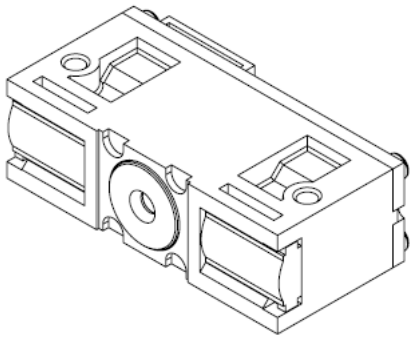
MT780

(3.3V Linear Image Barcode Scan Engine)

Integration Guide



Version 3.0

DATE: 2021/10/19

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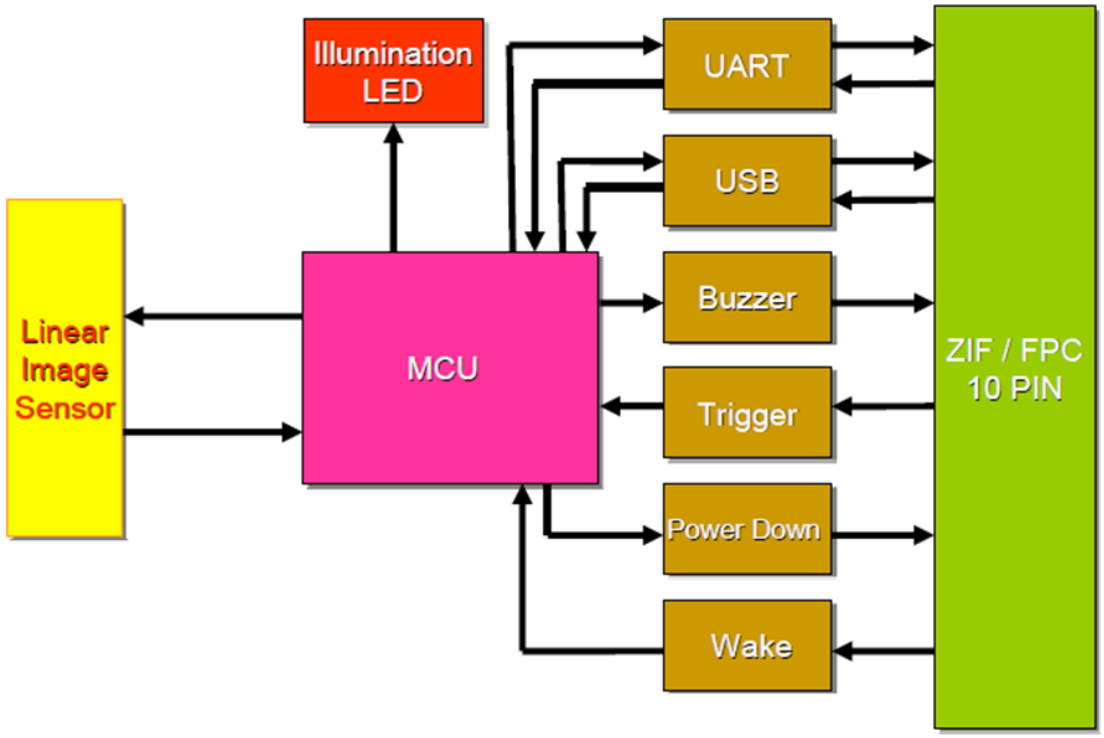
1. INTRODUCTION

The MT780 Linear Image Barcode Scan Engine is designed for 1D barcode reading, and high performance barcode scanning with optimal performance and easy integration. MT780 is ideal for integration into data terminals and other small mobile devices.

The MT780 consists of 2 illumination LEDs, a high-quality linear image sensor and a microprocessor that contains powerful firmware to control all aspects of operations and enable communication with the host system over the standard set of communication interfaces.

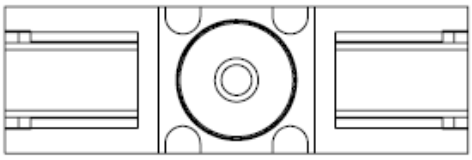
Two interfaces, UART & USB, are available. UART interface communicates with the host system over TTL-level RS232 communication; USB interface emulates a USB Keyboard device and communicates with the host system over USB.

1-1. MT780 Block Diagram

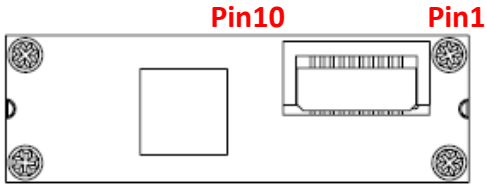


1-2. Electric Interface

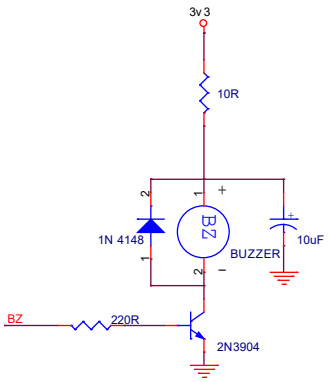
1-2-1. Pin Assignment

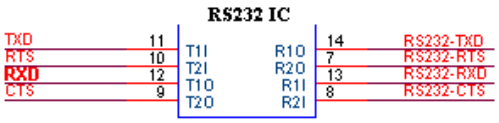
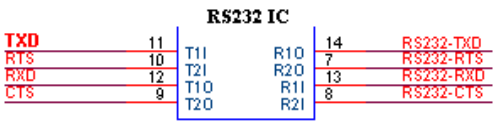


(Front View)



(Back View)

Pin#	UART	USB	I/O	Description	Schematic Example
1	Power Down	Power Down	Output	Power Down Status	High: Scan engine in idle mode Low: Scan engine in normal operation
2	VDD	VDD	---	Power Supply	Operating Voltage: 3.3V ± 5% **Note: An input voltage with capacitance value of at least 10μF.*
3	GND	GND	---	Ground	
4	Wake	Wake	Input	Wake Up	Active Low: Wake up scan engine from idle mode
5	Buzzer	Buzzer	Output	Beeper output	Active High: Power-Up or a successful barcode decode. PWM controlled signal can be used to drive an external buzzer 

Pin#	UART	USB	I/O	Description	Schematic Example
6	Trigger	Trigger	Input	Trigger input	High: Power-up/Standby Low: Scanning Operation **Note:* *1. Scanning operation continues until a barcode is successfully decoded or the trigger is released (pull high). To proceed to the next scanning operation, release (pull high) first and press (pull low) the trigger again.* *2. Pull low at power-up will promt the scan engine into firmware update mode*
7	---	USB_DP	Input / Output	USB Signal D+	Differential Signal Transmission
8	---	USB_DM	Input / Output	USB Signal D-	Differential Signal Transmission
9	RXD	---	Input	UART TTL data input	 Sipex® Vendor P/N: SP232ACT
10	TXD	---	Output	UART TTL data output	 Sipex® Vendor P/N: SP232ACT

