

MICRSAFE

TECHNICAL REFERENCE MANUAL

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MAGTEK[®]

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REVISIONS

Rev	Date	Notes
1.01	Mar 3, 2010	Initial Release
2.01	Aug 27, 2010	Updated images; change AC to DC; updated command information
3.01	Oct 20, 2010	Noted configuration 8.3; In troubleshooting guide changed18 "Return MICRSafe to MagTek" to "Return MICRSafe for service"; Removed 08 from troubleshooting guide

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

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

Cet appareil numérique de la classe B est conforme 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 ().

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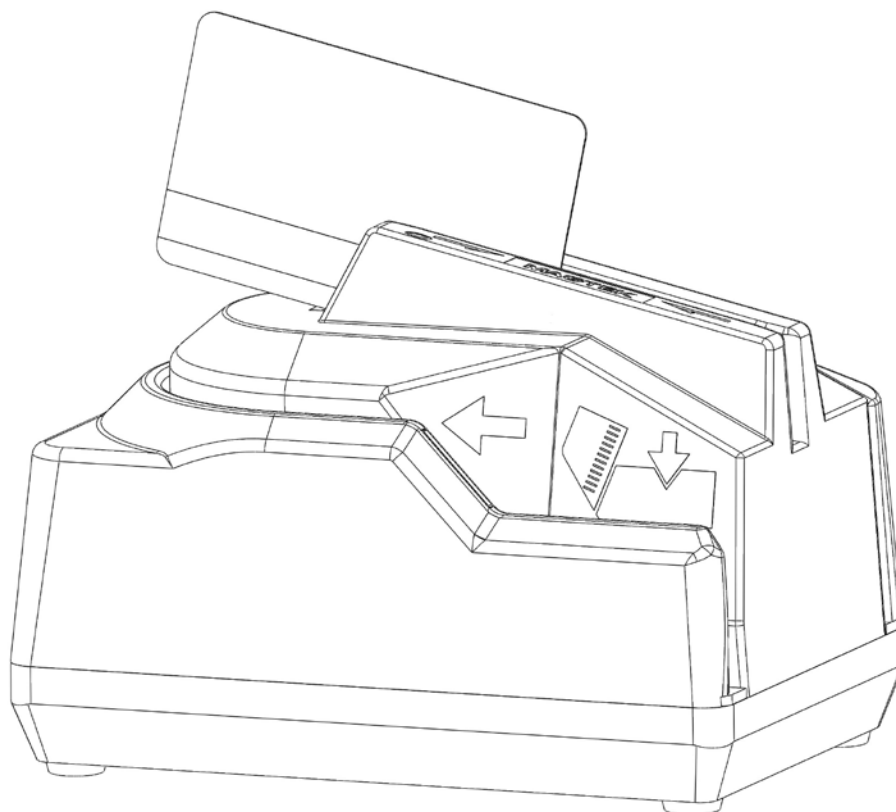


Figure 1-1. MICRSafe with 3-Track MSR

SECTION 1. OVERVIEW

The MICRSafe with 3-Track MSR is both a MICR (Magnetic Ink Character Recognition) Check Reader and an MSR (Magnetic Stripe Reader).

The MICRSafe, in a typical application, reads the magnetic data encoded on the bottom of checks or on magnetic stripe cards and transmits this data to a Host device. The Host device then uses a specific authorization or verification process to validate a business transaction.

The use of the MICRSafe improves accuracy and speed because there is no manual data entry; therefore there are no keying errors or unwanted delays.

The MICRSafe has three interface capabilities. First, the MICRSafe can communicate with the Host system using a standard USB interface. The driver will emulate a serial port on the host PC. All data is transmitted as ASCII characters (See Appendix D). This is MICRSafe VCOM unit.

Second, the MICRSafe can emulate a USB keyboard. This device is compatible with PCs or hosts that support USB keyboards. The Reader emulates a USB Human Interface Device (HID) United States keyboard or optionally all international keyboards using ALT ASCII code keypad key combinations or customizable key maps. This allows host applications designed to acquire card data from keyboard input to seamlessly acquire the card data from the reader. This is MICRSafe HID unit.

Caution

If another keyboard is connected to the same host as this device and a key is pressed on the other keyboard while this device is transmitting, then the data transmitted by this device may get corrupted.

Because of potential “data interleave” issues associated with the USB Keyboard interface, MagTek recommends that this product should only be used if the application requires data to be provided via the keyboard input.

Third, the MICRSafe can communicate with a device other than the host, for instance a POS terminal, through an auxiliary RS-232 interface. All data is transmitted as ASCII characters (See Appendix D). The MICRSafe has the capability of supporting some hardware handshaking signals. (See Section 4, Legacy Commands.) Depending on POS connection port, a ‘Mini DIN 9 Pin’ or a ‘DB9’ cable can be used to connect. Communication in this mode is one-way only, outputting data from the MICRSafe to POS terminal. Baudrate is always set to 9600 bps.

FEATURES

- This device incorporates a MICR Reader with a 3-Track MagneSafe MSR.
- The three track MSR autodiscriminates different card formats: ISO (International Standards Organization), CDL (California Drivers License), or AAMVA (American Association of Motor Vehicle Administrators).
- Small footprint.
- Automatic parsing of MICR fields: transit, account, etc.
- Extensive list of formats to transmit MICR data.
- Optional error/status reporting for check reading.
- Optional TDES DUKPT encryption of MICR and Card data.
- Reads E13-B and CMC-7 MICR fonts.
- Automatically goes into sleep mode when not in use; meets EnergyStar requirements.
- EMF noise detection
- Compatible with USB specification Revisions 2.0 and 1.1
- Compatible with HID specification Versions 2.0 and 1.1
- USB communications with the host may occur via a Virtual COM port or by HID/keyboard emulation.
- Communications with third party systems may occur via an auxiliary RS-232 interface or using standard Windows HID drivers. No third party device driver is required.

ACCESSORIES

Accessories available for the MICRSafe are as follows:

- Standard USB cable, Part Number 22553301
- Optional auxiliary RS-232 cable, Part Number 22517584 /22517509
- DC Power Adapter with Cable, 120VAC to 12 VDC, 1 Amp, Part Number 64300118 (64300121 for international customers)
- MICR Reader Cleaning Card, Part Number 96700006
- Sample Checks, Part Number 96530005
- MICRbase Setup Program, Part Number 22000021

SOFTWARE DRIVERS REQUIRED

If you are using the HID unit, the standard HID and Keyboard drivers that come with an operating system are usually all that is needed. For example, the Windows operating system provides all the drivers needed to communicate to the device, unless you requested that the factory configure your MICRSafe device(s) to use a VCOM port. In that case, you would need to download the VCOM driver from the MagTek website. This driver allows a USB device such as the MICRSafe to appear as an additional COM port available to the PC, enabling application software to access the USB device as if it were connected via a standard COM (RS-232) port.

REFERENCE DOCUMENTS

Axelson, Jan. *USB Complete, Everything You Need to Develop Custom USB Peripherals*, 1999. Lakeview Research, 2209 Winnebago St., Madison WI 53704, 396pp., <http://www.lvr.com>

MICRbase setup program for MICR readers Software and Operation P/N 99875102 *USB Human Interface Device (HID) Class Specification Version 1.1*

Universal Serial Bus (USB): HID Usage Tables Version 1.12 (1/21/2005)

USB (Universal Serial Bus) Specification, Version 1.1, Copyright© 1998 by Compaq Computer Corporation, Intel Corporation, Microsoft Corporation, NEC Corporation

USB Implementers Forum, Inc., www.usb.org

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

SPECIFICATIONS

Table 1-1 lists the specifications for the MICRSafe device:

Table 1-1. Specifications

OPERATING	
Reference Standards	ISO/CDL/AAMVA
Power Input	120 VAC, 50/60 Hz
Output Signal Levels	12 VDC, 200 mA (Idle), 600mA (Operating)
Check Read/Decode/Transit Time	2 second
MICR fonts supported	E13-B CMC-7
MSR supported	Tracks 1, 2, and 3
MECHANICAL	
Dimensions	Length 6.25", Width 4.0", Height 4.25"
Weight:	3.0 lbs. MSR and Adapter included
Cable length	6'
Connectors	USB Type B connector Mini Din-9 male,
ENVIRONMENTAL	
Temperature	
Operating	0°C to 50°C (32°F to 122°F)
Storage	-30°C to 60°C (-22°F to 140°F)
Humidity	
Operating	10% to 90% noncondensing
Storage	Up to 95% noncondensing

SECTION 2. INSTALLATION

The installation for the MICRSafe is as follows:

REQUIREMENTS

The following is required for the Installation:

- MICRSafe Device, Part Number 22551001 (VCOM) or 22551002(HID)
- Standard USB cable, Part Number 22553301
- Optional auxiliary RS-232 cable, Part Number 22517584
- DC Power Adapter with Cable, 120VAC to 12 VDC, 1 Amp, Part Number 64300118 (64300121 for international customers)
- MICRbase software, included in the CD Package Part Number 30037855, or can be downloaded from: http://www.magtek.com/support/software/demo_programs/ under 'MICRbase Setup Program'
- VCOM Driver for MICRSafe, included in the CD Part Number 30037903 or can be downloaded from: http://www.magtek.com/support/software/programming_tools/, under 'MICRSafe VCOM'.

PROCEDURE

Perform the following steps:

1. Connect the interface cable's USB A connector to the PC.
2. Connect the interface cable's USB B connector to the MICRSafe.
3. Connect the DC power adapter's jack to the plug on the MICRSafe.
4. Connect the DC power adapter's plug to the wall outlet.
5. The first time the Reader is connected to the PC, Windows will need to install the USB driver. See the instructions below.
6. The LED indicator on the MICRSafe should turn on to a steady green. The LED indicator is located to the left of the slot where the check is first inserted for reading.

Caution

Do not place the MICRSafe within 6 inches of a computer monitor or power supply. These devices may cause undesirable interference with the check reading operation.

USB DRIVER INSTALLATION (WINDOWS)

On hosts with the Windows operating system, the first time the MICRSafe is plugged into a specific USB port, Windows will open a dialog box which will guide you through the process of installing a driver for the device; follow the instructions given in the dialog box. Windows will install the driver that is used for HID keyboard devices; this driver is a basic component of all modern versions of the Windows operating system. Sometimes, Windows will find all the files it needs. Other times, Windows will need to know the location of the files it needs. If Windows prompts for the file locations, insert the CD that was used to install Windows on your PC and point Windows to the CD's root directory. Windows should find all the files it needs there. Once completed, the driver installation process described above will not recur unless the device is subsequently plugged into a different USB port. After this installation, the device can communicate with user's application programs such as MICRbase (P/N 22000021) to read checks, credit cards and setup configurations.

SECTION 3. OPERATION

This section contains check and card reading procedures and LED indicator states.

CHECK READING PROCEDURE

1. Orient the check so the MICR line is down and the printed side faces the center of the MICRSafe as shown in Figure 3-1.

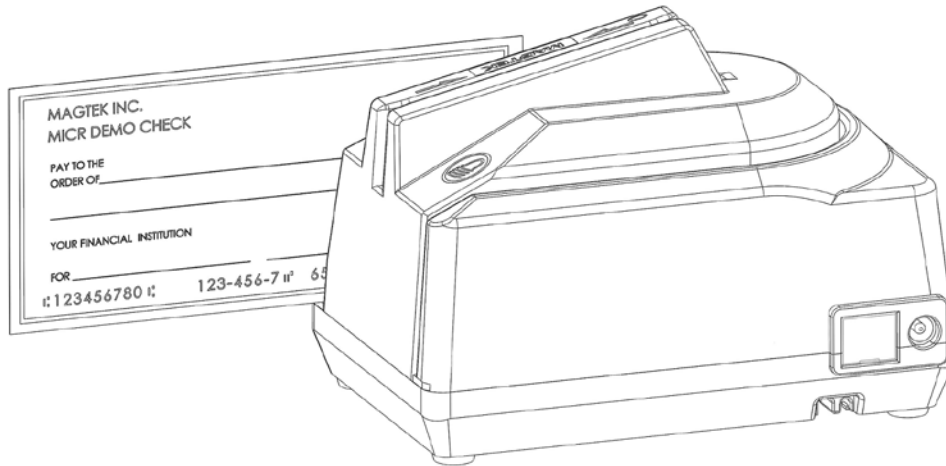


Figure 3-1. Check Orientation

2. Drop the check so the leading edge is in the open slot.
3. When the MICRSafe detects the presence of the check, the motor will turn on. At this time, gently urge the check forward until the unit grabs the check. When this happens, release the check. The check will then be transported around the check path and will exit through the other side.
4. After the check is read, the MICRSafe will transmit the data as specified by the parameters described in Section 4, Commands.

