Filtering and Data Extraction Reference Guide

COMTROL®

References

EPC Generation 1 Tag Data Standards Version 1.1 Rev. 1.27 – The EPC Global standard.

http://www.uc-council.org/gs1us.html - UCC Council web site. Contains barcode specifications.

http://www.barcodeisland.com - Barcode knowledge site. Contains barcode specifications and information.

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Chapter 1. Introduction

1.1. Products Supported

This *Reference Guide* supports the following products and protocols:

- DeviceMaster EIP | UP models with EtherNet/IP firmware
- DeviceMaster MOD | UP models with Modbus/TCP firmware

1.2. Overview

Programming complicated tasks on a PLC can be very difficult and time consuming. Quite simply, what may be relatively easy to program in a high-level programming language can be very difficult in ladder logic. The filtering and data extraction functions in the DeviceMaster are intended to help solve those problems for string, RFID and barcode data.

The data extraction and filtering processes in the DeviceMaster are designed to offload as much work as possible from the PLC and/or application and provide a very simple and easy to use interface for standard RFID and barcode data. This functionality and interface is designed to save dozens, possibly hundreds of lines of ladder logic in a typical PLC program.

1.3. Data Type Definitions

The following data type definitions apply:

UINT	Unsigned Integer (16 bit)
UDINT	Unsigned Double Integer (32 bit)
STRING	Character String (1 byte per character)
BYTE	Bit String (8 bit)

Chapter 2. Data Extraction/Filtering Process

2.1. Overview

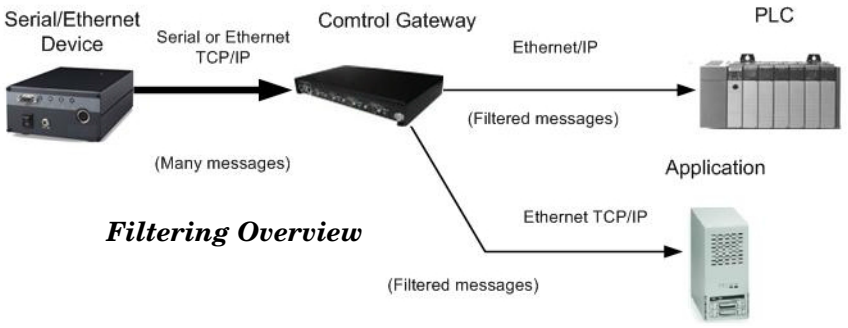
The data extraction and filtering processes work together to offer:

- String filtering for raw/ASCII data up to 128 bytes in length.
- RFID data extraction and filtering.
  - Extraction of all tag parameters from the 43 possible EPCglobal formats including:
    - Encoding scheme
    - Filtering value
    - Company code
    - Product/Location code
    - Serial number
  - Extraction of the antenna number located in the RFID reader tag ASCII string. (Included with the RFID tag data parameters).
  - Selectable filtering criteria to both the PLC and application based on these parameters.
  - Selectable RFID antenna groupings.
  - Selectable RFID reader formats.
  - Discarding of unknown data to the PLC and/or application.
- Barcode extraction and filtering.
  - Extraction of all barcode parameters from valid UPC/EAN barcode formats including:
    - Numbering code
    - Company code
    - Product code
  - Selective filtering criteria to both the PLC and application based on these parameters.
  - Discarding of unknown data to the PLC and/or application.
  - Selectable barcode data formats.

2.2. Filtering Criteria Definition

The filtering criteria is defined as the parameters used in the filtering process.

- As the number of selected filtering criteria options increases, the number of serial/socket messages that can potentially pass filtering increases.
- As the number of selected filtering criteria options decreases, the number of serial/socket messages that can potentially pass filtering decreases.



