets the signals into useful data, and provides the interface to other devices.

default(s) - Original parameters as programmed by Accu-Sort at the factory.

depth of field - The distance between the maximum and minimum plane in which a tag can be read.

DIP switches - Switches that are the approximate size of an integrated circuit.

downloading - The process of sending configuration parameters, operating software or related data from a central source to remote stations.

drop-down list, menu - A graphical user interface component that allows the user to select from a list of options that are displayed when a specific function has been selected. This options list drops down from the selected function.

DSR (Data Set Ready) - An RS232 modem interface control signal which indicates that the terminal is ready for transmission.

DTR (Data Terminal Ready) - Modem interface signal which alerts the modem that the DTE device is ready for transmission.

duplex transmission - See full and half duplex.

EDI (Electronic Data Interchange) - A method by which data is electronically transmitted from one point to another.

EIA-232 - Interface between data terminal equipment and data communication equipment employing serial binary data interchange.

EIA-422 - Electrical characteristics of balanced-voltage digital interface circuits.

EIA-485 - The recommended standard of the Electronic Industry Association that specifies the electrical characters of generators and receivers for use in balanced digital multi-point systems.

ENQ (Enquiry) - A transmission control character used as a request for a response from a remote station. (^E)

error - A discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition.

ESC (Escape) - A control character which is used to provide additional control functions. It alters the meaning of a limited number of continuously following bit combinations. (^[)

ETX (End of Text) - A transmission control character that terminates a text.

even parity - A data verification method in which each character must have an even number of on bits.

expansion bus - Allows the microprocessor to communicate with controllers for peripheral devices, such as a network card or an internal modem.

far distance - The distance (in inches) from the face of the scanner to the farthest point at which a code can be successfully read.

feet per minute (FPM) - Typically used to define the speed of a conveyor. Conveyor speed may also be defined in meters per second.

flying lead - A lead that exits the back of the connector hood on the outside of the cable jacket. It is normally attached to the drain wire or shield and connected to the chassis of the switch, modem, etc. It can also be a hardware control lead.

Frequency- The number of times a signal executes a complete cycle through its maximum and minimum values and returns to the same value.

full duplex (FDX) - Simultaneous, two-way, independent transmission in both directions.

gateway - A device used to connect networks using different protocols so that information can be passed from one system or network to the other(s).

gateway address - Like all other devices on a network, the device serving as the gateway must also have an IP address so that devices wishing to communicate with devices outside its own network can fine the gateway which will forward its data. Like all other addresses, it is displayed in the dotted-decimal format.

half duplex (HDX) - Transmission in either direction, but not simultaneous.

handshaking - Exchange of predetermined signals between two devices establishing a connection. Usually part of a communications protocol.

hardware cart - This is an electrical signal from a relay, photoeye, or proximity switch indicating that an object is passing by the scanner.

Harvesting- A term sometimes used to describe the way passive tags gather energy from an RFID reader's antenna.

header - A means of identifying the beginning of a message to be sent to the host. One example is <STX> or Start of Text.

hexadecimal - A base-16 numbering system that uses the symbols 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.

High-frequency- From 3 MHz to 30 MHz. High-frequency RFID tags typically operate at 13.56 MHz and can be read from less than 3 feet away and transmit data faster than low-frequency tags. But they consume more power than low-frequency tags.

host - 1) A central controlling computer in a network system. 2) Any device on a network system that provides a controlling function to another device on the network. 3) Any intelligent device for which another device is providing a communication interface to a network.

induct photoeye - The cart cycle begins when the start of cart photoeye is blocked and continues until the cart photoeye is unblocked. Blocking the induct photoeye causes relay decisions and data communication. For this placement the distance between the cart and induct photoeyes must be less than the minimum box size plus the minimum box spacing.