CARD SWIPE PROCEDURE

The card may be swiped through the MSR in either direction, but the magnetic stripe must be oriented in only one direction as shown in Figure 1-1. The MSR will transmit raw card data (“as is” on the card) for all tracks that have been enabled using the HW (Hardware) command (Section 4, Legacy Commands)

MICRSafe with 3-Track MSR

The MSR is capable of reading ISO, AAMVA, and CDL encoded cards. The MSR will autodiscriminate all the card formats when the ID Card Decoding option is enabled using the HW (Hardware) command (Section 4, Legacy Commands).

LED INDICATORS

Table 3-1 describes the LED indicator conditions for check and card reading operations. The LED indicator for check reading is located to the left of the slot where the check is first inserted for reading. The LED indicator for card reading is located on the upper left side of the MSR rail.

Table 3-1. LED indicators

LED INDICATOR	DESCRIPTION
OFF	Power off
SOLID GREEN	Ready to read check or card
OFF→ SOLID RED	Check or card read error
OFF→ SOLID GREEN	Good read
FLASH RED/GREEN	Data sensor blocked (motor does not run)*
FLASH RED	Motor sensor blocked (motor does not run)*

*Refer to Appendix C. Troubleshooting Guide.

SECTION 4. LEGACY COMMANDS

This section describes the use of commands and programmable options available for the MICRSafe.

Note

All options described below can be factory set as specified by the user when ordering.

You may use either of two methods to execute the MICRSafe commands: Insta-Change checks or the MICRbase Setup Program for Windows (see *NOTE below).

INSTA-CHANGE CHECKS

The first method is the use of Insta-Change checks, which is a more practical way of setting up the MICRSafe for most applications. The Insta-Change check is a MICR encoded document that contains commands and options used to reset the parameters of the MICR Reader. Multiple commands and options may be contained on one Insta-Change check. When used, the Insta-Change checks are run through the MICRSafe the same as a standard check, and the options to be used are automatically selected. To obtain Insta-Change checks, notify a MagTek representative and specify what options will be used. To operate Insta-Change checks, install the MICRSafe as described in Section 2 and watch the LED indicator. When the Insta-Change check is run through the MICRSafe and read successfully, the LED indicator will blink green. If the LED indicator turns red, the read was not successful. If the LED is blinking red and green, the Insta-Change check contains an invalid format. Try again or use a different Insta-Change check.

MICRBASE SETUP PROGRAM FOR WINDOWS

The MICRbase program (P/N 22000021) allows the user to control all the programmable options available in the MICRSafe. *NOTE: MICRbase version 8.3 or newer will work with this device in either configuration. If the MICRSafe model used is a Keyboard Emulation HID device, you may also program the device using the USB Swipe and Insert Reader demo (version 1.08 or newer). For details on this usage see the USB Communications section (section 5) of this manual.

The program provides a graphical, user-friendly interface that hides the complexities involved in manually entering MICR commands. The user is no longer required to know the specific commands or the detailed data associated with each command. However, the program still allows manual entry of commands for advanced users, and it also displays data from cards and checks that are read. If your MICRSafe is using a VCOM port, the legacy MICR commands found in this section may be sent to the device exactly as described below. However, if your MICRSafe is using an HID interface, you must send the legacy MICR commands to the device using the “Send Legacy Command”, details of which can be found in the “USB Communications” section of this manual. For details and examples of how to use MICRbase see P/N 99875102. For more detailed information also refer to the Readme.txt file that comes with this program. You can download the MICRbase program from the Internet at http://www.magtek.com/support/software/demo_programs/ under ‘MICRbase Setup Program’

COMMAND FORMAT

You must use the following format when entering the commands manually:

- **[COMMAND] [DATA] <CR>**

where:

- **[COMMAND]** is a string of alpha characters (usually 2 or 3 bytes in length).
- **[Data]** is optional as described below for each command.
- **<CR>** is always required.
- All characters are ASCII.
- No spaces, brackets, or angle brackets required.

If your MICRSafe is using an HID Keyboard Emulation interface, then all legacy MICR commands found in this section must be sent to the device using the “Send Legacy Command” Command. Details of this command can be found in the “USB Communications” section of this manual.

SWB - SWITCH B COMMAND

The SWB command controls the message format, shown in Table 4-2. The data for this command consists of 8 ASCII bits (“0” = hex 30 and “1” = hex 31).

To execute, send the SWB command as follows:

SWB01010101<CR> (with data)

or

SWB<CR> (without data)

When sending data, all 8 bits must be provided. The MICRSafe will execute the command but it will not reply. The new settings become effective immediately. To make this command permanent, use the command SA (Save) described at the end of this section.

If no data is sent, the MICRSafe responds with the current settings for SWB.

Table 4-2. SWB Command

BIT								PARAMETERS
7	6	5	4	3	2	1	0	
							0	<LF>: No
							1	<LF>: Yes
						0		<CR>: No
						1		<CR>: Yes
					0			<ETX>: No
					1			<ETX>: Yes
				0				<ESC>: No
				1				<ESC>: Yes
			0					<STX>: No
			1					<STX>: Yes
		0						Send Data After Error?: No
		1						Send Data After Error?: Yes
	0							Send Status After Data?: No
	1							Send Status After Data?: Yes
0			0	0	0	0	0	Comm Mode: 0 - Data Only
1			0	0	0	0	0	Comm Mode: 1 - Data<CR>
0			0	0	0	0	1	Comm Mode: 2 - Data<LF>
0			0	0	0	1	1	Comm Mode: 3 - Data<CR><LF>
0			0	1	0	0	0	Comm Mode: 4 - <ESC>Data
0			0	1	0	1	0	Comm Mode: 5 - <ESC>Data<CR>
0			1	0	1	0	0	Comm Mode: 6 - <STX>Data<ETX>
1			0	0	0	0	1	Comm Mode: 7 - <STX>Data<ETX><LRC>
0			1	1	1	1	1	Comm Mode- 8 – All controls
0			0	0	1	0	1	Comm Mode- 9- Data<ETX><LF>
0			1	0	0	1	0	Comm Mode- 10- <STX>Data<CR>

SWB PARAMETERS

The SWB functions are listed in Table 4-2 above and are described below:

Control Characters and MICR Data

Control Characters may be added to MICR Data messages. The MICRSafe will insert any control characters selected using this command into outgoing formatted MICR Data messages in the following sequence:

<STX> <ESC> data <ETX> <CR> <LF>

The control characters, descriptions, and hex values are shown in Table 4-3.

Table 4-3. Control Characters

CONTROL CHARACTER	DESCRIPTION	HEX VALUE
<STX>	Start of Text	02
<ESC>	Escape	1B
<ETX>	End of Text	03
<CR>	Carriage Return	0D
<LF>	Line Feed	0A

For example, if the <STX> and <CR> options are set to YES, a MICR Data message from the MICRSafe will look like this:

MICR Data: <STX>data<CR>

Control Characters and Card Data

If the card reader's head is set to security level 2, then the same control characters may also be added to Card Data messages, but they are applied to each track individually. For example, if the <STX> and <ETX> options are set to YES, a Card Data message from the MICRSafe will look like this:

Card Data: <STX>[TK1 data]<ETX><STX>[TK2 data]<ETX><STX>[TK3 data]<ETX>

Please note again that card reader heads that are set to security level 1 and 3 do not support this control characters.

Communication Modes

The selection of Comm modes is a quick way of selecting multiple Control Characters. For instance, to send a carriage return/line feed pair after the data, you can specify Comm Mode 3.

Comm Mode 7, also known as Packet Mode, calculates an LRC (Longitudinal Redundancy Check), and appends it to the data message. Also, if a <NAK> (hex 15) character is received in this mode, the MICRSafe will resend the last message.

Send Data After Error

The Send Data After Error option specifies whether the MICRSafe will return data to the Host after a read error. If YES is selected and the MICRSafe detects a read error, the MICRSafe will still send the data back to the Host. If NO is selected and the MICRSafe finds an error, it will discard the data and nothing will be sent. The error conditions are listed in Table 4-4.

Send Status After Data

The Send Status After Data option causes the MICRSafe to append a two-digit error/status code to the end of the MICR data. For most formats (See Appendix A), the error/status code will always be preceded by a forward slash (/). The error/status codes are listed in Table 4-4.

For example, if a Canadian check (code 08) is read and has no errors, and the MICR data is “1234567890”, then the message from the MICRSafe will look like this:

MICR Data: 1234567890/08

The status code is always at the end of the data, not the end of the message. For example, using the above conditions, with the message format set to send <STX> and <ETX>, the message from the MICRSafe will look like this:

MICR Data: <STX>1234567890/08<ETX>

Table 4-4. Error and Status Codes

PRIORITY	CODE	TYPE	DESCRIPTION
9	01	Error	No MICR data: no transit and no account found
8	09	Status	Mexican check
7	08	Status	Canadian check
6	05	Error	Transit error: No transit, bad character, bad length, bad check digit
5	07	Error	Account error: No account, bad character
4	04	Error	Check # error: Bad character in check number
4	04	Status	No check number
3	03	Status	Low MICR signal, good read
2	10	Status	Business check
1	11	Status	Amount field present
0	00	Status	Good read

Notes:

- The LED indicator will turn red on all error conditions.
- The absence of a check number is not considered an error.

- If a multiple error condition occurs, the error or status code with the highest priority is reported.
- All unreadable MICR characters are transmitted as an “?” ASCII character (hex 3F), except for Format 00xx (See Appendix A).

SWC - SWITCH C COMMAND

The SWC command controls miscellaneous functions, shown in Table 4-5. The data for this command consists of 8 ASCII bits (“0” = hex 30 and “1” = hex 31).

To execute, send the SWC command as follows:

SWC01010101<CR> (with data)

or

SWC<CR> (without data)

When sending data, all 8 bits must be provided. The MICRSafe will execute the command but it will not reply. The new settings become effective immediately. To make this command permanent, use the SA (Save) command described at the end of this section.

If no data is sent, the MICRSafe responds with the current settings for SWC.

Table 4-5. SWC Command

BITS								PARAMETERS
7	6	5	4	3	2	1	0	
							0	CMC-7 Character Set: No
							1	CMC-7 Character Set: Yes
					0	0		Invalid Commands: ?<CR>
					0	1		Invalid Commands : No Reply (Header Required)*
					1	0		Invalid Commands: No Reply (No Header Required)
					1	1		Ignore all Commands
				0				Reserved
			0					Data Header: No ¹
			1					Data Header: Yes ¹
		0						Card Data Message: Multiple ¹
		1						Card Data Message: Single ¹
0	0							These bits are always set to 0 but must be included.

* ‘Header Required’ means all commands must be preceded by a GS character (Hex 1D).

¹ For the card data, this parameter does not apply to units with card reader head set to security level 1 or 3

SWC PARAMETERS

The SWC functions are listed in Table 4-5 above and are described below:

CMC-7 Character Set

If NO is selected, the MICRSafe will only read E13-B characters. When YES is selected, the MICRSafe will read both CMC-7 and E13-B characters (see Appendix B). However, the MICRSafe will only output raw data ("as is" on the check) for checks with CMC-7 characters.

Invalid Command Response

Invalid command response is the action the MICRSafe will take upon receipt of a command it does not recognize. It can also be used to stop the MICRSafe from receiving any more commands.

