Bluetooth MagneSafe V5 Swipe Reader

TECHNICAL REFERENCE MANUAL

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REVISIONS

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1.01	24 Apr 2009	Initial Release
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3.01	19 April 2011	Updated MP flags property

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This equipment has been tested and was found to comply with the limits for a Class B digital device pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation.

FCC COMPLIANCE STATEMENT

This device complies with Part 15 of the FCC Rules. Operation of this device 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.

CANADIAN DOC STATEMENT

This digital apparatus does not exceed the Class B limits for radio noise from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le Réglement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numériqué de la classe B est conformé à la norme NMB-003 du Canada.

CE STANDARDS

Testing for compliance with CE requirements was performed by an independent laboratory. The unit under test was found compliant with standards established for Class B devices.

UL/CSA

This product is recognized per Underwriter Laboratories and Canadian Underwriter Laboratories 1950.

RoHS STATEMENT

When ordered as RoHS compliant, this product meets the Electrical and Electronic Equipment (EEE) Reduction of Hazardous Substances (RoHS) European Directive 2002/95/EC. The marking is clearly recognizable, either as written words like "Pb-free", "lead-free", or as another clear symbol (Pb).

BLUETOOTH WARNING STATEMENTS

The reader contains Bluetooth Transmitter Module FCC ID: T9JRN41-1.

CAUTION 1: The radiated output power of the Bluetooth reader is far below the FCC radio frequency exposure limits. Nevertheless, the Bluetooth reader should be used in such a manner that the potential for human contact during normal operation is minimized. To avoid the possibility of exceeding the FCC radio frequency exposure limits, you should keep a distance of at least 20 cm between you (or any other person in the vicinity) and the antenna that is built into the Bluetooth reader.

CAUTION 2: This device has been evaluated for and shown compliant with the FCC RF exposure limits under portable exposure conditions (antennae are within 20 cm of a person's body) when installed in certain specific OEM configurations.

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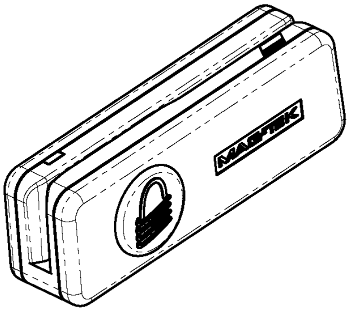


Figure 1-1. Bluetooth MagneSafe Swipe Reader

SECTION 1. FEATURES AND SPECIFICATIONS

The Bluetooth MagneSafe Swipe Reader is a compact, handheld magnetic stripe card reader that conforms to ISO standards. In addition to reading multiple tracks of data from a card, this Reader also includes MagnePrint technology and data encryption. The MagnePrint data will be included with the track data on each transaction. In order to maximize card security, this Reader incorporates data encryption to protect the card contents and the MagnePrint information. The Reader is compatible with any device having a host Bluetooth interface. A card is read by sliding it, stripe down and facing away from the LED side, through the slot either forward or backward.

An LED (Light Emitting Diode) indicator on the Reader panel provides the operator with continuous status of the Reader operations.

When a card is swiped through the Reader, the track data and MagnePrint information will be TDEA (Triple Data Encryption Algorithm, aka Triple DES) encrypted using DUKPT (Derived Unique Key Per Transaction) key management. This method of key management uses a base derivation key to encrypt a key serial number that produces an initial encryption key which is injected into the Reader prior to deployment. After each transaction, the encryption key is modified per the DUKPT algorithm so that each transaction uses a unique key. Thus, the data will be encrypted with a different encryption key for each transaction.

FEATURES

Major features of the Bluetooth Swipe Reader are as follows:

- Powered by a rechargeable battery; recharging can be provided via a standard USB cable (for recharging only)
- Compatible with any device that supports Bluetooth virtual serial port profile (SPP)
- Bi-directional card reading
- Reads encoded data that meets ANSI/ISO/AAMVA standards and some custom formats such as ISO track 1 format on track 2 or 3
- Reads up to three tracks of card data
- Red/Green/Amber LED for status
- Non-volatile memory for property storage
- Supplies 54 byte MagnePrint™ value
- Contains a unique, non-changeable device serial number which allows tracking each reader
- Encrypts all track data and the MagnePrint value
- Provides clear text confirmation data including card holder's name, expiration date, and a portion of the PAN as part of the Masked Track Data
- Mutual Authentication Mode for use with Magensa®

HARDWARE CONFIGURATION

The hardware configuration is as follows:

Part Number	Tracks	Style	Interface	Cable
21073021	1, 2, 3	BT90	Bluetooth	N/R*

* No cable is required to operate the reader but one of the cables listed below can be used to charge the battery.

ACCESSORIES

The accessories are as follows:

Part Number	Description	Notes
21051515	USB-A TO USB-Mini-B Gray, 750mm Cable	For battery charging Bluetooth readers
21051516	USB-A TO USB-Mini-B Gray, 1200mm Coiled Cable	For battery charging Bluetooth readers
51300010	Bluetooth USB 2.0 Adapter	For interface to PC

REFERENCE DOCUMENTS

ANS X9.24-2004 Retail Financial Services Symmetric Key Management Part 1: Using Symmetric Techniques

SPECIFICATIONS

Table 1-2 lists the specifications for the Bluetooth MagneSafe Reader. Figure 1-2 shows the dimensions of the Reader.

Table 1-2. Specifications

Reference Standards	ISO 7810 and ISO 7811; AAMVA*
Power Input	USB port or 5 VDC for battery charging
Time to Charge Battery	About 4.5 hours (from a fully discharged state)
Recording Method	Two-frequency coherent phase (F2F)
Message Format	ASCII
Card Speed	4 to 60 ips (10.1 to 152.4 cm/s)
Card Swipes per Full Charge	Over 500 swipes
ELECTRICAL	
Current	100mA maximum during charge
MECHANICAL – BT90 Bluetooth	
Dimensions	Length 3.49” (88.65mm) Width 0.90” (22.86mm) Height 1.17” (29.72mm)
Weight	1.4 oz. (39.7 gr)
Cable length	n/a
Connector	USB Mini B 5-pin
ENVIRONMENTAL	
Temperature	
Operating	0 °C to 45 °C ((32 °F to 113 °F)
Storage	-20 °C to 60 °C (-4 °F to 140 °F)
Humidity	
Operating	10% to 90% noncondensing
Storage	10% to 90% noncondensing

* ISO (International Standards Organization) and AAMVA (American Association of Motor Vehicle Administrators).

SECTION 2. INSTALLATION

This section describes the cable connection and the Windows setup.

BLUETOOTH CONNECTION

On hosts with the Windows operating system, the Bluetooth reader appears as a virtual COM port. Use the Windows Bluetooth installation utility or, if using another Bluetooth adapter, follow the directions for that device.

See Appendix B or Appendix C for connection information.

SECTION 3. OPERATION

ACTIVE INTERFACE

This reader communicates either via the Bluetooth interface or via the USB interface. When it first powers up, if the USB cable is attached, it is receptive to commands on both interfaces. Once it receives a command on one interface, that interface becomes the Active Interface and the other interface is disabled. The Active Interface stays active until the reader is disconnected from the USB cable or a Relinquish Interface command is received. A Relinquish Interface command causes both interfaces to be receptive to commands again.

If the reader is connected to a USB cable and the Active Interface is Bluetooth, any event that would cause the reader to power down if it were not connected to the USB cable will have the same effect as a Relinquish Interface command.

The intention here is to allow the user to communicate with the reader using whichever interface is convenient while giving the user a method to enable the other interface at any time. For a more detailed description of the USB interface, please refer to the USB MagneSafe V5 Swipe and Insert Reader Technical Reference Manual (99875388).

USER SWITCH

The User Switch, or Power Switch, is located on the side of the reader. Pressing the User Switch when the reader is off will turn the reader on. The reader will stay on for a predetermined amount of time (the default is 120 seconds) or until the completion of a card read transaction. Pressing the User Switch briefly when the reader is on will extend the Activity Timer to its full period, avoiding having the reader turn off due to inactivity.

If the power is already on, pressing the User Switch and holding it for three seconds will turn the reader off.

LED INDICATOR

The LED indicator will be either off, red, green, or amber. When the reader is not powered, the LED will be off.

When the Bluetooth reader is first turned on, the LED will flash amber and then go to solid green unless the battery power is too low, in which case it will be red for two seconds then turn solid green. When the reader shows a solid green, the reader is either awaiting Authentication (if configured to require Authentication), or armed to read (if configured NOT to require Authentication). When the Bluetooth reader is attached to a USB cable or other 5 volt power source, the battery will begin charging. The LED will *slowly* blink amber while the battery is charging and then turn solid amber when the battery is fully charged.

If enabled to operate with authentication (Security Level 4) and when the host completes Authentication successfully, the LED will blink green; the reader is now armed to read a card. If the host fails an Authentication sequence, the LED will turn solid red and stay red until either the host completes Authentication successfully or the reader is powered down.

When a card is being swiped, the LED will turn off temporarily until the swipe is completed. If there are no errors after decoding the card data, then the LED will turn green for approximately two seconds to indicate a successful read and remain green for two seconds to indicate a successful read and then turns off as the reader powers down.. If there are any errors after decoding the card data, the LED will turn red for approximately two seconds to indicate that an error occurred and then turn solid green to indicate that the card can be swiped again for another try; the retries can go on indefinitely until a good read or until power goes off.

After a card swipe, when data should be transmitted on the Bluetooth connection, if the connection is not available, the green LED will blink rapidly (10 times a second) until the connection becomes available (when data is transmitted), the user holds the user switch down for three seconds, the reader times out, or the battery power is too low. If the connection is established the data is transmitted and the LED goes green or red to indicate transmission of good or bad data.

CARD READ

A card may be swiped through the Reader slot when the LED is solid green or flashing green. The magnetic stripe must face toward the head (as indicated by a card image on the top of the reader) and may be swiped in either direction. If there is data encoded on the card, the reader will attempt to read the data, encrypt it, and then send the encrypted results to the host. After the results are sent to the host, the reader will automatically turn off.

READER STATES

This reader may be operated so that it *requires* Mutual Authentication with a Host in order to transmit card data to the Host. When this mode of operation is required, the application software (not necessarily the Authenticating Host) may need to know the state of the reader at any given moment. This can be done using the ***Get Reader State Command***. The application may retrieve this state at any time to get a clear definition of the reader’s operation at any given moment.

For convenience, this manual refers to states with the notation State:Antecedent (e.g., WaitActAuth:BadSwipe). State definitions can be found at the definition of the ***Get Reader State Command***.

In most cases, the application could also track the state by inference. As the application interacts with the reader, most state transitions are marked by commands and responses exchanged with the reader. The exception to this concept is the transition from WaitActRply:x to WaitActAuth:TOAuth. This state transition occurs as the result of a timeout and the transition is not reported to the Host. As the reader was waiting for the Host to send the Activation Challenge Reply command and the Host set the time limit that the reader should wait, the Host should be aware that a timeout *could* occur. If the reader does time out and the Host sends the Activation Challenge Reply command, the reader will return RC = 07 (Sequence error).

Examples of Host/Application/Reader interaction and state transitions:

Example 1 – Power Up followed by Authentication and good swipe:

1. Reader Powers Up (State = WaitActAuth:PU). The application should send the Get Reader State Command to discover the current state of the reader.
2. Host sends valid Activate Authenticated Mode command (State => WaitActRply:PU). Reader responds with RC = 0x00 inferring the transition to the WaitActRply:PU state.
3. Host sends valid Activation Challenge Reply command (State => WaitSwipe:PU). Reader responds with RC = 0x00 inferring the transition to the WaitSwipe:PU state.
4. User Swipes a card correctly (State => WaitActAuth:GoodSwipe). Reader sends the card data to the Host inferring the transition to the WaitActAuth:GoodSwipe state.

Example 2 – Reader times out waiting for swipe:

1. Reader waiting (State = WaitActAuth:GoodSwipe). This is after a good swipe. The application may send the Get Reader State Command to discover the current state of the reader.
2. Host sends valid Activate Authenticated Mode command (State => WaitActRply:GoodSwipe). Reader responds with RC = 0x00 inferring the transition to the WaitActRply:GoodSwipe state.
3. Host sends valid Activation Challenge Reply command (State => WaitSwipe:GoodSwipe). Reader responds with RC = 0x00 inferring the transition to the WaitSwipe:GoodSwipe state.
4. Timer expires (State => WaitActAuth:TOSwipe). Reader sends “card data” to the Host with no data, just a report about the Time Out (see Reader Encryption Status); the Host infers the transition to WaitActAuth:TOSwipe state.

Example 3 – Host sends invalid Activation Challenge Reply command:

1. Reader Waiting (State = WaitActAuth:GoodSwipe). This is after a good swipe. Application may send the Get Reader State Command to discover the current state of the reader.
2. Host sends valid Activate Authenticated Mode command (State => WaitActRply:GoodSwipe). Reader responds with RC=0x00 inferring the transition to the WaitActRply:GoodSwipe state.
3. Host sends *invalid* Activation Challenge Reply command (State => WaitActAuth:FailAuth). Reader responds with RC = 0x02 or 0x04 inferring the transition to the WaitActAuth:FailAuth state.

Example 4 – Host waits too long sending the Activation Challenge Reply command:

1. Reader Waiting (State = WaitActAuth:GoodSwipe). This is after a good swipe. Application may send the Get Reader State Command to discover the current state of the reader.
2. Host sends valid Activate Authenticated Mode command (State => WaitActRply:GoodSwipe). Reader responds with RC=0x00 inferring the transition to the WaitActRply:GoodSwipe state.
3. Reader times out waiting for Host to send Activation Challenge Reply command (State => WaitActAuth:TOAuth). Host doesn't know because the reader cannot/does not send any message.
4. Host finally sends Activation Challenge Reply command (State remains WaitActAuth:TOAuth). Reader responds with RC=0x07 inferring the previous transition to WaitActAuth:TOAuth state.

CHARGING THE BLUETOOTH READER BATTERY

As mentioned above (LED Indicator), the Bluetooth reader may indicate low battery at power up. The first time this happens there will probably be sufficient battery available for several more card swipes, but the battery should be charged soon. If the low battery warning is ignored and the battery gets too low, the reader will refuse to power up until it has been charged.

Charge the reader by connecting it to any USB port on a running system or a compatible 5VDC source. For best results, allow the battery to charge fully (until the LED goes to steady amber) before using the reader again.

SECTION 4. SECURITY

This reader is a secure reader. Security features include:

- Supplies 54 byte MagnePrint value
- Includes Device Serial Number
- Encrypts all track data and the MagnePrint value
- Provides clear text confirmation data including card holder's name, expiration date, and a portion of the PAN as part of the Masked Track Data
- Supports Mutual Authentication Mode for use with Magensa
- Offers selectable levels of Security

The reader supports two Security Levels. The Security Level can be increased by command, but can never be decreased.

SECURITY LEVEL 3

Security Level 3 enables encryption of track data, MagnePrint data, and the Session ID. MagnePrint data is always included and it is always encrypted. The format for the data is detailed later in this document. At Security Level 3, many commands require security—most notably, the **Set Property** command. Transition to Security Level 4 requires security.

SECURITY LEVEL 4

When the reader is at Security Level 4, a correctly executed Authentication Sequence is required before the reader will emit data from a card swipe. Correctly executing the Authentication Sequence also causes the Green LED to blink, alerting the user to the fact that the reader is being controlled by a Host with knowledge of the keys—that is, an Authentic Host.

Commands that require security must be sent with a four byte Message Authentication Code (MAC) appended to the end. The MAC is calculated as specified in ANSI X9.24 Part 1 – 2004, Annex A. Note that data supplied to the MAC algorithm should NOT be converted to the ASCII-Hex, rather it should be supplied in its raw binary form. The MAC key to be used is as specified in the same document ("Request PIN Entry 2" bullet 2). Calculating the MAC requires knowledge of the current DUKPT KSN, this could be retrieved using the **Get DUKPT KSN and Counter** command. For each command processed successfully, the DUKPT Key is advanced.

COMMANDS AND SECURITY LEVELS

The following table shows how security levels affect the various commands. "Y" means the command can run. "N" means the command is prohibited. "S" means the command is protected (requires MACing). "X" means other (notes to follow).

Command	Level 3	Level 4
Get Property	Y	Y
Set Property	S	S
Reset	X*	X*
Get DUKPT SN and Counter	Y	Y
Set Session ID	Y	Y
Activate Authenticated Mode	Y	Y
Activation Challenge Reply	Y	Y
Deactivate Authenticated Mode	Y	Y
Get Reader State	Y	Y
Set Security Level	S	S
Get Encryption Counter	Y	Y
Relinquish Interface	Y	Y
Power Down	Y	Y
Get Battery Status	Y	Y

* The Reset command has special behavior. When an Authentication sequence has failed, only a correctly MACed Reset command can be used to reset the reader. This is to prevent a dictionary attack on the keys and to minimize a denial of service attack.

SECTION 5. COMMUNICATIONS

CARD DATA

The details about how the card data and commands are structured follow later in this section. Windows applications that communicate with this reader can be easily developed.

The reader will send only one swipe message per card swipe. When a card is swiped, the swipe message will be sent even if the data is not decodable. If no data is detected on a track then nothing will be transmitted for that track. If an error is detected on a track, the ASCII character "E" will be sent in place of the track data to indicate an error. The LED will come on for about two seconds and another swipe will be allowed. Data from the bad swipe is still transmitted.

A Swipe Message is composed of readable ASCII characters. It includes:

- Structural ASCII characters intended to give clues to the structure of the rest of the data.
- Simple ASCII fields that convey the ASCII representation of:

  Masked Track Data
  Device Serial Number
  Format Code
- Binary fields that use sets of two ASCII characters representing hexadecimal digits to convey the binary value of each byte in the field. The Binary fields are:

  Reader Encryption Status
  Encrypted Track Data
  MagnePrint Status
  Encrypted MagnePrint Data
  Encrypted Session ID
  DUKPT Key Serial Number
  Clear Text CRC
  Encrypted CRC

For the encrypted fields, the original binary bytes are encrypted using the DES CBC mode with an Initialization Vector starting at all binary zeroes and the PIN Encryption Key associated with the current DUKPT KSN. This is done in segments of 8 bytes. If the last segment of the original data is less than eight bytes long (track data only), the last bytes of the block will be set to binary zeroes before encrypting. When decrypting track data, the End Sentinel can be used to find the actual end of the data (ignoring the final zeroes). Each byte of encrypted data is then converted to *two* bytes of ASCII data representing the Hexadecimal value of the encrypted byte (many of the encrypted bytes will not have values in the ASCII character range).

The card data format for all programmable configuration options is as follows:

[P30]
[P32] [Tk1 SS] [Tk1 Masked Data] [ES] [P33]
[P32] [Tk2 SS] [Tk2 Masked Data] [ES] [P33]
[P32] [Tk3 SS] [Tk3 Masked Data] [ES] [P33]
[P31]
[P35] [Reader Encryption Status]
[P35] [Tk1 Encrypted Data (including TK1 SS and ES)]
[P35] [Tk2 Encrypted Data (including TK2 SS and ES)]
[P35] [Tk3 Encrypted Data (including TK3 SS and ES)]
[P35] [MagnePrint Status]
[P35] [Encrypted MagnePrint data]
[P35] [Device serial number]
[P35] [Encrypted Session ID]
[P35] [DUKPT serial number/counter]
[P35] [Encryption Counter] (optional, off by default)
[P35] [Clear Text CRC]
[P35] [Encrypted CRC]
[P35] [Format Code]
[P34]

The characters and fields are described in the list below. The Property ID (e.g., P13) is the decimal value of the property ID in the command list (see **Pre Card String**).

