ZBA, Inc.

ZBA Motorized Magnetic Stripe Encoder
Assembly No. ZBMM-0312-N/S
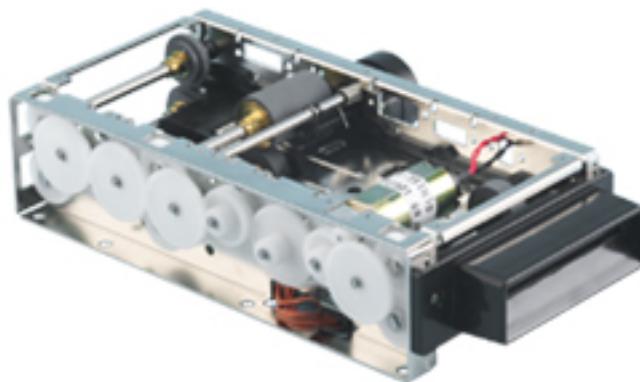
Software Communication Protocol for:

MOTOR DRIVE MAGNETIC CARD READER / ENCODER
Low Coercivity / High Coercivity Switchable
(300 / 650 / 2,500 to 4,000 Oe)
RS232 Interface

ZBA, Inc.

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1. Outline

This document describes Communication Protocol for ZBAs' motorized card reader ZBMM-0312-N/S. It is possible to control these devices from the host by sending commands through RS-232 serial Interface.

MODEL: **ZBMM-0312-N/S**

Available Tracks Number: = 1,2, 3

Maximum data length & character configuration for each track (ISO/IEC 7811-2,-6)

Track 1: 79 characters (6 bits + 1 odd parity bit)

Track 2: 40 characters (4 bits + 1 odd parity bit)

Track 3: 107 characters (4 bits + 1 odd parity bit)

 *Including STX, ETX and LRC on magnetic stripe

2. Functions

2.1. Unit Power ON Status

a) Power ON Operation mode is selectable between Operation Prohibited and Card Data Read.

b) During Operation Prohibited mode, the unit does not pull in a card until it receives any appropriate commands.

c) During Card Data Read mode, the unit pulls in a card and reads the data automatically upon card insertion.

2.2. Card Insert Position

a) Unit can take in a card from both front and rear of the unit. Card Insert Position set command specifies card insert position.

b) The unit reads or writes card data if a card inserted from specified direction.

2.3. Shutter Module (optional)

a) Shutter module prevents insertions of invalid cards.

b) Shutter module has card width sensor and pre-head for card data detection.

c) While the unit is waiting for a card insertion, the shutter will open by detecting card width. However, for data reading, the shutter opens only when the unit detects the presence of magnetic data on card.

d) The shutter closes when a card is removed from the shutter module.

2.4. Magnetic Card Reading

a) Unit takes in inserted cards automatically for data reading.

 * Unit performs data reading action during card transportation from the front to the rear.

 * When read error occur, unit repeats re-read action up to 2 times.
b) Unit ejects a card from the specified position after data reading.

c) Unit then transmits read data to the host. In addition, unit has the ability to transmit only specified portions of read data to the host.

2.5. Magnetic Card Encoding

a) Unit takes in inserted card automatically for data writing, and reads the written data again for verification.

* Unit performs both writing and read-verification actions during card transportation from the rear to the front.

* When write error occur, unit repeats re-write action up to 2 times.

b) Unit ejects a card from specified position after data writing.

c) Unit sends result information of writing operation to the host when operation terminated.

2.6. Switchable Coercivity

a) It is possible to select suitable coercivity according to card to be encoded.

b) Unit has following three encoding coercivity modes.

Mode0 – 24kA/m (300 Oe)

Mode1 – 52kA/m (650 Oe)

Mode2 – 200k~320kA/m (2500~4000 Oe)

c) Inappropriate combination of card coercivity and encoding coercivity will cause unstable data encoding. To avoid this, make sure to select correct coercivity for card.

2.7. Card Transportation/ Card Ejection

a) Card transportation means carrying an inserted card from the insertion position to the opposite end of the unit without reading card data.

b) Card ejection means to eject an internal card from the specified position of the unit without reading card data.

c) Card Hold Time is an available function when unit holds a card at the front or at the rear after reading or writing operation. Unit ejects the card from specified position if it is not removed during specified card holding time.

* Card positions and unit status are shown in below.

a) Inside hold

CARD

Encoder Front

b) Front hold

Encoder Front

CARD

c) Front Eject

Encoder Front

CARD

d) Rear hold

Encoder Front

CARD

e) Rear eject

Encoder Front
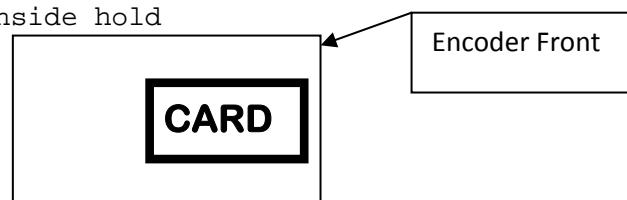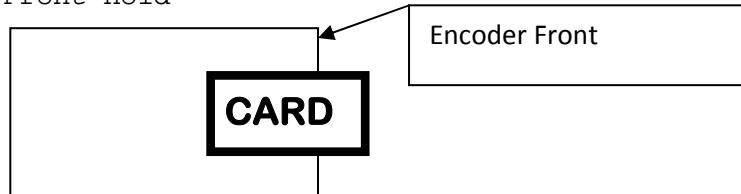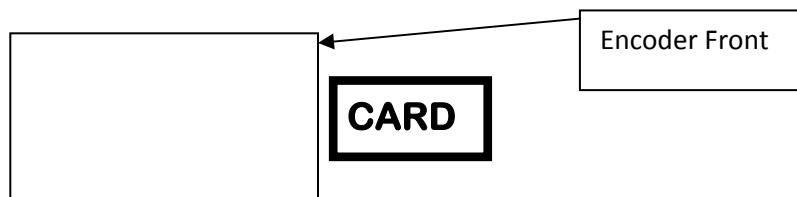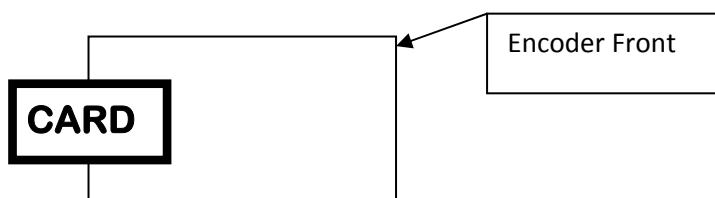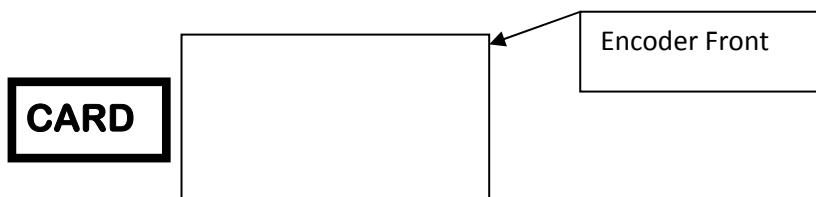
CARD

