

MSR120D

Magnetic Stripe Card Reader
Universal Serial Bus (USB) Interface

Programmer's Manual

UDN PM009 Revision E

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AGENCY APPROVED

- Specification for FCC Class B
- Specification for CE Class B
- Certificate by Taiwan BSMI

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

You are cautioned that any change or modifications to the equipment not expressly approve by the party responsible for compliance could void your authority to operate such equipment.

WARNING

You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

WARRANTY

This product is served under one-year warranty of defects in material and functionality to the original purchasers. Within the warranty period, if the product found to be defective will be repaired or replaced. This warranty applies to the products only under the normal use of the original purchasers, and in no circumstances covers incidental or consequential damages through consumers' misuse or modification of the product.

PREFACE

This manual provides detailed information relating to the overall operational, electrical, mechanical, environmental and functional aspects of the MSR120D. This document should be read and understood prior to initial operation of the product.

For ease of installation and programming use, we have addressed everything from its attractive features to its various configurations.

When designing the MSR120D, we selected what we feel are the most useful features and functions. If in some cases you find that your specific needs differ from our existing products, we welcome your comments and suggestions.

Custom-designed models are also available.

If further questions do arise, please call for technical support, our FAE will assist you in any way we can.

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Section 1 General Description

This section presents general information about the basic characters of the MSR120D.

➤ Features

The MSR120D provides the following features:

1	Light weight: 120g
2	Compact size: 100L*34W*28H (mm)
3	LED and Buzzer indicators indicate card status
4	Low power consumption
5	Single, dual, or triple track versions allow for reading all types of magnetic cards, including credit cards and drivers licenses.
6	Firmware download (refer to section 6)

➤ Application

This Magnetic Stripe Reader is design to read high or low coercive magnetic cards. It can decode/verify up to 3 tracks of data simultaneously. This product communicates with a host computer or other terminal using a standard USB interface. Because of the transmitting protocol of MSR120D is more precise, it is suitable for using in financial industry.

➤ Function

Self Test

Whenever the reader experiences a reset cycle, a self-test is performed. The reader will respond with “:” and the LED will turn green if the entire test is successful. Otherwise, the LED will turn orange and no response will be generated.

Table 1-1. Self Test

Indication		Cause	Post Condition
LED	Buzzer		
Green	1 Beep	Test Success	Responds with “:”
Orange		EEPROM Failed	Hang
Orange		Internal ROM Failed	Hang

Transmission Reset by Hardware

When the reader cannot communicate with the host, user can set the switch S1-1 on and power on the reader. The reader will beep twice and response the baud rate, parity, CTS and RTS default setting, but the data inside EEPROM will not be changed.

Reading

The reader can read magnetic data from any available track encoded per ISO 7810, 7811, AAMVA, CA old DMV, JIS. The host can request the read data from the reader with commands. For details and examples of commands and responses, refer to section 4.

Reading Customized Data

The interface can read customized encoded magnetic data. Data integrity is not verified when reading customized data. Customized data is not formatted into ASCII characters prior to transmission to the host.

Self –Arm Mode

The default reader configuration is the “Self-Arm Mode”, which allows the magstripe functions to run automatically, reporting magstripe activity to the host without instruction from the host. In the Self-Arm mode, the reader also can accept commands from host. However, the reader can be configured to only “Host Polled Mode” by disabling Self-Arm mode. The “Host Polled Mode” allows the magstripe functions to run by commands. The conditions of indicators when the reader is in Self-Arm mode are shown below.

Table 1-2. Self-Arm Mode

Indication		Cause
LED	Buzzer	
Off		Card Swipe
Orange	2 Beeps	1 or 2 Tracks Read Miss
Red	3 Beeps	Read Error
Green	1 Beep	Read Success

When the reader is in the Self-Arm mode, the green LED indicates the reader is waiting for accepting card. While card is moving, the LED will turn off. When one or two tracks read miss, the LED shows orange for 1 second and the buzzer beeps twice. If tracks read error, the LED turns red and beeps thrice. When the reader is in the Host Polled mode, the green LED keeps flashing.

Transmitting Data Block of Tracks

Each track could divide into 1-3 channels (blocks) for transmission. For example, user could set “Channel A” of track1 format as: ISO standard card track1 15th-30th characters. If the set data is different from the data after swiping, the reader will transmit completed data without limitation. The commands of setting channels are shown in section 5.

➤ **Part Number Description**

The brief configuration of MSR120D part number are shown as below:

MSR120D-12 Dual track 1&2

MSR120D-23 Dual track 2&3

MSR120D-33 Triple track 1&2&3

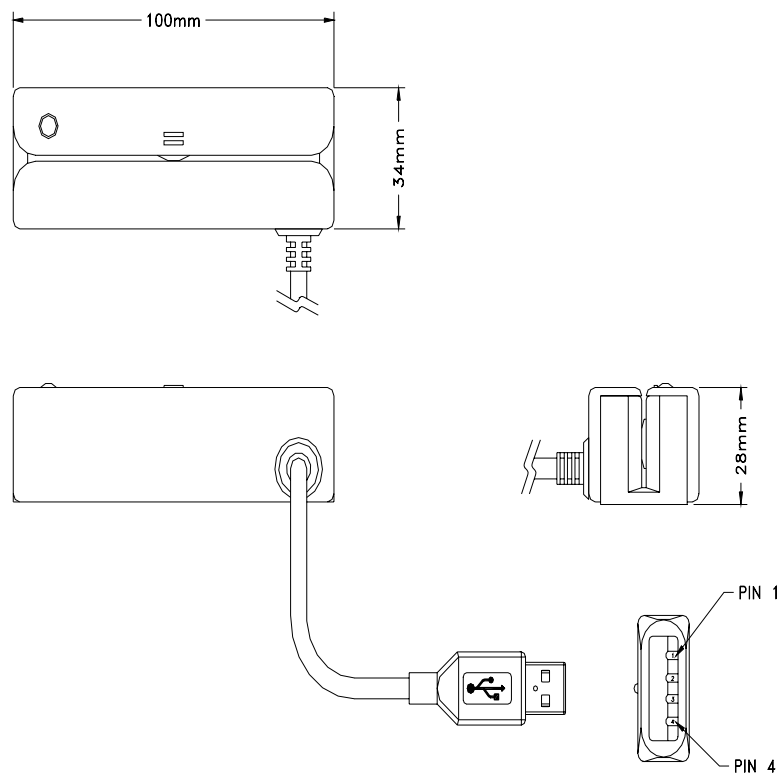
Note: Optional configuration is available.

Section 2 Configurations

This section shows the dimensions, accessories and setup for the MSR120D.

➤ **Dimensions of MSR120D**

Figure 2-1 Dimensions of MSR120D



➤ **Accessories of MSR120D**

The following accessories should be supplied along with MSR120D. Make sure all the following accessories are contained in your package.

