MT10

(3.3V Linear Image Barcode Scan Engine)

Integration Guide
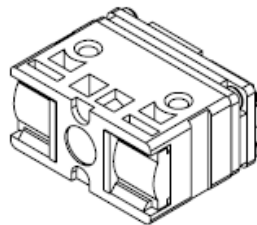
TABLE OF CONTENTS

1. INTRODUCTION

The MT10 Linear Image Barcode Scan Engine is designed for 1D barcode middle range reading, and high performance barcode scanning with optimal performance and easy integration. MT10 is ideal for integration into data terminals and other small mobile devices.

The MT10 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.
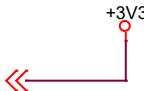
1-1. MT10 Block Diagram
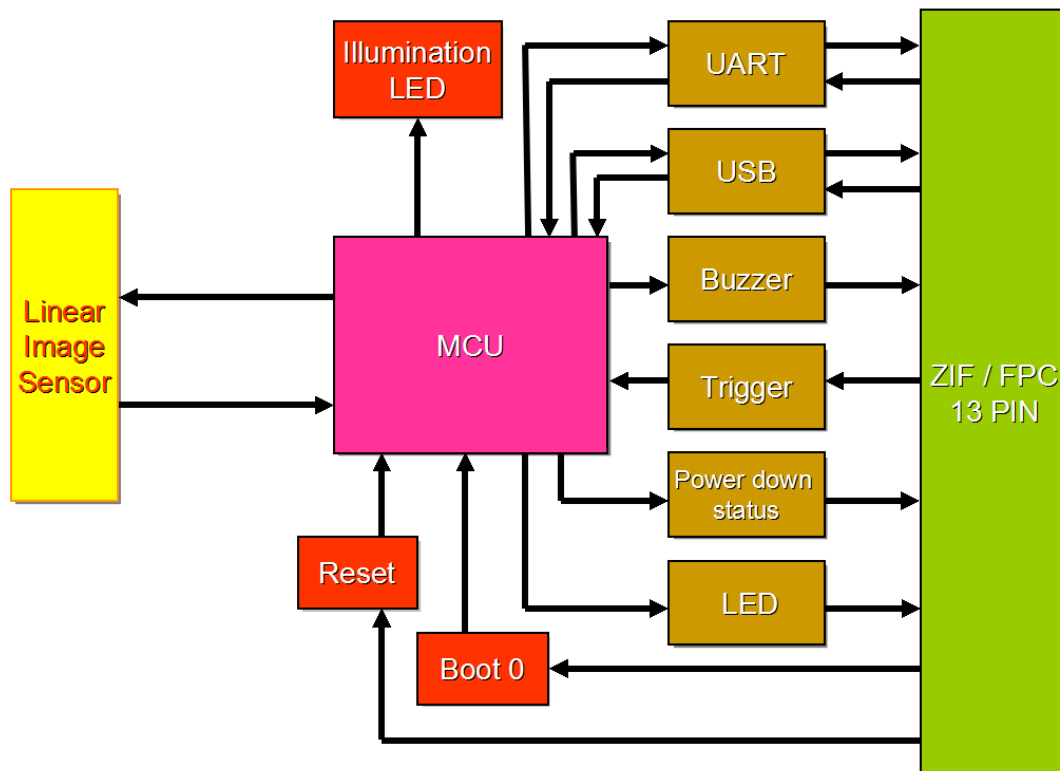
1-2. Electric Interface

1-2-1. Pin Assignment

(Back View of MT10)

Pin#	UART	USB	I/O	Description	Schematic Example
1	VCC	VCC	------------	Supply voltage input. Must always be connected to a 3.3V power supply.	+3V3
2	GND	GND	------------	Power and signal ground.	
3	RXD	------------	Input	UART TTL data input.	Sipex® Vendor P/N: SP232ACT
4	TXD	------------	Output	UART TTL data output.	Sipex® Vendor P/N: SP232ACT
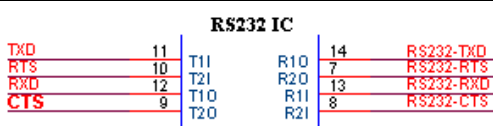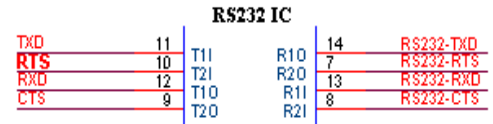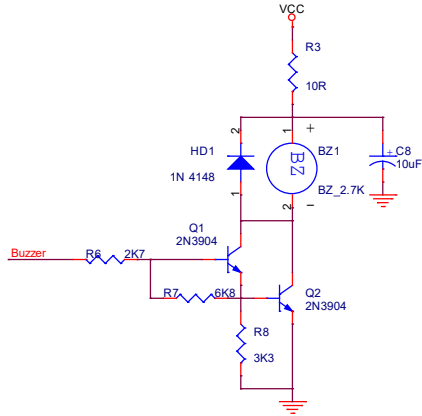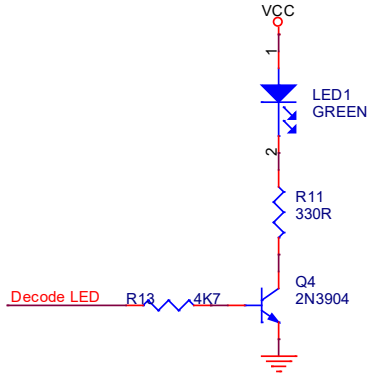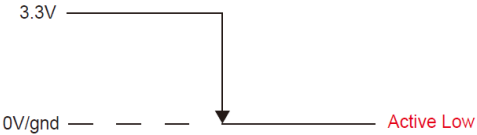
Pin#	UART	USB	I/O	Description	Schematic Example
5	CTS		Input	When handshaking is enabled, host authorizes MT10 to transmit data on TXD line.	**RS232 IC** ... Sipex® Vendor P/N: SP232ACT
		USB D+	Bidirectional	Differential Signal Transmission	---
6	RTS		Output	When handshaking is enabled, MT10 requests permission from host to transmit data on TXD line.	**RS232 IC** ... Sipex® Vendor P/N: SP232ACT
		USB D-	Bidirectional	Differential Signal Transmission	---
7	Power down	Power down	Output	Active high, it indicates that the MT10 is in **Sleep Mode** (See Chapter 6 for details)	---
8	Buzzer	Buzzer	Output	Active high: Power-Up or a successful barcode decoded. PWM controlled signal can be used to drive an external buzzer for a successful barcode decoded (Good Read).	(buzzer driver schematic: VCC, R3 10R, HD1 1N 4148, BZ1 BZ_2.7K, C8 10uF, Q1 2N3904, R6 2K7, R7 6K8, Q2 2N3904, R8 3K3)

