IDentity MaX

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ID*entity* MaX Desktop

Automatic Vehicle Identification

User's Guide

Notices

SIRIT INC.

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This equipment complies with FCC Part 15.247 and Industry Canada RSS-210 rules. Any changes or modifications not expressly approved by SIRIT could void the user's authority to operate the equipment. To maintain compliance, the IDentity MaX Desktop reader must be used with the power supply that was supplied with the reader.

RF Exposure Warning

To comply with the FCC radiofrequency (RF) Exposure requirements, the antenna(s) used with this device must be installed to provide a minimum separation distance of 20 cm from all persons

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CAUTION

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet or circuit different to that which the receiver is connected.
- Consult Sirit.

For PERMANENTLY CONNECTED EQUIPMENT, a readily accessible disconnect device shall be incorporated into the fixed wiring.

For PLUGGABLE EQUIPMENT, the socket/outlet shall be installed near the equipment and shall be easily accessible.

Note: To maintain FCC compliance, the ID*entity* MaX reader must be used with the power supply that was supplied with the reader.

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1.0 Introduction/Scope

Using This Manual

This User's Guide provides instructions for installing the IDentity MaX Desktop RFID reader and for integrating the host protocol onto a PC based application.

Intended Audience

This manual is intended for use by technical personnel responsible for installing IDentity MaX Desktop reader and writing PC applications to communicate with it:

- Electrical Engineers
- Mechanical Engineers
- Software Engineers
- Manufacturing Engineers

Topics

1	**Introduction/Scope**	Explains the scope of this manual and intended audience
2	**Reader Mechanical and Electrical Information**	Describes the physical and electrical characteristics of the reader
3	**Installation and Operation**	Describes the proper procedures to install and operate the reader
4	**Host Protocol**	Specifies the protocol used to communicate with the reader
5	**Troubleshooting**	Lists possible causes and remedies for operating abnormalities
Appendix A	**CRC Calculation**	Example CRC-16 calculation and sample "C" code

2.0 Mechanical and Electrical

2.1 Mechanical Specifications

Dimensions (LxWxD)

5.75” x 3.25” x 2.25” (not including cables)

Weight

1 lb, 7 oz.

Cables and Connectors

Data: 6 ft. Serial Cable with DB-9S (Female) connector

Power: 6 ft. cable with attached power supply using a two prong, non-polarized, North American power connector

2.2 Electrical Specifications

Table 1 IDentity MaX Desktop reader UHF RFID Reader Pin Definitions

Pin Number	Pin Description
1	No Connection
2	RXD – Receive Serial Data
3	TXD – Transmit Serial Data
4	No Connection
5	Ground
6	No Connection
7	DTR – Data Terminal Ready
8	No Connection
9	No Connection

Input voltage	120 VAC 60 Hz / 5VDC, 2A max
RF output power	5dBm
Frequency	UHF band, 902 - 928 MHz
Communications Protocol	Serial with CCITT CRC-16 error detection
Communications Parameters	115200 bps, 8 data bits, no parity, 1 stop bit
Communications Signal Level	Serial data at RS-232 logic levels
Regulatory	FCC Part 15

3.0 Installation and Operation

3.1 Installation

The following steps are recommended to properly install the IDentity MaX Desktop reader.

1. Unpack the contents of the shipping container.
2. Inspect the shipping container and contents for damage. If damaged, notify the carrier and Sirit. Keep all shipping materials for inspection by the carrier.
3. Determine the location of the reader. It will need to be within 6 feet of the PC that will be hosting the user application and within 6 feet of an AC power outlet.
4. Plug the AC power supply of the Desktop reader into the AC power outlet.
5. Align the DB 9 connector with the serial port connector on the host PC. Insert firmly. Screw down the thumbscrews to ensure retention in the connector.
6. Rotate the unit so that the toggle switch and LED face the operator.

3.2 Operation

The following steps are required to ensure proper operation of the IDentity MaX Desktop reader:

1. Verify that all power and host PC connections are made.
2. Move the toggle switch on the front of the unit to the ON (up) position.
3. Verify that the “Power On” LED illuminates.
4. Start the user application on the Host PC.
5. Place the RFID tag being read on the Desktop reader within the dotted lines shown on the top of the reader. Contact with the top of the reader must be maintained in order to obtain a proper tag read transaction.

NOTE: To avoid erroneous tag reads, keep all RFID tags other than the one being processed at least 1ft. away from the IDentity MaX Desktop reader.

6. Perform the required operations as specified by the user application and procedures.
7. After all tag transactions have been processed, flip the toggle switch on the front of the reader to the OFF (down) position.

4.0 Host Protocol

The Host Protocol supports communications between the IDentity MaX Desktop reader and a Host. The following sections define this protocol by breaking down the different fields and layers of the packet protocol.
This interface uses the serial port on the IDentity MaX Desktop reader. The serial port interface will be configured to transfer data at 115,200 bps, 8 data bits, no parity, and 1 stop bit.

4.1 Packet Format

The protocol is Byte Oriented (packets and messages are a sequence of bytes). All multi-byte commands, parameters and responses are encoded MSB first. All bit field parameters or responses are encoded left justified (MSBit in high order bit of MSByte).

MSB			LSB
SOF (0x01)	Length	Message	CRC
1 byte	1 byte	1-128 bytes	2 bytes

Figure 1 Packet Format

DEFINITIONS

CRC: Two bytes, CCITT CRC-16 calculated over the LENGTH field through the end of MESSAGE field in the FORWARD direction with a PRELOAD of 0xFFFF. If the CRC is calculated incorrectly, the reader will not respond. See Appendix A.

LENGTH: Number of bytes in the packet from the LENGTH byte through the end of the CRC, excluding the SOF

MESSAGE: Commands or responses

SOF: 0x01 Start-Of-Frame, byte field used to indicate the start of a packet boundary

4.2 Message Formats

The MESSAGE portion of a packet is used to transport both commands from the host to the reader and responses from the reader to the host. The reader will not send autonomous (unsolicited) responses.