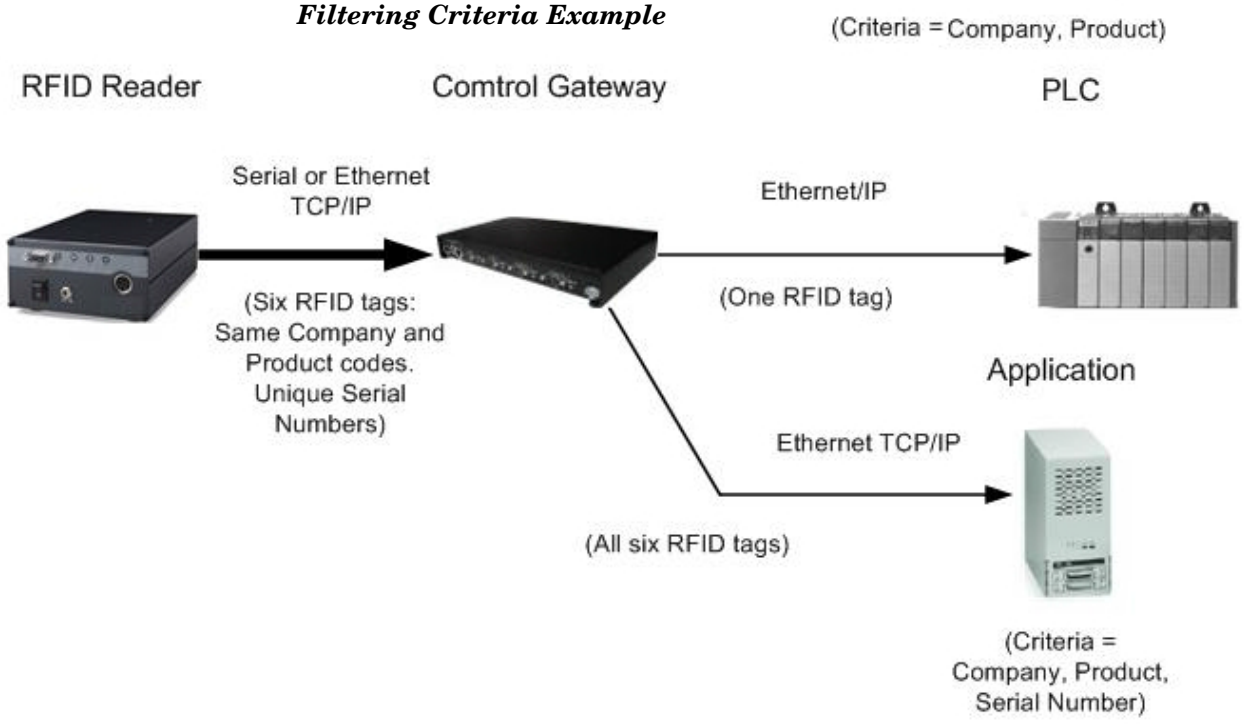
Filtering Overview

- The possible filtering criteria parameters for RFID filtering are Antenna, Encoding Scheme, Filtering Value, Company code, Product/Location code, and Serial Number.
- The possible filtering criteria parameters for barcode filtering are Numbering, Company code, and Product code.
- String filtering has no applicable filtering criteria. All serial/socket bytes are treated as raw data and compared in the filtering process.

Example:

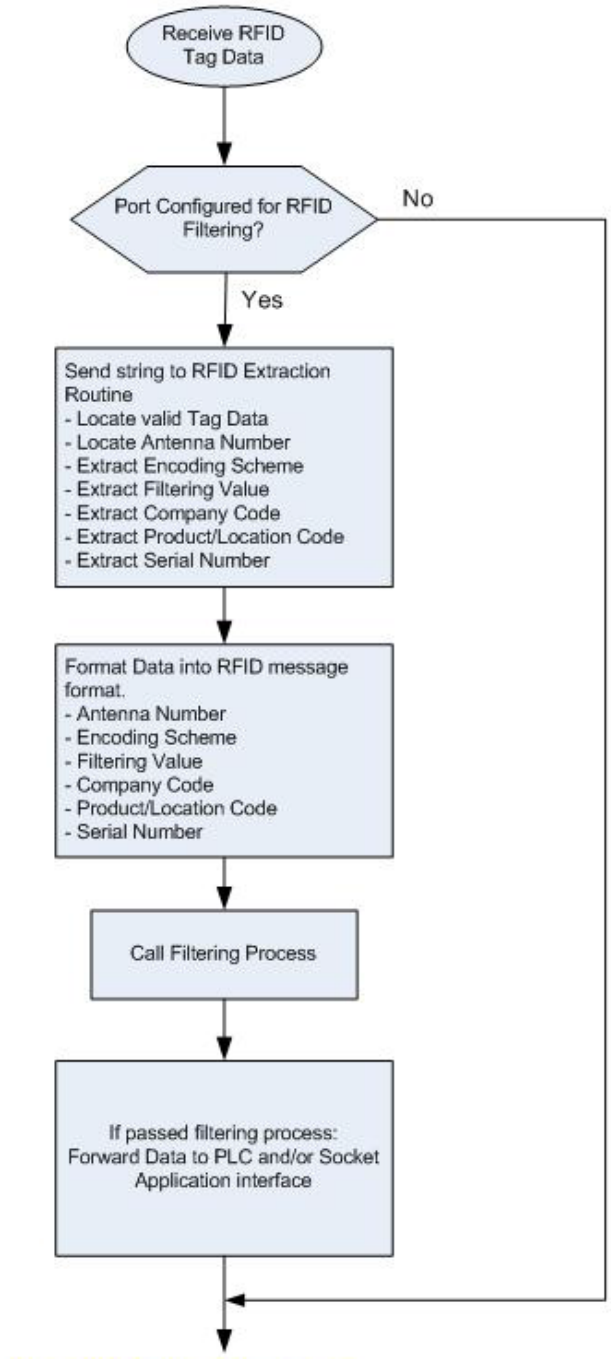
- A DeviceMaster is connected to an RFID reader.
- The PLC interface is enabled and is operating in RFID filtering mode. The PLC filtering criteria is set to Company code and Product/Location code.
- The application port is enabled and it is also operating in RFID filtering mode. The application filtering criteria is set to Company code, Product/Location code, and Serial Number.
- Six RFID tags are then read at one time. All have the same Company and Product/Location codes, but different Serial Numbers.
  - The PLC will receive one RFID tag because all have the same Company and Product/Location codes.
  - The application will receive all six RFID tags because the Serial Number is included in the filtering criteria and all six tags have unique serial numbers.