Pin#	UART	USB	I/O	Description	Schematic Example
9	LED	LED	Output	Active high, it indicates the status of Power-Up or a successful barcode decoded (Good Read).	VCC LED1 GREEN R11 330R Decode LED R13 4K7 Q4 2N3904
10	Boot 0	Boot 0	Input	Reserved for production only.	--
11	Trigger	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 prompt the scan engine into firmware update mode.*	3.3V 0V/gnd Active Low
12	Reset	Reset	Input	Reserved for production only.	--

1-2-2. Electric Characteristics

Symbol	Ratings	Min	Max	Unit
V_{IH}	Input high level	2.0	3.6	V
V_{IL}	Input low level	0	1.1	V
V_{OH}	Output high level	2.9		V
V_{OL}	Output low level		0.4	V
$|\triangle V_{DDx}|$	Variations between different V_{DD} power pins		50	mV

*Note:

1. Power Supply**:** V_{DD}=3.3

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 MT10 to the host side. There are 13 pins on the MT10 (engine) side and 12 pins on the host side. Please see 2-10 for more details of flex cable.
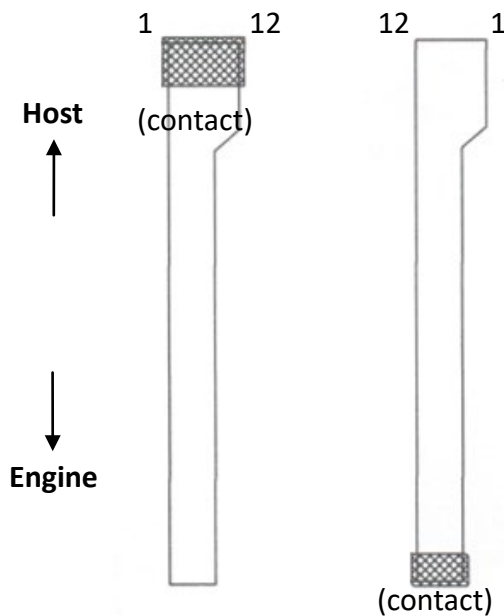
Flex cable (P/N: 6351-0501113)	
Pin#	**Pin Assignment To Host**
1	VCC
2	GND
3	RXD
4	TXD
5	USB D+ / CTS
6	USB D- / RTS
7	Power Down
8	Buzzer
9	LED
10	Boot0
11	Trigger
12	Reset

*Note: Conforms to MARSON MT700/MT710D's pin assignment.

1-3. Operational Timing

This chapter describes the timing associated with the various operating modes of the MT10 including Power Up, Sleep Mode, and Decode Timing.

1-3-1. Power Up

When power is initially applied, the MT10 is activated and begins the process of initialization. Once initialization (duration $\leqq$ 10mS) is completed, the MT10 enters **Standby Mode** and is ready for barcode scanning.

1-3-2. Sleep (Idle) Mode

The MT10 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 MT10 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/LED signals.

In **Sleep Mode**, the MT10 can be waken up 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/LED signal.

The total scan and decode time is approximately equal to the time from the Trigger signal going low to the Buzzer/LED signal going high. This time will vary slightly based on several factors including barcode quality, barcode type and the distance between MT10 and the barcode scanned.

Upon a successful scan, the MT10 outputs the Buzzer/LED signal and keeps this signal for the duration of the transmission of the data decoded to the host side. The duration is about 75 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

1. The maximum duration of initialization is 10mS.

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

3. The minimum duration of waking up MT10 from Sleep Mode by Trigger signal is about 2 ms.

4. The maximum duration of waking up MT10 from Sleep Mode by Trigger signal and completing decode (when barcode is within optimal focus) is about 120ms

2. SPECIFICATIONS

2-1. Introduction

This chapter provides technical specifications of the MT10 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	Linear Image Sensor
Scan Rate	650 Scans/ sec
Resolution	4mil/ 0.1mm
Scan Angle	41°
Print Contrast Ratio	30%
Width of Field	140mm (13Mil Code39)
Typical **Depth Of Field** (Environment: 800 lux)	4 Mil Code39: 36 ~ 70mm (4 digits)
	5 Mil Code39: 30 ~ 95mm (4 digits)
	10 Mil Code39: 21 ~ 201mm (4 digits)
	15 Mil Code39: 35 ~ 285mm (4 digits)
	13 Mil UPC/ EAN: 34 ~ 239mm (13 digits)
Guaranteed **Depth Of Field** (Environment: 800 lux)	4 Mil Code39: 45 ~ 70mm (4 digits)
	5 Mil Code39: 40 ~ 95mm (4 digits)
	10 Mil Code39: 35 ~ 195mm (4 digits)
	15 Mil Code39: 45 ~ 275mm (4 digits)
	13 Mil UPC/ EAN: 40 ~ 230mm (13 digits)
Physical Characteristics	

Dimension	W14 x L11.9 x H7 mm
Weight	1g
Color	Black
Material	PC
Cable	13pin to 12pin flex cable
Electrical	
Operation Voltage	3.3VDC±0.15VDC
Working Current	< 75mA (UART) ; < 85mA (USB)
Standby Current	< 35mA (UART) ; < 45mA (USB)
Idle Current (Sleep Mode)	< 300uA (UART) ; < 500uA (USB)
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

2-3-1. UART Interface

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, according to Serial Commands Manual.