Command messages contain a one byte “Command” field. Following the command byte field is the “Parameter” field that could contain zero to many parameters associated with the command field.

MSB		LSB
Message		
Command	Parameters	
1 byte	127 bytes	

Figure 2 Command Message Field Format

Response messages contain a one byte “Status” field that is common to all reader responses. The “Status” field contains an indication of the reader status. Following the status byte is the “Response” field that could contain zero to many responses associated with the “Status” field.

Figure 3 Response Message Field Format

MSB		LSB
Message		
Status	Response	
1 byte	127 bytes	

The “Status” field contains the following status codes:

Table 2 Status Field Status Codes

Status	Status Code	Description
STATUS_ERROR	0xFF	The command processing is complete with errors or faults detected.
STATUS_COMPLETE	0x00	The command has completed with no errors or faults encountered.
STATUS_IN_PROGRESS	0x01	The reader is still processing the command. More response data is to be expected.

4.3 Commands

The following table shows all the commands that are supported for command processing on the reader:

Table 3 Command Field Command Codes

Command	Code	Description
DOWNLOAD	0x00	Download new application software to the reader
SYSTEM	0x01	Set system operational mode and get software versions
TAG_0	0x02	Class 0 tag commands
TAG_1	0x03	Class 1 tag commands
TAG_G2	0x04	Class 1 Generation 2 commands

4.3.1 DOWNLOAD Command

The DOWNLOAD command is used to download new application software to the reader.

Figure 4 Download Command Format

<table>
<tr><th colspan="3">MSB LSB</th></tr>
<tr><td colspan="3">Message</td></tr>
<tr><td>Command Code</td><td colspan="2">Parameters</td></tr>
<tr><td>0x00</td><td>Sub-Command Code</td><td>Parameters</td></tr>
<tr><td>1 byte</td><td>1 byte</td><td>126 bytes</td></tr>
</table>

4.3.2 DOWNLOAD Sub-Command

The DOWNLOAD command further utilizes sub-commands and parameters to support the download process in the reader.

Table 4 Download Sub-Commands

Sub-Command	Code	Description	Return Status Message
NOTIFY	0x00	Both the reader and the application accept this command. If the application receives this command it will respond and reboot into the application into the reader. If the reader receives this command it will reboot the reader and then respond	Yes
START	0x01	Only the reader accepts this sub-command. Notifies the reader to erase the application area of flash memory. During the flash erase process, the reader may return several status messages of IN_PROGRESS before returning a completion status.	Yes
PROGRAM	0x02	Only the reader accepts this sub-command. A variable length message containing data to beprogrammed into flash. The reader will calculate a cumulative CRC of the data as it is being downloaded During the flash programming process, the reader may return several status messages of IN_PROGRESS before returning a completion status.	Yes
END	0x03	Only the reader accepts this sub-command. Notifies the reader that there are no more PROGRAM messages. Upon receipt, the reader will compare CRC values then program the application header into flash. During the flash programming process, the reader may return several status IN_PROGRESS messages before returning a completion status.	Yes
REBOOT	0x04	Both the reader and the application accept this sub-command. After responding to this command the system will reboot.	Yes

4.3.3 PROGRAM Sub-Command

The PROGRAM sub-command contains the following message format for programming the flash. The DATA field will contain one or more bytes of data that needs to be programmed.

Figure 5 PROGRAM Sub-Command Message Format

MSB			LSB
Message			
Command Code	Parameters		
	Sub-Command Code	Parameters	
0x00	0x02	Address	Data
1 byte	1 byte	4 bytes	122 bytes

4.3.4 END Sub-Command

The END sub-command notifies the reader that there are no more PROGRAM messages, compares the CRC values, and programs the application header into flash. The END sub-command contains the following message format:

Figure 6 END Sub-Command Message Format

MSB				LSB
Message				
Command Code	Parameters			
	Sub-Command Code	Parameters		
0x00	0x03	CRC	Start Address	Parameters
1 byte	1 byte	2 bytes	4 bytes	120 bytes

Table 5 END Sub-Command Field Definitions

Field	Definition
CRC	2-byte CCITT CRC-16 of all program data (forward with 0xFFFF pre-load)
START_ADDRESS	4-byte address at which to start code execution

4.4 SYSTEM Command

The SYSTEM command is used to set system operational mode and get software versions. The SYSTEM command is also used for manufacturing test and is supported with Test type system commands.

Figure 7 System Command Format

MSB		LSB
Message		
Command Code	Parameters	
0x01	Sub-Command Code	Parameters
1 byte	1 byte	126 bytes

The SYSTEM command returns the following response message:

<STATUS><LDR_SW_VER><APP_SW_VER><MODE>

Where:

<LDR_SW_VER> - The current loader software version mark (0x0000, 0xFFFF)

<APP_SW_VER> - The current application software version mark (0x0000, 0xFFFF)

<**MODE**> - The current MODE setting (0x01, 0x02)

The loader supports the SYSTEM command with the MODE value being ignored. In addition to the software version marks, the loader response returns a current MODE value of 0x00.

4.4.1 SYSTEM Sub-Commands

The SYSTEM command utilizes sub-commands and parameters in the following manner:

Table 6 System Sub-Commands

Sub-Command	Code	Type Command	Description	Return Status Message
NO_CHG	0x00	Mode	No change (the system mode is not changed)	Yes
STANDBY	0x01	Mode	This is a system mode command: STANDBY (0x01) - Processor ON, all RF circuitry OFF	Yes
ENABLED	0x02	Mode	Processor, receiver circuitry, and PLL ON, TX OFF	Yes
RF_ON	0x80	Test	Turn ON the RF transmitter	Yes

Note: when coming out of STANDBY and returning to the ENABLED state, allow 200ms before sending commands to the IDentity MaX Desktop reader.

4.5 Class 0 Commands

The following section describes the command messages used to support Class 0 tags. Class 0 tags are read-only and cannot be written. . The Command Code 0x02 is for TAG_0 (Class 0) tag commands.