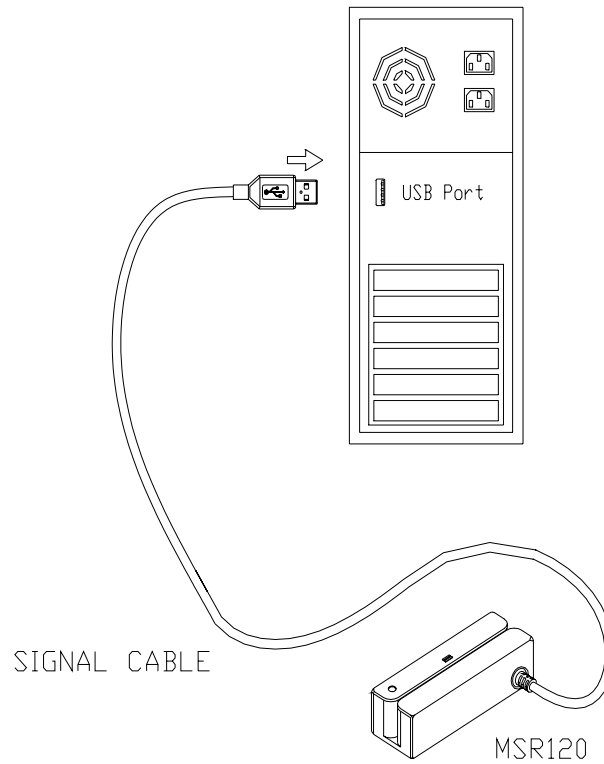
1. Signal cable (USB Connector, 1.7M)
2. Programmer's manual
3. Download application

➤ **Installation**

1. Power off your PC system.

2. Connect PC and MSR120D as below.
3. Connect USB connector of signal cable to a free USB port. Connect the connector to MSR120D.
4. Power on your PC system.

Figure 2-2 Installing MSR120D



Section 3 Technical Specifications

➤ **Card Specifications**

Card Type

ISO standard card

CA old DMV

AAMVA

JIS

Read high or low coercive magnetic stripes (300-4000oe)

Read triple track 7 BPC & 210 BPI cards

Thickness

0.76 mm ±0.08 mm

Card Format

Track 1 & 3: 210 bpi

Track 2: 75/210 bpi

JIS II 210 bpi

Note: The card data output sequence for Model J2 is ISO track 2 prior to JIS II.

The card data output sequence for Model J3 is ISO track 1 & 2 prior to JIS II.

Card Operation Speed

Table 3-1. Card Operation Speed

Test Card	Speed (IPS)
ISO standard card	5-55
* Jitter	5-50
** Low Amplitude	5-50

*Note: *Jitter card: Reliable reading of magnetic stripes encoded with bit cell length variations within +/-12% of normal as defined by ISO 7811.*

***Low amplitude: Reliable reading of magnetic stripes encoded at 60% or more of the encoding amplitude as defined by ISO 7811.*

➤ **Mechanical Specifications**

Body Material

ABS 94V-0

Dimension

Length: 100mm

Width: 34mm

Height: 28mm

Weight

120g

Magnetic Head Life

500K swipes Min. 1M optional

➤ **Electrical Specifications**

Power Required

DC 5V±10%

Power Consumption

98mA Max. in normal condition

Communication

Standard USB signal levels (comply with USB specification v 1.1)

Dielectric Strength

250VDC for 1 minute

Insulation Resistance

10M Ohms min. at 250VDC

➤ **Environmental Specifications**

Temperature

Operating: -10-50°C

Storage: -30-70°C

Humidity

Operating: 10-85% (non condensing)

Storage: 10-90% (non condensing)

➤ USB Connector Termination Assignment

Table 3-2. Connector Assignment

Contact Number	Signal Name	Typical Wiring Assignment
1	Vbus	Red
2	D-	White
3	D+	Green
4	GND	Black
Shell	Shield	Drain Wire

➤ Communication

The interface receives and transmits serial bit stream at voltage levels compatible with the USB specification.

Transmission Protocol

The user may select from three different protocols: Protocol 0, 1, and 2.

Upon reset, the reader sends the power-on response “:”, depending upon the configuration setting. The reader then configures itself to the protocol of the first command from the host. From this point on, the protocol is unchangeable until a reset occurs.

Protocol 0

In Protocol 0, all characters are transmitted and received using exactly the characters listed in section 4. There are no headers and Block Check Characters (BCC). Protocol 0 presumes no transmission errors. If the host detects an error, it may request a retransmission.

Table 3-3. Example for Protocol 0

Host Command	Reader Response	Comment
P		Ready to read
	^	Reader ACK

Protocol 1

In Protocol 1, all messages are preceded by the ASCII character <STX> and terminated with the ASCII character <ETX>, followed by a one byte <BCC>. <BCC> is an XOR of the 7 data bits, excluding parity, of each character in the entire message, including <STX>.

Format: <STX><MESSAGE><ETX><BCC>

where STX=02Hex and ETX=03Hex.

Table 3-4. Example for Protocol 1

Host Command	Reader Response	Comment
02h 50h 03h 51h		Ready to read
	02h 5Eh 03h 5Fh	Reader ACK

Protocol 2

In Protocol 2, all messages are preceded by the ASCII character <SOH>, followed by a one byte reader address, one byte character count and terminated with a one byte <BCC>. The <BCC> is an XOR of the characters (8 bits) in the entire message, including <SOH>.

Format: <SOH><ADDRESS><00Hex><COUNT><MESSAGE><BCC>

or

<SOH><ADDRESS><00Hex><00Hex><MESSAGE><EOT><BCC>

where STX=02Hex and ETX=03Hex.

Table 3-5. Example for Protocol 2

Host Command	Reader Response	Comment
01h 00h 00h 01h 50h 50h		Ready to read
	01h 00h 00h 01h 5Eh 5Eh	Reader ACK

The <ADDRESS> field is for a multi-reader system. This function is not currently supported. The recommended value for this field is NULL (00Hex), however, any value will work.

If the value of <COUNT> fields are zero, an <EOT>, followed by the <BCC>, completes the message. The reader may, at its option, use NULL for COUNT when transmitting.

For Protocols 1 and 2, if the reader detects an error in an incoming transmission, it will respond with a "Communications Error" message. If the host detects a transmission error, it may request a retransmission. Both protocols enforce a 100mSec timeout between characters.

For all Protocols, the host may, at any time, stop/start the reader transmission by using software "handshake" (DC3/DC1) or hardware "handshake" (if enabled in EEPROM configuration) by controlling the CTS line.

Transmission Format

Data output format (Self-ARM mode)

Protocol code	Tk1 prefix	Tk1 Data	Tk1 suffix	EOT	BCC	
Protocol code	Separator	Tk2 prefix	Tk2 Data	Tk2 suffix	EOT	BCC
Protocol code	Separator	Tk3 prefix	TK3 Data	Tk3 suffix	EOT	BCC

Read data for command

Read tk1 data for command

Protocol code	Tk1 prefix	Tk1 Data	Tk1 suffix	EOT	BCC
---------------	------------	----------	------------	-----	-----

Read tk2 data for command

Protocol code	Tk2 prefix	Tk2 Data	Tk2 suffix	EOT	BCC
---------------	------------	----------	------------	-----	-----

Read tk3 data for command

Protocol code	Tk3 prefix	Tk3 Data	Tk3 suffix	EOT	BCC
---------------	------------	----------	------------	-----	-----

Note: Tk x data: SS (option) track data ES (option) LRC (option)

Section 4 COMMANDS and RESPONSES

This section describes the commands and responses available for the MSR120D series. Each item includes the ASCII, hexadecimal codes and comments paragraph. The comments paragraph provides an explanation of the command. The letter 'x' indicates a variable and the letter 'h' is an abbreviation of 'hexadecimal'.