Inlay- An RFID microchip attached to an antenna and mounted on a substrate. Inlays are essentially unfinished RFID labels.

input/output modules - Since many readers are operating in environments that have electrical noise problems, it is helpful to have equipment electrically isolated from other equipment. The standard method for isolating inputs and outputs is through the use of optically isolated input/output modules. These flexible modules allow the reader to control high voltage outputs that are susceptible to noise. Since they are isolated from each other the noise is not picked up in the scanner. The modules come in both input and output versions. The output versions are controlled by a 5VDC input. The output of the modules can range from 24VAC - 140VAC or 3VDC - 200VDC. Foreign voltage ranges are available. The maximum current that the modules can supply is limited by the output voltage and the module type. The input versions are controlled by either a DC or AC input ranging from 3VDC - 32VDC or 90VAC - 140VAC. Foreign voltage ranges are available. The output of the modules is a 5VDC level. The maximum current is limited by the input modules. These output modules are commonly used to control diverters, alarms, external relays, etc. The input modules can be used for photoeye inputs.

interface - A shared boundary defined by common physical interconnection characteristics, signal characteristics and meanings of interchanged signals.

I/O - The abbreviation for input/output. The keyboard and a printer, are examples of I/O devices. I/O activity is different from computational activity. When a program sends a document to the printer, it is engaging in I/O activity; when the program sorts a list of terms, it is engaging in computational activity.

IP (internet protocol) address - IP address is the numeric address given to a network card which enables other devices on a network to find it. For readability, this number is displayed in dotted-decimal format (e.g. 127.0.0.1) as opposed to the binary equivalent (e.g. 01111111000000000000000000000001).

jumper - A wire that connects a number of pins on one end of a cable only, such as looping back Request to Send from Clear to Send pins 4 and 5.

LAN - The acronym for local area network. A LAN system is usually confined to the same building or a few nearby buildings, with all equipment linked by wiring dedicated specifically to the LAN.

LCD (Liquid Crystal Display) - A low-power display often used for notebook computers. An LCD consists of a liquid crystal solution between two sheets of polarizing material. An electric current causes each crystal to act like a shutter that can open to allow light past or close to block the light.

LED (Light Emitting Diode) - A semiconductor generally made from gallium arsenide, that can serve as a visible or near infrared light source when voltage is applied continuously or in pulses. LEDs have extremely long lifetimes when properly operated.

LF (Line Feed) - An ASCII control character that moves the cursor or print mechanism to the next line. (^J)

light curtain - A sensing device connected to a system that uses a series of transmitters and receivers to create a curtain of light that is both 90 degrees and perpendicular to the conveyors direction of travel. This device is used by the system to detect either the presence and/or the height of packages as they enter the cameras scanning area.

Low-frequency- From 30 kHz to 300 kHz. Low-frequency RFID tags typical operate at 125 kHz or 134 kHz. The main disadvantages of low-frequency tags are they have to be read from within three feet and the rate of data transfer is slow.

mA - The abbreviation for milliampere(s).

match - A condition in which decoded data matches data in the match entry.

match entry - An output condition in which decoded data matches and the data in a match entry configuration.

memory - A computer can contain several different forms of memory, such as RAM, ROM, and video memory. The term memory is generally used to define RAM. When a computer has 512 MB of memory, it actually has 512 MB of RAM.

memory address - A specific location, usually expressed as a hexadecimal number, in the computers RAM.

message - 1) A meaningful combination of alphanumeric characters that establishes the content and format of a report. 2) In a communication network, the unit of exchange at the application layer.

message buffer - Storage register for the temporary storage of data that allows decoding to continue while the host is retrieving data from the serial port.

message buffer warning - An output condition that occurs when the message buffer has used a defined amount of the message buffer.

MHz - The abbreviation for megahertz.

microprocessor - The primary computational chip inside the computer, referred to as the "brain." The microprocessor contains an arithmetic processing unit and a control unit. Software written for one microprocessor must usually be revised to run on another microprocessor.

mil - One thousandth of an inch (0.001 inch). Bars and spaces of codes are commonly referred to as being a certain number of mils wide.

modulo check digit or character - A calculated character within a data field used for error detection. The calculated character is determined by a modulus calculation on the sum or the weighted sum of the data field contents.

mouse - A pointing device that controls the movement of the cursor on a screen. Mouse-aware software allows the user to activate commands by clicking a mouse button while pointing at objects displayed on the screen.

MTBF - The abbreviation for mean time between failures.

multidrop line - A single communications circuit that interconnects many stations, each of which contains terminal devices. See EIA-485.