Figure 8 Class 0 Command Format

MSB		LSB
Message		
Command Code	Parameters	
0x02	Sub-Command Code	Parameters
1 byte	1 byte	1-126 bytes

4.5.1 Class 0 Sub-Commands

The Class 0 command utilizes sub-commands and parameters in the following manner:

Table 7 Class 0 Sub-Commands

Sub-Command	Code	Description	Return Status Message
KILL	0xFF	Kill Class 0 tag	Yes
SET	0x00	Set read parameters	Yes
READ	0x01	Read Class 0 tag IDs using the following parameters	Yes

4.5.2 KILL Sub-Command

The KILL sub-command contains the following command message format:

Figure 9 KILL Sub-Command Message Format

MSB						LSB
Message						
Command	Parameters					
	Sub-Command	Parameters				
0x02	0xFF	Singulation Mode	Singulation Bit Count	Singulation Bits	Pass Code	
1 byte	1 byte	1 byte	1 byte	12 bytes	3 bytes	109 bytes

Table 8 KILL Sub-Command Field Definitions

Field	Definition
SINGULATION_MODE	0x00 = ID0, 0x01 = ID1, or 0x02 = ID2
SINGULATION_BIT_COUNT	Number of singulation bits to follow (0x00, 0x7F)
SINGULATION_BITS	Singulation bits
PASSCODE	24-bit pass code

4.5.2.1 KILL Sub-Command Status Message

The KILL sub-command status message contains the following message format:

Figure 10 KILL Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	
0x00		
1 byte	1 byte	126 bytes

Table 9 Sub-Command Status Field Definitions

Field	Definition
STATUS	This field should be set to STATUS_COMPLETE
TAG_COUNT	Number of tags singulated and killed (0x00, 0x01)

4.5.3 SET Sub-Command

The SET sub-command changes the power level of the reader and contains the following message format:

Figure 11 SET Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x02	0x00	RF Level	Mod Depth	
1 byte	1 byte	1 byte	1 byte	124 bytes

Table 10 SET Sub-Command Message Format

Field	Definition
RF_LEVEL	RF power level to be used for reading Class 0 tags
	NO_CHG (0x00) - The current setting is to remain unchanged
	Setting (0x01, 0x10) - +15 dBm to +30 dBm in 16 steps of 1 dB
MOD_DEPTH	Modulation depth to be used for reading Class 0 tags
	NO_CHG (0x00) - The current setting is to remain unchanged
	Setting (0x01, 0x20) – 20 % to 95 % in steps of ~2.42 %

4.5.3.1 SET Sub-Command Status Message

The SET sub-command status message contains the following message format:

Figure 12 SET Sub-Command Status Message Format

MSB			LSB
MESSAGE			
Status	Response		
	RF Level	Mod Depth	
0x00			
1 byte	1 byte	1 byte	125 bytes

Table 11 SET Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
RF_LEVEL	This the Forward Power A/D target value for power control
MOD_DEPTH	The current Modulation Depth setting for reading Class 0 tags

4.5.4 READ Sub-Command

The READ sub-command is used with Class 0 (read-only capability), and when reading specific tags. The READ sub-command contains the following message format:

Figure 13 READ Sub-Command Message Format

MSB					LSB
Message					
Command	Parameters				
	Sub-Command	Parameters			
0x02	0x01	Singulation Mode	Filter Bit Count	Filter_Bits	
1 byte	1 byte	1 byte	1 byte	16 bytes	108 bytes

Table 12 READ Sub-Command Field Definitions

Field	Definition
SINGULATION_MODE	0x00=ID0, 0x01=ID1, or 0x02=ID2
FILTER_BIT_COUNT	Number of filter bits to follow (0x00.0x7F). If (0x80.0xFF), treat as negative value of filter bit count and treat FILTER_BITS as ID1 data.
FILTER_BITS	Holding filter bits

4.5.4.1 READ Sub-Command Status Message

The READ sub-command status message contains the following command message format:

Figure 14 READ Sub-Command Status Message Format

MSB			LSB
Message			
Status	Response		
Status Code	Tag Count	Tag ID	
0x01			
1 byte	1 byte	126 bytes	

Table 13 READ Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to IN_PROGRESS
TAG_COUNT	The number of tags reported in this message
TAG_ID	A sequence of 1 or more tag IDs. The 2 high order bits of the IDs are used to determine the number of bits in the tag ID per the EPC specification.). If either of the first two bits are a “1” then the tag is 64 bits long. If the fifth bit is a “1” and the first two bits are “00” the tag is 64-bits long otherwise if the first two bits are “00” and the fifth bit is “0”, then the tag is 96-bits long.

If any tags are filtered and read, this command will return multiple messages. After all tags have been reported, the reader will send a final summary message to the host.

4.5.4.2 READ Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 15 READ Sub-Command Status Message Format

MSB			LSB
Message			
Status	Response		
Status Code	Total Tag Count		
0x00			
1 byte	2 bytes	125 bytes	

Table 14 READ Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.6 Class 1 Commands

The following section describes the command messages used to support Class 1 tags. Class 1 tags may be read or written. The Command Code 0x03 is for TAG_1 (Class 1) tag commands.

Figure 16 Class 1 Command Format

MSB		LSB
	Message	
Command Code	Parameters	
0x03	Sub-Command Code	Parameters
1 byte	1 byte	1-126 bytes

4.6.1 Class 1 Sub-Commands

The Class 1 command utilizes sub-commands and parameters in the following manner.

