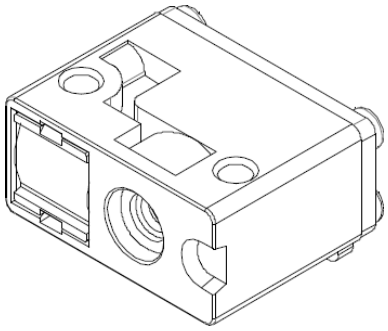
MT15

(3.3V Linear Image Barcode Scan Engine)

Integration Guide



Version 1.9 DATE: 2020/07/28

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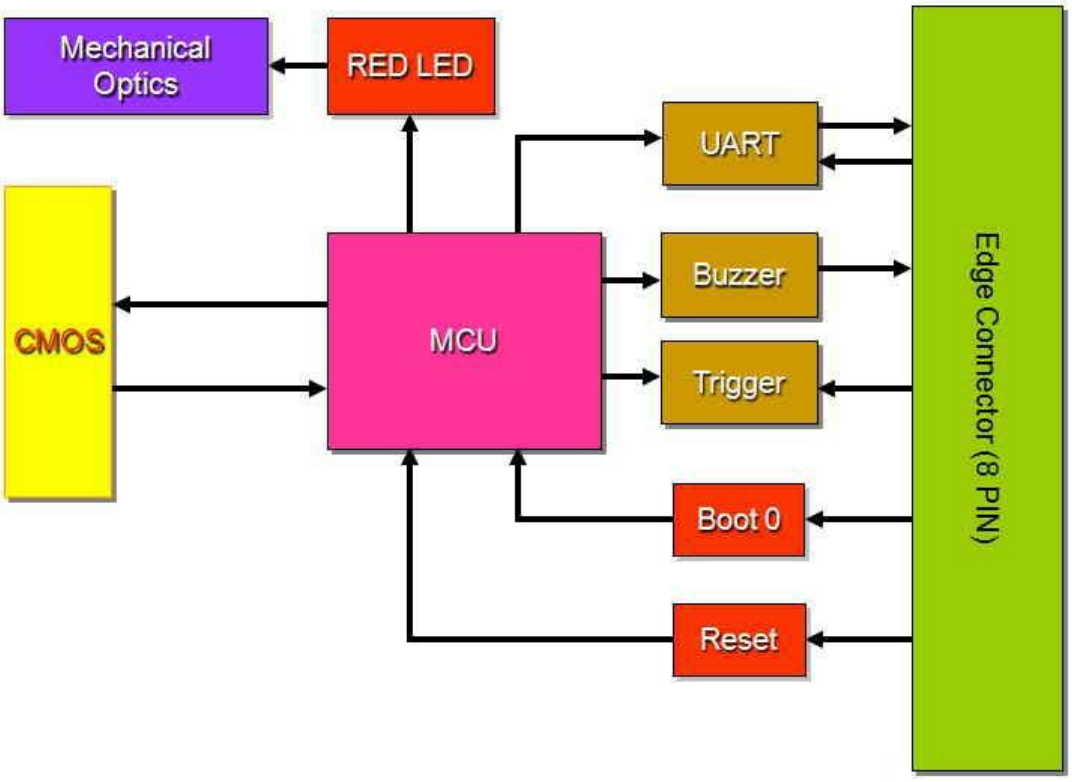
1. INTRODUCTION

The MT15 Linear Image Barcode Scan Engine is among the smallest 1D barcode scan engines in the industry; it features middle range reading, high performance barcode scanning with optimal performance and easy integration. MT15 is ideal for integration into data terminals and small mobile devices with limited space.

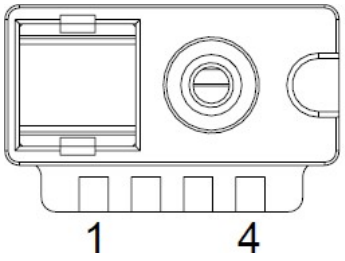
The MT15 consists of 1 illumination LED, a high-quality linear image sensor and a microprocessor that contains powerful firmware to control all aspects of operations and enable communication with the host system over the standard UART communication interface.

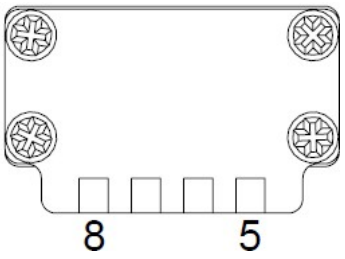
1-1. MT15 Block Diagram

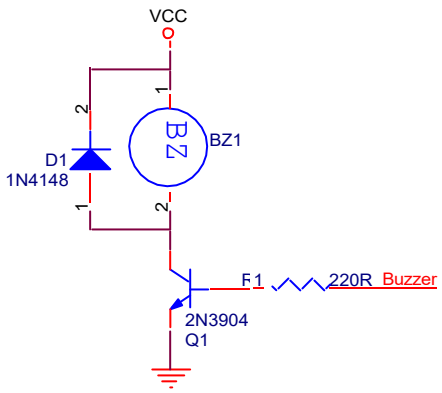
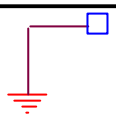
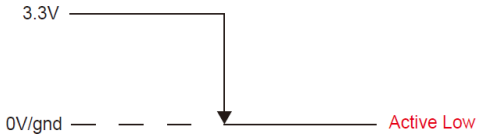


1-2. Electric Interface

1-2-1. Pin Assignment

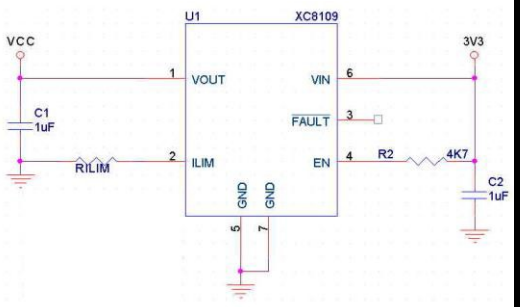




Pin#	Signal	I/O	Description	Schematic Example
1	Buzzer	Output	Active high: Power-Up or a successful barcode decoded. PWM controlled signal can be used to drive an external buzzer for a successful barcode decoded (Good Read).	
2	Reset	Input	Reserved for production only.	----------
3	Boot 0	Input	Reserved for production only.	----------
4	GND	----------	Ground.	
5	Trigger	Input	High: Power-up/Standby Low: Scanning Operation	 *Note:* *Scanning operation continues until a*

<table>
<tr><td></td><td></td><td></td><td></td><td>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.</td></tr>
<tr><td>6</td><td>VCC</td><td>----------</td><td>Supply voltage input. Must always be connected to a 3.3V power supply.