NAK (Negative Acknowledgment) - A control character used to indicate that the previous transmission block was in error and the receiver is ready to accept retransmissions.

NCDRH (National Center for Devices and Radiological Health) - This organization (a service of the Food and Drug Administration) is responsible for the safety regulations governing acceptable limitations on electronic radiation from laser devices. Accu-Sort is in compliance with the NCDRH regulations.

NEMA - In order to rate the quality of an enclosure the National Electrical Manufacturers Association (NEMA) has developed a system for rating all enclosures. A partial list of the NEMA enclosures is shown below along with what particles it is designed to restrict.

Ratings

3 - Enclosures are intended for indoor or outdoor use primarily to provide protection against windblown dust, rain, and sleet, and is undamaged by the formation of ice on the enclosure.

4 - Enclosures are intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure.

4X - Enclosures are intended for indoor or outdoor use primarily to provide protection against corrosion windblown dust and rain, splashing water, and hose directed water; undamaged by the formation of ice on the enclosure.

6 - Enclosures are intended for use indoors or outdoors where occasional submersion is encountered.

12 - Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping noncorrosive liquids.

13 - Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, noncorrosive coolant.

net mask - A numeric value that is used by devices to determine whether the device it wishes to communicate with is on the same network. If not, the data must be forwarded via a gateway. May also be referred to as subnet mask.

network - A series of stations (nodes) connected by some type of communication medium. A network may be made up of a single link or multiple links.

node - The connection point at which media access is provided.

noise- Unwanted electrical signals or electromagnetic energy found in the operating environment of RFID equipment. Noise can be caused by other RF devices, electric motors and other machines.

no-match - An output condition in which decoded data does not match an entry in the match code table.

no-read - When the reader is unable to capture a code as it passes through the scan zone.

non-read - The absence of data at the scanner or camera output after an attempted scan due to no code, defective code, scanner failure or operator error.

NVC - The acronym for non-valid code. Defines the condition that occurs when an object has been scanned and no bar code could be decoded. Usually, this indicates that either no code was on the object or the code was badly damaged and could not be decoded.

odd parity - A data verification method in which each character must have an odd number of on bits.

optimum reading distance - Typically, the center of the depth of field.

output counter - A counter that is associated with each output condition. The counter increments by 1 each time the condition occurs.

trigger or cart - The standard abbreviation for a signal indicating that an object is passing by the reader is called cart. This signal indicates to the reader to start or stop reading.

trigger or cart cycle - The time during which the reader is attempting to read the bar code.

hardware cart - This is an electrical signal from a relay, photoeye, or proximity switch indicating that an object is passing by the scanner.

start and end of cart photoeyes - The cart cycle begins when the start of cart photoeye is blocked and continues until the end of cart photoeye is unblocked. Relay decisions and data communication take place after the end of cart photoeye is unbroken.

induct photoeyes - The cart cycle begins when the start of cart photoeye is blocked and continues until the cart photoeye is unblocked. Blocking the induct photoeye causes relay decisions and data communication. For this placement the distance between the cart and induct photoeyes must be less than the minimum box size plus the minimum box spacing.

software cart - A serial message from an external device that controls the cart cycle.

self cart - This form of cart requires no input signal. The scanner is continuously attempting to decode bar codes. When a scanner is in self cart, there is no way of determining if there is a package present or a no-read.

package spacing - This is the spacing between items on a conveyor. Package spacing is measured one of two ways: Leading edge of one box to leading edge of the next or trailing edge of one box to trailing edge of the next. Package spacing is critical to system operations.

parameter - A value or opinion that the user specifies to a program. A parameter is sometimes called a switch or an argument.

parity bit - A bit that is set at "0" or "1" in a character to ensure that the total number of 1 bits in the data field is even or odd.

percent good reads - The number of successful reads per refresh period. This is valid only when the refresh period is set to 0.

peripheral device - An internal or external device, such as a printer, a disk drive, or a keyboard, connected to a computer.

photoeye - Used as a presence detector to identify objects in the scanners reading zone. The photoeye emits a beam and is used with a reflector to create a photoelectric circuit. When the beam is blocked by an object, breaking the circuit, a signal called CART is sent to the scanner.

polling - A means of controlling devices on a multipoint line.