All readers are capable of communicating in 3 protocols: 0, 1 and 2. If protocol 0 is selected, all commands and responses are as listed in this section. If protocol 1 is selected, the characters STX, ETX and BCC must be added to all transmissions. If protocol 2 is selected, the characters SOH, ADDRESS, COUNT and BCC must be added to all transmissions.

➤ **Command — Host to Reader**

P (50h) — Ready to Read

Comments

1	Clear buffers
2	Transmit "ACK"
3	Expect for card swipe
4	Transmit "ACK" after card swipe

After an "Ready to Read" command is received and acknowledged, the only valid commands that will be accepted for execution are: "Abort" <ESC>, "Status" <\$> and LED control commands. When the reader is ready for "Read on Insert", the "ACK" after card swipe will be transmitted after the rear sensor is activated. For read on reverse swipe, the "ACK" after card swipe will be transmitted after the front sensor is de-activated.

p (70h) — Ready to Read

Comments

Same as 'P' command, except an extra response " (" is reported when a media is detected through the read head. A ") " response is reported when media detect goes inactive, and response " > " when no magstripe.

Q (51h) — Transmit Standard Data, Track 1

R (52h) — Transmit Standard Data, Track 2

S (53h) — Transmit Standard Data, Track 3

Comments

1	Process data in the read buffer for the specified track according to ISO, AAMVA and DVM format.
2	Transmit data in ASCII.
3	If error is detected, transmit proper error response "*". If no data transmit "+". (Refer to Responses — Reader to Host later in this section).

U (55h) — Transmit Customized Data, Track 1

V (56h) — Transmit Customized Data, Track 2

W (57h) — Transmit Customized Data, Track 3

Comments

1	To request customized data with no "nulls" allowed, use the two bytes command: "transmit customized data" command, followed by an ASCII number (3-8), which specifies the number of bits per customized character.
2	Process data to the read buffer for the specified track, based upon the "number of bits" character.

u (75h) — Transmit Reverse Customized Data, Track 1

v (76h) — Transmit Reverse Customized Data, Track 2

w (77h) — Transmit Reverse Customized Data, Track 3

Comments

1	To request customized data with no "nulls" allowed, use the two bytes command: "transmit customized data" command, followed by an ASCII number (3-8), which specifies the number of bits per customized character.
2	Process reversed-bit data (result of reverse swipe) to the read buffer for the specified track, based upon the "number of bits" character.

% (25h) — Retransmit

Comments

Request to retransmit the previous valid command except "P" and "p" commands.

Note: Z (or z) won't be retransmitted.

(23h) — Configuration Request

Comments

Transmit a byte, which represent configuration of the interface as follows:

Table 4-2. Interface Configuration

Bit 0	Track 1 read capability
Bit 1	Track 2 read capability
Bit 2	Track 3 read capability
Bit 3	0
Bit 4	0
Bit 5	1
Bit 6	1
Bit 7	Parity (protocol 0 and 1 only), 0 (protocol 2)

Where "1" bit means "capable of..." and "0" bit means "not capable of...".

L (4Ch) — Green LED On

l (6Ch) — Green LED Off

M (4Dh) — Red LED On

m (6Dh) — Red LED Off

Comments

1	Turn green/red LED on/off, as specified.
2	Transmit "ACK".

((28h) — Green LED Flash

) (29h) — Red LED Flash

Comments

1	Begin flashing the specified LED on and off (approximately 250mSec On and 250mSec Off). Continues flashing until changed by another LED command or by continued interrupt mode operation.
2	Transmit "ACK".

Z (5Ah) — One Long Beep

z (7Ah) — One Short Beep

Comments

1	The buzzer beeps a long (approx. 0.5mSec)/short (approx. 0.2mSec) beep.
2	Transmit "ACK".

DC3 (13h) — Pause Transmit

Comments

Stop transmitting data.

DC1 (11h) — Resume Transmit

Comments

Resume transmission of data.

T (54h) — Card Type Report

Comments

Transmit a byte, which represent the swiping card type.

1 (31H)	CA old DMV
2 (32H)	AAMVA
3 (33H)	ISO
4 (34H)	JIS
6 (36H)	Trade Show Card
0 (30H)	No data (sending T command just right after power on)

ESC (1Bh) — Abort

Comments

1	Abort command is issued after the first character of double character "read" command has been issued.
2	Abort command is issued after the reader has responded to command "P" or "p". (Reader would be waiting for card swipe to read).
3	No response to "Abort" command if the reader just power on and no command is received before.

9 (39h) — Version Report

Comments

Transmit a string that includes the version number (8-digit) and its date (mmddy).

DEL (7Fh) — Warm Reset

Comments

Abort all current actions and cause the device to execute all initialization functions (device will respond exactly as it would for a "power on" cycle).

Note: This command byte is not recognized as a command within data strings.

\$ (24h) — Reader Status Request

Comments

Transmit one byte representing the reader status as follows:

Table 4-3. Reader Status

Bit	0	1
0 & 1	00:Green LED off 01:Green LED on 10:Green LED flash	
2 & 3	00:Red LED off 01:Red LED on 10:Red LED flash	
4	Buzzer disable	Buzzer enable
5	No magstripe data	Magstripe data available
6	Not ready to read	Ready to read
7	Parity for protocols 0 &1	Not used for protocol 2

➤ Response — Reader to Host

^ (5Eh) — ACK

Comments

Last command has been completed without an error condition, and ready for the next command.

+ (2Bh) — No Data

Comments

If host gets the response from reader, it may mean one of following:

1	In case of a "standard format" read command, this response "+" means "no start sentinel (SS) found".
2	In case of a "read error" command, this response "+" means "no history of a previous read error".

* (2Ah) — Error

Comments

If host gets the response from reader, it may mean one of following:

1	No end sentinel (ES).
2	Parity error.
3	LRC error.

? (3Fh) — Communication Error

Comments

If host gets the response from reader, it may mean one of following:

1	Bad parity.
2	Wrong BCC.
3	Receive character time-out (approximately 2mSec).
4	Message more than maximum character allowed.

! (21h) — Invalid Command

Comments

Command issued by the host was not recognized or won't accept.

: (3Ah) — Power On Report

Comments

The interface has completed its initialization cycle.

~ (7Eh) — Cannot Execute

Comments

Read or encode command cannot be executed due to lack of hardware in the device.

Section 5 CONFIGURATION COMMANDS

This section describes the internal configuration commands available for the MSR120D. Each item provides the ASCII, hexadecimal code and an explanation of the command. The letter “x” indicates a variable and the letter “h” is an abbreviation of “hexadecimal”. The hardware related configuration commands need to do warm reset before becoming effective.

➤ **Command Form**

<09Hex><ADDRESS><command counter Hex><COMMAND><BCC>

Note: Command Length is in hex value.

ESx (45h 53h x) — ES & SS Send Enable/Disable

x = E (45h enable) or D (44h disable)

Table 5-1. ES & SS Send Enable/Disable

Command Form (Hex)	ES&SS Sending
09h 00h 03h 45h 53h 44h 58h	Disable
09h 00h 03h 45h 53h 45h 59h	Enable (default)

LCx (4Ch 43h x) — LRC Send Enable/Disable

x = E(45h enable) or D(44h disable)

Table 5-2. LRC Send Enable/Disable

Command Form (Hex)	LRC Sending
09h 00h 03h 4Ch 43h 44h 41h	Disable (default)
09h 00h 03h 4Ch 43h 45h 40h	Enable

PCx (50h 43h x) — Set Protocol of Power On Report

x is an ASCII number (1-3)

Table 5-3. Protocol Setting

ASCII	Command Form (Hex)	Protocol
1	09h 00h 03h 50h 43h 31h 28h	Protocol 0 (default)
2	09h 00h 03h 50h 43h 32h 2Bh	Protocol 1
3	09h 00h 03h 50h 43h 33h 2Ah	Protocol 2

BZx (42h 5Ah x) — Buzzer Enable/Disable

x = E(45h enable) or D(44h disable)

Note: No matter buzzer is enable or not, the reader still can accept Z or z commands to let it beep.