The first option “?<CR>” is the default. If the MICRSafe receives an unrecognized command, it will return a question mark and carriage return to the Host. The MICRSafe will then return to an idle state and wait for further commands or check/credit card reads.

For the second option, “no reply - header required,” the MICRSafe will only execute commands preceded by a GS ASCII character (hex 1D). All other commands will be ignored. Also, the MICRSafe will not reply to invalid commands.

For the third option, “no reply – no header required,” the MICRSafe will execute all valid commands, but it will not reply to invalid commands.

The fourth option, “ignore all commands,” causes the MICRSafe to ignore any further commands. Even the SA (Save) command is ignored and therefore this fourth option is only temporary. To make this option permanent or to reset it, you must use an Insta-Change check.

Data Header

If YES is selected, a single character header precedes the data. For MICR data, the message is transmitted as follows:

MICR data: `C'[data]

For card data, the header position on the message is controlled by the Card Data Message parameter (see below). Therefore, the message may be transmitted as follows:

If Multiple Message: `M'[TK1]`M'[TK2]`M'[TK3]

If Single Message: `M'[TK1] [TK2] [TK3]

It is important to note that the Data Header precedes the data and not the message. For example, if <STX>, <ETX> and Data Header are set to YES, a MICR data message will be transmitted as follows:

MICR data: <STX>`C'[data]<ETX>

Card Data Message

This option determines the structure of the output message for the individual tracks when a credit card is read. If Multiple is selected, the Control Characters (see SWB command, above) and Data Header (see Data Header section, above) are added to each track individually. On the other hand, if Single is selected, all available tracks are lumped together into a single message. For example, if <STX>, <ETX> and Data Header are set to YES, the output message may be transmitted as follows:

Note: This option applies only when the card reader head is set to security level 2

If Multiple Message:

<STX>`M'[TK1]<ETX><STX>`M'[TK2]<ETX><STX>`M'[TK3]<ETX>

If Single Message: <STX>`M'[TK1] [TK2] [TK3]<ETX>

HW - HARDWARE COMMAND

This command controls miscellaneous hardware options, as shown in Table 4-6. The data for this command consists of 8 ASCII bits ("0" = hex 30 and "1" = hex 31).

To execute, send the HW command as follows:

HW 01010101<CR> (with data)

or

HW <CR> (without data)

When sending data, all 8 bits must be provided. The MICRSafe will execute the command but it will not reply. The new settings become effective immediately. To make this command permanent, use the SA (Save) command described at the end of this section.

If no data is sent, the MICRSafe responds with the current settings for HW.

Table 4-6. HW Command

7	6	5	4	3	2	1	0	PARAMETERS
					0			Track 3: Disable*
					1			Track 3: Enable*
				0				Track 2: Disable*
				1				Track 2: Enable*
			0					Track 1: Disable*
			1					Track 1: Enable*
		0						ID Card decoding: Disable*
		1						ID Card decoding: Enable*
						0		EMF detect: Yes
						1		EMF detect: No
0	0						0	These bits are always set to 0

* Note: This option applies only when the card reader head is set to security level 2

HW PARAMETERS

Disable/Enable Tracks

Each Track can be enabled or disabled individually. The tracks are always transmitted in ascending order: TK1, TK2, TK3. For example, if TK1 and TK3 are enabled and TK2 is disabled, the MSR will transmit TK1, TK3.

ID Card Decoding

The MSR has two modes of operation. In the first mode, ID Card decoding disabled, the MSR will only read ISO encoded cards. In the second mode, ID Card decoding enabled, the MSR will read and autodiscriminate ISO, AAMVA, and CDL encoded cards. When a card is swiped, the LED indicator will turn red and indicate an error if any of the enabled tracks read is incompatible with the selected mode of operation. TK2 is a standard track for all types of cards.

EMF Detect

The EMF Detect option allows the MICR Reader, when idle, to monitor EMF interference in its immediate environment. If YES is selected, the LED indicator will blink red/green when the MICRSafe detects a signal with amplitude large enough to affect check reading. If NO is selected, the MICRSafe will not monitor nor indicate the presence of EMF interference.

FC - FORMAT CHANGE COMMAND

Formats are used by the MICRSafe to process and transmit the MICR fields. The format command allows the selection of a format from the Format List (see Appendix A). The data for this command consists of 4 digits (ASCII characters 0-9). To execute, send the command as follows:

FCXXXX<CR> (with data)

or

FC<CR> (without data)

When sending data, all 4 digits must be provided. The MICRSafe will execute the command but it will not reply. The new settings become effective immediately. To make this command permanent, use the SA (Save) command described below.

If no data is sent, the MICRSafe responds with the current format number.

VR - VERSION COMMAND

The Version command gives the current software revision in the MICR Reader. To execute, send the VR command followed by a carriage return as follows:

VR<CR>

The MICRSafe responds as follows:

MICR data: [software revision]<CR>

SA - SAVE COMMAND

All changes are considered temporary until the Save command is executed. The Save command saves all changes to the MICRSafe memory and makes them permanent. The MICRSafe will execute the command but it will not reply. To execute, send the SA command followed by a carriage return as follows:

SA<CR>

RS - RESET COMMAND

The Reset command resets the MICRSafe firmware to the normal operating state of waiting for a check or card to be read. The command also resets the serial port to the most recently saved settings. To execute, send the RS command followed by a carriage return as follows:

RS<CR>

DM – DISABLE MICR COMMAND

This command disables the document reading function and turns off the LED. Communications are not affected. The motor will not turn on when a document is inserted. To execute, send the DM command followed by a carriage return as follows:

DM<CR>

EM – ENABLE MICR COMMAND

This command enables the document reading function, and the LED will turn green. To execute, send the EM command followed by a carriage return as follows:

EM<CR>

KS – ENABLE KEYSTROKE COMMAND

This command determines if the MICRSafe will send responses to the host via the USB interrupt pipe or as Keystrokes (that will appear to the host application as if typed on a keyboard). To execute, send the KS command followed by a carriage return as follows:

KS00<CR> (to send responses to the host via the USB interrupt pipe)

or

KS01<CR> (to send responses as keystrokes)

SLP – SLEEP MODE COMMAND

This command puts the MICRSafe into sleep mode for the specified time interval. While in sleep mode, the green LED dims to half brightness. To execute, send the SLP command followed by a carriage return as follows:

SLPB4<CR> (to put the MICRSafe in sleep mode after thirty minutes of idle state)

NOTE: The two characters following “SLP” contain the Hex value of the time before the device goes into sleep mode, with time measured in ten-second intervals. Hex FF (numeric 255) is the maximum time you can specify; 255 ten second intervals equal 42 minutes.

RD – ENABLE AUXILIARY PORT COMMAND

This command determines if the MICRSafe will send responses to the host via the auxiliary RS-232 port. To execute, send one of the following RD commands followed by a carriage return:

RD00<CR> (to disable the use of the auxiliary RS-232 port)

or

RD01<CR> (to enable the use of the auxiliary RS-232 port for transmitting MSR data only)

or

RD02<CR> (to enable the use of the auxiliary RS-232 port for transmitting check data only)

or

RD03<CR> (to enable the use of the auxiliary RS-232 port for transmitting both MSR and check data)

If no data is sent, the MICRSafe responds with the current value of RD.

CHKCNT – CHECK COUNT COMMAND

This command returns the number of checks that have been processed by the device. To execute, send the CHKCNT command followed by a carriage return as follows:

CHKCNT<CR>

SECTION 5. USB COMMUNICATIONS

This device conforms to the USB specification revisions 2.0 and 1.1. This device also conforms with the Human Interface Device (HID) class specification versions 2.0 and 1.1. The device communicates to the host as a HID keyboard device. The latest versions of the Windows operating systems come with a standard Windows USB HID keyboard driver. This section pertains only to the HID Keyboard Emulation configuration. For character mapping and character conversion, you may reference appendices D, E, and F for ASCII codes and USB Usage ID definitions.

This is a full speed USB device. This device 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. The device has an adjustable endpoint descriptor polling interval value that can be set to any value in the range of 1ms to 255ms. This property can be used to speed up or slow down the keyboard data transfer rate. The device also has an adjustable serial number descriptor. More details about these properties can be found later in this document in the command section.

The device will go into suspend mode when directed to do so by the host. The device will wake up from suspend mode when directed to do so by the host. The device does not support remote wakeup.

This device is powered from the USB bus. The vendor ID is 0x0801 and the product ID is 0x2251.

HOST APPLICATIONS

If your MICRSafe was configured as an HID device, then it can be used with existing applications that acquire card data via keyboard input. Also, applications that communicate with this device can be easily developed. These applications can be developed using compilers such as Microsoft's Visual Basic or Visual C++. To demonstrate this device's card reading capabilities, any application that accepts keyboard input (for instance Windows Notepad) can be used.

CARD and MICR DATA

The card and MICR data is converted to ASCII and transmitted to the host as if it had been typed on a keyboard.

Caution

If another keyboard is connected to the same host as this device and a key is pressed on the other keyboard while this device is transmitting, then the data transmitted by this device may get corrupted.

Because of potential “data interleave” issues associated with the USB Keyboard interface, MagTek recommends that you do not depress the keyboard while swiping a card or scanning a check. If previous applications were based upon RS-232 serial interface on a Windows operating system, it is recommended that you use MagTek’s MINI MICR USB Virtual COM Port product.

The device’s programmable configuration options affect the format of the card and MICR data. Refer to the legacy commands section for a description of how the card and MICR data is formatted. Some of the properties in this section also affect the format of the card and MICR data.

All data will be sent in upper case regardless of the state of the caps lock key on the keyboard.

PROGRAMMABLE CONFIGURATION OPTIONS

This device 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 device. During normal device operation, the device acts like a keyboard; the host operating system takes care of all low level communications with the device so that the application developer is not burdened with these low level details. Details on how to communicate with the device 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 device 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.

LOW LEVEL COMMUNICATIONS

It is strongly recommended that application software developers become familiar with the HID specification the USB specification before attempting to communicate directly with this device. This document assumes that the reader is familiar with these specifications. These specifications can be downloaded free from www.usb.org.

HID USAGES

HID devices send data in reports. Elements of data in a report are identified by unique identifiers called usages. The structure of the device's reports and the device's capabilities are reported to the host in a report descriptor. The host usually gets the report descriptor only once, right after the device is plugged in. The report descriptor usages identify the device's capabilities and report structures. For example, a device could be identified as a keyboard by analyzing the device's report descriptor. Usages are four byte integers. The most significant two bytes are called the usage page and the least significant two bytes are called usage IDs. Usages that are related can share a common usage page. Usages can be standardized or they can be vendor-defined. Standardized usages, such as usages for mice and keyboards, can be found in the HID Usage Tables document and can be downloaded free at www.usb.org. Vendor-defined usages must have a usage page in the range 0xFF00 – 0xFFFF. All usages for this device use the standard HID keyboard usages or vendor-defined magnetic stripe reader usage page 0xFF00. The vendor-defined usage IDs for this device are defined in the following table. The usage types are also listed. These usage types are defined in the HID Usage Tables document.

Magnetic Stripe Reader usage page 0xFF00:

Usage ID (Hex)	Usage Name	Usage Type	Report Type
20	Command message	Data	Feature

REPORT DESCRIPTOR

The HID report descriptor is structured as follows:

Item	Value(Hex)
Usage Page (Generic Desktop)	05 01
Usage (Keyboard)	09 06
Collection (Application)	A1 01
Usage Page (Key Codes)	05 07
Usage Minimum (224)	19 E0
Usage Maximum (231)	29 E7
Logical Minimum (0)	15 00
Logical Maximum (1)	25 01
Report Size (1)	75 01
Report Count (8)	95 08
Input (Data, Variable, Absolute)	81 02
Report Count (1)	95 01
Report Size (8)	75 08
Input (Constant)	81 03
Report Count (5)	95 05
Report Size (1)	75 01
Usage Page (LEDs)	05 08
Usage Minimum (1)	19 01
Usage Maximum (5)	29 05
Output (Data, Variable, Absolute)	91 02
Report Count (1)	95 01

Item	Value(Hex)
Report Size (3)	75 03
Output (Constant)	91 03
Report Count (6)	95 06
Report Size (8)	75 08
Logical Minimum (0)	15 00
Logical Maximum (101)	25 66
Usage Page (Key Codes)	05 07
Usage Minimum (0)	19 00
Usage Maximum (101)	29 66
Input (Data, Array)	81 00
Logical Maximum (255)	26 FF 00
Usage Page (vendor-defined (MSR))	06 00 FF
Usage (command data)	09 20
Report Count	95 18
Feature (Data, Variable, Absolute, Buffered Bytes)	B2 02 01
End Collection	C0

COMMANDS

Command requests and responses are sent to and received from the device using feature reports. Command requests are sent to the device using the HID class specific request **Set Report**. The response to a command is retrieved from the device using the HID class specific request **Get Report**. The requests are sent over the default control pipe. When a command request is sent, the device will Nak the Status stage of the **Set Report** request until the command is completed. This insures that as soon as the **Set Report** request is completed, the **Get Report** request can be sent to get the command response. The usage ID for the command message was shown previously in the Usage Table.