Table 15 Class 1 Sub-Commands

Sub-Command	Code	Description	Return Status Message
KILL	0xFF	Kill a Class 1 tag	Yes
SET	0x00	This command is used to set the RF power level and modulation depth.	Yes
READ	0x01	Read Class 1 tag IDs using the following parameters. This read utilizes the SCROLL_ALL_ID command.	Yes
PROGRAM_ID	0x02	All Class 1 tags receiving this command will program the specified tag id in memory.	Yes
VERIFY_ID	0x03	All tags receiving this command will reply with their CRC, followed by their entire ID code, and their password. A tag that has successfully executed the LOCK_ID command ignores the VERIFY_ID command.	Yes
LOCK_ID	0x04	This command prevents any further modification of the tag ID, CRC, and password.	Yes
ERASE_ID	0x05	This command sets all bits of the tag ID, CRC, and password to '0'. A tag that has successfully executed the LOCK_ID command ignores the ERASE_ID command.	Yes
PING_READ	0x06	Read Class 1 tag IDs using the specified parameters. This read utilizes the PING command.	Yes
SCROLL_ID	0x09	The SCROLL ID sub-command is used to search for tags in dense (very closely grouped) tag environments.	Yes
READ_ALL	0x0A	This command will read and report Class 1 tags that do not conform to the EPC tag data standards. It utilizes the Scroll_All_ID tag command.	Yes

4.6.2 KILL Sub-Command

Tags with IDs matching the singulation bits are permanently deactivated and will no longer respond to or execute reader commands. The password is used to enable this functionality. This "self-destruct" command renders the tag inactive forever. The KILL sub-command contains the following command message format:

Figure 17 KILL Sub-Command Message Format

MSB					LSB
Message					
Command	Parameters				
	Sub-Command	Parameters			
0x03	0xFF	Tag Id Bit Count	Password	Tag Id	
1 byte	1 byte	1 byte	1 byte	12 bytes	112 bytes

Table 16 KILL Sub-Command Field Definitions

Field	Definition
TAG_ID_BIT_COUNT	Number in the Tag ID (64, 96,)
PASSWORD	Tag 8-bit password
TAG_ID	This is the Tag ID to be used in addressing a single tag that is to be killed

4.6.2.1 KILL Sub-Command Status Message

The KILL sub-command status message contains the following message format:

Figure 18 KILL Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	
0x00		
1 byte	1 byte	126 bytes

Table 17 KILL Sub-Command Status Field Definitions

Field	Definition
STATUS	This field should be set to STATUS_COMPLETE
TAG_COUNT	Number of tags killed (0x00, 0x01)

4.6.3 SET Sub-Command

The SET sub-command contains the following message format:

Figure 19 SET Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x03	0x00	RF Level	Mod Depth	
1 byte	1 byte	1 byte	1 byte	124 bytes

Table 18 SET Sub-Command Field Definitions

Field	Definition
RF_LEVEL	RF power level to be used for reading Class 1 tags
	NO_CHG (0x00) - The current RF setting is to remain unchanged
	Setting (0x01 . . . 0x10) - +15 dBm to +30 dBm in 16 steps of 1 dB
MOD_DEPTH	Modulation depth to be used for reading Class 1 tags
	NO_CHG (0x00) - The current RF setting is to remain unchanged
	Setting (0x01 . . . 0x20) – 20 % to 95 % in steps of ~2.42 %

4.6.3.1 SET Sub-Command Status Message

The SET sub-command status message contains the following command message format:

Figure 20 SET Sub-Command Status Message Format

MSB			LSB
Message			
Status	Response		
	RF level	Mod Depth	
0x00			
1 byte	1 byte	1 byte	125 bytes

Table 19 SET Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to ERR_NONE
RF_LEVEL	This is the Forward Power A/D target value for power control
MOD_DEPTH	This is the current Modulation Depth setting

4.6.4 READ Sub-Command

The READ sub-command is used to read tags. The SCROLL_ALL_ID command is used to search for tags during the interrogation process. During this process, the reader listens for the loudest tag, responds, and "quiets" that tag in order to hear the next loudest tag. The READ sub-command contains the following message format:

Figure 21 READ Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x03	0x01	Filter Bit Count	Filter_Bits	
1 byte	1 byte	1 byte	16 bytes	109 bytes

Table 20 READ Sub-Command Field Definitions

Field	Definition
FILTER_BIT_COUNT	Number of filter bits to follow (0..96). Filter bit count of 0 indicates no filter bits.
FILTER_BITS	Holding filter bits

If any tags are filtered and read, this command will return multiple messages.

4.6.4.1 READ Sub-Command Status Message

The READ sub-command status message contains the following message format:

Figure 22 READ Sub-Command Status Message Format

MSB			LSB
Message			
Status	Response		
Status Code	Tag Count	Tag Id	
0x01			
1 byte	1 byte	126 bytes	

Table 21 READ Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to IN_PROGRESS
TAG_COUNT	The number of tags reported in this message
TAG_ID	A sequence of 1 or more tag IDs. The 2 high order bits of the IDs are used to determine the number of bits in the tag ID per the EPC specification.). If either of the first two bits are a “1” then the tag is 64 bits long. If the fifth bit is a “1” and the first two bits are “00” the tag is 64-bits long otherwise if the first two bits are “00” and the fifth bit is “0”, then the tag is 96-bits long.

If any tags are singulated and read, this command will return multiple messages. After all tags have been reported, the reader will send a final summary message to the host.