Filtering Criteria Example



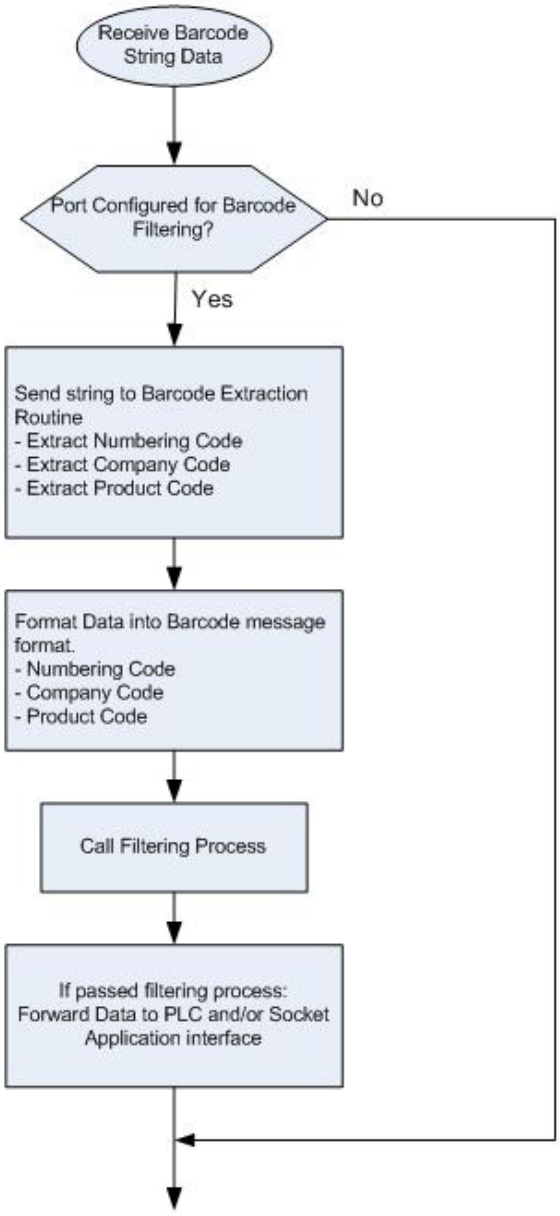
2.3. RFID Data Extraction and Filtering Process

The following diagrams describe the overall RFID data extraction and filtering process.



2.4. Barcode Data Extraction and Filtering Process

The following diagram describes the overall barcode data extraction and filtering process.



Chapter 3. RFID Data Extraction and PLC/ Application Interface

The RFID data extraction process extracts the various parameters from EPCglobal formatted tags. It is designed to greatly simplify PLC and application programming tasks.

EPCglobal is the world wide standard for RFID tag formats. It encompasses a number of 64 and 96 bit encoding schemes and, at present, a total of 43 specified formats, of which 35 are unique.

When RFID filtering is enabled and a valid filtering criteria is specified, all received data is sent to the PLC and/or application in a consistent format. If a tag with a valid EPCglobal format is received, the various parameters will be extracted and placed into a formatted data message. The associated tag ASCII string will be placed in the message data area. (The ASCII tag format may vary depending on the RFID reader.) Any non-tag messages will be placed in the data area and the tag parameters will be set to zero.

3.1. RFID Data Formats

The RFID data formats have the following characteristics:

- For the PLC, contains the same Produced Sequence Number and Length fields as a regular receive data message.
- Contains the RFID specific parameters and the RFID tag ASCII string (or unknown message data).
- Has a similar format for both the PLC and application interface.

