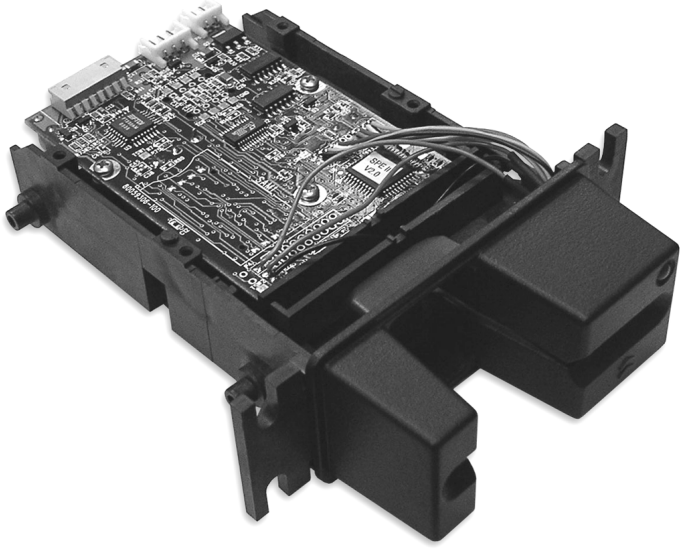
SPECTRUM™ II

Full Insert Magnetic Stripe Reader and Smart Card Reader-Writer RS-232 and USB/RS-232

User's Manual



EMV™

CE

Version 2.1 Rev. A
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#462

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Warning

This equipment has not been tested to comply with Part 15 of the FCC Rules for a digital device. This device is designed to be incorporated into a product that will be tested to comply with all regulatory requirements.

Certifications

A letter of approval, affirming reader hardware and firmware conformance to EMV 2000 ICC Specifications for Payment Systems Version 4.0, was issued on May 21, 2004.

The PC/SC driver was certified and signed by the Windows Hardware Quality Control Lab on March 24, 2004. This driver is certified for Windows 2000 and Windows XP (32 bit versions only).

CE certification has also been obtained.

Limited Warranty

ID TECH warrants this product to be in good working order for a period of one year from the date of purchase. If this product is not in good working order as warranted above, or should this product fail to be in good working order at any time during the warranty period, repair or replacement shall be provided by ID TECH.

This warranty does not cover incidental or consequential damages incurred by consumer misuse, or modification of said product. For limited warranty service during the warranty period, please contact ID TECH to obtain an RMA number and instructions for returning the product.

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Section 1
INTRODUCTION

Description

The ID TECH Spectrum II Hybrid Insert Reader can be configured to read 1, 2, or 3 tracks of magnetic stripe data from cards conforming to ISO 7810 and 7811 standards. It can also read and write data to IC cards conforming to ISO 7810, 7816, and Europay, MasterCard, and Visa (EMV) standards.

All communication (i.e. reader and message configuration set-up) is accomplished using a single standard RS-232 interface for both smart and magnetic cards, and makes use of landing-style contacts to ensure maximum card and connector contact life.

This intelligent reader allows the user to program interface parameters, as well as edit the data derived from magnetic stripes. It supports 3 and 5 VDC microprocessor or memory cards and has automatic hardware protection for card removal, ESD, supply voltage drop, short circuit, and overheating in compliance with EMV requirements.

The reader's chassis is molded from a glass and lubricant-filled engineering plastic that supports the magnetic head and electronics, and serves as a guide for the card. The head is spring-loaded for good contact with warped or bowed cards. The smart card connector has gold-plated contacts that "land" on the ICC's contacts and create a .02 inch "wiping" action to ensure a dependable connection and long life.

The card latch mechanism is designed to secure the card in the insert reader while a card transaction is in process. The programmable latch function is driven by a DC electric motor controlled by either the host or the reader, as desired.

The reader has an open internal design that allows foreign matter entering through the bezel (up to half a card) to fall away and not clog or otherwise obstruct the card path. It has multiple mounting options, and can be securely mounted in any position. A separate molded bezel attaches to the chassis to guide the card, and serves as a mount for a tri-colored LED.

Environmentally, the reader is designed to function at temperatures ranging from 32° to 131° F (0° to 55° C) in humidity up to 95% non-condensing. It can be stored or shipped at more extreme temperatures ranging from -40° to 158° F (-40° to 70° C).

To aid in application software development, a Dynamic Link Library (DLL) has been created for use with Windows 98, 2000, NT, Me, and XP editions. In addition, a Windows-based demonstration program and associated test card(s) are available to test the reader and familiarize the user with its various configuration options. Please see Appendix F: Demonstration Software and Card for details.

Section 2
INSTALLATION

RS-232 Interface

The ID TECH Hybrid Insert Reader is set at the factory to read magnetic stripe cards on withdrawal, but can be configured to read on both insertion and withdrawal or on insertion alone, as desired. It communicates with the host via an RS-232 port using the protocol defined in this document.

Upon installation, the host must be configured to accept the data and to perform the appropriate processing. Care must be taken to ensure that the host application's RS-232 parameters (baud rate, data bits, Start/Stop characters, parity, and handshaking method) match those expected by the reader. The magnetic reader's output can be formatted with terminating characters and special preamble and/or postamble character strings to match the data format expected by the host.

The ID TECH Hybrid Insert Reader with the standard bezel can be mounted via the front mounting flanges that are part of the chassis. Side mounting studs are also provided.

The reader can be mounted in any orientation, but the preferred position is with the board on top (so that debris and card fragments can fall free and not accumulate on the smart card connector). The reader accepts an 7-pin Molex 51004-0700 female connector (or equivalent) for both data and power. The I/O connector pin-outs are provided in Appendix E. Data is transmitted to the host in an ASCII data format.

USB/RS-232 Interface

The ID TECH Hybrid Insert Reader with the USB/RS-232 interface uses a special software driver to simulate a virtual com port on the Windows operating system, thereby enabling the reader to be connected via the USB port of the host computer. The reader is fully functional on a USB-equipped IBM PC or PC-compatible running Windows 98, Me, 2000, or XP, or on an Apple computer running Mac OS 8.1 and above.

Since USB devices are designed to be "plug and play," the host will search for a device driver when the reader is first connected. If one cannot be found, it will prompt you to make a selection. At this point, insert the ID TECH USB Serial Driver disk. The Wizard will require that you install two drivers; both are on the disk or available from the ID TECH website at www.idt-net.com.

The drivers appear to the system as an extra virtual com port. Application software accesses the USB reader in the same way it would access a standard Windows com port using the Windows VCOMM API calls, or by using a com port library.

Go to START → SETTINGS → CONTROL PANEL → SYSTEM → HARDWARE → DEVICE MANAGER → PORTS (COM & LPT). There should be one item: USB SERIAL PORT (COMX). The "X" can be a number between 1 and 127. You may change the port to a number your software can support (like COM3) by highlighting USB SERIAL PORT (COMX) and clicking on PROPERTIES. Click on PORT SETTINGS, then ADVANCED, then COM PORT NUMBER and use the down arrow to scroll to the number you desire. Close out by clicking OK in all the windows.

As with a standard serial interface, the host must be configured to accept the data and perform the appropriate processing. Care must be taken to ensure that the host application's RS-232 parameters (baud rate, data bits, Start/Stop characters, parity, and handshaking method) match those expected by the reader. The magnetic reader's output can be formatted with terminating characters and special preamble and/or postamble character strings to match the data format expected by the host.

Section 3
DEFINITIONS

The following are definitions of common terms and abbreviations used throughout this manual.

ACK	Acknowledge
ATR	Answer to Reset
BPI	Bits Per Inch
C-APDU	Command—Application Protocol Data Unit
EMV	Europay-MasterCard-Visa Payment System Specification
ESD	Electro-Static Discharge
ETX	End of Transmission
Hex	Hexadecimal
Hybrid	Combination of Two Technologies
IFS	Information Field Size
ISO	International Standards Organization
ICC	Integrated Circuit Card (aka Smart Card)
ICTC	IC Test Card
IPS	Inches Per Second
LRC	Longitudinal Redundancy Check
NACK	Non-acknowledge
PSC	Programmable Security Code
PPS	Protocol and Parameters Selection
R-APDU	Response—Application Protocol Data Unit
TPDU	Transport Protocol Data Unit
TLP-224	A protocol used for communication between the reader and the host.

Related Documents

EMV 2000	Integrated Circuit Card Specifications for Payment Systems Version 4.0, December, 2000. (Amendment January 2003)
ISO 7810	Identification Cards – Physical Characteristics (1995)
ISO 7811	Identification Cards –Recording Technique (1995)
ISO/IEC 7816	Identification Cards - Integrated circuit(s) cards with contacts Part 2: Dimension and location of the contacts (1989, DIS 1998) Part 3: Electronic signals and transmission protocols (1997) @ Part 4: Inter-industry commands for interchange (1995/Amd.1:1997) Amd1: Impact of secure messaging on the structures of APDU messages
AAMVA	Best Practices Guidelines for the Use of Magnetic Stripes

Related Links

AAMVA	http://www.aamva.org/
EMV	http://www.emvco.com/
ID TECH	http://www.idt-net.com/
SDK	SmartCardSDK@discuss.Microsoft.com

Section 4
CONFIGURATION PARAMETERS

The host's communication settings must agree with the Hybrid Insert Reader's communication settings in order to establish communication. Default settings, which are programmed into the reader at the factory, are listed in Appendix A.