The following table shows how the feature report is structured for command requests:

Offset	Field Name
0	Command Number
1	Data Length
2 – 23	Data

The following table shows how the feature report is structured for command responses.

Offset	Field Name
0	Result Code
1	Data Length
2 – 23	Data

COMMAND PROCESSING

Firmware in the MSR normally handles card swipes, gets MagnePrint data, and encrypts the data; it then passes the output to firmware in the MICRSafe for transmission to the host. Firmware in the MICRSafe controls all functions relating to check reading and handles all communications between the host and the device. Thus, all commands are received by the MICRSafe firmware, which, unless instructed otherwise, will attempt to process the command. For this reason, commands that affect card reading only (which are unknown to the MICRSafe firmware) must be distinguished from commands which the MICRSafe firmware is equipped to handle. The convention adopted to enable this necessary distinction is to prefix the data portion of a card reading command with the literal “MSR”. This will cause the MICRSafe firmware *not* to process a specific command. Instead, the MICRSafe firmware will pass the command through to the MSR firmware which will process the command.

COMMAND NUMBER

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

Value	Command Number	Description
0	Get Property	Gets a property from the device
1	Set Property	Sets a property in the device
2	Reset Device	Resets the device
3	Get Keymap Item	Gets a key map item
4	Set Keymap Item	Sets a key map item
5	Save Custom Keymap	Saves the custom key map
7	Send Legacy Command	Sends a legacy command

DATA LENGTH

This one-byte field contains the length of the valid data contained in the Data field.

DATA

This multi-byte field contains command data, if any. Note that the length of this field is fixed at 22 bytes. Valid data should be placed in the field starting at offset 2. Any remaining data after the valid data should be set to zero. This entire field must always be set even if there is no valid data. The HID specification requires that Reports be fixed in length. Command data may vary in length. Therefore, the Report should be filled with zeros after the valid data.

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	Result Code	Description
0	SUCCESS	The command completed successfully.
1	FAILURE	The command failed.
2	BAD_PARAMETER	The command failed due to a bad parameter or command syntax error.

GET AND SET PROPERTY COMMANDS

The **Get Property** command gets a property from the device. The **Get Property** command number is 0.

The **Set Property** command sets a property in the device. The **Set Property** command number is 1.

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.

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	Property ID	Description
0x00 (0)	Software ID	The device's software identifier
0x01 (1)	Serial Num	The device's serial number
0x02 (2)	Polling Interval	The interrupt pipe's polling interval
0x04 (4)	Track Data Send Flags	Track data send flags
0x0F (15)	ASCII To Keypress Conversion Type	Type of conversion performed when converting ASCII data to key strokes
0x11 (17)	Active Keymap	Selects which key map to use
0x1A (26)	Convert From Char A	Selects character to use when converting to string A
0x1B (27)	Convert To String A	Selects string to use when converting from char A
0x1C (28)	Convert From Char B	Selects character to use when converting to string B
0x1D (29)	Convert To String B	Selects string to use when converting from char B

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.

SOFTWARE ID PROPERTY

Property ID: 0
 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 device's USB CPU. The first 8 bytes represent the part number and the last 3 bytes represent the version. For example this string might be "22827021A01". 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	01	32 32 38 32 37 30 32 31 41 30 31

SERIAL NUM PROPERTY

Property ID: 1
Property Type: String
Length: 0 – 15 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 device's serial number. This string can be 0 – 15 bytes long. The value of this property, if any, will be sent to the host when the host requests the USB string descriptor.

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 **Serial Num** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	04	01	32 32 38 32 37 30 32 31 41 30 31

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

Result Code	Data Len	Data
00	00	

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

Cmd Num	Data Len	Prp ID
00	01	01

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

Result Code	Data Len	Prp Value
00	03	32 32 38 32 37 30 32 31 41 30 31

POLLING INTERVAL PROPERTY

Property ID: 2
 Property Type: Byte
 Length: 1 byte
 Get Property: Yes
 Set Property: Yes
 Default Value: 1
 Description: The value is a byte that represents the device's polling interval for the Interrupt In Endpoint. The value can be set in the range of 1 – 255 and has units of milliseconds. The polling interval tells the host how often to poll the device for keystroke data packets. For example, if the polling interval is set to 10, the host will poll the device for keystroke data packets every 10ms. This property can be used to speed up or slow down the time it takes to send keystroke data to the host. The trade-off is that speeding up the card data transfer rate increases the USB bus bandwidth used by the device, and slowing down the card data transfer rate decreases the USB bus bandwidth used by the device. The value of this property will be sent to the host when the host requests the device's USB endpoint descriptor.

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 **Polling Interval** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	02	0A

Example Set **Polling Interval** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Polling Interval** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	02

Example Get **Polling Interval** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	0A

TRACK DATA SEND FLAGS PROPERTY

Property ID: 4
 Property Type: Byte
 Length: 1 byte
 Get Property: Yes
 Set Property: Yes
 Default Value: 0x00

Description: This property is defined as follows:

ICL	0	0	0	0	0	0	0
-----	---	---	---	---	---	---	---

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

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.

ASCII TO KEYPRESS CONVERSION TYPE PROPERTY

Property ID: 15 (0x0F)

Property Type: Byte

Length: 1 byte

Get Property: Yes

Set Property: Yes

Default Value: 0 (keymap)

Description: The value is a byte that represents the device's ASCII to keypress conversion type. The value can be set to 0 for keymap (The active keymap is set with the **Active Keymap** property) or to 1 for ALT ASCII code (international keyboard emulation). When the value is set to 0 (keymap), data will be transmitted to the host according to the active keymap which defaults to the United States keyboard keymap. For example, to transmit the ASCII character '?' (063 decimal), the character is looked up in a keymap. For a United States keyboard keymap, the '/' (forward slash) key combined with the left shift key modifier are stored in the keymap to represent the key press combination that is used to represent the ASCII character '?' (063 decimal). When the value is set to 1 (ALT ASCII code), instead of using the key map, an international keyboard key press combination consisting of the decimal value of the ASCII character combined with the ALT key modifier is used. For example, to transmit the ASCII character '?' (063 decimal), keypad '0' is sent combined with left ALT key modifier, next keypad '6' is sent combined with the left ALT key modifier, last keypad '3' is sent combined with the left ALT key modifier. In general, if this device only needs to emulate United States keyboards then this property should be set to 0 (keymap).
If this device needs to be able to emulate all countries' keyboards then this property should be set to 1 (ALT ASCII code). The tradeoff is that the ALT ASCII code mode is slightly slower than keymap mode because more key presses need to be transmitted. Some applications are not compatible with ALT ASCII code mode.

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 **ASCII To Keypress Conversion Type** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	0F	00

Example Set **ASCII To Keypress Conversion Type** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **ASCII To Keypress Conversion Type** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	0F

Example Get **ASCII To Keypress Conversion Type** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	00

ACTIVE KEYMAP PROPERTY

Property ID: 17 (0x11)
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 0 (United States)
Description: The value is a byte that represents the device's active key map. The value can be set to 0 for the United States key map or to 1 for the custom key map. The active key map will be used by the device to convert ASCII data into key strokes. The United States key map should be used with all hosts that are configured to use United States keyboards. The custom key map can be used to set up the device to work with hosts that are configured to use other countries' keyboards. The default custom key map is the same as the United States key map. The key map can be modified to another country's key map by using commands "Get Key Map", "Set Key Map" and "Save Custom Key Map". See the command section of this manual for a complete description of these commands. To set up a device to use a custom key map, select the appropriate key map to be modified using the active key map property, reset the device to make this change take effect, use the "Get Key Map" and "Set Key Map" commands to modify the active key map, use the "Save Custom Key Map" command to save the active key map as the custom key map, set the active key map property to custom to use the custom key map, reset the device to make these changes take effect.

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 **Active Keymap** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	11	00

Example Set **Active Keymap** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Active Keymap** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	11

Example Get **Active Keymap** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	00

CONVERT FROM CHAR A PROPERTY

Property ID: 26 (0x1A)
 Property Type: Byte
 Length: 1 byte
 Get Property: Yes
 Set Property: Yes
 Default Value: 255 (0xFF) (None)
 Description: The value is a byte that represents the ASCII value of a character transmitted by the device as keystroke data that is to be changed into a string of ASCII values prior to being transmitted by the device as keystroke data. The string of ASCII values that this value will be changed into is contained in the **Convert To String A** property. If the value of this property is set to 0xFF, no characters will be changed into the string. For example, if you would like a carriage return to be sent as an end of text character you could set the **Convert From Char A** property to 0x0D (carriage return) and set the **Convert To String A** property to 0x03 (end of text). If you would like a carriage return to be sent as two carriage returns you could set the **Convert From Char A** property to 0x0D (carriage return) and set the **Convert To String A** property to 0x0D 0x0D (carriage return, carriage return). If you would like a carriage return not to be sent you could set the **Convert From Char A** property to 0x0D (carriage return) and set the **Convert To String A** property to no string.

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 **Convert From Char A** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	1A	FF

Example Set **Convert From Char A** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Convert From Char A** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1A

Example **Convert From Char A** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	FF

CONVERT TO STRING A PROPERTY

Property ID: 27 (0x1B)
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 device's **Convert To String A** property. This string can be 0 – 7 bytes long. This string is sent in place of the character specified in the **Convert From Char A** property. See the **Convert From Char A** property for more information and examples.

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 **Convert To String A** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	03	1B	0D 0D

Example Set **Convert To String A** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Convert To String A** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1B

Example Get **Convert To String A** property Response (Hex):

Result Code	Data Len	Prp Value
00	02	0D 0D

CONVERT FROM CHAR B PROPERTY

Property ID: 28 (0x1C)
Property Type: Byte
Length: 1 byte
Get Property: Yes
Set Property: Yes
Default Value: 255 (0xFF) (None)
Description: The value is a byte that represents the ASCII value of a character transmitted by the device as keystroke data that is to be changed into a string of ASCII values prior to being transmitted by the device as keystroke data. The string of ASCII values that this value will be changed into is contained in the **Convert To String B** property. If the value of this property is set to 0xFF, no characters will be changed into the string. For example, if you would like a

carriage return to be sent as an end of text character you could set the **Convert From Char B** property to 0x0D (carriage return) and set the **Convert To String B** property to 0x03 (end of text). If you would like a carriage return to be sent as two carriage returns you could set the **Convert From Char B** property to 0x0D (carriage return) and set the **Convert To String B** property to 0x0D 0x0D (carriage return, carriage return). If you would like a carriage return not to be sent you could set the **Convert From Char B** property to 0x0D (carriage return) and set the **Convert To String B** property to no string.

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 **Convert From Char B** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	02	1C	FF

Example Set **Convert From Char B** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Convert From Char B** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1C

Example **Convert From Char B** property Response (Hex):

Result Code	Data Len	Prp Value
00	01	FF

CONVERT TO STRING B PROPERTY

Property ID: 29 (0x1D)
 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 device's **Convert To String B** property. This string can be 0 – 7 bytes long. This string is sent in place of the character specified in the **Convert From Char B** property. See the **Convert From Char B** property for more information and examples.