Table 5-4. Buzzer Setting

Command Form (Hex)	Buzzer
--------------------	--------

09h 00h 03h 42h 5Ah 44h 56h	Disable
09h 00h 03h 42h 5Ah 45h 57h	Enable (default)

TKx (54h 4Bh x) — Set Transmitting Data Tracks

x is an ASCII number (1-7)

Table 5-5. Transmit Tracks Setting

ASCII	Command Form (Hex)	Transmit Tracks
1	09h 00h 03h 54h 4Bh 31h 24h	Track 1
2	09h 00h 03h 54h 4Bh 32h 27h	Track 2
3	09h 00h 03h 54h 4Bh 33h 26h	Track 1 & 2
4	09h 00h 03h 54h 4Bh 34h 21h	Track 3
5	09h 00h 03h 54h 4Bh 35h 20h	Track 1 & 3
6	09h 00h 03h 54h 4Bh 36h 23h	Track 2 & 3
7	09h 00h 03h 54h 4Bh 37h 22h	Track 1, 2 & 3 (default)

AAx (41h 41h x) — Set Address

1	x is a binary byte (00h-0Fh)
2	Set address 00h: <09h 00h 03h 41h 41h 00h 0Ah>

SAx (53h 41h x) — Self-Arm Mode Enable/Disable

x = E(45h enable) or D(44h disable)

Table 5-6. Self-Arm Mode Setting

Command Form (Hex)	Self-Arm Mode
09h 00h 03h 53h 41h 44h 5Ch	Disable
09h 00h 03h 53h 41h 45h 5Dh	Enable (default)

SPx (53h 50h x) — Set Track Separator

1	x = Hex Code
2	x = 00h means do not send separator code

Table 5-7. Track Separator Setting

Command Form (Hex)	Track Separator
09h 00h 03h 53h 50h 00h 09h	Disable (default)
09h 00h 03h 53h 50h 0Dh 04h	Enable

JHx (4Ah 48h x) — Set JIS Read Head

x = E(45h enable) or D(44h disable)

Table 5-8. JIS Read Head Setting

Command Form (Hex)	JIS Read Head
09h 00h 03h 4Ah 48h 44h 4Ch	Without (default)
09h 00h 03h 4Ah 48h 45h 4Dh	With

p1 data (70h 31h data) – Set Track 1 Prefix Code

1	Prefix can be set as 1-6 characters
2	If first character = 00h, prefix code of track 1 will not be sent. It means this function is disabling.

Table 5-9. Set Track 1 Prefix Code

Command Form (Hex)	Track 1 Prefix Code
09h 00h 03h 70h 31h 00h 4Bh	Disable (default)
Example of Track 1 Prefix Code Setting	
09h 00h 03h 70h 31h 0Ah 41h	One character: 0Ah
09h 00h 05h 70h 31h 54h 4Bh 41h 13h	Three characters: 54h 4Bh 41h

p2 data (70h 32h data) – Set Track 2 Prefix Code

1	Prefix can be set as 1-6 characters
2	If first character = 00h, prefix code of track 2 will not be sent. It means this function is disabling.

Table 5-10. Set Track 2 Prefix Code

Command Form (Hex)	Track 2 Prefix Code
09h 00h 03h 70h 32h 00h 48h	Disable (default)
Example of Track 2 Prefix Code Setting	
09h 00h 03h 70h 32h 0Bh 43h	One character: 0Bh
09h 00h 05h 70h 32h 54h 4Bh 42h 13h	Three characters: 54h 4Bh 42h

p3 data (70h 33h data) – Set Track 3 Prefix Code

1	Prefix can be set as 1-6 characters
2	If first character = 00h, prefix code of track 3 will not be sent. It means this function is disabling.

Table 5-11. Set Track 3 Prefix Code

Command Form (Hex)	Track 3 Prefix Code
09h 00h 03h 70h 33h 00h 49h	Disable (default)
Example of Track 3 Prefix Code Setting	
09h 00h 03h 70h 33h 0Ch 45h	One character: 0Ch
09h 00h 05h 70h 33h 54h 4Bh 43h 13h	Three characters: 54h 4Bh 43h

s1 (46h 61h x) – Set Track 1 Suffix Code

1	Suffix can be set as 1-6 characters
2	If first character = 00h, suffix code of track 1 will not be sent. It means this function is disabling.

Table 5-12. Set Track 1 Suffix Code

Command Form (Hex)	Track 1 Suffix Code
09h 00h 03h 73h 31h 00h 48h	Disable (default)
Example of Track 1 Suffix Code Setting	
09h 00h 03h 73h 31h 06h 4Eh	One character: 06h

s2 data (73h 32h data) — Set Track 2 Suffix Code

1	Suffix can be set as 1-6 characters
2	If first character = 00h, suffix code of track 2 will not be sent. It means this function is disabling.

Table 5-13. Set Track 2 Suffix Code

Command Form (Hex)	Track 2 Suffix Code
09h 00h 03h 73h 32h 00h 4Bh	Disable (default)
Example of Track 2 Suffix Code Setting	
09h 00h 03h 73h 32h 06h 4Dh	One character: 06h

s3 data (73h 33h data) — Set Track 3 Suffix Code

1	Suffix can be set as 1-6 characters
2	If first character = 00h, suffix code of track 3 will not be sent. It means this function is disabling.

Table 5-14. Set Track 3 Suffix Code

Command Form (Hex)	Track 3 Suffix Code
09h 00h 03h 73h 33h 00h 4Ah	Disable (default)
Example of Track 3 Suffix Code Setting	
09h 00h 03h 73h 33h 06h 4Ch	One character: 06h

K1A type start end (4Bh 31h 41h type start end)

— Set Transmitting Data Block, Channel A of Track 1

where *type* means card type, *start* means start address of transmitting data, and *end* means end address of transmitting data.