Processing a command may take a while. During command processing, the reader will not respond to a new command. Caution must be taken to maintain at least 250 ms between two commands if no response has been recieved.

Once communication between the host and the reader has been established, changes to the reader's settings can be entered by sending the appropriate setup commands to the reader from the host application.

Following are explanations and examples of the proper format and command content to send commands to the reader. All commands and characters are expressed in hex format and contained in brackets:

Structure

Every command follows the same basic structure:

HEADER	DATA	TRAILER

The **HEADER** consists of <60> followed by <Command Length>

The **DATA** consists of Function ID, Function Length, and Function Data

The **TRAILER** consists of <LRC> followed by <ETX>

EXAMPLE OF LRC

The Longitudinal Redundancy Check (LRC) is calculated by taking “Exclusive OR” (Modulus 2) of all characters preceding it. The total, with LRC, is equal to zero. For example, the following command means “read 16 bytes of data from <00 00>.”

<60><00><06><42><DA><B0><00><00><10><5E><03>

<5E> is the LRC character. It is derived from the following:

Characters	#1	#2	
<60>	0110	0000	
<00>	0000	0000	
<06>	0000	0110	
<42>	0100	0010	
<DA>	1101	1010	
<B0>	1011	0000	
<00>	0000	0000	
<00>	0000	0000	
<10>	0001	0000	
<5E>	0101	1110	<Result of Exclusive OR>

When sending a setup command:
<60><Command Length><53>[<XX><Len><FuncData>]<LRC><ETX>

xx xx | Func ID | xx

When sending a review command:
<60><Command Length><52><XX><LRC><ETX>

xx xx | Func ID | xx xx

...where <53> and <52> are the key codes for their respective commands.

In this example:
<Command Length> is a two-byte counter from <53> to the end of <FuncData>.
<FuncID> is the total of contents, a respective command, and one byte that identifies the particular function affected.
<Len> is a one byte length count for the <FuncData> block.
<FuncData> is the data block for the function.
<ETX> = 03h

The overall <LRC> (Modulus 2 = Exclusive OR) checksum (from <60> to <LRC>) should be zero.

General Commands

The following table is a summary of the general commands described in this section:

HEAD *<60><Command Length>*	**DATA** *<53><XX>*	**NAME**	**USAGE**
60 00 04	53 41 01 xx	Set Baud Rate	To set the rate of serial communication
60 00 02	52 1F	Get Settings	To retrieve current settings
60 00 02	4C 01	Latch On	To close the latch
60 00 02	4C 00	Latch Off	To release the latch
60 00 01	39	Get Version	To get the version of the reader's firmware
60 00 01	24	Get Reader Status	To get reader status in the form of a single byte
60 00 04	53 10 01 xx	Set Card Option	To elect either a memory card or a microprocessor card, 5v or 3v
60 00 04	53 11 01 xx	Set Operation Mode	To elect card seated, card present, data envelope, LED control, and decoder options
60 00 04	53 12 01 xx	Set Memory Card Type	To define which memory card to use
60 00 02	6C	LED Control	To set the LED to be controlled by the host
60 00 01	49	Reset the Reader	To reset the reader to its default settings

SET BAUD RATE

The rate of serial communication between the host application and the reader is set to 38,400 bps after power-up, but the host application can also select 9,600 bps if desired. The reader will go to the selected baud rate after sending back a response to the SET BAUD RATE command. The host application should go to the new baud rate after receiving that response.

To set the desired baud rate, enter the command:
<60><00><06><53><41><01><Baud Rate Setting><LRC><ETX>

Where the Baud Rate Setting is either:
<35> for 9,600 bps or
<37> for 38,400 bps

The response will be: <60><02><90><00><LRC><ETX>

GET SETTINGS

<60><00><02><52><1F><LRC><ETX>
Func ID

This command retrieves all current settings. The reader sends back an acknowledgement <ACK> and a response that is a collection of many function-setting blocks. Each function-setting block has the following format:

<FuncID><Len><FuncData>
XX

In this example:
<FuncID> is the total of contents, a respective command, and one byte that identifies the setting(s) for the function.
<Len> is a one-byte length count for the block that follows.
<FuncData> is the actual setting.

LATCH-ON COMMAND

<60><00><02><4C><01><LRC><ETX>

This command is used to close the latch.

The response will be: <60><00><02><90><00><LRC><ETX>
Note: Latch works only when the reader is equipped with the latch option and card has been fully inserted.

LATCH-OFF COMMAND

<60><00><02><4C><00><LRC><ETX>

This command is used to release the latch.

The response will be: <60><00><02><90><00><LRC><ETX>
Note: The first LATCH-OFF command does not work if someone has manually set the latch to ON.

GET FIRMWARE VERSION

<60><00><01><39><LRC><ETX>

The response will be: <60><00><Version String Length><Version><LRC><ETX>

In this example:
<Version> is greater than a 30-byte string

GET READER STATUS

<60><00><01><24><LRC><ETX>

The response will be: <60><00><01><Reader Status><LRC><ETX>

A single byte reader status will be returned.

Bit Position	0	1
0	IC power not ready	IC power ready
1	Card not seated*	Card seated*
2	Latch released*	Latch closed*
3	Card not present	Card present
4	No magnetic data*	Magnetic data present*
5-7	Unused	

* *Note: Flags are available only when optional features are supported by the reader. The flag will always be 0 if an option is not supported.*

SET CARD OPTION

<60><00><04><53><10><01><Setting><LRC><ETX>

A single byte setting is defined as follows:

Bit Position	0	1
0-3	unused	
4	**EMV Card**	ISO Card
5	**3V Off**	3V On
6	**5V On**	5V Off
7	**Microprocessor Card**	Memory Card

An EMV card is subject to all the checks described in the EMV 2000 4.0 specification. With a microprocessor card, the reader will try 3V first, then 5V if both 3V and 5V are set to ON. With a memory card, the reader will only try 3V if both 3V and 5V are set to ON.

The response will be: <60><00><02><Return Status><LRC><ETX>

SET OPERATION MODE

<60><00><04><53><11><01><Setting><LRC><ETX>

A single-byte setting is defined as follows:

Bit Position	0	1
0	**PC/SC Mode Off**	PC/SC Mode On*
1	Card Seated Change Off	**Card Seated Change On**
2	Card Present Change Off	**Card Present Change On**
3	MSR Data Envelope Off	**MSR Data Envelope On**
4	**LED Controlled by Reader**	LED Controlled by Host
5	**Magnetic Data Present Off**	Magnetic Data Present On
6	**Standard Decoder**	Raw Data Decoder
7	Unused	

The response will be: <60><00><02><Return Status><LRC><ETX>

The Raw Data Decoder enables raw data to be sent to the host for further processing. Two ASCII characters represent each raw data byte: The first ASCII character is for the low digit of the hex code. The second ASCII character is for the high digit of the hex code. For example, the characters “4” and “B” represent raw data “4Bh” (01001011).

If “Raw Data Decoder” has been set, all data will be treated as a bit string and will be sent out in hex format. Leading or trailing zeros (depending on whether the reader reads on insertion or withdrawal) will not be sent.

The “Magnetic Data Present” option is only available when the unit has been set to buffered mode.

Note: A “Card switch change notification” (<60><00><02><B0><Card Status><LRC><ETX>) will be issued by the reader if “Card seated change” or “Card present change” has been set to ON and the card switch was changed.

** If operating in RS-232 mode with a 7-pin connector, you will be unable to communicate with the reader in PC/SC Mode. To ensure proper communication with the reader, always have the PC/SC Mode set to off. The “Operation Mode” Setting cannot be reset by a default command.*

After a good read, the magnetic stripe data will be sent out with an envelope (<60> <Len_H> <Len_L> <Card data indication 1> <Card indication 2> <Magstripe data> <LRC> <ETX>), if “MSR Data Envelope” is ON. Otherwise, magnetic stripe data will be sent out without an envelope (<Magstripe Data>).

<Card data indication 1> (<Cx>) is an ID to indicate magnetic data.

Bit Position	
0-3	Unused
4	‘0’
5	‘0’
6	‘1’
7	‘1’

<Card data indication 2> flags the current read.

Bit Position	‘0’	‘1’
0	Track 1 decode fail	Track 1 decode success
1	Track 2 decode fail	Track 2 decode success
2	Track 3 decode fail	Track 3 decode success
3	No Track 1 data	Track 1 data exists
4	No Track 2 data	Track 2 data exists
5	No Track 3 data	Track 3 data exists
6-7	Unused	

Note: Track x decode flag available only when track x data exist.