If VCC ramp-up time is less than 1mS, it is recommended to adopt Case 2 (With Power Switch) in Schematic Example to limit surge current.</td><td>(Case 1 - Normal)
 

(Case 2 - With Power Switch)
 

<table>
<tr><th>$I_{LIMIT(T)}$ (mA)</th><th>R_{ILIM} (kΩ)</th><th>E96 External resistance value (kΩ)</th></tr>
<tr><td>75</td><td>515</td><td>511</td></tr>
<tr><td>100</td><td>356</td><td>357</td></tr>
<tr><td>200</td><td>147</td><td>147</td></tr>
<tr><td>300</td><td>87.2</td><td>86.6</td></tr>
<tr><td>400</td><td>60.3</td><td>60.4</td></tr>
<tr><td>500</td><td>38.6</td><td>38.3</td></tr>
</table>
Torex® Vendor P/N: XC8109</td></tr>
<tr><td>7</td><td>TXD</td><td>Output</td><td>UART TTL data output.</td><td> 

Sipex® Vendor P/N: SP232ACT</td></tr>
<tr><td>8</td><td>RXD</td><td>Input</td><td>UART TTL data input.</td><td> 

Sipex® Vendor P/N: SP232ACT</td></tr>
</table>

1-2-2. Electric Characteristics

Symbol	Ratings	Min	Max	Unit
V_{IH}	Input high level	0.7 V_{DD}	3.6	V
V_{IL}	Input low level	0	0.3 V_{DD}	V
V_{OH}	Output high level	2.4	---	V
V_{OL}	Output low level	---	0.4	V
$\|\triangle V_{DD}\|$	Variations between different V_{DD} power pins	---	50	mV

***Note:**

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

1-3. Operational Timing

This chapter describes the timing associated with the various operating modes of the MT15 including Power Up, Sleep Mode, and Decode Timing.

1-3-1. Power Up

When power is initially applied, the MT15 is activated and begins the process of initialization. Once initialization (duration ≦ 310ms) is completed, the MT15 enters **Standby Mode** and is ready for barcode scanning.

1-3-2. Sleep Mode

The MT15 will, if programmed, enter **Sleep Mode** 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 MT15 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.

In **Sleep Mode**, the MT15 can be waken up either by the Trigger signal at pin 5 which MUST be kept low for at least 2 mS, or by any signal sent via RXD at pin 8.

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 MT15 and the barcode scanned.

Upon a successful scan, the MT15 outputs the Buzzer signal and keeps this signal for the duration of the transmission of the data decoded to the host side. 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 310mS.
2. The maximum duration of scanning operation in Standby Mode is 120mS.
3. The minimum duration of waking up MT15 from Sleep Mode by Trigger signal is about 2 ms.
4. The maximum duration of waking up MT15 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 MT15 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	500 Scans/ sec
Resolution	5mil/ 0.125mm
Scan Angle	41°
Print Contrast Ratio	30%
Width of Field	171mm (13Mil Code39)
Depth Of Field (Environment: 800 lux)	5 Mil Code39: 33 ~ 110mm (4 digits)
	10 Mil Code39: 34 ~ 218mm (4 digits)
	15 Mil Code39: 45 ~ 322mm (4 digits)
	13 Mil UPC/ EAN: 45 ~ 277mm (13 digits)
Depth Of Field (Environment: 800 lux)	5 Mil Code39: 45 ~ 95mm (4 digits)
	10 Mil Code39: 50 ~ 205mm (4 digits)
	15 Mil Code39: 55 ~ 295mm (4 digits)
	13 Mil UPC/ EAN: 55 ~ 240mm (13 digits)
Physical Characteristics	
Dimension	W11.5 x L10 x H7.2 mm W11.5 x L10 x H5.5 mm (when mounted on PCB)
Weight	0.7g
Color	Black
Material	PC
Connector	Edge-board Contact x 8 pads
Electrical	
Operation Voltage	3.3VDC±0.15VDC
Working Current	< 55mA

Standby Current	< 30mA
Idle Current (**Sleep Mode**)	< 500uA
Surge Current	< 500mA (Condition: VCC Ramp-up Time > 1mS)
Connectivity	
Interface	UART
User Environment	
Operating Temperature	0°C ~ 50°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

Interface: UART
Baud rate: 9600
Data Bits: 8
Parity: None
Stop Bit: 1
Handshaking: None
Triggering Method: hardware trigger and software trigger

2-4. Configurations

Available versions of MT15 includes:

MT15 (P/N:1015-4000000)
Standard Version, PCB Gold Finger x 8 pads

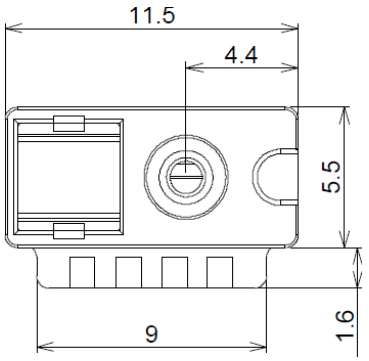
MT15 with Interface Board (P/N:1015-4000002)
Demo Version, ZIF Connector x 12 pins, works with MB100 demo board (see Chapter 5 for more details)

2-5. Operation Method

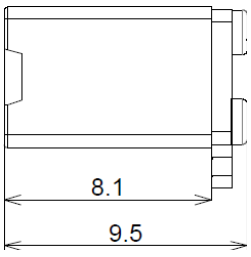
1. At power-up, the MT15 sends the Power-Up signals over Buzzer pin as an indication that the MT15 enters **Standby Mode** and is ready for operation.
2. Once the MT15 triggered by either hardware or software method, it will emit a narrow, horizontal slab of light which is aligned with the sensor's field 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 MT15.
4. Upon a successful barcode decoded, the MT15 turns off the illumination LEDs, sends the Good Read signals over Buzzer pin and transmits the decoded data to the host via TXD pin.
5. The MT15 may enter **Sleep Mode** (Please see Chapter 6 for more details) after a period of inactivity in order to reduce power consumption.