(3) Supports both hardware and software triggers

Interface Configuration Barcode:

. C002$

UART

Scanning above barcode will set your MT10 to UART interface.

2-3-2. USB Interface

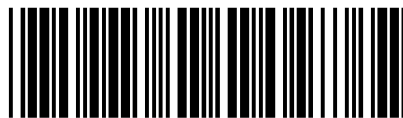**Characteristics:**

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

(2) Supports hardware trigger only

(3) Emulates a USB Keyboard device

Interface Configuration Barcode:

. C008$

USB HID

Scanning above barcode will set your MT10 to USB interface.

2-4. Operation Method

1. At power-up, the MT10 sends the Power-Up signals over Buzzer and LED pins as an indication that the MT10 enters into **Standby Mode** and is ready for operation.

2. Once the MT10 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 MT10.

4. Upon a successful barcode decoded, the MT10 turns off the illumination LEDs, sends the Good Read signals over Buzzer and LED pins and transmits the decoded data to the host.

5. The MT10 may enter into **Sleep Mode** (Please see Chapter 6 for more details) after a period of inactivity in order to reduce power consumption.

2-5. Mechanical Dimension

Front View

Side View

Two T1.7 (Self-forming screws)
thread maximum thread 2mm
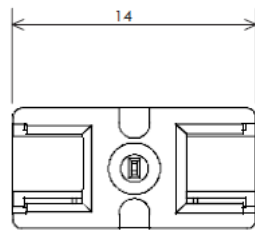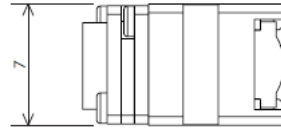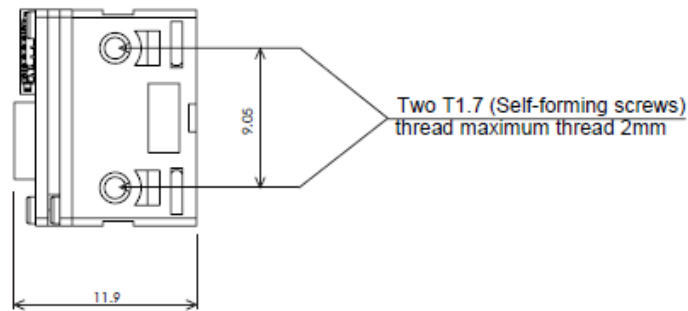
Top View

2-6. Scanning Range

2-6-1. Typical Scanning Range
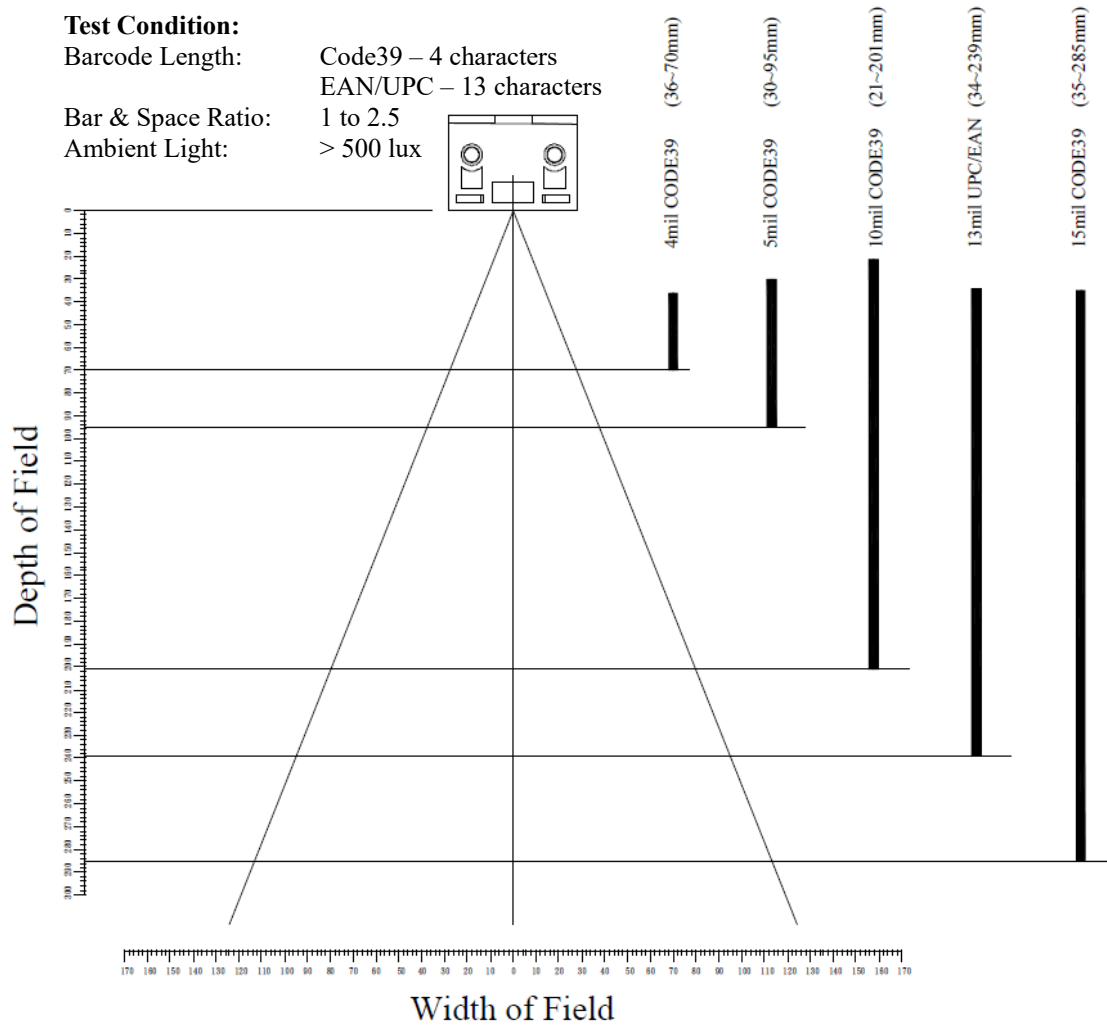
Test Condition:

Barcode Length:	Code39 – 4 characters
	EAN/UPC – 13 characters
Bar & Space Ratio:	1 to 2.5
Ambient Light:	> 500 lux

Minimum & Maximum Scan Distance

Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	4 Mil	36 ~ 70 mm	4 char.
	5 Mil	30 ~ 95 mm	
	10 Mil	21 ~ 201 mm	
	15 Mil	35 ~ 285 mm	
EAN 13	13 Mil	34 ~ 239 mm	13 char.