Label	Property ID	P-Value	Description	Default
	0x1E	P30	Pre card string	0 (0x00)
	0x1F	P31	Post card string	0 (0x00)
	0x20	P32	Pre track string	0 (0x00)
	0x21	P33	Post track string	0 (0x00)
	0x22	P34	Terminating string	C/R (0x0D)
	0x23	P35	Programmable field separator	"|" (0x7C)
Tk1 SS	0x24		ISO/ABA start sentinel	"%" (0x25)
Tk2-SS	0x25		ISO/ABA 5-bit start sentinel	";" (0x3B)
Tk3-SS	0x26		ISO/ABA start sentinel	"+" (0x2B)
Tk3-SS AAMVA	0x27		AAMVA start sentinel	"#" (0x23)
Tk2-SS 7 bit	0x28		7 bit start sentinel (ISO/ABA Track 1 start sentinel)	"@"(0x40)
Tk3-SS 7 bit	0x29		7 bit start sentinel (ISO/ABA Track 1 start sentinel)	"&"(0x26)
ES	0x2B 0x2D 0x2E 0x2F		End Sentinel (for all tracks) Track 1 Specific End Sentinel Track 2 Specific End Sentinel Track 3 Specific End Sentinel	"?" (0x3F) "?" (0x3F) "?" (0x3F) "?" (0x3F)

Track 1, Track 2 and Track 3 Encrypted Data includes the Start and End Sentinel that were decoded from the card.

All fields with the format P## are programmable configuration property numbers. They are described in detail later in this document.

Masked Track Data

If decodable track data exists for a given track, it is located in the Masked Track Data field that corresponds to the track number. The length of each Masked Track Data field is fixed at 112 bytes, but the length of valid data in each field is determined by the Masked Track Data Length field that corresponds to the track number. Masked Track Data located in positions greater than indicated in the Masked Track Data Length field are undefined and should be ignored.

The Masked Track Data is decoded and converted to ASCII and then it is "masked." The Masked Track Data includes all data starting with the start sentinel and ending with the end sentinel. Much of the data is "masked;" a specified mask character is sent instead of the actual character read from the track. Which characters are masked depends on the format of the card. Only ISO/ABA (Financial Cards with Format Code B) and AAMVA cards are selectively masked; all other card types are either wholly masked or wholly clear. There is a separate masking property for ISO/ABA cards and AAMVA cards. See the ISO Track Masking property and the AAMVA Track Masking property for more information. Refer to Appendix E for a description of how ISO/ABA and AAMVA cards are identified.

Each of these properties allows the application to specify masking details for the Primary Account Number and Driver's License / ID Number (DL/ID#), the masking character to be used, and whether a correction should be applied to make the Mod 10 (Luhn algorithm) digit at the end of the number be correct.

Track 1 Masked Data

This Simple ASCII field contains the Masked Track Data for track 1. All characters are transmitted.

For an ISO/ABA card, the PAN is masked as follows:

> The specified number of initial characters is sent unmasked. The specified number of trailing characters is sent unmasked. If Mod 10 correction is specified, all but one of the intermediate characters of the PAN are set to zero; one of them will be set such that the last digit of the PAN calculates an accurate Mod 10 check of the rest of the PAN *as transmitted*. If the Mod 10 correction is not specified, all of the intermediate characters of the PAN are set to the specified mask character.
>
> The Card Holder's name and the Expiration Date are transmitted unmasked.
>
> All Field Separators are sent unmasked.
>
> All other characters are set to the specified mask character.

For an AAMVA card, the specified mask character is substituted for each of the characters read from the card.

Track 2 Masked Data

This Simple ASCII field contains the Masked Track Data for track 2.

For an ISO/ABA card, the PAN is masked as follows:

- The specified number of initial characters is sent unmasked. The specified number of trailing characters is sent unmasked. If Mod 10 correction is specified, all but one of the intermediate characters of the PAN are set to zero; one of them will be set such that the last digit of the PAN calculates an accurate Mod 10 check of the rest of the PAN *as transmitted*. If the Mod 10 correction is not specified, all of the intermediate characters of the PAN are set to the specified mask character.
- The Expiration Date is transmitted unmasked.
- All Field Separators are sent unmasked.
- All other characters are set to the specified mask character.

For an AAMVA card, the DL/ID# is masked as follows:

- The specified number of initial characters are sent unmasked. The specified number of trailing characters are sent unmasked. If Mod 10 correction is specified, all but one of the intermediate characters of the DL/ID#PAN are set to zero; one of them will be set such that the last digit of the DL/ID# calculates an accurate Mod 10 check of the rest of the DL/ID# as transmitted. If the Mod 10 correction is not specified, all of the intermediate characters of the DL/ID# are set to the specified mask character.
- The Expiration Date and Birth Date are transmitted unmasked.
- All other characters are set to the specified mask character.

Track 3 Masked Data

This Simple ASCII field contains the Masked Track Data for track 3.

For an ISO card, the PAN is masked as follows:

- The specified number of initial characters are sent unmasked. The specified number of trailing characters are sent unmasked. If Mod 10 correction is specified, all but one of the intermediate characters of the PAN are set to zero; one of them will be set such that the last digit of the PAN calculates an accurate Mod 10 check of the rest of the PAN *as transmitted*. If the Mod 10 correction is not specified, all of the intermediate characters of the PAN are set to the specified mask character.
- All Field Separators are sent unmasked.
- All other characters are set to the specified mask character.

For an AAMVA card, the specified mask character is substituted for each of the characters read from the card.

Reader Encryption Status

This two byte Binary field contains the Encryption Status. The Reader Encryption Status is sent in big endian byte order. Byte 1 is the least significant byte. Byte 1 LSB is status bit 0. Byte 2 MSB is status bit 15. The Reader Encryption status is defined as follows:

Bit 0	=	DUKPT Keys exhausted
Bit 1	=	Initial DUKPT key Injected
Bit 2	=	Encryption Enabled
Bit 3	=	Authentication Required
Bit 4	=	Timed Out waiting for user to swipe card
Bits 5–7	=	Unassigned (always set to Zero)
Bit 8	=	Encryption Counter Expired
Bits 9–15	=	Unassigned (always set to Zero)

Notes:

1. Encryption will only be performed when Encryption Enabled and Initial DUKPT key Injected are set. Otherwise, data that are normally encrypted are sent in the clear in ASCII HEX format; the DUKPT Serial Number/counter will not be sent.
2. When DUKPT Keys Exhausted is set, the reader will no longer read cards and after a card swipe, the reader response will be sent as follows:
   [P30]
   [P31]
   [P35] [Reader Encryption Status]
   [P35]
   [P35]
   [P35]
   [P35]
   [P35]
   [P35] [Device serial number]
   [P35] [Encrypted Session ID]
   [P35] [DUKPT serial number/counter]
   [P35] [Encryption Counter] (optional, off by default)
   [P35] [Clear Text CRC]
   [P35] [Encrypted CRC]
   [P35] [Format Code]
   [P34]

Encrypted Track Data

If decodable track data exists for a given track, it is located in the ***Track x Encrypted Data*** field that corresponds to the track number. The length of each ***Encrypted Data*** field is fixed at 112 bytes, but the length of valid data in each field is determined by the corresponding ***Encrypted Data Length*** field that corresponds to the track number. Data located in positions greater than the encrypted track data length field indicates are undefined and should be ignored. The HID specification requires that reports be fixed in size, but the number of bytes encoded on a card may vary. Therefore, the Input Report always contains the maximum amount of bytes that can be encoded on the card and the number of valid bytes in each track is indicated by the ***Encrypted Data Length*** field.

The encrypted data from each track is decoded and converted to ASCII, and then it is encrypted. The encrypted track data includes all data starting with the start sentinel and ending with the end sentinel. The encryption begins with the first 8 bytes of the clear text track data. The 8-byte result of this encryption is placed in the ***Encrypted Data*** buffer for the corresponding track. The process continues using the CBC (Cipher Block Chaining) method with the encrypted 8 bytes XORed with the next 8 bytes of clear text. That result is placed in next 8 bytes of the ***Encrypted Data*** buffer and the process continues until all clear text bytes have been encrypted. If the final block of clear text contains fewer than 8 bytes, it is padded with binary zeros to fill up the 8 bytes. After this final clear text block is XORed with the prior 8 bytes of encrypted data, it is encrypted and placed in the ***Encrypted Data*** buffer. No Initial Vector is used in the process.

Decrypting the data must be done in 8 byte blocks, ignoring any final unused bytes in the last block. See Appendix A for more information.

Track 1 Encrypted Data

This Binary field contains the encrypted track data for track 1.

Track 2 Encrypted Data

This Binary field contains the encrypted track data for track 2.

Track 3 Encrypted Data

This Binary field contains the encrypted track data for track 3.

MagnePrint Status

This Binary field represents 32 bits of MagnePrint status information. Each character represents 4 bits (hexadecimal notation). For example, suppose the characters are: “A1050000”:

Nibble	1				2				3				4				5				6				7				8			
Value	A				1				0				5				0				0				0				0			
Bit	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8	23	22	21	20	19	18	17	16	31	30	29	28	27	26	25	24
Value	1	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Usage*	R	R	R	R	R	R	R	M	R	R	R	R	R	R	R	R	0	0	D	0	F	L	N	S	0	0	0	0	0	0	0	0

* Usage Legend:

- D = Direction
- F = Too Fast
- L = Too Slow
- M = MagnePrint capable
- N = Too Noisy
- R = Revision
- S = Status

This four-byte field contains the MagnePrint status. The MagnePrint status is in little endian byte order. Byte 1 is the least significant byte. Byte 1 LSB is status bit 0. Byte 4 MSB is status bit 31. MagnePrint status is defined as follows:

Bit 0	=	This is a MagnePrint-capable product (usage M)
Bits 1-15	=	Product revision & mode (usage R)
Bit 16	=	STATUS-only state (usage S)
Bit 17	=	Noise too high or “move me” away from the noise source (used only in STATUS) (usage N)
Bit 18	=	Swipe too slow (usage L)
Bit 19	=	Swipe too fast (usage F)
Bit 20	=	Unassigned (always set to Zero)
Bit 21	=	Actual Card Swipe Direction (0 = Forward, 1 = Reverse) (usage D)
Bits 22-31	=	Unassigned (always set to Zero)

If the Enable/Disable MagnePrint property is set to disable MagnePrint, this field will not be sent.

Encrypted MagnePrint Data

This 56-byte Binary field contains the MagnePrint data. Only the number of bytes specified in the MagnePrint data length field are valid. The least significant bit of the first byte of data in this field corresponds to the first bit of MagnePrint data. If the Enable/Disable MagnePrint property is set to disable MagnePrint, this field will not be sent.

Device Serial Number

This 16-byte ASCII field contains the device serial number. The device serial number is a NUL (zero) terminated string. So the maximum length of the device serial number, not including the null terminator, is 15 bytes. This device serial number can also be retrieved and set with the device serial number property explained in the property section of this document. This field is stored in non-volatile memory, so it will persist when the unit is power cycled.

Encrypted Session ID

This 8-byte Binary field contains the encrypted version of the current Session ID. Its primary purpose is to prevent replays. After a card is read, this property will be encrypted, along with the card data, and supplied as part of the transaction message. The clear text version of this will never be transmitted. To avoid replay, the application sets the Session ID property before a transaction and verifies that the Encrypted Session ID returned with card data decrypts to the value set.

DUKPT Key Serial Number

This 10 byte Binary field contains the DUKPT Key Serial Number used to encrypt the encrypted fields in this message. This 80-bit field includes the Initial Key Serial Number in the leftmost 59 bits and a value for the Encryption Counter in the rightmost 21 bits. If no keys are loaded, all bytes will have the value 0x00.

Encryption Counter

This 3-byte field contains the value of the Encryption Counter at the end of this transaction. See the **Get Encryption Counter** command for more information.

Clear Text CRC

This two byte Binary field contains a clear text version of a Cyclical Redundancy Check (CRC) (least significant byte sent first). It provides a CRC of all characters sent prior to this CRC. The CRC is converted to four characters of ASCII before being sent. The application may calculate a CRC from the data received prior to this CRC and compare it to the CRC received. If they are the same, the application can have high confidence that all the data was received correctly. The Send Clear Text CRC property controls whether this field is sent. If the property is True, the CRC is sent, if it is False, the CRC is not sent. The default state for this property is True.

Encrypted CRC

This 8-byte Binary field contains an encrypted version of a Cyclical Redundancy Check (CRC). It provides a CRC of all characters sent prior to this CRC. The CRC is converted to 16 characters of ASCII before being sent. After the receiver decrypts the message, the CRC is contained in the first 2 bytes of the message, all other bytes are meaningless. The application may calculate a CRC from the data received prior to this CRC and compare it to the CRC received. If they are the same, the application can have high confidence that all the data was received correctly. The **CRC Flag** property controls whether this field is sent.

Format Code

This 4-character ASCII field contains the Format Code. The purpose of the Format Code is to allow the receiver of this message to know how to find the different fields in the message. The default Format Code for this reader is “0000”. If any of the properties that affect the format of the message are changed, the first character of the Format Code will automatically change to a “1”. The application may change the final three characters, but making such a change will automatically cause the first character to a “1”.

PROGRAMMABLE CONFIGURATION OPTIONS

This reader has a number of programmable configuration properties. These properties are stored in non-volatile memory. These properties can be configured at the factory or by the end user using a program supplied by MagTek. Programming these parameters requires low level communications with the reader. Details on how to communicate with the reader to change programmable configuration properties follows in the next few sections. These details are included as a reference only. Most users will not need to know these details because the reader will be configured at the factory or by a program supplied by MagTek. Most users may want to skip over the next few sections on low level communications and continue with the details of the configuration properties.

COMMANDS

Most host applications do not need to send commands to the reader. Most host applications only need to obtain card data from the reader as described previously in this section. This section of the manual can be ignored by anyone who does not need to send commands to the reader.

Command requests and responses are sent to and received from the reader using command strings. Command requests are sent to the reader via a serial port. The response to a command is retrieved from the corresponding serial port.

Each command and response is composed of a series of readable ASCII characters followed by the ASCII character CR (0x0D). The ASCII characters preceding the CR are the message. There should always be an even number of characters and they should contain only the characters 0123456789ABCDEF. The receiver will combine two successive ASCII characters from the message to form one "byte" (see the descriptions of the commands) which may have any value from 0x00 to 0xFF.

The following table shows the structure of a command message:

Byte	Usage
0	Command Number
1	Data Length
2 – 23	Data

The following table shows the structure of a response to a command.

Byte	Usage
0	Result Code
1	Data Length
2 – 23	Data

PRIVILEGED COMMANDS

Some commands are, for security purposes, privileged. Those commands are:

1. Set Property
2. Reset Device*
3. Set Security Level†

* The Reset Device command is usually not Privileged. The exception is during a sequence to Activate the Authenticated Mode. During this sequence the Reset Device command is Privileged to avoid a hacker using this sequence to exhaust DUKPT keys rendering the reader unusable.

† The Set Security Level command is Privileged when it is being used to set the Security Level. It is not Privileged when it is being used to Get the Security Level.

When the Security Level is set to higher than 2 (see the Security section), the privileged commands must be MACed in order to be accepted. If a MAC is required but not present or incorrect, RC = 07 will be returned.

COMMAND NUMBER

This one-byte field contains the value of the requested command number. The following table lists all the existing commands:

Value (Hex)	Command Number	Description
00	Get Property	Gets a property from the reader
01	Set Property	Sets a property in the reader
02	Reset Device	Resets the reader
09	Get DUKPT KSN	Reports DUKPT KSN and Counter
0A	Set Session ID	Sets the current Session ID
10	Activate Authenticated Mode	Starts Activation of Authenticated Mode of secure operation
11	Activation Challenge Reply Command	Completes the Activation of Authenticated Mode of secure operation
12	Deactivate Authenticated Mode	Deactivates the Authenticated Mode of secure operation
13	Reserved	
14	Get Reader State	Gets the current state of the reader
15	Set Security Level	Sets or gets the current Security Level
25	Relinquish Interface	Makes reader receptive to commands on either Bluetooth or USB interface.
28	Power Down MSR	Powers down the MSR circuits (if running on battery turns reader off).
29	Get Battery Status	Gets Charge Status of battery

DATA LENGTH

This one-byte field contains the length of the valid data contained in the Data field. For example, a command with one byte of data would send 01 for this byte; a command with 18 bytes of data would send 12 for this byte.

DATA

This multi-byte field contains command data if any. Note that the maximum length of this field is fixed at 60 bytes. Valid data should be placed in the field starting at offset 2.

RESULT CODE

This one-byte field contains the value of the result code. There are two types of result codes: generic result codes and command-specific result codes. Generic result codes always have the most significant bit set to zero. Generic result codes have the same meaning for all commands and can be used by any command. Command-specific result codes always have the most significant bit set to one. Command-specific result codes are defined by the command that uses them. The same code can have different meanings for different commands. Command-specific result codes are defined in the documentation for the command that uses them. Generic result codes are defined in the following table.

Value (Hex)	Result Code	Description
00	Success	The command completed successfully.
01	Failure	The command failed.
02	Bad Parameter	The command failed due to a bad parameter or command syntax error.
05	Delayed	The request is refused due to anti-hacking mode
07	Invalid Operation	Depends on context of command

GET AND SET PROPERTY COMMANDS

The Get Property command gets a property from the reader. The **Get Property** command number is 00.

The **Set Property** command sets a property in the reader. The **Set Property** command number is 01. For security purposes, this command is privileged. This command must be MACed in order to be accepted.

The **Get** and **Set Property** command data fields for the requests and responses are structured as follows:

Get Property Request Data:

Data Offset	Value
0	Property ID

Get Property Response Data:

Data Offset	Value
0 – n	Property Value

Set Property Request Data:

Data Offset	Value
0	Property ID
1 – n	Property Value

Set Property Response Data:

None

The result codes for the **Get** and **Set Property** commands can be any of the codes listed in the generic result code table. If the **Set Property** command gets a result code of 0x07, it means the required MAC was absent or incorrect.

Property ID

Property ID is a one-byte field that contains a value that identifies the property. The following table lists all the current property ID values:

Value (Hex)	Property	Description
00	SOFTWARE ID	The reader's software identifier
03	DEVICE SERIAL NUM	Reader serial number
04	Reserved for future use	
05	TRACK ID ENABLE	Track enable / ID enable
06	Reserved for future use	
07	ISO Track Mask	Specifies Masking factors for ISO cards
08	AAMVA Track Mask	Specifies Masking factors for AAMVA cards
09-0A	Reserved for future use	
0B	Activity Timeout Period	Specifies minimum time reader will operate in the absence of activity (used to conserve battery life)
0B-0C	Reserved for future use	
0D	Bluetooth Disconnect Message	Message to be transmitted when reader disconnects
0E	Stay Powered After Swipe	Allows reader to stay powered after a good swipe
0F	Reserved for future use	
10	Interface Type	Type of interface

Value (Hex)	Property	Description
11-13	Reserved for future use	
14	Track Data Send Flags	Track data send flags
15	MP Flags	Enables sending of MagnePrint data
16-18	Reserved for future use	
19	CRC FLAG	Enables/disables sending CRC
1A	SureSwipe Flag	Sends data in SureSwipe format without MagnePrint
1B-1D	Reserved for future use	
1E	Pre Card String	Pre card string
1F	Post Card String	Post card string
20	Pre TK String	Pre track string
21	Post TK String	Post track string
22	Termination String	Terminating string
23	FS	Field Separator for additional data
24	SS TK1 ISO ABA	Start sentinel char for track 1 – ISO/ABA
25	SS TK2 ISO ABA	Start sentinel char for track 2 – ISO/ABA
26	SS TK3 ISO ABA	Start sentinel char for track 3 – ISO/ABA
27	SS TK3 AAMVA	Start sentinel char for track 3 - AAMVA
28	SS TK2 7BITS	Start sentinel char for track 2 – 7 bit data
29	SS TK3 7BITS	Start sentinel char for track 3 – 7 bit data
2A	Reserved for future use	
2B	ES	End sentinel char for all tracks/formats
2C	Format Code	Defines the Format Code to be sent with the message
2D	ES Track 1	End sentinel char for track 1
2E	ES Track 2	End sentinel char for track 2
2F	ES Track 3	End sentinel char for track 3
30	Send Encryption Counter	Enables/disables sending of Encryption Counter
31	Mask “Other” Cards	Enables/disables masking of don’t meet the ISO Financial format or the AAMVA format.
34	Send clear AAMVA card data flag	Enables/disables sending AAMVA data in the clear.

The Property Value is a multiple-byte field that contains the value of the property. The number of bytes in this field depends on the type of property and the length of the property. The following table lists all of the property types and describes them.