Programming a tag- Writing data to an RFID tag.

protocol - A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.

pulses per inch (PPI) - Defines the number of pulses per inch of transport travel as provided by the tachometer.

pulse width - A change from the leading edge of a bar or space to the trailing edge of a bar or space over time. Pulse width is also referred to as a transition.

queue - A buffer used to hold data in order until it is used or transmitted.

radio frequency (RF) - Non-optical automatic identification devices that use radio waves to transmit data.

Radio Frequency Identification (RFID)- A method of identifying unique items using radio waves. Typically, a reader communicates with a tag, which holds digital information in a microchip.

reader- A device used to communicate with RFID tags. The reader has one or more antennas, which emit radio waves and receive signals back from the tag.

reader field- The area of coverage. Tags outside the reader field do not receive radio waves and can't be read.

read-only - A read-only file is one that users are prohibited from editing or deleting. A file can have read-only status if:

Its read-only attribute is enabled.

It resides on a physically write-protected diskette.

It is located on a network in a directory to which the system administrator has assigned read-only rights to the user.

read range- The distance from which a reader can communicate with a tag.

read rate- The number of tags that can be read within a given period.

relay - Relays are simply electrical switches that are typically used to control external diverts, alarms, etc. Relay types available are FORM A and FORM C. FORM C type relays have both normally open and normally closed contacts available while FORM A type relays have only normally open contacts available.

relay output duration - This is the time (in seconds) after the relay is energized that it should be turned off.

relay output delay - The time lapse between an event and the energizing of the relay.

resolution - The narrowest element dimension which can be distinguished by a particular reading device or printed with a particular device or method.

response time - The elapsed time between the generation of the last character of a message at a terminal and the receipt of the first character of the reply. It includes terminal delay and network delay.

RFID tag- A microchip attached to an antenna that is packaged in a way that it can be applied to an object. The tag picks up signals from and sends signals to a reader. The tag contains a unique serial number, but may have other information, such as a customers' account number.

ROM - The acronym for read-only memory. The computer contains programs essential to its operation in ROM. A ROM chip retains its contents even after the computer is turned off.

RPM - The abbreviation for revolutions per minute.

RS232 - Interface between data terminal equipment and data communication equipment employing serial binary data interchange.

RS422 - The Electronic Industries Association standard that specifies the electrical characteristics of balanced voltage digital interface circuits.

RS485 - The Electronic Industries Association standard that specifies the electrical characters of generators and receivers for use in balanced digital multipoint systems.

RTS (Request To Send) - An RS232 modem interface signal which indicates that the DTE has data to transmit.

SCSI - The acronym for small computer system interface. An I/O but interface with faster data transmission rates than standard ports. Up to seven devices can be connected to one SCSI interface.

self cart - This form of cart requires no input signal. The scanner is continuously attempting to decode bar codes. When a scanner is in self cart, there is no way of determining if there is a package present or a no-read.

sensor - A device that detects or measures something and generates a corresponding electrical signal to an input circuit of a controller.

serial port - An I/O port used most often to connect a modem or a mouse to your computer, identifiable by its 9-pin connector.

serial transmission - The most common transmission mode; serial, information bits are sent sequentially on a single data channel.

serial asynchronous transmission of data - The following are common communications interfaces: RS232, RS422, RS485, 20mA current loop and RS423.

When data is transmitted serially from a communications port, the information is transferred between the two devices one data bit at a time. The data flow can follow one of three different communications modes: simplex, half duplex, or full duplex. Each character of data within the data flow is transported in a binary bit frame called the asynchronous data frame.

The start bit begins each frame. A low voltage signal on the data communications line marks the beginning of the start bit, at which point the receiving device begins looking for binary zeros and ones (0s and 1s). The following five to eight data bits (the number depends on the format used) comprise the binary character. For error detection, an optional parity bit can define whether the total number of zeros or ones was even or odd.

There are five different parity selections:

- ODD - last data bit is a logical 0 if the total number of logical 1s in the first seven data bits is odd.
- EVEN - last data bit is a logical 0 if the total number of logical 1s in the first seven data bits is even.
- MARK - last data bit is always a logical 1 (i.e.: high/mark).
- SPACE> - last data bit is always a logical 0 (i.e.: low/space).
- OFF (NONE) - last data bit is not present.