3.1.1. PLC RFID Data Format

When the PLC interface is operating in RFID filtering mode, all data sent to the PLC uses this format.

Fields	Data Type	Description
Produced data sequence number	UINT Values = 0-65535 (FFFF Hex)	Sequence number that is incremented with each new message.
Length of RFID message	UINT Values = 20-148	Length in bytes of following data.
Company Code	UINT[2]	Company Code extracted from tag data. Depending on encoding scheme, this field may include Company Prefixes, Company Prefix Indexes, or Government Managed Identifier.
Product/Location Code	UINT[2]	Product Code extracted from tag data. Depending on encoding scheme, this field may include the Item reference, location reference, asset reference, object class, or be set to zero.
Serial Number	UINT[2]	Serial Number extracted from tag data. Depending on the encoding scheme, this field may include the Serial Number or individual asset reference.
Encoding Scheme	UINT	Encoding scheme from tag data.
Filtering Value	UINT	Filtering value from tag data.
Antenna Number	UINT	Antenna number on RFID reader/scanner.
Tag Data Length	UINT	Length of RFID tag string in bytes.

Fields	Data Type	Description
Tag Data	BYTE[128]	Tag data string (variable length field). May also include non-tag messages, which can optionally be sent to the PLC and/or application.

Note the following:

- Not all fields will be valid for all formats. For some tag types, such as the DoD-64 and DoD-96, the Product Code will be set to zero.
- At present, the second Product/Location Code UINT will always be set to zero. The second UINT has been added to allow for future EPCglobal Specification extensions.
- The Company Code, Product/Location Code, Serial Number, Encoding Scheme, Antenna Number, and Filtering Value will be set to zero for non-tag messages.

Example:

- A DeviceMaster serial port is operating in RFID filtering mode.
- An RFID tag is received in Intermec ASCII Format: **4,H3014006860E511000001CE8C**
- The data sent to a PLC would have the following format:

Field	Data Value(s)
Produced data sequence number	0-65535 (FFFF Hex)
Length of RFID message	59
Company Code [0] **Company Code [1**	66800 0
Product/Location Code [1]	234564 0
Serial Number [0] **Serial Number [1]**	118412 0
Encoding Scheme	48
Filtering Value	0
Antenna Number	4
Tag Data Length	27
Tag Data	4,H3014006860E511000001CE8C (ASCII characters)

3.1.2. Application RFID Data Format

When the application interface is operating in RFID filtering mode, all data sent to the application will be in the following format:

Field	Data Type	Description
Company Code	UINT[2]	Company Code extracted from tag data. Depending on encoding scheme, this field may include Company Prefixes, Company Prefix Indexes, or Government Managed Identifier.
Product/Location Code	UINT[2]	Product Code extracted from tag data. Depending on encoding scheme, this field may include the Item reference, location reference, asset reference, object class, or be set to zero.
Serial Number	UINT[2]	Serial Number extracted from tag data. Depending on the encoding scheme, this field may include the Serial Number or individual asset reference.
Encoding Scheme	UINT	Encoding Scheme from tag data
Filtering Value	UINT	Filtering value from tag data
Antenna Number	UINT	Antenna number on RFID Reader/Scanner
Tag Data Length	UINT	Length of RFID tag string in bytes
Tag Data	BYTE[128]	Tag data string (variable length field). May also include non-tag messages, which can optionally be sent to the PLC and/or application.

Note the following:

- Not all fields will be valid for all formats. For some tag types, such as the DoD-64 and DoD-96, the Product Code will be set to zero.
- At present, the second Product Code UINT will always be set to zero. The second UINT has been added to allow for future EPCglobal Specification extensions.
- The Company Code, Product/Location Code, Serial Number, Encoding Scheme, Antenna Number, and Filtering Value will be set to zero for non-tag messages.
- The RFID parameters will be sent to the application in big-endian format. All parameters, with the exception of the Tag data string, will have to be byte-swapped for use on a little-endian system.

Example:

- A DeviceMaster socket port is operating in RFID filtering mode.
- An RFID tag is received in Intermec ASCII Format: **4,H3014006860E511000001CE8C**
- The data sent to an application would have the following format:

Field	Data Value(s)
Company Code [0] **Company Code [1]**	6680 0
Product/Location Code [0] **Product/Location Code [1]**	234564 0
Serial Number [0] **Serial Number [1]**	118412 0
Encoding Scheme	48
Filtering Value	0
Antenna Number	4
Tag Data Length	27
Tag Data	4,H3014006860E511000001CE8C (ASCII characters)

3.2. Supported RFID Reader Formats

The DeviceMaster supports several RFID reader formats.