Fig.1 Description of card positions and unit status

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2.8. Unit Status Information

a) It is possible to confirm unit status by sending specified command.

2.9. Reset function

a) Reinitialize the internal memory and configure the unit to Power ON Status.

b) If there is a card inside unit when receiving reset command, the unit ejects a card from a specified position.

2.10. Configurable Communication Condition & Format

a) Baud rate, parity, and other communication conditions are configurable.

b) Packet Block Format of commands or response messages is also configurable.

3. Control Characters

The following list shows available control characters for communication between Host and the unit. These characters are not considered as control characters when used in BCC data

ACK	06h	Acknowledge
NAK	15h	Negative Acknowledge
DLE	10h	Data Link Escape
STX	02h	Start of packet block(Header)
ETX	03h	End of packet block
US	1Fh	Unit Separator
CR	0Dh	Carriage Return
LF	0Ah	Line Feed
BCC	**h	Block Check Character

**h: Hex data

"**": ASCII character strings

4. Packet Block Format

The packet block format for RS-232 communication is as follows.

Start character	Character String Data	End character	BCC
1 byte	n bytes	1 byte	1 or 2 bytes + CR

4.1. Start character

This is a start character, which means a beginning of a command or data string. The default value is **STX (02h).**

4.2. Character String Data

This part consists of a command or data string detailed in following chapters.

4.3. End character

This is an end character, which means an end of command or data string. The default value is **ETX (03h).**

4.4. BCC (Block Check Character)
This is calculated value from XOR of command (or data string) and End characters, and used for error detection. It is possible to select either 1 byte BCC or 2 bytes BCC according to need. When one byte BCC selected, only calculated value is transmitted.
If set to two bytes, upper and lower character converted into ASCII code separately, and followed by **CR (0Dh).**

Default setting: One byte BCC

Example:

"CRC": 43h 52h 43h

STX + "CRC" + ETX -------------- > 43h XOR 52h XOR 43h XOR 03h

 "C" "R" "C" ETX

Result: BCC = 51h

        1 byte BCC: 51h

        2 byte BCC: 35h 31h 0Dh

* Although it is possible to eliminate Start/ End characters, it is strongly recommended to set some character for "Start character" and "End character".

5. Communication Protocol

This chapter explains communication procedures between the unit and Host with some examples.

(Unit status: Default setting)

5.1. Outline

There are 3types of communication procedures.

1) Type1

Unit returns ACK etc when it receives commands from the host.

HOST		Encoder
Command	------------→ ←--------------	ACK/NAK/DLE/"NGxxx"

2) Type2

Unit returns response message etc to the host.]

HOST		Encoder
Command	------------→ ←--------------	Response message/NAK/DLE/"NGxxx"

3) Type3

Unit sends event message to the host, and requests ACK returned from the host.

HOST		Encoder
Command	------------→ ←--------------	Response message

Command and Message

Command / Message Name	Identifier		Type 1	Type 2	Type 3
Card Pass Through	"CM"		O	--	--
Card Data Read	"CR"		O	--	--
Card Data Write	"CW"		O	--	--
Card Eject	"PE"		O	--	--
Coercivity Change	"PM"		O	--	--
Operation Prohibit	"PP"		O	--	--
Reset	"PR"		O	--	--
Unit Status Check	"PS"		--	O	--
Cleaning	"PW"		O	--	--
Card Insert/ End position Set	"SH"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Data Transmission area Set	"SJ"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Power On Coercivity Set	"SM"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Communication Format Set	"SN"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Power ON/OFF Status Set	"SP"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Communication Conditions Set	"SR"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Shutter Operation Control Set	"SS"	Parameters OFF	--	O	--
		Parameters ON	O	--	--
Retry Number Set	"SY"	Parameters	--	O	--

		OFF			
		Parameters ON	O	--	--
Error Status Message	"DH"		--	--	O
Read Data	"CR"		--	--	O
Write Operation result	"CW"		--	--	O

5.2. Communication Protocol Type 1

Unit returns ACK/NAK/"NGxxx" to the host without response message.

HOST			Encoder
Correct Command	Command	------------→ ←--------------	ACK
Wrong Command	Command	------------→ ←--------------	"NGxxx"
Command without End character	Command	------------→ ←--------------	Timeout NAK
Command without START character	Command	------------→ ←--------------	Neglect
BCC error	Command	------------→ ←--------------	NAK

*If unit receive NAK response 3times continuously from the host, unit cancels the command by sending DLE to the host, and wait a next command.

5.3. Communication Protocol Type 2

Host requests that unit return response message

HOST			Encoder
Correct Command	Command	------------→	
		←-------------	Response message
Wrong Command	Command	------------→	
		←-------------	"NGxxx"
Command without End character	Command	------------→	Timeout
		←-------------	NAK
Command without START character	Command	------------→	Neglect
		←-------------	
BCC error	Command	------------→	
		←-------------	NAK

*If unit receive NAK response 3 times continuously from the host, unit cancels the command by sending DLE to the host, and wait a next command.

5.4. Communication Protocol Type 3

Unit sends Read/Write results and error message to the host

HOST			Encoder
Correct Event message	ACK	------------→	
		←-------------	"CR" "CW" Event data
Abnormal movements	ACK	------------→	
		←-------------	"DH" Event data
BCC error	Receive NG	------------→	
	NAK	←-------------	Event data

*If unit receive NAK response 3 times continuously from the host, unit cancels the command by sending DLE to the host, and wait a next command.