The method used to catch errors by using parity bits is as follows: When the transmitter frames a character, it tallies the number of 0s and 1s within the frame and attaches a parity bit. (The

parity bit varies according to whether the total is even or odd.) The receiving end then counts the 0s and 1s and compares the total to the odd or even recorded by the parity bit. If a discrepancy is noticed by the receiving end, it can flag the error and request a retransmission of the data.

A stop bit is used to signal the end of the character. Stop bits are typically one or two bits in length. The slower the transmission speed, the more stop bits required for recognition of the end of the data frame.

In addition to the direction of data flow and the data framing, there are other considerations to insure uniform transmissions. Certain operating parameters must be followed to prevent the loss of valuable data.

The first consideration is the speed of transmission, known as baud rate. Serial data transmission is measured in bits per second (BPS). The baud rate selections available for the 6000 are: 110, 300, 1200, 2400, 4800, 9600 and 19200. To enable two devices to interact, they must both be transmitting/receiving data at the same baud rate. If it is not possible to do this, there must be a buffer (typically additional storage memory) that accommodates the differences in communications speed.

Many serial communications links also use a flow control system to handle data transmission in addition to memory buffers.

X-ON/X-OFF Protocol
A common type of flow control is the X-ON/X-OFF protocol. When a receive buffer nears its memory capacity, the receiving device sends an ASCII X-OFF signal to the transmitting device, telling it to stop sending data. When the memory buffer has enough space to handle more data, the X-ON signal is sent to the transmitting device, telling it to start sending data again.

ACK/NAK Protocol device transmits a message to the host, the host responds with either an ACK (06H) or a NAK (15H). If the host transmits an ACK to the device, the device deletes its transmit message and the communication sequence is complete. If the host transmits a NAK, the device will retransmit. The device resends data a maximum of three times. Optionally this may be changed to 1, 2, 3, or infinite retransmits by the user. If the device receives a fourth NAK, it will delete the data in its transmit buffer and display "MAX REXMITS."

A transmitting device ignores ACK and NAK characters received during data transmission. If, for example, a device receives a NAK during a data transmission, it will not resend the data at the completion of the transmission.

The device also has a retransmit timer. This timer is activated each time the device transmits data to the host. If the timer runs for two seconds (this is also changeable) and the device does not receive an ACK or NAK from the host, a timeout occurs and the device retransmits its data. Each time the device retransmits because of a timeout, it treats the timeout the same as receiving a NAK from the host computer. If the device does not receive an ACK before the end of the fourth timeout, it will delete the data in its transmit buffer and display "MAX REXMITS." The device deletes data in its transmit buffer and displays the error message when any combination of four timeouts and NAKs from the host occurs.

When the device receives a message from the host, it calculates the BCC for the message and compares the calculated BCC to the received BCC. If the two values match, the device transmits an ACK, ending the communication. If the values do not match, the device transmits a NAK to the host and waits for the host to retransmit the message. The host, like the device, should retransmit a maximum of three times.

The sequence number starts at zero (30H) and is incremented each time a device transmits a new message. When the sequence number reaches nine (39H), it wraps around to one (31H). If

the sequence number skips a number, the receiving device knows that a message was lost. If the same sequence number is received on two sequential messages, the second message is responded to with an ACK or NAK (as appropriate) and ignored.

shielding - Protective covering that eliminates electromagnetic and radio frequency interference.

side read - The scanner/antenna is mounted to read the side of a box as it passes by the head.

signal - An impulse or fluctuating electrical quantity (i.e.: a voltage or current) the variations of which represent changes in information.

Singulation- A means by which an RFID reader identifies a tag with a specific serial number from a number of tags in its field.

slider bar - A graphical user interface that enables the user to select an ascending/descending value for a definable parameter by clicking on the slider bar and then sliding (via the mouse) until the desired value is shown.

software cart - A serial message from an external device that controls the cart cycle.

spot - The undesirable presence of an area of low reflectance in a space. start and stop characters

start and end of cart photoeyes - The cart cycle begins when the start of cart photoeye is blocked and continues until the end of cart photoeye is unblocked. Relay decisions and data communication take place after the end of cart photoeye is unbroken.

start bit - In asynchronous transmission, the first bit or element in each character, normally a space, that prepares the receiving equipment for the reception and registration of the character.

stop bit - The last bit in an asynchronous transmission, used to indicate the end of a character, normally a mark condition, that serves to return the line to its idle or rest state.