4.6.4.2 READ Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 23 READ Sub-Command Status Message Format

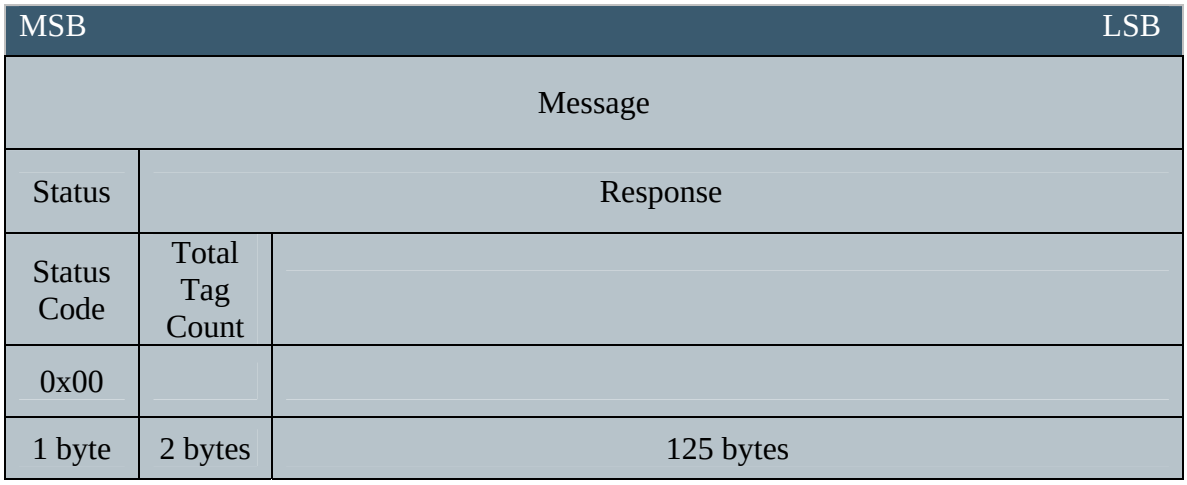

Table 22 READ Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.6.5 SCROLL ID Sub Command

The SCROLL ID sub-command is used to search for tags in dense (very closely grouped) tag environments. Using Scroll ID for tag singulation requires more time to execute than the standard READ sub-command. Therefore, it is not recommended for low density tag environments. The Scroll ID sub-command status message contains the following message format:

Figure 24 SCROLL ID Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x03	0x09	Filter Bit Count	Filter_Bits	
1 byte	1 byte	1 byte	16 byte	109 bytes

Table 23 SCROLL ID Subcommand Field Definitions

Field	Definition
FILTER_BIT_COUNT	Number of filter bits to follow (0..96). Filter bit 0 indicates no filter bits.
FILTER_BITS	Holding filter bits.

4.6.5.1 SCROLL ID Sub-Command Status Message

The SCROLL_ID sub-command status message contains the following message format:

Figure 25 SCROLL_ID Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	Tag ID
0x01		
1 byte	1 byte	126 bytes

Table 24 SCROLL_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to IN_PROGRESS
TAG_COUNT	The number of tags reported in this message
TAG_ID	A sequence of 1 or more tag IDs. The 2 high order bits of the IDs are used to determine the number of bits in the tag ID per the EPC specification.). If either of the first two bits are a “1” then the tag is 64 bits long. If the fifth bit is a “1” and the first two bits are “00” the tag is 64-bits long otherwise if the first two bits are “00” and the fifth bit is “0”, then the tag is 96-bits long.

If any tags are singulated and read, the SCROLL_ID command will return multiple messages.

4.6.5.2 SCROLL ID Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 26 SCROLL_ID Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Total Tag Count	
0x00		
1 byte	2 bytes	125 bytes

Table 25 SCROLL_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.6.6 READ_ALL Sub-Command

The READ_ALL sub-command is used to read tags. The SCROLL_ALL_ID command is used to search for tags during the interrogation process. During this process, the reader listens for the loudest tag, responds, and "quiets" that tag in order to hear the next loudest tag. This version of the read command will not filter out tag IDs that do not conform to the EPC tag data standards, as the standard READ command does. The READ_ALL sub-command contains the following message format:

Figure 27 READ_ALL Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x03	0x0A	Filter Bit Count	Filter_Bits	
1 byte	1 byte	1 byte	16 bytes	109 bytes

Table 26 READ_ALL Sub-Command Field Definitions

Field	Definition
FILTER_BIT_COUNT	Number of filter bits to follow (0..96). Filter bit count of 0 indicates no filter bits.
FILTER_BITS	Holding filter bits

4.6.6.1 READ_ALL Sub-Command Status Message

The READ_ALL sub-command status message contains the following message format:

Figure 28 READ_ALL Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	Tag ID Length - Tag ID
0x01		
1 byte	1 byte	126 bytes

Table 27 READ_ALL Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to IN_PROGRESS
TAG_COUNT	The number of tags reported in this message
Tag ID Length - Tag ID	A sequence of 1 or more tag lengths combined with tag IDs. The first byte will contain the length of the tag ID that follows, whether 64 or 96 bit (0x40 or 0x60), and the bytes that follow will contain the Tag ID up to the length specified in the first byte. Subsequent tag IDs will follow this same pattern.

If any tags are singulated and read, this command will return multiple messages. After all tags have been reported, the reader will send a final summary message to the host.

4.6.6.2 READ_ALL Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 29 READ_ALL Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Total Tag Count	
0x00		
1 byte	2 bytes	125 bytes

Table 28 READ_ALL Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.6.7 PROGRAM_ID Sub-Command

The PROGRAM_ID sub-command will program all Class 1 tags. The PROGRAM_ID message contains the Tag ID Bit Count, Password, and the Tag ID to be used in programming the tag.

In order to implement the PROGRAM_ID command, the reader sends a PROGRAM_ID command to the tag to program the tag ID and password. The reader further verifies the PROGRAM_ID command execution by sending a VERIFY_ID command. The reader will determine if the tag ID values were properly programmed and report any errors.

Figure 30 PROGRAM_ID Sub-Command Message Format

MSB					LSB
Message					
Command	Parameters				
	Sub-Command	Parameters			
0x03	0x02	Tag ID Bit Count	Password	Tag ID	
1 byte	1 byte	1 byte	1 byte	12 bytes	112 bytes

Table 29 PROGRAM_ID Sub-Command Field Definitions

Field	Definition
Tag ID Bit Count	This field should be set to the number of bits in the tag id
PASSWORD	This field contains the password received from the EPC tag, MSB first
TAG ID	This field contains the EPC tag ID code (up to 96 bits), MSB first

4.6.7.1 PROGRAM_ID Sub-Command Status Message

Once the tag has been programmed with the correct CRC, Tag ID, and Password, a status complete message will be sent to the host indicating the command execution result. A status complete message indicates the tag was programmed successfully. Otherwise, an error status message is sent indicating any of the following error conditions upon programming a tag:

ERR_PROG_ID_FAIL
ERR_TAG_READ_FAIL

Figure 31 PROGRAM_ID Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code		
0x00		
1 byte	127 bytes	

Table 30 PROGRAM_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE 0x00
ERR_PROG_ID_FAIL	This field would be set to 0xEB
ERR_TAG_READ_FAIL	This field would be set to 0xEA

4.6.8 VERIFY ID Sub-Command

All tags receiving the VERIFY_ID command will reply with their CRC, followed by their entire ID (MSB of the identifier first), followed by their Password. A tag that has successfully executed the LOCK_ID command ignores this command.