1-2-2. Electric Characteristics

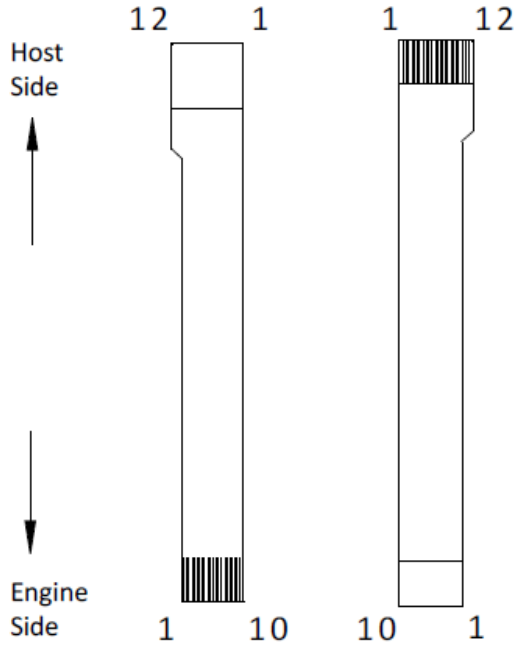
Symbol	Ratings	Min	Max	Unit
V_{IH}	Input high level	V_{DD} x 0.65	V_{DD} + 0.4	V
V_{IL}	Input low level	- 0.4	V_{DD} x 0.35	V
V_{OH}	Output high level	V_{DD} - 0.4	-	V
V_{OL}	Output low level	-	0.4	V
V_{ESD}	Electrostatic discharge voltage (human body mode)	- 4000	+ 4000	V

***Note:**

1. Power Supply**:** V_{DD}=3.3 ± 5%
2. Exposure to maximum rating conditions for extended periods may affect device reliability.

1-2-3. Flex Cable

The flex cable is used to connect MT780 to the host side. There are 10 pins on the MT780 (engine) side and 12 pins on the host side. Please see 2-10 for more details of flex cable.



Flex cable (P/N: 6341-0501010)	
Pin#	**Pin Assignment To Host**
1	VCC
2	GND
3	RXD
4	TXD
5	USB D+
6	USB D-
7	Power Down
8	Buzzer
9	N/A
10	N/A
11	Trigger
12	Wake

***Note:** Conforms to Marson MT700's pin assignment.

1-3. Operational Timing

This chapter describes the timing associated with the various operating modes of the MT780 including Power Up, Sleep Mode, and Decode Timing.

1-3-1. Power Up

When power is initially applied, the MT780 is activated and begins the process of initialization. Once initialization (duration ≦ 10mS) is completed, the MT780 emits a power-up beep, enters **Standby Mode** and is ready for barcode scanning.

1-3-2. Sleep (Idle) Mode

The MT780 will enter **Sleep (Idle) Mode** and output a Power Down signal (Active high) after a programmable time period has elapsed without any activity. Please see Chapter 6 for more details about Sleep Mode.

1-3-3. Decode Timing

In **Standby Mode**, the MT780 is activated by the Trigger signal which MUST be kept low for at least 20 mS until the successful scan is achieved, as indicated by the Buzzer signal.

The total scan and decode time is approximately equal to the time from the Trigger signal going low to the Buzzer signal going high. This time will vary slightly based on several factors including barcode quality, barcode type and the distance between MT780 and the barcode scanned. The following waveforms show a typical condition.

Upon a successful scan, the MT780 outputs the Buzzer signal and keeps this signal for the duration of the transmission of the data decoded to the host side. The duration is about 80 mS.

Therefore, the total duration of a typical scanning operation (from Trigger turning low to the end of Buzzer PWM signal) is approximately 120mS.

In **Sleep Mode**, the MT780 can be by the Trigger signal which MUST be

kept low for at least 20 mS until the successful scan is achieved, as indicated by the Buzzer signal. Wake signal can also be used to wake up the MT780, which, MUST also be kept low for at least 2 mS, will prompt the scan engine into **Standby Mode**.

The total scan and decode time is approximately equal to the time from the Trigger signal going low to the Buzzer signal going high. This time will vary slightly based on several factors including barcode quality, barcode type and the distance between MT780 and the barcode scanned. The following waveforms show a typical condition.

Upon a successful scan, the MT780 outputs the Buzzer signal and keeps this signal for the duration of the transmission of the data decoded to the host side. The duration is about 80 mS.

Therefore, the total duration of a typical scanning operation (from Trigger turning low to the end of Buzzer PWM signal) is also approximately 120mS.

1-3-4. Summary of Operation Timings

The maximum duration of initialization is 10mS.

The maximum duration of scanning operation in **Standby Mode** is 120mS.

The maximum duration of waking up MT780 from **Sleep Mode** by Trigger/Wake signal is about 2 mS.

The maximum duration of waking up MT780 from **Sleep Mode** by Trigger signal and completing decode is about 120ms.

2. SPECIFICATIONS

2-1. Introduction

This chapter provides technical specifications of the MT780 scan engine. Operating method, scanning range and scan angle are also presented.

2-2. Technical Specifications

Optic & Performance		
Light Source		625nm visible red LED
Sensor		CMOS Linear Sensor
Scan Rate		620 Scans/ sec (Smart Detection)
Resolution		3mil/ 0.075mm
Scan Angle		53°
Print Contrast Ratio		30%
Width of Field		200mm (13Mil Code39)
Typical Depth Of Field (Environment: 800 lux)	**3 mil Code39**	64 ~ 100mm (13 digits)
	4 mil Code39	56 ~ 132mm (4 digits)
	5 mil Code39	51 ~ 169mm (4 digits)
	10 mil Code39	25 ~ 304mm (4 digits)
	15 mil Code39	39 ~ 437mm (4 digits)
	13 mil UPC/ EAN	30 ~ 338mm (13 digits)
Guaranteed Depth Of Field (Environment: 800 lux)	**3 mil Code39**	N/A
	4 mil Code39	70 ~ 120mm (4 digits)
	5 mil Code39	70 ~ 150mm (4 digits)
	10 mil Code39	35 ~ 280mm (4 digits)
	15 mil Code39	45 ~ 410mm (4 digits)
	13 mil UPC/ EAN	40 ~ 320mm (13 digits)
Physical Characteristics		
Dimension		(L)23.7 x (W)12.2 x (H)7.5 mm
Weight		2g
Color		Black
Material		PC
Connector		10pin (pitch = 0.5mm) ZIF
Cable		10pin to 12pin (pitch = 0.5mm) flex cable

Electrical	
Operation Voltage	3.3VDC±5%
Working Current	< 170 mA
Standby Current	< 60 mA
Idle Current (Sleep Mode)	< 100 uA
Surge Current	< 500 mA
Connectivity	
Interface	UART (TTL-level RS232)
	USB (HID Keyboard)
User Environment	
Operating Temperature	-20°C ~ 60°C
Storage Temperature	-20°C ~ 60°C
Humidity	0% ~ 95%RH (Non-condensing)
Drop Durability	1.5M
Ambient Light	100,000 Lux (Sunlight)
Symbologies	UPC-A/ UPC-E EAN-8/ EAN-13 Matrix 2 of 5 China Postal Code (Toshiba Code) Industrial 2 of 5 Interleaved 2 of 5 Standard 2 of 5 (IATA Code) Codabar Code 11 Code 32 Standard Code 39 Full ASCII Code 39 Code 93 Code 128 EAN/ UCC 128 MSI Plessey Code UK Plessey Code Telepen Code GS1 Databar
Regulatory	
ESD	Functional after 4KV contact, 8KV air discharge

	(it requires housing that is designed for ESD protection and stray from electric fields.)
EMC	FCC – Part15 Subpart B (Class B) CE – EN55022, EN55024
Safety Approval	IEC 62471 (Exempt Group)
Environmental	WEEE, RoHS 2.0

2-3. Interface

MT780 supports both UART and USB output interface.