SET MEMORY CARD TYPE

<60><00><04><53><12><01><Setting><LRC><ETX>

A single byte defines the card type as follows:

<00>	**Three-byte I²C memory card**
<01>	Four-byte I²C memory card
<02>	SLE4428 card
<03>	SLE4442 card
<04>	GPM276 card
<05>	GPM271 card
<06>	AT88SC101 card

The response will be: <60><00><02><Return Status><LRC><ETX>

Note: The reader may not support all types of memory cards.

HOST LED CONTROL

The LED can either be controlled by the reader or the host. (The choice between reader and host control can be made by setting a bit in the Operation Mode. This command sets the LED when it is to be controlled by the host.

<60><00><02><6C><LED Status><LRC><ETX>

The LED status can be set as follows:

<30>	Set LED to off
<31>	Set LED to green
<32>	Set LED to red
<33>	Set LED to amber

The response will be: <60><00><02><90><00><LRC><03>

RESET THE READER

This command allows the host to return the reader to its default state (card not powered, not armed to read, latch should open, no magnetic or ICC data stored, etc.).

<60><00><01><49><LRC><ETX>

The response will be: <60><00><02><90><00><LRC><03>

Section 5
MAGNETIC STRIPE READER COMMANDS

The Magnetic Stripe Reader has a number of configuration and data editing options. Default settings, which are programmed into the reader at the factory, are printed in **boldface**.

For sending Setup Commands from the application program to the reader, the serial communication parameter default settings are 38400, None, 8, 1. Setup Commands include the Sending Commands that change the MSR configuration settings, and Receiving Commands that retrieve the current MSR configuration settings to the application program.

Command Structure

Every command follows the same basic structure:

HEADER	DATA	TRAILER

The **HEADER** consists of <60> followed by <Command Length>

The **DATA** consists of Function ID, Function Length, and Function Data

The **TRAILER** consists of <LRC> followed by <ETX>

A simple Turbo TLP-224 protocol with one byte “check sum” is used when sending setup commands to reader. When sending a command:
<60><Command Length><53>[<xx><Len><FuncData>]<LRC><ETX>

Func ID	xx	xx	xx

The response confirming the command structure will be:
<60><00><02><90><00><LRC><ETX>

In this example:
<Command Length> is a two-byte counter from <53> to the end of <FuncData>.
<FuncID> is the total of contents, a respective command, and one byte that identifies the particular function affected.
<Len> is a one byte length count for the <FuncData> block.
<FuncData> is the data block for the function.
<ETX> = 03h

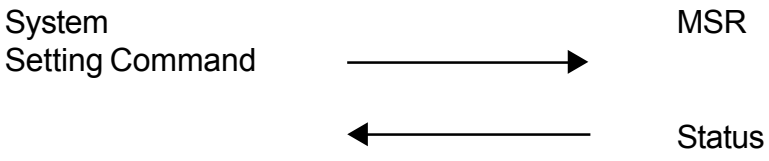
The overall <LRC> (Modulus 2 = Exclusive OR) checksum (from <60> to <LRC>) should be zero.

Communication Timing

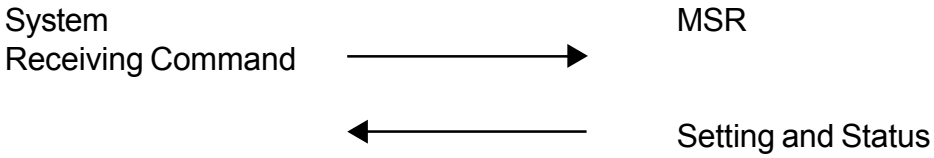
During command processing or the reading of a magnetic stripe, the reader will not respond to a new command. Caution must be taken to maintain a minimum delay (250 ms) between two commands. The maximum delay for the reader to respond to a setting command is 1 second. The typical delay is less than 150 ms. The response delay for an IC card depends on the card.

Before issuing a new command, always wait for a response to the last command. Make sure the inter-command delay is more than 250 ms.

Sending-Command Protocol



Receiving-Command Protocol



Commands

The following table is a summary of the magnetic stripe reader commands described in this section:

HEAD ***<60><Command Length>***	**DATA** ***<XX><XX>***	**NAME**	**USAGE**
60 00 02	S 18	Restore to Default	To return the reader to its default settings
60 00 04	S 1A 01 xx	MSR Reading	To turn the magnetic stripe reading function off or on in either auto-transmit or buffer mode
60 00 04	S 1D 01 xx	Decoding Method	To read a card in a selected direction
60 00 04	S 19 01 xx	Send Option	To enable or disable the sentinel or account number on Track 2 only
60 00 04 60 00 04	S 21 01 xx S 3X 01 xx	Terminator Setting Track 1, 2, 3 ID Setting	To format the data read from the card To edit the data read from the card
60 xx xx	S D x xx	Preamble and Postamble Settings	To edit the data read from the card
60 00 04	S 13 01 xx	Track Selection Setting	To select the tracks on the magnetic stripe to be read or decoded
60 00 04	S 17 01 xx	Track Separator Setting	To edit the data read from the card
60 00 03	50 01 30	Arm to Read in Buffer Mode	To enable reading in the buffer mode
60 00 03	50 01 32	MSR Reset in Buffer Mode	To return the reader to its default settings when buffer mode is enabled
60 00 03	51 01 xx	Read MSR Data in Buffer Mode	To set the tracks on the magnetic stripe to be read or decoded while in the buffer mode

The command responses given below indicate successfully-entered commands. If an error message is returned instead of an indicated response, please refer to Appendix B: Status Code Table for an explanation.

RESTORE TO DEFAULT

<60><00><02><53><18><LRC><ETX>

This command does not have any <FuncData>. It restores most settings to the default value. It does not restore Operation Mode Settings to their default settings; these must be done individually. Please see Appendix A: Default Settings for a chart of all default settings.

The response will be: <60><00><02><90><00><F2><03>

MSR READING

Turns the magnetic stripe reading function on or off or initiates reading with the buffer mode. If the reading function is disabled, no data will be sent to the host.

<60><00><04><53><1A><01><MSR Reading Setting><LRC><ETX>

MSR Reading Setting:
<30> MSR reading disable
<31> MSR reading enable
<32> MSR reading buffered mode

The response will be: <60><00><02><90><00><LRC><03>

DECODING METHOD

To ensure optimal reading performance, the reader is set at the factory to read magnetic stripe cards on withdrawal. Card velocity must be consistent to yield the best read rate, and a consistent speed of the card across the magnetic head is easier to achieve on withdrawl rather than insertion. However, the reader can be configured to read on both insertion and withdrawl or on insertion alone, if desired.

<60><00><04><53><1D><01><Decoding Method Setting><LRC><ETX>

Decoding Method Setting:
<31> Two Directions
<32> Read on insertion only
<33> Read on withdrawl only

The response will be: <60><00><02><90><00><F2><03>

SEND OPTION

This setting allows the application program to disable or enable the start/end sentinel, and to disable or enable the Account Number for Track 2 only.

<60><00><04><53><19><01><Send Option Setting><LRC><ETX>

Send Option Setting:
<30> Do not send Start/End sentinel, but do send all data on all tracks
<31> Send Start/End sentinel and all data on all tracks
<32> Do not send Start/End sentinel for any track, but do send account number on Track 2 only
<33> Send Start/End sentinel on Tracks 1, and account number on Track 2 only for a credit card, or Send Start/End sentinel on Tracks 1 and 3 for a standard card.

The response will be: <60><00><02><90><00><F2><03>

TERMINATOR SETTING

If the Data Edit feature is disabled, simple message formatting can be accomplished by using the Terminator, the Preamble, and the Postamble.

<60><00><04><S><21><01><Terminator Settings><LRC><ETX>

Terminator Settings:
<30> CR/LF
<31> CR
<32> LF
<33> None

The response will be: <60><00><02><90><00><F2><03>

TRACK 1 ID SETTING

<60><00><04><53><31><01><Track 1 ID><LRC><ETX>

<Track 1 ID> ASCII code set as Track 1 ID, <00> as none

The Track 1 ID can be any single ASCII character desired. No Track 1 ID is expressed as NULL.

The response will be: <60><00><02><90><00><F2><03>

TRACK 2 ID SETTING

<60><00><04><53><32><01><Track 2 ID><LRC><ETX>

The Track 2 ID can be any single ASCII character desired. No Track 2 ID is expressed as NULL.

The response will be: <60><00><02><90><00><F2><03>

TRACK 3 ID SETTING

<60><00><04><53><33><01><Track 3 ID><LRC><ETX>

The Track 3 ID can be any single ASCII character desired. No Track 3 ID is expressed as NULL.