6. Commands

The following list shows available commands for communication with host.

Each command consists of an identifier and some parameters.

Type number of each command shows a type of communication protocol described in chapter 5.

Card Operation Command List

Command Name	Identifier	Description
Card Pass Through	"CM"	Transport and eject a card without reading/writing
Card Data Read	"CR"	Read card data
Card Data Write	"CW"	Write card data

Motion Command List

Command Name	Identifier	Description
Card Eject	"PE"	Transport an internal card to the specified position
Coercivity Change	"PM"	Change write current for correct coercivity
Operation Prohibit	"PP"	Prohibit card operation
Reset	"PR"	Reinitialize the unit
Unit Status Check	"PS"	Check the unit status
Cleaning	"PW"	Control cleaning card

Setup Command List

Command Name	Identifier	Description
Card Insert/ End position Set	"SH"	Set card insert position, and end position on operation termination
Data Transmission area Set	"SJ"	Specify data transmission area
Power On Coercivity Set	"SM"	Set power on coercivity
Communication Format Set	"SN"	Set start character, end character, etc
Power ON/OFF Status Set	"SP"	Set power ON/OFF movements
Communication Conditions Set	"SR"	Set communication condition (baud rate, parity etc)
Shutter Operation Control Set	"SS"	Set a condition for shutter opening
Retry Number Set	"SY"	Set number of times for retry

6.1. Card Operation Commands

6.1.1. Card Pass through Command

Identifier	"CM" (43h 4Dh)		
Parameter	< a >		
	< a >	Card Insert Position	
		"F" (46h)	Front
		"R" (52h)	Rear
		None	Cancel Card Pass Through mode

Description:
1) This command enters the unit into Card Pass Through mode, but does not work if there is a card inside the unit.
2) In this mode, unit carries an inserted card from a specified position to the other end without data reading action.
3) Unit cancels this mode when:
   a. it receives "CR", "CW", "PP", "PR", or "PE" commands.
   b. It receives "CM" commands without parameter. (3) A card insertion error occurs by inserting a card from undesignated position.
4) In case of no-card error to "PE" command, this mode remains effective.

Parameters

< a >: Specify card insert direction
"F": Unit takes in a card from the front, then carries and ejects it from the rear.
"R": Unit takes in a card from the rear, then carries and ejects it from the front.

Note: If unit receive this command without parameter, it exits from Card Pass Though Mode and back to Power ON default status.

Example:

"CMF": Unit carries a card from the front, and ejects it from the rear without reading data.

6.1.2. Card Data Read Command

6.1.2.1. Operate Card Data Reading

Identifier	"CR" (43h 52h)		
Parameter	< a >< b >< c >< d >		
	< a >	"C" (43h)	Fixed
	< b >	Individual tracks: < b > Tr.1, < c > Tr.2, < d > Tr.3 "0" (30h)	
	< c >	Read disable for < b >, < c >, or < d > "1" (31h)	
	< d >	Read enable for < b >, < c >, or < d >	

Description:

1) This command enters the unit into Card Data Read mode.
2) After receiving this command, unit automatically reads a card and transports it to a specified position.
3) Read data is transmitted to the host with Read Data Message "CR" (Ref. 7.1) after card transportation finished.
4) Unit cancels this mode if an error occurs. However, if the Power ON status is set to card data read mode, the unit remains in this mode.
5) The encoder performs re-read action if read error occur. The unit returns error message when it receive this command during holding a card at different position from specified card insert position.

Parameters:

< a >: Fixed "C"

< b > < c > < d >: Specify each track whether to be read or not. If unit receive this command without any parameters, the unit reads all three tracks.

"0": Read disable

"1": Read enable

Example:

"CRC": Read all three tracks

"CRC110": Read track 1&2, do not read track 3

6.1.2.2. Operate Card Data Reading and Specify Card End Position

Identifier	"CR" (43h 52h)		
Parameter	< a >< b >< c >< d >< e >		
	< a >	"K" (4Bh)	Fixed
	< b >	Card End position	
		"F0" (46h 0h)	Eject from the front
		"F1" (46h 31h)	Hold at the front
		"R0" (52h 30h	Eject from the rear
		"R1" (52h 31h)	Hold at the rear
		"S0" (53h 30h)	Hold inside the unit
	< c >	Individual tracks. < c >= Tr.1, < d >= Tr.2, < e >= Tr.3	
	< d >	"0" (30h)	Read disable for < c >, < d >, or < e >
	< e >	"1" (31h)	Read enable for < c >, < d >, or < e>

Description:

    1) This command enables to specify card end position besides card data reading operation described in 6.1.2.1

Parameters:

< a >: Fixed "K"
< b >: Specify card end position after card data reading operation
 "F0": Unit ejects a card from the front
 "F1": Unit holds a card at the front rollers
 "R0": Unit ejects a card from the rear
 "R1": Unit holds a card at the rear rollers
 "S0": Unit holds a card inside the unit

< c > < d >< e >: Specify each track whether to be read or not. Refer to the preceding page.

Example:

"CRKF0": Unit ejects a card from the front after reading all three tracks

"CRKR1110": Unit holds a card at the rear after reading track 1&2

6.1.3. Card Data Write Command

6.1.3.1. Operate Card Data Writing

Identifier	"CW" (43h 57h)		
Parameter	< a >< b >< c >< d >< e >< f >		
	< a >	"C" (43h)	Fixed
	< b >	Track1 Write Data	
	< c >	Track separator (Default: US)	
	< d >	Track2 Write Data	
	< e >	Track separator (Default: US)	
	< f >	Track3 Write Data	

Description:

1) This command enters the unit into Card Data Write mode.
2) After receiving this command, unit automatically writes data on a card and transports it to the specified position.
3) Result of operation is transmitted to the host with write operation result message "CW" (Ref. 7.2) after card transportation finished.
4) Unit cancels this mode if an error occurs.

5) Unit performs re-write action up to 2 times if write error occur. The unit returns error message when receiving this command during holding a card at different position from specified card insert position.

Parameters:

< a >: Fixed "C"

< b >< d >< f >: Unit writes data in ASCII characters on each track. It is possible to omit data on each track if it is not necessary.