2-3-1. UART Interface

Below default values of communication parameters apply to both Standard mode and Command mode firmware.

Baud rate: 9600

Data Bits: 8

Parity: None

Stop Bit: 1

Handshaking: None

Flow Control Timeout: None

ACK/NAK: OFF

BCC: OFF

Characteristics:

(1) Configurable by scanning configuration barcodes from 1D Scan Engine User's Manual or by Ez Utility®, a PC-based software utility.

(2) Configurable by serial commands, which are listed in Serial Commands Manual.

(3) Supports both software & hardware trigger

Interface Configuration Barcode:

. C002$

UART

Scanning above barcode will set your MT780 to UART interface.

2-3-2. USB Interface

Characteristics:

(1) Configurable by scanning configuration barcodes from 1D Scan Engine User's Manual or by Ez Utility®, a PC-based software utility.

(2) Configurable by serial commands, which are listed in Serial Commands Manual.

(3) Supports hardware trigger only

(4) Emulates a USB Keyboard device

Interface Configuration Barcode:

. C008$

USB HID

Scanning above barcode will set your MT780 to USB interface.

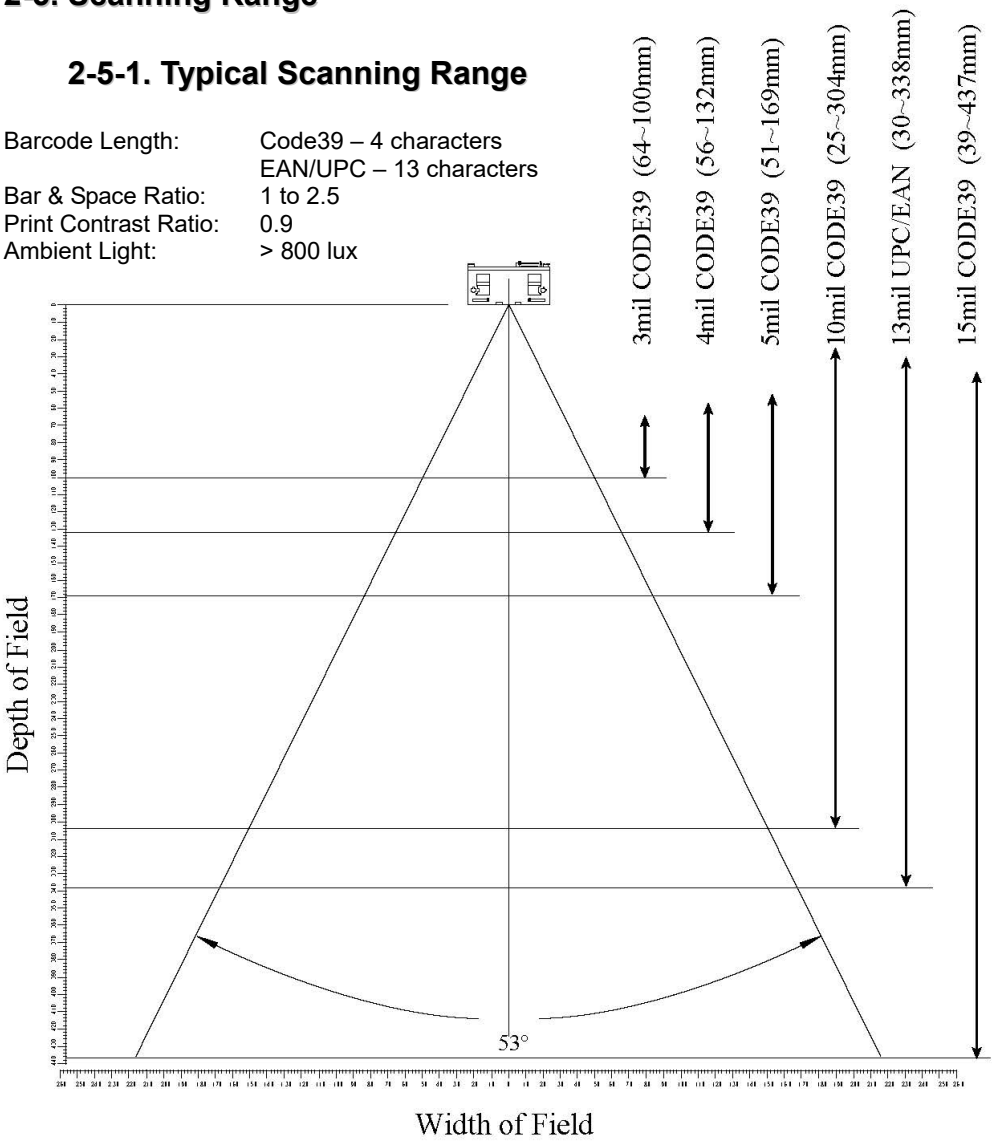
2-4. Operation Method

1. At power-up, the MT780 sends the Power-Up (PWM) signals over Buzzer pin as an indication that the MT780 enters **Standby Mode** and is ready for operation.
2. Once the MT780 triggered by either hardware or software method, it will emit a narrow, horizontal slab of light which is aligned with the sensor's field of view.
3. The linear image sensor captures the linear image of barcode and produces an analog waveform, which is sampled and analyzed by the decoder firmware running on the MT780.
4. Upon a successful barcode decoded, the MT780 turns off the illumination LEDs, sends the Good Read (PWM) signals over Buzzer pin and transmits the decoded data to the host.
5. The MT780 may enter **Sleep Mode** (Please see Chapter 6 for more details) after a period of inactivity in order to reduce power consumption.

2-5. Scanning Range

2-5-1. Typical Scanning Range

Barcode Length: Code39 – 4 characters
EAN/UPC – 13 characters
Bar & Space Ratio: 1 to 2.5
Print Contrast Ratio: 0.9
Ambient Light: > 800 lux