2-6. Mechanical Dimension

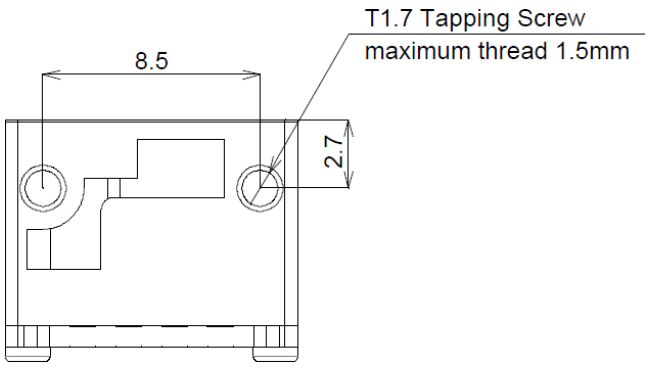
(unit = mm)



Front View



Side View

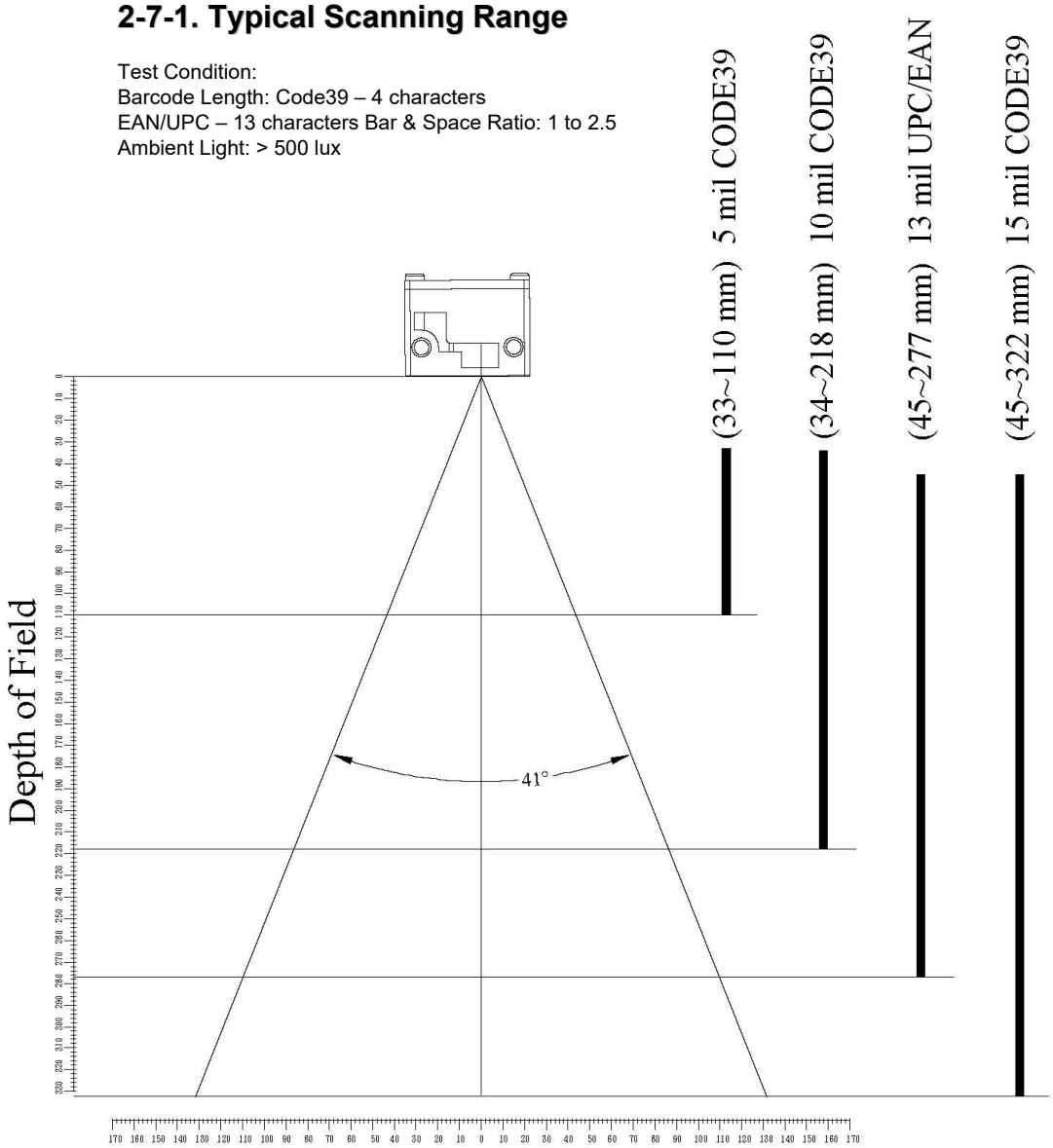


Top View

2-7. Scanning Range

2-7-1. 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

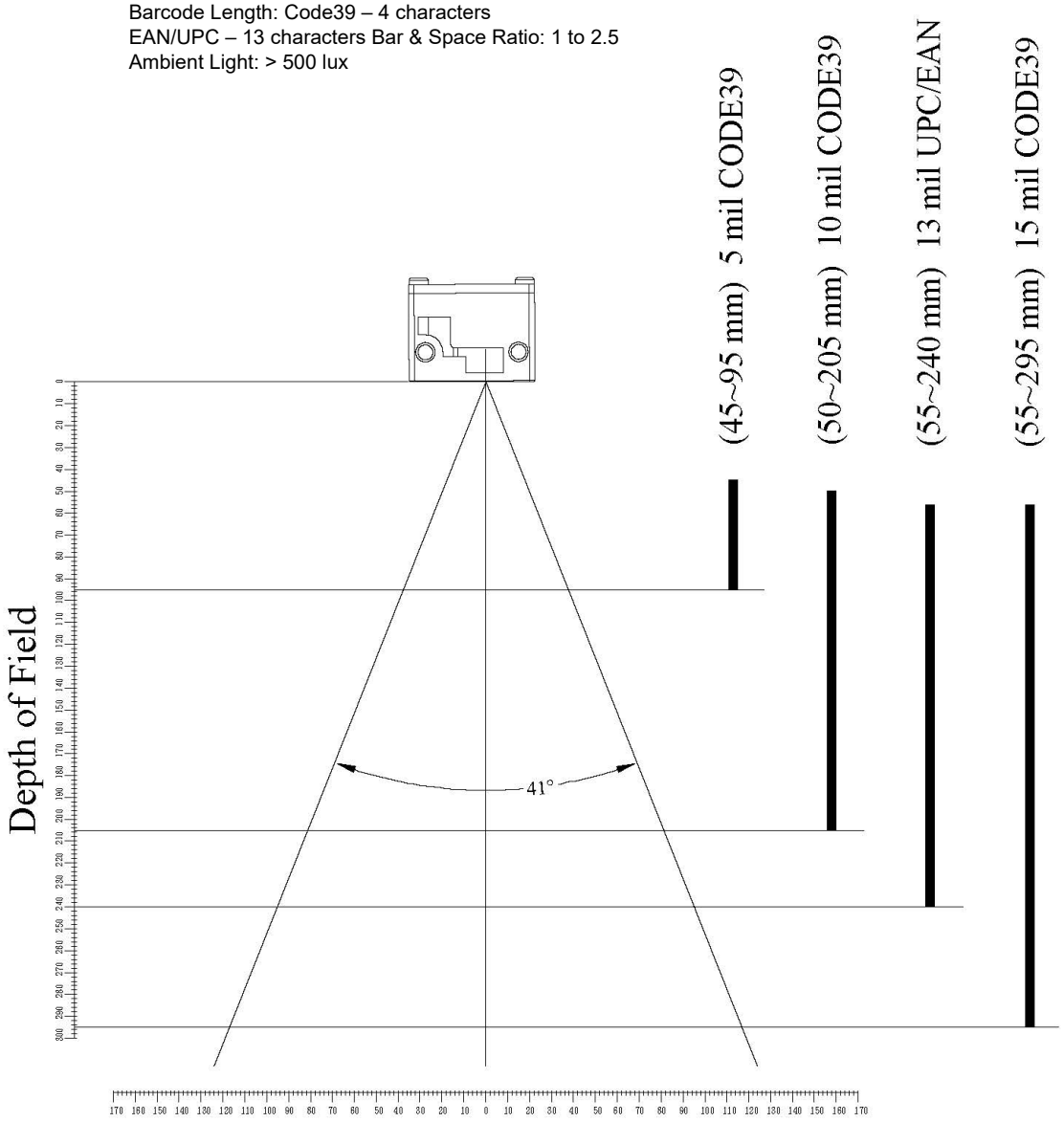
Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	5 Mil	33 ~ 110 mm	4 char.
	10 Mil	34 ~ 218 mm	
	15 Mil	45 ~ 322 mm	