The response will be: <60><00><02><90><00><F2><03>

PREAMBLE SETTING

<60><Command Length><53><D2><Len><Preamble String><LRC><ETX>

In this example:
<Command Length> is a two-byte length from <53> to <Preamble String>

<Len> is the number of bytes of Preamble String

<Preamble String> is {string length}{string} (String length is one byte, maximum 9.)

The response will be: <60><00><02><90><00><F2><03>

POSTAMBLE SETTING

<60><Command Length><53><D3><Len><Postamble String><LRC><ETX>

In this example:
<Command Length> is a two-byte length from <53> to <Postamble String>
<Len> is the number of bytes of Postamble String
<Postamble String> is {string length}{string} (String length is one byte, maximum 9.)

The response will be: <60><00><02><90><00><F2><03>

TRACK SELECTION SETTING

There are up to three tracks of encoded data on a magnetic stripe. This setting selects the tracks to be read and decoded.

<60><00><04><53><13><01><Track_Selection Settings><LRC><ETX>

Track Selection Settings:
<30> Any Track
<31> Track 1 Only
<32> Track 2 Only
<33> Track 1 & Track 2
<34> Track 3 Only
<35> Track 1 & Track 3
<36> Track 2 & Track 3
<37> All Three Tracks

Note: The default setting, "Any Track," permits the reader to read any track on which data is persent. The setting "All Three Tracks" will instruct the reader to read data from all three tracks. If any of the three tracks fails to read for any reason, no data will be sent from any of the tracks.

TRACK SEPARATOR SETTING

This setting allows the user to select the character to be used to separate data decoded by a multiple track reader.

<60><00><04><53><17><01><Track_Separator><LRC><ETX>

The Track Separator can be any one ASCII Character. The default value is **CR** (Hex 0D).

ENVELOPE FOR MAGNETIC STRIPE DATA

This command adds the ID TECH envelope to magnetic stripe data before it is sent to the host.

<60><Len_H><Len_L><card data indication 1><card data indication 2>[Track 1 data][Track 2 data][Track 3 data]<LRC><ETX>

<card data indicaiton 1>(<Cx>) is an ID to indicate magnetic data.

Bit Position	
0-3	Unused (set to 0)
4	'0'
5	'0'
6	'1'
7	'1'

<card data indication 2> is to indicate reading status.

Bit Position	'0'	'1'
0	Track 1 decode fail	Track 1 decode success
1	Track 2 decode fail	Track 2 decode success
2	Track 3 decode fail	Track 3 decode success
3	No Track 1 data	Track 1 data exists
4	No Track 2 data	Track 2 data exists
5	No Track 3 data	Track 3 data exists
6-7	Unused (set to 0)	

Note: The Track x decode flag will be 0 if Track x data does not exist.

The order of magnetic data and switch change notification depends on the order they come to the microcontroller. This is not fixed.

ARM TO READ IN BUFFER MODE

This command sets the reader to read magnetic stripe data and store it in memory.

<60> <00> <03> <50> <01> <30> <LRC> <ETX>

The response will be: <60> <00> <02> <90> <00> <LRC> <03>

If the reader controls the LED, the LED will turn green and the reader will send an ACK response to the host. Previously-read data will be erased, and the reader will wait for the next card insertion. If an MSR Reset Command is received, all data will be erased from memory.

When a card is inserted and withdrawn, the decoded data will be saved in memory and not sent to the host. If the reader controls the LED, the LED will turn green. (If there was no data to read, the LED will briefly turn red and then go green.) A notification will be sent to the host to indicate the presence of magnetic data. Data will be held until receiving the next Arm To Read Command or MSR Reset Command.

While in Buffer Mode, the reader will continue to allow non-ICC commands (e.g. unlatch, status, LED commands). If the reader receives an ICC command, it will respond but the magnetic data in memory will be erased.

MSR RESET IN BUFFER MODE

This command resets the reader to its MSR default settings when Buffer Mode is enabled.

<60> <00> <03><50> <01> <32> <LRC> <ETX>

The response will be: <60> <00> <02> <90><00> <LRC> <03>

If the reader is configured to automatically transmit magnetic data, the reader will respond that the command is not supported. Any stored magnetic data will be erased. The reader will send an ACK response to the host.

READ MSR DATA IN BUFFER MODE

There are up to three tracks of encoded data on a magnetic stripe. This setting selects the tracks to be read and decoded in Buffer Mode.

<60> <00> <03> <51> <01> <Track Select Byte> <LRC> <ETX>

Track Selection Settings:
<30> Any Track
<31> Track 1
<32> Track 2
<33> Track 1 & Track 2
<34> Track 3
<35> Track 1 & Track 3
<36> Track 2 & Track 3
<37> All Three Tracks

The data on the selected track(s) will be sent to the host either in envelope format or not, according to the Card Notification Setting, or in RAW format. The data will not be erased after this command.

Section 6
SMART CARD COMMANDS

Communication Timing

The Hybrid Insert Reader supports 3 and 5 VDC IC cards, and provides automatic hardware protection for card removal, ESD, supply voltage drop, short circuit, and overheating.

Following are the command/response protocols for communication between the hybrid reader (and ICC media) and the host. All commands and characters are presented in 'Hex' and (<>) brackets.
Note: The delay for the reader to respond to an IC card command is card-related.

Successful Command

Host to Hybrid Reader:
<60> <xx xx> <nnnnnnnnnnnnnnnnnnnn><ZZ><03>
ACK Command Length Data (C-APDU) LRC ETX

Hybrid Reader to Host:
<60> <UU UU> <mmmmmmmmmmmmmm><SS SS><TT><03>
ACK Command Length Data (R-APDU) Status LRC ETX

Unsuccessful Command

Host to Hybrid Reader:
<60> <xx xx> <nnnnnnnnnnnnnnnnnnnn><ZZ><03>
ACK Command Length Data (C-APDU) LRC ETX

Hybrid Reader to Host:
<E0> <UU UU> <SS SS> <ZZ><03>
NACK Command Length Status LRC ETX
or:
<E0> <UU UU> <nnnnnnnnnnnnnnnnnnnn> <SS SS> <TT> <03>
NACK Command Length Data (R-APDU) Status LRC ETX

The status either defines a successful transaction or gives an error code. Please see Appendix B for the Status Code table.

Command Structure

Every command follows the same basic structure:

HEADER	DATA	TRAILER

The **HEADER** consists of <60> followed by <Command Length>

The **DATA** consists of Function ID, Function Length, and Function Data

The **TRAILER** consists of <LRC> followed by <ETX>

All IC reader commands follow the Turbo TLP-224 protocol and use the ISO 7816-4 Application Protocol Data Unit (APDU) or ISO 7816-3 Transport Protocol Data Unit (TPDU) structure to communicate with an IC card.

IC Microprocessor Card Reader Output Command Structure:
<60><XX XX><41><Command or Response><LRC><ETX>
This command is used to pass an APDU or TPDU to a microprocessor card where only an ISO status is expected from the card.

IC Microprocessor Card Reader Input Command Structure:
<60><XX XX><61><Command or Response><LRC><ETX>
This command is used to pass an APDU or TPDU to a microprocessor card where both data and an ISO status are expected from the card.

IC Reader Microprocessor Card T=1 Command Structure:
<60><XX XX><46><NAD><PCB><LEN><INF><EDC><LRC><ETX>
This command is used to pass a T=1 data block to a microprocessor card.

IC Memory Card Reader Command Structure:
<60><XX XX><42><Command or Response><LRC><ETX>
This command is used to perform an operation on a memory card.

ISO 7816-3 Command Structure:
<CLA><INS><P1><P2><P3>(Lc or Le)<Data>(if P3 is Lc)

ISO7816-4 Commnad Structure:
<CLA><INS><P1><P2><Data>(Le)

Definitions of Commands:

<CLA>	ISO Class byte
<INS>	ISO instruction code
<P1>	ISO Parameter 1, usage varies with commands
<P2>	ISO Parameter 2, usage varies with commands
<P3>	ISO Parameter 3, length of data (Lc) or maximum length of expected reply (Le)
<Data>	Data to send, varies with commands

Response Structure:
<Data>(Optional)<SW1><SW2>

Definitions:

<Data>	Response data (usually Le bytes) if operation was successful
<SW1>	Status byte 1
<SW2>	Status byte 2

Commands

The following table is a summary of the smart card reader commands described in this section:

HEAD ***<60><Command Length>***	**DATA** ***<XX>***	**NAME**	**USAGE**
60 00 01	6E	ICC Power On	To apply power to a microprocessor or memory card and return the ATR
60 00 01	4D	ICC Power Off	To turn the power to a microprocessor or memory card off
60 xx xx	41XXXX	Output to a T=0 Microprocessor Card	To send a request (that could include data) to a microprocessor card
60 xx xx	61XXXX	Input to a T=0 Microprocessor Card	To send a request to a microprocessor card and wait for a response
60 xx xx	42XXXX	I/O to Memory Card	To perform an operation on a memory card
60 xx xx	46XX XX	T=1 Data Block	To send a T=1 data block to a microprocessor card

POWER-ON COMMAND

<60><00><Length><6E>[<Option>] [<PPS>]<LRC><ETX>

This command is used to power up the selected microprocessor card. It follows the ISO power-up sequence and returns the ATR as the response. Memory cards do not have an explicit power-up command, as the first I/O operation sent to the card causes a power-up.