Property Type	Description
Byte	This is a one-byte value. The valid values depend on the property.
String	This is a multiple byte ASCII string. Its length can range from zero to a maximum length that depends on the property. The value and length of the string does not include a terminating NUL character.

Property Default Values

Each property specifies a default value. This is the firmware default value and may be changed during the manufacturing or order fulfillment process to support the needs of specific clients.

SOFTWARE ID PROPERTY

Property ID:	0x00
Property Type:	String
Length:	Fixed at 11 bytes
Get Property:	Yes
Set Property:	No

Description: This is an 11 byte read-only property that identifies the software part number and version for the reader. The first 8 bytes represent the part number and the last 3 bytes represent the version. For example this string might be "21042812D01". Examples follow:

Example Get **Software ID** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	00

Example Get **Software ID** property Response (Hex):

Result Code	Data Len	Prp Value
00	0B	32 31 30 34 32 38 31 32 44 30 31

DEVICE SERIAL NUM PROPERTY

Property ID: 0x03
Property Type: String
Length: 0 – 15 bytes
Get Property: Yes
Set Property: Yes (Once only)
Default Value: The default value is no string with a length of zero.
Description: The value is an ASCII string that represents the reader serial number. This string can be 0 – 15 bytes long. This property may be Set once only. Attempts to Set the property again will fail with RC = 0x07 (Sequence Error).

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

Example Set **Device Serial Num** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	04	03	31 32 33

Example Set **Device Serial Num** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Device Serial Num** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	03

Example Get **Device Serial Num** property Response (Hex):

Result Code	Data Len	Prp Value
00	03	31 32 33

TRACK ID ENABLE PROPERTY

Property ID:	0x05
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x95
Description:	This property is defined as follows:

id	0	T_3	T_3	T_2	T_2	T_1	T_1

Id 0 – Decodes standard ISO/ABA cards only
1 – Decodes AAMVA and 7-bit cards also
If this flag is set to 0, only tracks that conform to the ISO format allowed for that track will be decoded. If the track cannot be decoded by the ISO method it will be considered to be in error.

$T_\#$ 00 – Track Disabled
01 – Track Enabled
10 – Track Enabled/Required (Error if blank)

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect. To properly power cycle this reader, it must be unplugged for at least 30 seconds.

Example Set **Track ID Enable** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	05	95

Example Set **Track ID Enable** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Track ID Enable** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	05

Example Get **Track ID Enable** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	95

ISO TRACK MASK PROPERTY

Property ID:	0x07
Property Type:	String
Length:	6 bytes
Get Property:	Yes
Set Property:	Yes
Default Value:	”04040Y”

Description: This property specifies the factors for masking data on ISO type cards:

- The first two bytes specify how many of the leading characters of the PAN should be sent unmasked. The range of masking is from “00” to “99.”
- The next two bytes specify how many of the trailing characters of the PAN should be sent unmasked. The range of masking is from “00” to “99.”
- The fifth byte specifies which character should be used for masking. If this byte contains the uppercase letter ‘V’, the following rules apply:
    - The character used for masking the PAN will be ‘0’
    - All data after the PAN will be sent without masking
- The sixth byte specifies whether the Mod 10 Correction should be applied to the PAN. “Y” means Yes, the Mod 10 Correction will be applied. “N” means No, the Mod 10 will not be applied. (This option is only effective if the masking character is “0”.)

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

AAMVA TRACK MASK PROPERTY

Property ID:	0x08
Property Type:	String
Length:	6 bytes
Get Property:	Yes
Set Property:	Yes
Default Value:	”04040Y”

Description: This property specifies the factors for masking data on AAMVA type cards:

- The first two bytes specify how many of the leading characters of the Driver’s License/ID Number (DL/ID#) should be sent unmasked. The range of masking is from “00” to “99.”
- The next two bytes specify how many of the trailing characters of the DL/ID# should be sent unmasked. The range of masking is from “00” to “99.”
- The fifth byte specifies which character should be used for masking. If this byte contains the uppercase letter ‘V’, the following rules apply:
    - The PAN will be masked according to the rules of this property (the Send Clear AAMVA Card Data property is ignored)
    - The character used for masking the PAN will be ‘0’
    - All data after the PAN will be sent without masking
- The sixth byte specifies whether the Mod 10 Correction should be applied to the DL/ID#. “Y” means Yes, the Mod 10 Correction will be applied. “N” means No, the Mod 10 will not be applied. (This option is only effective if the masking character is “0”.)

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

ACTIVITY TIMEOUT PERIOD PROPERTY

Property ID: 0x0B
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 120 (0x78) seconds
Description: This property specifies, in seconds, the minimum amount of time a Bluetooth reader will operate in the absence of activity. Activity is:

- Swiping and processing of a card.
- Receipt and processing of commands from a Host.
- Briefly pressing the User Switch

When the specified time passes without activity, the reader is powered down.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

BLUETOOTH DISCONNECT MESSAGE PROPERTY

Property ID: 0x0D
Property Type: String
Length: 7 bytes
Get Property: Yes
Set Property: Yes
Default Value: The default value is no string with a length of zero.
Description: This property specifies a string to be used as part of a Bluetooth Disconnect Message. The message is intended to give the connected host application a warning that the reader is disconnecting. The full disconnect message consists of the specified string followed by the character ‘-‘ (hyphen), followed by a single character Reason Code, followed by a Carriage Return (0x0D) character. The possible Reason Codes are:

‘T’ = Timeout
‘U’ = User Switch
‘B’ = Battery Low
‘S’ = Card Swipe
‘R’ = Reset command
‘I’ = Interface changed

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

STAY POWERED AFTER SWIPE PROPERTY

Property ID: 0x0E
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x00 (Don't Stay Powered)
Description: This property controls whether the reader stays powered after a good swipe. If the property value is 0x00 (the default), the reader powers down after a good swipe.

If the property value is 0x01, the reader stays powered after a good swipe. In this case, the reader may be powered down by the user pressing and holding the User Switch or it will time out eventually.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

INTERFACE TYPE PROPERTY

Property ID: 0x10
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: No
Default Value: 3 (Indicates Bluetooth interface)
Description: The value is a byte that represents the reader's interface type. It is always set to 3 indicating this is a Bluetooth reader.

Example Get **Interface Type** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	10

Example Get **Interface Type** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	03

TRACK DATA SEND FLAGS PROPERTY

Property ID: 0x14
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x63
Description: This property is defined as follows:

ICL	SS	ES	LRC	0	LC	Er	Er

ICL 0 – Changing the state of the caps lock key will not affect the case of the data
1 – Changing the state of the caps lock key will affect the case of the data

SS 0 – Don’t send Start Sentinel for each track
1 – Send Start Sentinel for each track

ES 0 – Don’t send End Sentinel for each track
1 – Send End Sentinel for each track

LRC 0 – Don’t send LRC for each track
1 – Send LRC for each track

Note that the LRC is the unmodified LRC from the track data. To verify the LRC the track data needs to be converted back from ASCII to card data format and the start sentinels that were modified to indicate the card encode type need to be converted back to their original values.

LC 0 – Send card data as upper case
1 – Send card data as lower case

Er 0x – Don’t send track data if error
11 – Send ‘E’ for each track error

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

MP FLAGS PROPERTY

Property ID:	0x15
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x00
Description:	This property is defined as follows:

0	0	0	0	0	0	0	S

S 0 – MagnePrint Data will NOT be sent
1 – MagnePrint Data will be sent.

This property is used to designate whether or not the MagnePrint data is sent as part of a message. Setting S to 1 causes the MagnePrint Status and Unencrypted MagnePrint Data to be sent with each swipe. Setting S to 0 causes these fields to be omitted from the data. When the fields are omitted, the Programmable Field Separator that precedes each of these fields will also be omitted.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

CRC FLAG PROPERTY

Property ID: 0x19
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x01
Description: This property is defined as follows:

0	0	0	0	0	0	E	S

E 0 – The Encrypted CRC will NOT be sent
1 – The Encrypted CRC will be sent

S 0 – The Clear Text CRC will NOT be sent
1 – The Clear Text CRC will be sent

This property is used to designate whether or not the calculated CRC is sent as part of a message. The default state of this property causes only the Clear Text CRC to be sent. When the fields are omitted, the Programmable Field Separator that precedes each of these fields will be sent anyhow.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

PRE CARD STRING PROPERTY

Property ID: 0x1E
Property Type: String
Length: 0 – 7 bytes
Get Property: Yes
Set Property: Yes
Default Value: The default value is no string with a length of zero.
Description: The value is an ASCII string that represents the reader's pre card string. This string can be 0 – 7 bytes long. This string is sent prior to all other card data.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

Example Set **Pre Card String** property Request (Hex):

Cmd Num	**Data Len**	**Prp ID**	**Prp Value**
01	04	1E	31 32 33

Example Set **Pre Card String** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Pre Card String** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1E

Example Get **Pre Card String** property Response (Hex):

Result Code	Data Len	Prp Value
00	03	31 32 33

POST CARD STRING PROPERTY

Property ID: 0x1F
Property Type: String
Length: 0 – 7 bytes
Get Property: Yes
Set Property: Yes
Default Value: The default value is no string with a length of zero.
Description: The value is an ASCII string that represents the reader's post card string. This string can be 0 – 7 bytes long. This string is sent after all other card data.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

Example Set **Post Card String** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	04	1F	31 32 33

Example Set **Post Card String** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Post Card String** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1F

Example Get **Post Card String** property Response (Hex):

Result Code	Data Len	Prp Value
00	03	31 32 33

PRE TRACK STRING PROPERTY

Property ID:	0x20
Property Type:	String
Length:	0-7 bytes
Get Property:	Yes
Set Property:	Yes
Default Value:	No string with a length of zero.
Description:	This string is sent prior to the data for each track. The string can be 0 – 7 bytes long. If the value is 0 no character is sent. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

Example Set **Pre Track String** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	04	20	31 32 33

Example Set **Pre Track String** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Pre Track String** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	20

Example Get **Pre Track String** property Response (Hex):

Result Code	Data Len	Prp Value
00	03	31 32 33

POST TRACK STRING PROPERTY

Property ID:	0x21
Property Type:	String
Length:	0-7 bytes
Get Property:	Yes
Set Property:	Yes
Default Value:	No string with a length of zero
Description:	This string is sent after the data for each track. The string can be 0 – 7 bytes long. If the value is 0 no character is sent. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

Example Set **Post Track String** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	04	21	31 32 33

Example Set **Post Track String** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Post Track String** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	21

Example Get **Post Track String** property Response (Hex):

Result Code	Data Len	Prp Value
00	03	31 32 33

TERMINATION STRING PROPERTY

Property ID: 0x22
Property Type: String
Length: 0-7 bytes
Get Property: Yes
Set Property: Yes
Default Value: 0x0D (carriage return)
Description: This string is sent after the all the data for a transaction. The string can be 0 – 7 bytes long. If the value is 0 no character is sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

FS PROPERTY

Property ID: 0x23
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x7C (‘|’)
Description: This character is sent as the field separator to delimit additional data (MagnePrint info, reader info, DUKPT info, etc.). If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK1 ISO ABA PROPERTY

Property ID: 0x24
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x25 (‘%’)
Description: This character is sent as the track 1 start sentinel for cards that have track 1 encoded in ISO/ABA format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK2 ISO ABA PROPERTY

Property ID: 0x25
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x3B (‘;’)
Description: This character is sent as the track 2 start sentinel for cards that have track 2 encoded in ISO/ABA format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK3 ISO ABA PROPERTY

Property ID: 0x26
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x2B (‘+’)
Description: This character is sent as the track 3 start sentinel for cards that have track 3 encoded in ISO/ABA format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK3 AAMVA PROPERTY

Property ID: 0x27
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x23 (‘#’)
Description: This character is sent as the track 3 start sentinel for cards that have track 3 encoded in AAMVA format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK2 7BITS PROPERTY

Property ID: 0x28
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x40 (‘@’)
Description: This character is sent as the track 2 start sentinel for cards that have track 2 encoded in 7 bits per character format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SS TK3 7BITS PROPERTY

Property ID: 0x29
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0x26 (‘&’)
Description: This character is sent as the track 3 start sentinel for cards that have track 3 encoded in 7 bits per character format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

ES PROPERTY

Property ID:	0x2B
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x3F (‘?’)
Description:	This character is sent as the end sentinel for all tracks with any format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

FORMAT CODE PROPERTY

Property ID:	0x2C
Property Type:	String
Length:	4 bytes
Get Property:	Yes
Set Property:	Yes
Default Value:	“0000”
Description:	This property is defined as follows: This property specifies the Format Code that will be returned at the end of a transmitted card swipe. The application sends four characters, but only the last three will be set. The first character is reserved for MagTek use. A value of ‘0’ in the first character means the Format Code is defined by MagTek. A value of ‘1’ in the first character means the Format Code is user defined. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

ES TRACK 1 PROPERTY

Property ID:	0x2D
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0xFF (use ES property)
Description:	This character is sent as the end sentinel for track 1 with any format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent. If the value is 0xFF then the value of the ES property will be used instead of this property.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

ES TRACK 2 PROPERTY

Property ID:	0x2E
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0xFF (use ES property)
Description:	This character is sent as the end sentinel for track 2 with any format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent. If the value is 0xFF then the value of the ES property will be used instead of this property. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

ES TRACK 3 PROPERTY

Property ID:	0x2F
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0xFF (use ES property)
Description:	This character is sent as the end sentinel for track 3 with any format. If the value is 0 no character is sent. If the value is in the range 1 – 127 then the equivalent ASCII character will be sent. If the value is 0xFF then the value of the ES property will be used instead of this property. This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SEND ENCRYPTION COUNTER

Property ID:	0x30
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x00 (don’t send Encryption Counter)
Description:	This property is used to designate whether or not the Encryption Counter is send as part of a keyboard message. If the property is set to 0x00, the Encryption Counter is not sent, neither is a field separator sent. If the property

is set to 0x01, the Encryption Counter is sent as the next field after the DUKPT Serial Number in a swipe message.

NOTE: *If this property is set to 0x01 and the Format Code is currently “0001”, the Format Code will be changed to “0002”.*
This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

MASK OTHER CARDS

Property ID:	0x31
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x00 (Don’t Mask Other cards)

Description: This property is used to designate whether or not the cards which do not decode as ISO/ABA Financial cards or AAMVA Driver License cards should be sent with their data masked or in the clear. The default state is to send the data in the clear (0x00). If this property is set to 0x01, the track(s) will be sent with a ”0” for each byte of encoded data read.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

SEND CLEAR AAMVA CARD DATA PROPERTY

Property ID:	0x34
Property Type:	Byte
Length:	1 byte
Get Property:	Yes
Set Property:	Yes
Default Value:	0x00

Description: This character is used to control how to send out AAMVA card data when the security level is above 2.

This property is stored in non-volatile memory, so it will persist when the unit is power cycled. When this property is changed, the unit must be reset (see Command Number 2) or power cycled for these changes to take effect.

0 – send out masked AAMVA card data
1 – send out clear AAMVA card data

Example Set **Send Clear AAMVA Card Data** property Request (Hex):

Cmd Num	Data Len	Prp ID	Data
01	06	34	01 xx xx xx xx *

* where “xx xx xx xx” is the MAC.

Example Set **Send Clear AAMVA Card Data** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Send Clear AAMVA Card Data** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	34

Example Get **Send Clear AAMVA Card Data** property Response (Hex):

Result Code	Data Len	Data
00	01	01

RESET DEVICE COMMAND

Command number: 0x02

Description: This command is used to reset the reader. This command can be used to make previously changed properties take affect without having to power cycle the reader. If communication is via the USB port, when the reader resets, it automatically does a USB detach followed by an attach. After the host sends this command to the reader it should close the USB port, wait a few seconds for the operating system to handle the reader detach followed by the attach, and then re-open the USB port before trying to communicate further with the reader.

When an Authentication sequence has failed, only a correctly MACed (See Section 2, Security) Reset command can be used to Reset the reader. This prevents a dictionary attack on the on the keys and minimizes a denial of service attack.

Note

When the reader begins an Authentication Sequence, the Reset command will not be honored until after the Authentication Sequence has successfully completed, the user swipes a card, or the unit is power cycled.

Data structure: No data is sent with this command

Result codes: 0x00 (Success)
0x01 (Failure)
0x07 (Incorrect MAC – Command not authorized)

Example **Reset Device** Request (Hex):

Cmd Num	Data Len	Data
02	00	

Example **Reset Device** Response (Hex):

Result Code	Data Len	Data
00	00	

DUKPT OPERATION

Since key loading is proprietary and performed at MagTek, there are no user commands to support key injection.

Get DUKPT KSN and Counter

Command number: 0x09

Description: This command is used to report the Key Serial Number and Encryption Counter.

Data structure: No data is sent with this command.

Response Data:

Offset	Field Name	Description
0	Current Key Serial Number	This eighty-bit field includes the Initial Key Serial Number in the leftmost 59 bits and a value for the Encryption Counter in the rightmost 21 bits.

Result codes: 0x00 (Success)
0x02 (Bad Parameters – the Request Data is not a correct length)

Example **Get DUKPT KSN and Counter** Request (Hex):

Cmd Num	Data Len	Data
09	00	none

Example **Get DUKPT KSN and Counter** Response (Hex):

Result Code	Data Len	Data
00	0A	FFFF 9876 5432 10E0 0001

SET SESSION ID COMMAND

Command number: 0x0A

Description: This command is used to set the current Session ID. The new Session ID stays in effect until one of the following occurs:

1. Another Set Session ID command is received.
2. The reader is powered down.
3. The reader is put into Suspend mode.

The Session ID is used by the host to uniquely identify the present transaction. Its primary purpose is to prevent replays. After a card is read, the Session ID will be encrypted, along with the card data, a supplied as part of the transaction message. The clear text version of this will never be transmitted.

Data structure:

Request Data:

Offset	Field Name	Description
0	New Session ID	This eight-byte field may contain any value the application wishes.

Response Data: None

Result codes: 0x00 (Success)
0x02 (Bad Parameters – the Request Data is not a correct length)

Example **Set Session ID** Request (Hex):

Cmd Num	Data Len	Data
0A	08	54 45 53 54 54 45 53 54

Example **Set Session ID** Response (Hex):

Result Code	Data Len	Data
00	00	

ACTIVATE AUTHENTICATED MODE COMMAND

Command number: 0x10

Description: This command is used to activate the Authenticated Mode. When set to Security Level 4, this reader will not transmit card data unless it is in the Authenticated Mode. The Authenticated Mode may only be entered by this command.

The application specifies a PreAuthentication Time Limit. This is the maximum number of seconds the reader will wait for the Activation Challenge Reply Command before timing out. If the supplied value is less than 120 seconds, the reader will use 120 seconds. If the reader times out waiting for the Activation Challenge Reply Command, the Authentication attempt fails and anti-hacking behavior may be invoked.

The reader responds with two challenges (Challenge 1 and Challenge 2) encrypted using a variant of the current DUKPT PIN Encryption Key (Key XOR F0F0 F0F0 F0F0 F0F0 F0F0 F0F0 F0F0 F0F0). When decrypted, Challenge 1 contains 6 bytes of random number (used in the Activation Challenge Reply command) followed by the last two bytes of the KSN. These last two bytes of the KSN may be compared with the last two bytes of the clear text KSN sent in the message to authenticate the reader. The application should complete the Activate Authentication sequence using the Activation Challenge Reply command (see below).

The first two Activate Authenticated Mode commands may proceed without any delay (one error is allowed with no anti-hacking consequences). If a second Activate Authenticated Mode in a row fails, the reader goes into anti-hacking behavior. This consists of an increasing delay being enforced between Activate Authenticated Mode commands. The first delay is 10 seconds, increasing by 10 seconds until a maximum delay of 10 minutes is reached. The user may remove the reader from the anti-hacking mode at any time by swiping any encoded magstripe card. When the reader is in this anti-hacking mode it is **NOT** receptive to the Reset Device command.

Data structure:

Request Data:

Offset	Field Name	Description
0	PreAuthentication Time Limit (msb)	Most significant byte of the PreAuthentication Time Limit.
1	PreAuthentication Time Limit (lsb)	Least significant byte of the PreAuthentication Time Limit.