- These formats can be selected on the embedded web pages and are not necessarily inclusive for that reader.
- If an unlisted RFID reader returns data in a format similar to that of the supported formats, then that RFID reader interface type can be used for the unlisted reader.

RFID reader formats supported by the DeviceMaster:

RFID Reader Interface Type	Description
Unspecified	Unknown format. The DeviceMaster will attempt to locate the antenna number and RFID tag data in the ASCII string. It will look for: • RFID tag data consisting of either 12 or 16 Hex ASCII characters strung together. • An antenna number either before or after the tag data.
Alien (Text Mode)	The Alien RFID reader Text Mode. RFID data is received with: • **Tag**: precedes the tag data. • The tag may consist of either 12 or 16 Hex ASCII characters strung together or separated in groups of four with spaces. Valid formats include **xxxxxxxxxxxx** or **xxxx xxxx xxxx**. • **Ant**: precedes the antenna number. Data Example: **Tag:1115 F268 81C3 C012, Ant:1** (*where* the antenna is one)
Alien (Terse Mode)	The Alien RFID Reader Terse Mode. RFID data is received with: • The tag may consist of either 12 or 16 Hex ASCII characters strung together or separated in groups of four with spaces. Valid formats include **xxxxxxxxxxxx** or **xxxx xxxx xxxx**. • A comma then separates the antenna number. • A comma then separates the count. Data Example: **1115 F268 81C3 C012,2,35** (*where* the antenna is two and the count is 35)
Intermec (Hex ASCII Mode)	The standard Intermec RFID Reader Terse Mode. RFID data is received with: • The antenna number. • A comma or space. • The tag consists of either 12 or 16 Hex ASCII characters strung together. • The antenna number may be placed after the RFID tag data. • An example read messages for the RFID reader may be: **read ant tagid** or **read tagid ant**. Any other command information should come after the antenna and tag data. Data Examples: **2,H1115F26881C3C012** **H1115F26881C3C012 2** (Where the antenna is two) • Valid Intermec RFID reader commands include: **read ant tagid** or **read tagid ant**. Any other command information should come after the antenna and tag data.

3.3. EPCglobal Formats

The EPCglobal specification lists a total of thirteen encoding schemes and a number of sub-formats that lay out the various data fields such as company, product, location, and serial numbers. The DeviceMaster will send the data to the PLC and/or application for each encoding scheme according to the table below:

Encoding Scheme	Bits	Format Description	Associated RFID Message Parameters
SGTIN-64 (2 hex)	64	14 bit Company Prefix Index 20 bit Item Reference 25 bit Serial Number	Company Code Product/Location Code Serial Number
DoD-64 (CE hex)	64	30 bit Government Managed Identifier 24 bit Serial Number	Company Code Serial Number
SSCC-64 (8 hex)	64	14 bit Company Prefix Index 39 bit Serial Number	Company Code Serial Number
SGLN-64 (9 hex)	64	14 bit Company Prefix Index 20 bit Location Reference 19 bit Serial Number	Company Code Product/Location Code Serial Number
GRAI-64 (A hex)	64	14 bit Company Prefix Index 20 bit Asset Type 19 bit Serial Number	Company Code Product/Location Code Serial Number
GIAI-64 (B hex)	64	14 bit Company Prefix Index 39 bit Individual Asset reference	Company Code Serial Number
DoD-96 (2F hex)	96	48 bit Government Managed Identifier 36 bit Serial Number	Company Code Serial Number
SGTIN-96 (30 hex)	96	20-40 bit Company Prefix 24-4 bit Item Reference 38 bit Serial Number	Company Code Product/Location Code Serial Number
SSCC-96 (31 hex)	96	20-40 bit Company Prefix 38-18 bit Serial Number 24 bits unused	Company Code Serial Number
SGLN-96 (32 hex)	96	20-40 bit Company Prefix 21-4 bit Location Reference 41 bit Serial Number	Company Code Product/Location Code Serial Number
GRAI-96 (33 hex)	96	20-40 bit Company Prefix 24-4 bit Asset Type 38 bit Serial Number	Company Code Product/Location Code Serial Number
GIAI-96 (34 hex)	96	20-40 bit Company Prefix 62-42 bit Individual Asset Reference	Company Code Serial Number
GID-96 (35 hex)	96	28 bit General Manager Number 24 bit Object Class 36 bit Serial Number	Company Code Product/Location Code Serial Number

Chapter 4. Barcode Data Extraction and PLC/ Application Interface

The barcode data extraction process extracts the various parameters from UPC/EAN formatted barcodes. It is designed to simplify PLC and application programming tasks.