< c >< e >: Used as delimiters to separate data between tracks. The default value is US (1Fh) and can be changed by "SN" command. It is impossible to omit this parameter even if data on the track is omitted.

Example:

"CWC12----34"<US>"12---56"<US>"12---78"<US>"12---90": Write all three tracks data

6.1.3.2. Operate Card Data Writing and Specify Card End Position

Identifier	"CW" (43h 57h)		
Parameter	< a >< b >< c >< d >< e >< f >< g >		
	< a >	"K" (4Bh)	Fixed
	< b >	Card End position	
		"F0" (46h 0h)	Eject from the front
		"F1" (46h 31h)	Hold at the front
		"R0" (52h 30h	Eject from the rear
		"R1" (52h 31h)	Hold at the rear
		"S0" (53h 30h)	Hold inside the unit
	< c >	Track1 Write Data	
	< d >	Track separator (Default: US)	
	< e >	Track2 Write Data	
	< f >	Track separator (Default: US)	
	< g >	Track3 Write Data	

Description:

1) This command enables to specify card end position besides card data writing operation described in 6.1.3.1.

Parameters:

< a >: Fixed "K"
< b >: Specify card end position after card data reading operation
"F0": Unit ejects a card from the front
"F1": Unit holds a card at the front rollers
"R0": Unit ejects a card from the rear
"R1": Unit ejects a card at the rear rollers
"S0": Unit holds a card inside the unit
< c >< e >< g >: Data for each track. Refer to < b >< d >< f > on the preceding page.
< d >< f >: Track separator character. Refer to < c >< e > on the preceding page.

Example:

"CWKR012----34"<US><US>"12---78": Write track1&3 data, do not write track 2. Unit ejects a card from the rear after writing.

6.2. Motion Commands

6.2.1. Card Eject Command

Identifier	"PE" (50h 45h)		
Parameter	< a >		
	< a >	Card End position	
		"F0" (46h 30h)	Eject from the front
		"F1" (46h 31h	Hold at the front
		"R0" (52h 30h)	Eject from the rear
		"R1" (52h 31h)	Hold at the rear
		"S0" (53h 30h)	Hold inside the unit

Description:

1) Receiving this command, an internal card is ejected from the specified position.
2) If there is no card inside the unit, it returns error message to the host.
3) 'Hold' means a status that a card is captured by rollers, and possible to be re-drawn inside the unit.

Parameters

< a >: Specify card end position
"F0": Unit ejects a card from the front
"F1": Unit holds a card at the front rollers
"R0": Unit ejects a card from the rear
"R1": Unit ejects a card at the rear rollers
"S0": Unit holds a card inside the unit

Example:

"PER0": Eject a card from the rear of the unit.

6.2.2. Coercivity Change Command

Identifier	"PM" (50h 4Dh)		
Parameter	< a >		
	< a >	Write Current Mode	
		"0" (30h)	Mode 0
		"1" (31h)	Mode 1
		"2" (32h)	Mode 2

Description:

1) This command specifies write current for appropriate coercivity.
2) This command is available only for coercivity switch no space able encoder.
3) In order to use this command, set the Dip SW-5 to ON (Ref. 8.)
4) Send this command to the host in advance of writing operation, if necessary.
5) Set value remains effective until turning off the power supply to the unit.
6) For changing power on coercivity, use another command "SM" (Ref. 6.3.3)
7) Wrong current will cause data encoding error. Be sure to select a correct mode according to cards to be encoded.

Parameters

< a >: Specify encoding coercivity
"0": Mode 0 – 24kA/m (300 Oe)
"1": Mode 1 – 52k /m (650 Oe)
"2": Mode 2 – 200k ~ 320kA/m (2500~4000 Oe)

Example:

"PM0": Set the coercivity at Mode 0 (300 Oe)

6.2.3. Operation Prohibit Command

Identifier	"PP" (50h 50h)
Parameter	NONE

Description:

1) This command cancels Card Data Read, Card Data Write, and Card Pass Through modes and enters the unit into Operation Prohibit mode.
2) Unit cancels Operation Prohibit mode when receiving Card Data Read or Write command.
3) When Operation Prohibit mode is cancelled, the unit returns to Power ON status.

6.2.4. Reset Command

Identifier	"PR" (50h 52h)
Parameter	NONE

Description:

1) All parameters reset to Power ON status when unit receives this command.
2) Before doing next operation, take at least 100mS interval after receiving ACK response from the host. However, if there is a card inside the unit, wait more than 2 seconds until unit finishes card ejection action.

6.2.5. Unit Status Check Command

Identifier	"PS" (50h 53h)		
Parameter	< a >		
	< a >	"C" (43h)	Fixed

Description:

1) This command requests for status information of the unit.
2) Upon receiving this command, unit returns Unit Status Message with "PS" (Ref. 7.2.2.)

Parameters

< a >: Fixed "C"

Example:

"PSC": Requests information of unit status

6.2.6. Cleaning Command

Identifier	"PW" (50h 57h)		
Parameter	< a > Card Insert position		
	< a >	"F" (46h)	Front
		"R" (52h)	Rear

Description:

    1) This command controls transportation of cleaning card.
    2) After receiving this command, unit moves inserted short type
       cleaning card (Same size as standard magnetic card) back and forth 5
       times.
    3) Cleaning card must be soaked with specified cleaning fluid.
    4) Do not operate the unit until the fluid dries.

 * Once receiving this command, unit does not receive any commands until
transportation finishes or the shutter closes.

Parameters

< a >: Specify card insert position

"F": Unit takes in cleaning card from the front

"R": Unit takes in cleaning card from the rear

Example:

"PWF": Insert cleaning card from the front of the unit for cleaning.

Refer to "Product specification" for the details of cleaning method.