EAN 13	13 Mil	45 ~ 277 mm	13 char.

Maximum Scan Width

Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 mil	171 mm	33 char.

2-7-2. 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

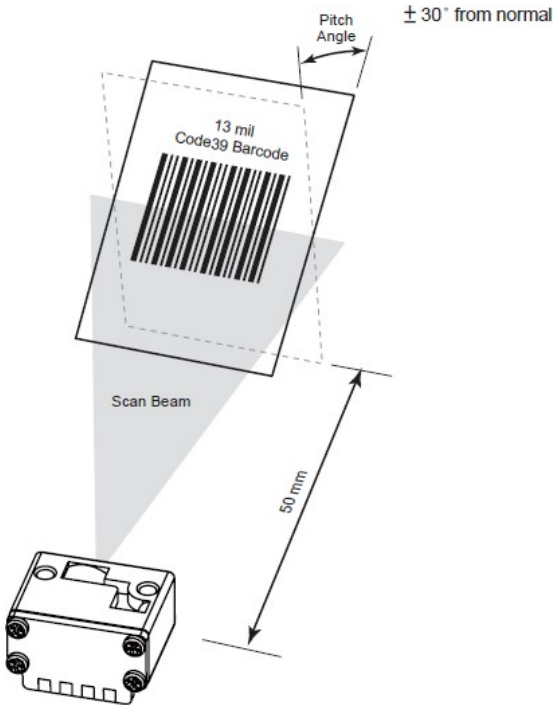
Symbology	Resolution	Distance	No. of Encoded Characters
Standard Code 39 (w/o checksum)	5 Mil	45 ~ 95 mm	4 char.
	10 Mil	50 ~ 205 mm	
	15 Mil	55 ~ 295 mm	
EAN 13	13 Mil	55 ~ 240 mm	13 char.