What are UPC/EAN barcodes? UPC/EAN are the terms used to define the barcode formats commonly used to identify company and products used worldwide.

When barcode filtering is enabled and a valid filtering criteria and format are specified, all data is sent to the PLC and/or application in a consistent format. If a tag with a valid UPC/EAN format is received, the various parameters will be extracted and placed into a formatted data message. The associated barcode ASCII string will be placed in the message data area. Any non-UPC/EAN barcodes or other messages will be placed in the data area and the barcode parameters will be set to zero.

4.1. Barcode Data Interface Format

The barcode data formats have the following characteristics:

- For the PLC, contains the same **Produced Sequence Number** and **Length** fields as a regular receive data message.
- Contains the barcode specific parameters and the barcode ASCII string (or unknown message data).
- Has a similar format for both the PLC and application interface.

4.1.1. To PLC Barcode Data Format

When the PLC interface is operating in barcode filtering mode, all data sent to the PLC will be in the following format:

Field	Size	Description
Produced data sequence number	UINT Values = 0-65535 (FFFF Hex)	Sequence number that is incremented with each new message.
Length	UINT Values = 12-140	Length in bytes of following data.
Company Code	UINT	Company Code
Product Code	UINT	Product Code
Numbering Code	UINT	Numbering Code (from first byte(s) of barcode data)
Barcode Data Length	UINT	Length of barcode string in bytes
Barcode Data	BYTE[128]	Barcode data string (variable length field)

Note: *The Company Code will be set to zero for all EAN-8 codes.*

Example:

- A DeviceMaster serial port is operating in barcode filtering mode.
- The barcode standard 12-14 digit format is set to *Company-5*/*Product-5*.
- The following barcode is received: “756727982906”
- The data sent to a PLC would have the following format:

Field	Data Value(s)
Produced data sequence number	0-65535 (FFFF Hex)
Length of barcode message	24
Company Code	56727
Product Code	98290
Numbering Code	7
Barcode Data Length	12
Barcode Data	756727982906 (in ASCII characters)

4.1.2. To Application Barcode Data Format

When the application interface is operating in barcode filtering mode, all data sent to the application will be in the following format:

Field	Size	Description
Company Code	UINT	Company Code
Product Code	UINT	Product Code
Numbering Code	UINT	Numbering Code (from first byte(s) of barcode data)
Barcode Data Length	UINT	Length of barcode string in bytes
Barcode Data	BYTE[128]	Barcode data string (variable length field)

Note: *The Company Code will be set to zero for all EAN-8 codes.*

The barcode parameters will be sent to the application in big-endian format. All parameters, with the exception of the barcode data string, will have to be byte-swapped for use on a little-endian system.

Example:

- A DeviceMaster socket port is operating in barcode filtering mode and the application port is enabled.
- The barcode standard 12-14 digit format is set to *Company-5*/*Product-5*.
- The following barcode is received: **756727982906**
- The data sent to an application would have the following format:

Field	Data Values
Company Code	56727
Product Code	98290
Numbering Code	7
Barcode Data Length	12
Barcode Data	756727982906 (in ASCII characters)

4.2. Supported UPC/EAN Formats

The following table lists the supported UPC/EAN formats.

Format	Total Digits	Numbering Digits	Company/ Product Digits	Check Digits	Description
UPC-A	12	1	10	1	Format used primarily in North America.
UPC-E	8	1	6	1	Format derived from UPC-A.
EAN-13	13	2	10	1	Format used primarily in Europe.
JAN (same as EAN-13)	13	2	10	1	Format used primarily in Japan.
EAN-14	14	3	10	1	Used worldwide.
EAN-8	8	2 or 3	5 or 4 (Product Code Only)	1	Not related to any other barcode format. Encodes only numbering and product codes.