6.3. Setting Commands

6.3.1. Card Insert/ End Position Set Command

Identifier	"SH" (53h 48h)		
Parameter	< a >< b >< c >		
	< a >	Card Insert Position	
		"F" (46h)	Front
		"R" (52h)	Rear
	< b >	Card End Position	
		"F0" (46h 30h)	Eject from the front
		"F1" (46h 31h)	Hold at the front
		"R0" (52h 30h)	Eject from the rear
		"R1" (52h 31h)	Hold at the rear
		"S0" (53h 30h)	Hold inside the unit
	< c >	Card Hold Time and Eject position after redraw action (Valid only when < b > is set to "F1" or "R1")	
		"F00" (46h 30h 30h)	No ejection action
		"R00" (52h 30h 30h)	
		"S00" (53h 30h 30h)	
		"Fxx" (46h 3xh 3xh)	Card hold time until front ejection
		"Rxx" (52h 3xh 3xh)	Card hold time until rear ejection
		"Sxx" (53h 3xh 3xh)	Card hold time until inside hold

Description:

1) This command sets Card Insert/ End positions after Card Read/ Write operations.
2) Unit moves a card to card end position after reading/writing operation, then re-draws and ejects it from card eject position if the card is not removed from the unit during card hold time.
3) When unit receives this command without any parameters, the unit returns response message "SH" (Ref. 7.2.3.) with the current settings information.

Parameters

< c >: Specify card hold time and card eject position

* This parameter is effective when < b > is set to "F1" or "R1", and possible to omit this parameter in other cases. When this parameter omitted even if < b > is set to "F1" or "R1", the latest setting remains effective.

"F00","R00","S00": Unit continues keeping a card at card end position specified by <b>
"Fxx": After xx seconds, unit ejects a card completely from the front
"Rxx": After xx seconds, unit ejects a card completely from the rear
"Sxx": After xx seconds, unit re-draws a card and holds it inside the unit
"xx"= Card hold time in second ("xx"="01" to "15")

Example:

"SHFF1R05": Unit holds a front-inserted card at the front when reading or writing
operation finishes. Unit keeps holding the card at the front up to 5 seconds for card removal. However, if the card is not removed within 5 seconds, unit ejects it from the rear completely.

6.3.2. Data Transmission area Set Command

Identifier	"SJ" (53h 4Ah)		
Parameter	< a >< b >< c >		
	< a >	Track number	
		"1" (31h) to "3" (33h)	1: Track1 2: Track2 3: Track3
	< b >	Start position of Data Transmission area	
		"01" (30h 31h) to "FF" (46h46h)	First digit of transmitted data (01h~FFh)
	< c >	End position of Data Transmission area	
		"01" (30h 31h) to "FF" (46h46h)	Last digit of transmitted data (01h~FFh)

Description:

1) This command specifies start and end positions of data transmission area of specified track.
2) When unit receives this command without parameters < b > and < c >, the unit returns response message "SJ" (Ref. 7.2.4.) to the host with current setting information.

 Parameters:

< b >< c >: Default value for data transmission area of each track is as follow:
Track 1: 01 ~ 76(01h ~ 4Ch) digits < b > "01" < c > "4C"
Track 2: 01 ~ 37(01h ~25h) digits < b > "01" < c > "25"
Track 3: 01 ~ 104(01h ~ 68h) digits < b > "01" < c > "68"
* The value "00" is considered as "01"

* If the value < c > is smaller than < b >, unit transmits only one digit to the host specified by < b >

Example:

"SJ10A14": Unit transmits track1 data from 10th digit to 20th digit inclusive

6.3.3. Power ON Coercivity Set Command

Identifier	"SM" (53h 4Dh)		
Parameter	< a > Power ON coercivity		
	< a >	"0" (30h)	Mode 0
		"1" (31h)	Mode 1
		"2" (32h)	Mode 2

Description:
1) This command specifies Power ON coercivity mode.
2) This command is only available for coercivity switchable encoder.
3) Before using this command, set the Dip SW-5 to ON (Ref. 8.)
4) When unit receives this command without parameter, the unit returns response message "SM" (Ref. 7.2.5.)to the host with current setting information.
5) Use "PM" command (Ref. 6.2.2.) to change coercivity for each operation.

Parameters

Default: < a >"2" (Mode 2)

< a >: Actual coercivity in each mode is as follows.
"0": Mode 0 24kA/m (300Oe)
"1": Mode 1 52k /m (650Oe)
 "2": Mode 2 200k ~ 320kA/m (2500~4000Oe)

Example:

"SM2": Specify Power ON coercivity to Mode 2.

6.3.4. Communication Format Set Command

Identifier	"SN" (53h 4Eh)		
Parameter	< a >< b >< c >< d >< e >< f >< g >		
	< a >	Start character	
		"0" (30h)	None
		"1" (31h)	STX
		"2" (32h)	User defined: < e >
	< b >	End character	
		"0" (30h)	None
		"1" (31h)	CR
		"2" (32h)	LF
		"3" (33h)	CR + LF
		"4" (34h)	ETX
		"5" (35h)	User defined: < f >
	< c >	BCC	
		"0" (30h)	None
		"1" (31h)	1 byte BCC
		"2" (32h)	2 bytes BCC + CR
	< d >	Separator character	
		"0" (30h)	US(1Fh)
		"1" (31h)	User defined:< g >
	< e >	"01"(30h 31h) to "7F"(37h46h)	User defined start character
	< f >	"01"(30h 31h) to "7F"(37h46h)	User defined end character
	< g >	"01"(30h 31h) to "7F"(37h46h)	User defined separator character

Description:
   1) This command specifies packet block format for RS232C communication.
   2) This setting goes into effect when turning on power, or reset command received.
   3) When unit receives this command without any parameters, the unit returns response message "SN" (Ref. 7.2.6.) to the host with current setting information

 Parameters

Default: < a > "1" (STX) < b > "4" (ETX) < c > "1" (1byte) < d > "0" (1F)
< c >: When this parameter is set to "2" (32h), "CR" is added to behind control characters such as ACK, NAK etc.
< e >< f >< g >: User defined characters in 2-digits hexadecimal number

The < e >< f > and < g > can be omitted together in set, but cannot be done individually

Example:

"SN1410": Use STX (02h), ETX (03h), 1 byte BCC, and US (1Fh) for
communication with host.