<Option> and <PPS> are optional. A single-byte defines the Option as follows:

Bit Position	"0"	"1"
0	**NO IFS**	Send S(IFS) request if T=1 protocol
1	**NO Explicit PPS**	Explicit PPS
2-5	Unused	
6	**Auto PPS**	No auto PPS
7	**IFS response check**	No check on response of S(IFS) request

The response will be: <60><00><ATR Length><ATR><LRC><ETX>
Note: The response will vary, depending upon the card used. Specific information should be available directly from the card manufacturer.

POWER-OFF COMMAND

<60><00><01><4D><LRC><ETX>

This command is used to power down the selected microprocessor card. It works for any type of card.

Response is as follows: <60><00><02><90><00><LRC><ETX>

OUTPUT TO A T=0 MICROPROCESSOR COMMAND

<60><XX><XX><41>[Data]<LRC><EXT>

This command is used to send a request (that could include data) to a microprocessor card.

Response is as follows: <60><00><02><90><00><LRC><EXT>

INPUT TO A T=0 MICROPROCESSOR COMMAND

<60><XX><XX><61>[Data]<LRC><EXT>

This command is used to send a request to a microprocessor card and wait for a response.

INPUT/OUTPUT TO A MEMORY CARD COMMAND

<60><XX><XX><42>[Data]<LRC><EXT>

This command is used to perform an operation on a memory card.

SEND A T=1 DATA BLOCK TO A MICROPROCESSOR CARD COMMAND

<60><XX><XX><46>[Data]<LRC><EXT>

This command is used to send a data block to a microprocessor card.

Memory Card Commands

Memory card commands pertain specifically to I²C SLE4428, SLE4442, GPM271, GPM276, and AT88SC101 cards only. These commands consist of the memory command identifier (42h) and an ISO APDU. The reader interprets the command based on the selected memory card type and performs the requested operation. The reader returns ISO 7816 status (SW1, SW2) after finishing the operation.

VERIFY PROGRAMMABLE SECURITY CODE

Note: This command is for SLE4428, SLE4442, and AT88SC101 cards only.

This command is used to verify the Programmable Security Code (PSC). Each failed attempt writes one more bit of the error counter to zero. When all bits of the error counter are at zero, the PSC will no longer be accessible.

<60><Command Length><42><DA><20><P1><P2>
<PSC Length><PSC><LRC><ETX>

For SLE4428 and SLE4442 cards, P1 and P2 are <00>. For the AT88SC101 card, P1 is the count of consecutive unsuccessful attempts allowed before further attempts are denied. P2 is the byte address of the password on the card. For the SLE4428 card, the PSC is two bytes long. For the SLE4442 card, the PSC is three bytes long.

<Length> is a two-byte counter indicating the length of data from <42> to the end of the PSC. (The most significant byte comes first.) Many operations on the card are blocked until a correct PSC has been presented. This command is used to verify the programmable security code. Each failed attempt writes one more bit of the Error Counter to zero. When all bits are zero, the PSC will no longer be accessible.

Response is as follows: <60><00><02><Return Status><LRC><ETX>

READ BINARY

<60><00><06><42><DA><B0><Addr_h><Addr_l><Length><LRC><ETX>

The Read Binary command is used to read data from the card, where:
<Addr_h><Addr_l> indicates the address from which the data should be read
<Addr_h> indicates the high byte of the two-byte address
<Addr_l> indicates the low byte of the two-byte address
<Length> indicates the length of data to be read from the card

READ BINARY WITH PROTECTION BIT

Note: This command is for the SLE4428 card only.

<60><00><06><42><DA><C2><Addr_h><Addr_l><Length><LRC><ETX>

The Read Binary with Protection Bit command is used to read data and its status from the card, where:
<Addr_h><Addr_l> indicates the address from which the data should be read
<Addr_h> indicates the high byte of the two-byte address
<Addr_l> indicates the low byte of the two-byte address
<Length> indicates the length of data to be read from the card

This command returns even bytes of data (less than <Length>). A two byte set is returned for each byte in the card. The first byte is card data, the second byte is the protection bit. “0” in the protection bit means “prohibit further writing.” “1” in the protection bit means “allow further writing.”

READ PROTECTION BIT

Note: This command is for the SLE4442 card only.

<60><00><06><42><DA><B1><00><00><04><LRC><ETX>

The Read Protection Bit command is used to read the protection bits. “0” in the protection bit means “prohibit further writing.” “1” in the protection bit means “allow further writing.”

READ SECURITY MEMORY

Note: This command is for the SLE4442 card only.

<60><00><06><42><DA><B2><00><00><04><LRC><ETX>

The Read Security Memory command is used to read four bytes of security memory. The PSC will be returned as <00> before successful verification of the PSC.

WRITE BINARY

<60><Command Length><42><DA><D0><Addr_h><Addr_l> <Data Length><Data><LRC><ETX>

The Write Binary command is used to write data to the card where:
<Addr_h><Addr_l> indicates the address to which the data should be written
<Addr_h> indicates the high byte of the two-byte address
<Addr_l> indicates the low byte of the two-byte address
<Data Length> indicates the length of the data to be written to the card
<Data> indicates the data to be written to the card
<Command Length> indicates the two-byte length of the command from <42> to <Data>

WRITE BINARY WITH PROTECTION BIT

Note: This command is for the SLE4428 and SLE4442 cards only.

<60><Command Length><42><DA><C1><Addr_h><Addr_l> <Data Length><Data><LRC><ETX>

The Write Binary with Protection Bit command is used to write data to the card and prohibit further writing to the specified addresses, where:
<Addr_h><Addr_l> indicates the address to which the data should be written
<Addr_h> indicates the high byte of the two-byte address
<Addr_l> indicates the low byte of the two-byte address
<Data Length> indicates the one-byte length of the data to be written to the card
<Data> indicates the data to be written to the card
<Command Length> indicates the two-byte length of the command from <42> to <Data>

WRITE SECURITY MEMORY

Note: This command is for the SLE4442 card only.

<60><Command Length><42><DA><D1><00><Addr><Data Length><Data><LRC><ETX>

The Write Security Memory command is used to write new PSC to the card.
<Addr> indicates the address to which the data should be written
<Data Length> indicates the one-byte length of the data to be written to the card
<Data> indicates security data to be written to the card
<Command Length> indicates the two-byte length of the command from <42> to <Data>

ERASE COMMAND

Note: This command is for the GPM271, GPM276, and AT88SC101 cards only.

XX XX
<60><00><06><42><DA><0E><00><Addr><Data Length><LRC><ETX>

The erase command is used to erase data at the specified address, where:
<Addr> indicates the address where the data is to be erased
<Data Length> indicates the length of the data to be erased

Note: A successful (<90><00>) return status does not necessarily mean the data was erased. Please attempt to read the data on the card after the erase operation has been completed to determine if the erase was actually accomplished.

DECREASE COUNTER BY ONE COMMAND

The Decrease Counter by One command is used to decrease the counter on GPM271 and GPM276 cards only.
<60><00><06><42><DA><DC><00><00><00><LRC><ETX>

RESTORE COUNTER COMMAND

The Restore Counter command is used to restore the counter on GPM271 and GPM276 cards only.
<60><00><06><42><DA><D4><00><00><00><LRC><ETX>

C4 CONTROL COMMAND

Note: This command is for the AT88SC101 card only.

The C4 Control command is used to control the state of the C4 line and blowing fuses.

<60><00><06><42><DA><C4><Value><00><00><LRC><EXT>

<Value> indicates the C4 status. <01> will set C4 to high, and <00> will set C4 to low.

FUSE COMMAND

Note: This command is for the AT88SC101 card only.

The Fuse command is used to blow a fuse.

<60><00><06><42><DA><C4><FE><Byte_Addr><Bit_Addr><LRC><EXT>

<Byte_Addr> and <Bit_Addr> indicate the byte and bit address of the fuse to be blown.

Section 7
SECURITY ACCESS MODULES

A Security Access Module (SAM) is like a smart card in a smaller form factor. It provides authentication and/or encryption support for a particular type of card. SAMs fit into the five SIM connectors on an expansion board that attaches to the reader. If a reader is set to support only one type of card, then the reader will probably need only one SAM. If a reader is configured to accept a variety of cards, such as Visa, MasterCard, and Discover, it may need a SAM for each type of card it supports.

In typical operation, the host will ask the smart card for a random number, which will be given to the SAM. The SAM will then generate an encoded message containing a secret key which is presented back to the card. The card will generate a response to the SAM which will establish the card's validity to the host.

The Spectrum II can support up to six connectors (five SAM connectors and one smart card connector). When addressing the connectors, the main (smart card) landing connector is assigned the number '0', and each of the SAMs is assigned a number from 1 to 5.