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 **Convert To String B** property Request (Hex):

Cmd Num	Data Len	Prp ID	Prp Value
01	03	1D	0D 0D

Example Set **Convert To String B** property Response (Hex):

Result Code	Data Len	Data
00	00	

Example Get **Convert To String B** property Request (Hex):

Cmd Num	Data Len	Prp ID
00	01	1D

Example Get **Convert To String B** property Response (Hex):

Result Code	Data Len	Prp Value
00	02	0D 0D

RESET DEVICE COMMAND

Command number: 2

Description: This command is used to reset the device's USB CPU. This command can be used to make previously changed properties take effect without having to unplug and then plug in the device. When the device resets it automatically does a USB detach followed by an attach. After the host sends this command to the device it should close the USB port, wait a few seconds for the operating system to handle the device detach followed by the attach and then re-open the USB port before trying to communicate further with the device.

Data structure: No data is sent with this command

Result codes: 0 (success)

Example Request (Hex):

Cmd Num	Data Len	Data
02	00	

Example Response (Hex):

Result Code	Data Len	Data
00	00	

GET KEYMAP ITEM COMMAND

Command number: 3

Description: This command is used to get a key map item from the active key map. The active key map is determined by the active key map property. Data from a card or check is a sequence of ASCII characters. These ASCII characters are mapped to key strokes and these key strokes are sent to the host to represent the ASCII character. The key map maps a single ASCII character to a single USB key usage ID and USB key modifier byte. The key usage ID and the key modifier byte are transmitted to the host via USB to represent the ASCII character. The ASCII value is the value of the ASCII character to be transmitted to the host. See the ASCII table in Appendix D for the values of the ASCII character set. The USB key usage ID is a unique value assigned to every keyboard key. For a list of all key usage IDs see Appendix E. The key modifier byte modifies the meaning of the key usage ID. The modifier byte indicates if any combination of the right or left Ctrl, Shift, Alt or GUI keys are pressed at the same time as the key usage ID. For a list and description of the key modifier byte see Appendix F.

When both the key usage ID and the key modifier byte are set to 0xFF for a given ASCII value, the ALT ASCII code is sent instead of the key map values. The ALT ASCII code is a key press combination consisting of the decimal value of the ASCII character combined with the ALT key modifier. For example, to transmit the ASCII character '?' (063 decimal), keypad '0' is sent combined with left ALT key modifier, next keypad '6' is sent combined with the left ALT key modifier, last keypad '3' is sent combined with the left ALT key modifier.

Data structure:

Request Data:

Offset	Field Name	Description
0	ASCII value	Value of the ASCII character to be retrieved from the key map. This can be any value between 0 and 127 (0x7F). For example, to retrieve the key map item for ASCII character '?' (card data end sentinel) use the ASCII value of '?' which is 63 (0x3F).

Response Data:

Offset	Field Name	Description
0	Key Usage ID	The value of the USB key usage ID that is mapped to the given ASCII value. For example, for the United States keyboard map, usage ID 56 (0x38) (keyboard / and ?) is mapped to ASCII character '?'.
1	Key Modifier Byte	The value of the USB key modifier byte that is mapped to the given ASCII value. For example, for the United States keyboard map, modifier byte 0x02 (left shift key) is mapped to ASCII character '?'.

Result codes: 0 (success)

Example Request (Hex):

Cmd Num	Data Len	Data
03	01	3F

Example Response (Hex):

Result Code	Data Len	Data
00	02	38 02

SET KEYMAP ITEM COMMAND

Command number: 4

Description: This command is used to set a key map item of the active key map. The active key map is determined by the active key map property. Data from a card or check is a sequence of ASCII characters. These ASCII characters are mapped to key strokes and these key strokes are sent to the host to represent the ASCII character. The key map maps a single ASCII character to a single USB key usage ID and USB key modifier byte. The key usage ID and the key modifier byte are transmitted to the host via USB to represent the ASCII character. The ASCII value is the value of the ASCII character to be transmitted to the host. See an ASCII table for the values of the ASCII character set. The USB key usage ID is a unique value assigned to every keyboard key. For a list of all key usage IDs see Appendix E. The key modifier byte modifies the meaning of the key usage ID. The modifier byte indicates if any combination of the right or left Ctrl, Shift, Alt or GUI keys are pressed at the same time as the key usage ID. For a list and description of the key modifier byte see Appendix F. Once a key map item is modified, the changes take effect immediately. However, the changes will be lost if the device is reset or power cycled. To make the changes permanent, the save custom key map command must be issued. To use the new custom key map after a reset or power cycle, the active key map property must be set to custom.

When both the key usage ID and the key modifier byte are set to 0xFF for a given ASCII value, the ALT ASCII code is sent instead of the key map values. The ALT ASCII code is a key press combination consisting of the decimal value of the ASCII character combined with the ALT key modifier. For example, to transmit the ASCII character '?' (063 decimal), keypad '0' is sent combined with left ALT key modifier, next keypad '6' is sent combined with the left ALT key modifier, and finally keypad '3' is sent combined with the left ALT key modifier.

Data structure:

Request Data:

Offset	Field Name	Description
0	ASCII value	Value of the ASCII character to be set in the key map. This can be any value between 0 and 127 (0x7F). For example, to set the key map item for ASCII character '?' (card data end sentinel) use the ASCII value of '?' which is 63 (0x3F).
1	Key Usage ID	The value of the USB key usage ID that is to be mapped to the given ASCII value. For example, for the United States keyboard map, usage ID 56 (0x38) (keyboard / and ?) is mapped to ASCII character '?'. To change this to the ASCII character '>' use usage ID 55 (0x37) (keyboard . and >).
2	Key Modifier Byte	The value of the USB key modifier byte that is to be mapped to the given ASCII value. For example, for the United States keyboard map, modifier byte 0x02 (left shift key) is mapped to ASCII character '?'. To change this to the ASCII character '>' use modifier byte 0x02 (left shift key).

Response Data: None

Result codes: 0 (success)

The following example maps the card ASCII data end sentinel character '?' to the '>' keyboard key.

Example Request (Hex):

Cmd Num	Data Len	Data
04	03	3F 37 02

Example Response (Hex):

Result Code	Data Len	Data
00	00	

SAVE CUSTOM KEYMAP COMMAND

Command number: 5

Description: This command is used to save the active key map as the custom key map in non volatile memory. The active key map is determined by the active key map property. Once a key map item is modified, the changes take effect immediately. However, the changes will be lost if the device is reset or power cycled. To make the changes permanent, the save custom key map command must be issued. To use the new custom key map after a reset or power cycle, the active key map property must be set to custom.

Data structure:

Request Data: None

Response Data: None

Result codes: 0 (success)

Example Request (Hex):

Cmd Num	Data Len	Data
05	00	

Example Response (Hex):

Result Code	Data Len	Data
00	00	

SEND LEGACY COMMAND COMMAND

Command number: 7

Description: This command is used to send legacy commands to the device over the USB. The device will send up to two responses to this command. The first response is the standard response to a USB command. This response indicates to the host that the USB command was received successfully. If the legacy command is expected to send a response, then this second response will be returned to the host as keystrokes. See the legacy command section for all of the legacy commands.

Data structure:

Request Data: Legacy command to be sent including carriage return if any. The legacy command must be converted from ASCII to binary data prior to sending it. For example, the command SWB<CR> must be sent as 53 57 42 0D (hex). The legacy command can be sent one character at a time or all at once up to the maximum size allowed by a set feature report (22 bytes). For example, the command SWB<CR> can also be sent by issuing the **Send Legacy Command** 4 times, once for each of the four characters. In this case, the response to the legacy command will not be sent by the device until after the <CR> is sent.

Response Data: None

Result codes: 0 (success)

Example Request (Hex):

Cmd Num	Data Len	Data (SWB<CR>)
07	04	53 57 42 0D

Example Response (Hex):

Result Code	Data Len	Data
00	00	

Example Legacy Command Response (send as keystrokes):

SWB=00000000<CR>

SECTION 6. ENCRYPTION

The UART/RS-232 MagneSafe IntelliHead™ Reader is a compact 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. The MagnePrint data will be included with the track data on each transaction. In order to maximize card security, this reader can incorporate data encryption to protect the card contents and the MagnePrint information. The serial output will be encrypted before it leaves the encapsulated head.

A separate LED (Light Emitting Diode) indicator provides the operator with continuous status of the operation of each Reader (MICR and MSR) module incorporated into the MICRSafe device.

When a card is swiped through the Reader, the track data and MagnePrint information may, depending on how the MICRSafe is configured, 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. The MICRSafe can be similarly configured to encrypt MICR data from scanned checks. More detailed information about the encryption methods used by this device can be found in the MagneSafe MSR Technical Manual, P/N 99875433. If the encryption feature is not set, then the MICRSafe will output data in SureSwipe format. See P/N 99875206 for more information about this non-encrypted output format.

APPENDIX A. FORMAT LIST

For check reading, the MICRSafe provides the flexibility to format the MICR fields and build a specific output string that will be transmitted to the Host. These output strings are referred to as formats. The Reader has a built-in list of formats (described below) from which the user may select one to become the active format every time a check is read. The formats may be selected using the FC command (Section 4, Legacy Commands) or Insta-Change checks provided by MagTek.

Each format is assigned a 4-digit number which indicates the format number. ***Note***
The formats listed in this section apply only to U.S. and Canadian checks. The MICR line on checks from other countries will not be broken or parsed as described in these formats.

A complete description for each format follows.

Fmt 00xx: Raw Data Format - sends the entire MICR line - where:

xx	Transit	On-Us	Amount	Dash	Error
00	T	U	\$	-	?
01	t	o	a	d	?
02	T	O	A	D	?

Fmt 0800: [transit] [acct #]

- [transit]: - all characters in the field
- keep dashes
- [acct #]: - all characters are sent
- remove spaces and dashes

Fmt 1100: [transit] 'T' [acct #] 'A' [check #]

- [transit]: - all characters in the field
- keep dashes
- [acct #]: - all characters are sent
- remove spaces and dashes
- [check #]: - all characters in the field

Fmt 1200: [transit] 'T' [acct #] 'A' [check #]

- [transit]: - all characters in the field
- keep dashes
- [acct #]: - all characters are sent
- remove spaces and dashes
- [check #]: - always 6 characters, zero filled

Fmt 2400: [transit] 'T' [acct #] 'A' [check #] 'C' [amount] '\$'

- [transit]: - all characters in the field
- keep dashes
- [acct #]: - all characters are sent
- remove spaces and dashes
- [check #]: - always 6 characters, zero filled
- [amount]: - all characters in the field

Fmt 3100: [transit] '/' [acct #] '/' [check #]

- [transit]: - all characters in the field
- remove dashes
- [acct #]: - all characters are sent
- remove spaces and dashes
- [check #]: - maximum of 10 digits
- remove spaces and dashes
- if no check number, remove preceding slash ('/')

Fmt 3800: 'T' [transit] 'A' [acct #] 'C' [check #]

- [transit]: - all characters in the field
- keep dashes
- [acct #]: - all characters are sent
- include leading characters

- keep spaces and dashes

- [check #]: -all characters in the field

Fmt 4500: [transit] <CR> [acct #] <CR> [check #]

- [transit]: - all characters in the field
- remove dashes
- [acct #]: - all characters are sent
- remove spaces, dashes and leading zeros
- [check #]: - all characters in the field

Fmt 6500: '!' [transit] '/' [acct #] '/' [check #] '/' [amount]

- [transit]: - all characters in the field
- remove dashes
- [acct #]: - all characters are sent
- remove spaces and dashes
- [check #]: - all characters in the field
- remove dashes and spaces
- [amount]: - all characters in the field
- remove dashes and spaces

Fmt 7600: 'T' [transit] 'A' [acct #] 'C' [check #] 'M' [raw data]

- [transit]: - all characters in the field
- remove dashes and spaces
- [acct #]: - all characters are sent
- remove dashes and spaces
- [check #]: - all characters in the field- remove dashes and spaces
- [raw data]: - translate MICR symbols to t,o,a,d

Fmt 7700: The Flexible Format















Select this format to activate a preloaded Flexible Format. The Flexible Format is a feature that allows the user to create custom MICR formats. The Flexible formats can be easily created and downloaded using the Windows based MICRbase program provided by MagTek (P/N 22000021). For more detailed information refer to Section 7 in the MICRbase reference manual (P/N 99875102).