Maximum Scan Width

Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 mil	140 mm	27 char.

2-6-2. Guaranteed Scanning Range

Test Condition:

Barcode Length: Code39 – 4 characters

                        EAN/UPC – 13 characters

Bar & Space Ratio: 1 to 2.5

Ambient Light: > 500 lux
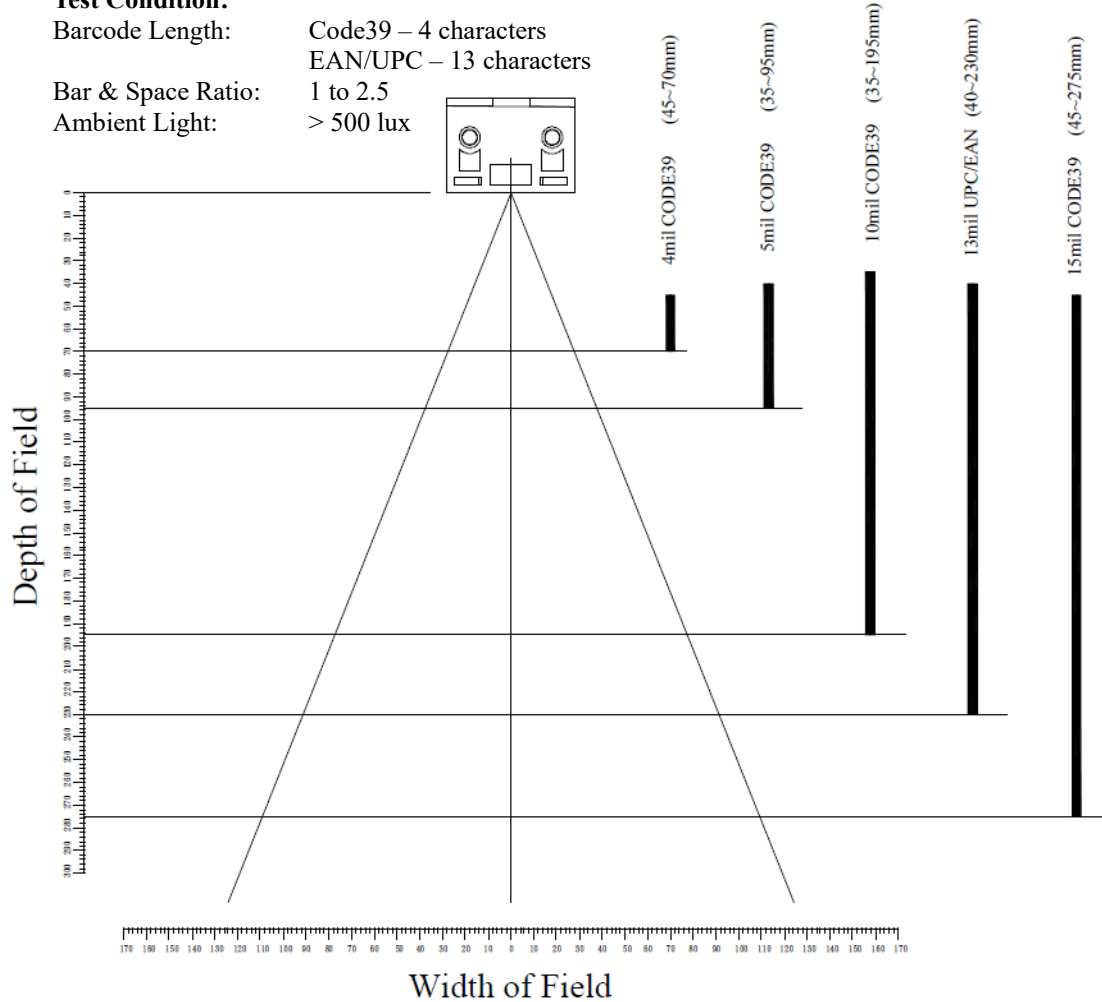
Minimum & Maximum Scan Distance

Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	4 Mil	45 ~ 70 mm	4 char.
	5 Mil	35 ~ 95 mm	
	10 Mil	35 ~ 195 mm	
	15 Mil	45 ~ 275 mm	
EAN 13	13 Mil	40 ~ 230 mm	13 char.

Maximum Scan Width

Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 mil	140 mm	27 char.