CARD SELECTION COMMAND

This command allows the host application to select a card with which to read or write. Only one card can communicate with the application, either via the main connector or a SAM. The main connector is selected after powering up the reader.

<60><00><02><43><Card Connector><LRC><ETX>

<Card Connector> is a single byte defined as follows:

<00>	Main Connector
<01>	SAM Connector 1
<02>	SAM Connector 2
<03>	SAM Connector 3
<04>	SAM Connector 4
<05>	SAM Connector 5

The response will be: <60><00><02><90><00><LRC><ETX>

SET SAM CARD COMMAND

This command configures each SAM connector to support cards with certain defined characteristics.

<60><00><05><53><SAM Setting><02><Card Option><Memory Card Type> <LRC><ETX>

A single byte <SAM Setting> is defined as follows:

<61>	SAM Connector 1
<62>	SAM Connector 2
<63>	SAM Connector 3
<64>	SAM Connector 4
<65>	SAM Connector 5

Single byte <Card Option> and <Memory Card Type> settings are the same as for the main connector.

The response will be: <60><00><02><90><00><LRC><ETX>

A TYPICAL SAM OPERATION SCENARIO

1. Set CARD OPTION and MEMORY CARD TYPE for cards that will read and write on both the main connector and each SAM (if necessary).
2. Select main card.
3. Power on main card.
4. Select SAM card.
5. Power On SAM card.
6. Select card (main or SAM).
7. Smart card (main or SAM) read/write operation.
8. Repeat 6 and 7 as necessary.
9. Select main card.
10. Power off main card.
11. Select SAM card.
12. Power off SAM card.

Notes: The GET READER STATUS command is available on main connector only.

Be sure to power off the other card when starting to read and write to a memory card.

Powering on a SAM card will power on all SAMs, but only the selected SAM will communicate with host application.

Section 8
COMMAND EXAMPLES

In the demonstration software there are examples of specific commands to the reader and the correct responses to those commands. For convenience, they are grouped into two test routines:

Testing Steps Using an I²C Card

1. Set the card type to be read as a 5V IC 3 bytes card.
   Command: \60\00\07**53\10\01\80\12\01\00**\B6\03
   Response: \60\00\02\90\00\F2\03

2. Tell the reader to read 32 bytes of data from 00.
   Command: \60\00\06**42\DA\B0\00\00\20**\6E\03
   Response: The answer will vary. The two-byte return status which comes before the LRC should be \90\00.

3. Tell the reader to write 10 bytes of 012345689.
   Command: \60\00\10**42\DA\D0\00\00\0A\30\31\32\33\34\35\36\37\38\39**\33\03
   Response: \60\00\02\90\00\F2\03

4. Tell the reader to read 10 bytes of data from 00.
   Command: \60\00\06**42\DA\B0\00\00\0A**\44\03
   Response: \60\00\0C\30\31\32\33\34\35\36\37\38\39\90\00\FD\03

5. Tell the reader to write the following 11 bytes of data: IDTECH Demo.
   Command: \60\00\11**42\DA\D0\00\00\0B\49\44\54\45\43\48\20\44\65\6D\6F**\26\03
   Response: \60\00\02\90\00\F2\03

6. Tell the reader to read 11 bytes from 00.
   Command: \60\00\06**42\DA\B0\00\00\0B**\45\03
   Response: \60\00\0D\49\44\54\45\43\48\20\44\65\6D\6F\90\00\E9\03

7. Power Off.
   Command: \60\00\01**4D**\2C\03
   Response: \60\00\02\90\00\F2\03

Testing Steps Using a GPM^{271} Card

1. Set the Card type to be read as 5V GPM271 card.
   Command: \60\00\04**\53\10\01\80**\A6\03
   Response: \60\00\02\90\00\F2\03
   Command: \60\00\04**\53\12\01\05**\21\03
   Response: \60\00\02\90\00\F2\03

2. Power On.
   Command: \60\00\01**\6E**\0F\03
   Response: \60\00\06\83\AB\FF\00\90\00\21\03

3. Tell the reader to read the user area.
   Command: \60\00\06**\42\DA\B0\00\28\07**\61\03
   Response: The answer will vary. The two-byte return status which comes before the LRC should be \90\00.

4. Tell the reader to erase the user area.
   Command: \60\00\06**\42\DA\0E\00\28\07**\DF\03
   Response: \60\00\02\90\00\F2\03

5. Tell the reader to write “ID TECH” to the user area.
   Command: \60\00\0D**\42\DA\D0\00\28\07\49\44\20\54\65\63\68**\1D\03
   Response: \60\00\02\90\00\F2\03

6. Tell the reader to read the user area.
   Command: \60\00\06**\42\DA\B0\00\28\07**\61\03
   Response: \60\00\09\49\44\20\54\65\63\68\90\00\EE\03

7. Tell the reader to read the counter.
   Command: \60\00\06**\42\DA\B0\00\08\05**\43\03
   Response: The answer will vary.

8. Tell the reader to decrease the counter.
   Command: \60\00\06**\42\DA\DC\00\00\00**\22\03
   Response: \60\00\02\90\00\F2\03

9. Tell the reader to read the counter.
   Command: \60\00\06**\42\DA\B0\00\08\05**\43\03
   Response: The answer will vary.

10. Tell the reader to restore the counter.
    Command: \60\00\06**\42\DA\D4\00\00\00**\2A\03
    Response: \60\00\02\90\00\F2\03

11. Power Off.
    Command: \60\00\01**\4D**\2C\03
    Response: \60\00\02\90\00\F2\03

Section 9
OPERATION

Operating Procedure

The ID TECH Hybrid Insert Reader is easy to operate. Make sure the reader is properly connected and receiving sufficient power. The green LED will indicate that it is ready to read.

LED INDICATION	MEANING (LED controlled by reader)
Amber	Reader is sending or receiving data from the host.
Green	Reader is ready to power on a smart card, read a magnetic stripe, or is idle.
Red	Bad magnetic stripe read.
Off	Reader is reading magnetic stripe data, or a smart card has been powered on (but is not communicating with the host).

By default, the LED is under the control of the reader. The LED can also be under the control of the host application. (Please see page 11 for the specific HOST LED CONTROL commands.) If the LED is under the control of the host, the following settings are available:

· Turn the LED off
· Turn the LED green
· Turn the LED red
· Turn the LED amber

To read a **Magnetic Stripe Card**, just follow these simple steps:

1. Insert the card, magnetic stripe down, into the reader until it hits a hard stop. As soon as the magnetic stripe is detected by the reader, the green LED indicator will go off.

2. When the card has been inserted all the way, the green LED will light again.

3. Withdraw the card in one continuous motion. The green LED will go off again. (The reader is capable of reading a magnetic stripe on both insertion and withdrawal, but a more reliable read is achieved on withdrawal.)

4. When the card has been fully withdrawn, the LED will turn amber to indicate processing.

5. The LED will turn red (to indicate a bad read) or return to green (to indicate a good read).

To read a **Smart Card**, follow these steps:

1. Insert the card, chip up, into the reader until it stops. Then push the card in another 1/8 inch until it clicks in place. The click indicates that the card is properly seated. When the card is properly seated and powered, the green LED indicator will go off.

2. If the “latch” option is present, and the LATCH ON command is sent by the host to the reader, the latch will engage, preventing the withdrawal of the card prior to the completion of processing.

3. The LED will turn amber to indicate processing. It will go off when processing is completed.

4. The LED will turn green again when power to the card is turned off. The latch, if present, will disengage when the LATCH OFF command is sent by the host to the reader. Withdraw the card.

For a list of ID TECH-compatible cards, please see Appendix C or visit our website at www.idt-net.com.

*Note: There are two notifications which may be sent to the host by the reader during operation. One is a **“Unit Error Notification”** (in the event of overheating or unstable VCC power, of if the card is removed during processing). The other is the optional “Card Status Change” notification.*

Buffer Mode

When the unit is armed to read in the buffer mode, decoded data will be retained in memory and an optional notice will be sent to the host to indicate its presence. Data will be held in memory until the reader receives the next ARM TO READ or MSR RESET command, at which point all data in memory will be erased. Please see page 18 for the specific ARM TO READ IN BUFFER MODE, MSR RESET IN BUFFER MODE, and READ MSR DATA IN BUFFER MODE commands.

Card Latch Option

The optional “latch” mechanism holds an inserted card in place in the reader’s slot until processing has been completed.

The mechanism operates using LATCH ON and LATCH OFF commands issued by the host. To ensure full latching and unlatching, the host terminal should wait a minimum of 500ms between latching and unlatching commands to allow the motor control circuits to properly reset after each motor operation. The host can request the status of the latch mechanism by issuing a GET READER STATUS command. Please see page 8 for the specific LATCH ON, LATCH OFF, and GET READER STATUS commands.