APPENDIX B. CHECK READING

The characters printed on the bottom line of commercial and personal checks are special. They are printed with magnetic ink to meet specific standards. These characters can be read by a MICR Safe at higher speeds and with more accuracy than manual data entry. Two MICR character sets are used worldwide; they are: E13-B and CMC-7. The E13-B set is used in the US, Canada, Australia, United Kingdom, Japan, India, Mexico, Venezuela, Colombia, and the Far East. The CMC-7 set is used in France, Spain, other Mediterranean countries, and most South American countries.

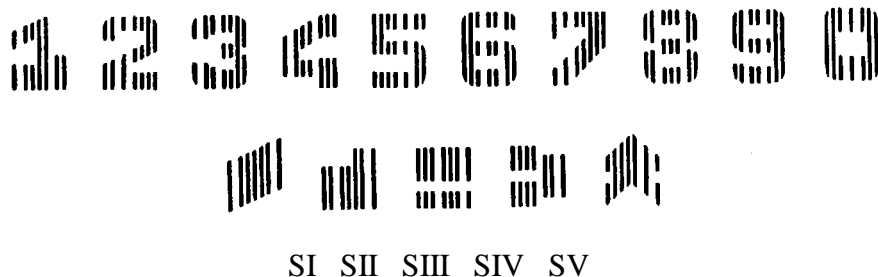
E13-B CHARACTER SET

The MICR font character set E13-B includes digits 0 through 9 and four symbols. The numbers found on U.S. checks are of the E13-B character set. The numbers and symbols of E13-B are as follows:

		
		 Transit symbol
		 Dash Symbol
		 On-Us Symbol
		 Amount Symbol

CMC-7 CHARACTER SET

The numbers and symbols of the CMC-7 character set are as follows:



The nonnumeric CMC-7 characters are translated by the MICRSafe as shown in Table B-1.

Table B-1. CMC-7 Nonnumeric Characters

CMC-7 Character	MICRSafe Output
SI	A
SII	B
SIII	C
SIV	D
SV	E

CHECK LAYOUTS

Personal checks with MICR fields are shown in Figure B-1. Business checks are shown in Figure B-2. The digits 1 through 4 in the illustrations are described below under MICR Fields.

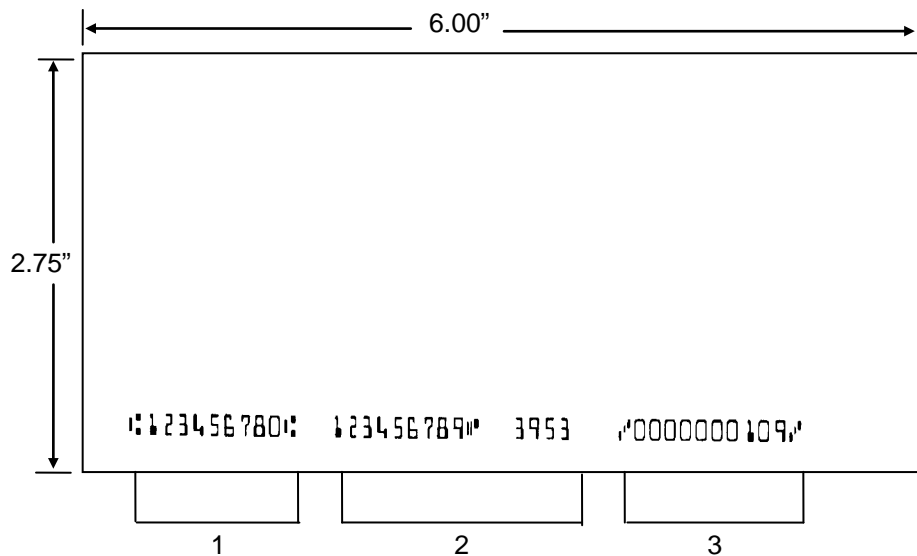


Figure B-1. Personal Checks

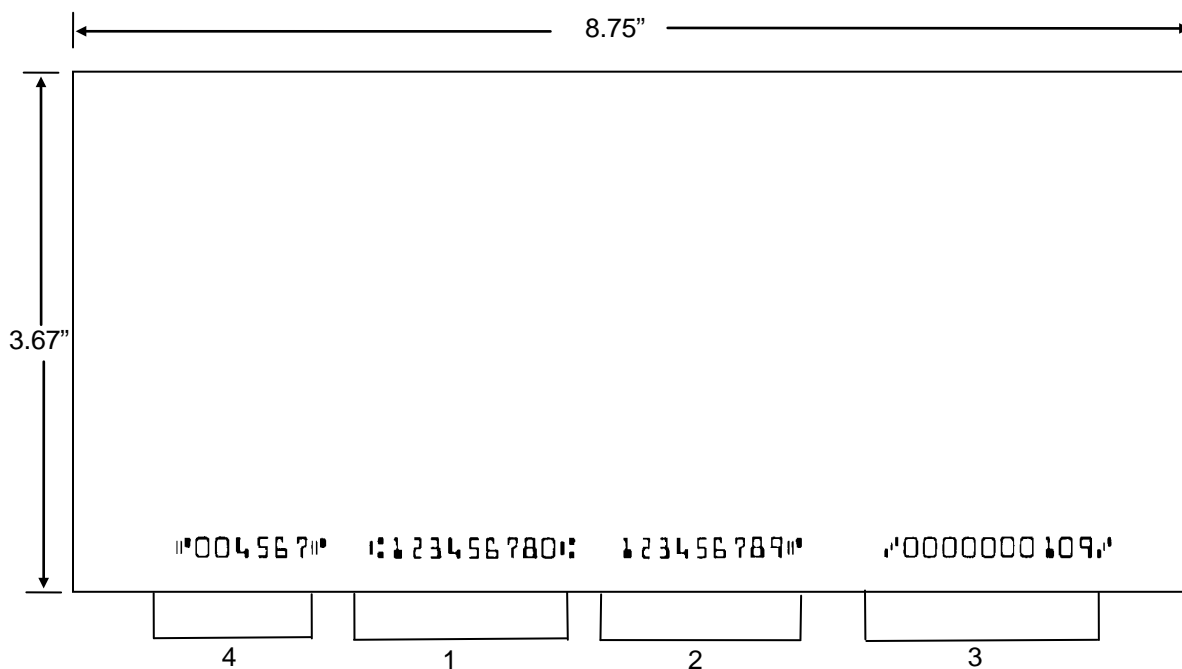


Figure B-2. Business Checks

MICR FIELDS

The numbers 1 through 4 refer to the numbers below the checks on the illustration and represent the 4 MICR fields.

1-Transit Field

The Transit field is a 9-digit field bracketed by two Transit symbols. The field is subdivided as follows:

- Digits 1-4 Federal Reserve Routing Number
- Digits 5-8 Bank ID Number (American Banking Association)
- Digit 9 Check Digit

2-On-Us Field

The On-Us field is variable, up to 19 characters (including symbols). Valid characters are digits, spaces, dashes, and On-Us symbols. The On-Us field contains the account number and may also contain a serial number (Check number) and/or a transaction code. Note that an On-Us symbol must always appear to the right of the account number.

3-Amount Field

The Amount field is a 10-digit field bracketed by Amount symbols. The field is always zero-filled to the left.

4-Auxiliary On-Us Field

The Auxiliary On-Us field is variable, 4-10 digits, bracketed by two On-Us symbols. This field is not present on personal checks. On business checks, this field contains the check serial number.

APPENDIX C. TROUBLESHOOTING GUIDE

REQUIREMENTS

- Personal Computer.
- USB Cable, P/N 22553301
- DC adapter, P/N 64300118 (64300121 for international customers).
- MICRbase setup program, P/N 22000021.
- Sample checks, P/N 96530005.
- A small bottle of compressed air.
- A cleaning card, P/N 96700006.

SET-UP

- Plug the USB Cable, P/N 22553301, into the MICR Safe and the host computer.
- Power on the MICR Reader.
- Run the MICRbase program on the PC.
- Start trouble-shooting procedure at Step 00.

00	CHECK LED
-----------	------------------

Check the status of the LED indicator:

- ◇ off, continue to step 01.
- ◇ green, continue to step 02.
- ◇ blinking red, continue to step 11.
- ◇ blinking red/green, continue to 12.
- ◇ red or orange, continue to step 18.

01	CHECK THE POWER TO THE MICRSafe
-----------	--

Possible causes for this problem are:

- DC adapter connection to outlet - make sure the DC adapter is securely connected to outlet on the wall or power strip.
- DC adapter connection to MICRSafe - make sure the DC adapter is securely connected to the power jack on the MICRSafe.
- Power strip - if using a power strip, make sure the strip is connected to outlet on the wall and the switch on the strip is turned on.
- DC adapter is defective - replace the DC adapter.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 00.
- ◇ If no, continue to step 18.

02	READ A CHECK
-----------	---------------------

Read a check through the MICRSafe:

- ◇ If the check is transported all the way around the check path, continue to step 03.
- ◇ If the check gets "stuck" in the check path, continue to step 10.
- ◇ If the motor does not turn on, continue to step 18.

03	DID PC RECEIVE DATA?
-----------	-----------------------------

After the check is read, did the PC receive any data?

- ◇ If yes, continue to step 04.
- ◇ If no, continue to step 05.

04	ANALYZE DATA
-----------	---------------------

Analyze the data received by the PC:

- ◇ If the data is good, continue to step 16.
- ◇ If the data contains one or more '?', continue to step 06.
- ◇ If the data is missing characters, continue to step 07.
- ◇ If the data is garbled, continue to step 08.
- ◇ If the data is good but not what is expected, continue to step 09.

05	VERIFY PARAMETERS
-----------	--------------------------

Use the “Configure” option within MICRbase to verify the following parameters:

- "Send Data After Error" - if this option is set to NO, the MICRSafe will not send any data after a read error. Use MICRbase to change this option to YES.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 14.

06	READ ERROR
-----------	-------------------

Possible causes for this problem are:

- Interference - the MICRSafe may be too close to a monitor, DC adapter or magnetic device. Move the MICRSafe away from the source of interference.
- Printing problem - the check being read may not meet the requirements of the ANSI Standards. Use one of the sample checks provided by MagTek.
- Feeding the check - do not hold on to the check as it goes around the path. Release the check immediately after the MICRSafe "grabs" it. Also, make sure that the front end is not tilted up while the check is being read.
- Foreign debris – power off the MICRSafe and try to push out any loose debris on the check path. Grab a cleaning card and force it through the check path (this is a manual process, the motor will not turn on). Try this procedure several times until the debris comes out. Power on the MICRSafe again.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 14.

07	MISSING CHARACTERS
-----------	---------------------------

Possible causes for this problem are:

- Feeding the check - When feeding the check, make sure that the MICR line is at the bottom and the printed side of the check is facing the MagTek logo on the MICR Reader.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 08.

08	INCORRECT FORMAT
-----------	-------------------------

Possible causes for this problem are:

- Incorrect Format Number - the current Check data format in the MICRSafe is not the desired format. Use the “Configure” option within MICRbase to verify/change the format.
- Incorrect Message Format - the current Message format in the MICRSafe is not the desired format. Use the “Configure” option within MICRbase to verify/change the Message format.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 18.

09	PATH IS OBSTRUCTED
-----------	---------------------------

Foreign debris is obstructing the check path:

- Loose debris - power off the MICRSafe and try to push out any loose debris on the check path. Grab a cleaning card and force it through the check path (this is a manual process, the motor will not turn on). Try this procedure several times until the debris comes out. Power on the MICR Reader.
- Wedged debris - the debris is wedged in and cannot be removed with the procedure described above.

Is the foreign debris removable?

- ◇ If yes, remove and continue to step 02.
- ◇ If no, continue to step 18.