2-7. Pitch Angle, Roll Angle and Skew Angle

Be aware of the tolerance for the pitch, roll and skew angle of bar code you are trying to scan.
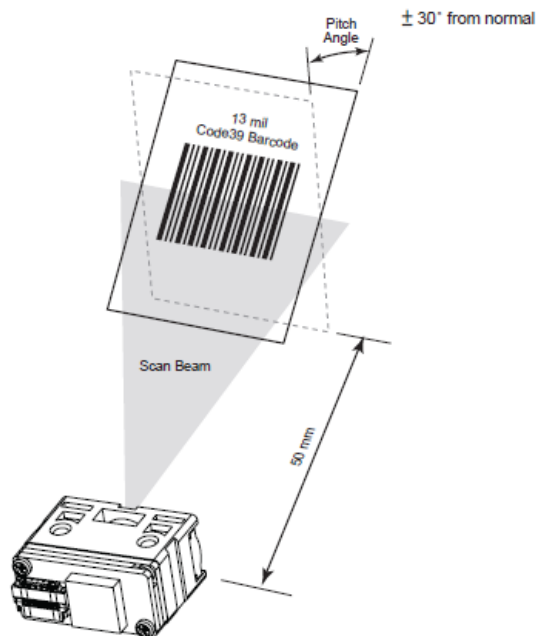
Pitch Angle: ± 30°
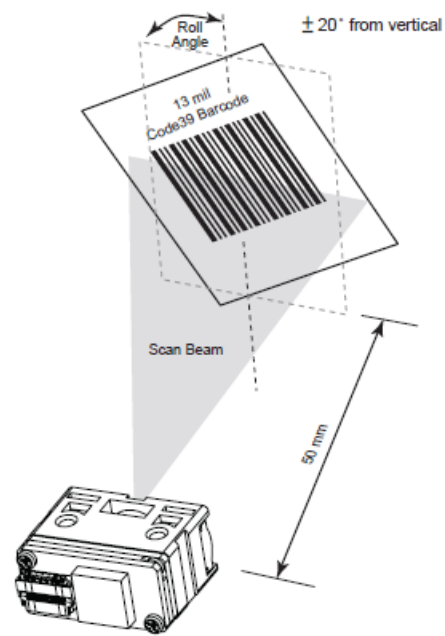
Roll Angle: ± 20°
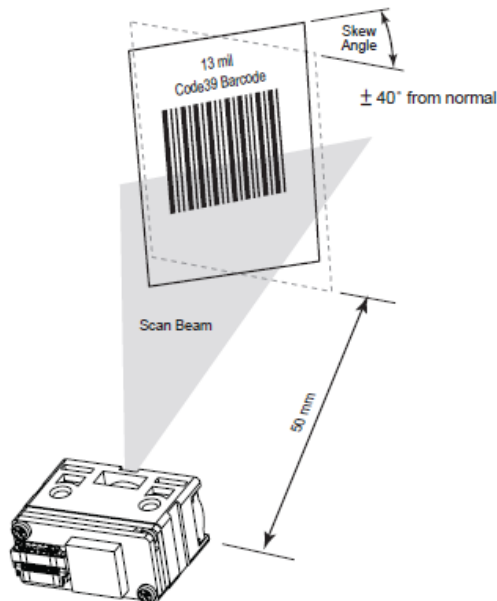
Skew Angle: ± 40°

2-8. Specular Dead Zone

Do not place the MT10 directly over the barcode. The light reflecting directly back into the MT10 from the barcode is known as specular reflection, which can make decoding difficult. The specular dead zone of MT10 is up to 5° depending on target distance and substrate glossiness.

Specular Dead Zone: ± 5°
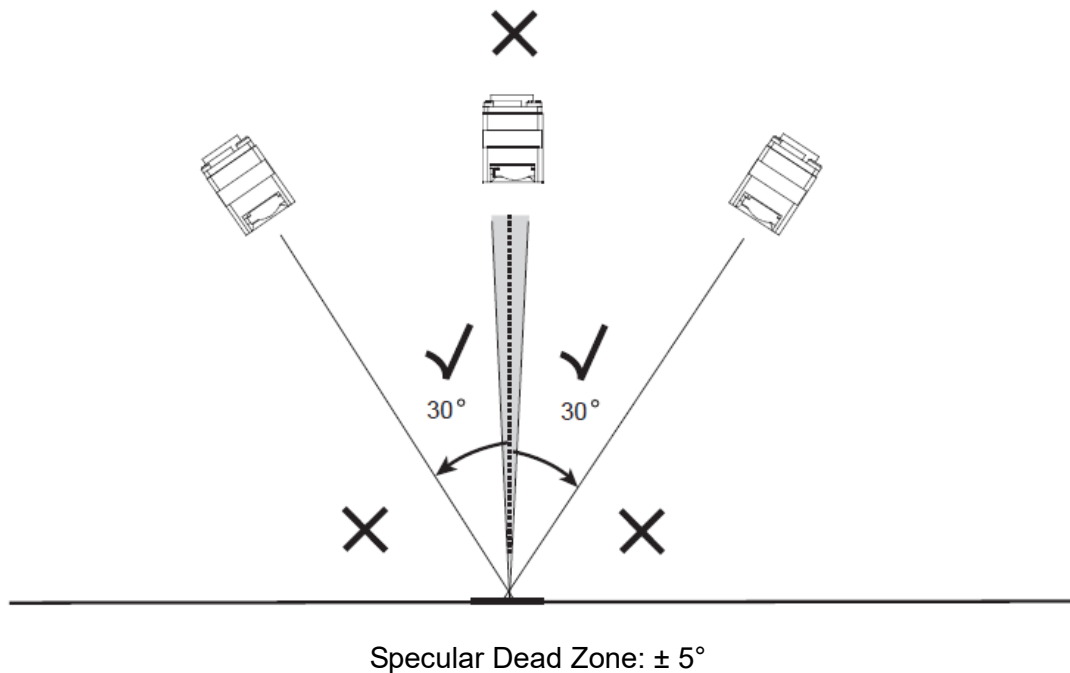
2-9. Curvature Degree

The curvature degree of a scanned barcode is specified as below:
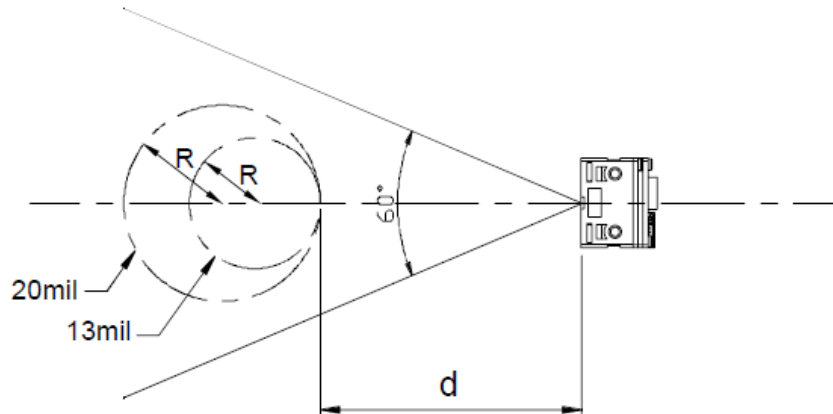
Barcode	Code 39 (L=32 mm)	Code 39 (L=43 mm)
Resolution	13 mil (0.33 mm)	20 mil (0.51 mm)
R	R ≧ 15 mm	R ≧ 20 mm
d	40 mm	
PCS	0.9 (printed on photographic paper)	

2-10. Flex Cable Specification

Below is the drawing of the flat cable(P/N: 6351-0501113) that comes with MT10.