Response Data:

Offset	Field Name	Description
0	Current Key Serial Number	This eighty-bit field includes the Initial Key Serial Number in the leftmost 59 bits and a value for the Encryption Counter in the rightmost 21 bits.
10	Challenge 1	This eight byte challenge may be used later in an Activation Challenge Reply command shown below, and to authenticate the reader as mentioned above.
18	Challenge 2	This eight byte challenge may be used later in a Deactivate Authenticated Mode command shown below.

Result codes:		
	0x00	(Success)
	0x03	(Redundant – the reader is already in this mode)
	0x05	(Delayed – the request is refused due to anti-hacking mode)
	0x07	(Sequence Error – the current Security Level is too low)
	0x80	(Encryption Counter Expired)

Example **Activate Authenticated Mode** Request (Hex):

Cmd Num	Data Len	Data
10	00	

Example **Activate Authenticated Mode** Response (Hex):

Result Code	Data Len	Data
00	20	FFFF 0123 4567 8000 0003 9845 A48B 7ED3 C294 7987 5FD4 03FA 8543

ACTIVATION CHALLENGE REPLY COMMAND

Command number: 0x11

Description: This command is used as the second part of an Activate Authentication sequence. In this command, the application sends the first 6 bytes of Challenge 1 (received in response to the Activate Authenticated Mode command), two bytes of time information, and (optionally) an eight byte Session ID encrypted with a variant of the current DUKPT PIN Encryption Key (Key XOR 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C).

The time information contains a count of the maximum number of seconds the reader should remain in the Authenticated Mode. Regardless of the value of this timer, a user card swipe in the Authenticated Mode ends the Authenticated Mode. The maximum time allowed is 3600 seconds (one hour). To get the full hour, use the value 0x0E10. To get the value of 3 minutes, use the value 0x012C. A value of zero forces the reader to stay in the Authenticated Mode until a card swipe or power down occurs (no timeout).

If the Session ID information is included and the command is successful, it will change the Session ID in the reader.

If the reader decrypts the CR response correctly the Activate Authenticated Mode has succeeded. If the reader can not decrypt the CR command correctly the Activate Authenticated Mode has failed, the DUKPT KSN advances.

Data structure:

Request Data: None

Offset	Field Name	Description
0	Response to Challenge 1	Six bytes of Challenge 1 plus two bytes of time as outlined above, encrypted by the specified variant of the current DUKPT Key
8	Session ID	Optional eight byte Session ID encrypted by the specified variant of the current DUKPT Key.

Response Data: None

Result codes:

0x00 (Success)
0x02 (Bad Parameters – the Request Data is not a correct length)
0x04 (Bad Data – the encrypted reply data could not be verified)
0x07 (Sequence – not expecting this command)

Example **Activation Challenge Reply** Request (Hex):

Cmd Num	Data Len	Data
11	08	8579 8275 2157 3495

Example **Activation Challenge Reply** Response (Hex):

Result Code	Data Len	Data
00	00	

DEACTIVATE AUTHENTICATED MODE COMMAND

Command number: 0x12

Description: This command is used to exit the Authenticated Mode command. It can be used to exit the mode with or without incrementing the DUKPT transaction counter (lower 21 bits of the KSN). The application must send the first 7 bytes of Challenge 2 (from the response to the Activate Authenticated Mode command) and the Increment flag (0x00 indicates no increment, 0x01 indicates increment of the KSN) encrypted with a variant of the current DUKPT PIN Encryption Key (Key XOR 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C 3C3C).

If the reader decrypts Challenge 2 successfully, it will exit the Authenticated Mode and, depending on the Increment flag, may increment the KSN.

If the reader cannot decrypt Challenge 2 successfully, it will stay in the Authenticated Mode until either the time specified in the Activate Authenticated Mode command passes or the user swipes a card. This behavior is intended to discourage denial of service attacks. Exiting the Authenticated Mode by timeout or card swipe *always* increments the KSN; exiting Authenticated Mode by the Deactivate Authenticated Mode command *may* increment the KSN.

Data structure:

Request Data:

Offset	Field Name	Description
0	Response to Challenge 2	Seven bytes of Challenge 2 plus one byte of Increment flag as outlined above, encrypted by the specified variant of the current DUKPT Key

Response Data: None

Result codes:

0x00 (Success)
0x02 (Bad Parameters – the Request Data is not a correct length)
0x03 (Bad Data – the encrypted reply data could not be verified)
0x07 (Sequence – not expecting this command)

Example **Deactivate Authenticated Mode** Request (Hex):

Cmd Num	Data Len	Data
12	08	8579827521573495

Example **Deactivate Authenticated Mode** Response (Hex):

Result Code	Data Len	Data
00	00	

GET READER STATE COMMAND

Command Number: 0x14

Description: This command is used to get the current state of the reader. The state is returned as two bytes that represent the Current State of the reader and how it got to that state (Antecedent). For more information see ***Reader States***.

Data Structure:

Request Data: None
Response Data:

The first byte specifies the current state as follows:

Current Reader State		
Value	Name	Meaning
0x00	WaitActAuth	Waiting for Activate Authenticated Mode. The reader requires Authentication before swipes are accepted.
0x01	WaitActRply	Waiting for Activation Challenge Reply. Activation has been started; the reader is waiting for the Activation Challenge Reply command.
0x02	WaitSwipe	Waiting for Swipe. The reader is waiting for the user to Swipe a card.
0x03	WaitDelay	Waiting for Anti-Hacking Timer. Two or more previous attempts to Authenticate failed, the reader is waiting for the Anti-Hacking timer to expire before it accepts further Activate Authenticated Mode commands.

The second byte specifies how the reader got to its current state as follows:

Current State Antecedent		
Value	Name	Meaning
0x00	PU	Just Powered Up. The reader has had no swipes and has not been Authenticated since it was powered up.
0x01	GoodAuth	Authentication Activation Successful. The reader processed a valid Activation Challenge Reply command.
0x02	GoodSwipe	Good Swipe. The user swiped a valid card correctly.
0x03	BadSwipe	Bad Swipe. The user swiped a card incorrectly or the card is not valid.
0x04	FailAuth	Authentication Activation Failed. The most recent Activation Challenge Reply command failed.
0x05	FailDeact	Authentication Deactivation Failed. A recent Deactivate Authenticated Mode command failed.
0x06	TOAuth	Authentication Activation Timed Out. The Host failed to send an Activation Challenge Reply command in the time period specified in the Activate Authentication Mode command.
0x07	TOSwipe	Swipe Timed Out. The user failed to swipe a card in the time period specified in the Activation Challenge Reply command.
0x08	KeySyncError	The keys between the MagneSafe processor and the Encrypting IntelliHead are not the same and must be re-loaded before correct operation can resume.

Result codes: 0x00 (Success)

Example **Get Reader State** Request (Hex):

Cmd Num	Data Len	Data
14	00	

Example **Get Reader State** Response (Hex):

Result Code	Data Len	Data
00	02	00 00

SET SECURITY LEVEL COMMAND

Command number: 0x15

Description: This command is used to set the Security Level (see Section 4). The Security Level can be set higher, but never lower. There are two versions of this command, the first one is used to retrieve the current Security Level and does not require MACing. The second one is used to set the Security Level and requires Security/MACing.

Data structure:

Request Data:

Offset	Field Name	Description
0	Security Level	Optional, if present must be either 0x03 or 0x04. If absent this is a query for the current Security Level. If this field is absent, the MAC field should NOT be sent.
1	MAC	Four byte MAC (See Section 4) to secure the command.

Response Data: None

Offset	Field Name	Description
0	Security Level	Only present if there was no request data. This field gives the current Security Level.

Result codes: 0x00 (Success)
0x02 (Bad Parameters – the Request Data is not a correct length OR the specified Security Level is invalid, OR the current Security Level is 0, 1, or 4)
0x07 (Incorrect MAC – command not authorized)

Example **Set Security Level** to 3 Request (Hex):

Cmd Num	Data Len	Data
15	05	03 xx xx xx xx

Where "xx xx xx xx" is the valid MAC (Message Authentication Code).

Example **Set Security Level** Response (Hex):

Result Code	Data Len	Data
00	00	

Example **Set Security Level** Request (Retrieving the Security Level) (Hex):

Cmd Num	Data Len	Data
15	00	

Example **Set Security Level** Response (Hex):

Result Code	Data Len	Data
00	01	03

GET ENCRYPTION COUNTER COMMAND

Command number: 0x1C

Description: This command is used to Get the Encryption Counter. The Encryption Counter gives the maximum number of transactions that can be performed by the reader. A transaction is either an encrypted card swipe or a correctly completed Activation Sequence (Activate Authenticated Mode followed by correct Activation Challenge Reply)

The Encryption Counter has three possible states:

1. Disabled – value 0xFFFFFF – In this state there is no limit to the number of transactions that can be performed.

2. Expired – value 0x000000 – This state indicates that all transactions are prohibited

3. Active – value 1 to 1,000,000 (0x000001 to 0x0F4240) – In this state, each transaction causes the Encryption Counter to be decremented and allows transactions to be processed. If an Activation Sequence decrements the Encryption Counter to 0, a last encrypted card swipe will be permitted.

Data structure:

Request Data: None
Response Data:

Offset	Field Name	Description
0	Device Serial #	16 bytes, if DSN is shorter than 15 bytes, left justify and fill with binary zeroes. At least one byte (usually the last one) must contain binary zero.
16	Actual Encryption Counter	This three byte field returns the current value of the Encryption Counter.

Result codes: 0x00 (Success)
0x02 (Invalid length)

Example **Get Encryption Counter** Request (Hex):

Cmd Num	Data Len	Data
1C	00	

Example **Get Encryption Counter** Response (Hex) - Encryption Counter is 2033:

Result Code	Data Len	Data
00	13	5445535420534554555020303030303100 0007F1

RELINQUISH INTERFACE COMMAND

Command number: 0x25

Description: This command is used to relinquish the Active Interface. It causes the reader to be receptive to commands on both the Bluetooth and USB interfaces.

Data structure:

Request Data: None
Response Data: None

Result codes: 0x00 (Success)

Example **Relinquish Interface** Request (Hex):

Cmd Num	Data Len	Data
25	00	

Example **Relinquish Interface** Response (Hex):

Result Code	Data Len	Data
00	00	

POWER DOWN COMMAND

Command number: 0x28

Description: This command is used to power down the magnetic stripe circuit. If the reader is running on battery only (no USB cable attached), the entire reader is powered down. The behavior of the reader is exactly the same as if the user had pressed and held down the User Switch for three seconds to turn it off.

Data structure:

Request Data: None
Response Data: None

Result codes: 0x00 (Success)

Example **Power Down** Request (Hex):

Cmd Num	Data Len	Data
28	00	

Example **Power Down** Response (Hex):

Result Code	Data Len	Data
00	00	

GET BATTERY STATUS COMMAND

Command number: 0x29

Description: This command is used to get the status of the battery.

Data structure:

Request Data: None
Response Data:

Offset	Field Name	Description
0	Battery Status	Value of 0x00 indicates battery charge is low, battery should be charged before further use. Value of 0x01 indicates battery charge is sufficient for normal use.

Result codes: 0x00 (success)

Example **Get Battery Status** Request (Hex):

Cmd Num	Data Len	Data
29	00	

Example **Get Battery Status** Response (Hex) (Charge is low):

Result Code	Data Len	Data
00	01	00

ENCRYPT BULK DATA COMMAND

Command number: 0x30

Description: This command will encrypt up to a maximum of 120 bytes. The Data-Response variant of the DUKPT key will be used to encrypt data. It will also compute a MAC for the S/N, Num Bytes Encrypted, KSN and Cryptogram. Data to be encrypted that are not a multiple of 8 bytes will be padded with NULLs to be a multiple of 8.

The DUKPT key counter/pointer will be incremented before processing this command.

Result codes:
0x00 – success
0x02 – Bad Parameters, the Data Len is not supported
0x07 – Security Level < 2, MSCI CMUT was incorrect.

Example **Encrypt Bulk Data** Request (Hex):

Cmd Num	Data Len	Data
30	05	01 02 03 04 05

Example **Encrypt Bulk Data** Response (Hex):

Result Code	Data Len	DSN (16 bytes)	Num Bytes Encrypted (1 byte)	KSN (10 bytes)	Cryptogram (8 bytes)	MAC (4 bytes)
00	0x27	32 31 30 34 32 38 31 32 44 30 31 31 31 31 31 00	05	31 32 33 34 35 31 32 33 34 35	01 02 03 04 05 06 07 08	01 02 03 04

DSN Device Serial Number, this data field will always be fixed at 16 bytes. If the serial number is less than 15 bytes, it will be left-justified. The 16th byte will always be set to NULL.

Cryptogram Encrypted data, the length of which is always a multiple of 8, this field can be maximum of 120 characters.

APPENDIX A. GUIDE ON DECRYPTING DATA

The key that was used to encrypt each data block can be determined by using the Key Serial Number field along with the Base Derivation Key associated with this reader. The resulting DUKPT key, as described in ANS X9.24 Part 1, is the key which was used to encrypt the data. (The key is described as the PIN key in the standard but since there are no PINs being used in this application, the derived key is used.)

These sequences are based on the following data:

- Derivation Key: 0123 4567 89AB CDEF FEDC BA98 7654 3210
- Initially Loaded Key Serial Number (KSN): FFFF 9876 5432 10E0 0000
- Initially Loaded PIN Entry Device Key: 6AC2 92FA A131 5B4D 858A B3A3 D7D5 933A

When a data field consists of more than one block, Cipher Block Chaining (CBC) method is used by the encrypting algorithm.

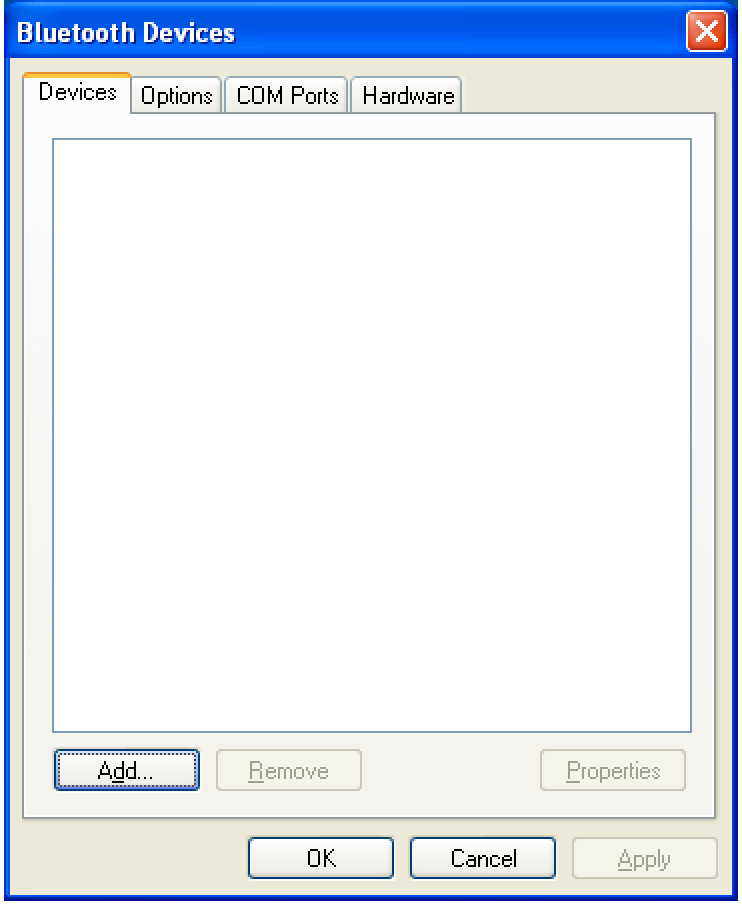
To decrypt this group of data, follow these steps:

- Start decryption on the last block.
- The result of the decryption is then XORed with the previous block.
- Continue until reaching the first block.
- The first block can skip the XOR operation.

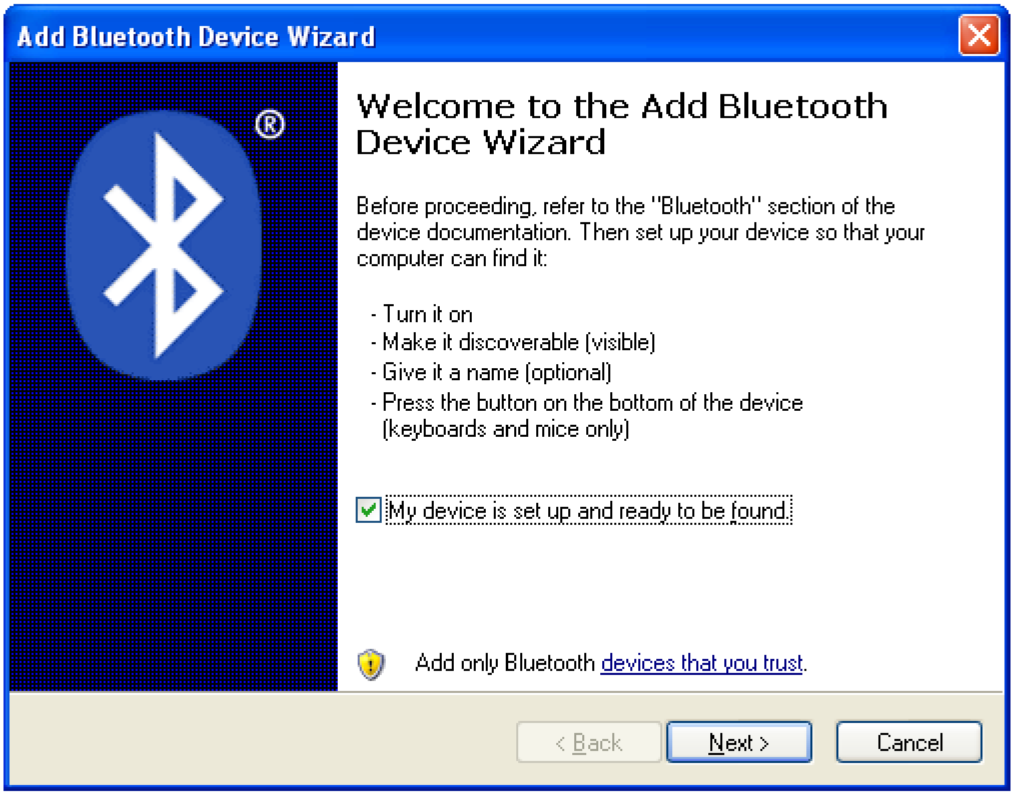
APPENDIX B. INSTALLING BLUETOOTH WITH WINDOWS DRIVER

Attach a Bluetooth adapter to the PC.

Select Bluetooth icon in Control Panel. The following will be shown.