STX (Start of Text) - A transmission control character that precedes a text and is used to terminate a heading. (^B)

syntax - The rules that dictate how the user must type a command or instruction so that the computer will understand it.

system.ini file - When the user starts Windows, it consults the system.ini file to determine a variety of options for the Windows operating environment. Among other things, the system.ini file records which video, mouse, and keyboard drivers are installed for Windows. Running the Control Panel or Windows Setup program may change options in the system.ini file.

tachometer (tach) - Hardware device used to provide conveyor speed information to the scanner or camera in x pulses per inch.

tag - A collection of information associated with a single variable or I/O point.

tap(s) - Taps (or channels) refer to the number of data paths out of the linear CCD sensor. A linear CCD sensor consists of a line of light-sensitive areas. The charge collected in all these areas is shifted to a parallel array of non-light sensitive holding areas all at once. The charges are then shifted along the second set of areas in a bucket brigade fashion with the last areas charge being shifted off the sensor entirely (for further processing). This holding area does not have to all be shifted out of a single port the holding line may be broken into several sections, each with its own exit from the sensor. Each exit is called a tap or channel. Generally, the more taps the more quickly the image data may be shifted out of the sensor. Current camera configurations offer either 2 or 4 taps. Tap Frequency (MHz) is the clock rate at which pixels are shifted out of the CCD sensor.

TCP/IP - An industry standard suite of protocols providing communications in a heterogeneous network environment. TCP/IP stands for Transport Control Protocol/Internet Protocol.

terminal program - Computer software that sends, receives, and displays serial data.

tracking - Process of keeping track of packages as they travel through the scanning area. Tracking can be done based on the leading edge or trailing edge of packages. Belt speed (as monitored via the tachometer signal) and camera mounting also figure into the tracking process.

trailer - A means of identifying the end of a message sent to the host. One example is <ETX> or End of Text.

transceiver- A device that both transmits and receives radio waves.

transmit point - The time it takes to transmit the decoded results from the time the object is first sensed (by photoeye or light curtain) until the completion of transmission to the host. Transmit point is shorter (faster) for cameras because it is not required to accommodate a scanning pattern length.

Transponder- A radio transmitter-receiver that is activated when it receives a predetermined signal.

trigger - A signal, typically provided by a photoeye or proximity switch, that informs the scan head of the presence of an object within its reading zone. Also called cart.

trigger or cart cycle - The time during which the scanner is attempting to read the bar code.

ultra-high frequency (UHF)- From 300 MHz to 3 Ghz. Typically, RFID tags that operate between 866 MHz to 960 MHz.

Uniform Code Council (UCC)- The nonprofit organization that overseas the Uniform Product Code, the barcode standard used in North America.

Unique Identifier (UID)- A serial number that identifies the transponder. The U.S. Department of Defense has also developed an identification scheme called UID.

UPS - The abbreviation for uninterruptible power supply. A battery-powered unit that automatically supplies power to your computer in the event of an electrical failure.

utility - A program used to manage system resources including memory, disk drives, and printers.

wedge - A device that plugs in between a keyboard and a terminal. It allows data to be entered either by keyboard or by various types of scanners.

word - A unit of data which contains two bytes (16 bits).

write-protected - Read-only files are said to be write-protected. The user can write-protect a 3.5-inch diskette by sliding its write-protect tab to the open position and a 5.25-inch diskette by placing an adhesive label over its write-protect notch.

XON - A control character sent by the receiving device to signal the transmitting device to begin sending data.

XOFF - A control character sent by the receiving device to signal the transmitting device to stop sending data.