Maximum Scan Width

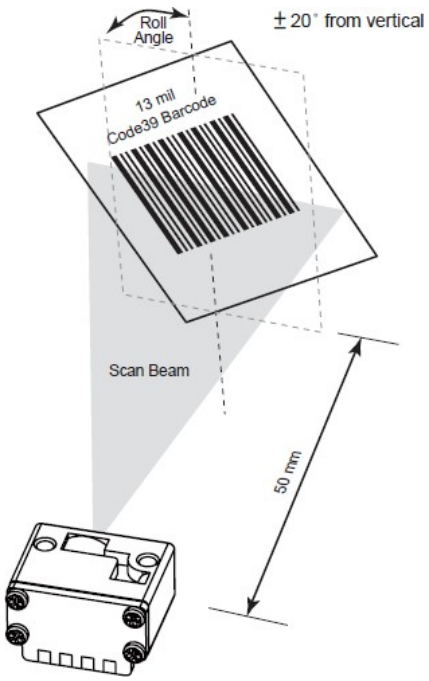
Symbology	Resolution	Barcode Length	No. of Encoded Characters
Standard Code 39 (w/o checksum)	13 mil	171 mm	33 char.

2-8. Pitch Angle, Roll Angle and Skew Angle

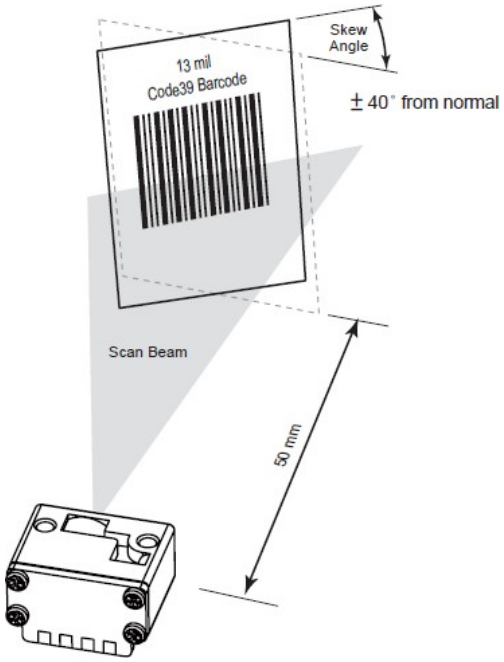
Be aware of the tolerance for the pitch, roll and skew angle of bar code you are trying to scan.



Pitch Angle: ± 30°



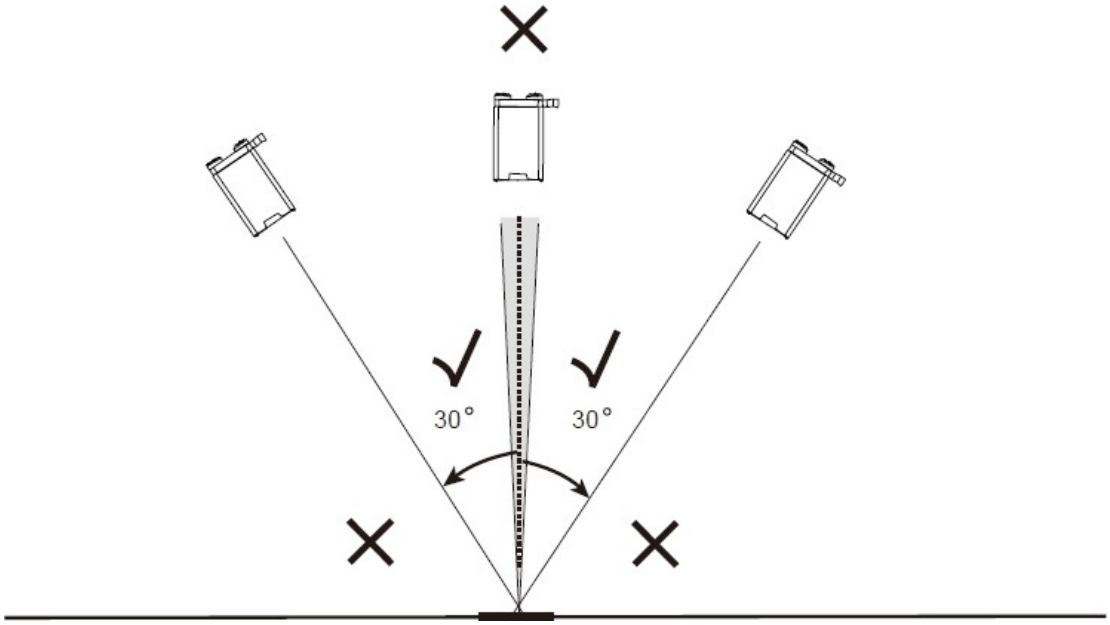
Roll Angle: ± 20°



Skew Angle: ± 40°

2-9. Specular Dead Zone

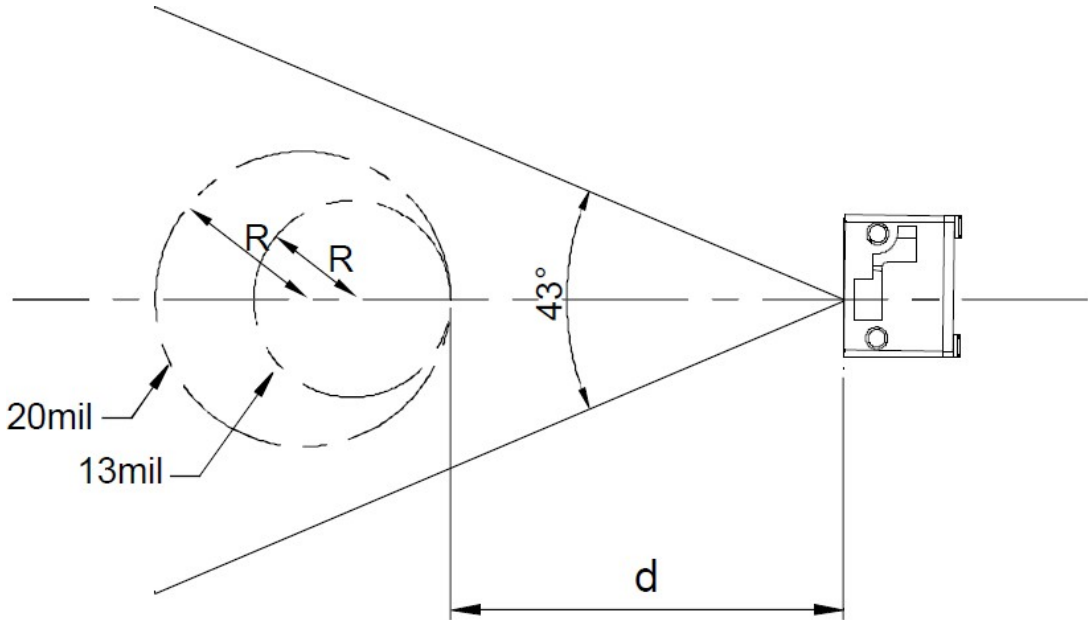
Do not place the MT15 directly over the barcode. The light reflecting directly back into the MT15 from the barcode is known as specular reflection, which can make decoding difficult. The specular dead zone of MT15 is up to 5° depending on target distance and substrate glossiness.