It should be noted that an all "0" or totally blank 64-bit tags cannot be read successfully by the VERIFY_ID sub-command. Because the tags are blank, they will be erroneously identified as 96-bit tags. But since they will only return 64-bits, the reader will misinterpret this and return an error.

The VERIFY_ID sub-command contains the following message format:

Figure 32 VERIFY_ID Sub-Command Message Format

MSB		LSB
Message		
Command	Parameters	
	Sub-Command	Parameters
0x03	0x03	
1 byte	1 byte	126 bytes

4.6.8.1 VERIFY ID Sub-Command Status Message

The VERIFY ID sub-command status message will contain a CRC, EPC ID Code and Password. The VERIFY ID sub-command status message contains the following message format:

Figure 33 VERIFY_ID Sub-Command Status Message Format

MSB					LSB
Message					
Status	Response				
0x00	Tag Count	EPC ID Code	Password	CRC	
1 byte	1 byte	12 bytes	1 byte	2 bytes	111 bytes

Table 31 VERIFY_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TAG COUNT	This field indicates the number of tags to be reported in this message
EPC ID CODE	This field contains the EPC tag ID code (up to 96 bits), MSB first
PASSWORD	This field contains the 8-bit password received from the EPC tag, MSB first
CRC	This field contains the 16-bit CRC response from the tag, MSB first

Upon error, an ERR_TAG_READ_FAIL status message (0xEA) is sent to the host.

4.6.8.2 VERIFY_ID Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 34 VERIFY_ID Sub-Command Summary Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Total Tag Count	
0x00		
1 byte	2 byte	125 bytes

Table 32 VERIFY_ID Sub-Command Summary Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.6.9 LOCK ID Sub-Command

The LOCK_ID command prevents any further modification of the tag ID, CRC, and Password. In order to implement the LOCK_ID command, the Reader first sends a VERIFY_ID command to the tag in order to retrieve the CRC, Tag ID, and Password information. The Reader then sends a LOCK_ID command to the tag to lock the tag information. The Reader further verifies the LOCK_ID command execution by sending a VERIFY_ID command. If the reader gets the CRC, Tag ID, and Password from the tag, the LOCK_ID command failed. No response signifies a successful LOCK_ID command execution. Failure to lock a tag is reported back with the appropriate status error code.

Figure 35 LOCK_ID Sub-Command Message Format

MSB			LSB
Message			
Command	Parameters		
	Sub-Command	Parameters	
0x03	0x04	Password	
1 byte	1 byte	1 byte	125 bytes

Table 33 LOCK_ID Sub-Command Field Definitions

Field	Definition
PASSWORD	8-bit Password

4.6.9.1 LOCK ID Sub-Command Status Message

Once the tag has been locked a status message will be sent to the host indicating the command execution result. A status complete status message indicates the tag was locked successfully. Otherwise, an error status message is sent indicating any of the following error conditions upon locking a tag:

ERR_TAG_READ_FAIL
ERR_LOCK_ID_FAIL

Figure 36 LOCK_ID Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code		
0x00		
1 byte	127 bytes	

Table 34 LOCK_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE 0x00
ERR_INVALID_PARAM	This will return a 0xFD
ERR_TAG_READ_FAIL	This will return a 0xEA
ERR_LOCK_ID_FAIL	This will return a 0xE8

4.6.10 ERASE ID Sub-Command

The ERASE_ID command sets all bits of the tag ID, CRC, and Password to '0'. A tag that has successfully executed the LOCK_ID command ignores the ERASE_ID command.

In order to implement the ERASE_ID command, the Reader sends an ERASE_ID command to the tag to erase all tag information. The Reader further verifies the ERASE_ID command execution by sending a VERIFY_ID command. If the reader receives non-zero values for the CRC, Tag ID, and Password from the tag, the ERASE_ID command failed. A successful ERASE_ID command execution is defined as a tag response of all zeros in the CRC, Tag ID, and Password fields. Failure to erase a tag is reported back with the appropriate status error code.

Figure 37 ERASE_ID Sub-Command Message Format

MSB		LSB
Message		
Command	Parameters	
	Sub-Command	Parameters
0x03	0x05	
1 byte	1 byte	126 bytes

4.6.10.1 ERASE ID Sub-Command Status Message

Once the tag has been erased a status message will be sent to the host indicating the command execution result. A STATUS_COMPLETE status message indicates the tag was erased successfully. Otherwise, an error status message is sent indicating any of the following error conditions upon erasing a tag:

ERR_ERASE_ID_FAIL
ERR_TAG_READ_FAIL

Figure 38 ERASE_ID Sub-Command Status Message

MSB		LSB
Message		
Status	Response	
Status Code		
0x00		
1 byte	127 bytes	

Table 35 ERASE_ID Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
ERR_ERASE_ID_FAIL	This field will return a 0xE9
ERR_TAG_READ_FAIL	This field will return a 0xEA

4.7 Class 1 Generation 2 Commands

The following section describes the command messages used to support Class 1 Generation 2 tags. Class 1 Generation 2 tags may be read and written. The Command Code 0x04 is for TAG_2 (Class 1 Generation 2) tag commands.

Figure 39 Class 1 Generation 2 Command Format

MSB		LSB
	Message	
Command Code	Parameters	
0x04	Sub-Command Code	Parameters
1 byte	1 byte	1-126 bytes

4.7.1 Class 1 Generation 2 Sub-Commands

The Class 1 Generation 2 command utilizes sub-commands and parameters in the following manner.