Click ***Add…***



Add Bluetooth Device Wizard

Welcome to the Add Bluetooth Device Wizard

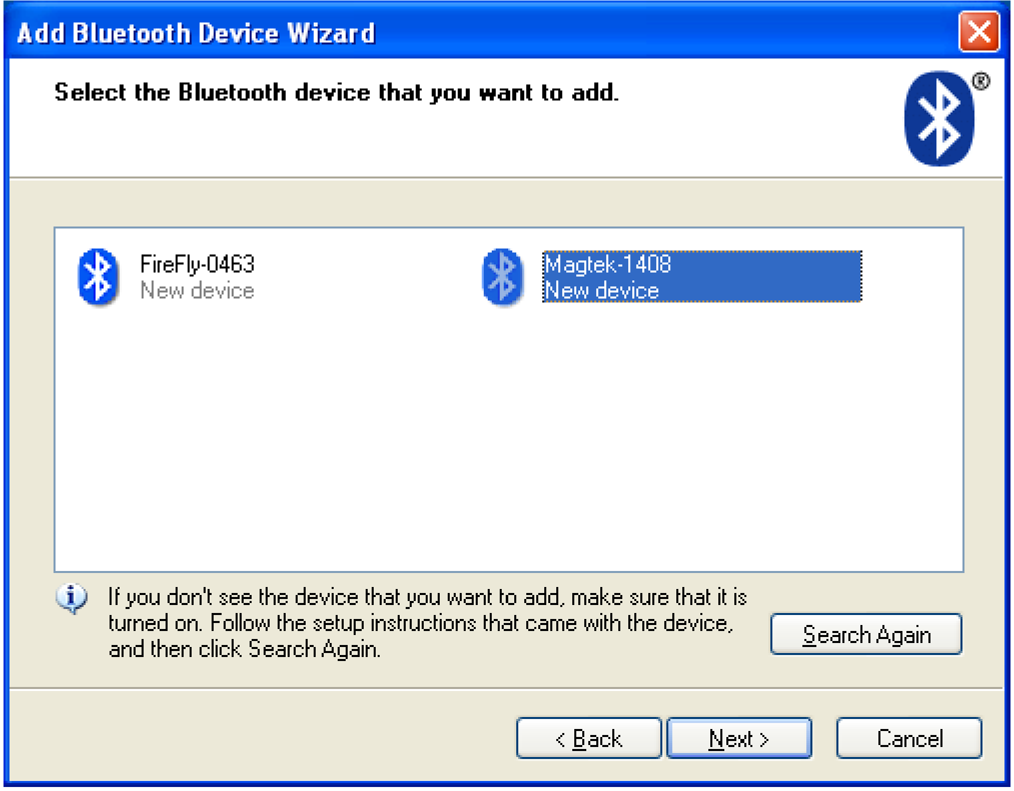
Before proceeding, refer to the "Bluetooth" section of the device documentation. Then set up your device so that your computer can find it:

- Turn it on
- Make it discoverable (visible)
- Give it a name (optional)
- Press the button on the bottom of the device (keyboards and mice only)

☑ My device is set up and ready to be found.

Add only Bluetooth devices that you trust.

Check *My device is set up and ready to be found.* Then click ***Next.***



Add Bluetooth Device Wizard

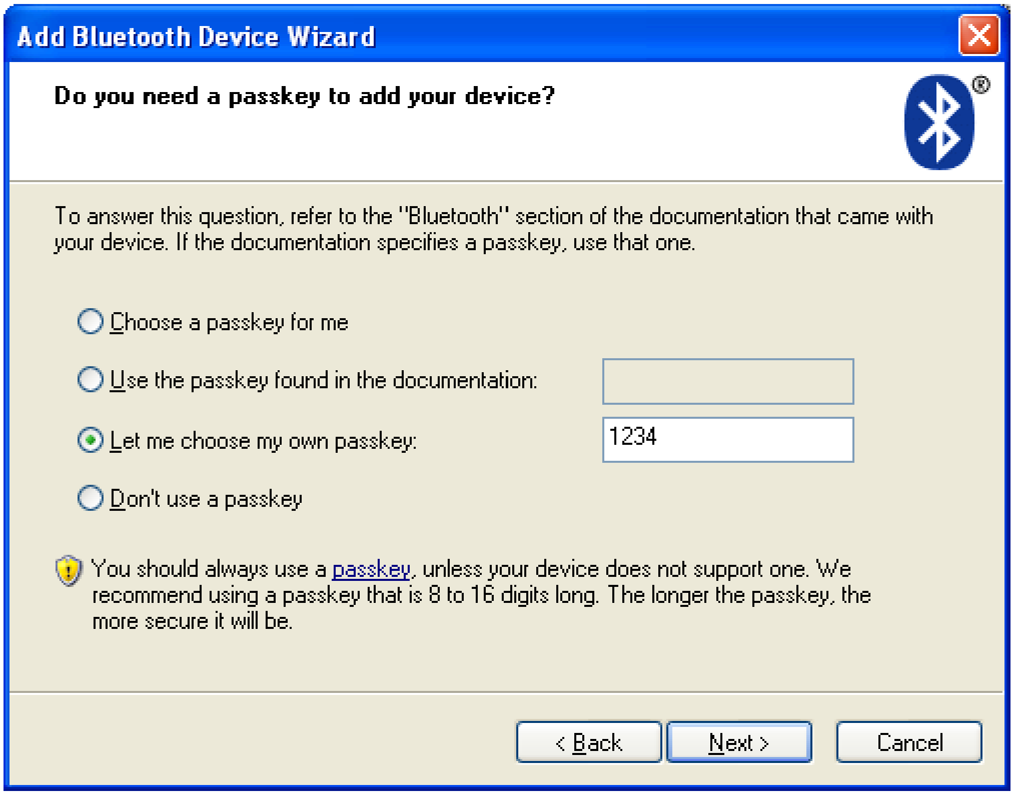
Select the Bluetooth device that you want to add.

FireFly-0463
New device

Magtek-1408
New device

If you don't see the device that you want to add, make sure that it is turned on. Follow the setup instructions that came with the device, and then click Search Again.

Select the *Magtek-xxxx* device using the number as indicated on the reader, then click ***Next.***



Do you need a passkey to add your device?

To answer this question, refer to the "Bluetooth" section of the documentation that came with your device. If the documentation specifies a passkey, use that one.

○ Choose a passkey for me

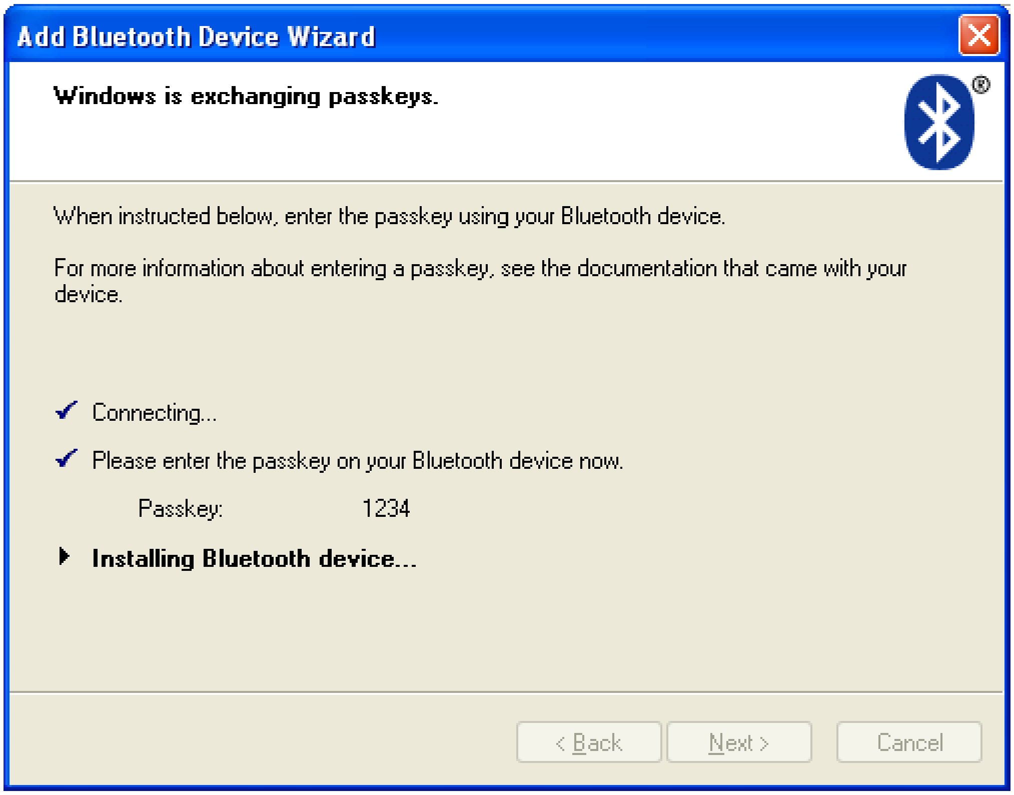
○ Use the passkey found in the documentation:

● Let me choose my own passkey: 1234

○ Don't use a passkey

You should always use a passkey, unless your device does not support one. We recommend using a passkey that is 8 to 16 digits long. The longer the passkey, the more secure it will be.

Select *Let me choose my own passkey:* then type “1234”, for example, in the associated box. Click ***Next*** when ready. Wait for the device to be installed:



Windows is exchanging passkeys.

When instructed below, enter the passkey using your Bluetooth device.

For more information about entering a passkey, see the documentation that came with your device.

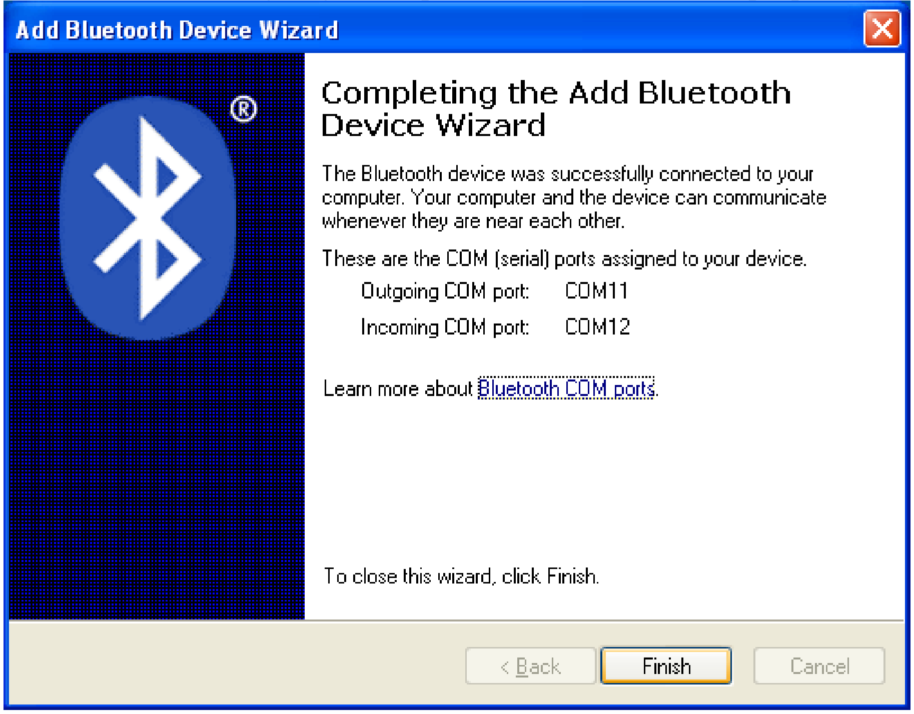
✓ Connecting...

✓ Please enter the passkey on your Bluetooth device now.

Passkey: 1234

▶ **Installing Bluetooth device...**

After the device is installed, note the *Outgoing COM port:* for communication purposes.



Completing the Add Bluetooth Device Wizard

The Bluetooth device was successfully connected to your computer. Your computer and the device can communicate whenever they are near each other.

These are the COM (serial) ports assigned to your device.

Outgoing COM port: COM11

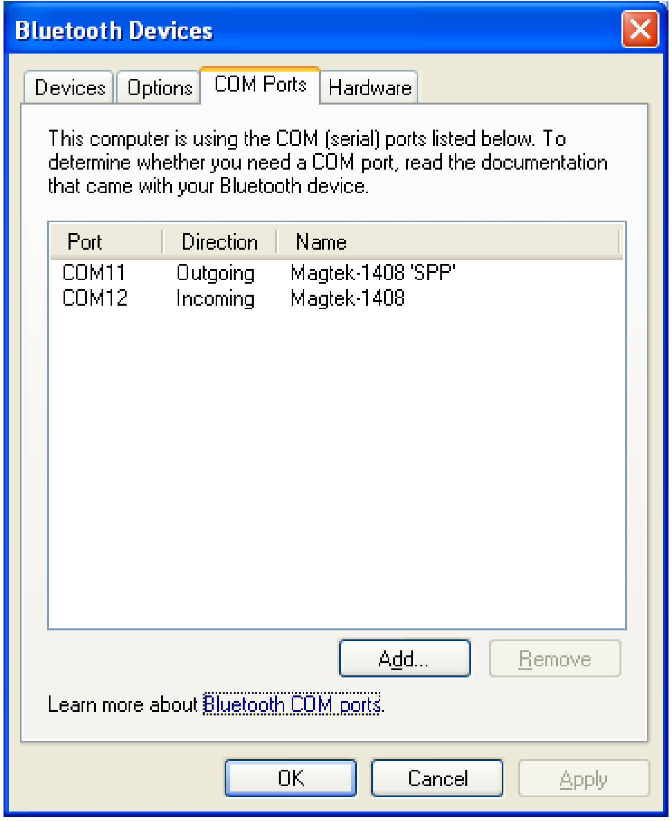
Incoming COM port: COM12

Learn more about Bluetooth COM ports.

To close this wizard, click Finish.

Click ***Finish***. The Bluetooth reader is now ready to use.

If you need to discover the COM port values later on, open the Bluetooth utility and select the *COM Ports* tab:



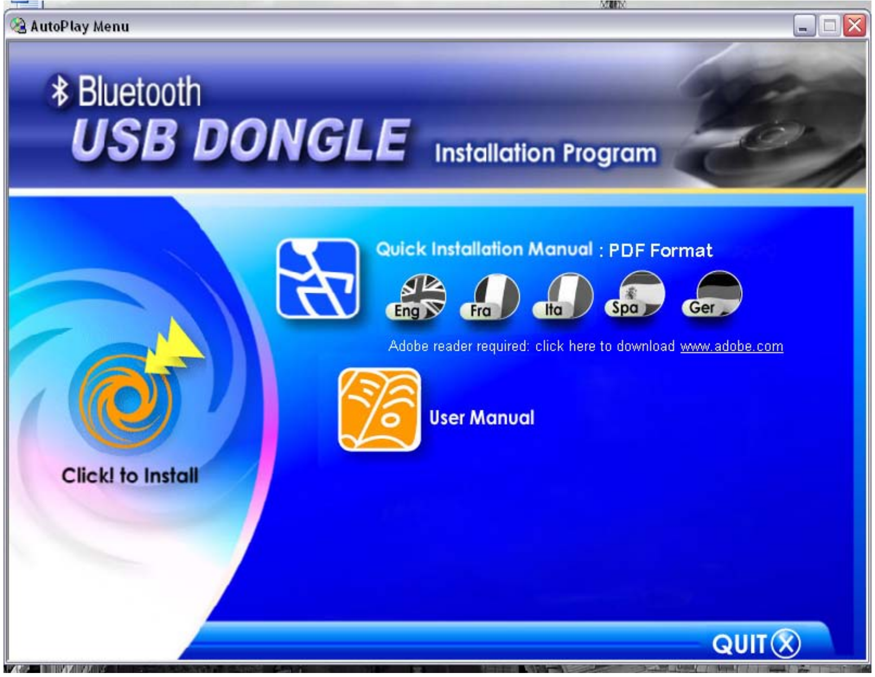
This computer is using the COM (serial) ports listed below. To determine whether you need a COM port, read the documentation that came with your Bluetooth device.

Port	Direction	Name
COM11	Outgoing	Magtek-1408 'SPP'
COM12	Incoming	Magtek-1408

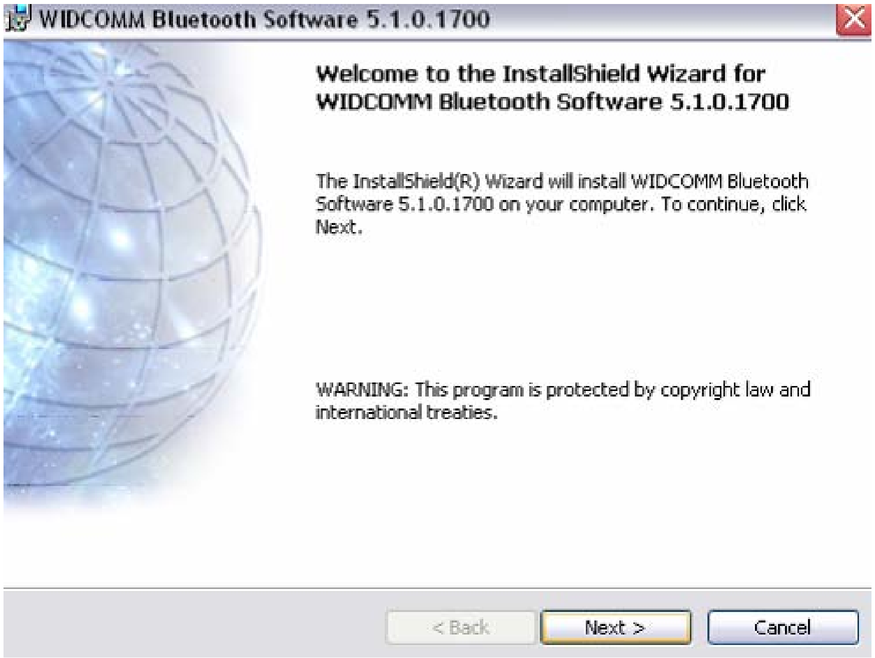
Learn more about Bluetooth COM ports.

APPENDIX C. INSTALLING BLUETOOTH WITH KENSINGTON DRIVER

Put the installation CD in your CD drive. Click **Click! To Install** to begin. (If the CD does not autoplay, select Start>Run… and type: D:autorun.exe, where 'D' is the letter of your CD drive.)



Click **Next**

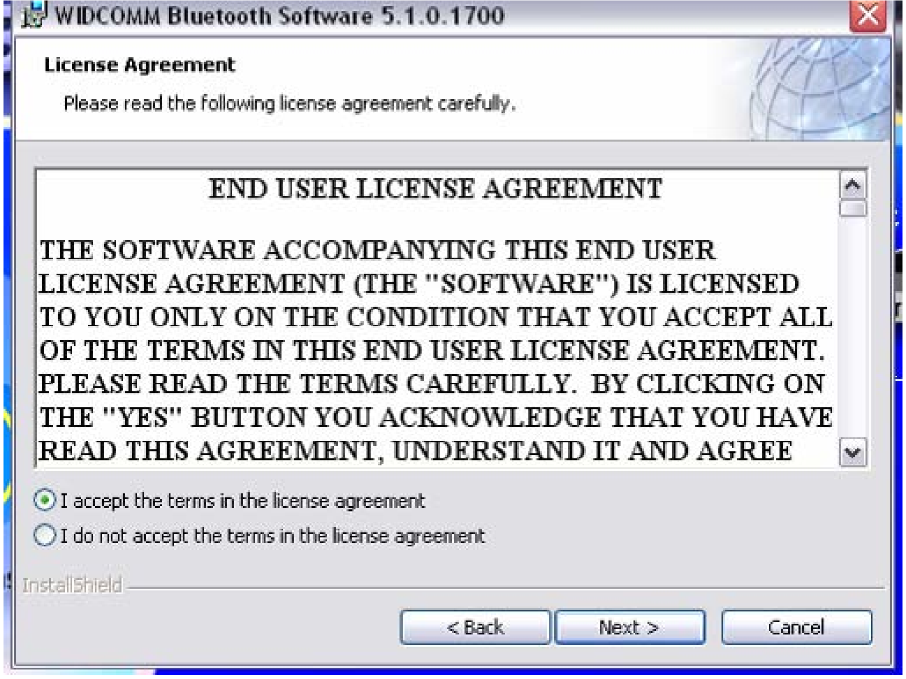


Welcome to the InstallShield Wizard for WIDCOMM Bluetooth Software 5.1.0.1700

The InstallShield(R) Wizard will install WIDCOMM Bluetooth Software 5.1.0.1700 on your computer. To continue, click Next.

WARNING: This program is protected by copyright law and international treaties.