6.3.5. Power ON/OFF Status Set Command

Identifier	"SP" (53h 50h)		
Parameter	< a >< b >< c >		
	< a >	Power ON status	
		"0" (30h)	Read/Write Prohibit mode
		"1" (31h)	Card Data Read mode
	< b >	Power ON Card Eject Position	
		"F" (46h)	Front
		"R" (52h)	Rear
	< c >	Power OFF Card Eject Position (Available only when external capacitor equipped)	
		"0" (30h)	No Ejection (Keep holding card inside the unit)
		"F" (46h)	Front
		"R" (52h)	Rear

Description:

1) This command specifies the unit movements upon Power ON/OFF.
2) This setting remains effective until reconfigured.
3) When unit receives this command without any parameters, the unit returns response message "SP" (Ref. 7.2.7.) to the host with current setting information.

Parameters

Default: < a > "0" (Prohibit) < b > "F" (Front eject) < c > "0" (No ejection)

< a >: If prohibit mode selected, the unit always returns to prohibit mode after every read/ write operations

< c >: This parameter is available only when external capacitors are equipped for power failure(See product specifications for more details).

Example:

"SP1FF": The unit enters Card Data Read mode upon turning on the power. If there is a card inside the unit, it ejects an internal card from the front when power ON. The unit also ejects an internal card from the front upon power failure if the unit is equipped with external capacitors.

6.3.6. Communication Condition Set Command

Identifier	"SR" (53h 52h)		
Parameter	< a >< b >< c >< d >< e >< f >< g >		
	< a >	Data length	
		"0" (30h)	7 bits
		"1" (31h)	8 bits
	< b >	Parity	
		"0" (30h)	None
		"1" (31h)	Even
		"2" (32h)	Odd
	< c >	Stop bit length	
		"0" (30h)	1 bit
		"1" (31h)	2 bits
	< d >	Baud rate	
		"0" (30h)	4800 bit/s
		"1" (31h)	9600 bit/s
		"2" (32h)	19200 bit/s
		"3" (33h)	38400 bit/s
	< e >	CTS line Monitor	
		"0" (30h)	Disable
		"1" (31h)	Enable
	< f >	Transmission Retry Times	
		"0"(30h) to "9"(39h)	Number of retries against NAK
	< g >	Communication Timeout	
		"0"(30h) to "9"(39h)	Data Waiting Times in sec

Description:
1) This command specifies RS232C communication conditions
2) This setting goes into effect when power on, or when unit receives a reset command.
3) When unit receives this command without any parameters, the unit returns response message "SR" (Ref. 7.2.8.) to the host with current setting information

Parameters

```
Default values
< a >: "1" (8bits)
< b >: "1" (Even parity)
< c >: "0" (1bit)
< d >: "1" (9600bit/s)
< e >: "0" (Disable)
< f >: "3" (3 times)
< g >: "3" (3 seconds)
```

Example:

"SR0101031": 7bits, even parity, 1bit, 9600bps, no CTS line monitoring, 3times, 1 second

6.3.7. Shutter Operation Control Set Command

Identifier	"SS" (53h 53h)		
Parameter	< a >		
	< a >	Shutter opening condition	
		"0" (30h)	Data pre-detected and card width sensed
		"1" (31h)	Card width sensed

Description:

1) This command specifies a condition for shutter opening.
2) When unit receives this command without a parameter, the unit returns response message "SS" (Ref. 7.2.9.) to the host with current setting information.

Parameters

Default: < a > "0" (Sensed by both pre-detect head and card with senor)

< a >: Pre-detection of card data is only available for card data read command "CR".
For other operations, the shutter opens when detecting card width.

Example:

"SS1": Shutter opens when the card width sensor detects a card insertion.

6.3.8. Retry Number set Command

Identifier	"SY" (53h 59h)		
Parameter	< a >		
	< a >	Number of retry	
		"0" (30h) to "9" (39h)	0 to 9times

Description:

1) This command specifies the number of times for retries when Read/ Write error occurs with Mag. Card.

Parameters:

< a >: Specify the number of retry.
"0": do not retry.
Default setting: 2 times

When unit receive this command without any parameters, the unit response message "SY" (Ref. 7.2.10.) to the host with the current settings information.

Example:

"SY4": retry 4 times

7. Response Messages

As described in chapter 5, unit sends these response messages to the host via RS-232 according to the protocols. Each message consists of an identifier and some parameters.

Event Message Name	Identifier	Description
Read Data	"CR"	Read Data of each track (Track-1,Track-2,Track-3)
Write Operation result	"CW"	Write Operation result for each track.
Error Status Message	"DH"	NG information

Message Name	Identifier	Description
NG Data	"NG"	NG information
Unit Status	"PS"	Unit status information
Card Insertion/End position	"SH"	Setting of Card Insertion/Eject position
Data Transmission area	"SJ"	Data transmitted area
Power ON Coercivity	"SM"	Coercivity when powered
Communication Format	"SN"	Setting of Communication Format
Power ON/OFF status	"SP"	Setting of Power ON/OFF status
Communication Condition	"SR"	Setting of Communication Conditions
Shutter Control	"SS"	Condition for shutter opening
Retry Number	"SY"	Setting of the retry number of times of

7.1. Event Messages

7.1.1. Read Data Message

Identifier	"CR" (43h 52h)		
Return Code	< a >< b >< c>< d >< e >< f >< g >< h >< i >		
	< a >	"C" (43h)	Fixed
	< b >	Track1 Result Code	
	< c >	Track1 Read Data	
	< d >	Unit Separator	
	< e >	Track2 Result Code	
	< f >	Track2 Read Data	
	< g >	Unit Separator	
	< h >	Track3 Result Code	
	< i >	Track3 Read Data	

Description:

   1) Unit sends this message to the host after data read operation

Parameter:

< b > < e > < h >: Result Code
"0": Read OK
"1": Unable to find STX on magnetic stripe
"2": Unable to find ETX on magnetic stripe
"3": Incorrect VRC (Vertical Redundancy Check)
"4": Incorrect LRC (Longitudinal Redundancy Check)
"5": Incorrect Data format
"6": System reserved
"7": System reserved
< c > < f > < i >: Read Data of each track

 If any error happens on a track, unit does not send data of the track to the host.

< d >< g > Separator character between tracks- Default: US (1Fh)

7.1.2. Write Operation Result Message

Identifier	"CW" (43h 57h)		
Return Code	< a >< b >< c>< d >< e >< f >< g >< h >		
	< a >	"C" (43h)	Fixed
	< b >	Track1 Result Code	
	< c >	Unit Separator	
	< d >	Track-2 Result Code	
	< e >	Unit Separator	
	< f >	Track-3 Result Code	
	< g >	Unit Separator	
	< h >	Track-4 Result Code	

Description:

1) The unit returns result message of writing operation.