Table 36 Class 1 Generation 2 Sub-Commands

Sub-Command	Code	Description	Return Status Message
KILL	0xFF	Kill a Class 1 Generation 2 tag	Yes
SET	0x00	This command is used to set the RF power level and modulation depth.	Yes
READ	0x01	Read Class 1 Generation 2 tags	Yes
PROGRAM	0x02	All Class 1 Generation 2 tags receiving this command will program the specified tag id in memory.	Yes
LOCK	0x03	This command prevents any further modification of the data stored on the tag	Yes

4.7.2 KILL Sub-Command

The KILL sub-command is used to render tags non-operational. The KILL sub-command contains the following message format:

Figure 40 KILL Sub-Command Message Format

MSB						LSB
Message						
Command	Parameters					
	Sub-Command	Parameters				
0x04	0xFF	Q value	Tag ID Bit Count	Kill Password	Tag ID	
1 byte	1 byte	1 bytes	1 byte	4 bytes	32 bytes	88 bytes

Table 37 KILL Sub-Command Field Definitions

Field	Definition
Q Value	Q Value for interrogation session with tags
Tag ID Bit Count	This field should be set to the number of bits in the tag id
Kill Password	The KILL password that is programmed onto the tag to be killed
TAG_ID	This is the Tag ID bits to be used in addressing a single tag that is to be killed

4.7.2.1 KILL Sub-Command Status Message

The KILL sub-command status message contains the following message format:

Figure 41 KILL Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	
0x00		
1 byte	2 bytes	126 bytes

Table 38 KILL Sub-Command Status Field Definitions

Field	Definition
STATUS	This field should be set to STATUS_COMPLETE
TAG_COUNT	Number of tags killed (0x0000 or more, MSB first)

4.7.3 SET Sub-Command

The SET sub-command contains the following message format:

Figure 42 SET Sub-Command Message Format

MSB				LSB
Message				
Command	Parameters			
	Sub-Command	Parameters		
0x04	0x00	RF Level	Mod Depth	
1 byte	1 byte	1 byte	1 byte	124 bytes

Table 39 SET Sub-Command Field Definitions

Field	Definition
RF_LEVEL	RF power level to be used for reading Class 1 Generation 2 tags
	NO_CHG (0x00) - The current RF setting is to remain unchanged
	Setting (0x01 . . . 0x10) - +15 dBm to +30 dBm in 16 steps of 1 dB
MOD_DEPTH	Modulation depth to be used for reading Class 1 Generation 2 tags
	NO_CHG (0x00) - The current RF setting is to remain unchanged
	Setting (0x01 . . . 0x20) – 20 % to 95 % in steps of ~2.42 %

4.7.3.1 SET Sub-Command Status Message

The SET sub-command status message contains the following command message format:

Figure 43 SET Sub-Command Status Message Format

MSB			LSB
Message			
Status	Response		
	RF level	Mod Depth	
0x00			
1 byte	1 byte	1 byte	125 bytes

Table 40 SET Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to ERR_NONE
RF_LEVEL	This is the Forward Power A/D target value for power control
MOD_DEPTH	This is the current Modulation Depth setting

4.7.4 READ Sub-Command

The READ sub-command is used to read tags. The READ sub-command contains the following message format:

Figure 44 READ Sub-Command Message Format

MSB					LSB
Message					
Command	Parameters				
	Sub-Command	Parameters			
0x04	0x01	Q value	Filter Bit Count	Filter_Bits	
1 byte	1 byte	1 byte	1 byte	32 bytes	92 bytes

Table 41 READ Sub-Command Field Definitions

Field	Definition
Q Value	Q Value for interrogation session with tags
FILTER_BIT_COUNT	Number of filter bits to follow (0..96). Filter bit count of 0 indicates no filter bits.
FILTER_BITS	Holding filter bits, based on Filter_Bit_Count

4.7.4.1 READ Sub-Command Status Message

Figure 45 READ Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	Tag ID Length - Tag ID
0x01		
1 byte	1 byte	126 bytes

Table 42 READ Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to IN_PROGRESS
TAG_COUNT	The number of tags reported in this message
Tag ID Length - Tag ID	A sequence of 1 or more tag lengths combined with tag IDs. The first byte will contain the length of the tag ID that follows, whether 64 or 96 bit (0x40 or 0x60), and the bytes that follow will contain the Tag ID up to the length specified in the first byte. Subsequent tag IDs will follow this same pattern.

If any tags are singulated and read, this command will return multiple messages. After all tags have been reported, the reader will send a final summary message to the host.

4.7.4.2 READ Sub-Command Summary Status Message

After all tags have been reported, the reader will send a final summary status message to the host.

Figure 46 READ Sub-Command Summary Status Message Format

MSB			LSB
Message			
Status	Response		
Status Code	Total Tag Count		
0x00			
1 byte	2 bytes	125 bytes	

Table 43 READ Sub-Command Summary Status Message Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TOTAL_TAG_COUNT	Total number of tags reported

4.7.5 PROGRAM Sub-Command

The PROGRAM sub-command is used to program an EPC ID into a Class 1 generation 2 tag. The PROGRAM sub-command contains the following message format:

Figure 47 PROGRAM Sub-Command Message Format

MSB						LSB
Message						
Command	Parameters					
	Sub-Command	Parameters				
0x04	0x02	Q value	Tag ID Bit Count	Kill Password	Tag ID	
1 byte	1 byte	1 byte	1 byte	4 bytes	32 bytes	88 bytes

Table 44 PROGRAM Sub-Command Field Definitions

Field	Definition
Q Value	Q Value for interrogation session with tags
Tag ID Bit Count	This field should be set to the number of bits in the tag id
Kill Password	The KILL password to be programmed onto the tag to allow it to be killed in the future
TAG_ID	This is the Tag ID to be programmed into the tag