An optional feature available with the latch mechanism is “power failure latch release,” which automatically unlatches the card when power fails. The host terminal’s +5V power supply must not decay at a rate greater than 50V/s for this feature to perform reliably, because the power for driving the latch motor in the event of a power failure is derived from the host terminal’s power supply filter capacitor. (The latch circuit gets its power from the power supply’s decaying voltage for a period of 20ms minimum to ensure a reliable latch release.) In the event the host terminal’s power supply filter capacitor is too small for reliable unlatching, an external capacitor with a voltage rating of at least 10V and a capacitance of 2200 microfarads must be used. (The capacitor’s positive lead must be connected to Pin 1.) If required, a capacitor can be installed on the reader at the factory.

Section 10
TROUBLESHOOTING

The ID TECH Hybrid Insert Reader is easy to install and use. Most problems encountered can be attributed to:

· Incorrect Interface Cabling
· Incorrect Configuration Setup
· Bad Magnetic Stripe Quality

General Procedures

The troubleshooting process can be simplified by following these simple diagnostic procedures.

1. Once it has been confirmed that the unit is correctly powered, try inserting a credit card. The LED will turn amber while processing, then either green or red, as appropriate.

2. Once the unit has indicated a “good read,” then proceed to check the interface cabling connections.

Questions to Ask

1. Is the desired track on the magnetic stripe enabled?

2. Does the output data format match the requirements of the application software?

3. Has the magnetic stripe been encoded in a standard format?

4. Is the smart card a valid EMV smart card? If not, change the default mode from EMV cards to ISO cards by configuring for ISO 7816.

Appendix A
DEFAULT SETTINGS

Default Settings for Magnetic Stripes

The ID TECH Hybrid Insert Reader is shipped from the factory with the following default settings already programmed:

Magnetic Track Basic Data Format

SS1><T1_DATA><ES><CR>
SS2><T2_DATA><ES><CR>
SS3><T3_DATA><ES><CR>
LRC><03>

where:
SS1(start sentinel track 1) = %
SS2(start sentinel track 2) = ;
SS3(start sentinel track 3) = ; for ISO, ! for CDL, % for AAMVA

ES(end sentinel all tracks) = ?

DEFINITIONS FOR MAGNETIC STRIPES

Start or End Sentinel: Characters in encoding format which come before the first data character (start) and after the last data character (end), indicating the beginning and end, respectively, of data. The Start Sentinel always begins with a “1” (one) bit to signal the start of data.

Track Separator: A designated character which separates data tracks.

Terminator: A designated character which comes at the end of the last track of data, to separate card reads.

LRC: Check character, following end sentinel.

CDL: Old California Drivers License format.

* *Note: The <CR> commands shown above for Tracks 1 & 2 and Tracks 2 & 3 denote the default character for this position, the Track Separator position. The <CR> command shown for Track 3 denotes the default character for this position, the Terminator position.*

Default Settings Table

Setting	Default
Baud Rate Setting	38,400 bps
Parity Setting	None
Data Bit Setting	8
Handshaking Setting	None
Stop Bit Setting	1
MSR Reading	Enable Auto Transmit Mode
Magnetic Decoding Method	Withdrawl Only
Send Option	Send Start/End Sentinel and all data
Terminator Setting	CR
Preamble Setting	None
Postamble Setting	None
Track Selection Setting	Any Track
Track Separator Setting	CR
Data Edit Setting	Disabled
Memory Card Type	3 byte I^2C Memory Card
Card Option	5V on, 3V off, Microprocessor Card, EMV
Operation Mode*	Card Seated Change On, Card Present Change On, MSR Data Envelope On, LED Controlled by Reader, Magnetic Data Present Off, Standard Decoder

**The RESTORE TO DEFAULT command will not change any selections in Operation Mode. These must be changed individually.*

Appendix B
STATUS CODE TABLE

Return Status and Explanations

Code	Definition
<B0><XX>*	Switch change notification
<90><00>	Operation completed successfully (all operations)
<8C><00>	Unsupported TCK
<8B><00>	Unsupported TAX, TBX, TCX, TDX
<89><00>	ATR too long
<88><00>	Power not ready for T=0 microprocessor card
<87><00>	Protocol not supported by the reader
<86><00>	Unsupported Fi or Di in PPS
<85><00>	PPS confirmation error
<84><00>	Parity error in reception
<83><00>	Parity error in transmission
<82><00>	Unknown TS
<81><00>	Time out
<6E><00>	CLA not supported
<6D><00>	INS not supported
<69><00>	Command not supported
<67><00>	Warning, value read is different from value written
<66><88>	Invalid PSC presented
<66><87>	No more retries
<66><86>	No more counter to decrease
<2F><00>	Fault alarm received
<2D><00>	Memory card not supported
<2C><00>	Card not present
<2B><00>	Address not supported
<2A><00>	Command received correctly, but could not be completed
<C0><XX>	Magnetic card data with envelope

**Note: XX is the reader status byte*

A fault alarm will be reported if a smart card is removed with the power still on, or a supply voltage drop, short circuit, or overheating has been detected.

Appendix C
COMPATIBLE MEMORY CARDS

ID TECH - Compatible Memory Cards

Card	Spec.	Typical Applications	Note (Card Type)
GemPlus GFM 4K	No	Small records storage, Loyalty, Conventions, Digital receipts	I^2C Memory Card (0)
Schlumberger PrimeFlex Open 2/4K	Yes	Small records storage, Loyalty, Conventions, Digital receipts	I^2C Memory Card (0)
CardLogix CLXSA001KA1	Yes	Small records storage, Loyalty, Conventions, Digital receipts	128 bytes I^2C MemoryCard (0)
CardLogix CLXSA002KA2	No	Small records storage, Loyalty, Conventions, Digital receipts	256 bytes I^2C Memory Card (0)
CardLogix CLXSA004KA6	Yes	Small records storage, Loyalty, Conventions, Digital receipts	512 bytes I^2C Memory Card (0)
CardLogix CLXSA008KA7	Yes	Small records storage, Loyalty, Conventions, Digital receipts	1K bytes I^2C Memory Card (0)
CardLogix CLXSA016KA8	Yes	Records storage, Health informatics, Loyalty, Conventions, Digital receipts	2K bytes Memory Card (0)
CardLogix CLXSA032KA9	Yes	Records storage, Health informatics, Loyalty, Conventions, Digital receipts	4K bytes I^2C Memory Card (2)
CardLogix CLXSA064KA3	Yes	Records storage, Health informatics, Loyalty, Conventions, Digital receipts	8K bytes I^2C Memory Card (1)
CardLogix CLXSA128KA4	Yes	Records storage, Health informatics, Loyalty, Conventions, Digital receipts	16K bytes I^2C Memory Card (1)
CardLogix CLXSA256KA5	Yes	Records storage, Health informatics, Loyalty, Conventions, Digital receipts	32K bytes I^2C Memory Card (1)
Gemplus GPM2K	Yes	Small records storage, Loyalty, Conventions, Digital receipts	256 bytes (SLE4442) 7816 Synchronous (Secured Memory Card) (2)
Schlumberger PrimeFlex Store 2K	Yes	Small records storage, Loyalty, Conventions, Digital receipts	256 bytes (SLE4442) 7816 Synchronous (Secured Memory Card) (2)
Gemplus GPM8K	Yes	Small records storage, Loyalty, Conventions, Digital receipts	1K bytes (SLE4428) 7816 Synchronous (Secured Memory Card) (3)
CardLogix CLXSA008KB3	Yes	Small records storage, Loyalty, Conventions, Digital receipts	1K bytes (SLE4428) 7816 Synchronous (Secured Memory Card) (3)
CardLogix CLXSA008KB4	Yes	Small records storage, Loyalty, Conventions, Digital receipts	1K bytes (SLE4428) 7816 Synchronous (Secured Memory Card) (3)
Gemplus GPM271	Yes	Stored value, Laundromats, Telephones, Prepaid systems, Tokens	7816 Synchronous (Token Card) (5)
Gemplus GPM276	Yes	Stored value, Laundromats, Telephones, Prepaid Systems, Tokens	7816 Synchronous (Token Card) (4)