10	MOTOR SENSOR IS BLOCKED
-----------	--------------------------------

The Motor sensor may be blocked by dust build-up or foreign debris (see Figure C-1). Use forced air to clean the sensor.

Power off the MICRSafe and then power on again; then observe the LED indicator:

- ◇ If the LED indicator blinks red, continue to step 18.
- ◇ Any other LED indicator status, continue to step 00.

11	EMF NOISE/INTERFERENCE
-----------	-------------------------------

When idle, if EMF detect is set to YES (see HW Command, Section 4), the MICRSafe monitors the signal coming from the MICR head. If any signal (noise/interference) with an amplitude large enough to affect check reading is detected, the LED indicator blinks red/green. Possible sources of EMF are monitors, DC adapters, or magnetic devices. Set EMF to NO or move the MICRSafe at least 6 inches away from the source of noise/interference.

Determine if the condition described above is true:

- ◇ If yes, rectify and continue to step 00.
- ◇ If no, continue to step 13.

12	DATA SENSOR IS BLOCKED
-----------	-------------------------------

The data sensor may be blocked (see Figure C-1). Try one or both of the following procedures:

- Forced air - use forced air to clean the sensor.
- Cleaning card - power off the MICRSafe and try to push out any loose debris in the check path. Grab a cleaning card and force it through the check path (this is a manual process, the motor will not turn on). Try this procedure several times until the debris comes out.

Power off the MICRSafe, then power on again and observe the LED indicator:

- ◇ If the LED indicator blinks red/green, continue to step 18.
- ◇ Any other LED indicator status, continue to step 00.

13	NO MICR DATA DETECTED
-----------	------------------------------

Possible causes for this problem are:

- No MICR characters - the ink used to print the MICR characters does not have magnetic properties. Try one of the sample checks provided by MagTek.
- Feeding the check - when feeding the check, make sure that the MICR line is at the bottom and the printed side of the check is facing the MagTek logo on the MICR Reader.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 15.

14	CABLE PROBLEM
-----------	----------------------

Possible causes for this problem are:

- Loose connection - the cable connector on the PC or the MICRSafe may be loose. Make sure that both connectors are tightly connected.
- Damaged cable - the connectors, pins or wires in the cable may be damaged. Replace cable.

Determine if any of the conditions described above are true:

- ◇ If yes, rectify and continue to step 02.
- ◇ If no, continue to step 18.

15	NO PROBLEM FOUND
-----------	-------------------------

The MICRSafe is operating properly. If you have additional concerns or requirements please contact your MagTek representative.

16	READ INSTA-CHANGE CHECK
-----------	--------------------------------

Read Insta-Change check with the appropriate settings. Return to step 00. If condition persists, continue to step 18.

17 RETURN MICRSafe FOR SERVICE

The MICRSafe has a problem that needs further analysis, testing, and possibly repair. Please contact your supplier or MagTek Support Services at (651) 415-6800, for additional troubleshooting and (if necessary) repair. Please have the device available and ready prior to contacting your supplier or MagTek.

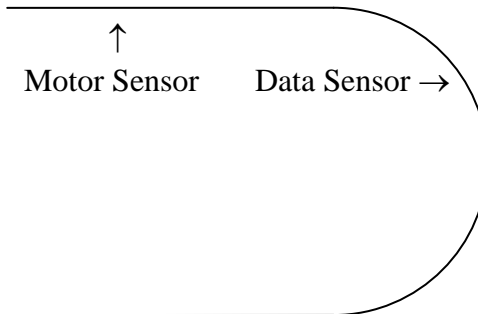


Figure C-1. Sensor Location

APPENDIX D. ASCII CODES

The following is a listing of the ASCII (American Standard Code for Information Interchange) codes. ASCII is a 7-bit code which is represented here by a pair of hexadecimal digits.

ASCII	Hex	Dec	ASCII	Hex	Dec	ASCII	Hex	Dec	ASCII	Hex	Dec
NUL	00	0	SP	20	32	@	40	64	`	60	96
SOH	01	1	!	21	33	A	41	65	a	61	97
STX	02	2	"	22	34	B	42	66	b	62	98
ETX	03	3	#	23	35	C	43	67	c	63	99
EOT	04	4	\$	24	36	D	44	68	d	64	100
ENQ	05	5	%	25	37	E	45	69	e	65	101
ACK	06	6	&	26	38	F	46	70	f	66	102
BEL	07	7	'	27	39	G	47	71	g	67	103
BS	08	8	(28	40	H	48	72	h	68	104
HT	09	9)	29	41	I	49	73	i	69	105
LF	0A	10	*	2A	42	J	4A	74	j	6A	106
VT	0B	11	+	2B	43	K	4B	75	k	6B	107
FF	0C	12	,	2C	44	L	4C	76	l	6C	108
CR	0D	13	-	2D	45	M	4D	77	m	6D	109
SO	0E	14	.	2E	46	N	4E	78	n	6E	110
SI	0F	15	/	2F	47	O	4F	79	o	6F	111
DLE	10	16	0	30	48	P	50	80	p	70	112
DC1	11	17	1	31	49	Q	51	81	q	71	113
DC2	12	18	2	32	50	R	52	82	r	72	114
DC3	13	19	3	33	51	S	53	83	s	73	115
DC4	14	20	4	34	52	T	54	84	t	74	116
NAK	15	21	5	35	53	U	55	85	u	75	117
SYN	16	22	6	36	54	V	56	86	v	76	118
ETB	17	23	7	37	55	W	57	87	w	77	119
CAN	18	24	8	38	56	X	58	88	x	78	120
EM	19	25	9	39	57	Y	59	89	y	79	121
SUB	1A	26	:	3A	58	Z	5A	90	z	7A	122
ESC	1B	27	;	3B	59	[5B	91	{	7B	123
FS	1C	28	<	3C	60	\	5C	92		7C	124
GS	1D	29	=	3D	61]	5D	93	}	7D	125
RS	1E	30	>	3E	62	^	5E	94	~	7E	126
US	1F	31	?	3F	63	_	5F	95	DEL	7F	127

APPENDIX E. USAGE ID DEFINITIONS

This appendix is from the following document found on www.usb.org: Universal Serial Bus HID Usage Tables, Version 1.12 and specifically for this manual, Section 10, Keyboard/Keypad Page (0x07).

KEYBOARD/KEYPAD PAGE (0X07)

This section is the Usage Page for key codes to be used in implementing a USB keyboard. A Boot Keyboard (84-, 101- or 104-key) should at a minimum support all associated usage codes as indicated in the “Boot” column below.

The usage type of all key codes is Selectors (Sel), except for the modifier keys Keyboard Left Control (0x224) to Keyboard Right GUI (0x231) which are Dynamic Flags (DV).

Note

A general note on Usages and languages: Due to the variation of keyboards from language to language, it is not feasible to specify exact key mappings for every language. Where this list is not specific for a key function in a language, the closest equivalent key position should be used, so that a keyboard may be modified for a different language by simply printing different keycaps. One example is the Y key on a North American keyboard. In Germany this is typically Z. Rather than changing the keyboard firmware to put the Z Usage into that place in the descriptor list, the vendor should use the Y Usage on both the North American and German keyboards. This continues to be the existing practice in the industry, in order to minimize the number of changes to the electronics to accommodate other languages.

Table E-1. Keyboard/Keypad

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
0	00	Reserved (no event indicated) ⁹	N/A	√	√	√	4/101/104
1	01	Keyboard ErrorRollOver ⁹	N/A	√	√	√	4/101/104
2	02	Keyboard POSTFail ⁹	N/A	√	√	√	4/101/104
3	03	Keyboard ErrorUndefined ⁹	N/A	√	√	√	4/101/104
4	04	Keyboard a and A ⁴	31	√	√	√	4/101/104
5	05	Keyboard b and B	50	√	√	√	4/101/104
6	06	Keyboard c and C ⁴	48	√	√	√	4/101/104
7	07	Keyboard d and D	33	√	√	√	4/101/104
8	08	Keyboard e and E	19	√	√	√	4/101/104
9	09	Keyboard f and F	34	√	√	√	4/101/104
10	0A	Keyboard g and G	35	√	√	√	4/101/104
11	0B	Keyboard h and H	36	√	√	√	4/101/104
12	0C	Keyboard i and I	24	√	√	√	4/101/104

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
13	0D	Keyboard j and J	37	✓	✓	✓	4/101/104
14	0E	Keyboard k and K	38	✓	✓	✓	4/101/104
15	0F	Keyboard l and L	39	✓	✓	✓	4/101/104
16	10	Keyboard m and M	52	✓	✓	✓	4/101/104
17	11	Keyboard n and N	51	✓	✓	✓	4/101/104
18	12	Keyboard o and O ⁴	25	✓	✓	✓	4/101/104
19	13	Keyboard p and P ⁴	26	✓	✓	✓	4/101/104
20	14	Keyboard q and Q ⁴	27	✓	✓	✓	4/101/104
21	15	Keyboard r and R	20	✓	✓	✓	4/101/104
22	16	Keyboard s and S ⁴	32	✓	✓	✓	4/101/104
23	17	Keyboard t and T	21	✓	✓	✓	4/101/104
24	18	Keyboard u and U	23	✓	✓	✓	4/101/104
25	19	Keyboard v and V	49	✓	✓	✓	4/101/104
26	1A	Keyboard w and W ⁴	18	✓	✓	✓	4/101/104
27	1B	Keyboard x and X ⁴	47	✓	✓	✓	4/101/104
28	1C	Keyboard y and Y ⁴	22	✓	✓	✓	4/101/104
29	1D	Keyboard z and Z ⁴	46	✓	✓	✓	4/101/104
30	1E	Keyboard 1 and ! ⁴	2	✓	✓	✓	4/101/104
31	1F	Keyboard 2 and ! ⁴	3	✓	✓	✓	4/101/104
32	20	Keyboard 3 and # ⁴	4	✓	✓	✓	4/101/104
33	21	Keyboard 4 and \$ ⁴	5	✓	✓	✓	4/101/104
34	22	Keyboard 5 and % ⁴	6	✓	✓	✓	4/101/104
35	23	Keyboard 6 and ^ ⁴	7	✓	✓	✓	4/101/104
36	24	Keyboard 7 and & ⁴	8	✓	✓	✓	4/101/104
37	25	Keyboard 8 and * ⁴	9	✓	✓	✓	4/101/104
38	26	Keyboard 9 and (⁴	10	✓	✓	✓	4/101/104
39	27	Keyboard 0 and) ⁴	11	✓	✓	✓	4/101/104
40	28	Keyboard Return (ENTER) ⁵	43	✓	✓	✓	4/101/104
41	29	Keyboard ESCAPE	110	✓	✓	✓	4/101/104
42	2A	Keyboard DELETE (Backspace)	15	✓	✓	✓	4/101/104
43	2B	Keyboard Tab	16	✓	✓	✓	4/101/104
44	2C	Keyboard Spacebar	61	✓	✓	✓	4/101/104
45	2D	Keyboard - and (underscore) ⁴	12	✓	✓	✓	4/101/104
46	2E	Keyboard = and + ⁴	13	✓	✓	✓	4/101/104
47	2F	Keyboard [and { ⁴	27	✓	✓	✓	4/101/104
48	30	Keyboard] and } ⁴	28	✓	✓	✓	4/101/104
49	31	Keyboard \ and	29	✓	✓	✓	4/101/104
50	32	Keyboard Non-US # and ~ ²	42	✓	✓	✓	4/101/104
51	33	Keyboard ; and : ⁴	40	✓	✓	✓	4/101/104
52	34	Keyboard ' and " ⁴	41	✓	✓	✓	4/101/104