Parameter:

< b > < d > < f >: Result Code for each track
"0": Write OK
"1": Unable to find STX digit on magnetic stripe
"2": Unable to find ETX digit on magnetic stripe
"3": Invalid VRC (Vertical Redundancy Check) data
 "4": Invalid LRC (Longitudinal Redundancy Check) data
"5": Invalid Data format
"6": System reserved
"7": Write - Read verify error

< c >< e >: Separator character between tracks - Default: US (1Fh)

 *Separator character cannot be omitted.

7.1.3. Error Status Message

Identifier	"DH" (44h 48h)		
Return Code	< a > Error Code		
	< a >	"01" (30h 31h)	Unit is holding a card internally
		"02" (30h 32h)	Shutter Movement Error
		"03" (30h 33h)	Card Transportation Error
		"04" (30h 34h)	Card Insertion Error
		"05" (30h 35h)	System Reserved

Description:
1) This message shows what error has occurred.
2) Unit sends this message to the host whenever an error has occurred. Therefore, the host terminal should monitor a signal line at any time to receive this message.

7.2. Response Messages

7.2.1. NG Data Message

Identifier	"NG" (4Eh 47h)		
Return Code	< a > Error Code		
	< a >	"001" (30h 30h 31h)	Identifier Error
		"002" (30h 30h 32h)	Parameter Error
		"003" (30h 30h 33h)	System reserved
		"004" (30h 30h 34h)	System reserved
		"005" (30h 30h 35h)	No Card Error
		"006" (30h 30h 36h)	Card Existence Error
		"007" (30h 30h 37h) to "199" (31h 39h 39h)	System reserved

Description:

1) Unit sends this message to the host if it receives a command string in wrong format, or receives it at inappropriate timing.

7.2.2. Unit Status Message

Identifier	"PS" (50h 53h)		
Return Code	< a >< b >< c>< d >< e >< f >< g >		
	< a >	"C" (43h)	Fixed
	< b >	Status of the Unit	
		"00" (30h 30h)	Operation prohibited (Unit receives "PP")
		"01" (30h 31h)	Card Data Read mode
		"02" (30h 32h)	Card Data Write mode
		"03" (30h 33h)	Ready to Re-draw (Card Hold Time)
		"04" (30h 34h)	Card Pass Through mode
	< c >	Status of Sensor Group 1 (S1, S2 S3, S4)	
	< d >	Status of Sensor Group 2 (S5, S6)	
	< e >	"0" (30h	Fixed
	< f >	Shutter status	
		"0" (30h)	No Shutter
		"1" (31h)	Shutter Closed
		"2" (32h)	Shutter Open
	< g >	Coercivity mode	
		"0" (30h)	Mode 0: 24kA/m (300Oe)
		"1" (31h)	Mode 1: 52kA/m (650Oe)
		"2" (32h)	Mode 2: 200k to 320kA/m (2500 to 4000Oe)

Description:

   1) This message shows unit status of magnetic card and sensors

 Parameter:

< b >: Unit sends "03" to the host only during Card Hold Time

 < c >< d >: Value of each parameter shows a combination of four sensor's status. Please refer to following chart.

< g >: This parameter is available when SW-5 of ENCODER is set to ON. If SW-5 of Encoder is set to OFF this parameter is fixed "0"

Sensor Information

Data	S4	S3	S2	S1	Sensor Group 1 < c >
	--	--	S6	S5	Sensor Group 2 < d >
"0" (30h)	OFF	OFF	OFF	OFF	
"1" (31h)	OFF	OFF	OFF	ON	
"2" (32h)	OFF	OFF	ON	OFF	
"3" (33h)	OFF	OFF	ON	ON	
"4" (34h)	OFF	ON	OFF	OFF	
"5" (35h)	OFF	ON	OFF	ON	
"6" (36h)	OFF	ON	ON	OFF	
"7" (37h)	OFF	ON	ON	ON	
"8" (38h)	ON	OFF	OFF	OFF	
"9" (39h)	ON	OFF	OFF	ON	
"A" (41h)		OFF	v	OFF	
"B" (42h)	ON	OFF	ON	ON	
"C" (43h)	ON	ON	OFF	OFF	
"D" (44h)	ON	ON	OFF		
"E" (45h)	ON	ON	ON	OFF	
"F" (46h)	ON	ON	ON	ON	

ON : Card present

OFF: Card absent

Sensor position.


```
S6 S4        S3 S2                    S5 S1
```
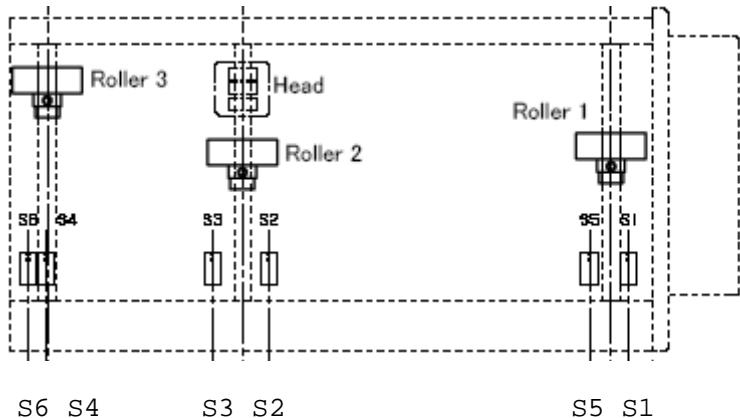
7.2.3. Card Insert Direction and End Position Setting Message

Identifier	"SH" (53h 48h)		
Return Code	< a >< b >< c>		
	< a >	Card Insert Position Setting	
		"F" (46h)	Front
		"R" (52h)	Rear
	< b >	Card End Position Setting	
		"F0" (46h 30h)	Eject from the front
		"F1" (46h 31h)	Hold at the front
		"R0" (52h 30h)	Eject from the rear
		"R1" (52h 31h)	Hold at the rear
		"S0" (53h 30h)	Hold inside the unit
	< c >	Card Hold Time and Eject Position Setting after redraw action	
		"F00" (46h 30h 30h)	No ejection action
		"R00" (52h 30h 30h)	
		"S00" (53h 30h 30h)	
		"Fxx" (46h 3xh 3xh)	After xx seconds, unit redraws a card inside and fully ejects it from the front
		"Rxx" (52h 3xh 3xh)	After xx seconds, unit redraws a card inside and fully ejects it from the rear
		"Sxx" (53h 3xh 3xh)	After xx seconds, unit redraws a card and holds it inside

Description:

 1) This message shows card movements during and after card reading and writing
operations.