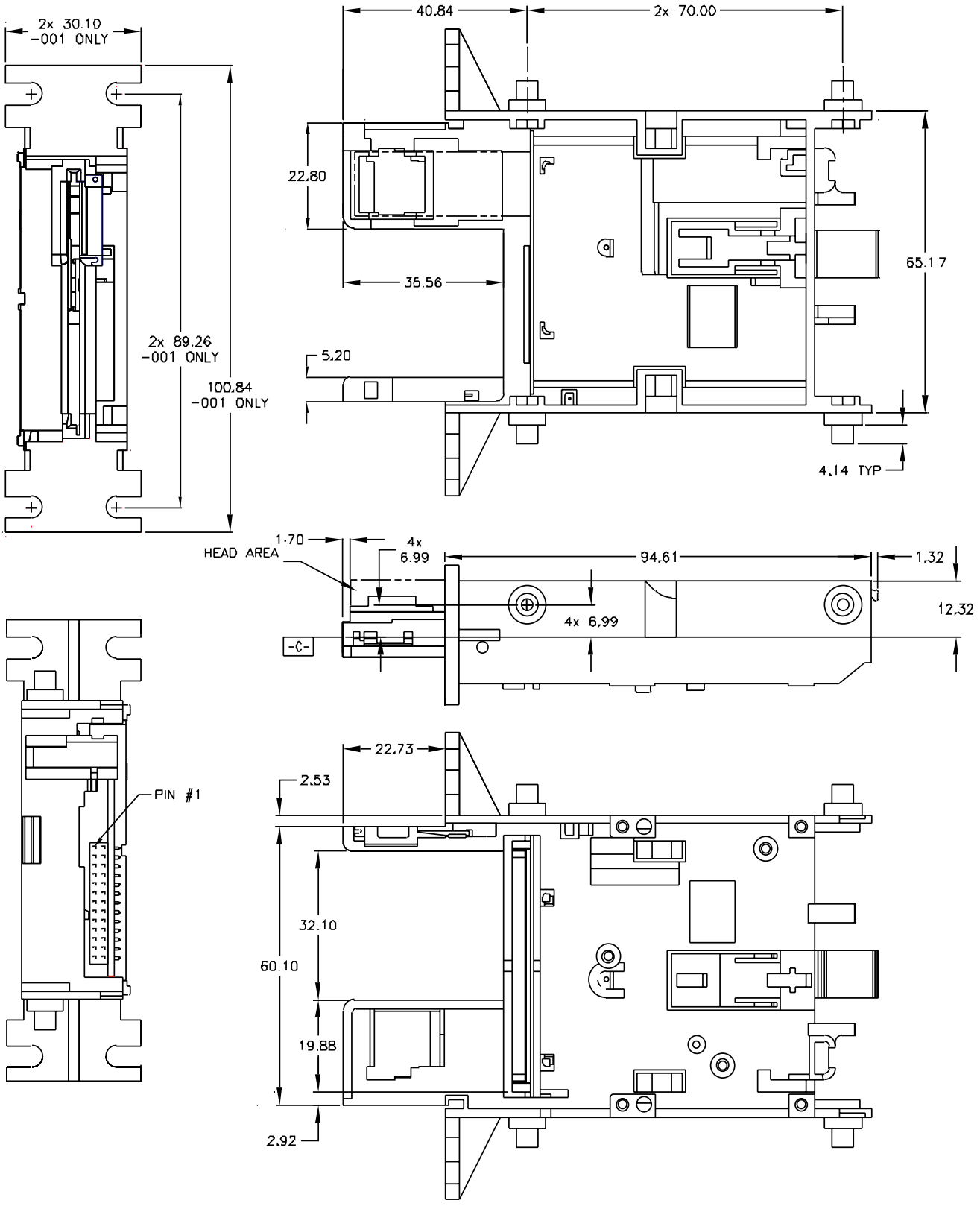
Note: For the latest additions to this list, please visit our website at www.idt-net.com.

Appendix D
FUNCTION ID TABLE

Function Description	Function ID	Function Value
IC Card Type	10	Any Value
Set Operation Mode	11	Any Value
Memory IC Card Type	12	0 - 6
Track Selected Settings	13	'0' - '7'
Track Separator Settings	17	Any ASCII Code
Send Option	19	'0' - '3'
MSR Reading	1A	'0' - '2'
Data Editing	1B	Not Used
Magnetic Decoding Method	1D	'1' - '3'
Terminator Settings	21	CR/LF, CR, LF, None
Track 1 ID	31	Any ASCII Code
Track 2 ID	32	Any ASCII Code
Track 3 ID	33	Any ASCII Code
Baud Rate	41	'5', '7'
X On ID	47	Not Used
X Off ID	48	Not Used
SAM 1 Setting	61	Any Value
SAM 2 Setting	62	Any Value
SAM 3 Setting	63	Any Value
SAM 4 Setting	64	Any Value
SAM 5 Setting	65	Any Value
Preaamble Setting	D2	String
Postamble Setting	D3	String

Appendix E

OUTLINE DRAWING OF READER



Appendix F
CONNECTOR

Connector Pin-Outs

PIN DESIGNATIONS FOR THE 7-PIN HEADER

POSITION	SIGNAL
PIN 1	CASE GND
PIN 2	TXD
PIN 3	RXD
PIN 4	VCC
PIN 5	RTS
PIN 6	CTS
PIN 7	GND

7-Pin Molex connector 53015-0710 accepts Molex 51004-0700

POWER ADAPTER

5V, 500 mA
Polarity: Inside (+)

Warning: Using any power supply (VCC) higher than 5.5V may damage the reader.

Appendix G
DEMONSTRATION SOFTWARE AND CARD

For evaluation and test purposes, the ID TECH Hybrid Insert Reader ships with demonstration software and a test card. These can be used to vary the reader's operational parameters and ensure that it is working correctly.

You will need the following:
1. An ID TECH Hybrid Insert Reader with a DB-9 cable and a 5-volt AC/DC power adapter.
2. A host PC running Windows 95, 98, 2000, Me, NT, or XP with a serial port.
3. The smart card test card shipped with the unit.
4. The ID TECH demonstration software.

Note: For programming the ID TECH reader in a custom application, a DLL is available upon request.

Using the Demonstration Software

To install the demonstration software, insert the disk into the computer's A drive and select **a:\Setup OK**. Then follow the instructions on the screen. Once the software has been installed, go to START/ PROGRAMS.

1. Click on SPECTRUM II FAMILY DEMO SOFTWARE.

2. Plug the reader's DB-9 connector into the serial port of the host computer.

3. Plug the 5V power adapter into a wall outlet and then connect it to the DB-9 cable.

4. Once the reader is powered, its LED indicator should light green.

5. Select a PORT from the pop-up window or pull-down menu on the menu bar.

6. Select DISPLAY MODE on the menu bar and choose either **ASCII** or HEX. If ASCII is chosen, a printable character will be displayed in ASCII code. If HEX is chosen, all characters will be displayed in HEX code.

7. From the menu bar, select which set of commands you wish to test first. You can choose from HYBRID READER COMMANDS, MAGNETIC STRIPE READER COMMANDS, and SMART CARD COMMANDS.

8. There are two ways of sending commands to the reader: a) by selecting a command from the menu bar, or b) by entering a command via the keyboard and clicking the SEND button. (It is not necessary to enter the head of the command, LRC, or ETX.)

9. The program will display a command in the COMPLETE COMMAND box. The program will display a response in the READER'S OUTPUT box.

10. When finished testing, select FILE/EXIT.

Testing Steps Using An I²C Card

1. Select HYBRID READER COMMANDS/SET CARD OPTION/5V MEMORY CARD from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\04\53\10\01\80\A6\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\02\90\00\F2\03 (If the HEX option is chosen)

'\00\02\90\00\F2\03 (If the ASCII option is chosen)

2. Select HYBRID READER COMMANDS/SET MEMORY CARD TYPE/IC 3 BYTES CARD from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\04\53\12\01\00\24\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\02\90\00\F2\03 (If the HEX option is chosen)

'\00\02\90\00\F2\03 (If the ASCII option is chosen)

3. Select SMART CARD COMMANDS/POWER ON from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\01\6E\0F\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\02\90\00\F2\03 (If the HEX option is chosen)

'\00\02\90\00\F2\03 (If the ASCII option is chosen)

4. Select SMART CARD COMMANDS/MEMORY CARD COMMANDS/READ BINARY/READ 11 BYTES from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\06\42\DA\B0\00\30\11\6F\03

The response displayed in the READER'S OUTPUT box will vary.

5. Select SMART CARD COMMANDS/MEMORY CARD COMMANDS/WRITE BINARY/WRITE 11 BYTES OF IDT HYBRID READER from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\17\42\DA\D0\00\30\11\49\44\54\20\48\79\62\72\69\64\20\52\65\61\64\65\72\4E\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\02\90\00\F2\03 (If the HEX option is chosen)

'\00\02\90\00\F2\03 (If the ASCII option is chosen)

6. Select SMART CARD COMMANDS/MEMORY CARD COMMANDS/READ BINARY/READ 11 BYTES from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\06\42\DA\B0\00\30\11\6F\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\13\49\44\54\20\48\79\62\72\69\64\20\52\65\61\64\65\72\90\00\B3\03
(If the HEX option is chosen)

'\00\13IDT Hybrid Reader\90\00\B3\03 (If the ASCII option is chosen)

7. Select SMART CARD COMMANDS/POWER OFF from the menu bar. The command will display in the COMPLETE COMMAND box as follows:
\60\00\01\4D\2C\03

The response will display in the READER'S OUTPUT box as follows:
\60\00\02\90\00\F2\03 (If the HEX option is chosen)

'\00\02\90\00\F2\03 (If the ASCII option is chosen)