Appendix E. Usage ID Definitions

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
53	35	Keyboard Grave Accent and Tilde ⁴	1	√	√	√	4/101/104
54	36	Keyboard , and < ⁴	53	√	√	√	4/101/104
55	37	Keyboard . and > ⁴	54	√	√	√	4/101/104
56	38	Keyboard / and ?	55	√	√	√	4/101/104
57	39	Keyboard Caps Lock ¹¹	30	√	√	√	4/101/104
58	3A	Keyboard F1	112	√	√	√	4/101/104
59	3B	Keyboard F2	113	√	√	√	4/101/104
60	3C	Keyboard F3	114	√	√	√	4/101/104
61	3D	Keyboard F4	115	√	√	√	4/101/104
62	3E	Keyboard F5	116	√	√	√	4/101/104
63	3F	Keyboard F6	117	√	√	√	4/101/104
64	40	Keyboard F7	118	√	√	√	4/101/104
65	41	Keyboard F8	119	√	√	√	4/101/104
66	42	Keyboard F9	120	√	√	√	4/101/104
67	43	Keyboard F10	121	√	√	√	4/101/104
68	44	Keyboard F11	122	√	√	√	101/104
69	45	Keyboard F12	123	√	√	√	101/104
70	46	Keyboard PrintScreen ¹	124	√	√	√	101/104
71	47	Keyboard Scroll Lock ¹¹	125	√	√	√	4/101/104
72	48	Keyboard Pause ¹	126	√	√	√	101/104
73	49	Keyboard Insert ¹	75	√	√	√	101/104
74	4A	Keyboard Home ¹	80	√	√	√	101/104
75	4B	Keyboard PageUp ¹	85	√	√	√	101/104
76	4C	Keyboard Delete Forward ^{1;14}	76	√	√	√	101/104
77	4D	Keyboard End ¹	81	√	√	√	101/104
78	4E	Keyboard PageDown ¹	86	√	√	√	101/104
79	4F	Keyboard RightArrow ¹	89	√	√	√	101/104
80	50	Keyboard LeftArrow ¹	79	√	√	√	101/104
81	51	Keyboard DownArrow ¹	84	√	√	√	101/104
82	52	Keyboard UpArrow ¹	83	√	√	√	101/104
83	53	Keypad Num Lock and Clear ¹	90	√	√	√	101/104
84	54	Keypad / ¹	95	√	√	√	101/104
85	55	Keypad *	100	√	√	√	4/101/104
86	56	Keypad -	105	√	√	√	4/101/104
87	57	Keypad +	106	√	√	√	4/101/104
88	58	Keypad ENTER5	108	√	√	√	101/104
89	59	Keypad 1 and End	93	√	√	√	4/101/104
90	5A	Keypad 2 and Down Arrow	98	√	√	√	4/101/104
91	5B	Keypad 3 and PageDn	103	√	√	√	4/101/104
92	5C	Keypad 4 and Left Arrow	92	√	√	√	4/101/104

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
93	5D	Keypad 4 and Left Arrow	97	√	√	√	4/101/104
94	5E	Keypad 4 and Left Arrow	102	√	√	√	4/101/104
95	5F	Keypad 7 and Home	91	√	√	√	4/101/104
96	60	Keypad 8 and Up Arrow	96	√	√	√	4/101/104
97	61	Keypad 9 and PageUp	101	√	√	√	4/101/104
98	62	Keypad 0 and Insert	99	√	√	√	4/101/104
99	63	Keypad . and Delete	104	√	√	√	4/101/104
100	64	Keyboard Non-US \ and ^{3,6}	45	√	√	√	4/101/104
101	65	Keyboard Application ¹⁰	129	√		√	104
102	66	Keyboard Power ⁹ =			√	√	
103	67	Keypad =			√		
104	68	Keyboard F13	62		√		
105	69	Keyboard F14	63		√		
106	6A	Keyboard F15	64		√		
107	6B	Keyboard F16	65				
107	6C	Keyboard F17					
109	6D	Keyboard F18					
110	6E	Keyboard F19					
111	6F	Keyboard F20					
112	70	Keyboard F21					
113	71	Keyboard F22					
114	72	Keyboard F23					
115	73	Keyboard F24					
116	74	Keyboard Execute				√	
117	75	Keyboard Help				√	
118	76	Keyboard Menu				√	
119	77	Keyboard Select				√	
120	78	Keyboard Stop				√	
121	79	Keyboard Again				√	
122	7A	Keyboard Undo				√	
123	7B	Keyboard Cut				√	
124	7C	Keyboard Copy				√	
125	7D	Keyboard Paste				√	
126	7E	Keyboard Find				√	
127	7F	Keyboard Mute				√	
128	80	Keyboard Volume Up				√	
129	81	Keyboard Volume Down				√	
130	82	Keyboard Locking Caps Lock ¹²				√	
131	83	Keyboard Locking Num Lock ¹²				√	
132	84	Keyboard Locking Scroll Lock ¹²				√	

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
133	85	Keypad Comma ²⁷	107				
134	86	Keypad Equal Sign ²⁹					
135	87	Keyboard International1 ¹⁵⁻²⁸	56				
136	88	Keyboard International2 ¹⁶					
137	89	Keyboard International3 ¹⁷					
138	8A	Keyboard International4 ¹⁸					
139	8B	Keyboard International5 ¹⁹					
140	8C	Keyboard International6 ²⁰					
141	8D	Keyboard International7 ²¹					
142	8E	Keyboard International8 ²²					
143	8F	Keyboard International9 ²²					
144	90	Keyboard Lang1 ²⁵					
145	91	Keyboard Lang2 ²⁶					
146	92	Keyboard Lang3 ³⁰					
147	93	Keyboard Lang4 ³¹					
148	94	Keyboard Lang5 ³²					
149	95	Keyboard Lang6 ⁸					
150	96	Keyboard Lang7 ⁸					
151	97	Keyboard Lang8 ⁸					
152	98	Keyboard Lang9 ⁸					
153	99	Keyboard Alternate Erase ⁷					
154	9A	Keyboard Sys/Req Attention ¹					
155	9B	Keyboard Cancel					
156	9C	Keyboard Clear					
157	9D	Keyboard Prior					
158	9E	Keyboard Return					
159	9F	Keyboard Separator					
160	A0	Keyboard Out					
161	A1	Keyboard Oper					
162	A2	Keyboard Clear/Again					
163	A3	Keyboard Cr/Sel/Props					
164	A4	Keyboard Ex Sel					
165-175	A5-CF	Reserved					
176	B0	Keypad 00					
177	B1	Keypad 000					
178	B2	Thousands Separator ³³					
179	B3	Decimal Separator ³³					
180	B4	Currency Unit ³⁴					
181	B5	Currency Sub-unit ³⁴					
182	B6	Keypad (

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
183	B7	Keypad)					
184	B8	Keypad {					
185	B9	Keypad}					
186	BA	Keypad Tab					
187	BB	Keypad Backspace					
188	BC	Keypad A					
189	BD	Keypad B					
190	BE	Keypad C					
191	BF	Keypad D					
192	C0	Keypad E					
193	C1	Keypad F					
194	C2	Keypad XOR					
195	C3	Keypad ^					
196	C4	Keypad %					
197	C5	Keypad <					
198	C6	Keypad >					
199	C7	Keypad &					
200	C8	Keypad &&					
201	C9	Keypad					
202	CA	Keypad					
203	CB	Keypad :					
204	CC	Keypad #					
205	CD	Keypad Space					
206	CE	Keypad @					
207	CF	Keypad !					
208	D0	Keypad Memory Store					
209	D1	Keypad Memory Recall					
210	D2	Keypad Memory Clear					
211	D3	Keypad Memory Add					
212	D4	Keypad Memory Subtract					
213	D5	Keypad Memory Multiple					
214	D6	Keypad Memory Divide					
215	D7	Keypad +/-					
216	D8	Keypad Clear					
217	D9	Keypad Clear Entry					
218	DA	Keypad Binary					
219	DB	Keypad Octal					
220	DC	Keypad Decimal					
221	DD	Keypad Hexadecimal					
222-223	DE-DF	Reserved					

Usage ID (Dec)	Usage ID (Hex)	Usage Name	Ref: Typical AT-101 Position	PC-AT	Mac	UNIX	Boot
224	E0	Keyboard LeftControl	58	✓	✓	✓	
225	E1	Keyboard LeftShift	44	✓	✓	✓	
226	E2	Keyboard LeftA;t	60	✓	✓	✓	
227	E3	Keyboard Left GUI ^{10;23}	127	✓	✓	✓	
228	E4	Keyboard RightControl	64	✓	✓	✓	
229	E5	Keyboard RightShift	57	✓	✓	✓	
230	E6	Keyboard RightAlt	62	✓	✓	✓	
231	E7	Keyboard Right GUI ^{10;24}	128	✓	✓	✓	
232 – 65535	E8-FFFF	Reserved					

Footnotes

- Usage of keys is not modified by the state of the Control, Alt, Shift or Num Lock keys. That is, a key does not send extra codes to compensate for the state of any Control, Alt, Shift or Num Lock keys.
- Typical language mappings: US: \ Belg: µ`£ FrCa: <> Dan: `* Dutch: <> Fren: *µ Ger: #` Ital: ù\$ LatAm: }` Nor: * Span: }Ç Swed: ,* Swiss: \$£ UK: #~.
- Typical language mappings: Belg:<> FrCa:<°> Dan:<> Dutch:]] Fren:<> Ger:<> Ital:<> LatAm:<> Nor:<> Span:<> Swed:<> Swiss:<> UK:\ Brazil: \.
- Typically remapped for other languages in the host system.
- Keyboard Enter and Keypad Enter generate different Usage codes.
- Typically near the Left-Shift key in AT-102 implementations.
- Example, Erase-Eaze™ key.
- Reserved for language-specific functions, such as Front End Processors and Input Method Editors.
- Reserved for typical keyboard status or keyboard errors. Sent as a member of the keyboard array. Not a physical key.
- Windows key for Windows 95, and "Compose."
- Implemented as a non-locking key; sent as member of an array.
- Implemented as a locking key; sent as a toggle button. Available for legacy support; however, most systems should use the non-locking version of this key.
- Backs up the cursor one position, deleting a character as it goes.
- Deletes one character without changing position.
- 15-20...See additional foot notes in Universal Serial Bus HID Usage Tables, Copyright © 1996-2005, USB Implementers Forum.
- Toggle Double-Byte/Single-Byte mode.
- Undefined, available for other Front End Language Processors.
- Windowing environment key, examples are Microsoft Left Win key, Mac Left Apple key, Sun Left Meta key
- Windowing environment key, examples are Microsoft® RIGHT WIN key, Macintosh® RIGHT APPLE key, Sun® RIGHT META key.
- Hangul/English toggle key. This usage is used as an input method editor control key on a Korean language keyboard.
- Hanja conversion key. This usage is used as an input method editor control key on a Korean language keyboard.
- Keypad Comma is the appropriate usage for the Brazilian keypad period (.) key. This represents the closest possible match, and system software should do the correct mapping based on the current locale setting.
- Keyboard International1 should be identified via footnote as the appropriate usage for the Brazilian forward-slash (/) and question-mark (?) key. This usage should also be renamed to either "Keyboard Non-US / and ?" or to "Keyboard International1" now that it's become clear that it does not only apply to Kanji keyboards anymore.
- Used on AS/400 keyboards.
- Defines the Katakana key for Japanese USB word-processing keyboards.
- Defines the Hiragana key for Japanese USB word-processing keyboards.
- Usage 0x94 (Keyboard LANG5) "Defines the Zenkaku/Hankaku key for Japanese USB word-processing keyboards.
- The symbol displayed will depend on the current locale settings of the operating system. For example, the US thousands separator would be a comma, and the decimal separator would be a period.
- The symbol displayed will depend on the current locale settings of the operating system. For example the US currency unit would be \$ and the sub-unit would be ¢.

APPENDIX F. MODIFIER BYTE DEFINITIONS

This appendix is from the following document found on www.usb.org: Device Class Definition for Human Interface Devices (HID) Version 1.11, and specifically for this manual, Section 8.3 Report Format for Array Items.

The modifier byte is defined as follows:

Table F-1. Modifier Byte

Bit	Key
0	LEFT CTRL
1	LEFT SHIFT
2	LEFT ALT
3	LEFT GUI
4	RIGHT CTRL
5	RIGHT SHIFT
6	RIGHT ALT
7	RIGHT GUI