Specular Dead Zone: ± 5°

2-10. 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)	

3. INSTALLATION

The MT15 scan engine is designed specifically for integration into customer's housing for OEM applications. However, the MT15'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 MT15.

3-1. Electrostatic Discharge Cautions

All MT15s 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 MT15.
2. Mount the MT15 in a housing that is designed for ESD protection and stray electric fields.

3-2. Integration and Soldering

Mounting the MT15

First of all, the MT15 should be fixed with tapping screws on the host PCBA. To secure MT15 the maximum thread depth is 1.5 mm and operator must use safe ESD practices when handling and mounting the MT15.

The thickness of PCBA: 0.8mm (for T1.7 x 2.0mm screw)

The size of screw hole: 1.4mm dia., 1.5mm deep

The size of screw: T1.7 X 2.0mm (Default)

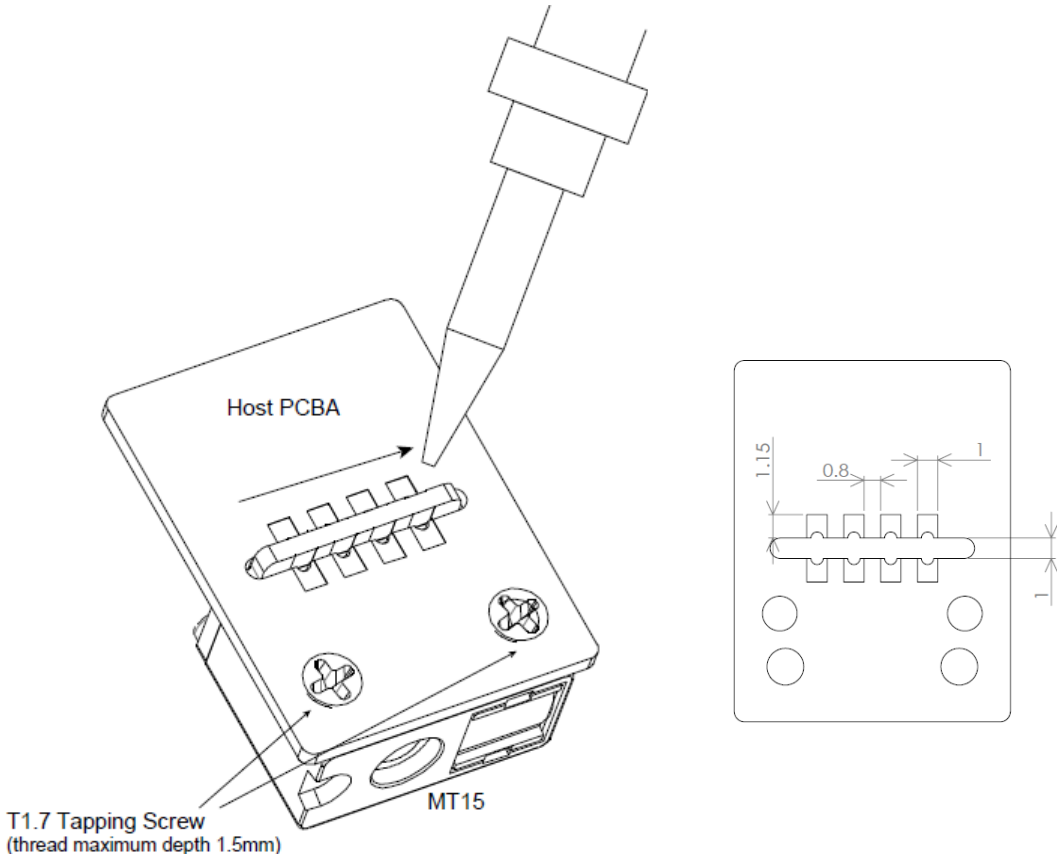
The torque of screwdriver: ≦ 500g-cm (0.43 lb-in)

Soldering Method

Wiping the soldering iron tip steadily and dragging a ball of solder across the pads . Please see figure below, the solder will go where it needs to go. With a bit of practice, this method has the most consistent results and the least chance of failure.

Soldering Temperature

380 ± 10˚C (Do not solder each pad for more than 3 seconds.)