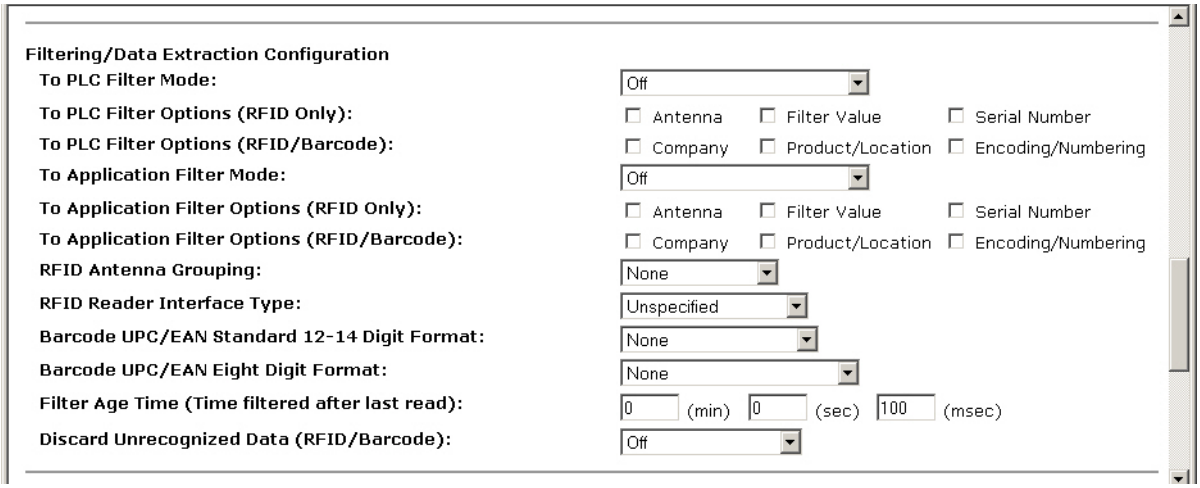
Chapter 5. Filtering Configuration Settings

Filtering is the process by which the DeviceMaster can control the number of similar received data messages sent to a PLC and/or application. The goal of filtering is to prevent extra, or unwanted, messages from being sent to the PLC and/or application.

The DeviceMaster provides filtering with the following capabilities:

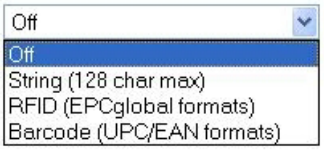
- Filter up to 256 filter entries at one time per port.
- Filter raw/ASCII String data up to 128 bytes in length.
- Allows the PLC and application to operate in different filtering modes. (i.e. The PLC filtering mode may be RFID while the application may have its filtering set to Off or String filtering.)
- Independent filtering criteria for both the PLC and application.
- RFID Antenna grouping. Allows the RFID filtering to work with numerous antenna configurations.
- Interfaces to different RFID readers.
- UPC/EAN barcode filtering.
- Aging of filtered entries. Allows a user to set how long a filter entry will be filtered after it has last been read.
- Discarding of unrecognized messages in RFID and barcode filtering modes.

All filtering and data extraction functionality can be configured separately for both the PLC and application socket interfaces using the *DeviceMaster Filtering/Data Extraction* web page interface (below).



5.1. Filtering Modes

The following settings are available for the filtering modes in the web page PLC interface.



Filtering Modes	Applicable Filtering Criteria Parameters	Description
Off	None	No Filtering of any type. Maximum packet sizes apply.
String	Up to 128 bytes of raw/ASCII data.	No data extraction. Messages are limited to 128 bytes in length. Any messages exceeding 128 bytes will automatically be truncated to 128 bytes.
RFID	**Antenna Number**: From RFID reader/scanner. **Encoding Scheme**: From RFID tag data. **Filtering Value**: From RFID tag data. **Company Code**: From RFID tag data. **Product/Location Code**: From RFID tag data. **Serial Number**: From RFID tag data.	RFID data in any of the EPCglobal formats will be filtered, the associated parameters will be extracted, and the extracted data and RFID tag will be sent to the PLC/application in a specified format.
Barcode	**Numbering**: One to three digits, depending on barcode format. **Company Code**: Length in digits varies depending on the format. **Product Code**: Length depends on the format.	Barcode data in UPC/EAN formats will be filtered, the associated parameters will be extracted, and the extracted data and barcode will be sent to the PLC/application in a specified format.

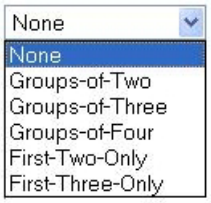
The application filter mode can be set independently of the PLC filtering mode. The only exceptions are:

- If the PLC filter mode is set to **RFID**, the application filter mode cannot be set to **Barcode**.
- If the PLC filter mode is set to **Barcode**, the application filter mode cannot be set to **RFID**.

5.2. RFID Antenna Grouping

This setting is applicable only to RFID filtering and only if the **Antenna Filtering** option is enabled. It allows the DeviceMaster to filter RFID tags based on antenna groupings.

When **Antenna Grouping** is enabled:



- Tags that have the same filtering criteria (i.e. company and product number), received from antennas within the same group will be filtered as if they are the same entry and will be treated as one filtering entry.
- Tags that have the same filtering criteria (i.e. company and product number), received from antennas not within the same group will be filtered as if they are different entries.