Select **I accept the terms in the license agreement,** and click **Next**



WIDCOMM Bluetooth Software 5.1.0.1700
License Agreement
Please read the following license agreement carefully.
InstallShield
< Back
Next >
Cancel

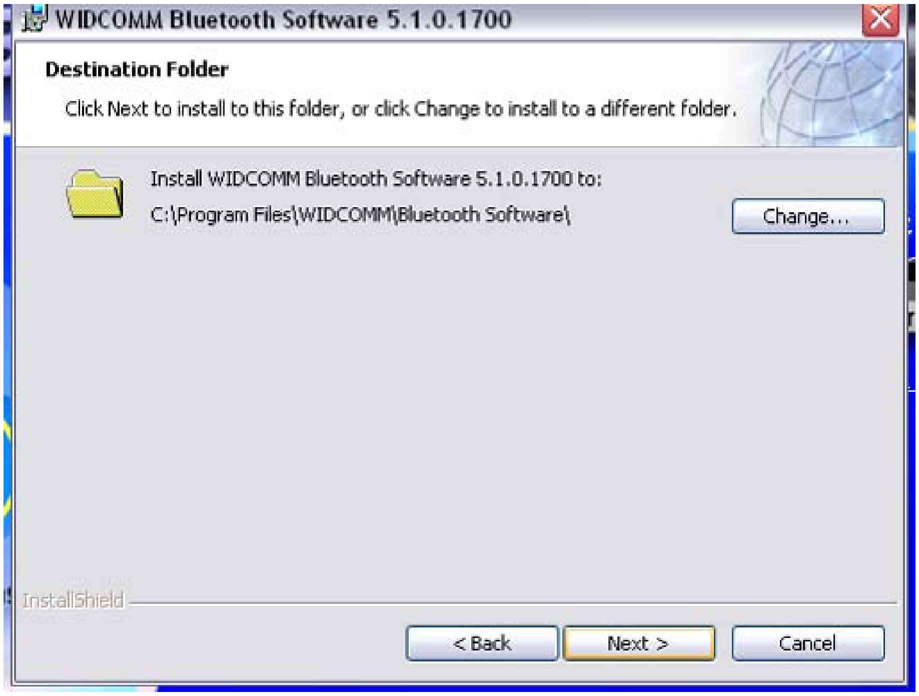
END USER LICENSE AGREEMENT

THE SOFTWARE ACCOMPANYING THIS END USER LICENSE AGREEMENT (THE "SOFTWARE") IS LICENSED TO YOU ONLY ON THE CONDITION THAT YOU ACCEPT ALL OF THE TERMS IN THIS END USER LICENSE AGREEMENT. PLEASE READ THE TERMS CAREFULLY. BY CLICKING ON THE "YES" BUTTON YOU ACKNOWLEDGE THAT YOU HAVE READ THIS AGREEMENT, UNDERSTAND IT AND AGREE

● I accept the terms in the license agreement

○ I do not accept the terms in the license agreement

Click **Next** to continue.

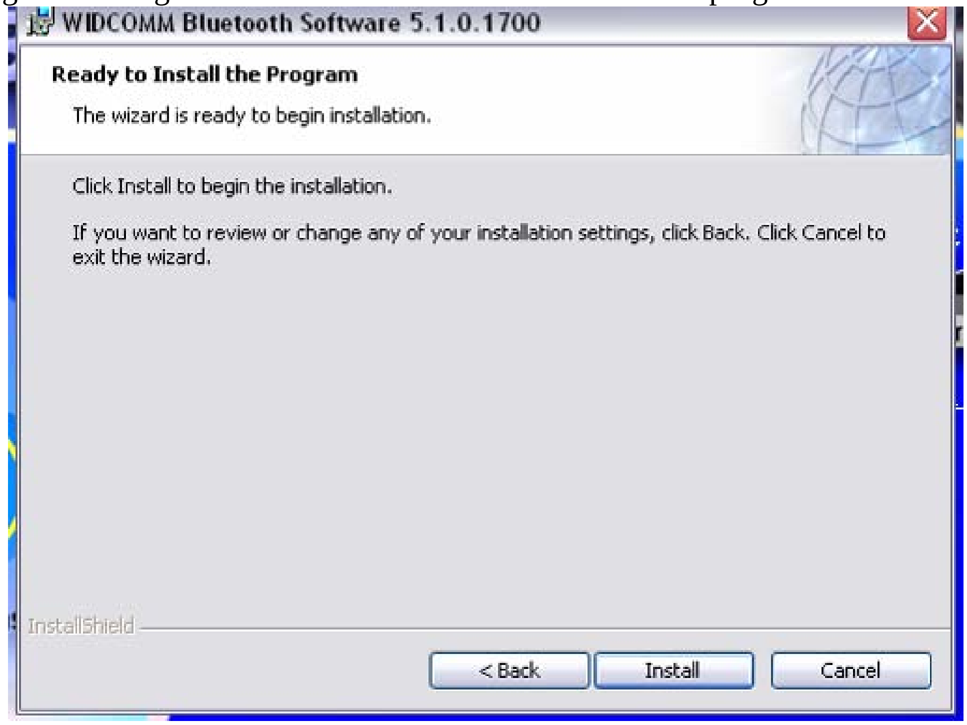


WIDCOMM Bluetooth Software 5.1.0.1700
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
Change...
InstallShield
< Back
Next >
Cancel

Install WIDCOMM Bluetooth Software 5.1.0.1700 to:

C:\Program Files\WIDCOMM\Bluetooth Software\

Click **Install** to begin installing the software. A status window shows the progress of the installation.



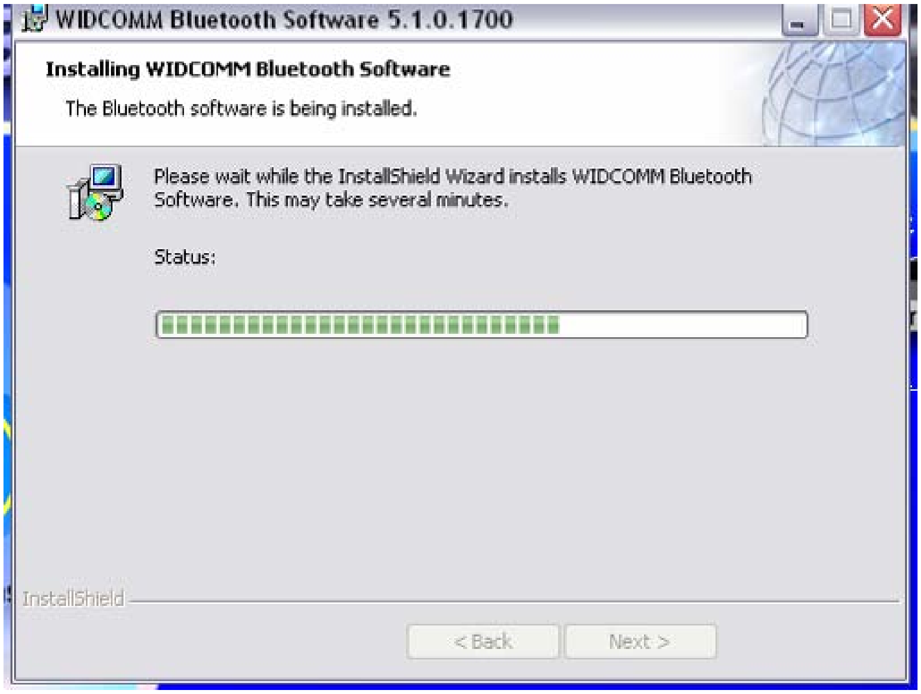
WIDCOMM Bluetooth Software 5.1.0.1700

Ready to Install the Program

The wizard is ready to begin installation.

Click Install to begin the installation.

If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.



WIDCOMM Bluetooth Software 5.1.0.1700

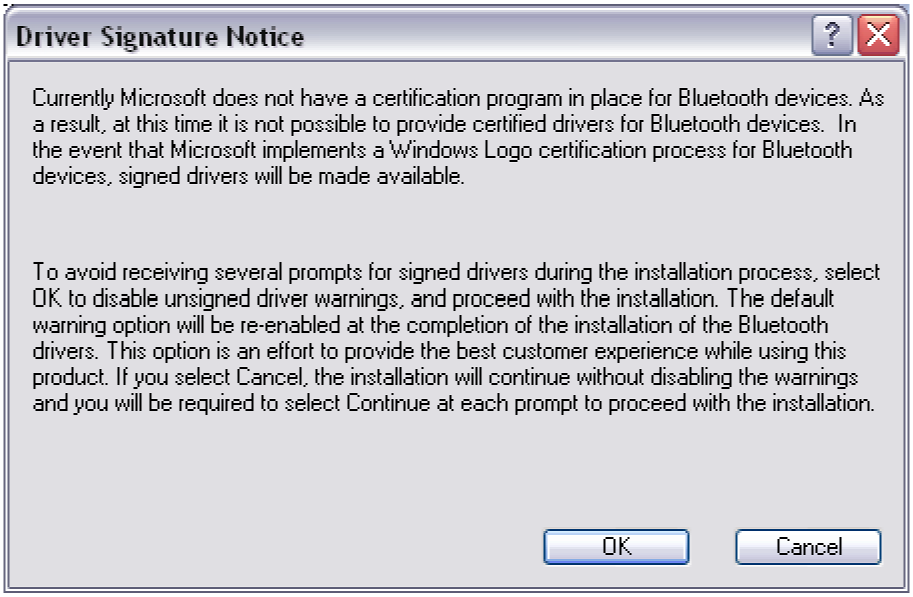
Installing WIDCOMM Bluetooth Software

The Bluetooth software is being installed.

Please wait while the InstallShield Wizard installs WIDCOMM Bluetooth Software. This may take several minutes.

Status:

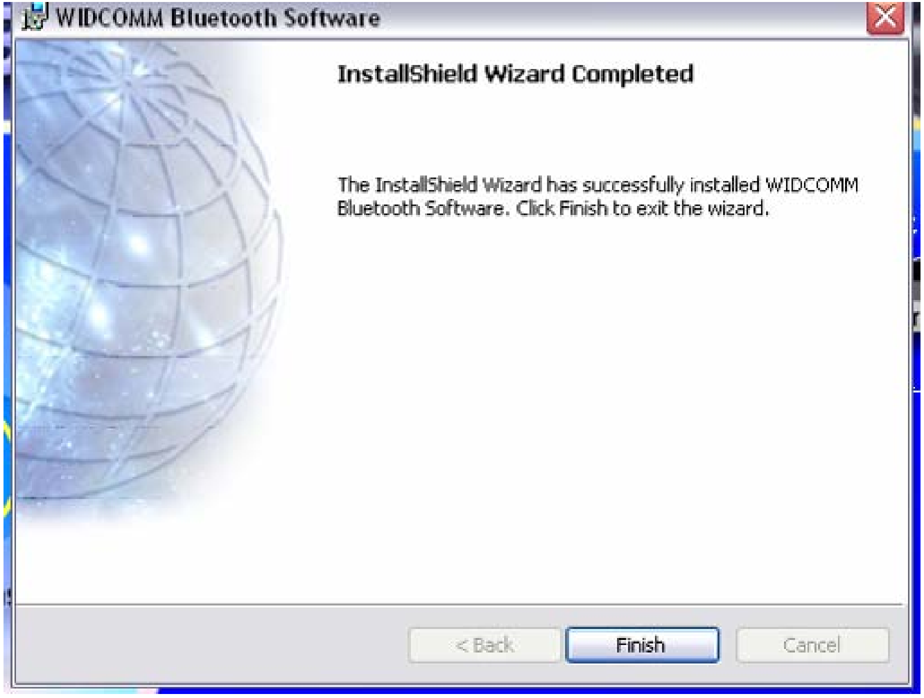
Click **OK** to continue.



Currently Microsoft does not have a certification program in place for Bluetooth devices. As a result, at this time it is not possible to provide certified drivers for Bluetooth devices. In the event that Microsoft implements a Windows Logo certification process for Bluetooth devices, signed drivers will be made available.

To avoid receiving several prompts for signed drivers during the installation process, select OK to disable unsigned driver warnings, and proceed with the installation. The default warning option will be re-enabled at the completion of the installation of the Bluetooth drivers. This option is an effort to provide the best customer experience while using this product. If you select Cancel, the installation will continue without disabling the warnings and you will be required to select Continue at each prompt to proceed with the installation.

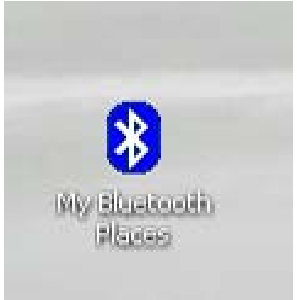
Click **Finish** and then click **Quit** on the main CD contents screen.



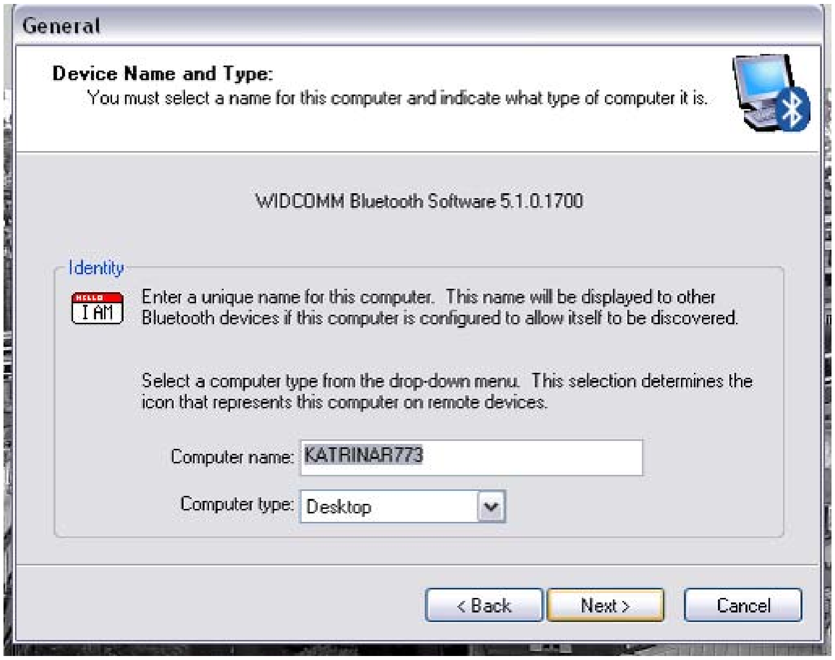
InstallShield Wizard Completed

The InstallShield Wizard has successfully installed WIDCOMM Bluetooth Software. Click Finish to exit the wizard.

Double-click **My Bluetooth Places** on the desktop to begin the setup.



Click **Next** to continue.



General

Device Name and Type:
You must select a name for this computer and indicate what type of computer it is.

WIDCOMM Bluetooth Software 5.1.0.1700

Identity

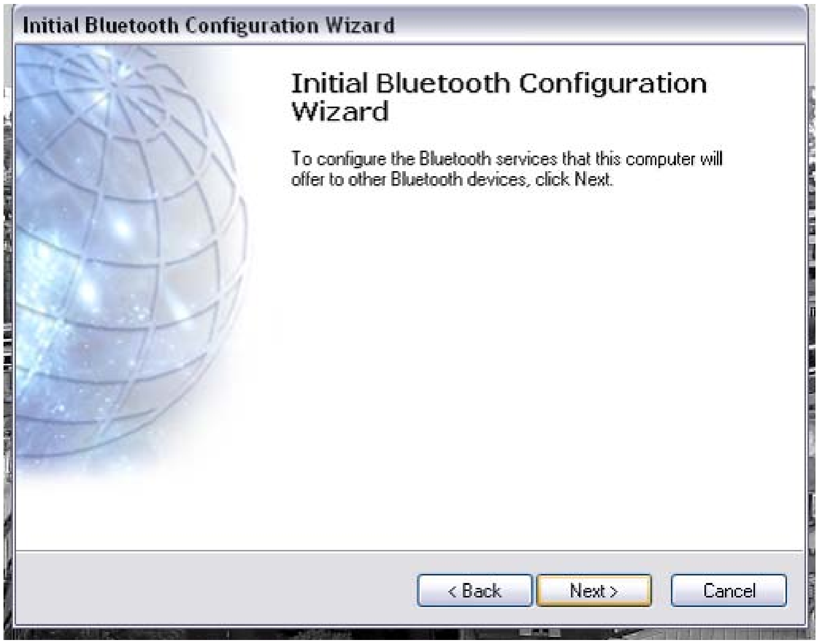
Enter a unique name for this computer. This name will be displayed to other Bluetooth devices if this computer is configured to allow itself to be discovered.

Select a computer type from the drop-down menu. This selection determines the icon that represents this computer on remote devices.

Computer name: KATRINAR773

Computer type: Desktop

Click **Next** to continue.

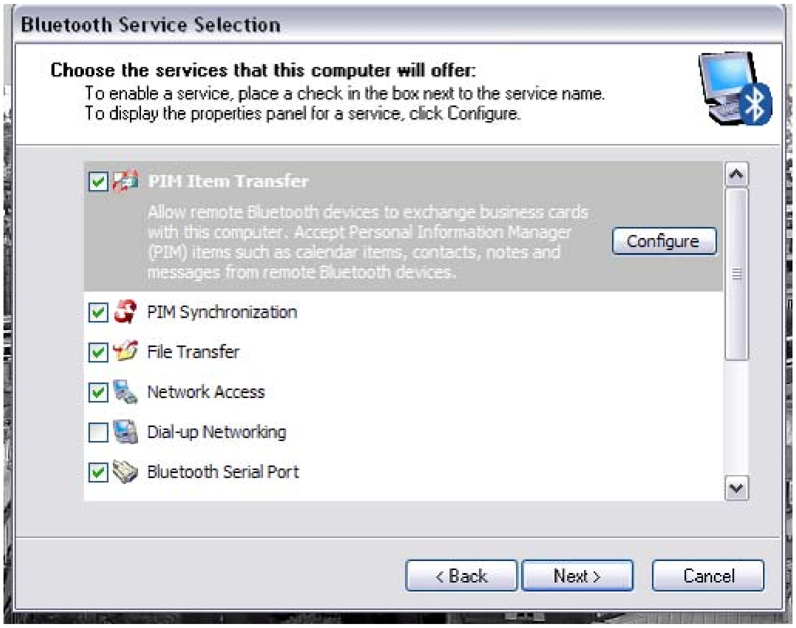


Initial Bluetooth Configuration Wizard

Initial Bluetooth Configuration Wizard

To configure the Bluetooth services that this computer will offer to other Bluetooth devices, click Next.

Click **Next** to continue.



Bluetooth Service Selection

Choose the services that this computer will offer:

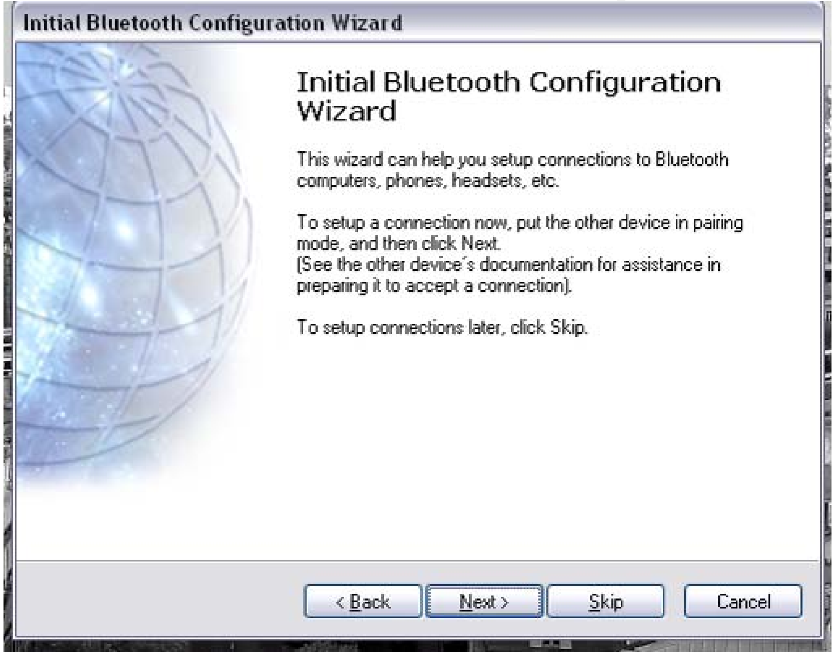
To enable a service, place a check in the box next to the service name.
To display the properties panel for a service, click Configure.

☑ **PIM Item Transfer**

Allow remote Bluetooth devices to exchange business cards with this computer. Accept Personal Information Manager (PIM) items such as calendar items, contacts, notes and messages from remote Bluetooth devices.