1 (31H)	CA old DMV
2 (32H)	AAMVA
3 (33H)	ISO
4 (34H)	JIS
6 (36h)	Trade Show
O (4FH)	any type

Table 5-15. Data Block Channel A, Tk1

Command Form (Hex)	Data Block Channel A, Tk1
09h 00h 06h 4Bh 31h 41h 00h 00h 00h 34h	Disable (default)

Example of Track 1 Data Block Channel A Setting	
09h 00h 06h 4Bh 31h 41h 33h 06h 20h 21h	ISO 6-32

K1B type start end (4Bh 31h 42h type start end)

- Set Transmitting Data Block, Channel B of Track 1

Table 5-16. Data Block Channel B, Tk1

Command Form (Hex)	Data Block Channel B, Tk1
09h 00h 06h 4Bh 31h 42h 00h 00h 00h 37h	Disable (default)
Example of Track 1 Data Block Channel B Setting	
09h 00h 06h 4Bh 31h 42h 33h 26h 30h 12h	ISO 38-48

K1C type start end (4Bh 31h 43h type start end)

- Set Transmitting Data Block, Channel C of Track 1

Table 5-17. Data Block Channel C, Tk1

Command Form (Hex)	Data Block Channel C, Tk1
09h 00h 06h 4Bh 31h 43h 00h 00h 00h 36h	Disable (default)
Example of Track 1 Data Block Channel C Setting	
09h 00h 06h 4Bh 31h 43h 33h 36h 40h 73h	ISO 54-64

K2A type start end (4Bh 32h 41h type start end)

- Set Transmitting Data Block, Channel A of Track 2

Table 5-18. Data Block Channel A, Tk2

Command Form (Hex)	Data Block Channel A, Tk2
09h 00h 06h 4Bh 32h 41h 00h 00h 00h 37h	Disable (default)
Example of Track 2 Data Block Channel A Setting	
09h 00h 06h 4Bh 32h 41h 32h 0Ah 16h 19h	AAMVA 10-22

K2B type start end (4Bh 32h 42h type start end)

- Set Transmitting Data Block, Channel B of Track 2

Table 5-19. Data Block Channel B, Tk2

Command Form (Hex)	Data Block Channel B, Tk2
09h 00h 06h 4Bh 32h 42h 00h 00h 00h 34h	Disable (default)
Example of Track 2 Data Block Channel B Setting	
09h 00h 06h 4Bh 32h 42h 33h 0Ah 1Ah 55h	ISO 10-26

K2C type start end (4Bh 32h 43h type start end)

– Set Transmitting Data Block, Channel C of Track 2

Table 5-20. Data Block Channel C, Tk2

Command Form (Hex)	Data Block Channel C, Tk2
09h 00h 06h 4Bh 32h 43h 00h 00h 00h 35h	Disable (default)
Example of Track 2 Data Block Channel C Setting	
09h 00h 06h 4Bh 32h 43h 31h 06h 20h 22h	CA old DMV 06-32

K3A type start end (4Bh 33h 41h type start end)

– Set Transmitting Data Block, Channel A of Track 3

Table 5-21. Data Block Channel A, Tk3

Command Form (Hex)	Data Block Channel A, Tk3
09h 00h 06h 4Bh 33h 41h 00h 00h 00h 36h	Disable (default)
Example of Track 3 Data Block Channel A Setting	
09h 00h 06h 4Bh 33h 41h 4Fh 10h 30h 59h	Any type 16-48

K3B type start end (4Bh 33h 42h type start end)

– Set Transmitting Data Block, Channel B of Track 3

Table 5-22. Data Block Channel B, Tk3

Command Form (Hex)	Data Block Channel B, Tk3
09h 00h 06h 4Bh 33h 42h 00h 00h 00h 35h	Disable (default)
Example of Track 3 Data Block Channel B Setting	
09h 00h 06h 4Bh 33h 42h 33h 11h 34h 23h	ISO 17-52

K3C type start end (4Bh 33h 43h type start end)

– Set Transmitting Data Block, Channel C of Track 3

Table 5-23. Data Block Channel C, Tk3

Command Form (Hex)	Data Block Channel C, Tk3
09h 00h 06h 4Bh 33h 43h 00h 00h 00h 34h	Disable (default)
Example of Track 3 Data Block Channel C Setting	
09h 00h 06h 4Bh 33h 43h 32h 06h 40h 40h	AAMVA 06-64

DF0 (44h 46h 00h) — Default Setting

Command Form: <09h 00h 03h 44h 46h 00h 08h>

Default setting is as below:

1	9600 baud rate	2	8 bits non parity
3	Send SS/ES	4	LRC not send

5	CTS disable	6	RTS disable
7	Buzzer enable	8	without JIS read head
9	Power on in protocol 0	10	Transmit TK1, TK2 and TK3
11	Self-Arm Mode enable	12	Read address = 00h

RE0 (52h 45h 00h) – Read EEPROM Data

Command Form: <09h 00h 03h 52h 45h 00h 1Dh>

1	The reader's setting status is recorded in EEPROM. 98 bytes total.
2	The symbol "*" in this paragraph indicates "do not care".

Byte1 and 2 in EEPROM are 00h, 13h separately. They are identical characters.

Byte 3 in EEPROM

Table 5-24. Byte 3 of EEPROM Status

Bit 7	SS&ES Status	Bit 6	LRC Status	Bit 5	Bit 4	Bit 3	Bit & Parity	Bit 2	Bit 1	Bit 0	Baud Rate Status
0	Not Send	0	Send	0	0	0	7 even	0	0	0	1200
1	Send	1	Not send	0	0	1	7 odd	0	0	1	2400
*	*	*	*	0	1	0	7 mark	0	1	0	4800
*	*	*	*	0	1	1	7 space	0	1	1	9600
*	*	*	*	1	0	0	8 none	1	0	0	19200

Note: Bit 0-5 are reserved.

Byte 4 in EEPROM

Table 5-25. Byte 4 of EEPROM Status

Bit 7	Bit 6	Protocol	Bit 5	CTS Status	Bit 4	RTS Status	Bit 3	MSR 100 output format	Bit 2	Bit 1	Bit 0	Transmitting Data Track
0	1	0	0	Ignore	0	Always low	0	Disable	*	*	0	Not Transmit Tk1
1	0	1	1	Consider	1	Low when transmit data	1	Enable	*	*	1	Transmit Tk1
1	1	2	*	*	*	*	*	*	*	0	*	Not Transmit Tk2
*	*	*	*	*	*	*	*	*	*	1	*	Transmit Tk2
*	*	*	*	*	*	*	*	*	0	*	*	Not Transmit Tk3
*	*	*	*	*	*	*	*	*	1	*	*	Transmit Tk3

Note: If never set "PC" command then bit 6 and bit 7 are 00, it means protocol 0.

Note: Bit 4 & 5 are reserved.

Byte 5 in EEPROM

Table 5-26. Byte 5 of EEPROM Status

Bit 7	Bit 6	Bit 5	Bit 4	Address (Hex code)	Bit 3	JIS Read Head	Bit 2	Self-Arm Mode	Bit 1	Bit 0	Buzzer
*	*	*	*	*	0	Without	0	Disable	*	0	Disable
*	*	*	*	*	1	With	1	Enable	*	1	Enable
*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*	*	*

Byte 6 in EEPROM: Track Separator Setting

Hex code “00h” means do not transmit this byte.

Byte 7-12 in EEPROM: Track 1 Prefix Code Setting

Byte 13-18 in EEPROM: Track 2 Prefix Code Setting

Byte 19-24 in EEPROM: Track 3 Prefix Code Setting

Byte 25-30 in EEPROM: Track 1 Suffix Code Setting

Byte 31-36 in EEPROM: Track 2 Suffix Code Setting

Byte 37-42 in EEPROM: Track 3 Suffix Code Setting

Note: Each byte in byte 7-42 is Hex code. When one of the byte is “00h” the device do not transmit data from this byte to the end byte of the block.

Byte 43-45 in EEPROM: Channel A of Track 1 Setting

Byte 47-49 in EEPROM: Channel B of Track 1 Setting

Byte 51-53 in EEPROM: Channel C of Track 1 Setting

Byte 55-57 in EEPROM: Channel A of Track 2 Setting

Byte 59-61 in EEPROM: Channel B of Track 2 Setting

Byte 63-65 in EEPROM: Channel C of Track 2 Setting

Byte 67-69 in EEPROM: Channel A of Track 3 Setting

Byte 71-73 in EEPROM: Channel B of Track 3 Setting

Byte 75-77 in EEPROM: Channel C of Track 3 Setting

Byte 78-84 in EEPROM: Reserved.