Minimum & Maximum Scan Distance

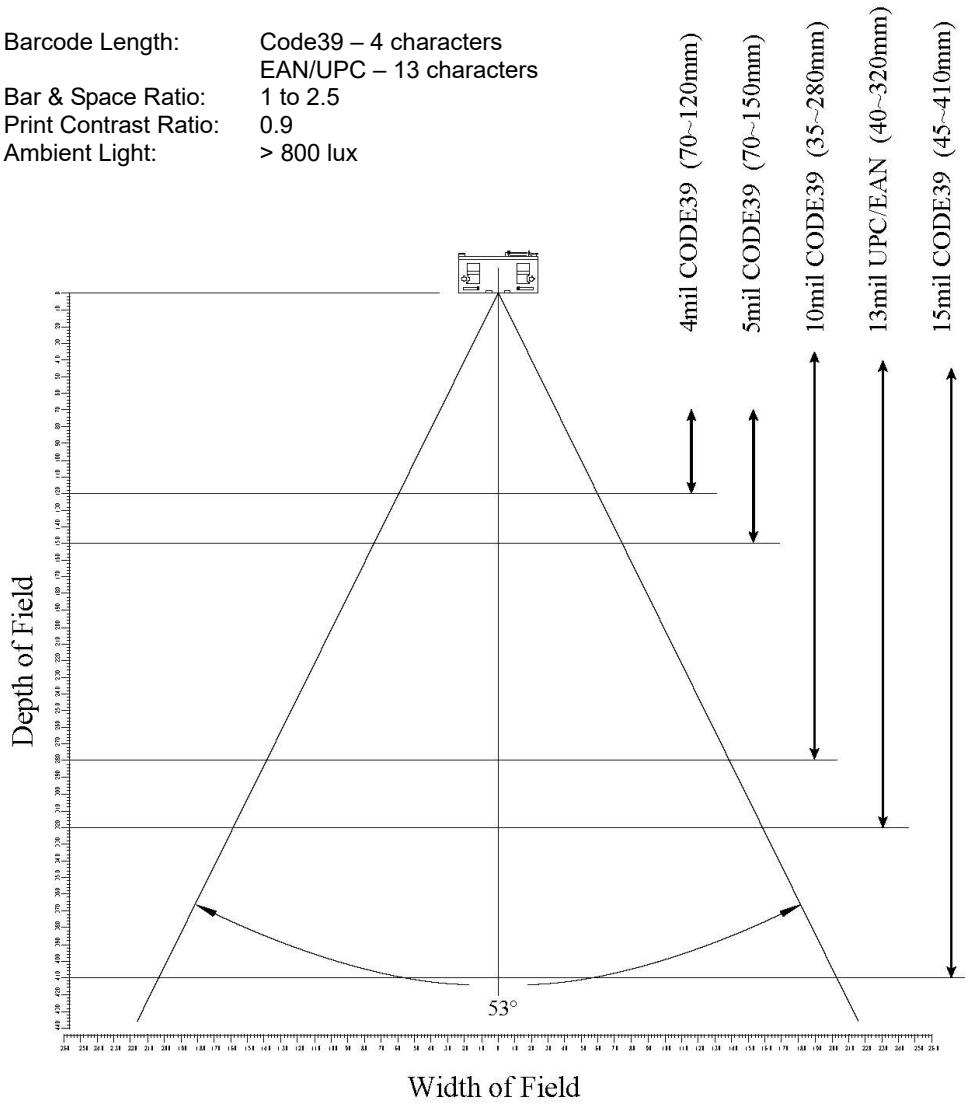
Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	3 Mil	64 ~ 100 mm	4 char.
	4 Mil	56 ~ 132 mm	
	5 Mil	51 ~ 169 mm	
	10 Mil	25 ~ 304 mm	
	15 Mil	39 ~ 437 mm	
EAN 13	13 Mil	30 ~ 338 mm	13 char.

Maximum Scan Width

Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 Mil	200 mm	37 char.

2-5-2. Guaranteed Scanning Range

Barcode Length: Code39 – 4 characters
EAN/UPC – 13 characters
Bar & Space Ratio: 1 to 2.5
Print Contrast Ratio: 0.9
Ambient Light: > 800 lux



Minimum & Maximum Scan Distance

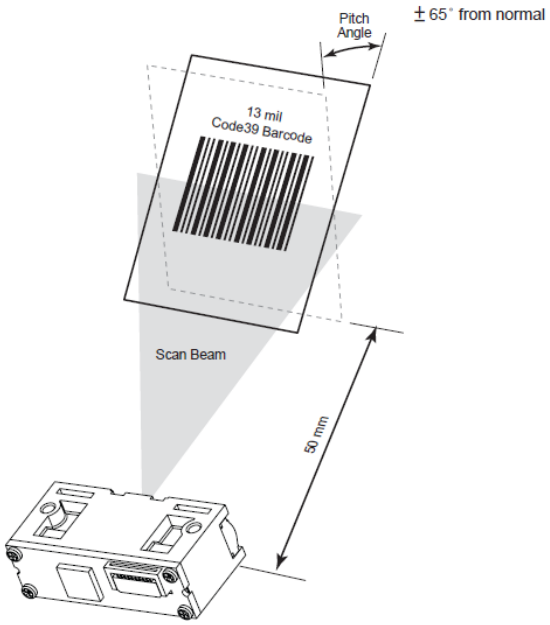
Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	3 Mil	N/A	13 char.
	4 Mil	70 ~ 120 mm	4 char.
	5 Mil	70 ~ 150 mm	
	10 Mil	35 ~ 280 mm	
	15 Mil	45 ~ 410 mm	
EAN 13	13 Mil	40 ~ 320 mm	13 char.

Maximum Scan Width

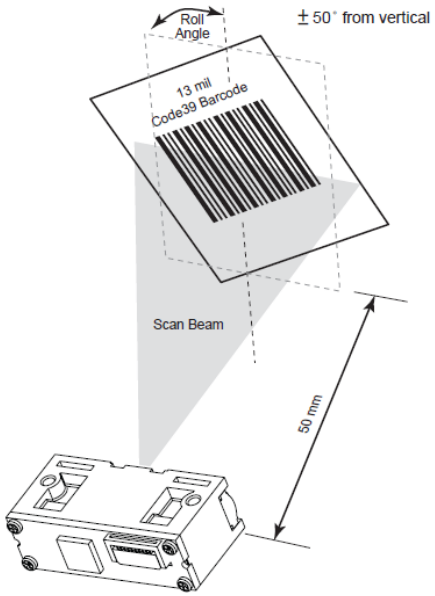
Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 Mil	200 mm	37 char.

2-6. Pitch Angle, Roll Angle and Skew Angle

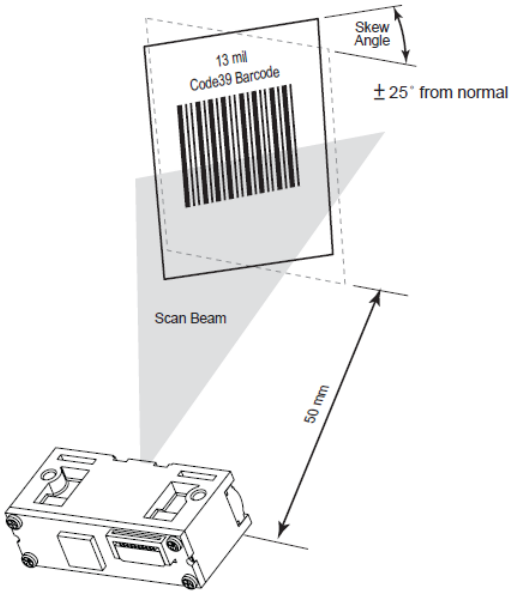
Be aware of the tolerance for the pitch, roll and skew angle of barcode you are trying to scan.