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)

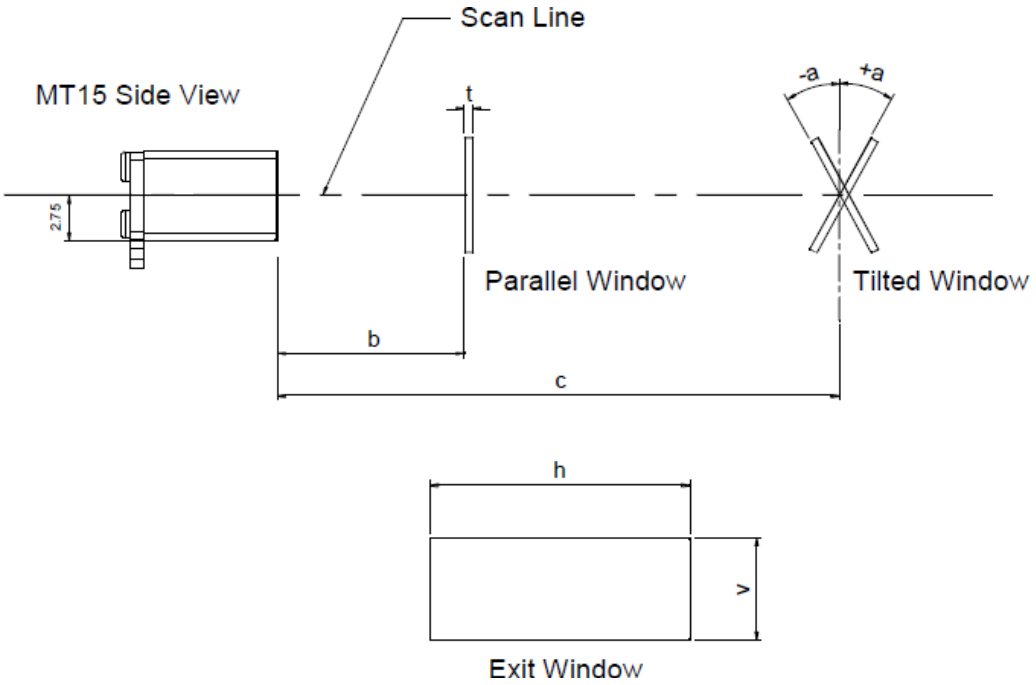
Also known as CR-39™, ADC, a thermal setting plastic widely used for plastic eyeglasses, has excellent chemical and environmental resistance. It also has an inherently moderate surface hardness and therefore does not require hard-coating. This material cannot be ultrasonically welded.

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.

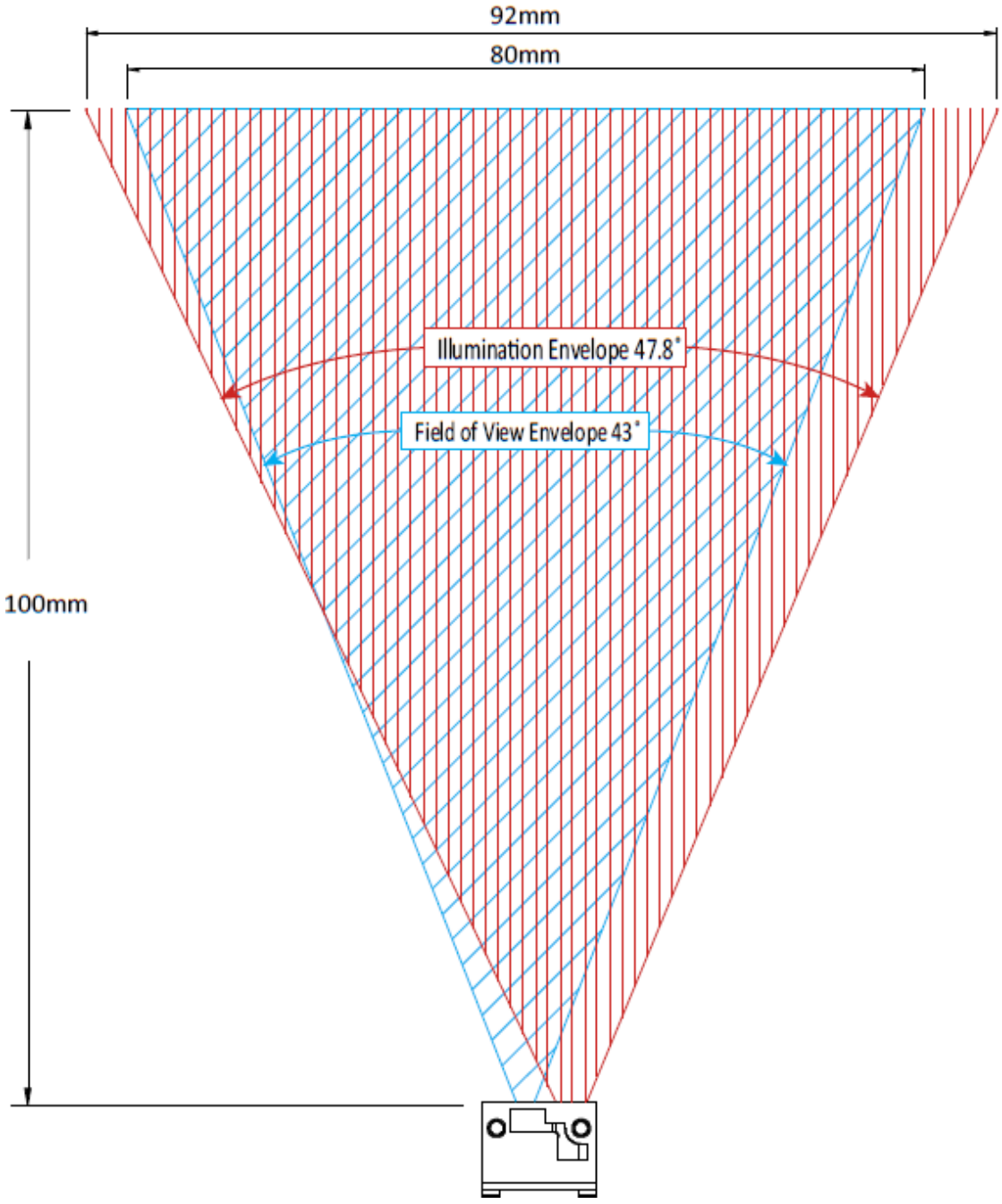
Property	Description
Spectral Transmission	85% minimum from 635 to 690 nanometers
Thickness	< 1 mm
Coating	Both sides to be anti-reflection coated to provide 1% maximum reflectivity from 635 to 690 nanometers at nominal window tilt angle. An anti-reflection coating can reduce the light that is reflected back to the host case. Coatings will comply with the hardness adherence requirements of MIL-M-13508.