Byte 85 in EEPROM: Raw Data Output Mode Setting.

Bit-0 = 1 is enable and bit-0 = 0 is disable. Bit 1-7 is 0.

Byte 86-98 in EEPROM: Reserved.

Note: Each byte in byte 43-77 is Hex code. The first byte of each block represents card type. The second byte of each block represents the start address of transmitting data. The third byte of each block represents the end address of transmitting data.

Note: Byte 46, 50, 54, 58, 62, 66, 70, 74 are not used.

RE1 (52h 45h 31h) — Read Configuration Status

Command Form: <09h 00h 03h 52h 45h 31h 2Ch>

This is used to send byte 3-6 data of EEPROM to host.

RE2 (52h 45h 32h) — Read Prefix & Suffix Setting Status of Tracks

Command Form: <09h 00h 03h 52h 45h 32h 2Fh >

This is used to send byte 7-42 data of EEPROM to host.

RE3 (52h 45h 33h) — Read Channel Setting Status of Tracks

Command Form: <09h 00h 03h 52h 45h 33h 2Eh>

This is used to send byte 43-77 data of EEPROM to host.

Note: In the case of RE1, RE2, RE3 command, the device transforms the EEPROM data from hexadecimal code into ASCII code, and send it out. For example, if the EEPROM data is “2Ah” the host will receive “32h 41h”. Hence, executing these 3 commands, the host will serially transform each 2 bits of received date into hexadecimal code.

RE4 (52h 45h 34h) — Read Serial Number

Command Form: <09h 00h 03h 52h 45h 34h 29h>

This is used to send byte 100-107 data of EEPROM to host.

Note: In the case of RE4 command, the device transforms the EEPROM data from hexadecimal code into ASCII code per byte, and sends it out.

Sdx (53h 64h x) — MSR100 Output Format Enable/Disable

x = E (45h enable) or D (44h disable)

Table 5-31. MSR100 output format setting

Command Form (Hex)	MSR100 output format
09h 00h 03h 53h 64h 44h 79h	Disable (default)
09h 00h 03h 53h 64h 45h 78h	Enable

This command is only effective in self-arm mode and protocol 0.

When MSR100 output format is enabled, the output data format is as below:

Single track	<STX><SS><SINGLE TRACK DATA><ES><LRC (optional)><ETX>
Dual track	<STX><SS><FIRST TRACK DATA><ES><LRC (optional)><DLE>
	<STX><SS><SECOND TRACK DATA><ES><LRC (optional)><ETX>
Triple track	<STX><SS><TRACK 1 DATA><ES><LRC (optional)><DLE>
	<STX><SS><TRACK 2 DATA><ES><LRC (optional)><DLE>
	<STX><SS><TRACK 3 DATA><ES><LRC (optional)><ETX>

Remarks:

SS = START SENTINEL
 TRACK1= “%” (ISO, DMV & AAMVA)
 TRACK2= “;” (ISO, DMV & AAMVA)
 TRACK3= “;” (ISO) “%” (AAMVA) “!” (CA old DMV)
 ES = END SENTINEL
 TRACK1, 2 & 3= “?” (ISO, CA old DMV & AAMVA)

STX = START TEXT, ETX = END TEXT, DLE = DATA LINK ESCAPE, LRC = CHECKSUM (optional).

When MSR100 output format is disabled, the output data format restores to previous setting.

Note: 1. Only following commands are valid while MSR100 output format is enabled:

BRx, DF0, LCx, RTx, CTx, and BL.

2. If read error or no data, then output nothing.

SN data (53h 4Eh data) – Write serial number

1	Serial number can be set as 0-7 characters
2	The character in hex is valid from 20 to 7E.

Table 5-32. Write serial number

Command Form (Hex)	Serial Number Code
09h 00h 02h 53h 4Eh 16h	0000000 (7 zeros, default)
Example of Serial Number Setting	
09h 00h 03h 53h 4Eh 0Ah 1Dh	One character: 0Ah
09h 00h 09h 53h 4Eh 31h 32h 33h 34h 35h 36h 37h 2Dh	Seven characters: 31h 32h 33h 34h 35h 36h 37h

Note: Before sending SN command, if the LED is blinking, it may let LED keep either on or off still during the SN is in the process of writing.

RDx (52h 44h x) – Raw Data Output Mode Enable/Disable

x = E (45h enable) or D (44h disable)

Table 5-32. Raw Data Output Mode Setting

Command Form (Hex)	Raw Data Output Mode
09h 00h 03h 52h 44h 44h 58h	Disable (default)
09h 00h 03h 52h 44h 45h 59h	Enable

This command is only effective in self-arm mode and protocol 0. The raw data output mode setting could be viewed from byte 85 in EEPROM via sending command RE0.

When Raw Data Output mode is enabled, the output data format is as below:

Single Track	<01H or 02H or 03H> Prefix <Raw Data>Suffix<CR>
Dual Track	<01H or 02H>Prefix<Raw Data>Suffix<CR> <02H or 03H>Prefix<Raw Data>Suffix<CR>
Triple Track	<01H>Prefix<Raw Data>Suffix<CR> <02H>Prefix<Raw Data>Suffix<CR> <03H>Prefix<Raw Data>Suffix<CR>

When Raw Data Output mode is disabled, the output data format restores to previous setting.

Note: 1. Only following commands are valid while Raw Data Output mode is enabled:

BRx, PTx, RTx, CTx, TKx, p1, p2, p3, s1, s2, s3, Sdx, DF0, RE0, RE1, RE2, RE3, RE4, SN, %, #, L, 1,
M, m, (,), Z, z, 9, DEL and \$.

2. It will output nothing while read no data.

Section 6 Download Specification

➤ Introduction

This section provides the information about firmware download via sending download commands from host to the reader. Except download commands, there are some system commands listed below can be used in boot mode for application purpose.

1. 9 (39h) -- Version Report
2. L (4Ch) -- Green LED On
3. l (6Ch) -- Green LED Off
4. Z (5Ah) -- One Long Beep
5. z (7Ah) -- One Short Beep

➤ Enter Boot Mode

The reader can go into boot mode by receiving the specific command from host when the f/w download is needed.

Anytime, in case the reader goes abnormally, user can use another way to let reader go into boot mode and re-download firmware. Power off reader, set the switch S1-2 on, and then power on the reader to force reader gets into boot mode. As soon as f/w download done, user have to power off the reader and turn switch S1-2 off.

The reader cannot do normal operation while switch S1-2 is on.

Procedure

According to the description above, user can use either ways below to go into boot mode:

1. Power off reader, set the switch S1-2 on, and then power on the reader to force reader gets into boot mode.
2. Send **command BL** to the reader. As soon as the reader acknowledges this command, it will go into **boot mode** and the LED keeps **red flashing**.

When the reader is in boot mode, it can accept download commands from host to do download firmware.

For download firmware, the host shall send the command(s) to reader sequentially. The host shall send the **command RS** to reset the reader after finishing download. If any errors are occurred during download, the host will receive the error response commands *. After the host received the command, it shall abort the process.