7.2.4 Data Transmission Area Setting Message

Identifier	"SJ" (53h 4Ah)		
Parameter	< a >< b >< c>		
	< a >	Track number	
		"1" (31h) to "3" (33h)	1: Track1, 2: Track2, 3: Track3
	< b >	Start position of Data Transmission area	
		"01"(30h 31h) to "FF"(46h 46h)	Start position
	< c >	End position of Data Transmission area	
		"01"(30h 31h) to "FF"(46h 46h)	End position

Description:

   1) This message shows data transmission area of specified track.

7.2.5. Power ON Coercivity Setting Message

Identifier	"SM" (53h 4Dh)		
Parameter	< a >		
	< a >	Power ON coercivity	
		"0" (30h)	Mode 0: 24kA/m (300 Oe)
		"1" (31h)	Mode 1: 52kA/m (650 Oe)
		"2" (32h)	Mode 2: 200k ~ 320kA/m (2500 ~ 4000 Oe)
Message	None		

Description:

   1) This message shows Power ON coercivity setting.

7.2.6. Communication Format Setting Message

Identifier	"SN" (53h 4Eh)		
Parameter	< a >< b >< c >< d >< e >< f >< g >		
	< a >	Start character	
		"0" (30h)	None
		"1" (31h)	STX
		"2" (32h)	User defined: < e >
	< b >	End character	
		"0" (30h)	None
		"1" (31h)	CR
		"2" (32h)	LF
		"3" (33h)	CR + LF
		"4" (34h)	ETX
		"5" (35h)	User defined: < f >
	< c >	BCC	
		"0" (30h)	None
		"1" (31h)	1 byte BCC
		"2" (32h)	2 bytes BCC + CR
	< d >	Separator character	
		"0" (30h)	US(1Fh)
		"1" (31h)	User defined: < g >
	< e >	"01"(30h 31h) to "7F"(37h 46h)	User defined start character
	< f >	"01"(30h 31h) to "7F"(37h 46h)	User defined end character
	< g >	"01"(30h 31h) to "7F"(37h 46h)	User defined separator character

Description:

1) This message shows setting of RS232C communication format.

7.2.7. Power ON/OFF Status Setting Message

Identifier	"SP" (53h 50h)		
Return code	< a >< b >< c >		
	< a >	Power ON status Setting	
		"0" (30h)	Read/Write Prohibit mode
		"1" (31h)	Card Data Read mode
	< b >	Power ON Card Ejection Setting	
		"F" (46h)	Front
		"R" (52h)	Rear
	< c >	Power OFF Card Ejection Setting (Only available when external capacitor equipped)	
		"0" (30h)	No Ejection
		"F" (46h)	Front
		"R" (52h)	Rear

Description:

1) This message shows the unit operation mode when power is ON/OFF.
2) Unit ejects an internal card completely

7.2.8. Communication Condition Setting Message

Identifier	"SR" (53h 52h)		
Parameter	< a >< b >< c >< d >< e >< f >< g >		
	< a >	Data length	
		"0" (30h)	7 bits
		"1" (31h)	8 bits
	< b >	Parity	
		"0" (30h)	None
		"1" (31h)	Even
		"2" (32h)	Odd
	< c >	Stop bit length	
		"0" (30h)	1 bit
		"1" (31h)	2 bits
	< d >	Baud rate	
		"0" (30h)	4800 bit/s
		"1" (31h)	9600 bit/s
		"2" (32h)	19200 bit/s
		"3" (33h)	38400 bit/s
	< e >	CTS line monitor	
		"0" (30h)	Disabled
		"1" (31h)	Enabled
	< f >	Transmission Retry Times	
		"0" (30h) to "9" (39h)	Number of retries against NAK
	< g >	Communication Timeout	
		"0" (30h) to "9" (39h)	Data Waiting Times in sec

Description:

1) This message shows setting of RS232C communication condition

7.2.9. Shutter Operation Control Message

Identifier	"SS" (53h 53h)		
Parameter	< a >		
	< a >	Shutter Opening Condition	
		"0" (30h)	Detecting both magnetic data and card width
		"1" (31h)	Detecting card width only

Description:

1) This message shows a shutter opening condition upon card insertion when card data read.

7.2.10. Retry Number Message

Identifier	"SY" (53h 59h)		
Parameter	< a >		
	< a >	Number of times retry	
		"0" (30h) to "9" (39h)	0 to 9times

Description:

1) This message shows the number of times for retry Reading/ Writing setting

8. Dip Switch Settings

Switch No.				
1,2,3	1	2	3	
	OFF	OFF	OFF	Normal Position
	ON	OFF	OFF	Initilization
	OFF	ON	OFF	Reserved
	ON	ON	OFF	Reserved
	OFF	OFF	ON	Reserved
		OFF	ON	Reserved
	OFF	ON	ON	Reserved
	ON	ON	ON	Reserved
4	OFF	Without shutter		
	ON	With shutter		
5	OFF	Coercivity fixed		
	ON	Coercivity switchable		
6	OFF	Normal Position		
7	OFF	Normal Position		
8	OFF	Normal Position		

8.1. Default setup

```
1) Communication setup:
     Baud rate: 9600 bit/s
     Data length: 8bits
     Parity: Even
     Stop bit: 1 bit

2) Communication format: STX (02h) + DATA + ETX (03h) + 1 byte BCC
3) Track Separator: US (1Fh)
4) Power ON Status: Operation Prohibited
5) Power ON Eject Position: Front
6) Card Insert Position: Front
7) Card End Position: Front Hold
```

9. Appendix

9.1. ASCII Code

L⟍H	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	'	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	`	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	'	<	L		l		
D	CR	GS	-	=	M	]	M	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

ZBA, Inc.