Pitch Angle: ± 65°



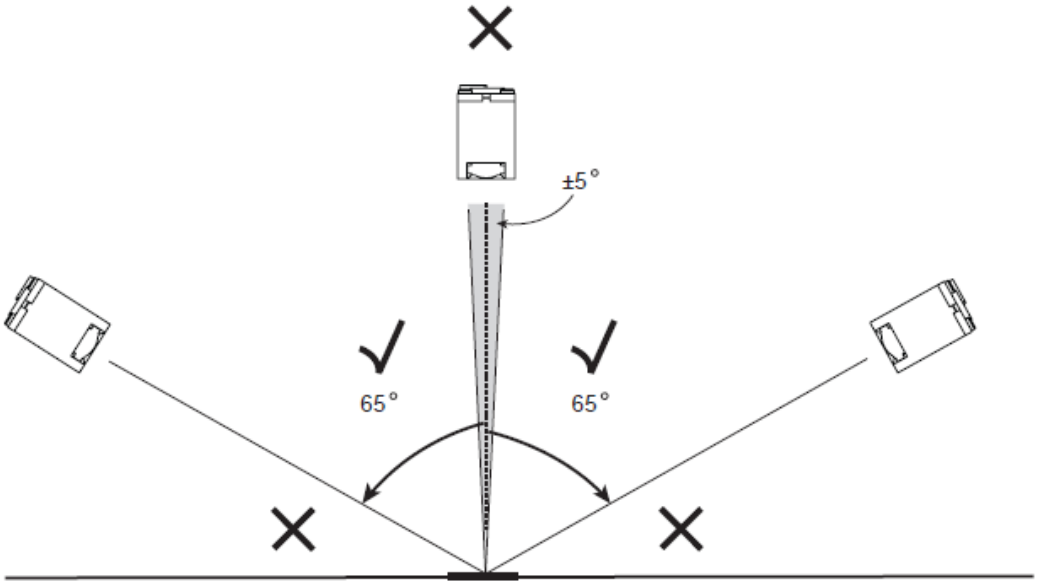
Roll Angle: ± 50°



Skew Angle: ± 25°

2-7. Specular Dead Zone

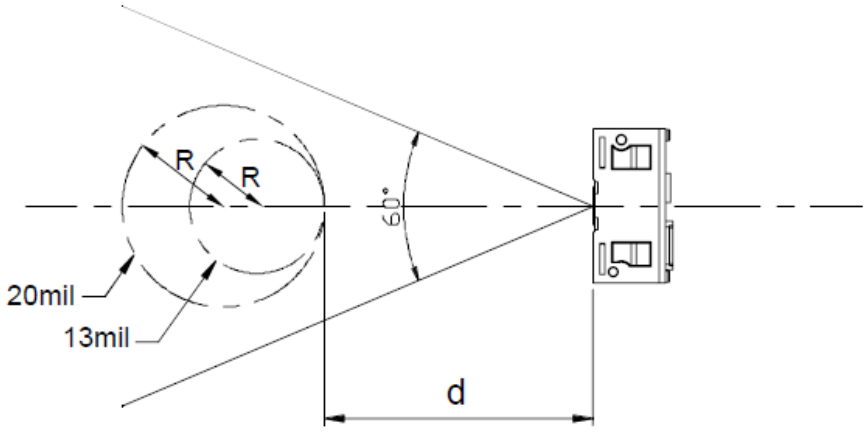
Do not place the MT780 directly over the barcode. The light reflecting directly back into the MT780 from the barcode is known as specular reflection, which can make decoding difficult. The specular dead zone of MT780 is up to 5° depending on target distance and substrate glossiness.



Specular Dead Zone: ± 5°

2-8. Curvature Degree

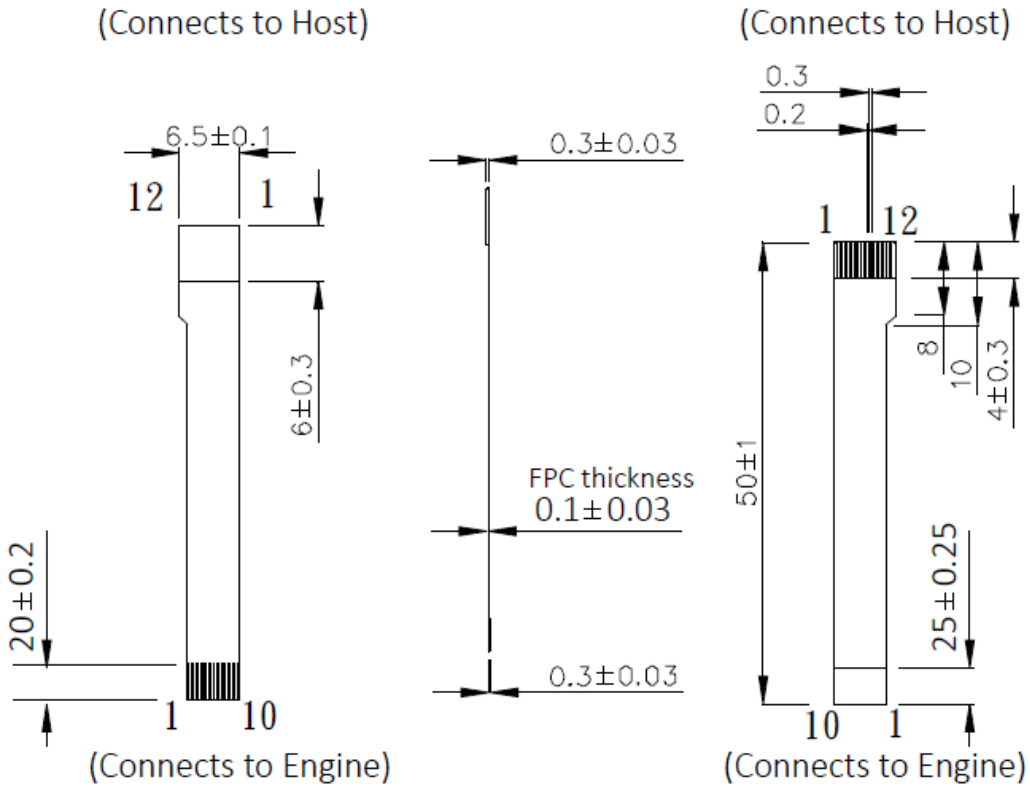
The curvature degree of a scanned barcode is specified as below:



Barcode	Code 39 (L=32 mm)	Code 39 (L=43 mm)
Resolution	13 mil (0.33 mm)	20 mil (0.51 mm)
R	R ≧ 15 mm	R ≧ 20 mm
d	40 mm	
PCS	0.9 (printed on photographic paper)	

2-9. Flex Cable Specification

Below is the drawing of the flat cable(P/N: 6341-0501010) that comes with MT780.



2-10. Connector Specification

Marson recommends that a 12-pin 0.5-pitch Molex® FPC Connector (Molex® P/N: 54548-1229), to be installed on Host side.

3. INSTALLATION

The MT780 scan engine is designed specifically for integration into customer's housing for OEM applications. However, the MT780's performance will be adversely affected or permanently damaged when mounted into an unsuitable enclosure.

Warning: The limited warranty is void if the following recommendations are not adhered to when mounting the MT780.