User shall follow the steps below in order to do firmware download:

1. **Erase system program area** first.
2. To do the **blank check** after step 1. If the result is failed, then repeat step 1.
3. Send **programming indicator** command to inform reader how much amount data will be downloaded.
4. Send **start programming** command to do firmware download. If it's timeout during downloading, repeat the procedure from step 1.

➤ Command Sets

This section describes the download commands and responses available for the reader. Except command BL, the download commands are effective only in boot mode.

Each download command description includes its data element, size and comments. The comments provide an explanation of each data element. The letter 'H/h' written in size column is an abbreviation of 'hexadecimal'.

Except transfer data command 06, all download commands are preceded by a header, hex code 09h, and terminated with one byte {LRC}. {LRC} is an XOR of the 8 data bits of each character in the entire download command.

Download Command Format:

<09Hex><Address><Command Length><Command>[Data 1][Data 2]<LRC>

Note: Default <Address> is 00h; <Command length> is in hex value; [Data] is optional.

Data Element	Size	Comments
<Header>	1H	Download Command Header, value: 09h
<Address>	1H	Address, value: 00h (default)
<Command Length>	1H	Indicate the length of <command> and [data]
<Command>	2H	Command code
[Data]	1H	Optional
{LRC}	1H	Error Check
Maximum: 8 characters		Minimum: 6 characters

Download Commands

The download commands are used to enter boot mode and do firmware related functions between host and reader.

Command	Description	Effective Mode
BL	Request the reader to enter boot mode	Both in system and boot mode
RS	Programming reset	Boot mode only
CS	Request checksum of system program	Boot mode only
ES	Erase system program area by filling with FFh	Boot mode only
BC	Blank check	Boot mode only
PRG	Programming indicator	Boot mode only
06	Start programming	Boot mode only

Command BL --- Request the reader to enter boot mode

When the reader receives this command from host, it will go into boot mode and let LED goes red flashing without responding any message to host.

Command: BL, RS, CS, ES, BC		
Command Format: <Header><Address><Command Length><Command>{LRC}		
Data Element	Size	Comments
<Header>	1H	Packet Command Header, value: 09h
<Address>	1H	Address, value: 00h (default)
<Command Length>	1H	Indicate the length of <command>, value: 02h
<Command>	2H	Command code
{LRC}	1H	Error Check
Maximum: 6 characters Minimum: 6 characters		

Command RS --- Programming reset

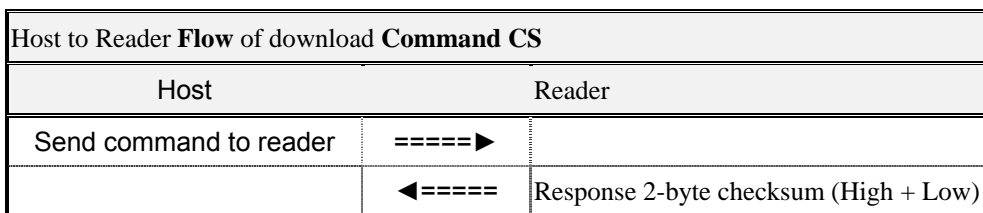
After download done, the host shall send this command to the reader to reset the reader. As soon as the reader receives this command, it will execute all initialization functions (device will respond exactly as it would for a "power on" cycle) and let the reader back to system mode.

Note: The command format can be found in command BL section.

Command CS --- Request checksum of system program

The host sends this command to request the checksum (2-byte) of system program.

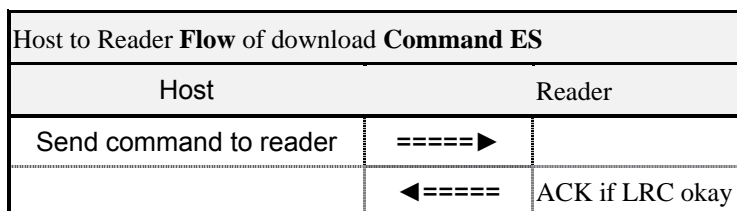
Note: The command format can be found in command BL section.



Command ES --- Erase system program area by filling with FFh

When the reader receives this command, it starts to fill FFh into system program area.

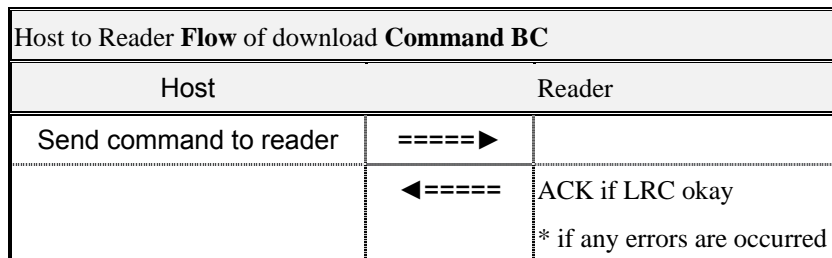
Note: The command format can be found in command BL section.



Command BC --- Blank check

This is used to verify if the erase command ES above works complete or not. If not, user shall send erase command ES and verify by command BC again prior to download f/w.

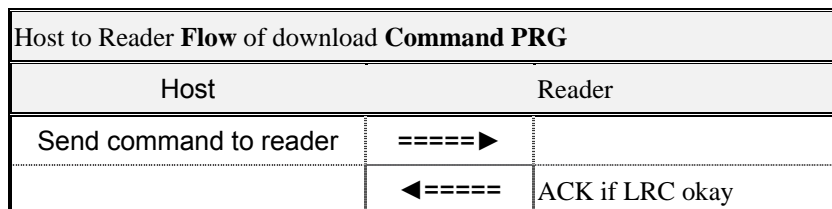
Note: The command format can be found in command BL section.



Command PRG --- Programming indicator

This is used to indicate how much amount data will be downloaded. This command shall be preceded prior to download firmware

Command: PRG		
Command Format: <Header><Address><Command Length><Command>[Data 1][Data 2]{LRC}		
Data Element	Size	Comments
<Header>	1H	Packet Command Header, value: 09h
<Address>	1H	Address, value: 00h (default)
<Command Length>	1H	Indicate the length of <command> and [data], value: 05h
<Command>	3H	Command code
[Data 1]	1H	Programming data amount, high-byte
[Data 2]	1H	Programming data amount, low-byte
{LRC}	1H	Error Check
Maximum: 9 characters Minimum: 9 characters		



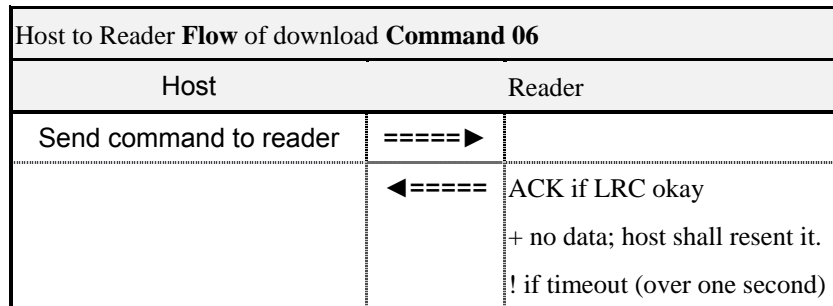
Command 06 --- Start programming

The host shall send this command to reader to download system program just right after sending out programming indicator command PRG. The interval prior to send out this command shall not exceed one second; otherwise, the host shall resend the programming indicator command PRG.

When the reader receives this command, it will start download firmware from the very first location. The reader may receive this command several times continuously that depends on how much amount data will be downloaded.