4.7.5.1 PROGRAM Sub-Command Status Message

The PROGRAM sub-command status message contains the following message format:

Figure 48 PROGRAM Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	
0x00		
1 byte	2 bytes	126 bytes

Table 45 PROGRAM Sub-Command Status Field Definitions

Field	Definition
STATUS	This field should be set to STATUS_COMPLETE
TAG_COUNT	Number of tags programmed

4.7.6 LOCK Sub-Command

The LOCK sub-command prevents further modification of the EPC ID and the Kill password stored on a tag. The LOCK sub-command contains the following message format:

Figure 49 LOCK Sub-Command Message Format

MSB					LSB
Message					
Command	Parameters				
	Sub-Command	Parameters			
0x04	0x03	Q value	Tag ID Bit Count	Tag ID	
1 byte	1 byte	1 byte	1 byte	32 bytes	92 bytes

Table 46 LOCK Sub-Command Field Definitions

Field	Definition
Q Value	Q Value for interrogation session with tags
Tag ID Bit Count	This field holds the number of bits in the tag id
TAG_ID	This is the ID of the tag to be locked

4.7.6.1 C1G2 LOCK Sub-Command Status Message

Figure 50 LOCK Sub-Command Status Message Format

MSB		LSB
Message		
Status	Response	
Status Code	Tag Count	
0x00		
1 byte	1 byte	126 bytes

Table 47 LOCK Sub-Command Status Field Definitions

Field	Definition
STATUS CODE	This field should be set to STATUS_COMPLETE
TAG_COUNT	The number of tags locked

5.0 Troubleshooting

This section is intended to help you identify and correct some common problems that can occur. For additional information or assistance with any query, please call SIRIT at 1-877-492-0101, ext. 2550.

No Response from Reader

Checklist	Solution
Check that the external power supply is plugged into a 120 VAC 60 Hz outlet	Correct voltage problem.
Check physical connection to serial port of the Host PC	Correct any connection issue at serial interface connector.
Check that serial communications parameters are correct (115200bps, 8 data bits, no parity, 1 stop bit)	Correct settings of serial communications port.
Check that serial commands are properly constructed	Correct commands to conform to serial protocol as specified in Section 4

Tags Will Not Read

Checklist	Solution
Check that the external power supply is plugged into a 120 VAC 60 Hz outlet	Correct voltage problem.
Check for proper reader response to commands	If reader does not respond per serial protocol as specified in Section 4, perform “No Response” troubleshooting.
Check reader response to serial commands for error codes	If Status field of reader response is “FF”, look up error code in Response field in section 4
Check serial command to reader for proper command	Correct command (i.e., Make sure to use Class 0 read command for Class 0 tags).
Check for working tags in read zone	Make sure tags are functional, and making contact with the top of the reader.
Check tag environment	UHF tags will not function well in some environments, such as in close proximity to metal.

Intermittent Tag Reads

Checklist	Solution
Check for working tags in read zone	Make sure tags are functional, and in contact with the top of the reader.
Check tag environment	UHF tags will not function well in some environments, such as in close proximity to metal.

Appendix A CRC Calculation

This section shows how to calculate the CCITT CRC-16 over the entire body of the message. The CCITT CRC-16 is calculated starting with the LENGTH byte and continuing through the length -2. The final two CRC bytes are not included in the calculation but should be checked against the CCITT CRC-16 for a match.

A typical command string, the Notify Command, with this CRC Calculated follows:

01 05 00 00 27 6C

Where the 01 is the SOF byte, the 05 is the length and 00 00 is the command for the Notify Command with the 276C as the correctly calculated CRC.

Here is a “C” language listing that shows the CCITT CRC-16 calculation.

```
// ***********************************************************************************************
//
// CRC_Calc
// Calculates CCITT-CRC for IDentity MaX Desktop RFID reader
//
// Version 1.0
//
// This routine calculates the two byte CCITT-CRC for command and data messages for the IDentity MaX Desktop reader UHF
RFID
// Reader.
//
// Inputs: Place the entire message to be transmitted including SOH and two empty bytes for CRC into an array.
// In this demo case CommandArray and the total length of the command in the length variable, CommandLength
// are passed. These are passed into "bytearray[]" and "arraylength" variables of the routine.
//
// Outputs: This routine will return the value of the two-byte CRC which is calculated in the variable "crc".
//
// The routine begins with array index [1], and goes to array length -2. You will have to move the two bytes returned
// into the last two bytes of the array before transmitting the command. You can also use it to verify received
// commands by checking the entire length, i.e. set your length to two more than the actual length of the command. If
// the returned, the CRC is "0000" then the command is valid
//
// ***********************************************************************************************

#include <stdio.h>
#include <stdlib.h>

unsigned short CRC_Calc(char bytearray[256],int arraylength)
{
        unsigned short crc = 0xFFFF;                    // Preload to FFFF
        unsigned short tempresults;                     // Just a temporary results holder
        unsigned short bitindex;                        // 0 - 7
        unsigned short byteindex;                       // The byte pointer into the byte
                                                        // array that holds
```

```
                                                        // the command to be checked.

        unsigned char  placeholder;                     // A place to put the byte while we
                                                        // work on it.

        for (byteindex = 1; byteindex <= (arraylength - 3); byteindex++)    // begin checking after SOH and
                                                                            // before CRC bytes
        {
                placeholder = bytearray[byteindex];
                for(bitindex = 0; bitindex <= 7; bitindex++)
                {
                tempresults = (crc >> 15) ^ (placeholder >> 7);     // Shift CRC right 15 bits then do a
                                                                    // bitwise XOR
                crc <<= 1;                                          // Shift CRC left one bit and store it
                                                                    // in CRC
                if(tempresults)
                   {
                   crc ^= 0x1021;
                                                                    // Standard CCITT Polynomial
                                                                    // X16+X12+X5+1
                   }
                placeholder <<= 1;
                }
        }
        return crc;                                     // Returns the CRC calculated in
                                                        // the variable crc
}
```

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