☑ PIM Synchronization
☑ File Transfer
☑ Network Access
□ Dial-up Networking
☑ Bluetooth Serial Port

If you have another Bluetooth device, Click **Next.** Otherwise, click **Skip.**



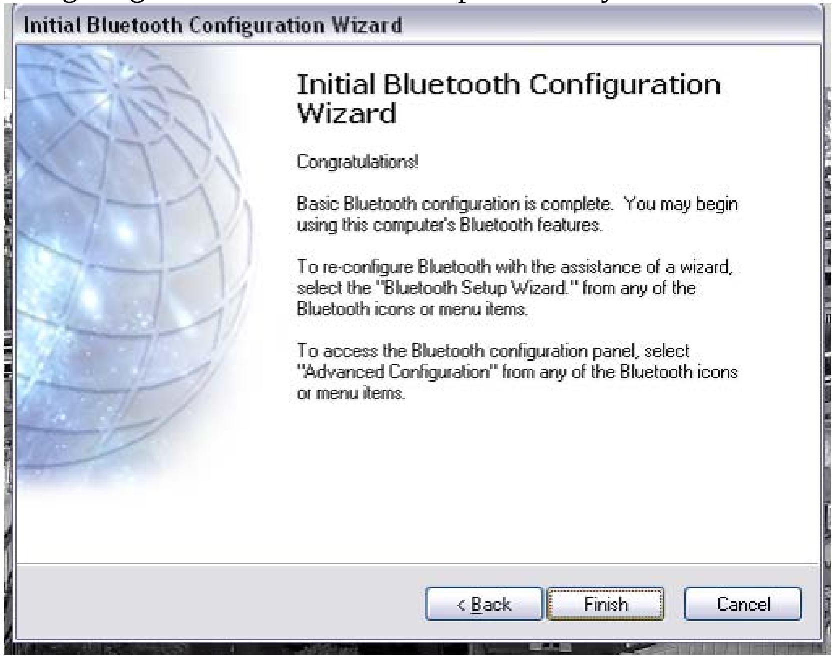
Initial Bluetooth Configuration Wizard

This wizard can help you setup connections to Bluetooth computers, phones, headsets, etc.

To setup a connection now, put the other device in pairing mode, and then click Next.
(See the other device's documentation for assistance in preparing it to accept a connection).

To setup connections later, click Skip.

When you are finished configuring the Bluetooth USB Adapter and any other Bluetooth devices, click **Finish.**



Initial Bluetooth Configuration Wizard

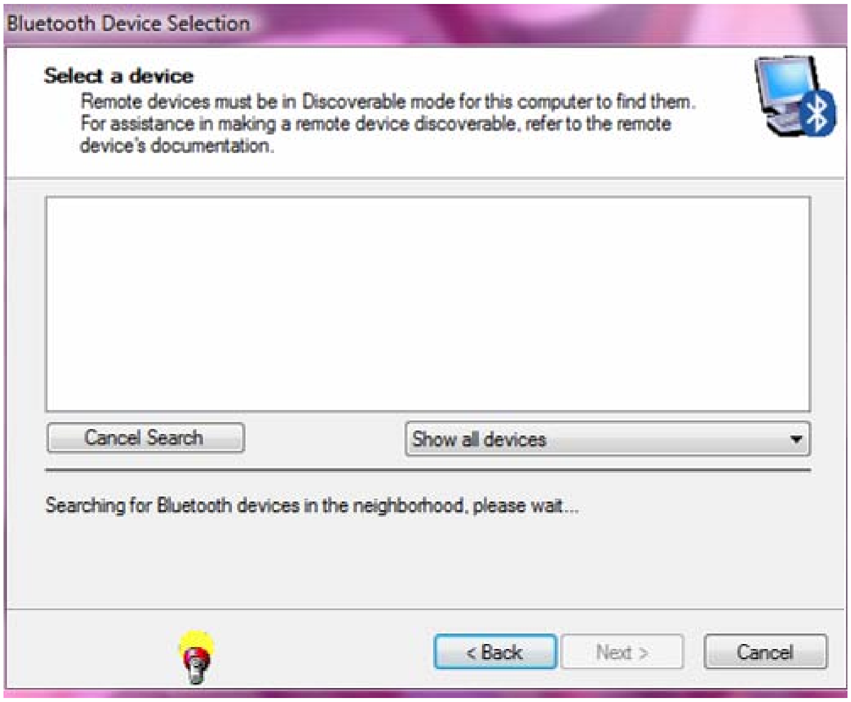
Congratulations!

Basic Bluetooth configuration is complete. You may begin using this computer's Bluetooth features.

To re-configure Bluetooth with the assistance of a wizard, select the "Bluetooth Setup Wizard." from any of the Bluetooth icons or menu items.

To access the Bluetooth configuration panel, select "Advanced Configuration" from any of the Bluetooth icons or menu items.

To add a device make sure the device is on while the program is searching. Once the device has been found, select the device and click **Next**.



Bluetooth Device Selection

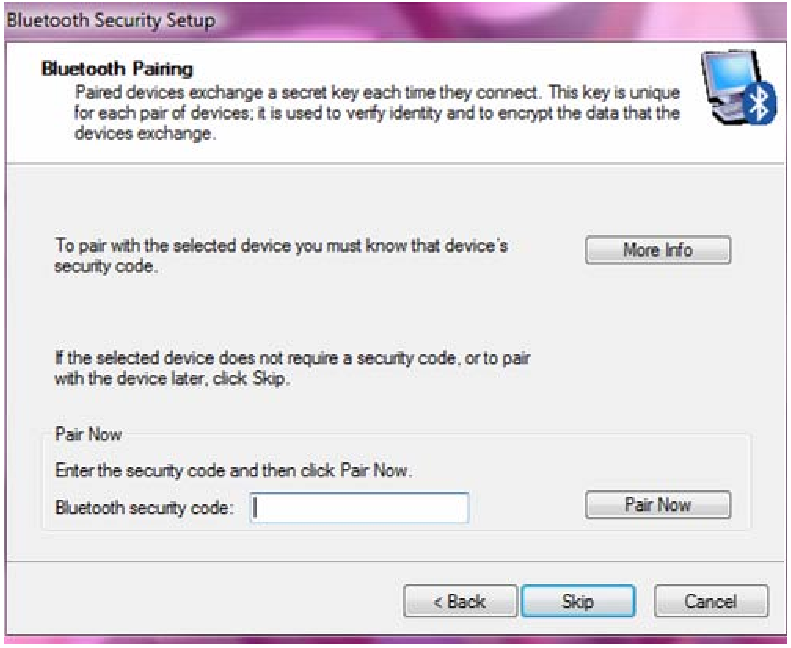
Select a device

Remote devices must be in Discoverable mode for this computer to find them. For assistance in making a remote device discoverable, refer to the remote device's documentation.

Show all devices

Searching for Bluetooth devices in the neighborhood, please wait...

Enter the security code, which is set to 1234 for initial use, and click **Pair Now**



Bluetooth Security Setup

Bluetooth Pairing

Paired devices exchange a secret key each time they connect. This key is unique for each pair of devices; it is used to verify identity and to encrypt the data that the devices exchange.

To pair with the selected device you must know that device's security code.

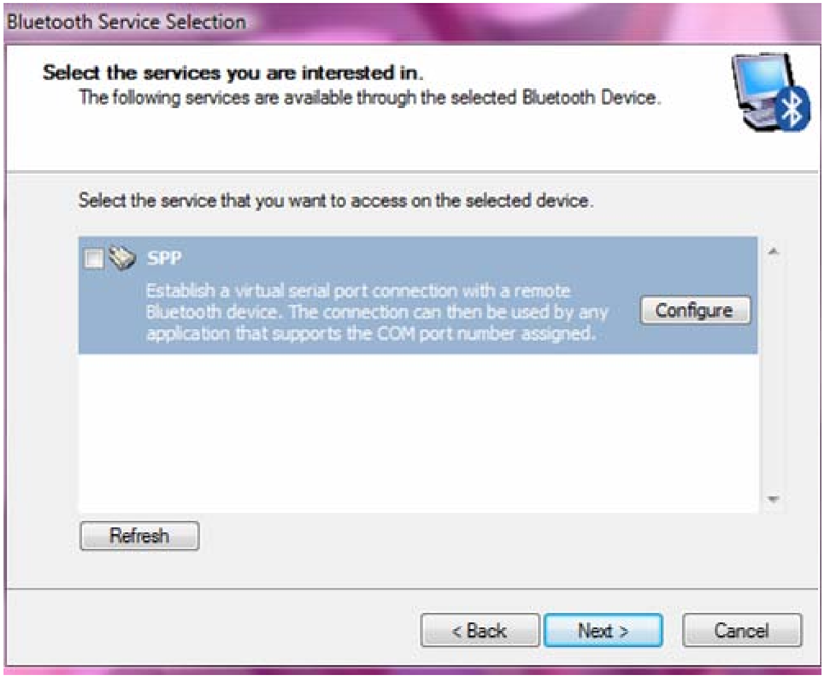
If the selected device does not require a security code, or to pair with the device later, click Skip.

Pair Now

Enter the security code and then click Pair Now.

Bluetooth security code:

Check the box next to SPP, then click **Next**.



Bluetooth Service Selection

Select the services you are interested in.

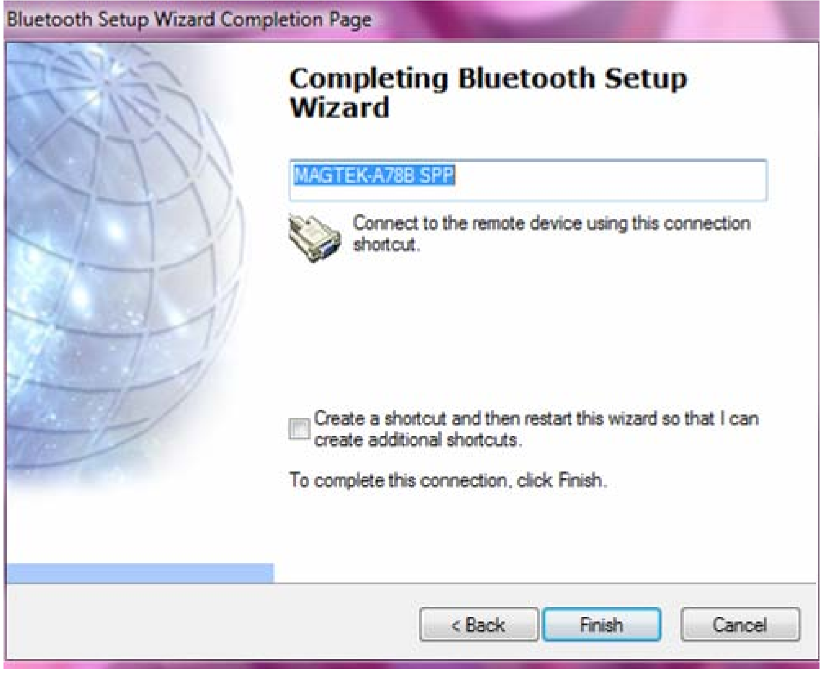
The following services are available through the selected Bluetooth Device.

Select the service that you want to access on the selected device.

□ SPP

Establish a virtual serial port connection with a remote Bluetooth device. The connection can then be used by any application that supports the COM port number assigned.

Click **Finish** to complete the process.



Bluetooth Setup Wizard Completion Page

Completing Bluetooth Setup Wizard

MAGTEK-A78B SPP

Connect to the remote device using this connection shortcut.

□ Create a shortcut and then restart this wizard so that I can create additional shortcuts.

To complete this connection, click Finish.

APPENDIX D. COMMAND EXAMPLES

This Appendix gives examples of command sequences and cryptographic operations. The intent is to clarify any ambiguities the user might find in the body of the document. Each example shows a sequence as it actually runs, thus the user can check algorithms against the examples to assure they are computing correctly.

Example 1: Changing from Security Level 3 to Security Level 4:

```
; This script demonstrates changing from Security Level 3 to Security Level 4.
; It assumes the reader is at Security Level 3 with the ANSI X9.24 Example
; key loaded and the KSN counter set to 2.
09 00        ; Get current KSN (should be FFFF9876543210E00002)
Request      : CMND=09, LEN=00, DATA=
Response     : RC=  00, LEN=0A, DATA=FF FF 98 76 54 32 10 E0 00 02

; For KSN 2, MAC Key: C46551CEF9FDDBB0 AA9AD834130DC4C7
;
; The command to change Security Level looks like: 15 05 04 nnnnnnnn
;  where nnnnnnnn is the MAC.
;
; The data to be MACd is: 15 05 04
; Data to be MACd must be in blocks of eight bytes, so we left justify and
; zero fill the block to get: 15 05 04 00 00 00 00 00 (This is the block to MAC)
; For convenience show it as the compacted form: 1505040000000000
;
; The MAC algorithm run with this data uses the following cryptographic
; operations:
;
;  Single DES Encrypt the data to be MACd with the left half of the MAC Key:
;     1505040000000000 1DES Enc with C46551CEF9FDDBB0 = 735323A914B9482E
;
;  Single DES Decrypt the result with the right half of the MAC Key:
;     735323A914B9482E 1DES Dec with AA9AD834130DC4C7 = 390E2E2AC8CB4EE6
;
;  Single DES Encrypt the result with the left half of the MAC Key:
;     390E2E2AC8CB4EE6 1DES Enc with C46551CEF9FDDBB0 = D9B7F3D8064C4B26
;
; The leftmost four bytes of the final result are the MAC = D9B7F3D8
;
; Send the MACd Set Security Level command
15 05 04 D9B7F3D8
Request      : CMND=15, LEN=05, DATA=04 D9 B7 F3 D8
Response     : RC=  00, LEN=00, DATA=

02 00        ; Reset so changes take effect
Request      : CMND=02, LEN=00, DATA=
Response     : RC=  00, LEN=00, DATA=

Delay        : (waited 5 seconds)
09 00        ; Get current KSN (should be FFFF9876543210E00003)
Request      : CMND=09, LEN=00, DATA=
Response     : RC=  00, LEN=0A, DATA=FF FF 98 76 54 32 10 E0 00 03

15 00        ; Get current Security Level (Should be 04)
Request      : CMND=15, LEN=00, DATA=
Response     : RC=  00, LEN=01, DATA=04
```

Example 2: Configuring a reader after encryption is enabled (Security Level 3 or 4).

```
; This script demonstrates configuration commands.
; It assumes the reader is at Security Level 3 or 4 and that the KSN counter
; is at 0x10.
09 00        ; Get current KSN (should be FFFF9876543210E00010)
Request      : CMND=09, LEN=00, DATA=
Response     : RC=  00, LEN=0A, DATA=FF FF 98 76 54 32 10 E0 00 10

; For this KSN counter the MAC Key is: 59598DCBD9BD6BC0 94165CE45358A057
00 01 02     ; Get current Polling Interval
Request      : CMND=00, LEN=01, DATA=02
Response     : RC=  00, LEN=01, DATA=01

00 01 1E     ; Get current Pre Card String
Request      : CMND=00, LEN=01, DATA=1E
Response     : RC=  00, LEN=00, DATA=

; Form MAC for Set Property command
;  Message to be sent is: 01 05 1E nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 01051E0000000000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           01051E0000000000 MACd with 59598DCBD9BD6BC0 94165CE45358A057
;     gets  5157FCBC179B0B95
;     MAC is first four bytes: 5157FCBC
01 05 1E 5157FCBC       ; Set to ""
Request      : CMND=01, LEN=05, DATA=1E 51 57 FC BC
Response     : RC=  00, LEN=00, DATA=

00 01 1F     ; Get current Post Card String
Request      : CMND=00, LEN=01, DATA=1F
Response     : RC=  00, LEN=00, DATA=

; Form MAC for Set Property command
;  Message to be sent is: 01 05 1F nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 01051F0000000000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           01051F0000000000 MACd with 2B5F01F4F0CCFAEA 639D523231BFE4A2
;     gets  4885838CCC672376
;     MAC is first four bytes: 4885838C 01 05 1F 4885838C       ; Set to ""
Request      : CMND=01, LEN=05, DATA=1F 48 85 83 8C Response     : RC=  00, LEN=00,
DATA=

00 01 20     ; Get current Pre Track String
Request      : CMND=00, LEN=01, DATA=20
Response     : RC=  00, LEN=00, DATA=

; Form MAC for Set Property command
;  Message to be sent is: 01 05 20 nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 0105200000000000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           0105200000000000 MACd with  9CF640F279C251E6 15F725EEEAC234AF
;     gets  442A09E6588BBF04
;     MAC is first four bytes: 442A09E6
```

```
01 05 20 442A09E6   ; Set to ""
Request      : CMND=01, LEN=05, DATA=20 44 2A 09 E6
Response     : RC=  00, LEN=00, DATA=

00 01 21     ; Get current Post Track String
Request      : CMND=00, LEN=01, DATA=21
Response     : RC=  00, LEN=00, DATA=

; Form MAC for Set Property command
;  Message to be sent is: 01 05 21 nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 0105210000000000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           0105210000000000 MACd with C3DF489FDF11ACB4 F03DE97C27DCB32F
;     gets  1FA9A44C703099E1
;     MAC is first four bytes: 1FA9A44C
01 05 21 1FA9A44C     ; Set to ""
Request      : CMND=01, LEN=05, DATA=21 1F A9 A4 4C
Response     : RC=  00, LEN=00, DATA=

00 01 22     ; Get current Termination String
Request      : CMND=00, LEN=01, DATA=22
Response     : RC=  00, LEN=01, DATA=0D

; Form MAC for Set Property command
;  Message to be sent is: 01 06 22 0D nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 0106220D00000000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           0106220D00000000 MACd with 6584885077214CF1 4737FA93F92334D2
;     gets  381AD461F2BDC522
;     MAC is first four bytes: 381AD461
01 06 22 0D 381AD461   ; Set to "<ENTER>"
Request      : CMND=01, LEN=06, DATA=22 0D 38 1A D4 61
Response     : RC=  00, LEN=00, DATA=

00 01 2C     ; Get current Format Code
Request      : CMND=00, LEN=01, DATA=2C
Response     : RC=  00, LEN=05, DATA=31 FF FF FF FF

; Form MAC for Set Property command
;  Message to be sent is: 01 09 2C 31303030 nnnnnnnn (nnnnnnnn is the MAC)
;  Message to be MACd is: 01092C3130303000
;  This is the simplest MAC, simply TDES encrypt the message to be MACd with
;   the MAC Key:
;           01092C3130303000 MACd with E161D1956A6109D2 F37AFD7F9CC3969A
;     gets  D153861529E88020
;     MAC is first four bytes: D1538615
01 09 2C 31303030 D1538615 ; Set to "1000"
Request      : CMND=01, LEN=09, DATA=2C 31 30 30 30 D1538615
Response     : RC=  00, LEN=00, DATA=

02 00        ; Reset so changes take effect
Request      : CMND=02, LEN=00, DATA=
Response     : RC=  00, LEN=00, DATA=

Delay        : (waited 5 seconds)
```

```
00 01 1E     ; Get current Pre Card String (should return "")
Request      : CMND=00, LEN=01, DATA=1E
Response     : RC=  00, LEN=00, DATA=

00 01 1F     ; Get current Post Card String (should return "")
Request      : CMND=00, LEN=01, DATA=1F
Response     : RC=  00, LEN=00, DATA=

00 01 20     ; Get current Pre Track String (should return "")
Request      : CMND=00, LEN=01, DATA=20
Response     : RC=  00, LEN=00, DATA=

00 01 21     ; Get current Post Track String (should return "")
Request      : CMND=00, LEN=01, DATA=21
Response     : RC=  00, LEN=00, DATA=

00 01 22     ; Get current Termination String (should return "<ENTER>")
Request      : CMND=00, LEN=01, DATA=22
Response     : RC=  00, LEN=01, DATA=0D

00 01 2C     ; Get current Format Code
Request      : CMND=00, LEN=01, DATA=2C
Response     : RC=  00, LEN=04, DATA=31 30 30 30
```