3-1. Electrostatic Discharge Cautions

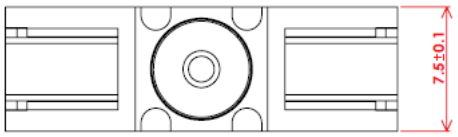
All MT780s are shipped in ESD protective packaging due to the sensitive nature of the exposed electrical components.

1. ALWAYS use grounding wrist straps and a grounded work area when unpacking and handling the MT780.
2. Mount the MT780 in a housing that is designed for ESD protection and stray electric fields.

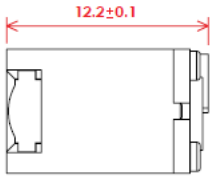
3-2. Mechanical Dimension

When securing the MT780 by T1.7x3mm tapping screws:

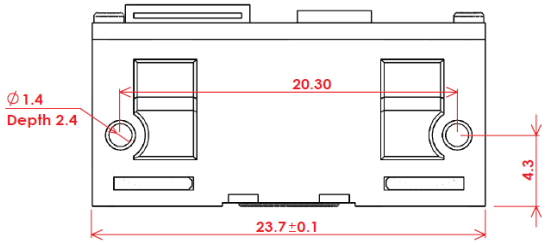
1. Leave sufficient space to accommodate the maximum size of the MT780.
2. Do not exceed 1.2±0.1kg-cm of torque when securing the MT780 to the host.
3. Use safe ESD practices when handling and mounting the MT780.



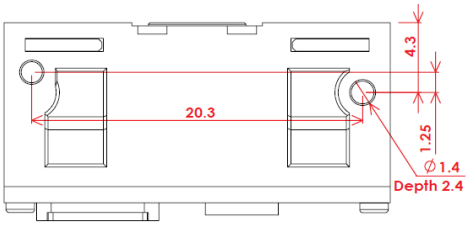
Front View



Side View



Top View



Bottom View

3-3. Window Materials

Following are descriptions of three popular window materials:

1. Poly-methyl Methacrylic (PMMA)
2. Allyl Diglycol Carbonate (ADC)
3. Chemically tempered float glass

Cell Cast Acrylic (ASTM: PMMA)

Cell cast Acrylic, or Poly-methyl Methacrylic is fabricated by casting acrylic between two precision sheet of glass. This material has very good optical quality, but is relatively soft and susceptible to attack by chemicals, mechanical stress and UV light. It is strongly recommended to have acrylic hard-coated with Polysiloxane to provide abrasion resistance and protection from environmental factors. Acrylic can be laser-cut into odd shapes and ultrasonically welded.

Cell Cast ADC, Allyl Diglycol Carbonate (ASTM: ADC)

Also known as CR-39^{TM}, ADC, a thermal setting plastic widely used for plastic eyeglasses, has excellent chemical and environmental resistance. It also has an inherently moderate surface hardness and therefore does not require hard-coating. This material cannot be ultrasonically welded.

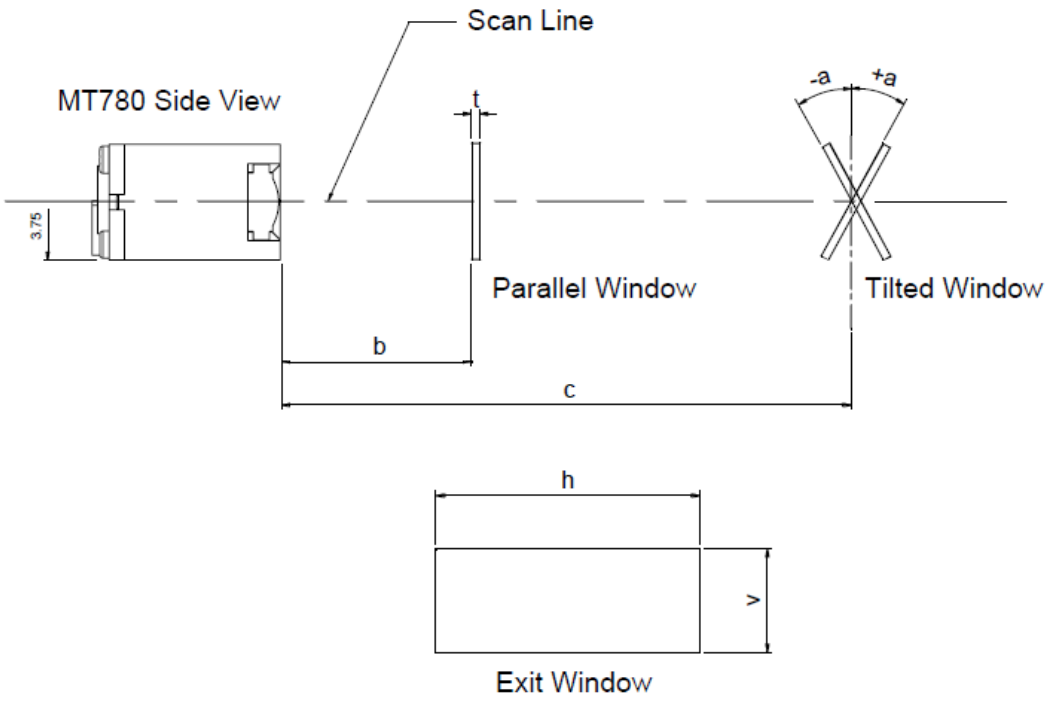
Chemically Tempered Float Glass

Glass is a hard material which provides excellent scratch and abrasion resistance. However, un-annealed glass is brittle. Increased flexibility strength with minimal optical distortion requires chemical tempering. Glass cannot be ultrasonically welded and is difficult to cut into odd shapes.

Property	Description
Spectral Transmission	85% minimum from 610 to 680 nanometers
Thickness	< 1 mm
Coating	Both sides to be anti-reflection coated to provide 1% maximum reflectivity from 610 to 680 nanometers at nominal window tilt angle. An anti-reflection coating can reduce the light that is reflected back to the host case. Coatings will comply with the hardness adherence requirements of MIL-M-13508.