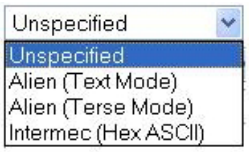
The possible groupings are:

Setting	Group 1 Antennas	Group 2 Antennas	Group 3 Antennas	Group N Antennas
None	1	2	3	4
Groups of Twos	1,2	3,4	5,6	Etc.
Groups of Threes	1,2,3	4,5,6	7,8,9	Etc.
Groups of Fours	1,2,3,4	5,6,7,8	9,10,11,12	Etc.

Setting	Group 1 Antennas	Group 2 Antennas	Group 3 Antennas	Group N Antennas
First Two Only	1,2	3	4	N+1
First Three Only	1,2,3	4	5	N+2

5.3. RFID Reader Interface Type

This setting defines the expected RFID data format to be used while operating in RFID filtering mode. Each Reader Interface Type is unique and pertains to the RFID reader manufacturer. If a different RFID reader is to be used and it provides a similar format to any of the RFID Readers listed below, it can also be used in RFID filtering mode.



- **Unspecified**: The DeviceMaster will assume a HEX ASCII format and will attempt to locate the antenna number.
- **Alien (Text Mode)**: Specifies the Alien RFID reader **Text Mode**.
- **Alien (Terse Mode)**: Specifies the Alien RFID reader **Terse Mode**.
- **Intermec (Hex ASCII Mode)**: Specifies the Intermec Reader returning data in the **Hex ASCII Mode**.

See 3.2. Supported RFID Reader Formats on Page 14 for a detailed description of the RFID reader formats.

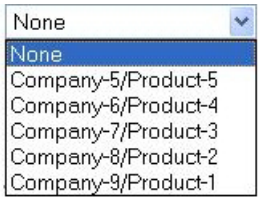
5.4. Barcode Formats

These settings define the barcode format to be used for both standard and eight digit barcodes. The term *standard* refers to UPC-A, EAN-13, JAN, and EAN-14 barcodes which all have ten company/ product digits. The eight digit barcodes include UPC-E and EAN-8 formats.

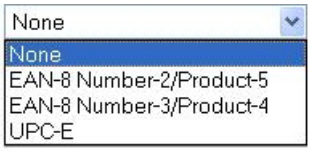
The standard and eight digit formats are selected independently and each operates independently.

Note: *The barcode filtering / data extraction will not function if no format is selected.*

Standard barcode web page interface



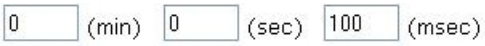
Eight digit barcode web page interface



Format	Numbering Digits	Company Digits	Product Digits	Check Digit
Standard Format				
None	N/A	N/A	N/A	N/A
Company-5/ Product-5	1-3	5	5	1
Company-6/ Product-4	1-3	6	4	1
Company-7/ Product-3	1-3	7	3	1
Company-8/ Product-2	1-3	8	2	1
Company-9/ Product-1	1-3	9	1	1
Eight Digit Formats				
None	N/A	N/A	N/A	N/A
EAN-8 Number-2/Product 5	2	0	5	1
EAN-8 Number-3/Product 4	3	0	4	1
UPC-E	1	Variable	Variable	1

5.5. Filter Age Time

This setting defines the time a filter string, RFID tag, or barcode will continue to be filtered after the last time it was received. If an entry is received before the **Filter Age Time** has passed, the entry will be filtered and the data will not be sent to the PLC and/or application. However, if the **Filter Age Time** has passed, it will pass filtering and be sent to the PLC and/or application.



Example:

- The **Filter Age Time** is set to five seconds:
  - An entry is received for the first time and sent to the PLC and/or application.
  - It is then received again in four seconds. The entry will not be sent to the PLC and/or application since it is still on the filter list.
  - The entry is then received after another six seconds. The entry will be sent to the PLC and/or application again since it was removed from the filter list after five seconds.
  - End result = entry is sent to the PLC and/or application twice.
- The **Filter Age Time** is then set to ten seconds.
  - An entry is received for the first time and sent to the PLC and/or application.
  - It is then received again in four seconds. The entry will not be sent to the PLC and/or application since it is still on the filter list.
  - The entry is then received after another six seconds. The entry will not be sent to the PLC and/or application since it is still on the filter list.
  - End result = entry is sent to the PLC and/or application once.

5.6. Discard Unknown RFID/Barcode Data

This setting specifies what to do with unrecognized RFID or barcode data.

- **Off:** Send unrecognized data to the PLC and/or application.
- **To-PLC**: Discard unrecognized data to the PLC. Allow sending of unrecognized data to the application.
- **To-Application**: Discard unrecognized data to the application. Allow sending of unrecognized data to the PLC.
- **To-PLC/Application**: Discard unrecognized data to both the PLC and application.