2-11. Connector Specification
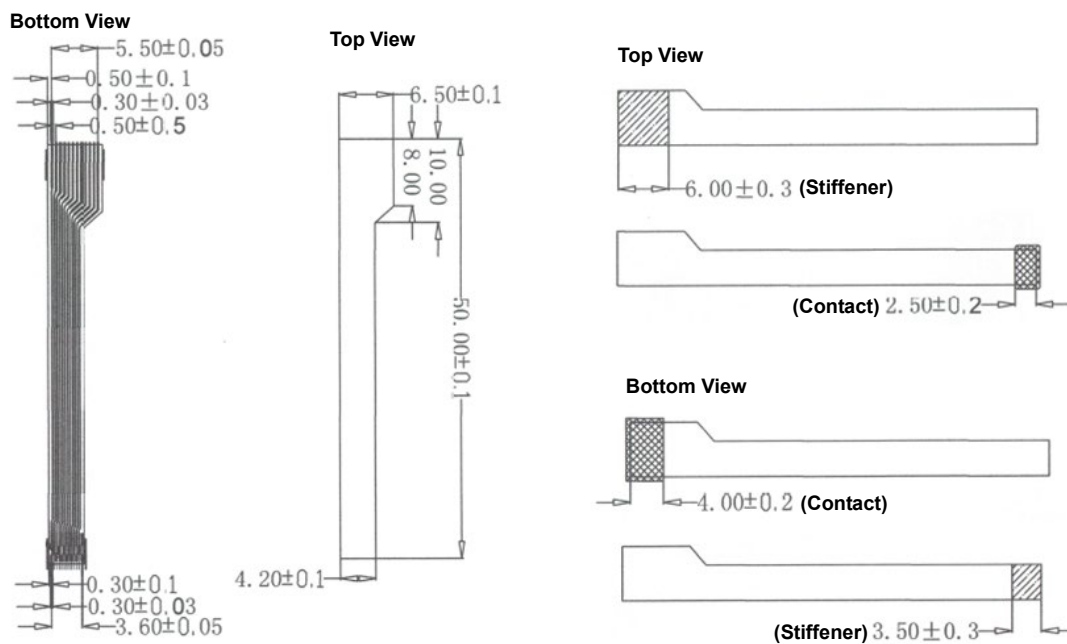
12-pin Molex® FPC Connector (Molex P/N: 54548-1229), to be installed on Host side.

FPC THICKNESS	D	C	B	A	EMBOSSED TAPE ORDER No. オーダー番号	製品番号 MATERIAL No.	極数 Ckt
0.28±0.03	13.65	17.0	12.5	18.2	54548-2671	54548-2629	26
	12.65	16.0	11.5	17.2	54548-2471	54548-2429	24
	12.15	15.5	11.0	16.7	54548-2371	54548-2329	23
	11.65	15.0	10.5	16.2	54548-2271	54548-2229	22
	11.15	14.5	10.0	15.7	54548-2171	54548-2129	21
	10.65	14.0	9.5	15.2	54548-2071	54548-2029	20
	10.15	13.5	9.0	14.7	54548-1971	54548-1929	19
	9.65	13.0	8.5	14.2	54548-1871	54548-1829	18
	9.15	12.5	8.0	13.7	54548-1771	54548-1729	17
	8.65	12.0	7.5	13.2	54548-1671	54548-1629	16
	8.15	11.5	7.0	12.7	54548-1571	54548-1529	15
	7.65	11.0	6.5	12.2	54548-1471	54548-1429	14
0.3±0.03	7.15	10.5	6.0	11.7	54548-1371	54548-1329	13
	6.65	10.0	5.5	11.2	54548-1271	54548-1229	12
	6.15	9.5	5.0	10.7	54548-1171	54548-1129	11
	5.65	9.0	4.5	10.2	54548-1071	54548-1029	10
	5.15	8.5	4.0	9.7	54548-0971	54548-0929	9
	4.65	8.0	3.5	9.2	54548-0871	54548-0829	8
	4.15	7.5	3.0	8.7	54548-0771	54548-0729	7
	3.65	7.0	2.5	8.2	54548-0671	54548-0629	6
	3.15	6.5	2.0	7.7	54548-0571	54548-0529	5
	2.65	6.0	1.5	7.2	54548-0471	54548-0429	4

MODEL No.: 54548-**29

TITLE: 0.5 FPC CONN ZIF HSG ASSY FOR SMT RA BTM CONT -LEAD FREE-

MOLEX INCORPORATED

DOCUMENT NO. SD-54548-039   SHEET NO. 1 OF 2

DIMENSION STYLE: MM ONLY   SCALE 10:1   DESIGN UNITS: METRIC   THIRD ANGLE PROJECTION

DRAWN BY: H.SHIMABUKURO DATE '04/02/10
CHECKED BY: K.TOJO DATE '04/02/10
APPROVED BY: M.SASAO DATE '04/02/10
MATERIAL NO. SEE TABLE

GENERAL TOLERANCES (UNLESS SPECIFIED)
10 UNDER ±0.2
10 OVER 30 UNDER ±0.25
30 OVER ±0.3
ANGULAR ±3°
DRAFT WHERE APPLICABLE MUST REMAIN WITHIN DIMENSIONS

REVISED EC NO: J2008-4048 2008/06/13
DRWN:M.MABEI 2008/06/16
CHKD:T.HARUYAMA 2008/06/16
APPR:N.KITA

SECT. J-J SCALE 20:1
INSERTION DEPTH OF FPC FPC挿入深さ 2.5
LENGTH TO CONTACT POINT 接点位置 1.35
CONTACT POINT (BOTTOM SIDE) 接点部(下面)

EN-02JA(021)

3. INSTALLATION

The MT10 scan engine is designed specifically for integration into customer's housing for OEM applications. However, the MT10'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 MT10.