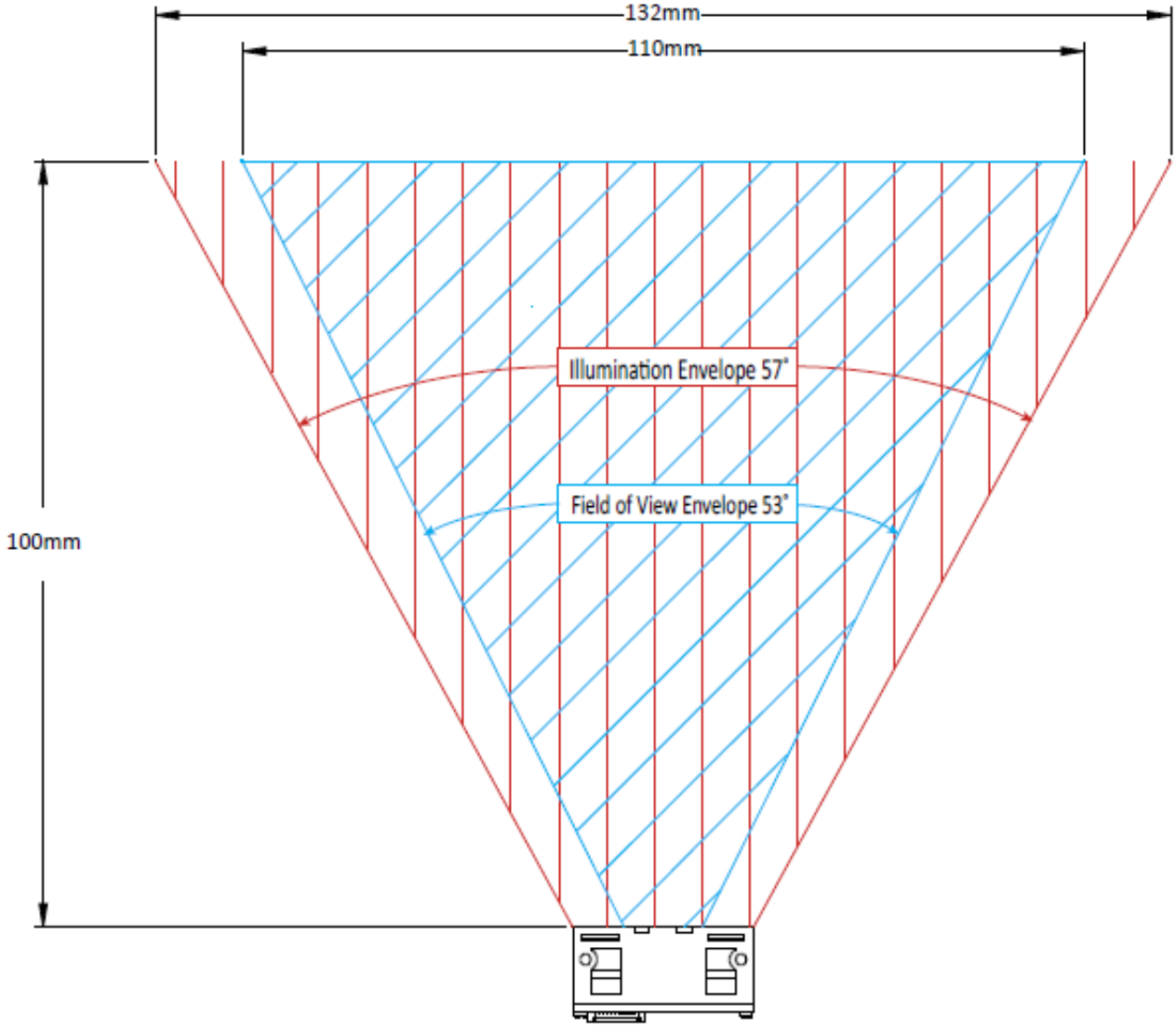
3-4. Window Specifications

The external transparent window is recommended to be AR coated which provides 1% maximum reflectivity from 610 to 680 nanometers for MT780 Integration. There are two types of window placement can be implemented while a parallel window must be close to MT780 within a distance under 0.5 mm.



Window Specifications for MT780 Integration					
Distance	Tilt Angle (a)		Minimum Window Size		
			Horizontal (h)	Vertical (v)	Thickness (t)
< 0.5mm (b)	0	0	25 mm	5.5 mm	< 1 mm
10 mm (c)	+20°~	-20°~	35 mm	6 mm	
20 mm (c)	+17°~	-17°~	48 mm	6.5 mm	
30 mm (c)	+15°~	-15°~	64 mm	7 mm	

The window size must increase as it is moved away from MT780 and should be sized to accommodate the field of view and illumination envelopes shown below:



3-5. Window Care

In the aspect of window, the performance of MT780 will be reduced due to any kind of scratch. Thus, reducing the damage of window, there are few things have to be noticed.

1. Avoid touching the window as much as possible.
2. When cleaning the window surface, please use non-abrasive cleaning cloth, and then gently wipe the host window with the cloth that is already sprayed with glass cleaner.

4. REGULATIONS

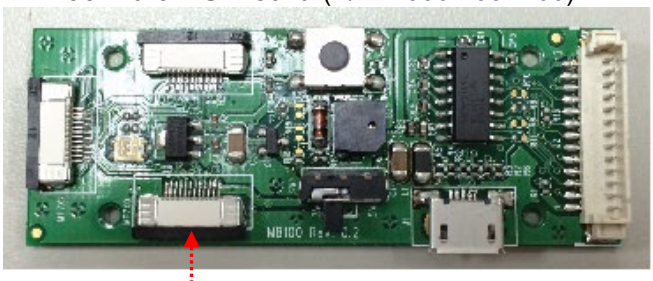
The MT780 scan engine conforms to the following regulations:

1. Electromagnetic Compliance – CE EN55022, EN55024
2. Electromagnetic Interference – FCC Part15 Subpart B (Class B)
3. Photobiological Safety – IEC 62471 (Exempt Group)
4. Environmental Regulations – RoHS 2.0, WEEE

5. DEVELOPMENT KIT

MARSON MB100 Demo Kit (P/N: 11A0-9801A20) enables the development of products and systems using the MT780 on the MS Windows OS platform. Besides the Multi I/O board (P/N: 2006-1007X00), the MB100 Demo Kit provides the software and hardware tools required for testing the MT780 applications before integrating it into the host device. Please contact your sales representative for ordering information.

MB100 Multi I/O Board (P/N: 2006-1007X00)

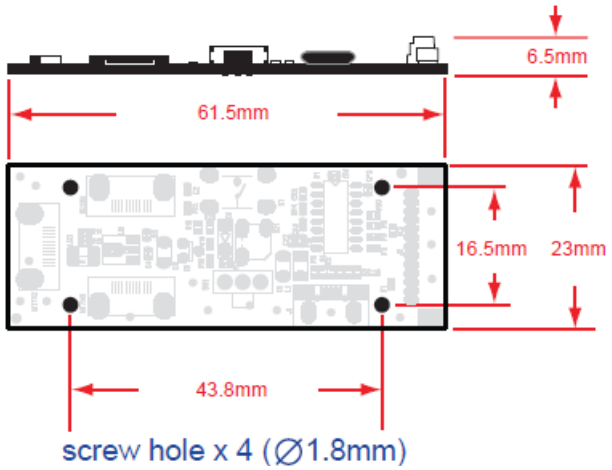


MB100 Demo Kit Accessories

O: Supported X : Not Supported

Interface / Cable	RS232	USB HID	USB VCP
External Y-cable (P/N: 7090-1583A00)	o	o	o
Internal Y-cable (P/N: 5300-1315X00)	o	o	o
Micro USB Cable (P/N: 7005-9892A50)	x	o	o

Due to the advantage of its small size, MB100 Multi I/O board is also suitable for being installed inside the host system, as an interface board connecting MT780 to the host device.