3-4. Window Specifications



Window Specifications for MT15 Integration					
Distance	Tilt Angle (a)		Minimum Window Size		
			Horizontal (h)	Vertical (v)	Thickness (t)
< 0.5mm (b)	0	0	11.5 mm	5.5 mm	< 1 mm
10 mm (c)	> +20°	< -20°	17 mm	7 mm	
20 mm (c)	> +17°	< -17°	25 mm	8.5 mm	
30 mm (c)	> +15°	< -15°	33 mm	10 mm	

The window size must increase as it is moved away from MT15 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 MT15 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 MT15 scan engine conforms to the following regulations:

1. Electromagnetic Compliance – CE EN55024, EN55032
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 MT15 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 MT15 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)

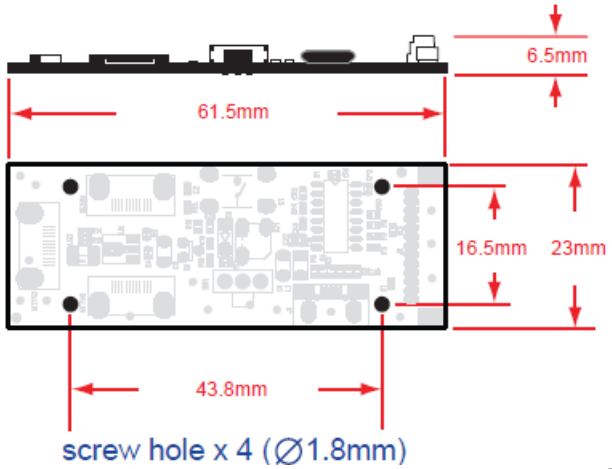
Connects to MT15 with interface board

MB100 Demo Kit Accessories

O: Supported X : Not Supported

Cable \ Interface	RS232 (UART)	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 MT15 to the host device.



6. SLEEP MODE

The **Sleep Mode** is enabled by default. To configure the “Sleep Timeout”, or the period of inactivity before MT15 enters Sleep Mode, please follow below steps.

Method A - Configuration Barcode

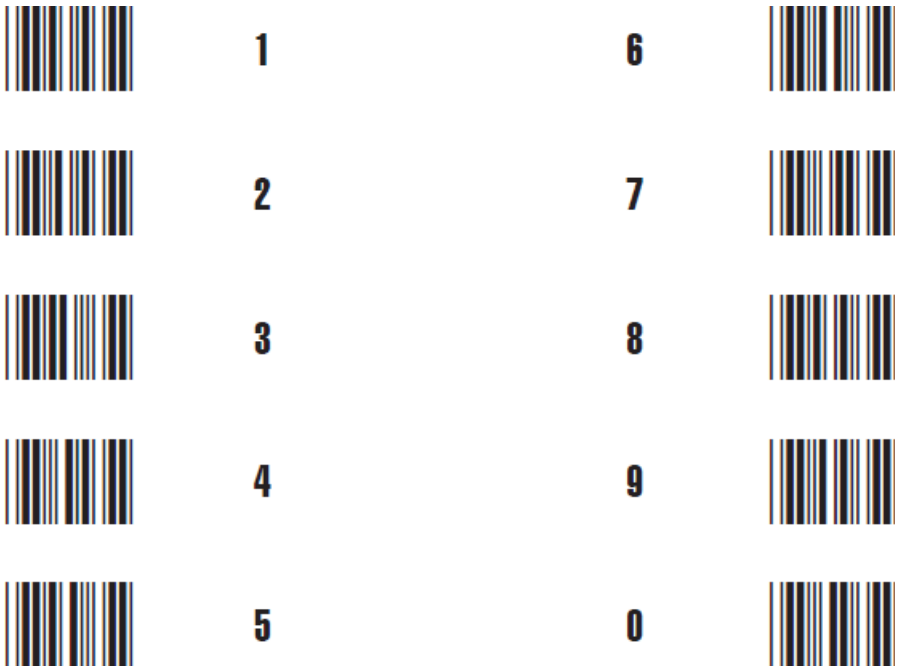
Steps:

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**3**,**0**}	A number from **0**~**60** (Minute) A number from **0**~**59** (Second)	Default : **3 minute 0 second** **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.

Example:

Send {MT007W0,10} to MT15 in the case of 10 seconds Sleep Timeout.

MT15 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 MT15 from Sleep Mode, send any command or pull low at Trigger pin.

7. PARAMETER SETUP

For full function configurations, please refer to below methods:

1. **Configuration Barcode**
   Scan configuration barcodes from the 1D Scan Engine User's Manual, which is available for download at www.marson.com.tw
2. **Serial Command**
   Send serial commands from the host, using Command_Test.exe or Serial Commands Manual which is available for download at www.marson.com.tw

8. VERSION HISTORY

Rev.	Date	Description	Issued	Checked
1.0	2018.03.30	Initial Release	Shaw	Jou & Hus
1.1	2018.06.13	Secondary Edition	Shaw	Peter
1.2	2018.07.23	Added Typical D.O.F & Guaranteed D.O.F	Shaw	Hus
1.3	2018.07.31	Added DIM when mounted on PCB	Shaw	Hus
1.4	2018.09.03	Updated Chapter 3-4	Shaw	Hus
1.5	2018.10.19	Updated Chapter 3-2	Shaw	Hus
1.6	2019.03.29	Updated VCC in Chapter 1-2-1	Shaw	Jou
1.7	2019.04.01	Updated VCC in Chapter 1-2-1 and Surge Current in Chapter 2-2	Shaw	Jou
1.8	2019.04.15	Updated Guaranteed D.O.F	Shaw	Jou
1.9	2020.07.28	Updated Resolution, Typical D.O.F & Guaranteed D.O.F	Shaw	Jou

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