## 3-1. Electrostatic Discharge Cautions

All MT10s 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 MT10.
2. Mount the MT10 in a housing that is designed for ESD protection and stray electric fields.
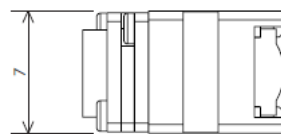
3-2. Mechanical Dimension

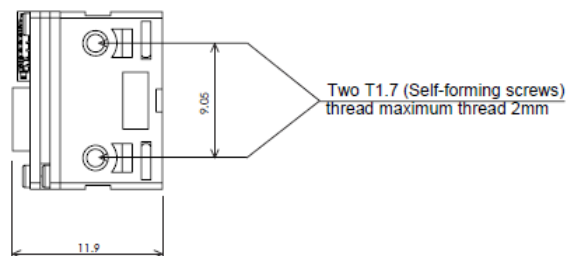When securing the MT10 by utilizing the self-forming screws:

1. Leave sufficient space to accommodate the maximum size of the MT10.
2. Do not exceed 1kg-cm (0.86 lb-in) of torque when securing the MT10 to the host.
3. Use safe ESD practices when handling and mounting the MT10.
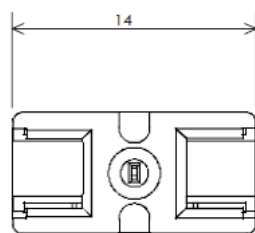
Front View   Side View

Top 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 635 to 690 nanometers
Thickness	< 1 mm
Coating	Both sides to be anti-reflection coated to provide 1% maximum reflectivity from 635 to 690 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
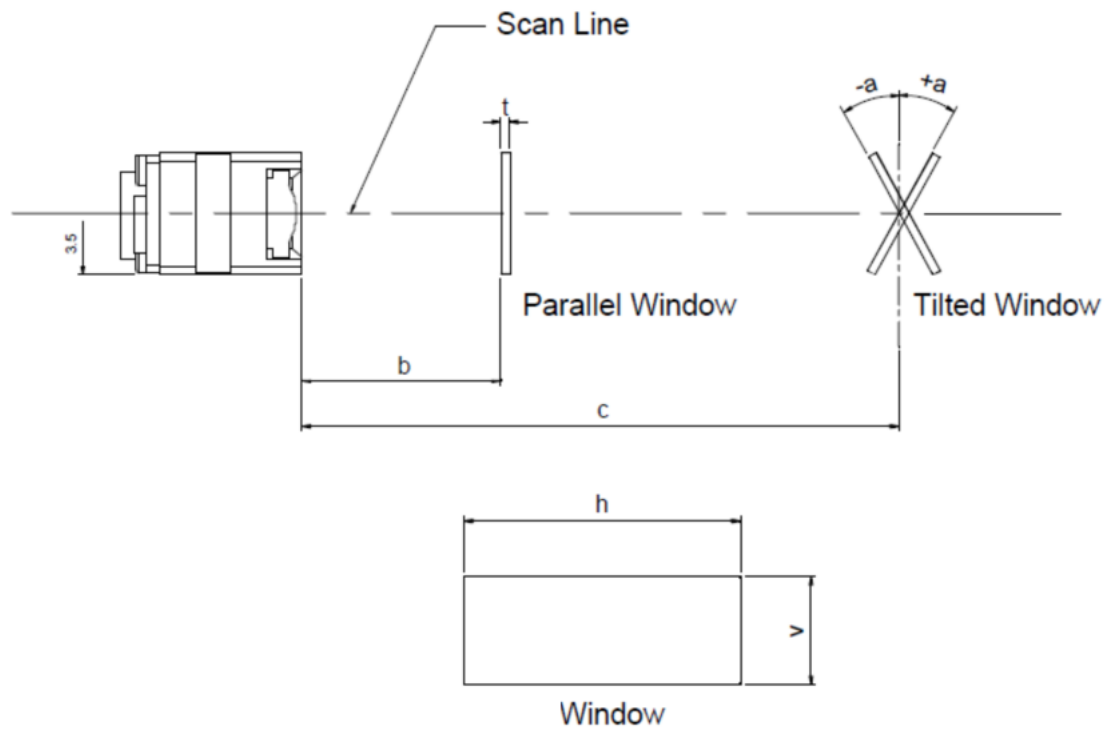
Window Specifications for MT10 Integration					
Distance	Tilt Angle (a)		Minimum Window Size		
			Horizontal (h)	Vertical (v)	Thickness (t)
< 0.5mm (b)	0	0	18 mm	5.5 mm	< 1 mm
10 mm (c)	+20°~	-20°~	32 mm	6 mm	
20 mm (c)	+17°~	-17°~	48 mm	6.5 mm	
30 mm (c)	+15°~	-15°~	64 mm	7 mm	

The window size must increase as it is moved away from MT10 and should be sized to accommodate the field of view and illumination envelopes shown below:

Top View
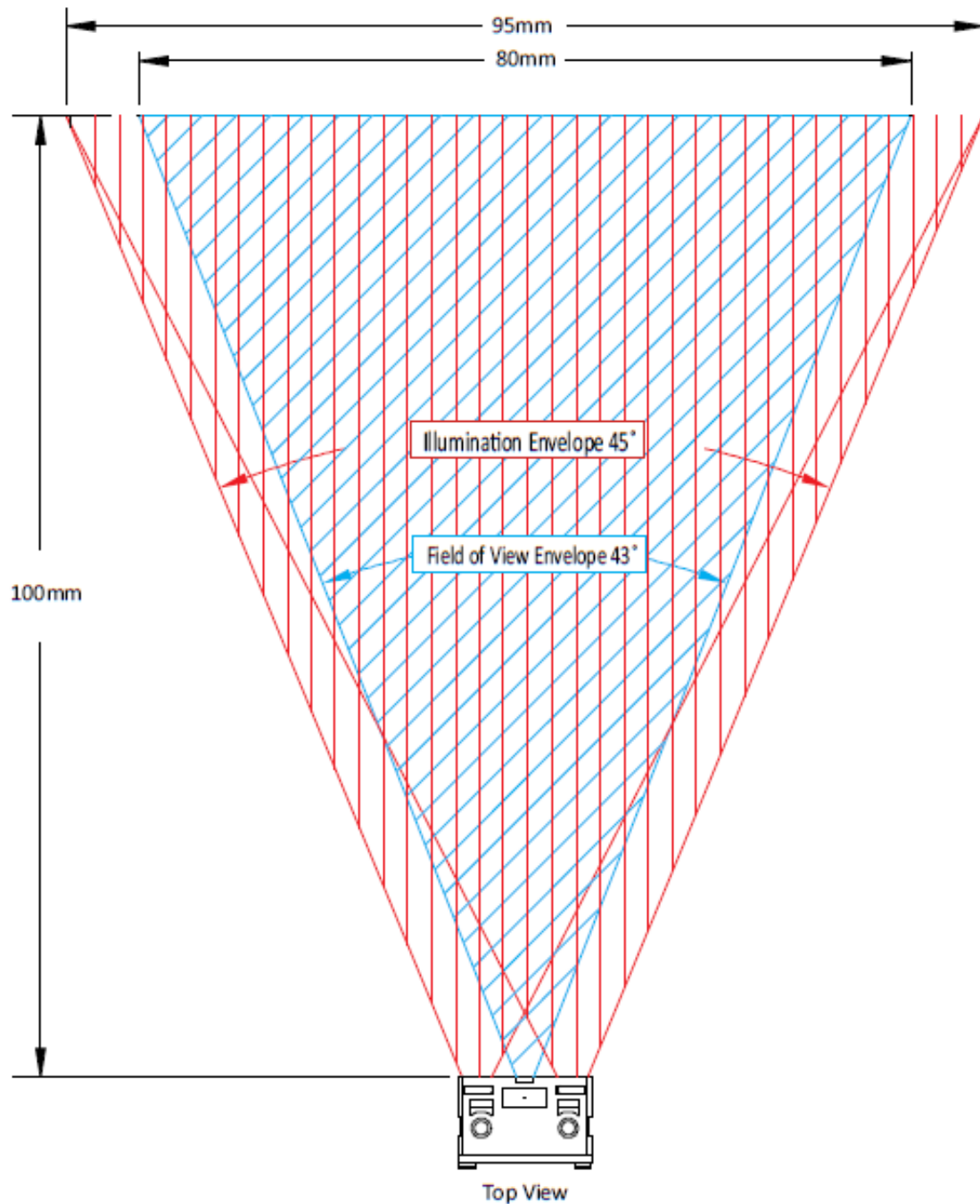
3-5. Window Care

In the aspect of window, the performance of MT10 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 MT10 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 MT10 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 MT10 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 MT10 to the host device.
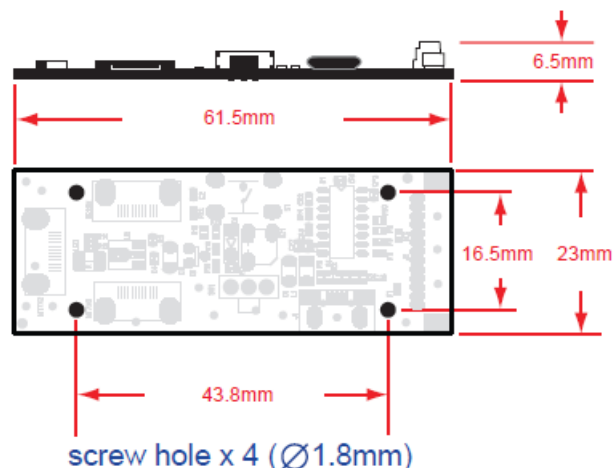
6. SLEEP (IDLE) MODE

The **Sleep Mode** is disabled by default. To enable **Sleep Timeout**, or the period of inactivity before MT10 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)

. B030$

SET MINUTE

. B029$

SET SECOND

	1	6	
	2	7	
	3	8	
	4	9	
	5	0	

Method B – Serial Command

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 MT10 using the following methods:

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. VERSION HISTORY

Rev.	Date	Description	Issued	Checked
1.0	2016.05.09	Preliminary Draft Release	Shaw	Jou
1.1	2016.05.11	Revised D.O.F	Shaw	Jou
1.2	2016.07.06	Revised Electric & Flex Cable Specification	Shaw	Jou
1.3	2016.10.31	Revised Sleep Mode command in Chapter 6	Shaw	Jou
1.4	2017.06.21	Deleted Red Cell-Cast Acrylic Description	Shaw	Hus
1.5	2018.03.06	Revised P/N on page 10&24	Shaw	Jou
1.6	2018.03.15	Updated Chapter 1 and 1-1 on MCU Updated Chapter 6 on Command Mode settings	Shaw	Jou & Hus
1.7	2018.06.19	Updated Working Temperature	Shaw	Jou
1.8	2018.07.23	Added Typical D.O.F & Guaranteed D.O.F	Shaw	Hus
1.9	2018.09.03	Updated Chapter 3-4	Shaw	Hus
2.0	2019.06.04	Updated Chapter 1-2-3, 2-5 & 2-10	Shaw	Hus
2.1	2019.06.11	Updated Chapter 2-10	Shaw	Hus
2.2	2021.11.18	Updated Interface, Sleep Mode, Parameter Setup for HM3 version	Shaw	Jou

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