Similarly, the interval between each command 06 shall not exceed one second; otherwise, the host shall resend command ES, BC, PRG, and 06 in order.

Command: 06		
Command Format: <Command><Data size counter + 1><Data>{LRC}		
Data Element	Size	Comments
<Command>	1H	Command code, value: 06h
<Data size counter + 1>	1H	Indicate the data size
<Data>	0-255H	Programming data
{LRC}	1H	Error Check
Maximum: 258 characters Minimum: 3 characters		




Appendix A Download Application

This section illustrates instructions in download application installation and firmware download via this application on Windows 98.

➤ **System Requirements**

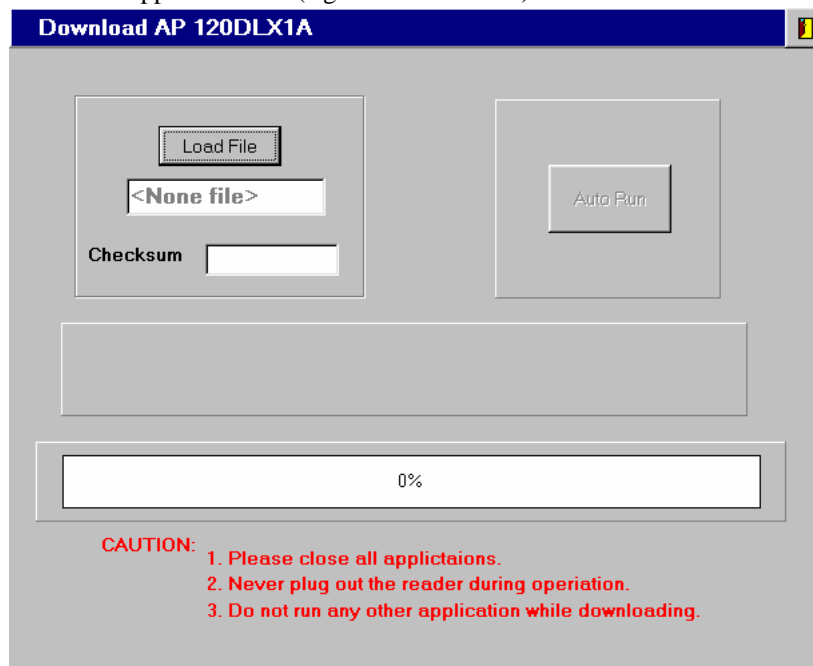
Before you use the MSR120D, make sure your computer is an IBM PC-compatible with the following minimum system requirements:

1. Intel-compatible 486DX-66 MHz CPU or higher
2. One standard USB port (4-pin) and has the symbol  with driver installed.
3. Either the following operating systems:
Windows 95 OSR2.1 (B version) with USB version 1214, Windows 98, or Windows 2000.

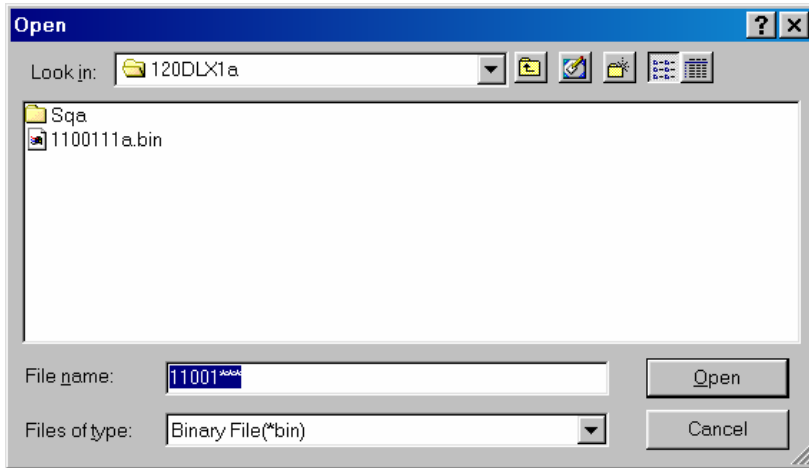
➤ **Application Installation and Firmware Download**

User shall follow the steps below in order to install application and do firmware download:

1. Connect MSR120D to USB port.
2. Execute application file (e.g. 120DLX1A.exe)



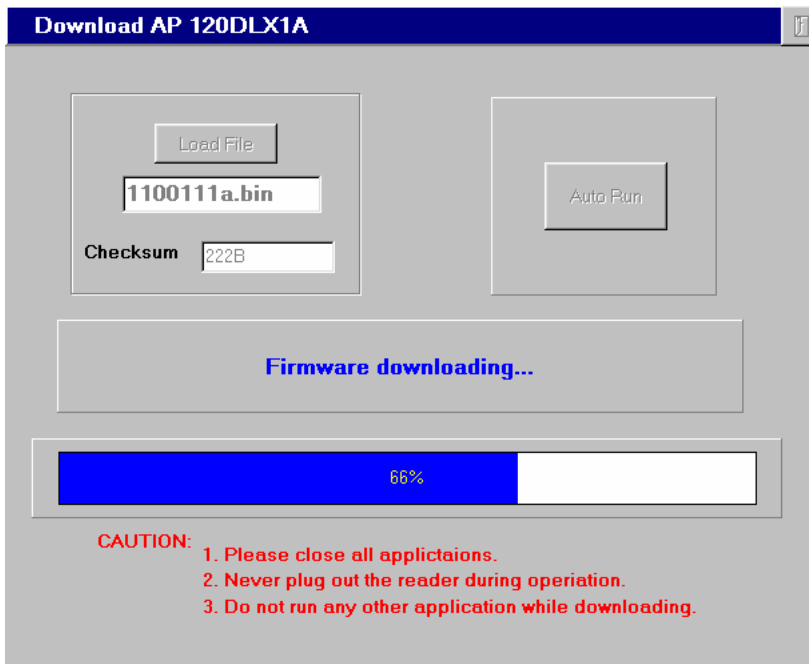
3. Select download firmware by click **Load File** button



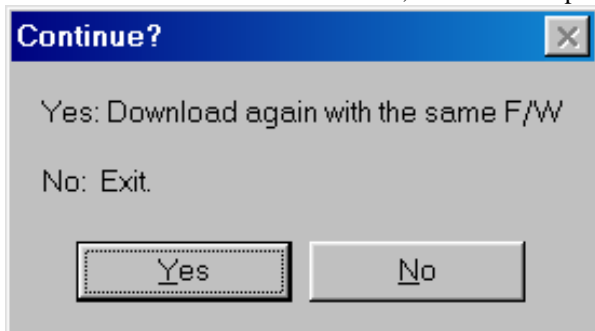
4. Press **Auto Run** button to do firmware download automatically.

At this stage, the application will do actions sequentially as follows:

- a. Enter boot mode, the application will auto detect reader's communication port, baud rate, data bit, and parity setting. As soon as reader gets into boot mode, the LED goes red flashing and beeps once.
- b. Erase system program area and do blank check.
- c. Start firmware download.



d. After successful download done, the reader beeps once.



After download done, user can close the application by click [No] button in 'Continue?' dialog box, and return to normal operation. If user wants to download the second unit with the same f/w, just connect the unit to USB port, and click [Yes] button in 'Continue?' dialog box to continue/repeat the download process automatically.

If there is any error occurred during process, the error message prompts. User may do error check per prompts.