Appendix A: ASCII Chart

HEXADECIMAL & DECIMAL CHARACTER ASCII TABLE

DEC	HEX	ASCII		DEC	HEX	ASCII	DEC	HEX	ASCII	DEC	HEX	ASCII
000	**00**	^@	NUL	**032**	**20**	SPC	**064**	**40**	@	**096**	**60**	'
001	**01**	^A	SOH	**033**	**21**	!	**065**	**41**	A	**097**	**61**	a
002	**02**	^B	STX	**034**	**22**	"	**066**	**42**	B	**098**	**62**	b
003	**03**	^C	ETX	**035**	**23**	#	**067**	**43**	C	**099**	**63**	c
004	**04**	^D	EOT	**036**	**24**	$	**068**	**44**	D	**100**	**64**	d
005	**05**	^E	ENQ	**037**	**25**	%	**069**	**45**	E	**101**	**65**	e
006	**06**	^F	ACK	**038**	**26**	&	**070**	**46**	F	**102**	**66**	f
007	**07**	^G	BEL	**039**	**27**	'	**071**	**47**	G	**103**	**67**	g
008	**08**	^H	BS	**040**	**28**	(	**072**	**48**	H	**104**	**68**	h
009	**09**	^I	HT	**041**	**29**	)	**073**	**49**	I	**105**	**69**	I
010	**0A**	^J	LF	**042**	**2A**	*	**074**	**4A**	J	**106**	**6A**	j
011	**0B**	^K	VT	**043**	**2B**	+	**075**	**4B**	K	**107**	**6B**	k
012	**0C**	^L	FF	**044**	**2C**	,	**076**	**4C**	L	**108**	**6C**	l
013	**0D**	^M	CR	**045**	**2D**	-	**077**	**4D**	M	**109**	**6D**	m
014	**0E**	^N	SO	**046**	**2E**	.	**078**	**4E**	N	**110**	**6E**	n
015	**0F**	^O	SI	**047**	**2F**	/	**079**	**4F**	O	**111**	**6F**	o
016	**10**	^P	DLE	**048**	**30**	0	**080**	**50**	P	**112**	**70**	p
017	**11**	^Q	DC1 XON	**049**	**31**	1	**081**	**51**	Q	**113**	**71**	q
018	**12**	^R	DC2	**050**	**32**	2	**082**	**52**	R	**114**	**72**	r
019	**13**	^S	DC3 XOFF	**051**	**33**	3	**083**	**53**	S	**115**	**73**	s
020	**14**	^T	DC4	**052**	**34**	4	**084**	**54**	T	**116**	**74**	t
021	**15**	^U	NAK	**053**	**35**	5	**085**	**55**	U	**117**	**75**	u
022	**16**	^V	SYN	**054**	**36**	6	**086**	**56**	V	**118**	**76**	v
023	**17**	^W	ETB	**055**	**37**	7	**087**	**57**	W	**119**	**77**	w
024	**18**	^X	CAN	**056**	**38**	8	**088**	**58**	X	**120**	**78**	x
025	**19**	^Y	EM	**057**	**39**	9	**089**	**59**	Y	**121**	**79**	y
026	**1A**	^Z	SUB	**058**	**3A**	:	**090**	**5A**	Z	**122**	**7A**	z
027	**1B**	^[	ESC	**059**	**3B**	;	**091**	**5B**	[	**123**	**7B**	{
028	**1C**	^\	FS	**060**	**3C**	<	**092**	**5C**	\	**124**	**7C**	|

DEC	HEX	ASCII	DEC	HEX	ASCII	DEC	HEX	ASCII	DEC	HEX	ASCII
029	**1D**	^] GS	**061**	**3D**	=	**093**	**5D**	]	**125**	**7D**	}
030	**1E**	^^ RS	**062**	**3E**	>	**094**	**5E**	^	**126**	**7E**	~
031	**1F**	^- US	**063**	**3F**	?	**095**	**5F**	_	**127**	**7F**	DEL

Revision History

This document is under revision control. The revision number is increased whenever technical information is changed or added. Any document with a revision number less than 1.0 is preliminary. Any document with a revision number of 1.0 or greater has been approved and, if it is a standard document, released by Accu-Sort Systems ECO process.

Document Revision Number	ECO Number	Date	Changes Made
0.1	N/A	06/29/06	Document submitted for review
1.0	N/A	07/18/06	Initial Release