6. SLEEP (IDLE) MODE

The **Sleep Mode** is disabled by default. To enable **Sleep Timeout**, or the period of inactivity before MT780 enters Sleep Mode, please follow below steps

Method A – Configuration Barcode

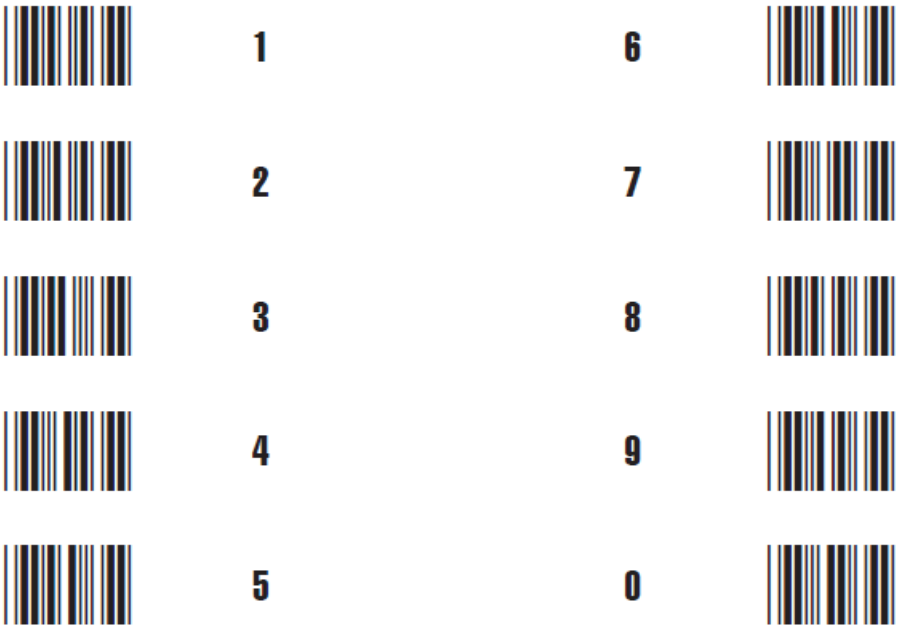
Steps:

1. Scan SET MINUTE [.B030$] (or SET SECOND [.B029$])
2. Scan two digit from the numeric barcode table below.
3. Scan SET MINUTE [.B030$] (or SET SECOND [.B029$])

Notes:

Sleep Timeout - Min: 0 min & 1 sec, Max: 60 min & 59 sec

(To disable Sleep Mode, simply set 0 min & 0 sec)



Property	Option	Remark
Sleep Timeout {MT007W**0**,**0**}	A number from **0**~**60**. (minute) A number from **0**~**59**. (second)	Default : **Disable (0 min, 0 sec)** **Sleep Timeout** (0 min & 1 sec ~ 60 min & 59 sec), the period of inactivity before the scanner enters **Sleep Mode.** To disable **Sleep Mode**, simply set **Sleep Timeout** as 0 min & 0 sec.

Steps:

Send {MT007W0,10} MT780 in the case of 10 seconds Sleep Timeout. MT780 will return {MT007WOK} to Host if it is successfully configured.

Notes:

1. Curly braces "{ }" must be included at both ends of each command.
2. To wake up MT780 from Sleep Mode, send any command or pull low at Trigger pin.

7. PARAMETER SETUP

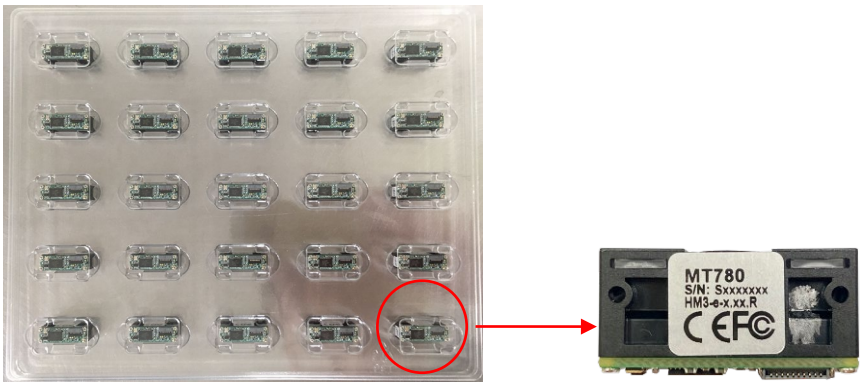
You can set up your MT780 using the following method:

1. **Configuration Barcode:**
   Scan configuration barcodes from the 1D Scan Engine User's Manual, or use Ez Utility®, both of which are available for download at www.marson.com.tw

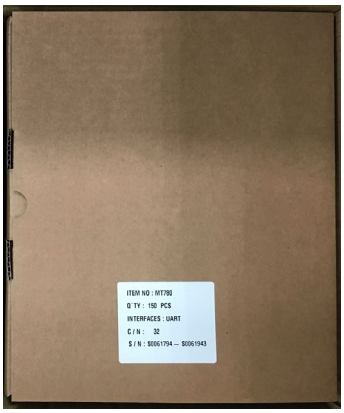
2. **Serial Command:**
   Refer to Serial Commands Manual which is available for download at www.marson.com.tw.

8. PACKAGING

1. Tray (size: 24 x 19.5 x 1.3cm)**:** Each tray contains 25pcs of MT780.



2. Box (size: 24.5 x 20.5 x 8.5cm)**:** Each Box contains 6pcs of tray, or 150pcs of MT780.



3. Carton (size: 44 x 36.5 x 27cm)**:** Each Carton contains 8pcs of boxes, or 1200pcs of MT780.

9. VERSION HISTORY

Rev.	Date	Description	Issued	Checked
1.0	2016.02.15	Initial Release	Shaw	Kenji
1.1	2016.03.01	Updated D.O.F	Shaw	Kenji
1.2	2016.03.09	Updated Scan Rate	Shaw	Kenji
1.3	2016.05.17	Updated Operating Temp.	Shaw	Kenji
1.4	2016.06.24	Added MT780HD	Shaw	Kenji
1.5	2016.10.31	Revised Sleep Mode command in Chapter 6	Shaw	Kenji
1.6	2017.03.24	Revised Skew & Roll Angle Added Packaging Chapter	Shaw	Hus
1.7	2017.06.21	Deleted Red Cell-Cast Acrylic Description	Shaw	Hus
1.8	2017.12.11	Deleted MT780HD Updated D.O.F & Resolution	Shaw	Hus
1.9	2018.01.31	Revised Skew & Roll Angle	Shaw	Hus
2.0	2018.03.15	Updated Chapter 1 and 1-1 on MCU. Updated Chapter 6 on Command Mode settings.	Shaw	Kenji & Hus
2.1	2018.06.19	Updated Standby Current Updated Operating Temperature	Shaw	Kenji
2.2	2018.07.23	Added Typical D.O.F & Guaranteed D.O.F	Shaw	Hus
2.3	2018.09.03	Updated Chapter 3-4	Shaw	Hus
2.4	2019.07.31	Updated Chapter 8	Shaw	Hus
2.5	2020.04.09	Updated Guaranteed D.O.F	Shaw	Hus
2.6	2021.02.19	Updated Mechanical Dimension & Torque	Shaw	Alice
2.7	2021.03.26	Updated screw information	Shaw	Alice
2.8	2021.07.07	Updated Interface, Sleep Mode, Parameter Setup and Packaging for HM3 version	Shaw	Kenji
2.9	2021.09.29	Updated thread depth	Shaw	Alice
3.0	2021.10.19	Updated Electric Characteristics Updated Product Picture	Shaw	Kenji

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