Example 3: Authentication. A reader already in Security Level 3 or 4 is put into the Authenticated Mode, allowed to stay in that mode for a time, then Deactivated.

```
; This example demonstrates the Authentication Sequence.
; It is not scripted; some of the data is deliberately randomized.  This
; makes it impossible for a simple script to produce the correct results.
; As an example it shows all the steps in authentication and deactivation.

; It assumes the reader is at Security Level 4, with the DUKPT KSN
;  counter set to 2.

09 00        ; Get current KSN (should be FFFF9876543210E00002)

; Send the Activate Authenticated Mode command (4 minutes)
10 02 00F0
Request      : CMND=10, LEN=02, DATA=00 F0
Response     : RC=  00, LEN=1A, DATA=FF FF 98 76 54 32 10 E0 00 03 AA AA AA AA AA AA AA
AA DD DD DD DD DD DD DD DD
                                     |------- Current KSN -------| |---- Challenge 1 ---
-| |---- Challenge 2 ----|
Response     : RC=  00, LEN=1A, DATA=FF FF 98 76 54 32 10 E0 00 03 BE 5C 98 35 17 7E 45
2A A7 2D 2D B2 36 BF 29 D2
;  Challenge 1 Encrypted: BE5C9835177E452A
;  Challenge 2 Encrypted: A72D2DB236BF29D2

; Note that the KSN now ends with a counter of 3!
; Decrypt Challenge 1 using variant of Current Encryption Key
;  (Current Encryption Key XOR with F0F0F0F0F0F0F0F0F0F0F0F0F0F0F0F0)
;
;  Current Key   0DF3D9422ACA561A 47676D07AD6BAD05
;          XOR   F0F0F0F0F0F0F0F0 F0F0F0F0F0F0F0F0
;            =   FD0329B2DA3AA6EA B7979DF75D9B5DF5
;
```

```
;     BE5C9835177E452A TDES Dec with FD0329B2DA3AA6EA B7979DF75D9B5DF5 =
7549AB6EB4840003
;
;  Note that the final two bytes of the result = 0003, matching the KSN as
;   transmitted in the clear.  This provides Authentication to the host that
;   the reader is what it claims to be (proves key knowledge).
;
; Decrypt Challenge 2 using Current Encryption Key variant as above
;     A72D2DB236BF29D2 TDES Dec with FD0329B2DA3AA6EA B7979DF75D9B5DF5 =
34DB9230698281B4
;
; Build an Activation Challenge Reply command (cmd, len, cryptogram)
;  11 08 XXXXXXXXXXXXXXXX
;
;  The clear text input for the cryptogram is composed of the first six bytes
;  of the decrypted Challenge 1 followed by two bytes specifying how long to
;  stay in the Authenticated Mode.
;
;     CCCCCCCCCCCC TTTT
;
;     Time examples:
;        For 30 seconds use 002E
;        For 99 seconds use 0063
;        For 480 seconds use 01E0
;        For 1200 seconds use 04B0
;
;  These fields are concatenated to form an eight byte block, we will use 480
;  seconds:
;
;     CCCCCCCCCCCC01E0
;
;  The block is encrypted using a variant of the Current Encryption Key
;  (Current Encryption Key XOR with 3C3C3C3C3C3C3C3C3C3C3C3C3C3C3C3C)
;
;  Current Key   0DF3D9422ACA561A 47676D07AD6BAD05
;          XOR   3C3C3C3C3C3C3C3C 3C3C3C3C3C3C3C3C
;            =   31CFE57E16F66A26 7B5B513B91579139
;
;     7549AB6EB48401E0 TDES Enc with 31CFE57E16F66A26 7B5B513B91579139 =
RRRRRRRRRRRRRRRR
;
; Send the Activation Challenge Reply Command
11 08 A30DDE3BFD629ACD

; Build a Deactivate Authenticated Mode command (cmd, len, cryptogram)
;  12 08 XXXXXXXXXXXXXXXX
;
;  The clear text input for the cryptogram is composed of the first seven bytes
;  of the decrypted Challenge 2 followed by one byte specifying whether to
;  increment the DUKPT KSN or not (00 = no increment, 01 = increment).
;
;     DDDDDDDDDDDDDD II
;
;  These fields are concatenated to form an eight byte block, we will specify
;  No Increment:
;
;     DDDDDDDDDDDDDD00
;
```

```
;  The block is encrypted using a variant of the Current Encryption Key
;  (Current Encryption Key XOR with 3C3C3C3C3C3C3C3C3C3C3C3C3C3C3C3C)
;
;  Current Key   0DF3D9422ACA561A 47676D07AD6BAD05
;          XOR   3C3C3C3C3C3C3C3C 3C3C3C3C3C3C3C3C
;            =   31CFE57E16F66A26 7B5B513B91579139
;
;     34DB923069828100 TDES Enc with 31CFE57E16F66A26 7B5B513B91579139 = CA CB BD 5F 58
D5 C9 50
;
; Send the Deactivate Authenticated Mode command
12 08 CACBBD5F58D5C950
```

Example 4: Swipe decryption, Bluetooth Reader in Security Level 3 or 4:

This example shows the data received in a Card Swipe for a reader at Security Level 3, KSN Count = 8. It will go on to show the steps to decrypt ALL the data received.

```
Raw Card Swipe Data:
Byte   Content
  0    %B5452000000007189^HOGAN/PAUL      ^08040000000000
 50    000000000?;5452000000007189=080400000000000000?+51
100    63000050000445=000000000000?|0600|C25C1D1197D31CAA
150    87285D59A892047426D9182EC11353C051ADD6D0F072A6CB34
200    36560B3071FC1FD11D9F7E74886742D9BEE0CFD1EA1064C213
250    BB55278B2F12|724C5DB7D6F901C7F0FEAE7908801093B3DBF
300    E51CCF6D483E789D7D2C007D539499BAADCC8D16CA2|E31234
350    A91059A0FBFE627954EE21868AEE3979540B67FCC40F61CECA
400    54152D1E|A1050000|8628E664C59BBAA232BA90BFB3E6B41D
450    6F4B691E633C311CBE6EE7466B81196EC07B12648DCAC4FD7F
500    D0E212B479C60BAD8C74F82F327667||21685F158B5C6BE0|F
550    FFF9876543210E00008|B78F||0000
```

The Card Swipe Data is broken down like this:

```
[P30]
[P32] [Tk1 SS] [Tk1 Masked Data] [ES] [P33]
[P32] [Tk2 SS] [Tk2 Masked Data] [ES] [P33]
[P32] [Tk3 SS] [Tk3 Masked Data] [ES] [P33]
[P31]
[P35] [Reader Encryption Status]
[P35] [Tk1 Encrypted Data (including TK1 SS and ES)]
[P35] [Tk2 Encrypted Data (including TK2 SS and ES)]
[P35] [Tk3 Encrypted Data (including TK3 SS and ES)]
[P35] [MagnePrint Status]
[P35] [Encrypted MagnePrint data]
[P35] [Device serial number]
[P35] [Encrypted Session ID]
[P35] [DUKPT serial number/counter]
[P35] [Clear Text CRC]
[P35] [Encrypted CRC]
[P35] [Format Code]
[P34]
```

Each of the Pxx elements has the default value in this configuration, thus we can reinterpret the format as:

```
%[Tk1 Masked Data]?
;[Tk2 Masked Data]?
+[Tk3 Masked Data]?
|[Reader Encryption Status]
|[Tk1 Encrypted Data (including TK1 SS and ES)]
|[Tk2 Encrypted Data (including TK2 SS and ES)]
|[Tk3 Encrypted Data (including TK3 SS and ES)]
|[MagnePrint Status]
|[Encrypted MagnePrint data]
|[Device serial number]
|[Encrypted Session ID]
|[DUKPT serial number/counter]
|[Clear Text CRC]
|[Encrypted CRC]
|[Format Code]
<ENTER>
```

Using this information, we can put the respective data from the Raw Data into the structure:

```
%B5452000000007189^HOGAN/PAUL      ^08040000000000000000000?
;5452000000007189=08040000000000000?
+5163000050000445=000000000000?
|0600
|C25C1D1197D31CAA87285D59A892047426D9182EC11353C051ADD6D0F072A6CB3436560B3071FC1FD11D9F7
E74886742D9BEE0CFD1EA1064C213BB55278B2F12
|724C5DB7D6F901C7F0FEAE7908801093B3DBFE51CCF6D483E789D7D2C007D539499BAADCC8D16CA2
|E31234A91059A0FBFE627954EE21868AEE3979540B67FCC40F61CECA54152D1E
|A1050000
|8628E664C59BBAA232BA90BFB3E6B41D6F4B691E633C311CBE6EE7466B81196EC07B12648DCAC4FD7FD0E21
2B479C60BAD8C74F82F327667
|
|21685F158B5C6BE0
|FFFF9876543210E00008
|B78F
|
|0000
```

Note: The Device Serial Number field is empty because the DSN has not been set.

Note: The Encrypted CRC field is empty because the default configuration is to send it empty.

Note that at Security Level 3 the following fields are represented as ASCII characters:

Masked Track data
Format Code

Note that all other fields are represented as Hexadecimal data, that is two ASCII characters together give the value of a single byte.

The data is coherent structurally, let's work on decryption.

First, we note the KSN = FFFF9876543210E00008, counter is 8.
For the standard ANSI key example, counter 8 gets us the following
Encryption Key: 27F66D5244FF621E AA6F6120EDEB427F

There are five encrypted fields: Tracks 1, 2, and 3 encrypted data, Encrypted MagnePrint data, Encrypted Session ID. We will show the decryption of each of these fields in detail. For convenience each will be grouped as blocks of eight bytes.

```
   Track 1 encrypted data
      Block # 1   C25C1D1197D31CAA
              2   87285D59A8920474
              3   26D9182EC11353C0
              4   51ADD6D0F072A6CB
              5   3436560B3071FC1F
              6   D11D9F7E74886742
              7   D9BEE0CFD1EA1064
              8   C213BB55278B2F12

      Appendix A tells us to decrypt the last block:
         C213BB55278B2F12 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets E98ED0F0D1EA1064
             XOR D9BEE0CFD1EA1064
            gets 3030303F00000000   (decrypted last block)

      Continue on in reverse block order:
         D9BEE0CFD1EA1064 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets E12DA84C41B85772
             XOR D11D9F7E74886742
            gets 3030373235303030   (decrypted block 7)

      Continue on in reverse block order:
         D11D9F7E74886742 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets 0704673B0041CC2F
             XOR 3436560B3071FC1F
            gets 3332313030303030   (decrypted block 6)

      Continue on in reverse block order:
         3436560B3071FC1F TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets 718DF68EC04A96FF
             XOR 51ADD6D0F072A6CB
            gets 2020205E30383034   (decrypted block 5)

      Continue on in reverse block order:
         51ADD6D0F072A6CB TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets 0989597B8D3373E0
             XOR 26D9182EC11353C0
            gets 2F5041554C202020   (decrypted block 4)

      Continue on in reverse block order:
         26D9182EC11353C0 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets BF110311E7D5453A
             XOR 87285D59A8920474
            gets 38395E484F47414E   (decrypted block 3)

      Continue on in reverse block order:
         87285D59A8920474 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
            gets F2692820A5E12B9B
             XOR C25C1D1197D31CAA
            gets 3035353132323731   (decrypted block 2)
   Continue on in reverse block order:
      C25C1D1197D31CAA TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 2542353435323330   (decrypted block 1)

   Ordering the decrypted blocks 1st to last we get:
         HEX               ASCII
         2542353435323330  %B545230
         3035353132323731  05512271
         38395E484F47414E  89^HOGAN
         2F5041554C202020  /PAUL
         2020205E30383034     ^0804
         3332313030303030  32100000
         3030373235303030  00725000
         3030303F00000000  000?

   We can ignore the last four bytes because they are all hex 00 and fall
   after the End Sentinel.

   ASCII string "%B5452300551227189^HOGAN/PAUL      ^08043210000000725000000?"

   This is an accurate decryption of the track.

Track 2 encrypted data
   Block # 1   724C5DB7D6F901C7
           2   F0FEAE7908801093
           3   B3DBFE51CCF6D483
           4   E789D7D2C007D539
           5   499BAADCC8D16CA2

   Appendix A tells us to decrypt the last block:
      499BAADCC8D16CA2 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets D0BBE2E2FF07D539
          XOR E789D7D2C007D539
         gets 373235303F000000   (decrypted last block)

   Continue on in reverse block order:
      E789D7D2C007D539 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 82EBCE61FCC6E4B3
          XOR B3DBFE51CCF6D483
         gets 3130303030303030   (decrypted block 4)

   Continue on in reverse block order:
      B3DBFE51CCF6D483 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets C9C39E4138B423A1
          XOR F0FEAE7908801093
         gets 393D303830343332   (decrypted block 3)

   Continue on in reverse block order:
      F0FEAE7908801093 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 47796C85E4CE30FF
          XOR 724C5DB7D6F901C7
         gets 3535313232373138   (decrypted block 2)

   Continue on in reverse block order:
      724C5DB7D6F901C7 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 3B35343532333030   (decrypted block 1)
   Ordering the decrypted blocks 1st to last we get:
         HEX               ASCII
         3B35343532333030  ;5452300
         3535313232373138  55122718
         393D303830343332  9=080432
         3130303030303030  10000000
         373235303F000000  7250?

   We can ignore the last three bytes because they are all hex 00 and fall
   after the End Sentinel.

   ASCII string ";5452300551227189=080432100000007250?"

   This is an accurate decryption of the track.

Track 3 encrypted data
   Block # 1   E31234A91059A0FB
           2   FE627954EE21868A
           3   EE3979540B67FCC4
           4   0F61CECA54152D1E

   Appendix A tells us to decrypt the last block:
      0F61CECA54152D1E TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets DE0949643B57C3C4
          XOR EE3979540B67FCC4
         gets 3030303030303F00   (decrypted last block)

   Continue on in reverse block order:
      EE3979540B67FCC4 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets CB5F4964DE11B6BA
          XOR FE627954EE21868A
         gets 353D303030303030   (decrypted block 3)

   Continue on in reverse block order:
      FE627954EE21868A TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets D32A0499226994CF
          XOR E31234A91059A0FB
         gets 3038303032303434   (decrypted block 2)

   Continue on in reverse block order:
      E31234A91059A0FB TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 2B35313633343939   (decrypted block 1)

   Ordering the decrypted blocks 1st to last we get:
         HEX               ASCII
         2B35313633343939  +5163499
         3038303032303434  08002044
         353D303030303030  3=000000
         3030303030303F00  000000?

   We can ignore the last byte because it is hex 00 and falls after the
   End Sentinel.

   ASCII string "+5163499080020443=000000000000? "

   This is an accurate decryption of the track.
```

```
MagnePrint data
      Block # 1   8628E664C59BBAA2
              2   32BA90BFB3E6B41D
              3   6F4B691E633C311C
              4   BE6EE7466B81196E
              5   C07B12648DCAC4FD
              6   7FD0E212B479C60B
              7   AD8C74F82F327667

   Appendix A tells us to decrypt the last block:
      AD8C74F82F327667 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 09162DCA11E5C60B
          XOR 7FD0E212B479C60B
         gets 76C6CFD8A59C0000   (decrypted last block)

   Continue on in reverse block order:
      7FD0E212B479C60B TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets AE81BFA4A2C80006
          XOR C07B12648DCAC4FD
         gets 6EFAADC02F02C4FB   (decrypted block 6)

   Continue on in reverse block order:
      C07B12648DCAC4FD TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets AAC8D06ACCF27E6D
          XOR BE6EE7466B81196E
         gets 14A6372CA7736703   (decrypted block 5)

   Continue on in reverse block order:
      BE6EE7466B81196E TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 01D78CB7D1DAEA95
          XOR 6F4B691E633C311C
         gets 6E9CE5A9B2E6DB89   (decrypted block 4)

   Continue on in reverse block order:
      6F4B691E633C311C TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 0D2620B051231748
          XOR 32BA90BFB3E6B41D
         gets 3F9CB00FE2C5A355   (decrypted block 3)

   Continue on in reverse block order:
      32BA90BFB3E6B41D TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 41499B60A6AAD427
          XOR 8628E664C59BBAA2
         gets C7617D0463316E85   (decrypted block 2)

   Continue on in reverse block order:
      8628E664C59BBAA2 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
         gets 010002D4B69CD2C0   (decrypted block 1)

   ***********************
   Ordering the decrypted blocks 1st to last we get:
         HEX
         010002D4B69CD2C0
         C7617D0463316E85
         3F9CB00FE2C5A355
         6E9CE5A9B2E6DB89
         14A6372CA7736703
         6EFAADC02F02C4FB
         76C6CFD8A59C0000
```

We can ignore the last two bytes because we know the MagnePrint data is actually 54 bytes long.

```
      010002D4B69CD2C0C7617D0463316E853F9CB00FE2C5A3556E9CE5A9B2E6DB8914A6372C
A77367036EFAADC02F02C4FB76C6CFD8A59C0000
```

This is an accurate decryption of the MagnePrint data.

Encrypted Session ID (user didn't load, all zeroes)

```
21685F158B5C6BE0
```

As this is a simple eight byte block, we only need decrypt it with the appropriate key:

```
21685F158B5C6BE0 TDES Dec with 27F66D5244FF621E AA6F6120EDEB427F
   gets 0000000000000000
```

This is an accurate decryption of the Encrypted Session ID, which was not loaded by the user and thus was all zeroes.

APPENDIX E. IDENTIFYING ISO/ABA AND AAMVA CARDS

ISO/ABA FINANCIAL CARDS

1. If low level decoding algorithm finds data for available tracks to be in the ISO format particular to each track, the card is classified as ISO. In order to be considered for ISO Financial masking, the card must first be classed as ISO.
2. In order for any track on a card to be considered for ISO/ABA masking, the card must be classified as ISO by the low level decoding algorithm.
3. ISO/ABA masking is considered for each track independently. One track may qualify for masking and another not.
4. Track 1
    a. The goal is to send the Format Code in the clear, the PAN partially masked, the Name and Expiration Date in the clear, and the rest of the track masked.
    b. If Format Code, PAN, Name, or Expiration Date are not correctly structured, the rest of the track (from the point of discrepancy) will be sent in the clear.
    c. If the Format Code, PAN, Name, or Expiration Date contain the '?' character (End Sentinel), the field is not correctly structured.
    d. A correctly structured Format Code is the first character on the card and contains the character 'B'.
    e. A correctly structured PAN has a maximum of 19 digits and is ended by the character '^' (Field Separator).
    f. A correctly structured Name has a maximum of 26 characters and is ended by the character '^' (Field Separator).
    g. A correctly structured Expiration Date has 4 characters.
5. Tracks 2 & 3
    a. The goal is to send the PAN partially masked, the Expiration Date in the clear, and the rest of the track masked.
    b. If the PAN or Expiration Date are not correctly structured, the rest of the track (from the point of discrepancy) will be sent in the clear.
    c. If the PAN or Expiration Date contain the '?' character (End Sentinel), the field is not correctly structured.
    d. A correctly structured PAN has a maximum of 19 digits and is ended by the character '=' (Field Separator).
    e. A correctly structured Expiration Date has 4 characters.

AAMVA DRIVER LICENSES

1. If the card reader reads three tracks of data and Track 1 is formatted per ISO Track 1 rules, Track 2 is formatted per ISO Track 2 rules, and Track 3 is formatted per ISO Track 1 rules, the card is considered to be an AAMVA card. Some MagTek readers do not support reading of Track 3, so this rule will not apply on such readers.
2. If low level decoding algorithm finds data for available tracks to be in the ISO format particular to each track, and Track 2 contains a correctly structured PAN field whose first 6 digits are "604425" or contain values in the range "636000" to "636062" inclusive, the card is considered to be an AAMVA card.

3. AAMVA card masking, when enabled, works as follows:
    a. Tracks 1 & 3 are sent entirely masked i.e., zeros are supplied in all character positions.
    b. Track 2:
        - The goal is to send the Driver License ID (DLID) partially masked, the Expiration Date in the clear, the Birth Date in the clear, and the rest of the track masked.
        - If the DLID, Expiration Date, or Birth Date are not correctly structured, the rest of the track (from the point of discrepancy) will be sent in the clear.
        - If the DLID, Expiration Date, or Birth Date contain the '?' character (End Sentinel), the field is not correctly structured.
        - A correctly structured DLID has a maximum of 19 digits and is ended by the character '=' (Field Separator).
        - A correctly structured Expiration Date has 4 characters.
        - A correctly structured Birth Date has 8 characters.